FORA ESCA REMEDIATION PROGRAM

Final

Phase II Interim Action Work Plan Addendum

Habitat Restoration Plan

Interim Action Ranges Munitions Response Area

Former Fort Ord
Monterey County, California

March 26, 2013

Prepared for:

FORT ORD REUSE AUTHORITY

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Environmental Services Cooperative Agreement
No. W9128F-07-2-01621
and
FORA Remediation Services Agreement (3/30/07)

Document Control Number: 09595-10-086-012

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This effort was sponsored by the Army, Assistant Chief of Staff Installation Management. The content of the information does not necessarily reflect the position or policy of the Government and no official endorsement should be inferred.

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ACRONYMS AND ABBREVIATIONS

AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
Army	U.S. Department of the Army
BO	Biological Opinion
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
CNPS	California Native Plant Society
DGM	digital geophysical mapping
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESCA RP	Environmental Services Cooperative Agreement Remediation Program
ESCA RP Team	ARCADIS U.S., Inc., Weston Solutions, Inc., and Westcliffe Engineers, Inc.
FFA	Federal Facility Agreement
FORA	Fort Ord Reuse Authority
FVF	Field Variance Form
GPS	Global Positioning System
ha	hectare
HE	high explosive
HMP	Habitat Management Plan
HRP	Habitat Restoration Plan
IAR	Interim Action Ranges
km	kilometer
lbs	pounds
LTO	Long Term Obligations
m	meter
MD	munitions debris
MEC	munitions and explosives of concern
mm	millimeter
MRA	Munitions Response Area

MRS	Munitions Response Site
NCA	Non-Completed Area
NPL	National Priority List
QA/QC	quality analysis/quality control
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RP	Remediation Program
RWQCB	Regional Water Quality Control Board
SCA	Special Case Area
site(s)	a contiguous area that was disturbed by ESCA RP activities and which is subject to monitoring and/or restoration
SSRP	Site-Specific Restoration Plan
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

EXECUTIVE SUMMARY

This Habitat Restoration Plan (HRP) is an addendum to the Phase II Interim Action Work Plan for the Interim Action Ranges (IAR) Munitions Response Area (MRA; ESCA RP Team 2011a). This HRP has been developed by the Fort Ord Reuse Authority (FORA) Environmental Services Cooperative Agreement (ESCA) Remediation Program (RP) Team to describe the activities to be undertaken to restore the central maritime chaparral community and associated plant populations in habitat parcels that were affected by munitions and explosives of concern (MEC) remedial activities for the IAR MRA. This HRP has been developed in accordance with the Installation-Wide Multispecies Habitat Management Plan (HMP; USACE 1997) and the Biological Opinions (BOs; USFWS 1999, 2002, 2005) issued to the United States Department of the Army (Army) to enable compliance with the federal Endangered Species Act (ESA) and to avoid or minimize, to the extent feasible, take of listed species as well as protecting other species of concern.

The IAR MRA ("the site") is located in the north-central portion of the former Fort Ord, within the boundary of the former disturbance area (Figure 1). The IAR MRA is approximately 227 acres (92 hectares [ha]) in size and is located in the area designated by the Army as Munitions Response Site (MRS) Ranges 43-48. Habitat parcels in this MRA have historically supported high quality maritime chaparral communities; however, portions of the communities have been affected by prior Army activities and exotic plant populations (Figure 2).

An Interim Action Record of Decision (ROD) was produced by the Army in August 2002 (Army 2002) for Interim Action Sites at the former Fort Ord. The Interim Action Sites include MRS Ranges 43-48. The ROD summarizes the Final Interim Action Ordnance and Explosives Remedial Investigation/Feasibility Study for Ranges 43-48, Range 30A, Site OE-16, Former Fort Ord, which summarizes the previous field activities conducted at the Interim Action Sites, and examines and selects a preferred interim remedial action for the Interim Action Sites.

To address the imminent threat to human health (public safety) or welfare or the environment posed by the presence of MEC on MRS Ranges 43-48, the Army performed interim remedial action, which included surface removal and subsurface removal operations. The previous interim remedial actions conducted by the Army resulted in areas where only surface removals were conducted on MRS Ranges 43-48. Within the IAR MRA, the areas where subsurface removals were not completed by the Army are known as Special Case Areas (SCAs) and Non-Completed Areas (NCAs). The FORA ESCA RP Team's efforts are focused on these remaining SCAs and NCAs as the remainder of the IAR MRA has been addressed through the Army's previous interim remedial actions.

ESCA RP Regulatory History

On March 31, 2007, the Army and FORA entered into an ESCA, thereby allowing the Army to transfer approximately 3,340 acres of property to FORA as an Economic Development Conveyance. In accordance with the ESCA, FORA is responsible for

addressing all response actions for the property except for those responsibilities retained by the Army. To accomplish this effort, FORA entered into an agreement with ARCADIS U.S., Inc., teamed with Weston Solutions, Inc., and Westcliffe Engineers, Inc. ("the ESCA RP Team"), to assist in the completion of the MEC remediation activities on the 3,340 acres in accordance with the ESCA and an Administrative Order on Consent (AOC).

The AOC was entered into voluntarily by FORA, the United States Environmental Protection Agency (EPA) Region 9, the Department of Toxic Substances Control (DTSC), and the United States Department of Justice Environment and Natural Resources Division on December 20, 2006 (EPA Region 9 CERCLA Docket No. R9-2007-03). The AOC was issued under the authority vested in the President of the United States by Sections 104, 106, and 122 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended 42 U.S.C. §§ 9604, 9606, and 9622. FORA, through the ESCA RP Team, will complete the Army's munitions response actions in a program identified as the FORA ESCA RP.

Restoration Strategies

The total area affected by the MEC investigation and remediation activities in the IAR MRA is still to be determined; however, the total affected area is estimated to be approximately 34 acres (13.8 ha), of which approximately 13.4 acres (5.4 ha), constituting less than 10% of the MRA, are expected to be substantially disturbed. Disturbances from the MEC investigation and remedial action work range from minor (e.g., light traffic on existing roads) to major (e.g., soil excavation up to 3 feet [1 meter (m)] below ground surface over approximately 12 acres [5 ha]).

One of the three restoration strategies listed below will be applied to each affected site, depending on the type and extent of disturbances. Restored sites will be monitored for erosion and invasion by exotic plant species.

- **Monitoring Only** - Monitoring only will be implemented where above-ground vegetation was cut or disturbed, but root systems remain intact. The primary activity will be monitoring regrowth of vegetation; however, minor site grading and/or erosion protection may be employed.
- **Passive Restoration** - Passive restoration (seeding only) will be implemented where root systems were removed or substantially disturbed (primarily as a result of excavation) within contiguous areas that are either less than 1 acre (0.4 ha) or less than 100 feet (30 m) wide and surrounded by undisturbed vegetation. Backfilling of subsoil and topsoil in the proper sequence; grading to reflect the pre-existing topography or a natural landform; seeding of native species; and monitoring will be implemented in passive restoration sites.
- **Passive and Active Restoration** - Both passive (seeding) and active (container plantings) restoration will be implemented where root systems were removed in a contiguous area greater than 1 acre (0.4 ha) in size and greater than 100 feet (30 m) wide in smallest dimension. Restoration effort will primarily occur in the active restoration

sites. Actions that will be taken in active restoration sites include: backfilling of subsoil and topsoil in the proper sequence; grading to match original topography; limited amendment of soil with fertilizer, charred wood, and natural plant materials (litter); creation of microhabitats for focus species; seeding and planting of native species; irrigation; and intensive monitoring of progress. These activities will generate habitat improvements beyond those in the pre-existing habitat baseline.

Quantitative success criteria for plant survival, species richness, and percentage cover targeted for the first seven years following site restoration are shown in Table 10 and discussed in Section 10 of this plan. Metrics for most criteria are based on the pre-existing baseline values, and progress toward those values is based on anticipated restoration trajectories. Trends in species richness and vegetative percentage cover following the 2003 fire in the IAR MRA are consistent with the generally accepted trajectory of chaparral regrowth. The trend in percentage cover of vegetation at the sites will be compared with this trajectory to assist in determining if habitat restoration meets the performance targets. Site monitoring and other restoration activities will be adjusted over time as appropriate and terminated when it is determined that success criteria have been met.

As part of implementation of this HRP, a comprehensive adaptive management plan will be implemented that will focus on managing the active restoration sites. The adaptive management plan will utilize a wide range of qualitative and quantitative monitoring data to evaluate site conditions and determine the need for additional actions. A variety of corrective actions associated with plant mortality, erosion, exotic invasion, and other potential issues have been identified for use in the adaptive management process.

Annual reports describing the activities and monitoring results will be submitted to the Army and United States Fish and Wildlife Service (USFWS). Annual meetings will be held to review the annual reports and proposed future actions which are planned to occur in the first quarter of the year.

Implementation

The IAR MRA HRP will be implemented by FORA and/or its approved successors on behalf of the Army as defined in the ESCA. For the purposes of the IAR MRA HRP, site restoration will be established in accordance with the BOs and HMP requirements.

The activities outlined in this HRP are designed to establish native vegetation at the site that is progressing on a trajectory toward a self-sustaining native plant community equitable with the species richness and relative cover of species included in the HMP ("HMP species") that were present on the site prior to the FORA ESCA RP Team investigation and remedial efforts.

For the purposes of the IAR MRA HRP, performance standards are identified as meeting the goals, objectives, and requirements of the HMP. The 1997 HMP pertinent goals are summarized below.

- Preserve, protect, and enhance populations and habitats of federally listed threatened and endangered wildlife and plant species.
- Avoid reducing populations or habitat of federal proposed and candidate wildlife and plant species to levels that may result in one or more of these species becoming listed as threatened or endangered.
- Preserve and protect populations and habitat of state-listed threatened and endangered wildlife and plant species.
- Avoid reducing populations or habitat of species listed as rare, threatened, and endangered by the California Native Plant Society (List 1 B), or with large portions of their range at former Fort Ord, to levels that may result in one or more of these species becoming listed as threatened or endangered.

A number of quantitative success criteria and performance targets have been proposed, which will provide the basis for reporting of progress towards and achievement of performance standards. Evaluation of and reporting against performance standards will be required to support compliance with ARARs (ESA requirements) in completion of the Army's Interim Remedial Action under the ROD. Habitat restoration activities and monitoring will be documented consistent with the Phase II Interim Action Work Plan. Site activity and success criteria reporting will be captured and reported in the Annual Natural Resource Monitoring, Mitigation, and Management Report and will be the basis for annual meetings with the Army and the USFWS. This meeting is tentatively planned to occur in the first quarter of each year. Site Restoration will be approved by the USFWS based on meeting the requirements of the BOs and HMP in accordance with the Federal ESA.

IAR MRA HRP activities, monitoring, and findings will be presented in a summary report for the Phase II Interim Remedial Actions prepared in accordance with Task 09 of the AOC and will be used to support the Remedial Investigation/Feasibility Study for the IAR MRA. In accordance with CERCLA, a Final ROD will be prepared and other appropriate final remedial actions will be taken as necessary to protect public health and the environment.

The anticipated general schedule for implementation of IAR MRA habitat restoration per the HRP is as follows:

Year	Activity *Implementing Party*	Expected Date
0	Restoration Construction and Implementation/Annual Natural Resource Monitoring, Mitigation and Management Report *ESCA RP Team with FORA Oversight*	2012
1-2	Adaptive Management/Yearly Review Meeting with Army & USFWS / Annual Natural Resource Monitoring, Mitigation, and Management Report *ESCA RP Team with FORA Oversight*	2013 - 2014
3	Evaluate Restoration Trajectory/Completion of Remedial Action / Yearly Review Meeting with Army & USFWS / Annual Natural Resource Monitoring, Mitigation, and Management Report *ESCA RP Team with FORA Oversight*	2015
3	Transition to Long Term Monitoring (LTM) / Operations &Maintenance (O&M) and LTM Plans *FORA*	2015
3-7	Implement O&M and LTM Plans and Reporting / Yearly Review Meeting with Army & USFWS / Evaluate Achievement of Success Criteria in Annual Meetings / Monitoring Reporting Annual Results / Completion of Work *FORA or its approved successor*	2015 to 2019

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1.0 INTRODUCTION

1.1 Purpose and Scope

This Habitat Restoration Plan (HRP) is an addendum to the Phase II Interim Action Work Plan for the Interim Action Ranges (IAR) Munitions Response Area (MRA; ESCA RP Team 2011a). This HRP has been prepared by the Fort Ord Reuse Authority (FORA) Environmental Services Cooperative Agreement Remediation Program (ESCA RP) Team (ARCADIS U.S., Inc., Weston Solutions, Inc., and Westcliffe Engineers, Inc.) in response to ground disturbing field activities to address residual munitions and explosives of concern (MEC) on the IAR MRA. The MEC remedial activities to be conducted at the IAR MRA have been described in detail in the Phase II Interim Action Work Plan, Interim Action Ranges Munitions Response Area (ESCA RP Team 2011a), Field Variance Form (FVF) No. IARWP-002 (ESCA RP Team 2011b), FVF No. IARWP-003 (ESCA RP Team 2011c), and FVF No. IARWP-004 (ESCA RP Team 2011d).

The purpose of this HRP is to describe the activities to be undertaken to restore the natural resources in habitat parcels that were affected by the FORA ESCA Team MEC remedial activities. The goals of this HRP reflect those outlined in the Installation-Wide Multispecies Habitat Management Plan (HMP; USACE 1997); pertinent goals from the HMP are summarized below.

- Preserve, protect, and enhance populations and habitats of federally listed threatened and endangered wildlife and plant species.
- Avoid reducing populations or habitat of federal proposed and candidate wildlife and plant species to levels that may result in one or more of these species becoming listed as threatened or endangered.
- Preserve and protect populations and habitat of state-listed threatened and endangered wildlife and plant species.
- Avoid reducing populations or habitat of species listed as rare, threatened, and endangered by the California Native Plant Society (CNPS; List 1 B), or with large portions of their range at former Fort Ord, to levels that may result in one or more of these species becoming listed as threatened or endangered.

All activities outlined in this HRP are designed to establish native vegetation at the site that is progressing on a trajectory toward a self-sustaining native plant community equitable with the species richness and relative cover of species included in the HMP ("HMP species") that were present on the site prior to the FORA ESCA RP Team investigation and remedial efforts. Botanical nomenclature in this plan follows *The Jepson Manual – Vascular Plants of California*, Second Edition (Baldwin et al. 2012).

1.2 General Site Description

Former Fort Ord served as a training and staging facility for infantry troops from 1917 until its closure in 1994. The IAR MRA is located in the north-central portion of the former Fort Ord, within the boundary of the former disturbance area (Figure 1). The IAR

MRA is approximately 227 acres (92 hectares [ha]) in size and is bordered by the Parker Flats MRA to the north, the Seaside MRA to the northwest, and the former disturbance area to the east, south, and southwest. United States Army Corp of Engineer (USACE) property transfer parcels, E38, E39, E40, E41, and E42 are contained within the MRA. The IAR MRA is within the jurisdictional boundaries of the City of Seaside and Monterey County. A detailed description of the site before the FORA ESCA RP Team MEC investigation and remedial actions were implemented is provided in Section 2.

The IAR MRA is located in the area designated by the United States Department of the Army (Army) as Munitions Response Site (MRS) Ranges 43-48. To address the imminent threat to human health (public safety) or welfare or the environment posed by the presence of MEC on MRS Ranges 43-48, the Army performed interim remedial action, which included surface removal and subsurface removal operations from November 2003 to December 2005 as summarized in the MRS Ranges 43-48 Interim Action Technical Information Paper (Parsons 2007). The previous interim remedial actions conducted by the Army resulted in areas where only surface removals were conducted on MRS Ranges 43-48. Within the IAR MRA, the areas where subsurface removals were not completed by the Army are known as Special Case Areas (SCAs) and Non-Completed Areas (NCAs), covering approximately 53 acres (21 ha). The FORA ESCA RP Team's efforts are focused on these remaining SCAs and NCAs, since the remainder of the IAR MRA has been addressed through the Army's previous interim remedial actions.

1.3 Environmental Cleanup Programs and Authorities at Former Fort Ord

1.3.1 Environmental Cleanup Program under the United States Army

The former Fort Ord was placed on the National Priority List (NPL) in 1990, primarily because of chemical contamination in soil and groundwater that resulted from past Army operations. To oversee the cleanup of the base, the Army, the California Department of Toxic Substances Control (DTSC), the California Central Coast Regional Water Quality Control Board (RWQCB), and the U.S. Environmental Protection Agency (EPA) entered into a Federal Facility Agreement (FFA). One of the purposes of the FFA was to ensure that the environmental impacts associated with past and present activities at the former Fort Ord were thoroughly investigated and appropriate remedial action taken as necessary to protect the public health and the environment. In accordance with the FFA, the Army was designated as the lead agency under CERCLA for conducting environmental investigations, making cleanup decisions, and taking cleanup actions at the former Fort Ord. The EPA was designated as the lead regulatory agency for the cleanup, while the DTSC and RWQCB are supporting agencies.

Habitat reserve areas support plant and animal species that require implementation of mitigation measures identified in the HMP (USACE 1997) to ensure compliance with the Endangered Species Act (ESA) and to minimize disturbances to listed species. To ensure compliance with the federal ESA requirements, the Army has consulted with the United States Fish and Wildlife Service (USFWS) on the Army's predisposal actions, including cleanup of MEC. These consultations have resulted in the development of biological

opinions (BOs). The current activities being performed by the ESCA at the site are being conducted under the 2002 Interim Action Record of Decision (ROD; Army 2002). Table 1 outlines the Applicable or Relevant and Appropriate Requirements (ARARs) as provided in the Group 3 Remedial Investigation/Feasibility Study (RI/FS) Work Plan (ESCA RP Team 2009b) and outlined in the 2002 Interim Action ROD (Army 2002), with respect to the habitat restoration activities and the ESA.

Endangered plant and animal species as well as designated critical habitat occur at the former Fort Ord. Each reuse area has been screened for potential disturbances to any endangered species identified in the HMP (USACE 1997) and additional requirements are identified in subsequent documents (USFWS 1999, 2002, and 2005; Zander 2002). Implementation of the provisions of the HMP and referenced additional requirements satisfy the requirements of the ESA.

1.3.2 Early Transfer of Property and Environmental Services Cooperative Agreement

The transfer of a portion of the former Fort Ord, pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 120(h)(3)(C), was requested by FORA in a letter to the Army dated May 18, 2005. Under CERCLA Section 120(h)(3), the United States is required to provide a covenant in the deed conveying the property warranting that all remedial action necessary to protect human health and the environment has been taken before the date of transfer. For a federal facility listed on the NPL, CERCLA Section 120(h)(3)(C) allows the EPA Administrator, with concurrence of the Governor of the State, to defer the CERCLA covenant requirement.

On March 31, 2007, the Army and FORA entered into an ESCA thereby allowing the Army to transfer approximately 3,340 acres (1,352 ha) of property and the responsibility of removing MEC to FORA as an Economic Development Conveyance. In accordance with the ESCA, FORA is responsible for addressing all response actions for the property except for those responsibilities retained by the Army. Lastly, the ESCA allowed the Army to provide dedicated funding for munitions remediation on these specific parcels of land.

To accomplish this effort, FORA entered into an agreement with the ESCA RP Team to assist in the completion of the MEC remediation activities on the 3,340 acres in accordance with the ESCA and an Administrative Order on Consent (AOC).

The AOC was entered into voluntarily by FORA, the United States EPA Region 9, the DTSC, and the United States Department of Justice Environment and Natural Resources Division on December 20, 2006 (EPA Region 9 CERCLA Docket No. R9-2007-03). The AOC was issued under the authority vested in the President of the United States by Sections 104, 106, and 122 of the CERCLA, as amended 42 U.S.C. §§ 9604, 9606, and 9622. FORA, through the ESCA RP Team, will complete the Army's munitions response actions in a program identified as the FORA ESCA RP.

1.3.3 FORA ESCA RP

The primary objective of the FORA ESCA RP is to complete a timely cleanup of the property in accordance with the ESCA and the AOC, while promoting and enhancing public health and safety. In addition, the ESCA RP allows FORA to integrate remediation activities with infrastructure development, such as street improvements and utility services, to respond to the Fort Ord Base Reuse Plan objectives.

1.4 Regulatory Documentation Concerning Habitat Resources

To ensure compliance with the federal ESA requirements, the Army has consulted with the USFWS on the Army's predisposal actions, including cleanup of MEC. These consultations have resulted in several BOs that include incidental take coverage for specific numbers of (or habitat acres for) the following wildlife species: Smith's blue butterfly (*Euphilotes enoptes smithi*), black legless lizard (*Anniella pulchra nigra*), western snowy plover (*Charadrius alexandrines nivosus*), and California tiger salamander (*Ambystoma californiense*). The incidental take statements allow impacts to and incidental take of these listed species during project activities, and specify a variety of measures to be implemented during the project to avoid and minimize impacts to the protected species and their habitats (USFWS 1999, 2005). In addressing listed plant species, these BOs state that "Sections 7(b)(4) and 7(o)(2) of the Act do not apply to the incidental take of listed plant species. However, protection of listed plants is provided to the extent that the Act requires a Federal permit for the removal or reduction to possession of endangered plants from areas under Federal jurisdiction. In addition, the Army prepared the HMP (USACE 1997) and modifications to the HMP provided in the "Assessment, East Garrison—Parker Flats Land Use Modifications, Fort Ord, California" (Zander 2002), which together present the boundaries of habitat reserve and development areas and describe land use, conservation, management, and habitat monitoring requirements for target species within the IAR MRA. The HMP for former Fort Ord was prepared in accordance with the USFWS BO and establishes the guidelines for the conservation and management of wildlife and plant species and habitats that largely depend on former Fort Ord land for survival (USACE 1997).

Endangered plant and animal species as well as designated critical habitat occur at the former Fort Ord. Each reuse area has been screened for potential impacts or disturbances to any endangered species identified in the HMP (USACE 1997). Implementation of the provisions of the HMP and referenced additional measures satisfy the requirements of the ESA.

1.5 Restoration Requirements

Restoration requirements for MEC investigation and remedial action activities on former Fort Ord are described in BOs issued by the USFWS and in the HMP (USFWS 1999, USACE 1997). These requirements pertain to the FORA ESCA RP Team MEC investigation and remedial action and constitute the basis for this restoration plan. These requirements also ensure compliance with ARARs identified in the Interim Action ROD (Army 2002) and the Phase II Interim Action Work Plan (ESCA RP Team 2011a). In the

following sections, specific restoration (and restoration-related) requirements are described and the section(s) of this restoration plan that describe compliance with the requirement are cited immediately thereafter.

1.5.1 Biological Opinions

Several BOs have been issued by the USFWS for former Fort Ord activities. The following three opinions included requirements for habitat restoration that pertain to the FORA ESCA RP Team activities.

1.5.1.1 1999 Biological Opinion

The USFWS BO on closure and reuse of Fort Ord (USFWS 1999, p. 21) states that "The Army shall implement all portions of the April 1997 HMP for all predisposal activities undertaken." This biological opinion cited the following HMP (USACE 1997) requirements for lead removal in dunes associated with restoration (USFWS 1999, pp. 12-14). The habitat disturbances resulting from the ESCA RP remedial activities being conducted in the IAR MRA are similar to those associated with lead removal in the dunes.

- Limit removal to the smallest area possible (*see Section 2.2 of this plan*)
- Avoid unnecessary disturbance of habitat (*see Section 2.2 of this plan*)
- Develop a restoration plan with success criteria and a monitoring plan (*see Sections 10.2 and 8, respectively, of this plan*)
- Have a goal to establish native vegetation at each site and to establish populations of any HMP species affected to levels equitable to those observed before the disturbance (*see Section 4.2 of this plan*)
- Place roads, staging areas, and other facilities so as to avoid, to the extent feasible, habitat with HMP species (*see Sections 2.2 and 2.3 of this plan*)
- Conduct monitoring of disturbed populations in accordance with the HMP (*see Section 8 of this plan*)

1.5.1.2 2002 Biological Opinion

The USFWS BO on critical habitat of Monterey spineflower (*Chorizanthe pungens* var. *pungens*; USFWS 2002) summarized restoration-related measures for excavation of soils that are described in the HMP (USACE 1997) as follows:

- After excavation, fill will be added to the excavated areas or they will be recontoured into the landscape (*see Sections 5.2 and 5.3 of this plan*)
- The areas will be allowed to revegetate naturally or will be passively or passively/actively restored; erosion and weed control will be implemented (*see Sections 4.3, 8.3, 8.4, 9.3.4, and 9.3.5 of this plan*)

- Access routes will be aligned to minimize habitat disturbance (*see Section 2.2 of this plan*)
- Multi-year monitoring, evaluating, and implementing corrective actions will be employed (*see Sections 8 and 10 of this plan*)

1.5.1.3 2005 Biological Opinion

The USFWS BO on California tiger salamander and critical habitat for Contra Costa goldfields (*Lasthenia conjugens*; USFWS 2005, pp. 11-12) summarized restoration requirements proposed by the Army (i.e., conservation measures for contaminated soil remediation in chaparral-dominated locations) as follows:

- Minimize remediation footprints (*see Section 2.2 of this plan*)
- Develop measures to enhance natural regeneration and recolonization of the [excavated] site (*see Sections 4 through 7 of this plan*)
- Either allow sites to recover naturally or passively and/or actively restore sites by planting species consistent with the baseline condition (*see Sections 4.3 and 4.4 of this plan*)
- Passively and/or actively restore the site if recolonization does not appear likely (*see Sections 4.3 and 9 of this plan*)
- Determine a baseline condition during pre-activity assessment (*see Section 2 of this plan*)
- Biological surveys for HMP plant species will be conducted using the protocol for conducting vegetation sampling at Fort Ord (*see Section 8 of this plan*)
- Conduct invasive weed and erosion control (*see Sections 8.3, 8.4, 9.3.4, and 9.3.5 of this plan)*
- Monitor sites annually for five years to determine if success criteria are met (*see Section 10.2 of this plan*)
- Report monitoring results to the USFWS annually (*see Section 11.1 of this plan*)

The proposed measures also include development of a habitat restoration plan that is to include:

- Regrading of disturbed sites to recreate a natural landscape and smooth transition to surrounding topography (*see Section 5.3 of this plan*)
- Soil stabilization to prevent erosion (*see Sections 5.4, 8.4, and 9.3.5 of this plan*)
- Identification of plant species and population densities to be re-established at each site, including a monitoring plan and corrective measures to be used if goals are not met (*see Sections 2.1.4, 4.4, 8, and 9 of this plan*)
- Establish chaparral plant species that were present prior to remediation through passive and/or active planting (*see Sections 2.1.4, 4.3, and 4.4 of this plan*)

It should be noted that Contra Costa goldfields have not been reported to occur within the IAR MRA and there is no designated critical habitat for Contra Costa goldfields within the former Fort Ord site.

1.5.2 Habitat Management Plan

The HMP and modifications to the HMP (USACE 1997, Zander 2002) detail the boundaries of habitat reserve and development areas and describe land use, conservation, management, and habitat monitoring requirements for target species within the IAR MRA. The HMP specifically addresses protection of habitats and certain wildlife and plant species ("HMP species") on former Fort Ord. HMP species were chosen based on their legal protection under the state and federal ESAs, their listing status, and the relative importance of existing populations and habitats at former Fort Ord to the continued survival of the species. CNPS- listed species with more than 10 percent of their known range at former Fort Ord were also included.

Restoration requirements for MEC investigation and remedial action and/or large-scale excavation work are described in two sections of Chapter 3 of the HMP. The section on Ordnance and Explosives Removal (i.e., MEC removal, pp. 3-16 to 3-25) includes the following mitigation requirements that are relevant to the IAR MRA restoration effort:

- Restrict MEC removal to the smallest area possible (*see Section 2.2 of this plan*)
- Where feasible avoid disturbance of Monterey gilia (i.e., sand gilia [*Gilia tenuiflora* ssp. *Arenaria]*) and seaside bird's-beak (*Cordylanthus rigidus* ssp. Littoralis; *see Section 2.2 of this plan*)
- Develop feedback mechanisms that allow restoration results to guide the Army's restoration program (*see Section 11 of this plan*)
- Conduct an employee education program (*see Section 2.2 of this plan*)
- Minimize impacts on black legless lizards (*see Section 2.2 of this plan*)
- Meet success criteria for healthy maritime chaparral through comparison with undisturbed sites supporting maritime chaparral (*see Section 4.2 of this plan for requirements associated with the Ordnance and Explosives Removal section of the HMP; for areas where soil excavation is performed, the comparable requirement stated in the HMP section titled Removal of Lead and Other Heavy Metals has been applied in this plan [see below]*)
- Meet success criteria for Monterey gilia, Monterey spineflower, and seaside bird's-beak including restoration results after five years consistent with self-sustaining populations (in different age stands) of maritime chaparral, occupying the same amount of habitat and with population sizes comparable to those recorded during the Army's vegetation survey of the former Fort Ord conducted in 1992 (USACE 1992; *Note: these criteria have been interpreted to apply to the former Fort Ord in its entirety; see Sections 4.2 and 10.2 of this plan*)
- Monitor re-establishment of vegetation in accordance with the Army's protocol for vegetation monitoring (*see Section 8 of this plan*)

- Prepare annual monitoring reports (*see Section 11.1 of this plan*)
- Implement corrective measures including changes in management of the site, weeding, planting, or seeding to meet the established success criteria for Monterey gilia, Monterey spineflower, and seaside bird's-beak (*see Section 9 of this plan*)

The section titled Removal of Lead and Other Heavy Metals included in Chapter 3 of the HMP (pp. 3-4 to 3-16) addresses major soil excavation. Although this section is focused on remediation and subsequent restoration of beach ranges (dune habitat), the general restoration requirements described are applicable to this plan.

This section requires that a restoration plan be developed for soil excavation sites with a goal of establishing "native … vegetation" and "HMP species populations [that are] equitable."

The following requirements of this section are relevant to the IAR MRA restoration effort:

- Limit excavation to the smallest area possible (*see Section 2.2 of this plan*)
- If a site exhibits poor quality habitat, conduct surveys of existing plant resources to provide a baseline for vegetation replacement (*see Sections 2.1.4, 4.4, and 10.2 of this plan*)
- Survey sites before disturbance to estimate restoration potential (including information on pre-existing species, soil, non-native species, slope, aspect, and microhabitats) and establish success criteria (*see Sections 2, 4, 8, and 10.2 of this plan*)
- Develop a restoration plan (*see this HRP*)
- Establish native vegetation and HMP species populations that are equitable with those that were removed (*see Sections 2.1.4, 4.2, and 4.4 of this plan*)
- Recontour excavation sites to recreate a natural landscape that grades smoothly into existing topography (*see Section 5.3 of this plan*)
- Collect seed and cuttings from within 1 kilometer (km) of the restoration site (*see Sections 3 and 6 of this plan*)
- Implement erosion control (*see Sections 8.4 and 9.3.5 of this plan*)
- Meet success criteria related to vegetative cover and species diversity (detailed success criteria in this section of the HMP addressed coastal strand and dune scrub habitats; for comparable success criteria for maritime chaparral see Section 10.2 of this plan)
- Conduct monitoring to evaluate the success of restoration efforts (detailed monitoring requirements in this section of the HMP addressed native dune vegetation; for comparable monitoring requirements for maritime chaparral see Section 8.2 of this plan)
- Implement corrective measures if monitoring indicates that success criteria for vegetation or HMP species are not being met, including recontouring, weeding, replanting, reseeding, and improvement of habitat for Monterey gilia and Monterey spineflower (*see Sections 8, 9, and 10 in this plan*)

1.6 Critical Habitat

The IAR MRA is included within the area designated as critical habitat for Monterey spineflower (listing status: threatened; USFWS 2002). This restoration plan is consistent with the requirements of USFWS associated with critical habitat of this species as described in the BO, including soil replacement, recontouring, establishment of native species populations (in particular Monterey spineflower populations) and exotic plant control.

1.7 Recovery Plans

Recovery plans for two species addressed in this restoration plan have been issued by the USFWS: Monterey spineflower and Monterey gilia (listing status: endangered; USFWS 1998).

1.7.1 Monterey Spineflower

In 1998, Monterey spineflower was reported to have a population size between 200,000 and 2,000,000 (USFWS 1998). At Fort Ord, this species was observed in firebreaks, along roadsides, in sandy openings between shrubs, the central portion of the firing range, and areas where military activities resulted infrequent habitat disturbances (USACE 1997). The preference of this species for gaps in the vegetation (i.e., bare soil) or sparsely vegetated areas on sandy substrate allows seedlings to establish in areas that are relatively free from other competing native species.

1.7.2 Monterey Gilia

In 1998, Monterey gilia was reported to have a population size of 100,400 (USFWS 1998). Preliminary estimates indicate that as much as 60% of the total known individuals of this species may occur at Fort Ord. According to USFWS (1998), the species occurs on recently stabilized U-dunes, semi-open older dune scrub of Holocene age, and on Pleistocene dunes with coastal grassland and scrub vegetation. It occurs in many topographic positions and aspects. Suitable habitat usually has a north, east, or west aspect or, in wet years, even a south aspect. The species occurs at elevations no higher than 100 feet (30 m). The substrate is sand with some soil development and litter accumulation (Thomas Reid Associates 1987). The species favors sites with limited exposure to strong winds, salt spray, and waves. It grows in open areas and wind-sheltered openings in the low-growing dune scrub vegetation and in areas where the sand has experienced some disturbance, such as along trails and roads. The species is usually tolerant of small amounts of drifting sand, but tends to occur in stable sites with minimal sand accretion or deflation.

1.7.3 Consistency with Recovery Plan Criteria

Successful implementation of this HRP will advance the following Recovery Plan criteria:

- Protection of habitat presently occupied by the species (see Sections 2.1.4, 4.2, 4.3, 4.4, 7, and 10.2 in this plan)
- Successful control of invasive non-native plants (*see Sections 8.3 and 9.3.4 in this plan*)

2.0 SITE DESCRIPTION

Former Fort Ord is located about 8 miles north of the city of Monterey, California. The IAR MRA is located in the north-central portion of the former Fort Ord, within the boundary of the former disturbance area (Figure 1). The IAR MRA is approximately 227 acres (92 ha) in size and is densely vegetated with native species characteristic of central maritime chaparral (Figure 2). It is bordered by the Parker Flats MRA to the north, the Seaside MRA to the northwest, and the former disturbance area to the east, south, and southwest. USACE property transfer parcels E38, E39, E40, E41, and E42 are contained within the MRA. The IAR MRA is within the jurisdictional boundaries of the City of Seaside and Monterey County. Approximately 206 of the 227 acres are designated as habitat reserve.

The Base Reuse Plan indicates that the IAR MRA is planned for development with borderland interfaces and habitat reserve areas (Figure 3). The general development land use category encompasses infrastructure activities such as roadway and utility construction as well as commercial/retail, parks, and borderland activities. There is no residential development planned for the IAR MRA. Special circumstances apply for the reuse areas designated as habitat reserve areas and borderlands between habitat reserve areas and development areas.

The IAR MRA is located in the area designated by the Army as MRS Ranges 43-48. To address the imminent threat to human health (public safety) or welfare or the environment posed by the presence of MEC on MRS Ranges 43-48, the Army performed interim remedial action, which included surface removal and subsurface removal operations from November 2003 to December 2005 as summarized in the MRS Ranges 43-48 Interim Action Technical Information Paper (Parsons 2007). The previous interim remedial actions conducted by the Army resulted in areas where only surface removals were conducted on MRS Ranges 43-48. Within the IAR MRA, the areas where subsurface removals were not completed by the Army are known as SCAs and NCAs, covering approximately 53 acres (21 ha). The FORA ESCA RP Team's efforts are focused on these remaining SCAs and NCAs, since the remainder of the IAR MRA has been addressed through the Army's previous interim remedial actions.

2.1 Prior and Pre-Existing Site Conditions

The site has been previously affected by Army activities when the IAR MRA was an active portion of the Fort Ord base and when earlier MEC investigation and remedial action was performed by the Army. In this plan, "prior" site conditions were documented before 2010, whereas "pre-existing" site conditions encompass conditions in the IAR MRA in 2010 and early 2011.

The Army conducted a prescribed burn in the IAR MRA in 2003, followed by MEC clearance activities. The burn removed essentially all live above-ground vegetation. The Army's pre-burn baseline survey established sampling locations and generated baseline data for areas of central maritime chaparral. After the burn and remedial investigation activity disturbances, monitoring surveys were conducted to document the recovery of

the shrub community as well as populations of species of concern (HMP species). The baseline data were used to assess the progress of vegetation recovery in the area.

The FORA ESCA RP Team assumed responsibility for the monitoring program in the IAR MRA in 2008 (ESCA RP Team 2009a). The monitoring survey was repeated in 2010 (ESCA RP Team 2012).

MEC investigation and remedial action and associated field activities by the ESCA RP were initiated in the latter part of 2011. Restoration requirements of the BOs and HMP pertaining to the FORA ESCA Team are primarily limited to those disturbances that resulted from the ESCA RP activities.

2.1.1 Topography

The former Fort Ord is located within the Coast Ranges Geomorphic Province, which consists of northwest-trending mountain ranges, broad basins, and elongated valleys generally paralleling the major geologic structures. The IAR MRA comprises gently rolling (2 to 15 percent slopes) stabilized dunes of Pleistocene age with elevations ranging from approximately 370 to 530 feet (113 to 162 m) above mean sea level (Figure 4).

Topography affects plant establishment because slope and aspect influence microhabitat conditions such as precipitation, evapotranspiration, temperature, insolation, erosion, and propagule distribution associated with natural dispersal. Topographic features may also indicate those locations where there has been substantial soil disturbance in the past, such as from earthwork and/or soil excavation. In some locations, such disturbances may have resulted in long-term alteration of site conditions and therefore have different baseline conditions than undisturbed areas. Where such alternations influence native plant establishment, site characteristics should be considered in the development of (reasonably achievable) success criteria.

Within the Range 47 SCA is an area ("Subarea A" on Figure 6) that supports very little native vegetation compared with the remainder of Range 47 SCA (Subareas B and C), less than 10% shrub cover. Aerial images from 1978, 1986, and 2007 show a large excavated bare area in the same location as Subarea A. The general location of Subarea A appears to be congruent with a dune hill in the pre-disturbed 1963 aerial image, consistent with the presence of a 15 to 20 foot (5 to 6 m) scarp on the southwest side of Subarea A. In summary, major earthwork disturbance of the Range 47 SCA area occurred in about 1964 and active use of the area appeared to have ended prior to 1978. Subarea A appears to be an area that was excavated to expose deep subsoil and has exhibited suppressed natural plant colonization over the past few decades.

2.1.2 Soils

Two soil types have been mapped within the Range 47 SCA: Baywood sand in the northwestern one-third and Arnold-Santa Ynez Complex in the southeastern two-thirds of the area (Figure 4). Based on the topography, the boundary between these two soil types

may not have been correctly georectified to the aerial image and may be located about 200 feet northwest of its position on the figure. If this is correct, the excavated hill represented by Subarea A was composed of the Arnold-Santa Ynez Complex soil type. The scarp where the hill was cut reveals a reddish soil color, which is consistent with Aromas-type soils such as Arnold-Santa Ynez Complex. The red coloration is likely attributable to the ferric oxides present in Aromas-type soils.

2.1.3 Climate

The IAR MRA area lies at the southern edge of the "Northwest Pacific Coast" climate class, which is characterized by variable precipitation concentrated between October and April, cool summer temperatures, and mild winter temperatures typical of Mediterranean climates (Major 1988). In the Monterey area, local climate is influenced by summer fog and predominant cool northwest winds. There is a sharp gradient in climate from the coast to inland areas, where summer temperatures may be much higher, especially during calm periods and/or in areas sheltered from the prevailing winds (Major 1988). The IAR MRA, just over 2 miles from the Monterey Bay coastline, is closer to the coastal portion of this gradient.

2.1.4 Vegetation and HMP Focus Species Baselines

Vegetation and HMP focus species baseline data are used in formulating success criteria and expected restoration trajectories.

The vegetation of the former Fort Ord as a whole was broadly surveyed in 1992 (USACE 1992). The vegetation of the Interim Action Ranges MRA is described primarily as central maritime chaparral (Figure 2). In addition there is a small patch of grassland located in a closed non-wetland depression in the north central part of the Central Area.

At the end of the nineteenth century, chaparral covered much of California's central coast in dense stands (Cooper 1922, Griffin 1978). Presently, only small, isolated fragments of maritime chaparral remain. Maritime chaparral occurs in well-drained sandy soils within the summer fog zone between Sonoma and Santa Barbara counties and on the Channel Islands (ESNERR 2005, Holland 1986). These stands are dominated by one or more *Arctostaphylos* species, including about twenty that are narrowly distributed endemics (Baldwin et. al 2012).

Maritime chaparral is a vegetation type of particular concern in the HMP because it supports a number of rare, threatened, and endangered species populations (i.e., "HMP species," including HMP shrub species and HMP herbaceous species; HMP herbaceous species are referred to as "focus species" in this HRP). The focus species that occur in the IAR MRA include Monterey gilia, Monterey spineflower, and seaside bird's-beak.

There are two subtypes of maritime chaparral at the former Fort Ord: sand hill maritime chaparral and Aromas formation maritime chaparral (USACE 1992). The IAR MRA occurs in a transition point from the more coastal sand hill maritime chaparral and the more inland Aromas formation maritime chaparral. Sand hill maritime chaparral grows on

sandy Baywood soils (Smith et al. 2002) and is dominated by shaggy-barked manzanita (*Arctostaphylos tomentosa* ssp. *tomentosa*), sandmat manzanita (*A. pumila*), and chamise (*Adenostoma fasciculatum*). All of these species are common in the IAR MRA. The Aromas formation maritime chaparral occurs on the Aromas formation with rocky red soils (Smith et al. 2002) and is dominated by manzanita and chamise.

2.1.4.1 Prior Vegetation Conditions (1999-2008)

Baseline and subsequent vegetation surveys of the IAR MRA, in accordance with the HMP, were obtained to evaluate post-MEC investigation and remedial action vegetation recovery conducted prior to 2010. Beginning in 1999, detailed information and quantitative vegetation data were collected in the form of shrub transects and focus species surveys (Monterey gilia, Monterey spineflower, and seaside bird's-beak). Shrub transects generally were 165 feet (50 m) in length, along which line-intercept (top canopy surface projection) data were collected. Focus species methodology varied over time but generally involved species-specific plant density counts within either irregular polygons or fixed areas (see ESCA RP Team 2009a for detailed review of prior survey methodologies).

Vegetation surveys conducted prior to 2008 spanned Ranges 43-48, which included the IAR MRA (Ranges 44-47). Therefore, only a portion of the results presented in the 1999-2005 monitoring reports are directly relevant to the IAR MRA. The vegetation surveys summarized below were conducted in accordance with the "Protocol for Conducting Vegetation Sampling at Former Fort Ord in Compliance with the Installation-Wide Multispecies Habitat Management Plan" (USACE 1992). A summary of events from 1999 through 2008 that are relevant to this HRP is presented below.

1999 and 2000: Baseline shrub transects were established and sampled within the Ranges 43-48 MRS, including 12 transects in 1999 and 67 transects in 2000, to document baseline conditions (HLA 2001). In this HRP, the survey reported by HLA (2001) is referred to as the "2000 survey" even though some of the data were collected in late 1999. Of the 79 transects established, 33 were placed within what is now the IAR MRA. Surveys were conducted for Monterey gilia and Monterey spineflower in April-May and for seaside bird's-beak.

2003 (October): Prescribed burn was conducted and vegetation in the IAR MRA was burnt, except for the coast live oaks (*Quercus agrifolia*), which are few in the MRA. This fire reset the baseline for all shrub vegetation structure.

2004 (April-May): In the first spring following the burn, a survey was conducted by MACTEC for three HMP focus species: Monterey spineflower, Monterey gilia, and seaside bird's-beak (MACTEC 2005). No shrub (i.e., transect) sampling was conducted, because only a few months had elapsed since the burn, and there was insufficient regeneration of shrubs to provide adequate assessment of shrub recovery.

2005 (April-September): Surveys were conducted for the three focus species (Parsons 2005) and the first post-baseline shrub transects (HLA 2001).

2008: Shrub transect-based and focus species plot-based monitoring was conducted in 2008 by the FORA ESCA RP Team as part of post-baseline monitoring associated with remediation work performed by the Army. In 2008 the above-ground shrub vegetation in the IAR MRA represented a maximum of five years of growth since the 2003 prescribed burn. The vegetation was relatively uniform across the IAR MRA with shrub heights ranging up to 3-5 feet (1-2 m) in most locations. Monterey gilia, Monterey spineflower, and seaside bird's-beak were all observed during monitoring.

2.1.4.2 Recent Baseline Vegetation Conditions (2010-2011)

The FORA ESCA RP Team assumed responsibility for the monitoring program in the IAR MRA in 2008 (ESCA RP Team 2009a). The monitoring survey was repeated in 2010 and 2011 (ESCA RP Team 2012).

Surveys of herbaceous HMP focus species were conducted 1, 2, 5, and 7 years after the 2003 burn and MEC cleanup. Populations of two of the species (sand gilia [now referred to as Monterey gilia] and Monterey spineflower) increased by approximately 1-2 orders of magnitude over baseline values within 1-2 years after the burn. By 2010, the most recent survey, populations of both species were reduced from their peaks, but were still nearly one order of magnitude larger than in the baseline survey. The consistency of population ratios of these species indicates that factors influencing annual population fluctuations similarly affect the populations of the two species. The third HMP focus species present in the survey area, seaside bird's-beak (a hemi-parasite), exhibited a different trend. One year after the burn, this species had a moderately reduced population but in the second year post-burn its population had increased by an order of magnitude over that in the baseline survey. By 2008, its population had increased to two orders of magnitude above that of the baseline. In 2010, the data revealed a slightly increased population compared with 2008, indicating that the species' population trend may have plateaued.

Central maritime chaparral shrub monitoring surveys using line-intercept transects were conducted 2, 5, and 7 years after the 2003 burn and MEC cleanup. Based on the generally known community development trajectory for this vegetation type, natural recovery during the 7-year period would produce a stand of initial intermediate-age central maritime chaparral; overall, a younger stand than that observed during the baseline survey (7-20+ year stands). Species richness of shrub and shrub-like plants on the transects in 2008-2010 was 31% higher compared with the baseline survey. All of the species recorded during the baseline survey had returned to the area by 2008 and 2010. In addition to the two (non-focus) HMP species recorded in 2000, a third (Eastwood's ericameria) was reported in 2008 and 2010. Species frequency of occurrence values revealed little change in 2008 and 2010 from those of the baseline survey, indicating that species presence and spatial distribution in 2010 had returned to that of the baseline survey. Bare ground decreased from 100% immediately after the burn to 22.2% in 2008 and 18.2% in 2010, indicating the steady maturation of the shrub canopy while maintaining ample amounts of habitat favorable for sustainability of populations of HMP focus species such as sand gilia (now referred to as Monterey gilia) and Monterey spineflower. The abundance data indicate that the vegetation has reached and by some

parameters exceeded the expected early intermediate-age phase of recovery and is thus progressing satisfactorily toward development of a mature shrub community. The abundance in 2010 of two HMP shrub species had increased compared with the baseline, while one (sandmat manzanita) had decreased (ESCA RP Team 2012).

SCAs and NCAs

Safety exclusion zones prevented ESCA RP Biologists from entering the SCAs and NCAs in 2010 and 2011. Therefore, it was not possible to collect baseline data or perform observations using close inspection techniques and/or the Army's vegetation monitoring protocol in the sites that would be affected by the MEC investigation and remedial action activities. In order to establish baseline vegetation conditions for the remediation areas (SCAs/NCAs) a proxy approach was used that involved monitoring plots and shrub transects in areas close to the SCAs/NCAs that contain similar vegetation as viewed from the ground and on aerial imagery (Figure 7). In addition, baseline focus species monitoring plots were established in ingress/egress corridors located outside the SCAs/NCAs (Figure 8).

Vegetation baselines were established in six different locations. Different vegetation baselines were needed because remediation work areas vary by habitat types (e.g., grassland, maritime chaparral), species distribution areas (e.g., seaside bird's-beak present or absent), and/or disturbance type (e.g., historically-altered chaparral, proposed remediation haul road). The baseline areas are: 1) North Range 44 SCA, South Range 44 SCA and Central Area NCA ("South/Central Area"); 2) Grassland; 3) Range 47 SCA – Subarea A (low recruitment area); 4) Range 47 – Subarea B; 5) Range 47 SCA – Subarea C; and 6) Ingress/Egress corridors. Vegetation baseline areas vary based on presence of focus species (HMP forbs) and vegetation type. These differences are described in detail below.

During the 2010-2011 baseline vegetation monitoring, the IAR MRA shrub community was generally healthy maritime chaparral ranging from 3 to 6 feet (2 m) in height. The low-lying areas tend to have taller vegetation and the hill tops are more sparsely vegetated. Some areas have closed-canopy dense chaparral but most areas are loosely closed canopy chaparral with sunny openings in the shrub vegetation ranging from approximately 2 to 6 feet (1 to 2 m) wide. Some areas consist of bare ground with widely scattered individual shrubs or clumps of shrubs.

Routine and baseline monitoring: Both focus species plots and shrub transects were sampled in 2010 as part of routine monitoring and baseline monitoring (see Section 8.2.4 for a description of sampling methodologies). For baseline monitoring, new transects were installed around the perimeter for the SCAs/NCAs as a proxy for vegetation conditions inside the restricted areas. These transects were situated around the Range 44 SCA/NCA and Central Area and west of Range 47 SCA (see Figure 8). Baseline focus species monitoring plots (Monterey spineflower, Monterey gilia and seaside bird's-beak) were installed and monitored along ingress/egress routes for vehicles and equipment (haul roads) and around the perimeter of the SCAs/NCAs.

Species with limited distributions: While the shrub community in the IAR MRA is fairly homogenous, several important species have limited distribution in the MRA. For example, seaside bird's-beak has been observed only in the eastern half of the IAR MRA. Historical monitoring reports and 2010-2011 proxy monitoring show seaside bird's-beak only grows in or near the North Range 44 SCA work area. In Range 47 SCA, the native shrub pitcher sage (*Lepechinia calycina*) has only been observed within and immediately to the south of Range 47, where it is relatively common. Silver beach lupine (*Lupinus chamissonis*) is found in many parts of the IAR MRA in very low numbers but is quite common in Range 47 SCA, and especially in Subarea A. Historical data for Range 47 SCA indicate that Monterey gilia was absent or present in low numbers in this area, while Monterey spineflower was abundant.

Design Study transect monitoring: The "Design Study" is the initiation phase of the remedial investigation in the SCAs and NCAs to determine the approach and extent of munitions removal work. Design Study sampling consists of parallel, 10-foot (3 m) wide transects placed in the SCAs and/or NCAs where either: 1) vegetation is cut to ground level and digital geophysical mapping (DGM) surveys and subsurface target investigation are conducted or 2) vegetation is cut, root material is removed, and excavation and soil screening operations are conducted in order to evaluate the need for additional MEC investigation. In July 2011, a limited vegetation monitoring approach was developed and implemented along 10-foot (3 m) wide excavated Design Study investigation transects running through the middle of most grid cells in the Range 47 SCA. The limited monitoring approach allowed biologists to visually observe the presence of plant species from a distance. These observations revealed that Range 47 contains initial and intermediate phase maritime chaparral, disturbed vegetation with abundant coyote brush, a few coast live oaks and young pines, and an abundance of ice plant (*Carpobrotus edulis*) and mature pampas grass (*Cortaderia jubata*; see Section 2.1.4.3).

Baseline Monitoring Methods

Several approaches were used to compensate for the inability to conduct baseline monitoring within the SCAs and NCAs, such as reconnaissance visual surveys around the perimeters of the SCAs/NCAs, installing proxy monitoring plots and transects around the perimeter or in similar habitat, and visually monitoring species richness and relative abundance in the Design Study remediation transects. Whenever possible, baseline data was collected using the methodology described in the Protocol for Conducting Vegetation Monitoring in Compliance with the Installation-Wide Multispecies Habitat Management Plan at Former Fort Ord (Burleson 2009). Some exceptions are the focus species road surveys and the Design Study transect surveys. These approaches are described in the following subsections.

Reconnaissance Observations (Subareas A, B and C): This involved biologists walking around the perimeter of the Range 47 SCA and documenting the vegetation from the corners of grid cells looking into the SCA/NCA. Photo-documentation, species presence and general vegetation structure were observed with binoculars and recorded on aerial image maps.

Road Surveys (Ingress/Egress Corridors): Unlike other site types it was possible to conduct baseline vegetation monitoring (non-proxy) in actual ingress/egress corridors. Along all designated ingress/egress corridors focus species surveys were conducted at the appropriate time of year (April-May for Monterey gilia and Monterey spineflower and July for seaside bird's beak) in a linear fashion along the roads. Biologists walked on either side of the road and documented presence of focus species extending 5 meters out into chaparral from the side of the road. Individual plants or density classes were identified and GPS polygons or points were recorded. On smaller roads containing more undisturbed vegetation, focus species monitoring covered entire grid cells surrounding the road and neighboring area as per the 2009 Vegetation Monitoring Protocol (Burleson 2009).

Vegetation Surveys (Subareas A and B): The vegetation community baseline conditions were documented using 164 foot (50 m) line intercept transects located around the SCAs and NCAs and using the Army's protocol for vegetation monitoring (Burleson 2009). Vegetation transects were placed outside the SCAs/NCAs in vegetation that was deemed to be similar in species diversity and cover to the vegetation within the SCAs/NCAs. Within the IAR MRA the vegetation community differs qualitatively between the Range 47 SCA Subarea A and B and the rest of the ESCA RP work areas in the MRA (hereafter called "IAR-wide"; Figures 5 and 6). This difference was observed initially by examining vegetation patterns in recent aerial imagery and later with ground reconnaissance surveys around the perimeter of Range 47 SCA, which appeared distinct from the rest of the vegetation in the IAR. A berm of soil runs along the north side of the Range 47 fan and is included in the Subarea B. During reconnaissance surveys it was observed that the berm vegetation was dominated by coyote brush, contained many non-native weeds, and appeared to have experienced similar vegetation disturbance as Subarea A and B. The shrub community baselines for Range 47 SCA Subareas A and B are based on three vegetation transects randomly located in a 25 grid-cell area to the west of Range 47 SCA in an area with similar appearing vegetation as seen on aerials and on the ground (Table 2). Visual inspection of the 25 grid-cell area revealed that about 50% of the area was bare ground and the vegetation that was present had a clearly different appearance on an aerial image as compared to the neighboring intact maritime chaparral. The shrub community baseline for all areas outside the Range 47 SCA Subarea A and B is based on 29 vegetation transects situated in representative and randomized areas around the MRA (IAR-wide; Table 2). Comparison of the two sets of data (frequency ranking, frequency of occurrence, and percentage cover of live native vegetation) reveals quantitative differences between the areas that are consistent with visual inspection on the ground and in aerial images.

Design Study Transects Surveys (Subarea A): Subarea A occurs at the southwest end of the Range 47 fan and exhibits unusually low seedling recruitment (Figure 5). This area was initially identified as a low recruitment area based on the apparent sparse vegetation evident in aerial imagery. This tentative assessment was later validated when ESCA RP Biologists made visual observations of the area from the Design Study transects.

Proxy Grid Surveys (Subarea C): Subarea C is located immediately north and south of the range fan (Subarea B) within Range 47 SCA (Figure 6). This area was surveyed using proxy surveys in select grid cells immediately adjacent to the restricted SCA area.

Proxy Plot Surveys (Grassland): The grassland is a relatively small feature located in the southern part of the IAR MRA (Figure 2). It is approximately 1 acre (0.4 ha) in total area, of which approximately 0.35 acres (0.14 ha, 1.3 grid cells) are located in the South Range 44 SCA/Central Area NCAs area and are inaccessible to biologists due to safety concerns. Because there were no shrubs in the grassland, the 2009 vegetation monitoring protocol specifies that 0.25 m quadrats be used to document the cover and diversity of herbaceous species in the grassland grid cells outside the SCA/NCA. Three proxy baseline plots were placed in a stratified fashion to capture the species present. A plot was placed in the middle of the grassland, along the perimeter, and halfway between the middle and perimeter.

Vegetation Baseline Results

This describes the vegetation baselines as discussed in the 2009 monitoring protocol. As per monitoring transect results, the vegetation baselines are almost entirely woody species except for the grassland, which is entirely herbaceous. While non-woody species exist in the IAR MRA, their cover is often too small to be recorded in the vegetation transect monitoring. The vegetation baselines are described below:

- North Range 44 SCA and South/Central Area: The baseline for this area is the IAR-wide shrub community. Table 2 shows the frequency of occurrence ranking, frequency of occurrence, and average areal vegetative cover by species in the 29 transects that make up IAR-wide baseline. In the IAR-wide vegetation baseline there is 80.7% vegetation cover and 19.3% bare ground. The 80.7% vegetation cover includes herbaceous and graminoid plants that are native and non-native species. There are also very uncommon woody species present in this cover like coast live oak and coast silk-tassel (*Garrya elliptica*).
- Grassland: The grassland was surveyed in September 2011 when many summer native forbs were blooming or beginning to set seed. Annual grasses were also present on the site but these were not identified during the baseline survey. Horseweed (*Erigeron [Conyza] canadensis)* grows in the middle of the grassland. Coast tarplant *(Deinandra corybmosa* ssp. *corybmosa)* is widespread throughout much of the grassland. Around the perimeter of the relatively circular grassland area, valley lessingia (*Lessingia pectinata* var. *pectinata)* and telegraph weed (*Heterotheca grandiflora*) occur infrequently and croton (*Croton californicus*) forms small mats. The grassland perimeter is largely bare in late summer and has as much as 50% bare ground mixed with dead annual grass debris.
- Range 47 SCA – Subarea A: The nearest vegetation baseline transects to Subarea A are the three that were established near Subarea B (see below). However, shrub cover in Subarea A was 10% or less prior to site activities. In Subarea A evidence of rapid re-colonization by large native shrubs is absent, although small native shrubs are present. The area has much higher bare ground than anywhere else in Range 47 SCA, ranging from 80 to 100%. Non-native pampas grass is abundant in places. Historical aerial

imagery indicates that the vegetation of the area has changed little since the 1970s, despite an apparent lack of recent disturbance, except for fire that has affected the whole range. It appears that full natural regeneration of Subarea A could take many decades, based on the pace of vegetation development over the past 40+ years. Therefore, the expected trajectory for vegetation cover in this area is 10%.

- Range 47 SCA – Subarea B: The vegetation baseline for Subarea B is derived from three transects established in an area of similar prior disturbance west of the Range 47 SCA (Table 2). The baseline area has an average of 28% bare ground and 72% vegetative cover. Like IAR-wide results the vegetative cover includes herbaceous and graminoid species, as well as non-native plant cover. There were seven less species present in the transect data compared with the IAR-wide results.
- Range 47 SCA – Subarea C: This area has the same proxy baseline as the IAR-wide transect monitoring because it is composed of intact vegetation that does not appear to have been disturbed by prior range activities. Table 2 shows the frequency of occurrence ranking, frequency of occurrence, and average aerial vegetative cover by species in the IAR-wide baseline.

HMP Focus Species Baseline Results

Forbs are non-woody broad-leaved plants. The HMP forbs occurring in the IAR MRA are either annuals or biennials. The baseline for these plants was determined as follows:

- North Range 44 SCA and South/Central Area: Baseline for this area is the monitored grid cells located around the perimeter of the SCAs/NCAs as seen on Figure 8. Monterey gilia and Monterey spineflower are present in this proxy baseline location. Seaside bird's-beak occurs only in or around the North Range 44 SCA. Occurrence within the SCA was recorded during past (2000, 2005, and 2008) monitoring and perimeter monitoring during 2010-2011 monitoring. Results are presented on Table 3.
- Grassland: Baseline focus species surveys were conducted in 2010-2011 in a grassland grid cell adjacent to the SCA/NCA (Figure 8). Monterey spineflower was present. Monterey gilia and seaside bird's-beak were not observed in the grassland during focus species surveys. Baseline results are found on Table 3.
- Range 47 SCA – Subarea A (low recruitment area): The focus species baseline for Subarea A is the adjacent grid cell located just outside the SCA (Figure 8). Monterey spineflower was present in 2010-2011 (Table 3). Monterey gilia and seaside bird's-beak were not present.
- Range 47 – Subarea B: The focus species reference area for Subarea B includes the 24 grid cells to the west and northwest. Monterey spineflower was abundant in 2010-2011 (Figure 8; Table 3). Monterey gilia was only present in one grid cell. Seaside bird's-beak was not present.
- Range 47 SCA – Subarea C: Data collected from the grid cells along the northern and southern sides of the Range 47 SCA in 2010-2011 were used to establish the focus species baseline for this area. Monterey spineflower and Monterey gilia were present (Table 3). Seaside bird's-beak was not present.

2.1.4.3 Exotic (Non-Native) Species

The three non-native invasive plants targeted for control if they invade the restoration area are ice plant, French broom (*Genista monspessulana*), and jubata grass and/or pampas grass (*Cortaderia selloana*), as required by the HMP (USACE 1997). Jubata grass is often referred to as pampas grass and this usage applies to this HRP. This distribution varies between Range 47 SCA and the rest of the MRA (referred to as "IAR-wide") as described below.

Range 47: Weeds were initially monitored remotely in Range 47 by means of reconnaissance surveys from the perimeter of the SCA using binoculars to identify and record weed presence and abundance. This procedure was feasible for large pampas grass individuals but it was not a reliable method for detecting the presence of ice plant or French broom. Aerial imagery was used to document the abundance of large pampas grass plants and large patches of ice plant. Later monitoring along excavated Design Study transects revealed that there was a large mixed-age population of pampas grass and that ice plant was abundant in many areas, especially in the eastern portion. French broom was not observed; however, without close inspection, the possibility that inconspicuous plants of this species were present cannot be excluded.

IAR-wide: Ice plant is common in the IAR-wide area, and was present in all 100x100 feet (30x30 m) grid cells that were closely inspected by ESCA RP Biologists in the IAR MRA. In some areas it forms large mats whereas in other areas it occurs in very low density. In contrast, pampas grass is relatively uncommon, although a few plants were observed in the southern part of the development parcel, which likely originated from seeds dispersed from the large population in the Range 47 SCA. French broom has not been recorded in the IAR-wide area.

2.1.5 Sensitive Wildlife Habitat

Central maritime chaparral and annual grassland are the primary vegetation types in the IAR MRA planned for restoration. Sensitive wildlife species reported to occur or potentially present in the IAR MRA that can utilize these habitats include the California tiger salamander and the California black legless lizard.

The California tiger salamander is an HMP species that uses burrows in grassy and non-grassy upland habitats within 2 km of breeding ponds. The eastern two-thirds of the IAR MRA falls within the 2 km range of the nearest known California tiger salamander breeding pond. The California black legless lizard is an HMP species often observed near the surface of loose sandy soils or under leaf litter. Restoration activities in the IAR MRA will restore potential habitat for both the California tiger salamander and the California black legless lizard.

2.2 Habitat Disturbance Minimization

The FORA ESCA Team has taken an iterative data-driven approach to define remedial activities required to address the residual MEC at the IAR MRA within the designated

areas. This approach strives to minimize, to the extent possible, disturbance of the habitat parcels found in the IAR MRA. Elements of this approach and the implementation of it include:

- Coordination with ESCA RP Qualified Biologists in developing interim remedial action work plan.
- Application of a data-driven investigation approach to better define areal extent of soil excavation, which resulted in intrusive activities footprint reduction while still addressing residual MEC safety issues.
- Siting the staging areas, sift plant and stockpiles on the development parcel.
- Review of field operations and development of plan for vehicle operations and circulation prior to intrusive site activities including:
    - uses existing roads as primary corridors for vehicle operation and "haul roads";
    - limits heavy construction vehicle traffic on roads in the habitat parcel; and
    - minimizes traffic on roads in the habitat parcel to the extent possible.
- Preparation of Natural Resources Impact Mitigation Checklist in advance of field activities, requiring ESCA RP Program Manager approval.
- Require Environmental Awareness Training for site workers prior to commencement of site activities and as new workers are brought into the site.
- Weekly reporting of construction activities and coordination with ESCA RP Qualified Biologists.

2.3 Site Conditions Following ESCA RP MEC Investigation and Remedial Action

As stated in the introduction, the Army conducted significant surface and subsurface removal actions on the IAR MRA prior to the early transfer to FORA. The previous interim remedial actions conducted by the Army resulted in areas where only surface removals were conducted on MRS Ranges 43-48. The areas where subsurface removals were not completed are known as SCAs and NCAs (Figure 5).

In 2009, a high explosive (HE) 40 millimeter (mm) projectile was found on the ground surface on Range 47 SCA by the FORA ESCA RP Team during site reconnaissance. Additionally, the Army found an HE 40 mm projectile in the Range 44 SCA in 2010 during an Army soil remediation project. The discovery of these 40 mm projectiles indicates that sensitively fuzed munitions may still remain within the IAR MRA Range 47 SCA and Range 44 SCA/Central Area NCA. This led the FORA ESCA Team to conduct additional remedial actions, which are being performed on an interim basis because the IAR MRA RI/FS will not be complete until 2012. Therefore, the cleanup goals for this site are to: take quick action to protect human health from imminent threat

and/or institute temporary measures to stabilize the area in the short term, while the final remedial solution is being developed under an RI/FS for the MRA. The solution will also incorporate assumptions about intrusive work by habitat restoration and monitoring personnel who are implementing this plan as well as similar future activities so that those activities would also be addressed.

The MEC remedial activities to be conducted at IAR MRA are described in detail in the Final Group 3 RI/FS Work Plan (ESCA RP Team 2009b), the Phase II Interim Action Work Plan Interim Action Ranges Munitions Response Area (ESCA RP Team 2011a), FVF No. IARWP-002 (ESCA RP Team 2011b), FVF No. IARWP-003 (ESCA RP Team 2011c) and FVF No. IARWP-004 (ESCA RP Team 2011d).

The IAR MRA areas disturbed by FORA ESCA Team MEC remedial activities are found within three identified footprints - Range 47 SCA, North Range 44 SCA, and South Range 44 SCA/Central Area NCA (Figure 5). Remedial actions and regulatory approval for the other areas in Ranges 43-48 found on the IAR MRA have been documented by the Army and are not the focus of this HRP. The technical approach and specific field activities associated with these areas are described in the following section.

2.3.1 Designated Ground Disturbance Categories Associated with MEC Remedial Activities

Four designated categories of MEC remedial activities correlated with ground disturbing actions are addressed in this HRP (Table 4 and Figure 9). These designated activity categories include:

- Activity A – Ingress/egress pathways and roads: includes light and heavy traffic ingress/egress pathways on existing roads within the boundaries of the IAR MRA. Estimated total area affected: 5.5 acres (2.2 ha).
- Activity B – Above-ground vegetation cutting only, prior to target-specific excavation: vegetation is cut at ground level, and removed material is chipped and left in place. Estimated total area affected: 12.4 acres (5.0 ha). Target-specific excavations (i.e., highly localized typically small excavations commonly referred to as “mag and dig” involving typically hand tools, but occasionally backhoe operation) are conducted in SCA and NCA areas that were not excavated, as described below for Activities C and D.
- Activity C – Small-scale soil excavation: includes both above- and below-ground vegetation removal, root raking, and soil excavation in limited areas (less than 1 acre [0.4 ha] or less than 100 feet [30 m] wide). Removed vegetation is stockpiled separately, along with the top 12 inches (30 centimeters [cm]) of soil, to preserve the existing seed bank. Stockpiled soils will be used to backfill the excavated areas within the IAR MRA. Estimated total area affected: 2.8 acres (1.1 ha); see Section 4.3.
- Activity D – Large-scale soil excavation: includes both above-and below-ground vegetation removal, root material removal, and soil excavation in a larger area (more than 1 acre [0.4 ha]). Removed vegetation is stockpiled separately, along with the top 12 inches (30 cm) of soil to preserve the existing seed bank. Stockpiled soils will be used to

backfill the excavated areas within the IAR MRA. Estimated total area affected: 13.4 acres (5.4 ha); see Section 4.3.

2.3.2 MEC Remedial Activities

2.3.2.1 Range 47 SCA

In 2011, the Range 47 SCA Design Study was conducted using an excavation and soil screening approach. Vegetation removal and root raking activities were conducted to support transect investigation in 10 foot by 100 foot (3 m by 30 m) grid transects (Activity C). Eleven grid transects were excavated and screened to a depth of 6 to 8 inches (15 to 20 cm), 36 grid transects were excavated and screened to a depth of 12 inches (30 cm), and four grid transects were excavated and screened to a depth of 24 inches (60 cm).

Vegetation removal was conducted over the berm area in the northern portion of Range 47 SCA to support excavation and sifting operations to ground surface. Vegetation that was removed from the investigation areas was relocated from the work area and stockpiled separately in a designated bare soil area within the boundary of the non-residential parcel of the IAR MRA.

In order to salvage the seedbank in the topsoil layer, the topsoil (top 0-12 inches [0-30 cm]) within Subarea B was excavated, sifted, and stockpiled separately; topsoil also contains beneficial micro-organisms and higher soil fertility than subsoil. However, topsoil from the man-made berm in this area was not stockpiled because the berm area contained a higher abundance of weeds. After the topsoil was removed, subsoil (all soil beneath the top 0-12 inches [0-30 cm]) from Subarea B was excavated, sifted and stockpiled separately from the top soil.

Two locations within Range 47 have been excavated to the subsoil layer and have no stockpiles of existing salvaged topsoil: Subarea A, from which topsoil was removed in the 1960s, and the berm area after weedy topsoil was recently removed.

The Design Study portion of field activities for Range 47 SCA was completed in accordance with the Final Phase II Interim Action Work Plan for the IAR MRA. Based on the Design Study findings of 85 MEC items consisting of 40 mm HE projectiles/components, 498 pounds (lbs) of 40 mm HE projectile munitions debris (MD) and 6,944 lbs of 40mm projectile unknown model MD, the FORA ESCA RP Team recommended interim remedial actions to be conducted in accordance with the procedures described in the Final Phase II Interim Action Work Plan (ESCA RP Team 2011a).

Ongoing vegetation removal and grinding activities will be conducted to support large-scale soil excavation activities (Activity D). Excavation and screening activities will be conducted in approximately 12.1 acres (4.1 ha) of soil to a depth of 6 to 24 inches (15 to 60 cm). Vegetation cutting, as necessary, followed by DGM survey and target investigation (Activity B), will be conducted in approximately 3.5 acres (1.4 ha; see Figure 9).

2.3.2.2 North Range 44 SCA

The Design Study for North Range 44 SCA has progressed in accordance with the Final Phase II Interim Action Work Plan for the IAR MRA. Range 44 SCA Design Study activities were conducted using DGM survey and subsurface target investigation along parallel transects running through the grids. The area within and immediately surrounding HA-44 (Figure 9) was not evaluated because the 1.8-acre (0.7-ha) HA-44 area was remediated by the Army and restoration is occurring in accordance with Final Habitat Restoration Plan Site 39 Inland Ranges, Former Fort Ord California, September 2009 (Shaw 2009).

Vegetation removal was conducted to support transect DGM investigation in 10 foot by 100 foot (3 m by 30 m) grid transects during 2011. Fourteen grid transects in the northern portion of Range 44 SCA (Figure 9) were root raked, excavated, and screened to a depth of 6 inches (15 cm; Activity C). Vegetation that was removed from the investigation areas was relocated from the work area and stockpiled separately in a designated bare soil area within the boundary of the non-residential parcel of the IAR MRA. The top 12 inches (30 cm) of soil was excavated, sifted and stockpiled separately from the subsurface soils to assist in the preservation of the existing seed bank. Stockpiled soils will be used to backfill the excavated areas within the IAR MRA.

Design Study activities in the northern portion of Range 44 SCA are ongoing in accordance with the Final Phase II Interim Action Work Plan for the IAR MRA. Based on the Design Study findings to date there is a potential for additional subsurface sensitively fuzed munitions to remain in the northern portion of Range 44 SCA; therefore, the FORA ESCA RP Team has recommended an expansion of DGM survey and target investigation into the northern portion Range 44 SCA (ESCA RP 2011a). Vegetation cutting, as necessary to support DGM survey and excavation to depth of digitally detected and reacquired anomalies on approximately 8 acres (3.2 ha; Activity B), will occur within the footprint of North Range 44 SCA (Figure 9).

2.3.2.3 South Range 44 SCA/Central Area NCA

Design Study activities in the Central Area NCA have been completed to date with no further design study expansion or interim remedial activities recommended at this time. Vegetation removal was conducted to support transect DGM investigation in 10 foot by 100 foot (3 m by 30 m) grid transects, approximately 2.5 acres (1.1 ha) in the Central Area NCA (Figure 9). Twenty-two grid transects, approximately 0.5 acres (0.2 ha; Activity C), were root raked, excavated and screened to a depth of 6 inches (15 cm; see Figure 9). Vegetation that was removed from the investigation areas was relocated from the work area and stockpiled separately in a designated bare soil area within the boundary of the non-residential parcel of the IAR MRA. The top 12 inches (30 cm) of soil was excavated, sifted and stockpiled separately from the subsurface soils to assist in the preservation of the existing seed bank. Stockpiled soils will be used to backfill the excavated areas within the IAR MRA.

2.3.3 Haul Roads

Approximately 5.5 acres (2.3 ha) of existing hauls roads are utilized within the boundaries of the IAR MRA and produce limited disturbance of adjacent native vegetation. Short extensions to existing roads have resulted in limited vegetation removal and will be utilized for access to restoration areas. All disturbances associated with existing roads are categorized as Activity A.

3.0 RESTORATION-RELEVANT ECOLOGICAL FACTORS

Virtually all of the sites to be restored under this plan were occupied by central coast maritime chaparral prior to disturbance (Figure 2). Outcomes of restoration are optimized when restoration strategies and procedures facilitate the natural vegetative development and ecological processes of the community to be restored. Some of these factors may be particularly influential on initial growth and survival of the restored community. A review of literature on these factors, selected for their relevance to restoration of the maritime chaparral and associated species populations is presented in Appendix A. This section includes a summary of the findings from that review and their application to this restoration plan. The findings presented are most relevant to the active restoration sites.

3.1 Physical Factors

3.1.1 Topographic Heterogeneity

Topographic elements to be implemented in this plan will facilitate re-establishment of species populations, biodiversity and recovery of healthy maritime chaparral vegetation at the sites. These elements include:

- Recontouring targeted areas to pre-existing site topography
- Matching adjacent topography at the site boundaries ("smoothing")
- Cross-slope contouring and terracing
- Creation of small-scale microhabitats

3.1.2 Edaphic (Soil) Factors

3.1.2.1 Moisture Availability

Annual rainfall totals in the former Fort Ord area between 2000-2008 ranged from approximately 10 to 25 inches (25 to 60 cm). Distribution of rainfall within a water year (October 1 through September 30) varies markedly from year to year, but is generally concentrated between October and April, a pattern characteristic of Mediterranean climates exhibiting cool moist winters and warm dry summers. Rainfall amounts greater than 0.5 inches (1 cm) per month are typically recorded from November through March; however, in 2005 (the wettest year during the period 2000-2008) 0.5 inches (1 cm) or more per month were recorded from October through May. The IAR MRA is exposed to extensive coastal fog in summer, and the effect of the dry summers on plants is ameliorated somewhat by cool temperatures, prevailing oceanic winds, and the marine layer.

Lack of adequate soil moisture due to erratic rainfall and summer drought periods can interfere with plant establishment in restoration areas (of both seeds and installed plants). Augmentation of natural rainfall by irrigation is recommended. Irrigation may benefit restoration by reducing mortality, increasing germination, facilitating annual plant production, encouraging robust development of perennials and shrubs, encouraging deep

root development of shrub species, and enhancing the effects of soil amendments. Adverse effects of irrigation may include enhancement of some pathogen populations and facilitation of weed populations. Careful management of irrigation can minimize these adverse effects.

3.1.2.2 Nutrient Availability

Soils in the IAR MRA are generally naturally low in nutrients. Nutrient availability increases temporarily after fire events in chaparral, and maritime chaparral regeneration is thought to be adapted to this periodicity in nutrient cycling. However, non-native weedy species also respond to increased nutrients. Therefore, if used, nutrient amendment (i.e., fertilizer application) should be limited to the immediate vicinity of container plants to encourage (deep) root growth while avoiding enhancement of exotic plant growth. The plant palette includes nitrogen-fixing symbionts to rapidly replenish soil nitrogen.

3.1.2.3 Physical Soil Structure

Soils at most of the IAR MRA restoration sites are comprised of medium-grained sands with little organic content and low fertility. These soils are very well-drained and can be subject to wind erosion when exposed at the surface. Water erosion potential is slight to moderate except on steep slopes, and the effective rooting depth is greater than 60 inches (152 cm). Soil decompaction as a result of excavation may alter soil properties and have unknown effects on restoration processes. Backfilled soil properties should be evaluated and any adverse effects should be mitigated. Excessive soil compaction can inhibit or modify vegetation development in arid regions; however, on former Fort Ord compacted trails and unimproved roads are considered to be important microhabitats for HMP focus species. Steps should be taken to minimize and/or eliminate soil compaction to the extent feasible before seeding and planting in restoration sites. Stockpiled topsoil should be evaluated to determine the need, if any, for amendment during or after backfilling.

As mentioned, Range 47 Subarea A was excavated to the subsoil layer in the 1960s and lacks the structure and content of topsoil. Although topsoil replacement is planned, the causes of poor plant establishment in this area are unknown as are the effects of replacing topsoil in this area.

3.1.2.4 Seed Bank

Seed banks occur in topsoil as the result of years of seed deposition by existing vegetation. Separating topsoil from subsoil and stockpiling separate soil layers prior to replacement is a recommended practice where feasible. The top 0 to 12-inch (30-cm) layer is an approximation of the topsoil layer in the IAR MRA. When soils are replaced in an excavated area, subsoils should be applied first, followed by topsoil at the same depth as predisturbance conditions.

3.1.2.5 Soil Biota

Native topsoil contains native seeds, other propagules such as bulbs, and plant growth factors (i.e., nutrients, organic matter, beneficial microorganisms, etc.) and it should be replaced at restoration sites wherever possible. Replacement of topsoil and addition of plant litter in the IAR MRA restoration sites will facilitate plant establishment by providing the desired soil conditions and natural microbial inocula to facilitate initial recruitment/survival and growth of plants.

3.1.2.6 Plant Litter

Plant litter is a natural element in maritime chaparral and should be considered as a surface amendment in restoration sites. Plant litter is correlated with the distribution of Monterey gilia (see Section 7.3.4.2). Surface application of litter at the site, carefully managed to avoid inhibiting seed germination, may facilitate soil quality, seed trapping, and microhabitat creation and can also function as an erosion mitigation measure.

3.1.2.7 Allelopathy

Some plants produce chemicals that accumulate in the soil and inhibit recruitment by other plants; this process is called allelopathy. Allelopathic effects have been documented for chaparral shrubs such as chamise, and allelochemicals may be present in the pre-existing IAR MRA topsoil. Allelopathic effects may be reduced as a result of the physical effects of soil excavation and backfill (e.g., dilution by soil mixing, volatilization, and degradation).

3.1.3 Microspatial Factors

There are many microspatial factors that could influence plant establishment: focus species such as Monterey gilia and Monterey spineflower are adapted to “disturbance” or “open” areas (however, not to soil deflation/accumulation areas), woody chaparral vegetation is adapted to water availability at depth as well as in the upper soil layers, and small rodents (i.e., seed predator or herbivore) prey upon nearby vegetation. Microspatial factors should be considered during restoration planting activities to enhance attainment of restoration objectives.

3.1.4 Physical Disturbance Factors

3.1.4.1 Fire

Extensive research has demonstrated that seed germination of many chaparral species is triggered by certain effects of fire events (i.e., heat, charred wood, etc.). Because the pre-existing vegetation of the IAR MRA was not burned immediately before the ESCA RP MEC investigation and remedial action work, these germination triggers are absent and seed germination of certain species may fail to occur or be substantially retarded. Amending the soil with charate (i.e., charred wood) may facilitate seed germination of some of these chaparral species within the restoration sites.

3.1.4.2 Erosion

Maritime chaparral communities at the IAR MRA occur on relatively stable back dunes where erosion (wind or water-induced) is infrequent, even following fire events. However, fires leave most of the root systems intact, whereas soil excavation destroys root systems that help to stabilize soil. Initial erosion risks and prevention should be considered during restoration planning, so that the site is managed to avoid erosion until soils are stabilized by restoration plantings.

3.2 Biological Factors

3.2.1 Vegetation Structure

Mature chaparral vegetation structure consists of a relatively simple canopy layer and does not involve the long-term development of complex plant structural relationships observed in some forest communities. Higher diversity of annual and short-lived herbaceous species is expected following disturbance, since seed of these species often lie dormant in the seed bank for many years between disturbance episodes. As chaparral stands mature, herbaceous and smaller species tend to be excluded by expanding canopies of the dominant shrubs, often due to decreased light availability; however, even in mature stands of chaparral, open areas may occur between shrubs that are not dominated by shrub canopy.

The terminology employed in this plan for the phases of this trajectory is presented in Table 5 and is comprised of three phases: initial, intermediate, and mature, which reflects the generalized phases of chaparral maturation, as observed in the IAR MRA following the 2003 burn. After the 2003 IAR MRA burn, herbaceous species were abundant in the first few years following the fire, and shrub cover took three years to reach 25% and seven to eight years to reach 75% or more.

The proposed success criteria reflect similar gradual increases in cover from an initial low of 0% (see Section 10). Unlike vegetation recovery following fire, however, planted areas will not experience the same flush of natural minerals and nutrients coupled with germination stimulants, which range from heat to charred wood and other unknown factors, although these conditions will be replicated in some restoration areas (see Section 7). In addition, cleared areas lack established stump-sprouting shrubs that often form the highest cover in post-fire locales. Thus, the initial years post-installation may exhibit lower increases in vegetation cover when compared with that of vegetation recovery following fire.

3.2.2 Seasonal Growth

Seasonal growth of dominant chaparral shrub species is initiated only after substantial moisture penetrates into deeper soil layers (i.e., not following initial light rain events but only after extensive rainfall has occurred). To facilitate initial (i.e., Years 1-3 post-installation) robust growth for longer periods in the initial restoration years, irrigation

should be managed to provide adequate deep-soil penetration during the extended rainy season and be curtailed during the dry summer months.

3.2.3 Microhabitats

The microhabitat most discussed in maritime chaparral consists of sunny openings between mature shrubs where annual and herbaceous species may persist for several years or more. These microhabitats occupied by Monterey gilia and Monterey spineflower are affected by chaparral growth stage, animal activity, allelopathy or other factors. To facilitate initial establishment of these species, efforts should be made to create open habitats in a portion of the site.

3.2.4 Local and Regional Genotypes

The genetic makeup of species in part reflects their adaptation to local habitats and these subpopulations are thought to be the most "fit" for a particular location. Preservation of local genotypes and genetic variability in a population can be maintained through local seed and propagule collection from a wide mix of parent plants. Plant materials used to restore the IAR MRA sites should be obtained from areas as close to the sites as possible.

3.2.5 Biological Interactions

3.2.5.1 Competition

Seeding densities proposed in this plan have been calculated to obtain sufficient recruitment in the restoration site while avoiding adverse effects of seedling overcrowding due to competition for limited resources. Proposed container plant spacing aims to enhance establishment and reduce potential competition for moisture and nutrients in the first one to three years following planting.

3.2.5.2 Grazing and Herbivory

The relatively high abundance of herbaceous biomass in the initial growth phase of the restoration site may attract large mobile grazers such as deer. In a large restoration site such as the Range 47 SCA, grazing by rodents may be reduced initially as a result of low cover, a limited foraging range, and exposure to avian and reptile predation in relatively open sites. Microhabitats created for Monterey gilia may be enhanced by placing them at some distance from the dense shrub planting areas. Fencing is proposed to exclude large mobile grazers around large-scale restoration areas.

Seed predation by ants at former Fort Ord may be at relatively low rates compared with similar plant communities elsewhere, and is not anticipated to be a problem.

3.2.5.3 Susceptibility to Invasion by Exotics

Invasion by exotic plants into restoration sites is a common problem. There are indications that maritime chaparral in general and the IAR MRA in particular (except for

prior conditions in the Range 47 SCA) may be relatively less susceptible to exotic invasion compared with other plant communities in California due to low nutrient levels. Therefore, pre-emptive exotic plant control is not proposed, but the sites should be monitored carefully to control exotics if they invade the sites and impede restoration progress.

3.2.5.4 Seed Dispersal

Seed dispersal is affected by many factors, including dispersal mechanisms (e.g., wind, animals, etc.), plant stature, microhabitat, and other factors. Seeds of some maritime chaparral species are known to be dispersed by wind (e.g., the small statured Monterey gilia) whereas others may be dispersed by attaching to passing animals (e.g., Monterey spineflower) or passage through the gut. Large-scale restoration sites will be sown with seeds of the less-dispersive species. All sites adjacent to healthy maritime chaparral will receive naturally dispersed seeds of most species over time.

3.2.5.5 Hemi-parasitism

One of the HMP species (seaside bird's-beak) is a hemi-parasite. Both field experimental research and observations on natural restoration sites on former Fort Ord indicate that seeds of this species can germinate and produce viable populations in the absence of pre-existing mature root systems of host plants. The experimental studies indicated that presence of host plants may influence the vigor of populations. Historical data on seaside bird's-beak in the IAR MRA indicate that its primary population occurs consistently in the eastern portion of the MRA. Therefore, this HRP recommends seeding of this species in areas where it has been shown to occur and success criteria are tempered to reflect the uncertainties regarding restoration procedures suitable for establishing vigorous populations.

4.0 RESTORATION PLAN OVERVIEW

Several restoration concepts have guided the development of this plan and the formulation of specific restoration-related activities. The landscape context, relationships between the level of disturbance and the proposed restoration strategy, the method by which the restoration palette was assembled, and collateral net habitat benefits are presented in this section.

This HRP focuses on achieving a successful restoration outcome as soon as feasible. A number of elements (e.g., installation of irrigation and use of charate in targeted locations) are proposed to facilitate recovery of the disturbed areas as rapidly as feasible and may enable USFWS to determine that the restoration goals and objectives have been met by Year 7 post-installation. This approach is also consistent with reducing temporal losses associated with periods of lesser habitat quality while facilitating more rapid recovery of ecosystem functionality.

4.1 Landscape Context

Former Fort Ord encompassed approximately 28,000 acres (11,331 ha) of which 16,000 acres (6,475 ha) have been designated for habitat (EMC and EDAW 1997). The habitat portion of the IAR MRA, approximately 206 acres (83.4 ha), represents about 1.3% of the total designated habitat area within former Fort Ord.

Two federal-listed annual forb species, Monterey gilia and Monterey spineflower, inhabit the IAR MRA habitat parcels. These two plant species occur in naturally "disturbed" habitats such as "open areas" as well as in anthropogenically disturbed areas such as roads and trails (USACE 1997) that occur within the IAR MRA. A number of other rare and/or sensitive plant species ("HMP plant species") also inhabit these parcels. Wildlife species of special interest ("HMP wildlife species") that are reported from or potentially present in the IAR MRA include the California tiger salamander (federal-listed as threatened), California black legless lizard, and Monterey ornate shrew (*Sorex ornatus* ssp. *salaries*; which is suspected to be present in the Fort Ord area).

Overall, the IAR MRA habitat area supports high quality central maritime chaparral vegetation. This vegetation type is well adapted to natural disturbance (specifically fires) that periodically destroys most above-ground and potentially some below ground biomass. Many of the dominant shrub species of this vegetation type are considered to be "fire-adapted," and some of the associated less competitive plant species, such as annual forbs, benefit from periodic removal of shrub overstory.

The 2003 prescribed burn in the IAR MRA mimicked that of a wild land fire event, which is considered to be a natural element in the ecology of most chaparral vegetation. Virtually all live above-ground vegetation was removed during the burn, most importantly large-statured shrub canopy. The post-disturbance vegetation changes described above are consistent with the anticipated natural ecological processes and plant community responses following such disturbances. Initial opportunistic expansion of native herbaceous and subshrub populations was followed by decreasing abundance of

opportunistic species as the plant community matured. Concomitantly, shrub cover has increased. Seven years after the disturbance, ample amounts of bare ground (i.e., "open" habitat) provide sufficient habitat for sustaining healthy populations of herbaceous HMP species. These results indicate that the native plant community and associated species populations have recovered appropriately, are sustainable, and that habitat values have not been adversely affected by the burn or the post-burn MEC clearance activities performed by the Army. The survey findings indicate that the plant community of the IAR MRA has recovered as expected to, and in some respects progressed beyond the initial intermediate-age phase of community development and is on an appropriate and sustainable trajectory associated with high quality habitat (ESCA RP Team 2012).

A summary of the landscape disturbances resulting from ESCA RP MEC investigation and remedial action activities is presented in Section 2.3.1 and Table 4. Disturbances range from minor (limited vehicle traffic on existing unimproved roads, Activity A) to substantial (vegetation removal and large-scale soil excavation, Activity D). The precise spatial extent of disturbance upon completion of the MEC investigation and remedial action work is not known as of the date of this plan because MEC evaluations are still underway for some of the areas. However, the extent of most of the activities is known and reasonable best estimates of others have been developed (Table 4). The total area estimated to be disturbed within habitat parcels by the FORA ESCA RP is 34.1 acres (13.8 ha, 0.1% of the habitat acreage within former Fort Ord and 16.5% of the habitat area within the IAR MRA). Based on past experience at former Fort Ord, areas of central maritime chaparral that are subject to relatively minor disturbances such as brush cutting and mag and dig (i.e., primarily manual) excavation tend to regenerate rapidly and re-establish the original habitat characteristics. There is less experience and therefore less certainty regarding vegetation re-establishment in areas where root systems have been removed, such as where soil excavation has been conducted. The total estimated area affected by this type of activity is 16.2 acres (6.6 ha, approximately 8% of the habitat parcels in the IAR MRA).

4.2 Goals and Objectives

The goals of this HRP reflect those outlined in the 1997 HMP. The pertinent performance goals from the HMP are summarized below.

- Preserve, protect, and enhance populations and habitats of federally listed threatened and endangered wildlife and plant species.
- Avoid reducing populations or habitat of federal proposed and candidate wildlife and plant species to levels that may result in one or more of these species becoming listed as threatened or endangered.
- Preserve and protect populations and habitat of state-listed threatened and endangered wildlife and plant species.
- Avoid reducing populations or habitat of species listed as rare, threatened, and endangered by the CNPS (List 1 B), or with large portions of their range at former Fort Ord, to levels that may result in one or more of these species becoming listed as threatened or endangered.

All activities outlined in this HRP are designed to establish native vegetation at the site that is progressing on a trajectory toward a self-sustaining native plant community equitable with the species richness and HMP species relative cover that were present on the site prior to the FORA ESCA RP Team investigation and remedial efforts.

This HRP proposes to establish the following:

- a healthy self-sustaining maritime chaparral community;
- a community that is equitable with the native plant community that was removed;
- populations of HMP species that are self-sustaining;
- populations of HMP species that are equitable with those that were removed; and
- a habitat that is devoid of or minimally affected by exotic invasive plant populations.

Successful accomplishment of these goals will be determined by meeting the following objectives:

- The health of the restored community will be determined by successful establishment of the community's component species, most importantly the HMP species (USACE 1997, p. 3-20).
- The self-sustainability of the restored community will be determined by vegetative development (i.e., community species richness and percentage cover) over a minimum of three to five years that is consistent with the generally accepted trajectory of chaparral vegetation development.
- The equity of the restored community will be determined by its consistency with the baseline (i.e., pre-disturbance) community. The baseline community represents the community that was removed (USACE 1997, p. 3-6).
- The equity of the restored populations of the HMP species will be determined by their consistency with the baseline (i.e., pre-disturbance) HMP populations. The baseline HMP populations represent the populations that were removed (USACE 1997, p. 3-6).
- The self-sustainability of restored populations of HMP species will be determined by their initial establishment and subsequent colonization of seeded and/or planted areas (i.e., HMP species richness and population estimates) over a minimum of three to five years that is consistent with the HMP baseline populations.
- The establishment of a restored habitat that is devoid of or minimally affected by exotic invasive plant populations will be determined by eliminating populations of the target exotic species and/or documenting that their populations are below the quantitative target levels (i.e., total community percentage cover) for a minimum of three to five years.
- These objectives have been translated into numerical targets that are referred to as success criteria (see Section 10.2). The determinations described above will be made by comparing site monitoring data, collected annually at a minimum, with the success criteria. An objective will be considered to have been met when the monitoring data reveal that the success criterion has been met or exceeded for the appropriate time period.

Successful achievement of the goals of this restoration plan will contribute to accomplishing the following overall goals and objectives of the HMP (USACE 1997 p. 1-13):

- Preserve, protect, and enhance populations and habitat of federally listed threatened and endangered wildlife and plant species;
- Prevent the decline of populations or habitat of special-status species to levels that may result in one or more of these species becoming listed as threatened or endangered;
- Preserve and protect populations and habitat of state listed threatened and endangered wildlife and plant species; and
- Avoid reducing populations or habitat of species listed as rare, threatened, and endangered by the CNPS (List 1B) or with large portions of their range at Fort Ord to levels that may result in one or more of these species becoming listed as threatened or endangered.

Restoration implementation, maintenance, and monitoring in the restoration areas will be overseen by FORA and its contractors.

4.3 Restoration Strategies

The restoration requirements of the BOs and HMP described in the foregoing section are focused on facilitating re-establishment of plant communities at the sites. As the plant communities re-establish, it is anticipated that wildlife in the surrounding high-quality habitat areas will migrate into the restored sites in a manner that is similar to the process that occurs following a fire event. Plant community development as facilitated through restoration strategies described in this plan in combination with natural dispersal processes will, over time, restore full ecosystem functionality to the disturbed sites.

To address the range of disturbance to native habitats anticipated as a result of the MEC investigation and remedial action work, three alternative strategies focused on plant community recovery were identified. This multi-strategy approach is based on the assumption that sites experiencing lesser disturbance will be more easily restored via natural processes, whereas sites experiencing greater disturbance (especially those of larger extent) require restoration interventions that facilitate natural recovery processes. Two principals follow from this assumption:

- The level of restoration effort should be commensurate with the level and/or extent of site disturbance.
- Allocation of restoration resources should be biased toward more disturbed and/or larger sites where prevention of site deterioration and facilitation of natural recovery processes are most needed.

The following three alternative restoration strategies are listed in order of increasing degree of restoration effort:

- Monitoring only
- Passive restoration (seeding only)
- active restoration (seeding and planting)

4.3.1 Monitoring Only

The monitoring only strategy involves the least restoration effort. It relies upon vegetation re-establishment from existing root biomass, soil seed bank, and dispersal of plant propagules from adjoining high quality habitat into the sites to rapidly re-establish the plant community. Monitoring only will be implemented at sites where disturbances are minimal (i.e., areas of brush cutting only and ingress/egress pathways that were minimally disturbed, see Table 4 and Figure 10).

Target-specific excavations that are typically small in area, shallow in depth and performed primarily with manual tools ("mag and dig" excavations) involve segregating the topsoil from subsoil and backfilling in the proper sequence followed by leveling. At brush cut only and minimally disturbed pathway locations, site preparation will not be necessary (with the possible exception of as-needed erosion control). Monitoring will be implemented and no passive and/or active restoration activity is anticipated unless corrective measures are subsequently determined to be needed through the adaptive management process.

Monitoring and reporting of this activity are described in Sections 8 and 11, respectively.

4.3.2 Passive Restoration (Seeding Only)

The passive restoration strategy involves an intermediate level of effort and includes a number of restoration procedures. It relies upon topsoil seed bank (i.e., the back-filled topsoil), seeding by restoration personnel, and natural dispersal of plant propagules from adjoining high quality habitat into the sites to re-establish the plant community. Topsoil is also highly important in providing a medium that is conducive to seed germination (i.e., nutrients, organic material, microorganisms, etc.). Passive restoration will be applied to sites where disturbance activities include small-scale soil excavation or soil disturbance in areas of limited extent (i.e., less than 100 feet [30 m] wide [regardless of acreage] or less than 1 acre (0.4 ha) and in both types, surrounded by undisturbed habitat; Table 4 and Figure 10). If heavy construction traffic along ingress/egress pathways unavoidably causes substantial soil disturbance in small areas outside of the pre-existing road footprint (i.e., along the "shoulder" transition to maritime chaparral vegetation) seed may be sown in such areas based on the recommendation of field biologists as part of the adaptive management process.

Site preparation will involve backfilling excavated soil in the correct sequence (stockpiled subsoil first, followed by stockpiled topsoil), recontouring as needed to match original topography, and seeding of the site by restoration personnel. Erosion controls will be applied as needed (see Section 9.3.5). The seed palette is described in Section 4.4. Seeded areas in passive restoration sites will not be irrigated, so seed will be sown at the

beginning of the rainy season in fall, and after 0.5 to 1 inch (1 to 2 cm) of rain has fallen (Burkhart 1988).

Monitoring will be implemented (see Section 8) and no further restoration activity is anticipated unless corrective measures are subsequently determined to be needed through the adaptive management process. Monitoring and reporting of this activity are described in Sections 8 and 11, respectively.

4.3.3 Active Restoration (Both Seeding and Planting)

The active restoration strategy involves the greatest level of effort and a wide range of restoration procedures and materials. This strategy will be applied to sites where disturbances included large-scale soil excavation (i.e., greater than 100 feet [30 m] wide and more than 1 acre [0.4 ha]; Table 4 and Figure 10). Most of the restoration resources and effort described in this plan will be allocated to these sites. As of the date of this plan, the only large-scale excavation identified is in the Range 47 SCA; however, MEC evaluations ongoing as of the plan date may determine a need for large-scale excavation in the North Range 44 SCA.

Site preparation will involve backfilling excavated soil in the correct sequence and recontouring as needed to match original topography (for more details see Section 5). Topsoil will provide highly beneficial conditions including natural seed bank and a medium that is conducive to seed germination (i.e., nutrients, organic material, microorganisms, etc.). Erosion controls will be applied as needed (see Section 9.3.5). An irrigation system will be constructed for these sites (see Sections 5.5 and 9.3.3). After site preparation, various amendments, seeding and planting of container plants will be performed (see Sections 4.4, 6 and 7). Both seeding and installation of plant stock should occur in the fall (end of September or early October) to the extent possible. Active restoration sites will be a primary focus of the adaptive management process, which will determine if and when corrective measures are needed to maintain restoration progress (see Section 9).

Monitoring and reporting of this activity are described in Sections 8 and 11, respectively.

4.4 Restoration Palette

The restoration plant palette has been selected to represent the 15 most frequently occurring species in central maritime chaparral coupled with HMP species documented from the site. The species in the palette will be introduced to the restoration site using a single or combination of propagule types including seedlings, seeds, or soil seed bank.

4.4.1 Plant Palette Selection

The restoration plant palette for the IAR MRA was created after reviewing prior monitoring reports, conducting field baseline monitoring, and evaluating ecological strategies and benefits of different species. The following reports were reviewed and where appropriate species presence was recorded in Table 6: Flora and Fauna Baseline

Study of Fort Ord (USACE 1992), Installation-Wide Multispecies Habitat Management Plan for Former Fort Ord, California (USACE 1997), 1999 Annual Monitoring Report Former Fort Ord Monterey County (HLA 1999), 2000 Annual Monitoring Report Former Fort Ord Monterey County (HLA 2001), Final 2005 Annual Biological Monitoring Report, Ranges 43-48 (Parsons 2005), 2008 Annual Natural Resource Monitoring, Mitigation, and Management Report, Former Fort Ord, Monterey County, California (ESCA RP Team 2009a), Final Habitat Restoration Plan, Site 39 Inland Ranges, Former Fort Ord, California (Shaw 2009), and Draft Final Site Specific Restoration Plan (SSRP) Historic Areas 18, 19, 22, 23, 27, 27A, 29, 33, 36, 39/40, and 43 Former Fort Ord, California (Burleson 2010). The table "Example of potential seed mixes for restoring coastal strand and dune scrub communities" (Table 3-1, USACE 1997) was used as a conceptual guide to determine the restoration palette, but most species in the table were not applicable because the IAR MRA does not support coastal dune scrub vegetation. Appropriate sections of the SSRP were evaluated to compare plant palettes from ranges with similar habitat to the IAR MRA, most specifically Historic Area/Range 43.

4.4.2 Species Presence

A comprehensive summary of the species reported to occur in the IAR MRA is presented in Table 6. The 1992 Flora and Fauna Baseline Study of Fort Ord (USACE 1992) and relevant monitoring of vegetation from 1999 through 2011 were the principal sources of this information. The list includes species that commonly occur in central maritime chaparral, as well as species associated with the sand hill and Aromas formation subdivisions of this vegetation type.

Species that were documented more frequently were more likely to be included in the plant palette because higher frequency suggests that the species plays an important role in the system over time.

The 2003 prescribed fire in the IAR MRA reset the structure of the vegetation to initial stage. Monitoring data obtained after the fire provided a site-specific basis for the trajectory from initial to late-intermediate phase of stand development that also informed development of the palette.

Vegetation cover and frequency of occurrence data from the 2010-2012 monitoring results were other criteria considered in selecting which species to include in the plant palette (Table 2). The fifteen most frequently occurring native species (except for poison oak, which is a health hazard for field planting crews) were included in the plant palette (Table 7). Some of these species exhibited low overall cover, often because of small stature, but all were recorded in at least 10% of the transects.

4.4.3 Ecological Criteria

In addition to evaluating plant species presence, frequency and cover, the restoration palette was developed to enhance habitat conditions during the initial restoration phase. The objectives were to encourage rapid development of vegetative structure, provide appropriate species diversity (especially for HMP species), and improve soil quality. Soil

excavation not only destabilizes soil and removes existing root systems, but also typically results in lower soil quality (loss or reduction of organic matter, nutrients, and soil micro-organisms). To counteract these effects and to enhance early stages of site restoration, nitrogen fixing species (e.g., deerweed [*Acmispon glaber* (*Lotus scoparius*)] and *Ceanothus* spp.) and rapidly growing shrubs (e.g., coyote brush [*Baccharis pilularis* ssp. *consanguinea*]) were included in the plant palette to add nutrients and organic matter, stabilize soil via leaf litter and root mass, reduce erosion, and slow surface air flow.

4.4.4 HMP Species Selection

The HMP specifies that HMP plant species will be restored if they are damaged or disturbed during remediation work. "Baselines" for pre-existing vegetation in the various portions of the IAR MRA to be restored were established by evaluating the monitoring data, vegetation mapping, and reconnaissance observations over a several year period (see Section 2.1.4). Plant palettes for all areas include Monterey gilia, Monterey spineflower, Monterey ceanothus (*Ceanothus rigidus)*, Eastwood's ericameria (*Ericameria fasciculata*), and sandmat manzanita, which are briefly described below. It was determined that seaside bird's-beak occurred only within a limited area in the eastern portion of the IAR MRA and this species was included only in the palette for that area to be consistent with its distribution in undisturbed habitat.

A brief description of each HMP species used in the planting palette follows, along with information on occurrence in surveys.

***Arctostaphylos pumila* – sandmat manzanita**

Sandmat manzanita is a spreading evergreen shrub in the Heather Family that is generally low in stature but may reach 3 feet (1 m) in height. It usually blooms from February to April, establishes only by seed after fire, and will not resprout if cut. Fruits attract avifauna and other animals that help disperse seeds. ESCA RP biologists have observed this species typically in intermediate to mature phase maritime chaparral stands. Seeds are easy to collect and may also be grown from cuttings. Seed germination of this species may be stimulated by charate and heat (Keeley 1987).

Sandmat manzanita was present in the IAR MRA during the 2000 (baseline), 2005, 2008, and 2010-2011 shrub transect surveys. It was present in 66% of monitoring transects in 2010-2011. The species was used by the Army in the restoration plant palettes for nearby Ranges 18 and 43 (Burleson 2010).

***Ceanothus rigidus* – Monterey ceanothus**

Monterey ceanothus is a densely branched upright to spreading evergreen shrub in the Buckthorn Family that reaches 2 to 3 feet (0.5 to 1 m) in height and blooms from March to May. It establishes vigorously by seed after fire and will not resprout if cut. ESCA RP biologists have observed this species typically in initial to intermediate phase maritime chaparral stands, with numbers diminishing through time. Seeds are challenging to

collect due to explosive dehiscence of the seed capsules. Seed germination of this species may be stimulated by charate and heat (Keeley 1987).

Monterey ceanothus was present in the IAR MRA during the 2000 (baseline), 2005, 2008, and 2010-2011 shrub transect surveys. It was present in 97% of monitoring transects in 2010-2011. The species was used by the Army in the restoration plant palettes for nearby Ranges 18 and 43 (Burleson 2010).

***Chorizanthe pungens* var. *pungens* – Monterey spineflower**

Monterey spineflower is a prostrate to low spreading annual in the Buckwheat Family that is covered with soft hairs and produces distinctive flowers and associated bracts that are used for identification. It occurs primarily in open sandy areas in central maritime chaparral from Monterey to southern Santa Cruz Counties and blooms from April to July. Seeds are easy to collect.

Monterey spineflower was present in the IAR MRA during the 2000 (baseline), 2005, 2008, and 2010-2011 HMP focus species surveys. It was present in 84% of grid cells surveyed in 2010-2011. The species was used by the Army in the restoration plant palettes for nearby Ranges 18 and 43 (Burleson 2010).

***Cordylanthus rigidus* ssp. *littoralis* – seaside bird's beak**

Seaside bird's-beak is a late spring to summer-blooming annual root parasite that reaches 2 to 3 feet (0.5 to 1 m) in height at maturity. Plants are often tinged pale green to reddish and are covered with soft, downy hairs on the linear leaves and branching stems. It blooms from May to October.

Seaside bird's beak was present in the IAR MRA during the 2000 (baseline), 2005, 2008, and 2010-2011 HMP focus species surveys. It was confined to the northern portion of Range 44, where it was found in 17% of grid cells surveyed in 2010-2011. The species was used by the Army in the restoration plant palettes for nearby Range 43 (Burleson 2010).

***Ericameria fasciculata* – Eastwood's ericameria, Eastwood's goldenbush**

Eastwood's ericameria is a medium-sized to large shrub in the Sunflower Family reaching 3 to 5 feet (1 to 1.5 m) in height that blooms from July to October. It is endemic to sandy soils in Monterey County and produces wind-dispersed seeds following flowering that are easy to collect.

Eastwood's ericameria was present in the IAR MRA during the 2000 (baseline), 2005, 2008, and 2010-2011 HMP focus species surveys. It was present in 17% of monitoring transects in 2010-2011. The species was used by the Army in the restoration plant palettes for nearby Ranges 18 and 43 (Burleson 2010).

***Gilia tenuiflora* spp. *arenaria* – Monterey gilia (previously referred to as sand gilia)**

Monterey gilia is a small annual in the Phlox family that produces basal lobed leaves and blooms from March to May. It is endemic to sandy soils near Monterey Bay and produces small seeds following flowering that are easy to collect.

Monterey gilia was present in the IAR MRA during the 2000 (baseline), 2005, 2008, and 2010-2011 HMP focus species surveys. It was present in 34% of grid cells surveyed 2010-2011. The species was used by the Army in the restoration plant palettes for nearby Range 43 (Burleson 2010).

4.4.5 Non-HMP Species Selection

The non-HMP species were selected for the planting palette based on the considerations outlined above and detailed for each species below. Table 2 shows the plant species' cover and frequency of occurrence as recorded during the 2010-2011 baseline monitoring surveys. The non-HMP species palette is based on data from 30 IAR-wide transects and includes the following species.

***Acmispon glaber* var. *glaber* [*Lotus scoparius*] - deerweed**

Deerweed is small statured fast-growing nitrogen-fixing subshrub in the Pea Family that will help ameliorate low-nutrient soil; it produces yellow to reddish flowers from March to August. ESCA RP biologists have observed this species typically in initial-intermediate phase maritime chaparral stands. Burkhart (1988) reported that the species reproduces well, transplants easily and establishes quickly at restoration sites. Seed germination of this species may be stimulated by charate and heat (Keeley 1987).

Deerweed was present in the IAR MRA during the 2000 (baseline), 2005, 2008, and 2010-2011 shrub transect surveys. It was present in 79% of monitoring transects in 2010-2011. The species was used by the Army in the restoration plant palettes for nearby Ranges 18 and 43 (Burleson 2010).

***Adenostoma fasciculatum* - chamise**

Chamise is a large evergreen shrub to 6 feet [2 m] high in the Rose Family with small waxy needle-shaped leaves; it produces white flowers from May to July. It occurs in dense stands in the most arid sites occupied by central maritime chaparral; it will contribute to increased vegetation cover. Chamise is tolerant of low nutrient soil and is fire tolerant once established, forming a lignotuber (burl). Chamise sends up new stems from a burl and can resprout after being cut. It is a common dominant in sand hill and Aromas maritime chaparral. Seed germination is stimulated by charate (Keeley 1987).

Chamise was present in the IAR MRA during 2000 (baseline), 2005, 2008, and 2010 (baseline) shrub transect surveys. It was present in 90% of monitoring transects in 2008. The species was used by the Army in the restoration plant palettes for nearby Ranges 18 and 43 (Burleson 2010).

***Arctostaphylos tomentosa* ssp. *tomentosa* - shaggy-barked manzanita**

Shaggy-barked manzanita is a large evergreen shrub up to 6 feet [2 m] high in the Heather Family that forms dense stands at the site. It generally bears bicolored leaves and produces white urn-shaped flowers from December to March. It sends up new stems from a burl (lignotuber) and can resprout after being cut. Fruits attract avifauna and other animals that help disperse seeds. This species is often dominant in sand hill and Aromas maritime chaparral. The species is fire tolerant once established. Plants are propagated by cutting. Seed germination of some species in this genus may be stimulated by charate and heat (Keeley 1987).

Shaggy-barked manzanita was present in the IAR MRA during 2000 (baseline), 2005, 2008, and 2010 (baseline) shrub transect surveys. It was present in 100% of monitoring transects in 2008. The species was used by the Army in the restoration plant palettes for nearby Ranges 18 and 43 (Burleson 2010). The most recent taxonomic treatment for this shrub (Baldwin et. al 2012) splits *A. tomentosa* into two species, *A. tomentosa* and *A. crustacea*, both of which occur at the site. This HRP addresses both species as *A. tomentosa* so that the data are consistent with the HMP. ESCA RP biologists have noted increasing cover of shaggy-barked manzanita from initial through mature phases of maritime chaparral development.

***Baccharis pilularis* ssp. *consanguinea* - coyote brush**

Coyote bush is a large evergreen shrub up to 6 feet [2 m] in height in the Sunflower Family with small green toothed leaves and greenish flowers from June to December, followed by copious seeds that are easily collected and wind dispersed.

This species produces rapid growth and will increase vegetation cover quickly.

Coyote brush was present in the IAR MRA during 2000 (baseline), 2005, 2008, and 2010 shrub transect surveys. The species was used by the Army in the restoration plant palettes for nearby Ranges 18 and 43 (Burleson 2010) and was present in 24% of monitoring transects in 2008. ESCA RP biologists have noted that coyote brush is common in the initial and intermediate phases of maritime chaparral development. A lower density of this species will be used relative to other species because it can be spread rapidly and was not abundant in the MRA.

***Ceanothus dentatus* - dwarf ceanothus**

Dwarf ceanothus is a spreading evergreen shrub in the Buckthorn Family that usually remains below 3 feet (1 m) in height at maturity. Deep blue flowers are produced from March to June. It establishes vigorously by seed after fire and will not resprout if cut. Seed is time-consuming to collect. Seed germination of many ceanothus species is stimulated by heat and possibly by charate (Keeley 1987).

Dwarf ceanothus was present in the IAR MRA during 2000 (baseline), 2005, 2008, and 2010 shrub transect surveys. ESCA RP biologists have noted that the species typically

occurs in intermediate and mature phases of maritime chaparral development. It was present in 90% of monitoring transects in 2008.

***Ericameria ericoides* – mock-heather, also referred to as dune-heather**

Mock-heather is an evergreen shrub in the Sunflower Family that reaches up to 5 feet (2 m) in height and produces yellow flowers from September to November, followed by copious seeds that are easily collected and wind dispersed.

Mock-heather was present in the IAR MRA during 2000 (baseline), 2005, 2008, and 2010 shrub transect surveys. The species was used by the Army in the restoration plant palettes for nearby Range 18 (Burleson 2010). It was present in 24% of monitoring transects in 2008. ESCA RP biologists observed that the species typically occurs in initial and intermediate phases of maritime chaparral development.

***Eriophyllum confertiflorum* var. *confertiflorum* – golden yarrow**

Golden yarrow is a small subshrub (1 foot+ [0.3 m] high) in the Sunflower Family that is woody only at the base and often loses most of its leaves in summer. It produces bright yellow flowers from April to August. Seeds are easily collected and wind dispersed.

Golden yarrow was present in the IAR MRA during 2000 (baseline), 2005, 2008, and 2010 shrub transect surveys. The species was used by the Army in the restoration plant palettes for nearby Ranges 18 and 43 (Burleson 2010). It was present in 66% of monitoring transects in 2008.

***Frangula [Rhamnus] californica* var. *californica* – California coffeeberry**

California coffeeberry is a large spreading evergreen shrub 6 feet (2 m) in height in the Coffeeberry Family that occurs commonly in shrub communities along the Central Coast and blooms from April to July. Fruits attract avifauna and other animals that help disperse seeds. Seeds are easy to collect.

California coffeeberry was present in the IAR MRA during 2000 (baseline), 2005, 2008, and 2010 shrub transect surveys. The species was used by the Army in the restoration plant palettes for nearby Range 43 (Burleson 2010). It was present in 31% of monitoring transects in 2008. ESCA RP biologists have observed that the species typically occurs in intermediate to mature phases of maritime chaparral development.

***Helianthemum scoparium* - rush-rose, also referred to as peak rush-rose**

Rush-rose is a small subshrub in the Rock-rose Family that is woody only at the base and blooms from February to August; it is often summer deciduous. Small soil mounds often form under these plants because of their ability to trap sand. They may also trap seeds. Seeds are difficult to collect.

Rush-rose was present in the IAR MRA during 2000 (baseline), 2005, 2008, and 2010 shrub transect surveys. The species was used by the Army in the restoration plant palettes for nearby Ranges 18 and 43 (Burleson 2010). It was present in 86% of monitoring transects in 2008. ESCA RP biologists have observed that the species typically occurs in initial and intermediate phases of maritime chaparral development.

***Horkelia cuneata* ssp. *cuneata*- wedge-leaved horkelia, also referred to as coast horkelia**

Wedge-leaved horkelia is a low-growing herbaceous perennial in the Rose Family that forms gradually increasing colonies in age; it produces white flowers from March to July. The plants trap seeds and may act as a "nurse plant" for other species. Seeds are easily collected.

Wedge-leaved horkelia was present in the IAR MRA during 2000 (baseline), 2005, 2008, and 2010 shrub transect surveys. The species was used by the Army in the restoration plant palettes for nearby Ranges 18 and 43 (Burleson 2010). It was present in about 52% of monitoring transects in 2008. ESCA RP biologists have observed that the species typically occurs in initial and intermediate phases of maritime chaparral development.

***Lepechinia calycina* - pitcher sage** Pitcher sage is a medium-sized shrub to 5 feet (1.5 m) or more in height in the Mint Family that produces white to pinkish flowers from April to July.

During the 2008 IAR MRA shrub transect survey, ESCA RP biologists noted that pitcher sage was present near the Range 47 SCA, although it was not recorded on the transects. It would be planted only in this area.

***Mimulus aurantiacus* – sticky monkeyflower**

Sticky monkeyflower is a medium-sized subshrub in the Lopseed Family that reaches up to 3 feet (1 m) in height and produces pale apricot-colored flowers from March to June. It loses many of its leaves during the dry summer months. Seeds are easy to collect. This species exhibits rapid growth upon establishment.

Sticky monkeyflower was present in the IAR MRA during 2000 (baseline), 2005, 2008, and 2010 shrub transect surveys. It was present in about 28% of monitoring transects in 2008. The species was used by the Army in the restoration plant palettes for nearby Range 18 (Burleson 2010). ESCA RP biologists have observed that the species typically occurs in initial and intermediate phases of maritime chaparral development.

***Salvia mellifera* – black sage**

Black sage is a medium to large shrub in the Mint Family that reaches up to 3 feet (1 m) or more in height and blooms from March to June. It exhibits rapid growth upon establishment and loses many of its leaves during the dry summer months. Seeds are easy to collect.

Black sage was present in the IAR MRA during 2000 (baseline), 2005, 2008, and 2010 shrub transect surveys. It was present in about 69% of monitoring transects in 2008. The species was used by the Army in the restoration plant palettes for nearby Ranges 18 and 43 (Burleson 2010). ESCA RP biologists have observed that the species typically occurs abundantly in initial and intermediate phases of maritime chaparral development and in lower numbers in mature maritime chaparral.

4.5 Collateral Habitat Net Benefits

A number of collateral habitat net benefits will result from the MEC investigation and remedial action and restoration activities. These benefits derive from alterations that restore habitat quality in specific locations of the Range 47 SCA to a higher level than is required (i.e., a higher habitat quality than that of the pre-existing community and populations). In addition, the restored areas will introduce heterogeneity of stands in the maritime chaparral community (i.e., patches of different ages), which will improve overall habitat quality in the IAR MRA.

4.5.1 Road Decompaction

A pre-existing unimproved road crossed a portion of the Range 47 SCA. Although, as described elsewhere, such features may act as habitat for Monterey gilia and Monterey spineflower, they are not natural features. Observations of similar roads on former Fort Ord indicate that shrub vegetation is very slow to recolonize these features, possibly owing to soil compaction. The excavation activities in the Range 47 SCA will loosen the soil, thus returning it to a more natural condition. Populations of Monterey gilia and Monterey spineflower that may have inhabited the original road, will be replaced by populations in focus species habitats developed as part of the restoration effort (see Section 7).

4.5.2 Exotic Plant Population Removal

Exotic plant populations occur throughout the IAR MRA. In the Range 47 SCA, the pre-existing vegetation included a large population of pampas grass as well as numerous scattered ice plants, which contributed to substantially lower habitat value in the SCA. These exotics were removed during the MEC investigation and remedial action work and restoration activities will replace them with a plant community of much higher habitat value.

4.5.3 Subarea A Backfill and Topsoil Placement

As described in Section 2.1.4, a portion (approximately 1.3 acres [0.5 ha]) of the Range 47 SCA exhibited substantially lower vegetation cover, shrubs of lower stature, and apparently lower diversity than the surrounding maritime chaparral. This area is designated “Subarea A” and is described by ESCA RP biologists as a “low recruitment” area. Subarea A is conspicuous in contemporary aerial images as well as those extending back to the 1960s when Range 47 was constructed. Subarea A does not appear in an aerial image taken prior to the construction of Range 47. The southwestern boundary of

Subarea A is coincident with a scarp face whose maximum height is about 20 feet (6 m) above Subarea A. The shape of Subarea A and the surrounding topography support the hypothesis that a dune hill existed in the area that was partially excavated when Range 47 was built. It is further speculated that the "low recruitment" character of the area may be attributable to subsoil that was exposed and which is deficient in properties suitable for normal development of maritime chaparral (e.g., low nutrients). The pre-existing conditions and baseline vegetation cover in this area is different than those of all other restoration areas on site, with only 10% shrub cover after many decades (see Section 2.1.4.2).

During backfill of subsoil and topsoil in the Range 47 SCA, biologists will coordinate with construction crews to replace subsoil and topsoil in Subarea A, to the extent feasible (all soil excavated from Subarea A was placed in the subsoil stockpile; topsoil to be backfilled into Subarea A will be obtained from topsoil reserved from other areas of the Range 47 SCA). Backfilling of Subarea A to its pre-existing topography is planned; the effort to place additional subsoil as well as topsoil in this area will have no practical effect on the time and effort required to backfill the excavated area of Range 47 SCA. Although it is hoped that plant establishment after topsoil placement and seeding will result in development of vegetation that is more characteristic of undisturbed maritime chaparral than the pre-existing Subarea A vegetation, the primary objective is to restore this area to preexisting conditions.

4.5.4 Stand Heterogeneity

The HMP (p. 2-5) describes healthy maritime chaparral as a patchwork of stands (i.e., patches of various ages, species composition and extent of canopy). This patchwork results from natural disturbance factors, particularly fire events. Successful completion of this restoration project will introduce stand heterogeneity into the IAR MRA consistent with this description of a healthy ecosystem. After successful implementation of restoration actions, vegetation in the ESCA RP-disturbed areas will be of the initial maritime chaparral growth phase, whereas surrounding areas will be transitioning from intermediate to mature phases. Therefore, although the MEC investigation and remedial action work will have caused temporary disturbances in portions of the landscape, the ultimate outcome (comparable to natural disturbance events) will be to increase habitat value (specifically floristic diversity and wildlife foraging) in the landscape.

4.5.5 Habitat Reserve Management

Prior to the FORA ESCA RP Team MEC investigation and remedial action, personnel were not able to enter these areas for safety reasons. Accordingly, the ability to perform required habitat management activities was precluded. Completion of the MEC investigation and remedial action will enable the landowner to perform these requirements.

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5.0 SITE PREPARATION

This section describes the site preparation actions that will be implemented at sites where passive and active restoration is planned.

All apparel, tools and equipment (i.e., clothing, work shoes, boots, hand tools, vehicles, mechanized equipment, etc.) will be cleaned by the owner prior to arrival onsite and inspected by ESCA RP personnel prior to use on the restoration sites, to avoid importation of soil-borne micro-organisms, weed seeds, and other issues.

5.1 Soil Decompaction

Soil within ingress/egress pathways that experienced heavy traffic during the MEC investigation and remedial action work were compacted. Upon completion of work requiring heavy equipment in the area, a final pass will be made with a bulldozer rip unit to decompact the soil. This procedure will facilitate development of robust root structures for container plants of the shrub species in these locations.

5.2 Backfill Soil

As part of the planning process for the excavation work, a protocol was developed to segregate topsoil from subsoil. Topsoil is defined as the uppermost 6 to 12 inches (15 to 30 cm) of soil and subsoil is defined as the subtending soil. Subsoil was separately stockpiled from topsoil during the excavation work. After MEC investigation and remedial action work is completed, the remediated excavated material will be backfilled.

As described in Section 4.5.3, augmented backfilling (topsoil and possibly subsoil) will occur in Subarea A of the Range 47 SCA.

5.2.1 Subsoil

The first step in backfilling the excavated areas will be to transport stockpiled subsoil back to the excavation sites as a first lift. The volume backfilled will allow for the second lift of topsoil.

5.2.2 Topsoil

Observations of the soil profile in the IAR MRA indicate that the true topsoil is very shallow, possibly several inches in thickness. However, it is impractical for heavy construction equipment to excavate a thin soil layer reliably across terrain of variable topography. Therefore, a nominal 0 to 12 inch (0 to 30 cm) layer was considered to represent topsoil even though the quality of the true topsoil layer will be diluted by mixing with slightly lower soil layers.

Following subsoil backfill and grading, soil from the topsoil stockpile will be transported to the excavation sites as a second lift of 6 to 12 inches (15 to 30 cm). The volume backfilled will allow for grading to match the original topography.

5.3 Grading

5.3.1 Site-wide Grading

Following placement of the subsoil into the excavated sites, it will be graded to match the pre-existing topography (less the second lift of topsoil). Upon backfill of topsoil, the material will be graded to match the original topography and will be smoothed at the boundaries to match adjacent elevations. Final grading elevations of subsoil and topsoil may be slightly higher than the desired elevation to allow for the "fluff" factor and natural soil compaction over time.

Care will be taken to minimize soil compaction from mechanized equipment during backfill operations. Areas where soil becomes compacted will be decompacted prior to surface dressing, seed distribution and plant installation.

5.3.2 Slope Contouring

Additional cross-slope contouring may be performed to create microspatial heterogeneity, enhance seed and moisture trapping and reduce erosion potential on slopes. Slopes may also be terraced in certain locations (e.g., for focus species habitat, see Section 4.3.3).

5.3.3 Grading in Subarea A of Range 47 SCA

As described in Section 4.5.3, augmented backfilling will occur in Subarea A of the Range 47 SCA. Grading in this location will be performed to produce gradual slope/transition to the surrounding pre-existing topography.

5.4 Soil Surface Stabilization

Soil that had been backfilled at the site is potentially unstable and subject to erosion from wind or rainfall events until vegetation is sufficiently established to stabilize surface soil. The following measures will be employed to prevent/mitigate soil erosion:

- Slopes within the site will be cross-harrowed and/or terraced to reduce downhill water erosion
- The irrigation system will be used to wet the soil to mitigate wind erosion (except during summer months)
- Litter will be applied over the site, which will intercept moving soil

Straw crimping has been used for erosion control at former Fort Ord, typically at sites not designed for restoration. This method has been recommended for use in dune restoration

(Dorrell-Canepa 2005) to facilitate soil stabilization. However, this method compacts soil, which could affect subsequent plant recruitment and development. Therefore, measures that do not involve soil compaction have been selected for initial soil stabilization. If these measures are determined to insufficiently mitigate erosion effects, straw crimping and other measures may be considered as corrective measures (Section 9).

Use of sterile crops for initial soil stabilization is not planned because such crops may compete with establishment of native annuals (Keeley et al. 1981).

5.5 Irrigation System

Survival of seedlings and installed plants in restoration sites without supplemental water supply in California is considered to be highly uncertain owing to the unpredictable, limited and variable natural rainfall pattern. Experience indicates that total failure is not uncommon (Burkhart 1988). To increase the probability of successful restoration, a temporary overhead irrigation system will be constructed in all large-scale restoration areas and operated to provide moisture for plant germination and growth as well as for soil stabilization, as needed, in sites where active restoration includes installation of plant stock. The irrigation system will be comprised of two major elements: the irrigation unit and the distribution system. The irrigation unit will be sited on the development parcel to avoid disturbances to habitat parcels. It will include an access road, above-ground water storage tanks, pump, manifold and maintenance shed. The distribution system will be above-ground and will be comprised of valves, PVC pipes and overhead delivery units. Water will be delivered by truck to the storage tanks and/or supplied directly via pipeline. Operation of the system is described in the Section 9. At the end of the irrigation period (planned for 2-4 years), the system will be dismantled and removed from the site. Management procedures for this system are described in Section 9.3.3.

5.6 Deer Exclusion Fence

A temporary deer exclusion fence will be erected around the large-scale restoration areas to prevent severe grazing damage to installed plants and seedlings. The fence will include one or more gates to provide access to restoration workers. Fence posts will be secured in concrete footings (intrusion into soil will be a maximum of 24 inches [60 cm] below ground surface) at appropriate spacing, and fence material will consist of 8 foot (2.5 m) steel wire mesh small enough to prevent deer passage. Smaller mesh may be affixed to the bottom 1 feet of the larger mesh to exclude rodents, if feasible. The fence will be maintained by restoration field crews. The fence will remain in place until plants in the restoration site have grown large enough to withstand grazing damage (likely 2-4 years post-installation). This determination will be made in the adaptive management process. When the fence is no longer needed, it will be dismantled and removed from the site (concrete footings will also be removed and holes will be backfilled).

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6.0 RESTORATION MATERIALS

This section describes the source and preparation of restoration materials that will be installed at restoration sites. A summary of the materials, application sites and methods, and restoration purpose is presented in Table 8.

For species of limited distribution, including several HMP species, consideration of genetic fidelity will assist in maintaining the overall genetic diversity of the entire species. The overall purpose of the restoration project is to re-introduce and re-establish populations as similar as possible to those that were removed during MEC investigation and remedial action. By definition, propagules that disperse to and naturally recruit at the site have acceptable genetic fidelity. To meet the purpose of the project, resident species' populations in nearby sites possess the requisite genetic fidelity and will be used as sources for seed and container plant propagation materials. Thus, there should be substantial commonality of genetic fidelity between the naturally recruiting and the passively and actively restored populations at the site.

6.1 Plant Litter

Litter cover may be necessary for seedling recruitment in chaparral. Vegetation removed from the excavation sites has been masticated and stockpiled. Although this material contained small amounts of pampas grass and ice plant, which could contribute to exotic invasion at the sites, on balance it was determined that this vegetation material would be used as an amendment for the active restoration sites. Plant litter will be obtained from the stockpile of masticated vegetation and will be sparingly applied as one of the final steps in site preparation.

6.2 Charate

As discussed in Section 3.1.4.1, charate (charred woody material) is a key soil factor that triggers germination of certain seeds in chaparral communities (Keeley 1987). A small portion of the vegetation material that was removed from the excavation sites, masticated and stockpiled will be used to produce charate. The charate may be produced by controlled (i.e., confined) burning within a metal structure at the site. Charate operations will comply with local air emissions regulations. Appropriate fire protection equipment, staffing and procedures will be implemented. The confined nature of the burn, the small amount of material involved, the flexibility regarding timing of the burn and the ability to immediately stop combustion will enable this effort to proceed in a safe and efficient manner.

6.3 Fertilizer

Slow-release fertilizer may be used as a soil amendment to encourage above-ground growth and vertical root development. Small amounts of this material may be mixed into soil immediately below the root depth of container plants, to encourage vertical robust root formation.

6.4 Soil Seed Bank

Soil seed bank is an important restoration material because, in addition to containing the seeds of target species, it often contains seeds of associated species and is likely to contain soil elements typical of undisturbed chaparral habitat, such as nutrients, chemistry, mycorrhizae, and beneficial bacteria.

Soil seed bank has been collected as salvage. To maintain viability and protect from loss or deterioration, soil seed bank material was stored in plastic buckets in a cool dry secure building location where temperature is moderated. The material was monitored regularly for evidence of rodent or insect damage and appropriate pest controls were performed as needed.

Species suitable for soil seed bank collection are Monterey gilia, Monterey spineflower and rush-rose. These and similar species are prone to quickly or continuously dropping their seed making collection from the plant quite difficult.

Soil seed bank will be applied within the focus species habitat areas (see Figure 11).

6.5 Seed

Seeds are an important restoration material because they can be collected at the location where vegetation removal is going to occur, they can often be stored and used later to grow containers in a nursery and/or be sown directly in the field, and they are genetically related to the parent plant yet contain mutations that can have adaptive benefits (unlike cuttings).

Seeds will be collected for two uses in the IAR MRA restoration: propagation in greenhouses to produce potted plants for installation and for seed mixtures to be applied to the site. Use of seeds to produce container-grown plants is discussed in Section 6.6. Seed application to topsoil in the field will be performed by broadcast, seed drill, or other appropriate method. Broadcast-seeded areas will be lightly raked using hand tools, vertical mower (or power rake), or other suitable equipment to incorporate seeds into the surface layer of topsoil.

Seeds of HMP focus species (Monterey gilia, Monterey spineflower, and/or seaside bird's beak) will be added at sites if these species are present either in the baseline pre-remediation data, or in surrounding vegetation stands. Seeds should be broadcast and lightly raked in as a separate seed mixture on the 10 percent bare ground areas reserved for these HMP forbs. At the Fort Ord Dunes Site 3 Restoration (Harlen 2000) and at the Moss Landing Marine Labs Restoration (Oliver 2000), Monterey spineflower was successfully restored by raking seed into the sand. Other studies also suggest that raking seeds into the ground improves the success of restoration efforts (Turner et al. 2006). Seeds of other endangered annual species occurring in maritime chaparral elsewhere, such as Pismo clarkia (*Clarkia speciosa* ssp. *immaculata*), have been successfully utilized to reestablish viable populations in previously disturbed soil and were raked into the soil (ESCA RP Team 2012).

6.5.1 Seed Collection

Seed material will be collected on site, in order to ensure genetic integrity in local populations. Seed material will be collected during the appropriate season for the plant. To minimize disturbances to existing HMP populations, no more than 5 percent of the seeds from any single population, or 5 percent of the seeds of any single individual plant of an HMP forb species may be collected. If HMP forb seed can be salvaged from the remediation site, 100 percent of the seed may be taken. No more than 20 percent of the seeds on any one individual may be collected from HMP shrub species to reduce disturbances to the individual plants, and to maximize genetic diversity at each restoration site. This applies to Eastwood's ericameria, Monterey ceanothus, and all of the HMP manzanita (*Arctostaphylos*) species. Any non-HMP species nursery stock must be collected from plants within a 10 mile (16 km) radius of the site.

Populations of local HMP forbs should be established in greenhouse conditions to use as seed sources for the following two years. These species should be held for no more than two generations in the greenhouse to prevent genetic selection that could affect the local population gene pool. Previous work indicates that at least sand gilia and Monterey spineflower can be successfully grown in greenhouses (Dorrell-Canepa 1994, Fox et al. 2006). However, for the first 1-2 years of the project when greenhouse seeds will not be available, wild seed will be collected within designated habitat reserves (with the restrictions mentioned above) or salvaged from development areas.

6.5.2 Seed Processing and Storage

Native seed should be initially field processed to remove excess chaff and possible insects. This should be followed by a combination of processing, drying, treating with larvacide and packaging for storage. The protocol for seed processing and storing is included as Appendix C. Seed of some species are not viable for long storage periods. For these species, collection will occur in the late summer and fall immediately prior to seeding, as available.

6.5.3 Seed Pretreatment

Seeds of many native species may have well-developed dormancy mechanisms requiring specific conditions for germination to occur. Species differ in their requirements for breaking a seed coat or embryo dormancy. To ensure adequate germination, seeds grown in nurseries will be pre-treated by the nursery prior to planting. Seed pre-treatment will be species-specific and may include subjecting seeds to heat, cold moist conditions, hot water, charate, smoke, and/or scarification. Published information and advice from native plant professionals will be used to determine the appropriate method of pre-treatment for each species.

6.5.4 Seed Allocation

Seeds will be weighed and counted out to deliver to nurseries for plant production of the appropriate number of seedlings or to include in seed mixtures for broadcast seeding.

Seeds of each species will be sampled and multiplied to determine the number of seeds per gram of processed seed. The number of seeds per unit weight may vary.

6.6 Container-Grown Plants

The use of container-grown plantings will be used for species that require specific propagation treatments in order to ensure establishment. Container-grown plants will be produced from seeds collected as indicated above, or from cuttings.

Many of the species in maritime chaparral are difficult to grow in the greenhouse and are very slow growing (McKnew 2007). For this reason, orders for container-grown plants have been placed one to two years in advance of planting. The stock of chaparral species will be grown in an off-site greenhouse facility.

Container sizes will be determined appropriately for the species and age to avoid root binding and maximize quick, healthy root and shoot development. A container such as a D40 (DeepotsTM) may be used for deep-rooted plants because the pot is deep and directs the roots downward with linear grooves. If conditions are suitable in the field, container-grown plantings should be installed when the plants are young, usually after 4-8 months in the nursery. Some species may require longer in the nursery to fully establish.

6.6.1 Planting and Seeding Density

As with many restoration sites, there is little information available on plant density in natural maritime chaparral communities at former Fort Ord. Keeley (1992) conducted a wide-ranging study of chaparral vegetation across California. In his Marin County study sites (located within the range of maritime chaparral) genet (i.e., individual shrub) density was reported to be 1.1 and 2.5 live genets/square meter.

Proposed planting and seeding density per acre is presented in Table 7, which reflects areas of contiguous habitat requiring active restoration (seeds and plants) or passive restoration (seeds only). Similar to the Army's HRP (Shaw and DDA 2009) and SSRP (Burleson 2010), 90% of areas requiring active restoration will be planted and seeded with most shrub species at the per acre density listed in Table 7. The other 10% of these areas will be planted and seeded with HMP forbs at the densities listed. Therefore, the per acre planting density only refers to the habitat the species is intended for (HMP forb or shrub habitat). In addition, some species will be planted at greater or lesser densities depending on their specific microhabitat preference. For example, pitcher sage has only been recorded to grow at the southeastern part of Range 47 SCA. If this specific area is restored it will be planted and seeded at the rates in Table 7.

Micro-site- planting mixes, densities, and arrangement may be adjusted after final site re-contouring to ensure the greatest chance of plant survival and recruitment.

6.6.1.1 Container Planting Density

The shrub planting area occupies approximately 90% of the active restoration areas. Shrub container plant density is based on 1 plant per 1.5 meter (4.9 square feet) on-center spacing, or over 1,900 shrubs per acre. Each individual species' planting densities were determined by evaluating 2008 and 2010 IAR MRA biomonitoring data, as well as plant size, plant growth rate, and typical growth during the maritime chaparral vegetation trajectory. The proposed spacing is consistent with that employed in related plans (Burleson 2010, Shaw and DDA 2009).

6.6.1.2 Seeding Density

Seeding rates are based on the number of seeds per acre in both active and passive restoration areas. Exact seeding rates may vary depending on how much the soil was disturbed, whether the soil seed bank was removed and replaced, and baseline conditions.

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7.0 RESTORATION IMPLEMENTATION

Actions to be implemented in the restoration sites are described in the following sections.

7.1 Monitoring Only Implementation

Monitoring only sites initially will receive site preparation, typically leveling or recontouring (if needed), and installation of erosion controls (if needed). No additional restoration implementation is proposed.

Monitoring only sites will be monitored (at a minimum annually) by reconnaissance surveys and a subset of the sites will be monitored using quantitative methods (see Sections 8.2.3 and 8.2.4, respectively). Exotic plant and erosion monitoring will also be performed (see Sections 8.3 and 8.4, respectively).

In the adaptive management process, the site monitoring results will be compared with baseline and reference area monitoring results. If the site results indicate that restoration is proceeding satisfactorily, no additional actions will be taken. If issues are identified that indicate the need for corrective actions or additional measures (e.g., seeding, planting, exotic plant control, erosion control, etc.) appropriate plans will be developed and implemented. Beginning no later than Year 3 after site restoration, evaluations will be performed to determine whether or not the desired outcome has been achieved (see Section 10). Reporting requirements are described in Section 11.

7.2 Passive Restoration Implementation

Similar to the monitoring only sites, passive restoration sites initially will receive site preparation, typically backfilling of subsoil and topsoil in proper sequence, recontouring, and installation of erosion controls (if needed). In addition, the sites will be seeded (see Section 4.4). Seeds of seaside bird's-beak will be sown only in the area occupied by that species, as determined by the baseline data.

Passive restoration sites will be monitored (at a minimum annually) by reconnaissance surveys and a subset of the sites will be monitored using quantitative methods (see Sections 8.2.3 and 8.2.4, respectively). Exotic plant and erosion monitoring will also be performed (see Sections 8.3 and 8.4, respectively).

In the adaptive management process, the site monitoring results will be compared with baseline and reference area monitoring results. If the site results indicate that restoration is proceeding satisfactorily, no additional actions will be taken. If issues are identified that indicate the need for corrective actions or additional measures (e.g., planting, exotic plant control, erosion control, etc.) appropriate measures will be developed and implemented. Beginning no later than Year 3 post-installation, evaluations will be performed to determine whether or not the desired outcome has been achieved (see Section 10). Reporting requirements are described in Section 11.

7.3 Active Restoration Implementation

Active restoration sites will be the focus of the restoration implementation effort, as described in the following sections.

7.3.1 Initial Site Preparation

Similar to the monitoring only and passive restoration sites, active restoration sites will receive initial site preparation including: ripping of areas that were subjected to repeated heavy excavation vehicle traffic to decompact the soil, backfilling of subsoil and topsoil in proper sequence, recontouring, and installation of erosion controls (if needed; see Section 5). An irrigation system will be built to deliver water to active restoration sites (see Sections 5.5 and 9.3.3).

7.3.2 Restoration Landscape Elements

The objective of the plan for spatial positioning of restoration materials in the active restoration sites is to produce, to the extent feasible, a plant community landscape that appears to be natural in its pattern (i.e., to produce a spatial pattern in the restoration sites that is consistent with that of adjacent undisturbed sites within the IAR MRA). The pre-existing maritime chaparral community in the IAR MRA varies across the landscape, but gradients in detailed vegetation structure that may be associated with physical aspects of the landscape such as slope, aspect, etc., have not been sufficiently defined to be employed in this restoration plan. With the exception of a portion of the focus species habitats designed for slopes, the major restoration elements will be distributed irregularly across the landscape. These elements include (see Figure 11):

- charate amendment areas
- focus species habitat (including salvaged focus species soil/seed bank)
- container plant and seeding areas

Plant litter will be applied across the site in scattered light patches similar to those observed in undisturbed areas. A specific pattern of litter placement for certain focus species habitats is discussed below.

7.3.3 Charate Application

Charate material will be generated as discussed in Section 6.2. The purpose for applying this material is to enhance the germination of seeds of fire-adapted species, such as Toro manzanita, that may be present in the topsoil seed bank and in the seeding mixture to be sown at the site (e.g., sandmat manzanita). Depending on the quantity of material available, charate will be applied to approximately 5-20% of the total site in two to several irregular polygons. Charate will be spread on the surface prior to seeding and planting and will be lightly tilled into surface soil, using hand rakes or comparable tools/equipment.

7.3.4 HMP Focus Species Habitats

Because of their special ecological requirements, three of the HMP forb species occurring within the IAR MRA will receive specific habitat consideration: seaside bird's-beak, Monterey gilia, and Monterey spineflower.

7.3.4.1 Seaside Bird's-beak

Seaside bird's-beak is a hemi-parasite occurring primarily in the eastern portion of the IAR MRA. As of the date of this plan, active restoration sites have not been identified in the seaside bird's-beak portion of the IAR MRA; however, if ongoing MEC evaluations determine the need for large-scale excavation in this area, restoration in sites that overlap with the species' IAR MRA distribution range would include sowing of seaside bird's-beak seeds. It is not known whether or not seedling survival of this species is dependent upon infection of a host plant. If survival is dependent on infection, establishment of seaside bird's-beak populations would be limited primarily to the immediate vicinity of installed plants that could act as hosts.

7.3.4.2 Monterey Gilia and Monterey Spineflower

Open sandy habitats for Monterey gilia and Monterey spineflower will be created within maritime chaparral plantings at the site. Polygons designated as habitat for these two species would be established to cover approximately 10% of the total site. A portion of each of the polygons will contain previously salvaged soil with associated seed bank, as well as supplemental seeds of Monterey spineflower and container plants of Monterey gilia. Seeds will be lightly tilled into the surface soil, using hand rakes or comparable tools/equipment. Soil seed bank will be thinly spread over about one-half or less of the surface of each polygon.

Two types of habitat were observed by ESCA RP biologists for Monterey gilia in the IAR MRA. On some slopes, Monterey gilia was observed to inhabit very subtle "drainages" where gentle downslope sheet flows occur in narrowly open areas between shrubs. Close inspection of such areas reveals that a portion of the surface plant litter is arranged in cross-slope drift lines and Monterey gilia plants appear to be more abundant near such microhabitat features. Key aspects of proposed planting areas for Monterey gilia include establishing a narrow downslope feature in a zigzag pattern between terraces. Shrubs will be planted at the boundaries of this feature to anchor the soil, but not at an initial density that would provide dense cover for rodent herbivores. Surface soil within the feature will be very shallowly concavely contoured. After seeding and planting, plant litter material mimicking micro-drift lines will be placed in a cross-slope pattern. This design will be applied on slopes in the active restoration sites.

The second type of microhabitat is more commonly reported for both Monterey gilia and Monterey spineflower (USACE 1997). These "plain placement" areas are comparable to the "open areas" described in the HMP which are unvegetated, with loose surface soil, occurring predominantly on relatively flat areas. Shrubs will be planted around the boundary of this feature, but not at a density (initially) that would provide dense cover for

rodent herbivores. Seeding and planting will be implemented but litter application will be sparse to none because drift lines were not observed to be important features in this type of focus species habitat. Plain type focus species habitats will be established in relatively flat areas of the site where soil is highly decompacted. The total area occupied by slope versus plain habitats will be proportional to the occurrence of slopes versus flat terrain within the restoration site.

7.3.5 Seeding

Except for the focus species habitat polygons, seeds of the IAR-wide seed palette will be distributed over the site (including charate polygons) prior to litter application (Figure 11). Broadcast seeding by hand or sowing equipment and/or seed drills may be employed, depending on site topography. After seeds are sown, the area will be lightly tilled (i.e., using hand rakes or comparable equipment to gently move seeds into topsoil).

Seeding should be performed at the end of September or (preferably) within a week after 0.5-1 inch (2.5 cm) of rainfall if the site is not irrigated (Burkhart 1988).

7.3.6 Container-Grown Plant Installation

Except for the focus species habitat polygons, container plants will be distributed across the site (including charate polygons, see Figure 11). Container-grown plants of Monterey gilia will be installed only within the focus species habitats. Container plants of other species will be installed in appropriate microsites and random patterns to reflect natural conditions. While IAR MRA maritime chaparral has the visual appearance of uniform cover, close inspection reveals that individual shrubs, subshrubs and perennials occur in a "haphazard" pattern with apparent "clustering" of smaller plants associated with plants of larger species (at early growth phases). Field personnel will apply the planting pattern and spacing recommendations to achieve a pattern that mimics the natural pattern.

Container plants should be "hardened off" at the nursery (in full sun and without misting) a minimum of two weeks prior to delivery to the site. If plants require top-pruning, this should be done no less than two weeks prior to delivery. Container plants will be kept moist prior to planting on site.

Plant installation will follow these general steps:

1. Container plants will be watered shortly before installation.

2. Planting holes should be dug as deep as the container and up to twice as wide.

3. Planting holes and soil in the immediate vicinity of and prior to installation should be watered to ensure moist soil for a minimum of 1 foot below root level. Water in planting holes should drain completely before planting.

4. Plants should be removed from containers carefully to minimize root damage: roots should not be pruned.

5. Plants should be set plumb and braced in position until the backfill has been tamped solidly around the rootball.

6. The planting holes should be backfilled with the native soil from the hole so that the plant is level with adjacent ground. Large rocks or clods shall not be used in the backfill soil. All plants with numbered labels should have the label located on the west side of the plant.

7. Plantings should be watered thoroughly immediately after installation. Each plant should then be checked after watering to ensure that it received adequate water and to correct any soil settling during and after planting.

8. Daily inspections of all installed plants should be made during the first two weeks after planting to determine the need for supplemental water.

9. A trained biologist and/or horticulturist should supervise installation.

7.3.7 Monitoring and Restoration Assessment

Active restoration sites will be monitored regularly for qualitative assessments of plant health, growth, flowering, irrigation requirements, herbivory, weed competition, and other variables. Corrective actions to address potential problems will be implemented as needed.

Restoration areas will also be quantitatively monitored during reconnaissance surveys, and a subset of the sites will be monitored using a standardized monitoring protocol (see Sections 8.2.3 and 8.2.4, respectively). Exotic plant and erosion monitoring will also be performed (see Sections 8.3 and 8.4, respectively).

In the adaptive management process, the monitoring results will be compared with baseline and reference area monitoring results. If the results indicate that restoration is proceeding satisfactorily, no additional actions will be taken. If issues are identified that indicate the need for corrective actions or additional measures (e.g., planting, exotic plant control, erosion control, etc.) appropriate plans will be developed and implemented (see Section 9.1.1). Beginning no later than Year 3 post-installation, assessments will be performed to determine whether or not the desired outcome has been achieved (see Sections 9.1.2 and 10). Reporting requirements are described in Section 11.

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8.0 MONITORING

Monitoring and documentation information will be collected for three distinct but related purposes:

- to document initial site preparation and restoration installation
- to provide input to the adaptive management process (see Section 9)
- to evaluate overall success of the project (see Section 10)

Quantitative monitoring data will be recorded on data sheets, reviewed using standard quality assurance/quality control (QA/QC) procedures, and transferred into digital records. As appropriate, the data will be tabulated and analyzed. Qualitative information and non-repetitive data may be recorded on data sheets or in field log books and associated attachments such as maps. The results will be presented in annual reports (see Section 11).

Several types of monitoring or documentation will be conducted both on and off the restoration sites:

- Documentation of site preparation and restoration installation
- Biological monitoring to evaluate restoration progress/performance
- Site ground-level imagery
- Site aerial imagery
- Exotic plant species monitoring
- Erosion monitoring
- Reference area (off-site) monitoring

All monitoring efforts at a site will be terminated when it has been determined that the site has met its success criteria as described in Section 10.

8.1 Site Preparation and Restoration Installation

Field personnel will document the implementation of planned site preparation and initial installation activities as described in Sections 4 through 7 (these items are also listed in Section 10.2). This information will be included in the "as-built" report to be submitted as part of the first annual monitoring report (see Section 11.1).

8.2 Native Plant Species and Vegetation

Native plant monitoring will include several procedures for monitoring restoration outcomes at the sites.

8.2.1 Container Plant Survival Surveys

Container plants installed at the site will be monitored at a minimum annually to assess their survival and general condition. Qualitative surveys, conducted as part of the reconnaissance surveys, will identify areas of the site where mortality occurs and that may be candidates for replanting or other actions. Quantitative surveys will be based on a stratified census by species and location. These results will be used as a performance metric (see Section 10.2). Both qualitative and quantitative results will be considered in the adaptive management process to determine the need for corrective actions.

The duration (i.e., number of years post-installation) for recording this information will depend upon the ability of field biologists to distinguish plants originating from containers from those recruiting into the sites. Monitoring will discontinue when they can no longer be reliably distinguished.

8.2.2 Site Imagery

Site imagery (photographs) provides visual information that will assist in interpreting the written information provided in the annual reports.

8.2.2.1 Ground-level Photo Points

Image points (photo points) will be established at each site on the ground to provide views of the site's condition. Initially, these points will be located at appropriate positions in each site to provide one or more representative views. Each location will be documented by a GPS reading and compass bearing. Images will be captured at these points at a minimum of once per year and will be included in that year's annual report. Focus species areas will have images taken at their peak vegetative development (April-July depending on the species) and general vegetation images will be obtained in early summer. As the site matures, image points may be added or deleted if vegetation obscures the view, as determined in the adaptive management process.

8.2.2.2 Aerial Imagery

If needed to confirm that the sites have achieved the required percentage cover, an aerial image may be obtained of the sites. This information would supplement the shrub transect results, which provide similar information based on sampling the sites. The aerial image would confirm that the sampling data are representative of the site conditions. This image, if obtained, would be taken once during Years 3-5 post-installation. This requirement could be met by obtaining a copy of an existing contemporary image file (e.g., Army image, if available). The image would be included in that year's annual report.

8.2.3 Reconnaissance Surveys

Owing to the fact that recruitment resulting from seeding, topsoil seed bank, and natural dispersal are spatially unpredictable, reconnaissance surveys will be conducted at a minimum annually for the following purposes:

- Identify and record native plant species recruiting into the sites
- Assess spatial variation of community and HMP species populations

Reconnaissance surveys will involve a biologist making visual observations of all areas of the site and recording the appropriate information. A photographic record will also be made, as appropriate. The species lists obtained will contribute to the total and HMP species richness metrics as described in Section 10.2.

Information on spatial variation will be used in the adaptive management process to assess the need for modifying the sampling design for quantitative data collection (e.g., add sampling locations to document vegetation strata that become established in the sites but are absent from or under-represented in the existing sampling design).

8.2.4 Quantitative Plant Surveys

Quantitative plant surveys will be conducted to provide detailed information on the abundance of the HMP species and dominant shrub species. The methods to be used will be the same as those described in the current protocol for vegetation monitoring as required by the HMP (Burleson 2009), with variations needed to accommodate project conditions (e.g., transects may be shorter than 165 feet [50 m] if the site is less than 165 feet [50 m] long, etc.). Both sampling methods described in the protocol, shrub transect and focus species (HMP annual) circular plot sampling will be employed at the restoration sites.

8.2.4.1 Shrub Transect Surveys

Fixed line transects will be established at each site. Fifty-meter transects are the standard used in the protocol, but may need to be modified at some sites to fit the dimensions of the restoration area. The protocol (Burleson 2009) indicates that the transect locations and sample size are to be determined by the existing (well developed) vegetation at the site being monitored. This method is inappropriate in restoration sites where vegetation is sparse and the eventual establishment of "open" areas may be unpredictable. Therefore, the following method will be employed. Sites will be evaluated to determine if a stratified sampling design is warranted (i.e., different strata may be associated with varying aspect, slope, etc.). Each stratum will have a minimum of three transects unless the size of the stratum will not accommodate all three. Larger strata may have more than three transects if warranted. Transects will be positioned such that they provide a representative sample of the stratum (i.e., spread across the stratum, avoiding boundaries to minimize influence of edge effects, avoiding planned focus species habitats, etc.). Natural development of

"open" areas within a transect over time may require moving the transect location. The adaptive management process would address this issue.

At each transect location, a determination will be made as to the compass bearing of the transect. The transect starting point (0 meter) is the more northern or eastern point. From the starting point a 164 foot (50 m) tape is extended to the end point. GPS readings are taken at both locations and are labeled as starting or end point. Start and end points of transects may be "permanently" marked by stakes. When ready to collect data, the meter tape is secured at the starting stake end and run atop the vegetation, and secured to the transect's end stake. A photograph is taken of the transect from the starting end, with the starting stake visible in the foreground. This photo number is recorded on both field books and field data sheets. If the majority of the transect is obstructed from view due to topographic change or vegetation height, additional photographs will be taken of the transect in the same viewing direction, and will be recorded on data sheets and field books.

In order to collect shrub data, one biologist is required to record the written data as the second biologist identifies the vegetation, noting where it starts and stops along the meter tape. All transect data is recorded from a Start to an End (or Stop) point in meters or in tenths of meters. Each transect's data begins at "0" meters. If there are multiple shrub species occurring at the starting point, then more than one species on the data sheet will show a starting point of "0."

Shrub data is collected only where the meter tape crosses the shrub(s). If there is a break in a species' cover under the tape that is less than one-tenth of a meter (<0.1 m [0.3 feet]), it is generally considered a consistent cover to the true end point of said shrub species as it falls under the meter tape.

Bare ground, if truly bare ground, is recorded as such (e.g., "BG"). If expanses of the meter-tape cross areas of what appears to be dead vegetation without any observed green/live matter attached, it is recorded as "BG/dv" (Bare ground/dead vegetation), and noted on the data sheet with a key.

Species observed in proximity to the shrub transect but not appearing in the transect itself are noted as "associated species" on the field data sheets.

The results of these surveys contribute to evaluating success criteria for species richness (total and HMP species) and vegetative cover (see Section 10.2).

8.2.4.2 Focus Species Plot Surveys

The purpose of the focus species surveys is to provide quantitative estimates of the species populations. Three focus species (also referred to as "HMP annuals", "HMP forbs", etc.) are known to occur in the IAR MRA: Monterey gilia, Monterey spineflower and seaside bird's-beak. During installation, specific areas will be designated for these species (i.e., focus species habitat and seaside bird's-beak grid cells) and these are the areas that will be sampled initially. However, these species may recruit into other

locations and other focus species (e.g., coast wallflower) potentially could recruit into the sites. Therefore, reconnaissance surveys will be conducted once per year for the first three years for the three species during the peak flowering and/or development period for the species. Other focus species will be searched for during these surveys. The adaptive management process will use the reconnaissance information to determine whether or not changes to the established sampling design are warranted after the initial post-installation survey (e.g., adding sample locations, deleting sample locations, re-designing the sampling effort, etc.) so that the purpose of the sampling effort (estimation of focus species populations) is accomplished.

The Army's 100 x 100 foot (30 m x 30 m) Fort Ord grid is the coordinate system within which sample plots are located. Sampling for focus species will be in accordance with the following guidelines during the first post-installation survey:

1) Focus species habitat:

- All grid cells occupied by focus species habitat created during installation will be sampled for Monterey gilia and Monterey spineflower
- All grid cells identified as "seaside bird's-beak grid cells" will be sampled for seaside bird's-beak

2) Areas of the site that are not planned focus species habitat:

Perform a preliminary reconnaissance/mapping survey to identify the grid cells within the site where the species occurs. Where the plants are very sparse, occur only in one small area, and/or are highly cryptic, the locations may be marked with a flagged stake for relocation later. The observer should record either impressions of abundance or estimated counts if few plants are present. This information establishes the frequency of occurrence and estimated density distribution of the species in grid cells. After all grid cells have been surveyed, the surveyor should review the information and select the number of grid cells within which sample plots will be located, using the following rules:

a) For species populations that are infrequent and/or irregularly distributed and for sites that have 10 or fewer grid cells:

- A minimum of three grid cells will be selected unless there are fewer than three grid cells occupied (in which case the occupied cells will be sampled)
- A minimum of 10% of the occupied grid cells will be sampled
- Grid cells should be selected for sampling so that the range of estimated abundance across the grid cells is evenly sampled

b) For sites where the species populations occupy greater than 50% of the grid cells and/or are regularly distributed across the site and include more than 10 grid cells:

- Using a random number-set procedure, select 10% of the grid cells in the site or 10 grid cells, whichever is greater

Once the sample locations have been determined, the following sampling procedure will be employed:

- If high density populations will be sampled, observers should perform a calibration exercise using sub-meter quadrats in an area of high density.
- Within the selected grid cell, locate the center point of the circular 5 m (16.4 foot) diameter plot so that it will encompass a representative portion of the grid cell or the maximum number of plants if only a few plants are present (note: field experience has shown that use of the term "representative" is misleading when only a few plants occur in the grid cell) – record which procedure was employed and brief notes on the species' distribution within the grid cell.
- Record the GPS location of the plot center point.
- Insert a pole or stake at the center point, attach a 2.5 m (8.2 foot) length of rope as a guide and count the number of plants within the sample plot using a hand counter (the stake or pole may be "permanently" installed for ease of location during the next survey).
- Photograph the plot.
- Record plot conditions and notes on other vegetation within the plot.
- If the species occurs in high density in the plot, it may be sub-sampled by dividing it into quadrants and counting plants within one or two quadrants (care must be taken to record the fact that the data represent a sub-sample).
- Record information on data sheets and perform a field QC review of the data sheet before departing for the next plot.

Plot locations will be considered to be "fixed" (i.e., to be re-sampled during the following survey) unless the sampling design is altered by the adaptive management process.

The focus species survey results will be included in the annual report and will contribute to the success criteria for HMP species (see Section 10.2).

8.3 Exotic Plant Species

The purpose of the exotic plant species monitoring is to locate and monitor exotic plant recruits in restoration areas. Monitoring for exotic plant species will use a survey procedure very similar to the reconnaissance surveys, but with a focus on the three target exotic species. These surveys will be conducted annually at a minimum. Exotic surveys

will involve a biologist making visual observations of all areas of the site and recording the presence and abundance of target exotic species. The biologist should be familiar with the appearance of juvenile target exotic species. Other exotic species will be noted, particularly if they appear to be affecting restoration progress. A photographic record will also be made, as appropriate. Further details and involvement of the adaptive management process are presented in Section 9.3.4.

Overall percentage cover (i.e., percentage of the total area of the site) cumulatively occupied by target exotic species will be used as a performance metric (see Section 10.2).

8.4 Erosion

Monitoring for erosion will use a survey procedure very similar to the reconnaissance surveys, but with a focus on areas of greatest erosion risk. These surveys will be conducted annually at a minimum. Erosion surveys will involve visual observations of all areas of the site, estimations of the frequency, length, width, and depth of any rills and gullies, and documentation of the presence, extent, and effect on plant communities of eroded locations. A photographic record will also be made, as appropriate. Further details are presented in Section 9.3.5.

8.5 Reference Areas

As described in Section 10.3, reference areas will be established adjacent to (outside of) the restoration sites for the purpose of detecting ecosystem changes that could affect the sites. These areas will be surveyed at a minimum annually using the same methods described in Section 8.2.4. Results will be included in the annual monitoring reports.

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9.0 ADAPTIVE MANAGEMENT

Because future outcomes and conditions are uncertain in ecological systems (especially those that are being restored), management actions that may be needed at the site (i.e., "maintenance," replacement planting, corrective actions, etc.) cannot be fully anticipated. The ultimate success of such projects is enhanced when a post-installation management system is designed to evaluate and act upon information generated over time until the site or a particular activity is determined to have produced the desired outcomes. The term "adaptive management" is applied to this approach. While adaptive management may have a variety of meanings depending on the context in which it is used, in this plan adaptive management refers to the process that is employed to evaluate and manage the restoration site following installation. Post-installation actions that may be needed range from those that are anticipated and understood but not known in detail (e.g., irrigation management, see below) to completely unexpected events (e.g., extreme and unexpected deleterious weather conditions). Adaptive management is a recurrent (sometimes iterative) process that receives information periodically, evaluates the information to determine if current results are consistent with the predicted outcomes, and executes the appropriate action (i.e., terminating an activity that has accomplished its purpose, implementing corrective actions, etc.). Adaptive management may result in adjustments and/or additions to pre-determined protocols, methods and procedures (particularly monitoring protocols) and even to the adaptive management process itself if needed to accomplish its goal. In effect, adaptive management is the command and control center for all post-installation activities up to (until there is) determination of success.

It is anticipated that most of the adaptive management effort will be directed to issues in the active restoration areas; however, monitoring data from the other areas will be evaluated via the adaptive management process to determine the need (if any) for corrective measures at those locations.

9.1 Decision Criteria and Action Determination

Adaptive management decision-making for this project will focus on two types of activities:

- Site management
- Restoration progress

9.1.1 Site Management

Adaptive site management will involve ongoing assessment of site conditions to determine whether or not the results of implementation are generating the intended outcomes and fulfilling the objectives of the restoration plan. If the outcomes are not consistent, or if opportunities arise for improving outcomes, actions may be undertaken. This activity is expected to be most intensive during the initial 6-12 months post-installation when initial responses to site conditions are being revealed by the restored site elements. Adjustments and corrective actions made during this period will minimize

deleterious effects and delays in restoration progress while reducing the need for more extensive corrective actions in the future.

Adjustments that may arise during this period include:

- Enhancing progress based on interim outcomes;
- Reducing shock, stunting and/or mortality of container plants;
- Controlling erosion (including performance evaluation of installed erosion controls);
- Controlling invasive exotic populations;
- Implementing additional herbivore controls;
- Managing the irrigation system to maximize its benefits; and
- Evaluating recruitment from seeds and its implications for ongoing and future planned activities at the site.

Some of these issues are discussed in greater detail in Section 9.3. It is anticipated that many of the actions identified will be time-critical and generally consistent with the plan and restoration objectives. Such activities will be implemented without prior consultation with the Army and will be documented in the annual reports and/or in interim communications if appropriate. If an issue arises that is time-critical and whose resolution appears to require a substantial change in one or more aspects of the restoration effort, consultation with the Army will be initiated before action is taken. If the issue requires a substantial change but is not time-critical, it will be included in the adaptive management discussion and the recommendations section in the next annual report and will be addressed in the annual meeting with the Army and USFWS (see Section 11).

Because the site is secured by a fence and no trespassing signage, adaptive management will likely have to deal with few if any disturbances associated with unauthorized access to the sites.

9.1.2 Restoration Progress

Whereas site management activities focus on short-term issues, long-term progress toward successful restoration of the sites will also be addressed in the adaptive management process. This activity will focus on the goals, objectives and success criteria that were established to determine overall success of the project (see Sections 1, 4 and 10). Progress evaluation will be iterative, and will be driven by evidence of significant outcomes and trends in the sites and may include the following elements:

- Site history (post-installation experience to date)
- Current site conditions
- Status of site trajectory
- Comparison with expected trajectory

- Projected future outcomes
- Comparison with expected long-term outcomes

At a minimum, progress evaluation will occur annually (post-installation) and will have two primary objectives:

- To inform the Army of progress toward successful restoration (see Section 10)
- To identify actions that may facilitate desired outcomes and/or that may shorten the time required for self-sustainability

An example of a long-term restoration progress issue is the status/trend of focus species populations in the sites (particularly Monterey gilia and Monterey spineflower). The status and site distribution of these populations over time will be carefully evaluated to determine whether or not population establishment is satisfactory. Success of created focus species habitats, recruitment into site areas from seed bank, and recruitment from adjoining undisturbed areas will be evaluated to the extent possible. If restoration objectives are not being met, proposed corrective actions will be identified and discussed with USFWS.

9.2 Information Input

The completeness, quality and timing of the information input to the adaptive management system are essential to its success. Such information includes informal ad hoc observations, comments by field crews, planned reconnaissance events, quantitative data, etc. The formal monitoring efforts planned for the project are discussed in detail in Section 8. Additional or revised monitoring efforts may be implemented as needed for the adaptive management activity.

9.3 Special Considerations

A number of important components of the adaptive management process are described in detail because of their importance to the success of the project.

9.3.1 Plant Mortality

Monitoring the stress level, incipient mortality and/or actual mortality of container plantings is highly important because of their expected contribution to successful outcomes and the monetary investment in this resource. In real time, mortality information may be crucial to changing site conditions to alleviate poor conditions (e.g., insufficient soil moisture) so as to reduce future mortality. Over longer periods, mortality results may dictate the need to replant (replace dead plants) or take other appropriate actions. The decision to replant needs to take into account several considerations: Are surviving container plantings meeting objectives without replanting? Is site seed germination compensating for plants that died? Is the cause of mortality understood? Would the benefits of replanting be sufficient to compensate for site disturbances

involved in the activity? These considerations and others would be used in the adaptive management process to determine the appropriate action to be taken.

9.3.2 Seed Germination

Seeds at the site are derived from the original topsoil that was backfilled at the site, salvaged soil seed bank of focus species, and seeding of the site during installation. The results of these seed resources are highly unpredictable. Native plants originating from seeds within the site are generally considered to be more adaptable to site conditions and to produce more robust vegetation. Therefore, presence of these seedlings may preclude other activities (e.g., replanting, weeding, etc.). The adaptive management process will carefully evaluate the potential deleterious effects of proposed site activities on the plants in the area and will identify measures to minimize such effects.

9.3.3 Irrigation Management

Moisture supply is the single most important factor controlling plant survival. As discussed in Section 3 and Appendix B, irrigation systems have been employed in a number of chaparral restoration sites and dune restoration sites in the Monterey area. The consensus of restoration managers is that irrigation was a key factor in success at these sites. The IAR MRA restoration sites that will be passively/actively restored (i.e., the large-scale excavation sites where container plants will be installed) will be provided with an irrigation system.

The goals of irrigation management for these active restoration sites are:

1. Enhance success of outplantings, and

2. Enhance seed germination and seedling survival and growth.

Irrigation management will accomplish these goals by augmenting natural rainfall, to the extent required, to mimic a high-rainfall year in the first year after planting at a minimum and additional irrigation in the subsequent 2-4 years, providing shallow soil moisture conditions that enable outplantings to survive initial transplant shock while developing robust root systems. This approach is consistent with recommendations for *Ceanothus* planting by Stewart (1942). It is anticipated that irrigation ordinarily will not be applied during the summer months when rainfall does not occur (at a minimum during July-August, see Appendix B).

Irrigation will also enhance germination of the soil seed bank and seeded areas. Moisture conditions (i.e., conditions established by natural rainfall and augmented as needed by the irrigation system) will be maintained in the following phases:

1. Initial establishment phase: Maintain shallow soil moisture conditions by frequent low volume application so that ample moisture is provided to newly installed plants and evapotranspiration stress is reduced to minimize mortality (Burkhart 1988). Transplant shock will be minimized and outplanting survival will be

maximized. In addition, seed germination/seedling establishment will be enhanced. (Phase duration: 0-6 months after planting.)

2. Root mass development phase: Increase frequency of low moisture conditions in shallow soil (i.e., decrease irrigation frequency) while increasing the delivery volume. Container plantings and seedlings, particularly dominant chaparral shrubs, will be encouraged to develop vertical root systems as a result of periodic low moisture conditions in shallow soil while deeper soil layers remain moist. Established plants will be maintained in a healthy and vigorous condition. (Phase duration: 3 months to 2-4 years after planting.)

3. Hardening off phase: "Hardening off" is a horticultural term that is used to describe the gradual modification of growing conditions in anticipation of transferring plants from one set of conditions to another (e.g., from a warm greenhouse to a cold open field). Hardening off procedures reduce the shock to plants so that stunting and/or mortality is prevented or minimized. Hardening off is used in this section to refer to the transition from less stressful augmented moisture conditions to more stressful natural moisture conditions, by gradual reduction of the frequency and/or delivery volume of irrigation events to zero. Depending on the strength of plant development in the first year after planting and the natural rainfall pattern, it is anticipated that the hardening off phase may occur as early as the end of the second wet season but more likely will occur during the third or possibly the fourth wet season. It is possible that hardening off will not be needed if the natural rainfall pattern during the appropriate period accomplishes the same result without the need for irrigation. Irrigation is not anticipated to be needed beyond the end of the third or fourth wet season.

Moisture management as described above will foster establishment of central maritime chaparral at the site by reducing initial mortality after planting, seeding, and germination from the seed bank to the maximum extent possible; by promoting the development of deep root systems typical of dominant chaparral shrubs; and by maintaining established plants in a healthy and vigorous condition.

Because natural rainfall and evapotranspiration conditions (i.e., conditions that affect plant water needs) cannot be predicted, operation of the irrigation system will be controlled by an adaptive management process. Monitoring data (plant stress condition, plant development status, site soil moisture conditions and natural rainfall) will be evaluated within a set of irrigation guidelines. The objective of the guidelines is that irrigation will provide an adequate supply of moisture to the entire root zone of each plant equivalent to a high water year pattern during the normal growing season for native species at the site, typically October through April (however, as described in Section 3 and Appendix B, substantial rainfall has been recorded in the Fort Ord area in the September-June period in some years). The frequency and duration of irrigation will be consistent with the three phases described above and will depend on ambient weather patterns and site-specific soil moisture conditions.

Calibration of water application rates to the site and modifications to the watering schedule and duration will be conducted as part of the adaptive management process. It is anticipated that initial irrigation scheduling may include watering once weekly during the rainy season during any gap between storms of 10 days or more that do not deliver at least 1 inch (2.5 cm) of rain. The watering frequency and duration will be adjusted to match historical patterns of wet years based on data from local weather stations. The primary data for modifying irrigation scheduling will be soil moisture. Soil moisture will be checked at multiple locations throughout the growing season either with a soil moisture probe or an auger sampling probe. The target soil moisture for the first year should be greater than 70% of field capacity in the upper 24 inches throughout the first growing season. Sampling will employ standard gravimetric soil moisture methods and will be taken at topographic concavities and convexities and crown and toes of slopes and among any areas of substantially different soils on site. In addition, catch pans will be placed at multiple locations around the site to verify the quantity of water applied and evenness of application. Pans will verify areas of sprinkler overlap, compare elevation extremes, and check for adequacy of coverage at areas near and far from water supply.

Periodic surveys will be conducted of the sites to evaluate the condition of plants, the need for irrigation, and the application of water. These investigations will include inspection of plants for signs of inappropriate watering, including water stress, stunted growth, disease, wilting, premature leaf loss, leaf yellowing, etc. If 5% or more of the plant material appears to be stressed, the frequency and duration of watering will be adjusted. Other procedures, such as sampling for pathogens, may be implemented as needed to address issues that arise during the surveys.

Irrigation will be carefully managed to avoid erosion, damage to container plantings, runoff, or damage to recruiting vegetation (i.e., seed recruits).

Artificially changing conditions in natural systems, such as augmenting moisture via irrigation, may have deleterious effects, as described in Section 3 and Appendix B. Such effects may include: plant condition that is inadequately adapted to natural stress factors (i.e., shallow root systems incapable of supporting above ground biomass during periods of low soil moisture), enhancement of plant fungal diseases because of continuous moisture (i.e., “damping off” of seedlings and infection of above-ground plant parts) and fostering establishment of invasive exotic species. Proper management of the system during the root mass development phase will encourage natural root mass formation so that plants will be adapted to moisture stress. The IAR MRA sites are frequently exposed to heavy coastal fog and therefore, increased moisture from the irrigation system should not differ substantially from natural fog conditions. Exotic species populations will be monitored and abated, as needed, per the success criteria; therefore, increased exotic recruitment, if it occurs, will be mitigated to prevent deleterious effects on the native species.

9.3.4 Exotic Plant (Weed) Control

Invasive exotic (i.e., non-native) plant populations may adversely alter habitat functionality, threaten native plant populations and reduce diversity of native plant

communities. Restoration sites are especially susceptible to exotic invasion because they are "open" sites where competitive pressures have been temporarily eliminated or substantially reduced. Successful recruitment into and population establishment within restoration sites by exotic species may retard or prevent restoration progress and forestall the achievement of restoration goals and objectives.

9.3.4.1 Invasive Weed Target Species

Consistent with the HMP (USACE 1997, pp. 4-56, 4-57), the Army (USFWS 2005, pp. 14-15) and Shaw and DDA (2009), the following invasive plant species are targeted for monitoring and abatement:

- pampas or jubata grass
- sea fig (*Carpobrotus chilensis*) and hottentot fig (*C. edulis*; collectively referred to as "ice plant")
- French broom

Control of the target invasive species is included in the success criteria (see Section 10.2). Invasive species eradication along ingress/egress routes and vegetation clearance areas will be restricted to removal of recruits of pampas grass and French broom due to large pre-existing mats of ice plant found widespread throughout the IAR. In soil excavation areas, populations of all three invasive species will be abated so that less than 5% of the total area of the site is occupied collectively by the target species (see also Table 10).

9.3.4.2 Other Weed Species

Other exotic species may recruit into the site, such as fennel (*Foeniculum vulgare*), yellow star thistle (*Centaurea solstitialis*), poison hemlock (*Conium maculatum*), etc. During the monitoring period prior to attainment of restoration success criteria, site monitoring for non-target exotic species will be performed and their populations will be abated as needed. Focus species (i.e., Monterey gilia, Monterey spineflower, and seaside bird's-beak) typically inhabit "open" (i.e., bare ground) areas. If cover by exotic species (e.g., non-native grasses) predominates in open areas supporting HMP species to the extent that less than 10% of the restoration site remains open, thereby potentially impeding HMP focus species population development, abatement of the non-native species in these areas will be performed.

9.3.4.3 Weed Monitoring

Restoration sites will be monitored annually at a minimum. Additional monitoring, as determined by the adaptive management process, may be needed during and/or after the wet season when recruitment and growth of exotic invasives may be at higher levels. As the timing and locations of invasions are unpredictable, exotic plant monitoring will involve reconnaissance surveys whereby biologists conduct visual observations over the entire site. Areas of infestation will be mapped, the species present recorded and abundance estimates made. If the population is not abated at the time of the survey, the

results will be evaluated to determine whether abatement and/or additional monitoring is warranted. Weed monitoring activities will be documented in the annual reports.

9.3.4.4 Weed Abatement

Abatement of exotic plants should be performed before they set seed. The preferred abatement protocol for restoration sites is to physically remove young recruits as soon as they are detected (removal may occur during the monitoring surveys, if feasible). These plants will be placed in bags, removed from the site and properly disposed of. This approach precludes plant establishment and seed set and minimizes soil and native plant disturbance while avoiding the need to apply herbicides at the site. Seedlings of the target exotic species are easily identified in the field, which will facilitate use of this approach. Prior to removal, exotic plants will be carefully identified and marked with flags if necessary to avoid accidental removal of native plants.

Additional weed abatement methods may be considered if the above approach is ineffective or too labor intensive. Other methods may include seed head cutting, above-ground biomass removal, herbicide application, etc. Herbicide use (e.g., wick applicators, sprayers, etc.), if proposed, will be approved by the Army prior to implementation. Abatement procedures will be implemented in a manner that minimizes soil disturbance. Seed heads will be carefully removed and bagged to avoid scattering more seed in the area.

The monitoring information and results of abatement activities will be incorporated into the adaptive management process for consideration of additional monitoring and/or other measures that may be needed to enhance control of exotics and to facilitate the restoration process. Weed abatement activities will be documented in the annual reports.

9.3.5 Erosion Control

Minor surface soil erosion benefits ecosystems such as maritime chaparral by dispersing seeds and enhancing germination by lightly covering seeds with soil. However, above a certain threshold, erosion can be detrimental to restoration progress by altering topography and microhabitats; exposing subsoil; changing drainage patterns; transporting litter, soil amendments, and seeds; and adversely affecting seedlings and/or plants (i.e., exposure of roots or burial of above-ground plant structures). The species occurring in back dune maritime chaparral communities are generally not well adapted for sand trapping (as are the species that inhabit active dune systems to the west); therefore, excessive sand erosion in the IAR MRA restoration sites should be minimized to avoid plant mortality.

9.3.5.1 Erosion Mechanisms in the Interim Action Ranges MRA

There are two primary mechanisms that could cause erosion in the IAR MRA:

- Surface water sheet flow-driven soil movement caused by rainfall or excessive irrigation

- Wind-driven deflation/deposition of surface soil during high wind events

Water erosion occurs only during the wet season and the primary risk factors are slope angle and roughness. Wind erosion is more likely during the dry summer months and the primary risk factor is topography that is aligned with prevailing westerly winds and/or that channels/accelerates turbulent air flow at the soil interface (i.e., wind flow that is constricted and forced upslope by local topography, as in active dune systems).

9.3.5.2 Erosion Risk in IAR MRA Restoration Sites

Erosion risk varies substantially among the sites being restored under this restoration plan. The anticipated wind and water erosion risks presented in this section are based on observations in the Fort Ord area over the past several years and do not take into account the effects of low probability extreme weather events (e.g., major El Niño storm); however, the adaptive management process will be capable of addressing corrective measures associated with such events.

The anticipated risks associated with the restoration sites are (from least to highest risk of erosion):

- Monitoring only sites (i.e., sites that were brush cut only): Erosion risk is very low in these sites owing to the presence of extensive live root systems. Areas that were brush cut by ESCA RP elsewhere on the former Fort Ord have not exhibited evidence of erosion.
- Passive restoration sites, except Subarea A (i.e., sites that experienced small-scale soil excavation): Erosion risk is low in these sites for several reasons: they are surrounded by healthy maritime chaparral, they occur mostly on shallow slopes, they are very narrow (typically 10 feet wide) and mostly oriented perpendicular to the prevailing westerly winds, and they are generally not in topographic settings that are most at risk of wind erosion.
- Active restoration site R44 (i.e., a site that may experience large scale soil excavation): As of the date of this plan, it was uncertain whether or not large-scale excavation will be conducted in the Range 44 SCA polygon that is east of the development parcel. Erosion risk of large scale excavation in this area is moderate to low and primarily dependent on the exact location and spatial extent of the excavation. This area is somewhat protected from prevailing westerly winds by an elevated berm located at the eastern border of the development parcel from which the landscape generally trends downward to the east. This topography should not present a high risk for wind erosion. The gentle slope in the area indicates that water erosion risk is low to moderate.
- Active restoration site R47, including Subareas A and B (i.e., a site that will experience large-scale soil excavation): Erosion risk is highest in the R47 site for several reasons. The site does not have protection from prevailing westerly winds and its topography (an approximately U-shaped valley trending WNW to ESE that occupies most of the Range 47 SCA [in military parlance termed the Range 47 “fan”]) is such that the prevailing winds will funnel through the site. The relatively flat floor of the valley slopes gently downward in an easterly direction, which should present low to moderate risk of both

wind and water erosion (however, wind erosion potential is higher at the western end). The walls of the valley are the areas predicted to be most at risk for both wind and water erosion. The western ends of the walls are considered to have the highest wind erosion potential as they are more exposed to the prevailing wind owing to their relatively high elevation and the absence of wind barriers to the west. These walls are expected to have the steepest slopes of all the excavated sites, putting them at high risk of water erosion.

9.3.5.3 Erosion Control Measures

A number of site preparation activities will minimize erosion risk. Cross-slope contouring and terracing (in limited areas where focus species habitats are located on slopes) will increase slope roughness and reduce water erosion risk. In the active restoration sites, application of litter will reduce both water and wind erosion; however, because the portion of soil surface to be covered by litter will be low to avoid inhibition of seed germination, litter will provide limited erosion risk reduction. Installing container plants will provide some reduction in both wind and water erosion risk. When dry periods occur during the wet season, operation of the irrigation system in the active restoration sites will reduce wind erosion potential by moistening the soil surface.

For all but the R47 site (including Subareas A and B), prospective erosion control measures beyond the site preparation activities are not proposed. These sites will be monitored closely during substantial rainfall events and windy periods to identify erosion activity. Real-time corrective actions will be considered as part of the adaptive management process to minimize erosional areas and repair damage to the site and plant communities, if appropriate. As experience with the site is gained, preventive measures may be implemented as determined by adaptive management.

Prospective erosion control measures are proposed for the steeply sloped wall areas within the R47 site. Erosion control blankets will be installed along the northern and southern walls beginning at the western ends and extending for a minimum of 300 and up to 900 feet east. Narrow openings may be left between some blankets to allow installation of focus species habitats, as determined at the time of installation. Wall areas where blankets have not been installed as well as the western end of the valley floor will be carefully monitored and control measures (such as blankets) will be installed as needed.

9.3.5.4 Erosion Control Procedures and Materials

A wide range of erosion control procedures and materials are available for use at restoration sites. Erosion control measures will be installed as needed at the site. Such measures will prevent erosion but should avoid compacting soil or creating other undesirable disturbances. Erosion control measures can include the installation of erosion control blankets, straw wattles, silt fencing, straw crimping, and other measures, as needed. This section includes procedures and materials that have proven to be effective at other maritime chaparral restoration sites and/or have been implemented at Fort Ord for erosion control. Additional control procedures and materials may be employed at the site as needed.

Erosion control blankets. Biodegradable erosion control blankets can be utilized in steep areas where excavated soil has been backfilled. The mats are a temporary stabilizing measure, contain no monofilaments, and are left in place. Typically, erosion control blankets are installed prior to plant installation but after seeding, and container plants are placed through the mats. Experience of ARCADIS biologists in other maritime chaparral restoration projects has shown that when properly installed these mats do not substantially interfere with seed germination, seedlings easily grow through the openings in the mats and seedling recruitment is high.

Blankets are rolled down the slopes, from the crest to the toe, or from the crest to the upslope side of fiber rolls, when present. Erosion control blankets should be secured properly in accordance with manufacturer's recommendations on upper and lower ends, with staples at 1-foot (0.3 m) centers, and have a minimum of 1.5-foot (0.5 m) overlap. The slope surface should be smooth to enable contact of the mat with the soil in all locations. Recommended erosion control blankets consist of 100 % biodegradable coconut fiber mesh mat, such as North American Green SC-150BN or GreenFix Double Net Coconut CF 072RR or CF 0728 (0.5 to 0.7 pounds per square yard [0.2 to 0.3 kilograms per square meter], 100% biodegradable jute fiber netting on both sides). Staples are made of steel wire (preferably biodegradable) for anchoring, bent U-shaped with a throat width of 1 to 2 inches (2 to 5 cm), with an effective driving depth of not less than 6 inches (15 cm).

Fiber rolls or wattles. Biodegradable fiber rolls or wattles may be installed at the site in areas where excavated soil has been backfilled. They may be used in conjunction with erosion control blankets to stabilize soil and prevent its migration. These materials are especially effective in absorbing the energy of fast-moving sheet flow. The biodegradable fiber rolls or wattles contain no monofilaments and are a temporary stabilizing measure that are left in place.

To install fiber rolls, a shallow trench is excavated 6 inches (15 cm) below grade at the toe of the slope, and the fiber roll is placed in the trench. Wooden stakes are pounded into the ground at a diagonal angle on both sides of the roll at 3-foot (0.9 m) spacing. The top of the stakes should extend above the fiber roll by 3 inches (7 cm). Twine is used to secure rolls to stakes. The ends of the fiber rolls are bent upslope and secured with a stake to prevent undermining of the roll from water flow. These ends are keyed into the banks and secured as necessary to prevent being dislodged.

Recommended fiber rolls or wattles consist of 100% biodegradable coconut fiber or straw and coconut fiber rolls, 12 inches (30 cm) in diameter, 25 feet (7.6 m) long, and 5 to 7 pounds per cubic yard. Rope twine should be machine-spun bristle coir, minimum thickness ¼ inch, and minimum breaking strength of 90 pounds.

Silt Fencing. Silt fencing is typically employed to intercept movement of soil from a disturbed soil surface. FORA ESCA RP procedures for silt fence installation were described by Grattan et al. (2008).

Straw Crimping. Straw crimping has been used extensively with success at Fort Ord locations where erosion control was deemed to be needed. This procedure employs heavy machinery to insert straw vertically into the soil with short stubs remaining above ground. It may be considered for use if it is determined that the resulting soil compaction will not adversely affect seed germination.

Crop Application. Crops (typically sterile barley) may be sown onto a site to provide initial stabilization and add organic matter to the soil. This procedure has been implemented on Fort Ord. Because such crops can compete with and potentially cause stunting of native plants if they germinate at the same time, this procedure must be used carefully to avoid adverse effects on restoration.

10.0 OUTCOME EVALUATION

The purpose of this section is to lay out the foundation of the evaluation and reporting process to determine restoration success. In support of this evaluation, both success criteria and performance factors have been identified. Outcome evaluation is a significant component of the adaptive management process (see Section 9.1.2) that will be employed to assess whether or not the restoration outcomes have achieved their desired objectives and are on track to reach the performance targets on schedule. This process will occur annually at a minimum when the annual monitoring report is prepared and submitted to the Army for review and coordination, as described in Section 11.

For the purposes of the IAR MRA HRP, performance standards are identified as meeting the goals, objectives, and requirements of the HMP. The 1997 HMP pertinent goals are summarized below.

- Preserve, protect, and enhance populations and habitats of federally listed threatened and endangered wildlife and plant species.

- Avoid reducing populations or habitat of federal proposed and candidate wildlife and plant species to levels that may result in one or more of these species becoming listed as threatened or endangered.

- Preserve and protect populations and habitat of state-listed threatened and endangered wildlife and plant species.

- Avoid reducing populations or habitat of species listed as rare, threatened, and endangered by the California Native Plant Society (List 1 B), or with large portions of their range at former Fort Ord, to levels that may result in one or more of these species becoming listed as threatened or endangered.

10.1 Evaluation Process

Information generated by the monitoring effort (see Section 8) will be evaluated and analyzed to generate results for comparison with success criteria (Tables 9, 10, and 11). For statistical or range-based criteria, the evaluation will include a determination of whether or not the criterion has been met. For some criteria (e.g., implementation), documenting completion will satisfy the requirement. The ESCA RP will report site activities and progress to document that the remedy is in place and operating successfully in terms of plant trajectory and growth.

To assist the evaluation process the following information will be assembled:

1. Restoration Implementation: The completion of planned restoration actions (or functionally equivalent actions) will be documented and submitted in partial demonstration of the remedy being “in place” (see Section 10.2). If certain actions

need to be modified at the time of installation, the reason(s) for modifications and a description of their functional equivalency will be included in the submission.

2. Adaptive Management: The adaptive management process (see Section 9) will be documented, including all activities and accomplishments as of the end of 2014. A functional and effective adaptive management process is essential to the long-term success of restoration at the site.

3. Progress Toward Attainment of Performance Targets: The monitoring data available by the end of 2014 (see Section 8) will be limited to the initial restoration responses at the site. Nevertheless, these results will be compared with the anticipated trajectory for the site and an evaluation of progress along the trajectory will be presented. Progress along the trajectory will demonstrate that the installation and adaptive management approaches have been successful.

4. Corrective Actions Completed: Corrective actions implemented prior to the end of 2014 (if any) will be documented and their efficacy will be evaluated.

5. Corrective Actions Planned: Corrective actions that are planned for future implementation at the site as of the end of 2014 (if any) will be described.

The final step in the evaluation process will be to make a comprehensive determination of the completion of the restoration effort, taking all success criteria into account and comparing the results with the overall goal of establishing a healthy self-sustaining maritime chaparral community. Relatively small deviations from one or a few criteria (e.g., one non-HMP species below its success criterion) may be considered to be of minor importance in the context of exceedances for other criteria (e.g., exceedances in listed HMP species) and an overall positive outcome.

10.2 Success Criteria and Performance Targets

Demonstration that the restoration requirements of the BOs (USFWS 1999, 2002, 2005) and the HMP (USACE 1997; see Section 1.5 of this plan) have been met will be accomplished by documenting two categories of outcomes:

1. Successful soil and topography remediation in targeted areas (Table 9)

2. Species and vegetation establishment that meet success criteria (Table 10)

As described in Section 4.2, the following restoration objectives were derived from the restoration goals:

- The health of the restored community will be determined by successful establishment of the community's component species, most importantly the HMP species (USACE 1997, p. 3-20).

- The self-sustainability of the restored community will be determined by vegetative development (i.e., community species richness and percentage cover) over a minimum of three to five years that is consistent with the generally accepted trajectory of chaparral vegetation development.
- The equity of the restored community will be determined by its consistency with the baseline (i.e., pre-disturbance) community. The baseline community represents the community that was removed (USACE 1997, p. 3-6).
- The equity of the restored populations of the HMP species will be determined by their consistency with the baseline (i.e., pre-disturbance) HMP populations. The baseline HMP populations represent the populations that were removed (USACE 1997, p. 3-6).
- The self-sustainability of restored populations of HMP species will be determined by their initial establishment and subsequent colonization of seeded and/or planted areas (i.e., HMP species richness and population estimates) over a minimum of three to five years that is consistent with the HMP baseline populations.
- The establishment of a restored habitat that is devoid of or minimally affected by exotic invasive plant populations will be determined by eliminating populations of the target exotic species and/or documenting that their populations are below the quantitative target levels (i.e., total community percentage cover) for a minimum of three to five years.

Achievement of these restoration objectives will be evaluated via the following parameters and their associated quantitative metrics:

- Restored community health and HMP equity will be assessed by comparing the total number of HMP species present in the site with the number present prior to disturbance (shown in Table 11 on the line labeled "HMP Shrub Species Richness" as well as separate criteria for HMP focus species)
- Community equity will be assessed by comparing the total number of plant species present in the site with the number present prior to disturbance (i.e., the plant palette or baseline, including HMP species; shown in Table 11 on the line labeled "Native Species Richness")
- Self-sustainability of the community will be assessed by: a) achievement of community equity and b) vegetative development as exhibited by the total percentage live plant cover at the site and in a pattern that is consistent with the anticipated trajectory of chaparral regeneration (shown in Table 11 on the line labeled "Native Vegetation Cover")
- Minimization of habitat degradation via exotic invasion will be assessed by preventing the total area of the site occupied collectively by populations of pampas grass, ice plant and French broom from exceeding a target value (shown in Table 11 on the line labeled "Target Weed Cover")

The values of most of the metrics are not static but reflect the increases associated with growth and maturation of the community to be expected as it progresses along the anticipated trajectory. The following assumptions were made in selecting quantitative success criteria (Table 10).

- Vegetation cover will start at a low of 0% in most areas in Year 1 and increase through time.
- The trajectory for vegetation cover to be equitable with pre-disturbance baseline conditions for each location will generally take 10 years.
- Species diversity will increase with time and achievement of equitable diversity to pre-disturbance baseline conditions for each location will take 15 years. This process is assumed to be slower than vegetative growth since long-distance seed dispersal and ideal germination conditions are required for seedling establishment and growth for each new species at a given site.
- HMP shrub species presence will increase through time.
- Monterey spineflower and Monterey gilia cover and frequency will decrease through time as the chaparral shrub canopy fills in and microsites are occupied by other species.
- Seaside bird's beak is restricted to one location and requires a host plant for long-term presence. This species will recovery more quickly in areas with above-ground vegetation removal where host plants are present but will take time to become established in excavated areas.
- Plant establishment in Range 47 Subarea A will be slow initially but will increase slowly to at least a minimum of pre-disturbance conditions within 7 years.
- Container plant survival will vary by species and individuals may gradually die, but these may be replaced by recruits of the same species.

In order to evaluate progress towards achieving success criteria, monitoring results will be tabulated at least annually, and the result for each parameter will be compared with its expected outcome for Year 7 post-installation (see Table 10). Results that meet or exceed the target criterion for the monitoring period will be considered to have demonstrated a successful outcome and achievement of the restoration objective. Results that are below the expected outcome for Year 7 post-installation will be examined by the adaptive management process to determine an appropriate course of action, if any. Review and potential reconsideration of past or proposed adaptive management actions will be conducted jointly with USFWS during annual review meetings.

10.3 Evaluation of Unanticipated Ecosystem Alterations

The possibility cannot be excluded that unanticipated events that are deleterious to the plant communities of the IAR MRA ecosystem could occur while the restoration is in progress. Events such as a burn, plant disease epidemic, severe drought, severe storm, etc., could adversely affect the ecosystem while retarding or eliminating the anticipated progress of the sites that are being restored. Although the likelihood of such an event occurring is considered to be very low, it is prudent and generally accepted practice to establish a protocol involving "reference" areas to detect and document ecosystem alterations. Reference areas are monitored contemporaneously with the restoration sites and provide the means to evaluate the effects of deleterious ecosystem changes on the sites.

A reference area will be established for each site and monitoring procedures will be the same as those used to establish the site's baseline. The one exception is Subarea A in the Range 47 SCA. Because the restoration effort will involve essentially the entire footprint of Subarea A, and there is no other area that is similar to it, the R47 reference area will be used as a surrogate for a Subarea A reference area.

Reference areas will be monitored annually during the post-installation restoration period. Data will be tabulated and presented in the annual reports; however, detailed analyses will not be performed on the reference area data unless there is indication of a deleterious event occurring within the ecosystem. If a deleterious event occurs, the data will be evaluated as part of the adaptive management process and coordination will be initiated with the Army. Additional consideration will be given to how this deleterious event may constitute a *force majeure* in concurrence with Section C5.12 of the ESCA and section XXI, paragraphs 68, 69, 70, and 71 of the AOC.

10.4 Responsibilities and Site Closure

The IAR MRA HRP will be implemented by FORA and/or its approved successors on behalf of the Army as defined in the ESCA. As presented in this plan, the outlined activities are designed to establish native vegetation at the site that is progressing on a trajectory toward a self-sustaining native plant community equitable with the species richness and HMP species relative cover that were present on the site prior to the FORA ESCA RP Team investigation and remedial efforts.

The IAR MRA HRP shall be conducted at the site in a manner consistent with the land use requirements, engineering and institutional controls, and site management restrictions, as detailed in the HMP. Quantitative success criteria for plant survival, species richness, and percentage cover have been established for the first seven years following site restoration. Metrics for most criteria are based on the pre-existing baseline values, and progress toward those values over the years is based on anticipated restoration trajectories.

As presented above, a number of quantitative success criteria and performance targets have been proposed, which will provide the basis for reporting of progress towards and achievement of performance standards. Evaluation of and reporting against performance standards will be required to support compliance with ARARs (ESA requirements) in completion of the Army's Interim Remedial Action under the ROD. Habitat restoration activities and monitoring will be documented consistent with the Phase II Interim Action Work Plan. Site activity and success criteria reporting will be captured and reported in the Annual Natural Resource Monitoring, Mitigation, and Management Report and will be the basis for annual meetings with the Army and the USFWS. This meeting is tentatively planned to occur in the first quarter of each year. Site restoration will be approved by the USFWS based on meeting the requirements of the BOs and HMP in accordance with the Federal ESA.

IAR MRA HRP activities, monitoring, and findings will be presented in a summary report for the Phase II Interim Remedial Actions prepared in accordance with Task 09 of

the AOC and will be used to support the Remedial Investigation/Feasibility Study for the IAR MRA. In accordance with CERCLA, a Final ROD will be prepared and other appropriate final remedial actions will be taken as necessary to protect public health and the environment.

The anticipated general schedule for implementation of IAR MRA habitat restoration per the HRP is as follows:

Year	Activity *Implementing Party*	Expected Date
0	Restoration Construction and Implementation/Annual Natural Resource Monitoring, Mitigation and Management Report *ESCA RP Team with FORA Oversight*	2012
1-2	Adaptive Management/Yearly Review Meeting with Army & USFWS / Annual Natural Resource Monitoring, Mitigation, and Management Report *ESCA RP Team with FORA Oversight*	2013 - 2014
3	Evaluate Restoration Trajectory/Completion of Remedial Action / Yearly Review Meeting with Army & USFWS / Annual Natural Resource Monitoring, Mitigation, and Management Report *ESCA RP Team with FORA Oversight*	2015
3	Transition to Long Term Monitoring (LTM) / Operations &Maintenance (O&M) and LTM Plans *FORA*	2015
3-7	Implement O&M and LTM Plans and Reporting / Yearly Review Meeting with Army & USFWS / Evaluate Achievement of Success Criteria in Annual Meetings / Monitoring Reporting Annual Results / Completion of Work *FORA or its approved successor*	2015 to 2019

11.0 REPORTING AND COORDINATION

The results of the monitoring and other actions associated with the restoration sites will be communicated to the Army and USFWS at least annually until it has been determined that the success criteria have been met. These activities will provide a feedback mechanism that will allow the restoration results from the IAR MRA to contribute to guiding this restoration program.

11.1 Reporting

The site restoration activities and subsequent monitoring will be documented in annual reports. The "construction" or implementation of restoration activities will be documented and shared with the Army and USFWS. Beginning with the first full year post-installation, annual reports (for calendar years, except for the first report, which may include a longer period) will be generated. These reports will include the following information:

- list of major activities conducted during the year (monitoring, erosion and weed control, corrective actions, etc.) and their outcomes
- monitoring data: tabulated and summarized as appropriate
- analysis of monitoring data and discussion of results
- evaluation of progress toward meeting success criteria
- overall assessment of progress
- review of adaptive management activity and recommendations for changes in protocols, procedures and methods and/or future actions (if any)
- "as-built" report: documentation of initial installation, comparison with planned installation and assessment of installation performance accomplishments (this item will appear only in the first annual report)

The reports will be submitted to the Army and USFWS in the first part of the year following the reporting period.

11.2 Coordination

Annual meetings will be held with the Army and USFWS after submittal of the annual reports. The topics that may be discussed in these meetings include:

- review of site activities in the reporting period
- review of report contents and response to questions
- evaluation of progress relative to success criteria, goals and objectives
- decisions regarding proposed changes and/or actions
- additional issues

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Table 1
Potential Applicable or Relevant and Appropriate Requirements (ARARs)[4]

Source or Authority	Requirement, Standard, or Criterion	Type	Description	Remarks
Federal ARARs				
Endangered Species Act (ESA) (16 United States Code [U.S.C.] §§ 1531-1543)	16 U.S.C. § 1536 (a) and (c); 16 U.S.C. § 1538 (a)(1)	Applicable [1, 2, 3] / Location	Federal agencies are required under Section 7 of the ESA to ensure that their actions do not jeopardize the continued existence of a listed species or result in destruction of or adverse modification of its critical habitat (16 U.S.C. § 1536). If the proposed action may affect the listed species or its critical habitat, consultation with the United States Fish and Wildlife Service (USFWS) and/or California Department of Fish and Game may be required (50 Code of Federal Regulations [CFR] § 402.14). Additionally, Section 9 of the ESA prohibits the illegal taking of a listed species (16 U.S.C. § 1538(a)(1)).	Endangered plant and animal species and critical habitats occur at the former Fort Ord. Each reuse area will be screened for potential impacts to any endangered species identified in the Installation-Wide Multispecies Habitat Management Plan (HMP; USACE 1997) and additional requirements identified in subsequent documents (USFWS 1999, 2002, and 2005; and Zander 2002). The provisions of the HMP and referenced additional requirements satisfy the requirements of the ESA.
Migratory Bird Treaty Act (MBTA)	16 U.S.C. §§ 703-712	Applicable [1, 2, 3] / Location	The statute sections prohibit the taking, possession of, buying, selling, purchasing, or bartering of any migratory bird, including feathers or other parts, nest eggs, or products, except as allowed by regulations.	The requirement includes specific standards of control.
Hazardous Materials & Transportation Act	49 CFR Part 172.101	Applicable [3] / Chemical and Action	These regulations impose procedures and controls on the transportation of hazardous materials.	The regulations include specific standards of control and substantive requirements, criteria, and limitations that may apply to the transport of detonation materials and selected recyclable ordnance materials.
National Pollutant Discharge Elimination System (NPDES)	40 CFR Parts 122, 123, 124	Relevant and Appropriate [1, 2,] / Action	Regulates the discharge of pollutants to waters of the United States.	The regulations include specific standards of control and substantive requirements, criteria, and limitations that may apply to discharges of pollutants to waters of the United States. Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), procedural requirements such as obtaining a permit while conducting MEC investigation/remediation do not apply.
Federal Resource Conservation and Recovery Act (RCRA), Subpart M (Military Munitions Rule [“the Military Munitions Rule”])	40 CFR Parts 266 and 270	Relevant and Appropriate [2, 3] / Chemical and Action	The regulations identify when military munitions on active ranges become subject to the regulatory definition of “solid waste,” for purposes of RCRA Subtitle C and, if these wastes are hazardous, the management standards that apply.	Portions of the Military Munitions Rule may be relevant and appropriate, but those provisions of the Rule that exclude military munitions from RCRA Subtitle C regulations are not appropriate to the remediation of a closed range. The relevant portions relate to the management of munitions and explosives of concern (MEC), which is recovered, including characterization as hazardous waste and requirements for treatment, storage, and transportation. The Rule provides for the storage and transportation of recovered military munitions in accordance with Department of Defense Explosives Safety Board (DDESB) standards.
State of California ARARs				
California Endangered Species Act	Fish and Game Code §§ 2051 et seq. and §2080	Relevant and Appropriate [1, 2, 3] / Location	The statute sections provide a declaration of policy and definitions. Section 2080 provides that no person shall take, possess, purchase, or sell within this state, any species, or any part or product thereof, that the commission determines to be an endangered species or a threatened species, or attempt any of those acts.	Section 2080 includes specific standards of control with respect to the taking of endangered or threatened species.

Table 1
Potential Applicable or Relevant and Appropriate Requirements (ARARs)[4]

Source or Authority	Requirement, Standard, or Criterion	Type	Description	Remarks
California Fish and Game Code	§ 3511	Relevant and Appropriate [1, 2, 3] / Location	This statute section prohibits taking or possessing fully protected birds or parts thereof, listed as: (a) American peregrine falcon *(Falco peregrinus analum)*; (b) Brown pelican; (c) California black rail *(Lateralhus jamaicensis coturniculus)*; (d) California clapper rail *(Rallus longirostris obsoletus)*; (e) California condor *(Gymnogyps californianus)*; (f) California least tern *(Sterna albifrons browni)*; (g) Golden eagle; (h) Greater sandhill crane *(Grus canadensis tabida)*; (i) Light-footed clapper rail *(Rallus longirostris levipes)*; (j) Southern bald eagle *(Haliaeetus leucocephalus leucocephalus)*; (k) Trumpeter swan *(Cygnus buccinator)*; (l) White-tailed kite *(Elanus leucurus)*; and (m) Yuma clapper rail *(Rallus longirostris yumanensis)*.	The requirement includes specific standards of control that may apply to the American peregrine falcon (some possibility), golden eagle (slight possibility), brown pelican (not likely but possible), and California least tern (not likely but possible).
California Fish and Game Code	§ 3513	Relevant and Appropriate [1, 2, 3] / Location	This statute section declares that it is unlawful to take or possess any migratory non-game bird as designated in the MBTA or any part of such migratory non-game bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the MBTA.	The requirement includes specific standards of control.
California Fish and Game Code	§ 3503.5	Relevant and Appropriate [1, 2, 3] / Location	This statute section prohibits the take, possession, or destruction of any birds in the orders of Falconiformes or Strigiformes, or to take, possess, or destroy the nest or eggs of any such bird, except as provided in the code.	The requirement includes specific standards of control that may apply to vultures, hawks, ospreys, falcons, and owls.
California Fish and Game Code	Title 14, California Code of Regulations (CCR) § 472	Relevant and Appropriate [1, 2, 3] / Location	This regulation limits the taking of non-game birds and mammals except for specified species.	The requirement includes specific standards of control that may affect American crows.
California Fish and Game Code	§ 4800 et seq.	Relevant and Appropriate [1, 2, 3] / Location	This statute section declares that it is unlawful to take, injure, possess, transport, or sell any mountain lion.	The requirement includes specific standards of control.
California Fish and Game Code	Title 14, CCR §§ 40-42	Relevant and Appropriate [1, 2, 3] / Location	These regulations make it unlawful to take, possess, purchase, propagate, sell, transport, import, or export any native reptile or amphibian, unless under special permit.	The requirement includes specific standards of control that may apply to California black legless lizard and coast horned lizard.
California Health and Safety Code, Division 20	Title 22, CCR Division 4.5	Applicable [3] / Chemical and Action	The statute and regulations provide for identification of hazardous waste in §§ 66261. If a material is a hazardous waste, Division 4.5 provisions further regulate hazardous waste generators, transporters, and treatment, storage, and disposal facilities.	The Environmental Services Cooperative Agreement Remediation Program (ESCA RP) Team will evaluate discovered items in accordance with the approved work plan to determine the presence of energetic materials or other constituents that would cause it to be characterized as a hazardous waste. Substantive requirements: • Storage: on-site storage of MEC items occur in a designated bunker that meets the standard of DDESB 6055.9 STD, including security measures such as fences, signs, and an alarm system. • Transportation: off-site transportation of small arms ammunition will incorporate applicable manifesting and placarding requirements. Conforms to Defense Reutilization and Marketing Office instruction. • Disposal/recycling: off-site disposal or recycling facility or facilities for small arms ammunition will be state and/or RCRA-authorized.

Table 1
Potential Applicable or Relevant and Appropriate Requirements (ARARs)[4]

Source or Authority	Requirement, Standard, or Criterion	Type	Description	Remarks
California Health and Safety Code	Title 22, CCR § 66264.601-603	Relevant and Appropriate [2] / Action	These regulations apply to hazardous waste treatment, which is conducted in a device that does not meet the definition of a "container" in 22 CCR § 66260.10 or is characterized as a "Miscellaneous Unit" subject to the provisions of 22 CCR § 66264.601-603. For activities where detonations are in a device that meets the 22 CCR § 66260.10 definition of a container, the requirements for "temporary units," as set forth in 22 CCR § 66264.553, apply.	The regulations include generally described narrative standards. Compliance with substantive requirements is achieved through regulatory coordination of site-specific work plans in accordance with the CERCLA and Federal Facility Agreement.
California Health and Safety Code	Title 22, CCR § 66265.382	Relevant and Appropriate [3] / Chemical and Action	Open burning of hazardous waste is prohibited except for the open burning and open detonation (OB/OD) of waste explosives. Waste explosives include waste that has the potential to detonate and bulk military propellants that cannot safely be disposed of through other modes of treatment. Detonation is an explosion in which chemical transformation passes through the material faster than the speed of sound (0.33 kilometer/second at sea level). Owners or operators choosing to open burn or detonate waste explosives shall do so in accordance with the following table and in a manner that does not threaten human health or the environment. Pounds Waste Explosives — Minimum Distance from OB/OD to property 0 to 100 — 204 meters (670 feet) 101 to 1,000 — 380 meters (1,250 feet) 1,001 to 10,000 — 530 meters (1,730 feet) 10,001 to 30,000 — 690 meters (2,260 feet)	The requirement includes specific standards of control and addresses situations similar to those that may be addressed during MEC remediation; detonation of MEC will comply with these requirements.
California Fish and Game Code	§ 1900 et seq.	Relevant and Appropriate [1, 2, 3] / Action	These statute sections sets forth programmatic and administrative provisions and, in § 1908, provides that no person shall import into the state, or take, possess, or sell within this state, except as incident to the possession or sale of the real property on which the plant is growing, any native plant, or any part or product thereof, that the commission determines to be an endangered native plant or rare native plant.	The standards of control are relevant and appropriate, and the citation is therefore considered as an ARAR.
California Fish and Game Code	Title 14, CCR § 783 et seq.	Relevant and Appropriate [1, 2, 3] / Action	These regulations provide that no person shall import into the State, export out of the State or take, possess, purchase, or sell within the State, any endangered species, threatened species, or part or product thereof, or attempt any of those acts, except as otherwise provided in the California Endangered Species Act, Fish and Game Code Section 2050, et seq., the Native Plant Protection Act, the Natural Community Conservation Planning Act, the California Desert Native Plants Act, or as authorized under this article in an incidental take permit. The regulations also provide programmatic and administrative procedures for incidental take permits.	The section includes specific standards of control with respect to taking rare or endangered plants. The standards of control are relevant and appropriate, and the citation is therefore considered as an ARAR.

Table 1
Potential Applicable or Relevant and Appropriate Requirements (ARARs)[4]

Source or Authority	Requirement, Standard, or Criterion	Type	Description	Remarks
Porter Cologne Water Quality Control Act	California Water Code, Division 7, Section 13200	Relevant and Appropriate [1, 2] / Action	Requires submission of Report of Waste Discharge and obtaining waste discharge requirements for specified waste discharges.	Investigation and MEC remediation activities may require submitting Report of Waste Discharge and obtaining waste discharge requirements; this may be addressed as part of NPDES permit requirements. Under CERCLA, procedural requirements such as obtaining a permit while conducting MEC investigation/remediation do not apply.
State of California To-Be-Considered Criteria (TBCs)				
California Fish and Game Commission	Wetlands Resources (pursuant to § 703 of California Fish and Game Code; not a statute)	Policy [1, 2, 3] / Location	This policy: (1) seeks to provide for the protection, preservation, restoration, enhancement, and expansion of wetland habitat in California; (2) strongly discourages development in or conversion of wetlands; and (3) opposes, consistent with its legal authority, any development or conversion that would result in a reduction of wetland acreage or wetland habitat values. To that end, the Commission: (1) opposes wetland development proposals unless, at a minimum, project mitigation assures there will be "no net loss" of either wetland habitat values or acreage; and (2) strongly prefers mitigation that would achieve expansion of wetland acreage and enhancement of wetland habitat values.	The policy provides for the protection of wetland resources.
Regulations that were considered as Potential ARARs but were not considered applicable				
California Fish and Game Code	§ 3005		The statute section prohibits the taking of birds or mammals, except non-game mammals, with any net, pound, cage, trap, set line, or wire, or poisonous substance. Included in the term "taking" is the killing of birds or mammals by poison.	
California Fish and Game Code	§ 4000 et seq.		This statute section provides that a fur-bearing mammal may be taken only with a trap, firearm, bow and arrow, poison under a proper permit, or with the use of dogs.	
California Fish and Game Code	Title 14, CCR § 460		This regulation makes it unlawful to take Fisher, marten, river otter, desert kit fox and red fox.	The species of red fox protected by the State is located in the Sierra Nevada mountain range. The species of red fox located at the former Fort Ord is an introduced species and is not protected by this section.
California Clean Air Act	Health and Safety Code § 41701		This statute section prohibits the discharge into the atmosphere from any source whatsoever any air contaminant for a period or periods aggregated more than three minutes in any one hour that is dark or darker than No. 2 on the Ringelmann Chart or obscures the view to a degree equal to or greater than smoke.	Agricultural burning for which a permit has been granted pursuant to Article 3 (commencing with § 41850, emission limitations for agricultural burning) are exempt from this requirement per § 41704(b). Any prescribed bums that would be conducted for vegetation removal prior to MEC remediation will be conducted under Monterey Bay Unified Air Pollution Control District Rule 407, which implements the requirements of Article 3 (California Health and Safety Code § 41850 et seq.).

Notes:
1. Vegetation Clearance
2. MEC Remediation
3. Detonation of MEC
4. ESCA 2009b

Table 2
2010-2011 IAR MRA Baseline Vegetation Frequency and Cover
IAR MRA Habitat Restoration Plan
FORA ESCA RP

		IAR-wide vegetation baseline (29 transects)			Range 47 SCA Subarea B vegetation baseline (3 transects)		
Scientific name	**Common name**	**Frequency of Occurrence Ranking (maximum of 14)**	**Frequency of Occurrence**	**Cover**	**Frequency of Occurrence Ranking (maximum of 3)**	**Frequency of Occurrence**	**Cover**
Acmispon glaber [Lotus scoparius]	deerweed	5	79%	1.4%	2	67%	2.3%
Adenostoma fasciculatum	chamise	3	90%	9.0%	3	33%	4.8%
*Arctostaphylos pumila**	sandmat manzanita	7	66%	1.6%	3	33%	0.3%
Arctostaphylos tomentosa ssp. *tomentosa*	shaggy-barked manzanita	1	100%	29.3%	2	67%	20.8%
Baccharis pilularis ssp. *consanguinea*	coyote brush	11	24%	0.7%	1	100%	13.9%
Ceanothus dentatus	dwarf ceanothus	3	90%	20.2%	1	100%	21.1%
*Ceanothus rigidus**	Monterey ceanothus	2	97%	13.5%	1	100%	12.6%
Ericameria ericoides	mock-heather	11	24%	1.5%	not present	0%	0.0%
*Ericameria fasciculata**	Eastwood's ericameria	13	17%	0.2%	not present	0%	0.0%
Eriophyllum confertiflorum	golden yarrow	7	66%	1.5%	not present	0%	0.0%
Frangula [Rhamnus] californica	coffee berry	9	31%	0.9%	not present	0%	0.0%
Helianthemum scoparium	rush-rose	4	86%	8.1%	1	100%	3.0%
Horkelia cuneata ssp. *cuneata*	wedge leaved horkelia	8	52%	1.3%	2	67%	0.9%
Lepechinia calycina	pitcher sage	12	21%	0.4%	not present	0%	0.0%
Lupinus chamissonis	silver beach lupine	14	14%	0.4%	not present	0%	0.0%
Mimulus aurantiacus	sticky monkey flower	10	28%	0.5%	not present	0%	0.0%
Salvia mellifera	black sage	6	69%	5.3%	2	67%	5.3%
Bare Ground		1	100%	19.3%	1	100%	28.0%
	Total average vegetation cover**:			80.7%			72.0%

Notes:
* HMP species
** "Total average vegetation cover" (100% minus bare ground) includes all herbaceous and woody species.

Table 3
2010-2011 IAR MRA Baseline Focus Species Presence
IAR MRA Habitat Restoration Plan
FORA ESCA RP

	Monterey spineflower			Monterey gilia			seaside bird's-beak*		
Habitat or Site Type	Grid cells surveyed	Grid cells with Monterey spineflower	Proportion of surveyed grid cells containing Monterey spineflower	Grid cells surveyed	Grid cells with Monterey gilia	Proportion of surveyed grid cells containing Monterey gilia	Grid cells surveyed	Grid cells with seaside bird's-beak	Proportion of surveyed grid cells containing seaside birds-beak
North Range 44 SCA and Central Area NCA	41	33	80%	30	18	60%	24	4	17%
Grassland	1	1	100%	1	0	0%	*		
Range 47 SCA - Subarea A	1	1	100%	1	0	0%	1	0	0%
Range 47 SCA - Subarea B	24	22	92%	24	1	4%	5	0	0%
Range 47 SCA - Subarea C	3	2	67%	3	1	33%	30	0	0%

Note:

* seaside bird's-beak only occurs in North Range 44 SCA.

Table 4
Summary of Planned Activities in the IAR MRA
IAR MRA Habitat Restoration Plan
FORA ESCA RP

Activity Type	Activity Category	Estimated Area (acres)	Restoration Strategy	Planned Actions
Ingress/egress routes	A	5.5	Monitoring only	- monitor
Above-ground vegetation cutting prior to target-specific excavaton ("mag and dig")	B	12.3	Monitoring only	- separate/replace topsoil/subsoil in specified sequence
All vegetation removed (above and below ground). Small-scale soil excavation (less than 1 acre or no more than 100 feet wide)	C	2.9	Passive (seeding)	- separate/replace topsoil/subsoil in specified sequence - recontour to match original - control erosion as needed - seed - monitor
All vegetation removed (above and below ground). Large scale soil excavation (more than 1 acre or more than 100 feet wide)	D	13.4	Active (seeding and container planting)	- separate/replace topsoil/subsoil in specified sequence - recontour to match original - control erosion as needed - seed - container plantings - monitor
Totals	**4 activity categories**	**34.1**	**acres**	

Table 5
Terminology and Characteristics of Growth Phases in Maritime Chaparral
IAR MRA Habitat Restoration Plan
FORA ESCA RP

Overall Process	Phase (or Stand) Name	Shrub Age (years, average)	Shrub Canopy (percentage cover)	Floristic Diversity (native annuals, herbaceous perennials, woody species)
Chaparral Maturation Cycle (restoration trajectory)	initial	<1-3	0-30	highest
	intermediate	3-6	30-70	moderate
	mature	6-20+	70-90+	lowest

Table 6
IAR MRA Observed Floristic Species
IAR MRA Habitat Restoration Plan
FORA ESCA RP

Scientific Name	Common Name	Habit	IAR HRP Plant Palette	Recorded in 2000[a]	Recorded in 2004[a]	Recorded in 2005[a]	Recorded in 2008[b]	Recorded in 2010[c] and/or 2012	SSRP Range 43 palette[d]	SSRP HA 18 palette[d]
HMP[c] Species										
Arctostaphylos pumila	sandmat manzanita	shrub	x	x		x	x	x	x	x
Ceanothus rigidus	Monterey ceanothus	shrub	x	x		x	x	x	x	x
Chorizanthe pungens var. *pungens*	Monterey spine-flower	annual	x	x	x	x	x	x	x	x
Cordylanthus rigidus ssp. *littoralis*	seaside bird's-beak	annual	x	x	x	x	x	x	x	
Ericameria fasciculata	Eastwood's ericameria	shrub	x	x		x	x	x	x	x
Gilia tenuiflora ssp. *arenaria*	Monterey [sand] gilia	annual	x	x	x	x	x	x	x	
Non-HMP Native Species										
Achillea millefolium	common yarrow	perennial herb						x		
Acmispon [Lotus] heermannii	Heermann's lotus	annual						x		
Acmispon [Lotus] strigosus	Bishop's lotus	annual						x		
Acmispon glaber [Lotus scoparius]	deerweed	perennial herb/sub shrub	x	x		x	x	x	x	x
Adenostoma fasciculatum	chamise	shrub	x	x		x	x	x	x	x
Anaphalis margaritacea	pearly everlasting	perennial herb						x		
Arctostaphylos tomentosa ssp. *tomentosa*	shaggy-barked manzanita	shrub	x	x		x	x	x	x	
Baccharis pilularis ssp. *consanguinea*	coyote brush	shrub	x	x		x	x	x	x	x
Calochortus albus var. *albus*	globe lily	perennial herb						x		
Cardionema ramosissimum	sand mat	perennial herb						x		

Table 6
IAR MRA Observed Floristic Species
IAR MRA Habitat Restoration Plan
FORA ESCA RP

Scientific Name	Common Name	Habit	IAR HRP Plant Palette	Recorded in 2000[a]	Recorded in 2004[a]	Recorded in 2005[a]	Recorded in 2008[b]	Recorded in 2010[c] and/or 2012	SSRP Range 43 palette[d]	SSRP HA 18 palette[d]
Carex brevicaulis	short-stemmed sedge	perennial herb		x			x	x		
Castilleja densiflora	owl's clover	annual						x		
Castilleja exserta ssp. *exserta*	purple owl's clover	annual						x		
Caulanthus lasiophyllus	California mustard	annual						x		
Ceanothus dentatus	dwarf ceanothus	shrub	x	x		x	x	x		
Chorizanthe diffusa	diffuse chorizanthe	annual						x		
Cirsium brevistylum	clustered thistle, Indian thistle	annual						x		
Cirsium occidentale ssp. occidentale	cobweb thistle	annual		x			x	x		
Claytonia perfoliata	miner's lettuce	annual						x		
Corethrogyne [Lessingia] filaginifolia	silver carpet, California aster	perennial herb		x			x			
Croton californicus	California croton	perennial herb		x			x	x		
Cryptantha clevelandii	Cleveland's cryptantha, white forget-me-not	annual						x		
Cryptantha micromeres	dwarf cryptantha	annual						x		
Deinandra [Hemizonia] corymbosa ssp. corymbosa	coast tarweed	annual						x		
Deinandra [Hemizonia] increscens	grassland tarweed	annual					x	x		
Dichelostemma capitatum	blue dicks	perennial herb						x		
Elymus glaucus	western ryegrass	perennial grass					x	x		x
Eriastrum virgatum	wand woolly start	annual						x		
Ericameria ericoides	mock-heather	shrub	x	x		x	x	x		x
Eriophyllum confertiflorum	golden yarrow	subshrub	x	x		x	x	x	x	x

Table 6
IAR MRA Observed Floristic Species
IAR MRA Habitat Restoration Plan
FORA ESCA RP

Scientific Name	Common Name	Habit	IAR HRP Plant Palette	Recorded in 2000[a]	Recorded in 2004[a]	Recorded in 2005[a]	Recorded in 2008[b]	Recorded in 2010[c] and/or 2012	SSRP Range 43 palette[d]	SSRP HA 18 palette[d]
Eschscholzia californica	California poppy	annual						x		
Frangula [Rhamnus] californica	coffee berry	shrub	x	x		x	x	x	x	
Fritillaria affinis	checker lily	perennial herb						x		
Galium californicum	California bedstraw	perennial herb						x		
Galium porrigens	climbing bedstraw	perennial herb						x		
Garrya elliptica	coast silk-tassel	shrub		x			x	x		
Helianthemum scoparium	rush-rose	subshrub	x	x		x	x	x	x	x
Heterotheca grandifolia	telegraph weed	annual					x			
Horkelia cuneata ssp. *cuneata*	wedge leaved horkelia	perennial herb	x	x		x	x	x	x	x
Layia platyglossa	tidy tips	annual								
Lepechinia calycina	pitcher sage	shrub	x					x		
Lessingia glandulifera var. *glandulifera*	common lessingia	annual						x		
Lessingia pectinata var. *pectinata*	common lessingia	annual						x		
Logfia filaginoides [Filago californica]	California filago	annual						x		
Lupinus chamissonis	silver beach lupine	shrub	x	x		x	x	x		
Lupinus nanus	sky lupine	annual						x		
Madia sativa	coast tarweed	annual						x		
Mimulus aurantiacus	sticky monkey flower	shrub	x	x		x	x	x		x
Monardella undulata	curly-leaved monardella	annual						x		
Monardella villosa	coyote mint	perennial herb						x		
Navarretia atractyloides	holly-leaved navarretia	annual						x		
Navarretia hamata ssp. *leptantha*	hooked navarretia	annual						x		
Navarretia intertexta	needle-leaved navarretia	annual						x		

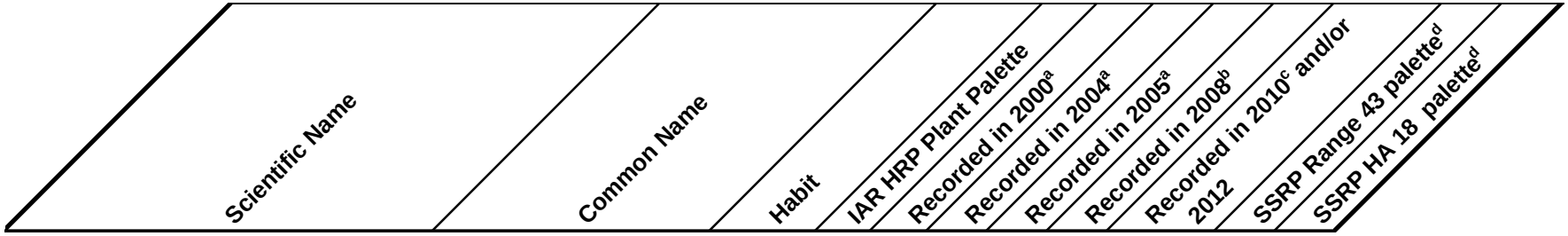
Table 6
IAR MRA Observed Floristic Species
IAR MRA Habitat Restoration Plan
FORA ESCA RP

Scientific Name	Common Name	Habit	IAR HRP Plant Palette	Recorded in 2000[a]	Recorded in 2004[a]	Recorded in 2005[a]	Recorded in 2008[b]	Recorded in 2010[c] and/or 2012	SSRP Range 43 palette[d]	SSRP HA 18 palette[d]
Nuttallanthus texanus [Linaria canadensis]	toad-flax	annual						x		
Orobanche bulbosa	chaparral broomrape	perennial herb						x		
Pinus radiata	Monterey pine	tree						x		
Piperia michaelii	Michael's rein-orchid	perennial herb						x		
Pseudognaphalium [Gnaphalium] californicum	California everlasting	annual		x			x	x		
Pseudognaphalium beneolens [Gnaphalium canescens ssp. *beneolens]*	fragrant everlasting	annual						x		
Pteridium aquilinum var. *pubescens*	western bracken fern	perennial fern		x		x	x	x		
Quercus agrifolia var. *agrifolia*	coast live oak	tree		x			x	x		
Salix lasiolepis	arroyo willow	shrub						x		
Salvia mellifera	black sage	shrub	x	x		x	x	x	x	x
Sanicula laciniata	coast sanicle	perennial herb						x		
Sisyrinchium bellum	blue-eyed grass	perennial fern						x		
Solanum umbelliferum	blue witch	shrub				x		x		
Stephanomeria virgata ssp. *virgata*	tall milk aster	annual					x			
Symphorocarpus mollis	trailing snowberry	shrub		x		x	x			
Taraxia [Camissonia] ovata	suncups	perennial herb						x		

Table 6
IAR MRA Observed Floristic Species
IAR MRA Habitat Restoration Plan
FORA ESCA RP

Scientific Name	Common Name	Habit	IAR HRP Plant Palette	Recorded in 2000[a]		Recorded in 2004[a]	Recorded in 2005[a]	Recorded in 2008[b]	Recorded in 2010[c] and/or 2012	SSRP Range 43 palette[d]	SSRP HA 18 palette[d]
Toxicodendron diversilobum	poison-oak	shrub		x		x	x	x			
Trifolium gracilentum	pinpoint clover	annual									
Non-native Species											
Bromus diandrus	ripgut brome	annual grass					x	x			
Bromus madritensis ssp. *rubens*	red brome	annual grass					x	x			
Carduus pycnocephalus	Italian thistle	annual						x			
Carpobrotus edulis	hottentot fig/ice plant	perennial herb		x		x	x	x			
Centaurea solstitialis	yellow star thistle	annual						x			
Conium maculatum	poison hemlock	annual						x			
Cortaderia jubata	jubata grass	perennial grass						x			
Erodium botrys	long-beaked filaree	annual						x			
Erodium cicutarium	red-stemmed filaree	annual						x			
Hypochaeris glabra	smooth cat's ears	annual						x			
Logfia [Filago] gallica	narrow-leaved filago	annual						x			
Petrohagia dubia	hairypink	annual						x			
Rumex acetosella	sheep sorrel	perennial herb					x	x			
Sonchus asper ssp. *asper*	prickly sow-thistle	annual						x			
Sonchus oleraceus	common sow-thistle	annual						x			

Table 6
IAR MRA Observed Floristic Species
IAR MRA Habitat Restoration Plan
FORA ESCA RP



Notes:
Grayed out lines indicate plant species used in IAR restoration

[a]Results of monitoring conducted in Ranges 43-48 (otherwise monitoring conducted in the IAR MRA) (Parsons 2005, LFR 2009)

[b]Plant species observed during 2008 routine transect, quadrat and plot-based monitoring in IAR MRA habitat parcels. This was not a floristic survey (ESCA RP 2008)

[c]Floristic survey of IAR MRA habitat parcels conducted in Spring and Summer 2010 and 2012

[d]Plant palettes used in specific Historic Area by the Army in the Site Specific Restoration Plan Historic Areas 18, 19, 22, 23, 27, 27A, 29, 33, 36, 39/40, and 43, Former Fort Ord, California, 2010

Table 7
IAR MRA Plant Palette
IAR MRA Habitat Restoration Plan
FORA ESCA RP

Scientific name	Common name	Propagation method	Seeding rate (seeds/acre)	Planting density at 1.5 m spacing (plants/acre)*	Estimated container size(s)	Estimated container quantities
HMP species						
Arctostaphylos pumila	sandmat manzanita	cutting	n/a	130	Gallon/4"	4,640
Ceanothus rigidus	Monterey ceanothus	seed and cutting	1,000	130	Gallon/D40	4,800
Chorizanthe pungens var. *pungens*	Monterey spine-flower	seed and soil seed bank	120,000	n/a	n/a	n/a
Cordylanthus rigidus ssp. *littoralis*	seaside bird's-beak	seed	1,000	100	D40/4"	**
Ericameria fasciculata	Eastwood's ericameria, Eastwood's goldenfleece	seed and cutting	1,000	110	Gallon/D40	4,000
Gilia tenuiflora ssp. *arenaria*	Monterey [sand] gilia	seed and soil seed bank	1,500	75	D40/4"	**
Non-HMP species						
Acmispon glaber [Lotus scoparius]	deerweed	seed	2,000	150	Gallon/D40	5,600
Adenostoma fasciculatum	chamise	seed	1,000	80	Gallon/2x5"	3,040
Arctostaphylos tomentosa ssp. *tomentosa*	shaggy-barked manzanita	cutting	n/a	110	Gallon/4"	4,000
Baccharis pilularis ssp. *consanguinea*	coyote brush	seed	1,000	90	Gallon/D40	2,720
Ceanothus dentatus	dwarf ceanothus	seed and cutting	1,000	120	Gallon/D40	4,320
Ericameria ericoides	mock-heather	seed and cutting	1,000	120	Gallon/D40	4,000
Eriophyllum confertiflorum	golden yarrow	seed	2,000	150	Gallon/D40	5,600
Frangula [Rhamnus] californica	coffee berry	seed	1,000	50	Gallon/D40	1,872
Helianthemum scoparium	rush-rose	seed	2,000	150	Gallon/D40	5,600
Horkelia cuneata ssp. *cuneata*	wedge-leaved horkelia, coast horkelia	seed	2,000	150	Gallon/D40	4,960
Lepechinia calycina	pitcher sage	n/a	100	n/a	n/a	n/a
Mimulus aurantiacus	sticky monkey flower	seed	2,000	130	Gallon/D40	4,800
Salvia mellifera	black sage	seed	2,000	130	Gallon/D40	4,800
Totals			**141,600**	**1,975**		**64,752**

Notes:

*Planting density in the active restoration vegetation planting area will be 1.5m spacing or 1,975 plants/acre (this includes all species in the plant palette except Monterey spineflower, seaside bird's beak, and Monterey gilia). Planting density in the active restoration HMP focus species areas will vary depending on exact strategy used (e.g. broadcast seed vs. container) and site specific baseline conditions. These species include Monterey spineflower, seaside bird's beak, and Monterey gilia.

** Exact quantities pending nursery success in propagating these species

Table 8
Restoration Material Categories
IAR MRA Habitat Restoration Plan
FORA ESCA RP

Material	Type	Subtype	Location	Application	Purpose
Topsoil	reserved (stockpiled) surface soil	0-12" soil horizon	site-wide	backfill to create upper 0-12" soil horizon	topsoil and seed bank replacement
Mulch and soil litter	litter	chipped vegetation from vegetation cutting areas	20% site-wide	surface scatter on soil surface: light (focus species areas) to moderate cover	erosion control, organic matter, seed trapping, mulching, mycorrhizal inoculant
Soil Amendment	charate	chipped and charred vegetation from vegetation cutting areas	charate areas	surface scatter followed by light raking or tillage	enhanced germination of seeds of fire-adapted species
Seeds	widespread native species	shrubs and non-HMP herbaceous species	common species seeding areas	surface scatter followed by light tillage; seed drill, etc.	enhancement of native species seed bank
	HMP species	Monterey gilia and spineflower, seaside bird's-beak	focus species habitat	surface scatter in target microsites followed by light raking or tillage	enhancement of focus species seed bank
Container plantings	widespread native species	shrubs and non-HMP herbaceous species	common species planting areas	planting holes matching depth of container, container plant placement, soil backfilling, watering in	chaparral vegetation establishment
	HMP focus species	Monterey gilia	focus species habitat		focus species establishment

Table 9
Soil and Topography Remediation Success Criteria
IAR MRA Habitat Restoration Plan
FORA ESCA RP

Restoration Strategy	Success Criterion	Evaluation Method/Procedure	Monitoring Frequency
Soil decompaction on trails and roads	match soil texture and structure to that of nearby native soils	linear measurements via GIS of trails and roads requiring restoration	at end of construction activities prior to restoration
		comparison of samples every 0.25 mile with nearby native soils	after completion of de-compaction efforts
Remove constructed berm in Range 47and restore to pre-existing conditions	match original topography as closely as possible	comparison with 1964 aerial image for reference	at end of construction activities prior to remediation
		ground-level photographic imagery before and after remediation	after completion of re-contouring
Topsoil and subsoil placement in Range 47 Subarea A	6-inch topsoil improvement on 80% of exposed dune hill in Range 47 Subarea A	comparison with 1964 aerial image for reference	at end of construction activities prior to remediation
		volume calculations	during re-contouring
		document soil placement in specified manner	during re-contouring
		ground-level photographic imagery before and after remediation	after completion of re-contouring

Table 10
Plant Species Diversity and Vegetation-based Success Criteria
IAR MRA Habitat Restoration Plan
FORA ESCA RP

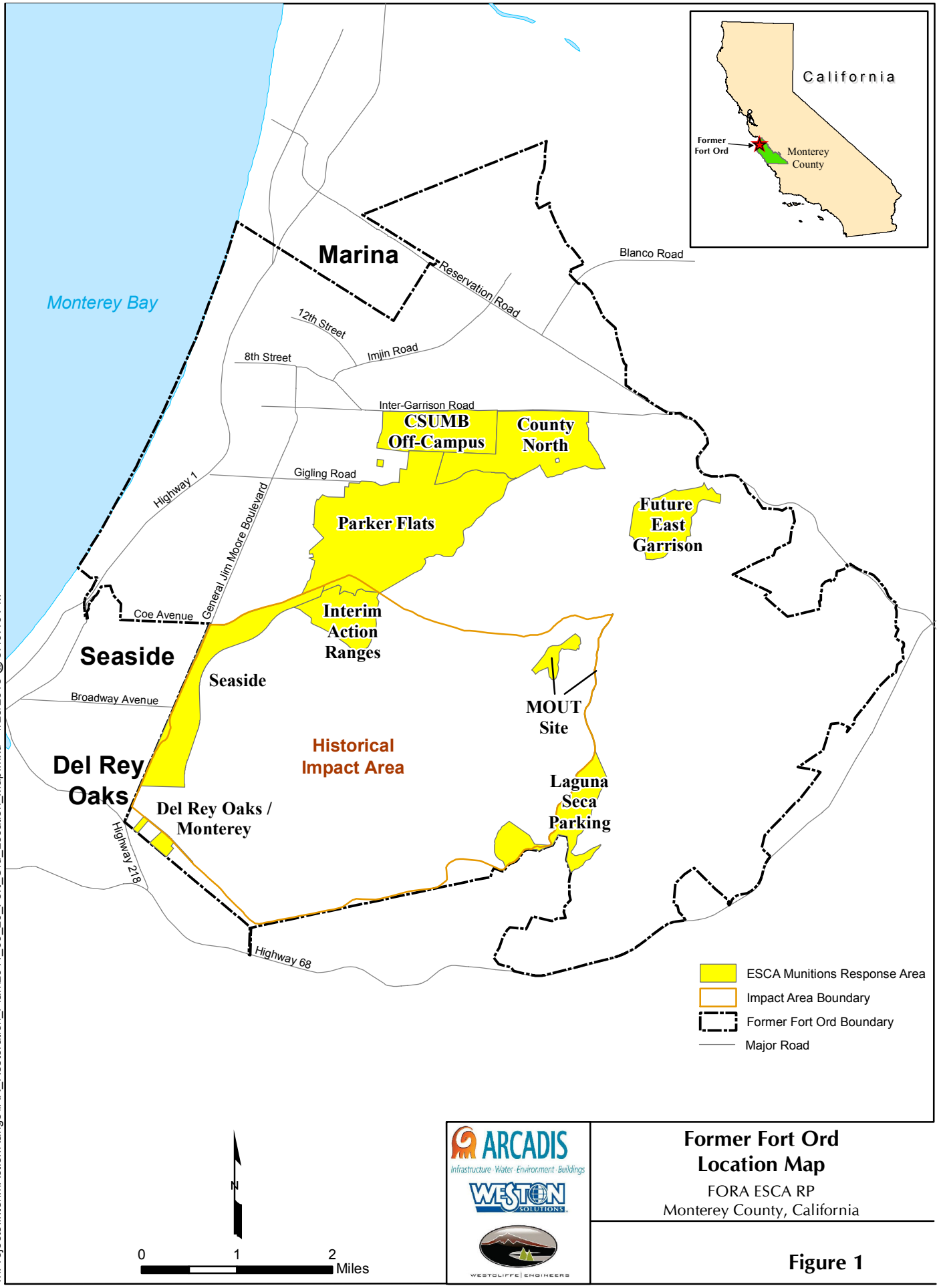
Activity Category	Location	Total Area (acres)	Restoration Strategy	Performance Category	Performance Metric	Performance Target for Post-installation by Year							Baseline for Comparison
						1	2	3	4	5	6	7	
Ingress/egress routes (Activity A)	All ingress/ egress routes	5.5	Monitoring only	Monterey spineflower presence	% focus species baseline	100	70	60	50	30	20	10	2010-2012 unpublished monitoring data
				Monterey gilia presence	% focus species baseline	100	50	40	30	20	10	0	
				Pampas grass and French broom recruits	% total area	<5	<5	<5	<5	<5	<5	<5	total area
Above-ground vegetation cutting followed by target-specific excavation (Activity B)	North Range 44 SCAs, South Range 44 SCAs and Central Area NCAs, Range 47 SCA Subarea C	12.3	Monitoring only	Non-HMP shrub species richness (max. value = 14)	% IAR-wide baseline by area	21	28	36	43	50	57	64	Tables 2 and 3 of this HRP
				HMP shrub species richness (max. value =3)	% IAR-wide baseline by area	0	0	33	33	33	66	66	
				HMP shrub species frequency	% frequency of HMP shrub species	0	5	5	10	15	20	20	
				Native vegetation cover	% cover by location	0	5	10	20	25	30	50	
				Monterey spineflower presence	% focus species baseline	100	70	60	50	30	20	10	2012 baseline monitoring plots
				Monterey gilia presence	% focus species baseline	100	50	40	30	20	10	0	
				Seaside bird's beak presence	% focus species baseline	10	10	5	5	5	5	5	
				Pampas grass and French broom recruits	% total area	<5	<5	<5	<5	<5	<5	<5	total area
Small-scale soil excavation (Activity C)	North Range 44 SCAs, South Range 44 SCAs and Central Area NCAs, Range 47 SCA Subarea C	2.7	Passive (seeding)	Non-HMP shrub species richness (max. value = 14)	% of Total Present	14	21	28	36	43	50	50	Tables 2 and 3 of this HRP
				HMP shrub species richness (max. value =3)	% of total present	0	0	33	33	33	66	66	
				Native vegetation cover	% cover by location	0	5	10	20	25	30	50	
				Monterey spineflower presence	% focus species baseline	100	30	10	0	0	0	0	2012 baseline monitoring plots
				Monterey gilia presence	% focus species baseline	100	20	10	0	0	0	0	
				Seaside bird's beak presence	% focus species baseline	0	0	0	5	5	5	5	
				Pampas grass, iceplant, and French broom recruits	% total area	<5	<5	<5	<5	<5	<5	<5	total area
	Grassland grid cell in South Range 44 SCA	0.2	Passive (seeding)	Total Species Richness	% baseline	10	20	30	40	45	50	50	Grassland Reference Site - 2010/2011 unpublished
				Native vegetation cover	% cover	8	12	20	25	30	35	40	Grassland Reference Site - 2010/2011 unpublished
				Monterey spineflower presence	% focus species baseline	100	50	30	10	10	10	10	2012 baseline monitoring plots
				Pampas grass, iceplant, and French broom recruits	% total area	<5	<5	<5	<5	<5	<5	<5	total area

Table 10
Plant Species Diversity and Vegetation-based Success Criteria
IAR MRA Habitat Restoration Plan
FORA ESCA RP

Activity Category	Location	Total Area (acres)	Restoration Strategy	Performance Category	Performance Metric	Performance Target for Post-installation by Year							Baseline for Comparison
						1	2	3	4	5	6	7	
Large-scale soil excavation (Activity D)	Range 47 Subarea A (low recruitment area)	1.3	Passive (seeding)	Shrub species richness (max. value=10)	% of total present	0	10	10	10	20	20	30	Tables 2 and 3 in this HRP
				Native vegetation cover	% cover by location	0	1	2	4	6	8	10	
				Monterey spineflower presence	% focus species baseline	0	0	30	10	10	10	10	2012 baseline monitoring plots
				Pampas grass, iceplant, and French broom recruits	% total area	<5	<5	<5	<5	<5	<5	<5	total area
	Range 47 Subarea B	12.1	Active (container planting and seeding)	Container plant survival	% total planted	0	60	60	60	50	50	50	Tables 2 and 3 in this HRP
				Non-HMP shrub species richness (max. value = 8)	% of total present	0	25	37	49	61	74	86	
				HMP shrub species richness (max. value = 2)	% of total present	0	0	50	50	50	100	100	
				HMP shrub species frequency	% frequency of HMP shrub species in IAR-wide baseline	0	5	5	10	15	20	20	
				Native vegetation cover	% cover by location	0	5	15	20	25	30	50	
				Monterey spineflower presence	% focus species baseline	100	70	60	50	30	20	10	2012 baseline monitoring plots
				Monterey gilia presence	% focus species baseline	100	50	40	30	20	10	0	
				Pampas grass, iceplant, and French broom recruits	% total area	<5	<5	<5	<5	<5	<5	<5	total area

Table 11
Restoration Monitoring Summary
IAR MRA Habitat Restoration Plan
FORA ESCA RP

Performance Category	Performance Target (see Table 10)	Evaluation Method/Procedure	Monitoring Frequency
Native species richness (all activities)	native species richness equal to baseline data	visual inspection in each restoration area	6, 12, 18, 24 months, annually thereafter
Native vegetation cover (Activities B, C, and D)	vegetation cover greater or equal to performance target	transect monitoring in each restoration area	annually
HMP shrub species richness (Activities B, C, D); HMP shrub species frequency (Activities B and D)	HMP shrub species establishment greater or equal to performance targets in designated locations	transect monitoring in each location; if no individuals occur in transects, # individuals counted in surrounding restoration area	annually
Monterey spineflower presence and density in targeted plots (all activities)	Monterey spineflower present in targeted number of grid cells in designated locations	density within targeted monitoring plots in designated areas	annually
Monterey gilia presence and density in targeted plots (all activities)	Monterey gilia present in targeted number of grid cells in designated locations	density within targeted monitoring plots in designated areas	annually
Seaside bird's beak presence and density in targeted plots (Activity C)	Seaside bird's beak present in targeted number of grid cells in designated locations	density within targeted monitoring plots in designated areas	annually
Container plant survival (Activity D)	planting survival by year in designated locations	stratified census by species and location	6, 12,18, 24 months and annually thereafter
Target weed cover (all activitites)	< 5% absolute cover	visual inspection in each restoration area; annual transect monitoring in each restoration area	6, 12, 18, 24 months, annually thereafter



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Former Fort Ord Location Map

FORA ESCA RP
Monterey County, California

Figure 1

EUCALYPTUS ROAD (WEST)

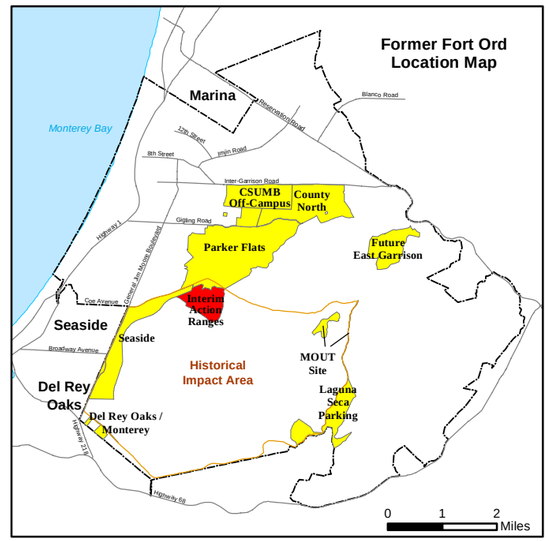
EUCALYPTUS ROAD (EAST)

2 km

Legend

- Grassland
- Maritime Chaparral
- Special Case Areas (SCAs) and Non-Completed Areas (NCAs)
- California Tiger Salamander Buffer
- Munitions Response Area
- Major Road
- HA-44 Remediation Area (U.S. Army Action)

Source: Flora and Fauna Baseline Study of Fort Ord, California, Jones and Stokes Association Inc., December 1992. Grassland in IAR MRA designated by ESCA RP, Unpublished, 2010.



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Interim Action Ranges MRA Vegetation Types

FORA ESCA RP
Monterey County, California

Figure 2

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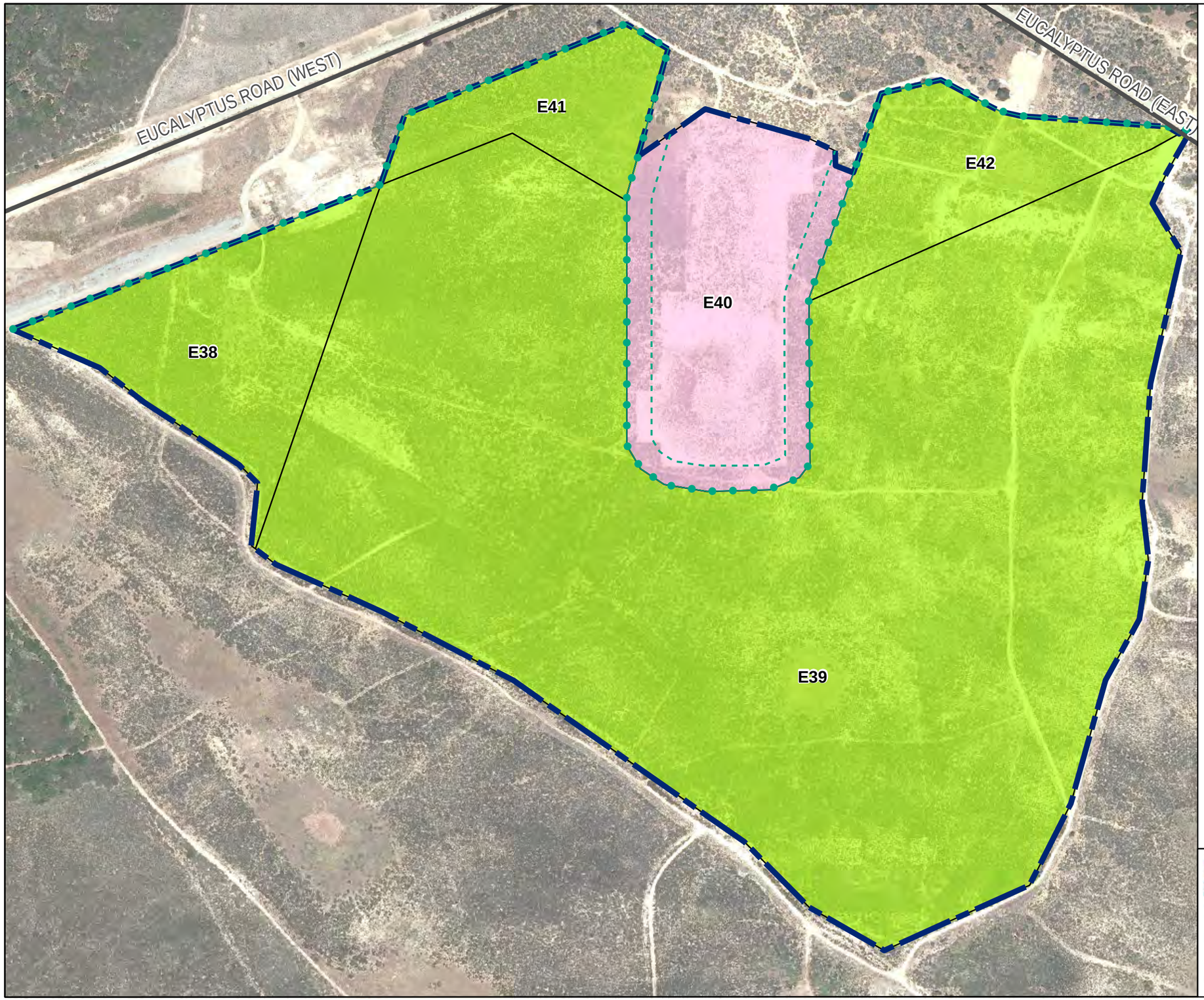
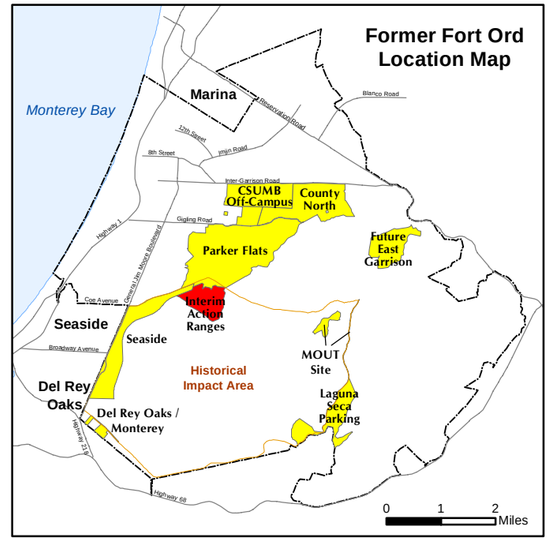


Legend

- Munitions Response Area
- Major Road
- E40 — USACE Parcel

Proposed Future Land Use

- Non-Residential
- Habitat Reserve
- Borderland Interface
- 100-Foot Buffer from Borderland Interface



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Interim Action Ranges MRA
Proposed Future Land Use

FORA ESCA RP
Monterey County, California

Figure 3

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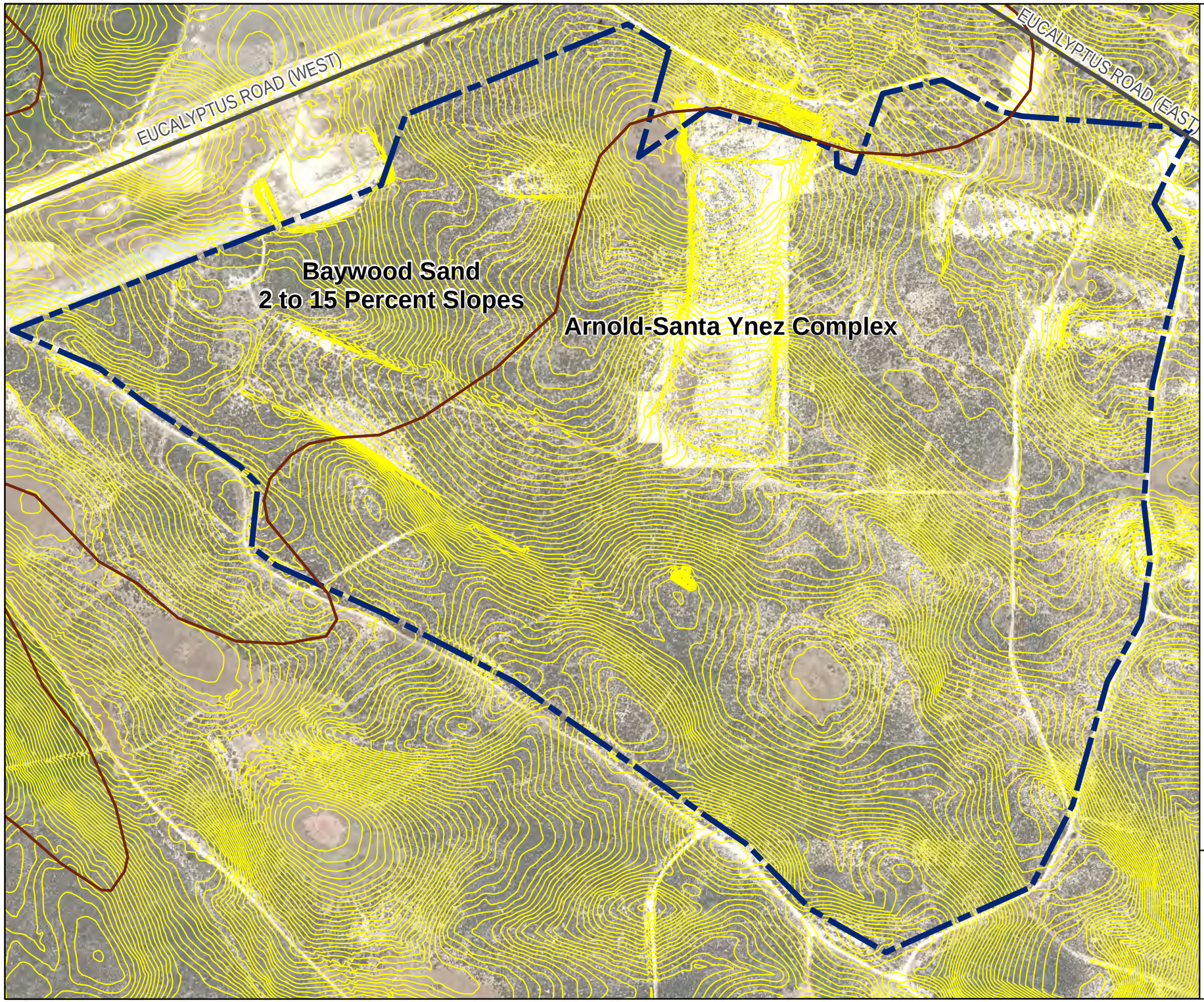
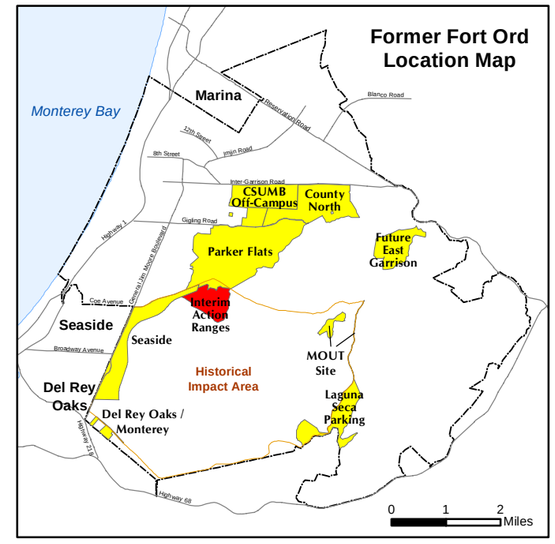


Legend

- 2-Foot Topography
- Soil Type Boundary
- Munitions Response Area
- Major Road



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Interim Action Ranges MRA
2-Foot Topography and Soil Types

FORA ESCA RP
Monterey County, California

Figure 4

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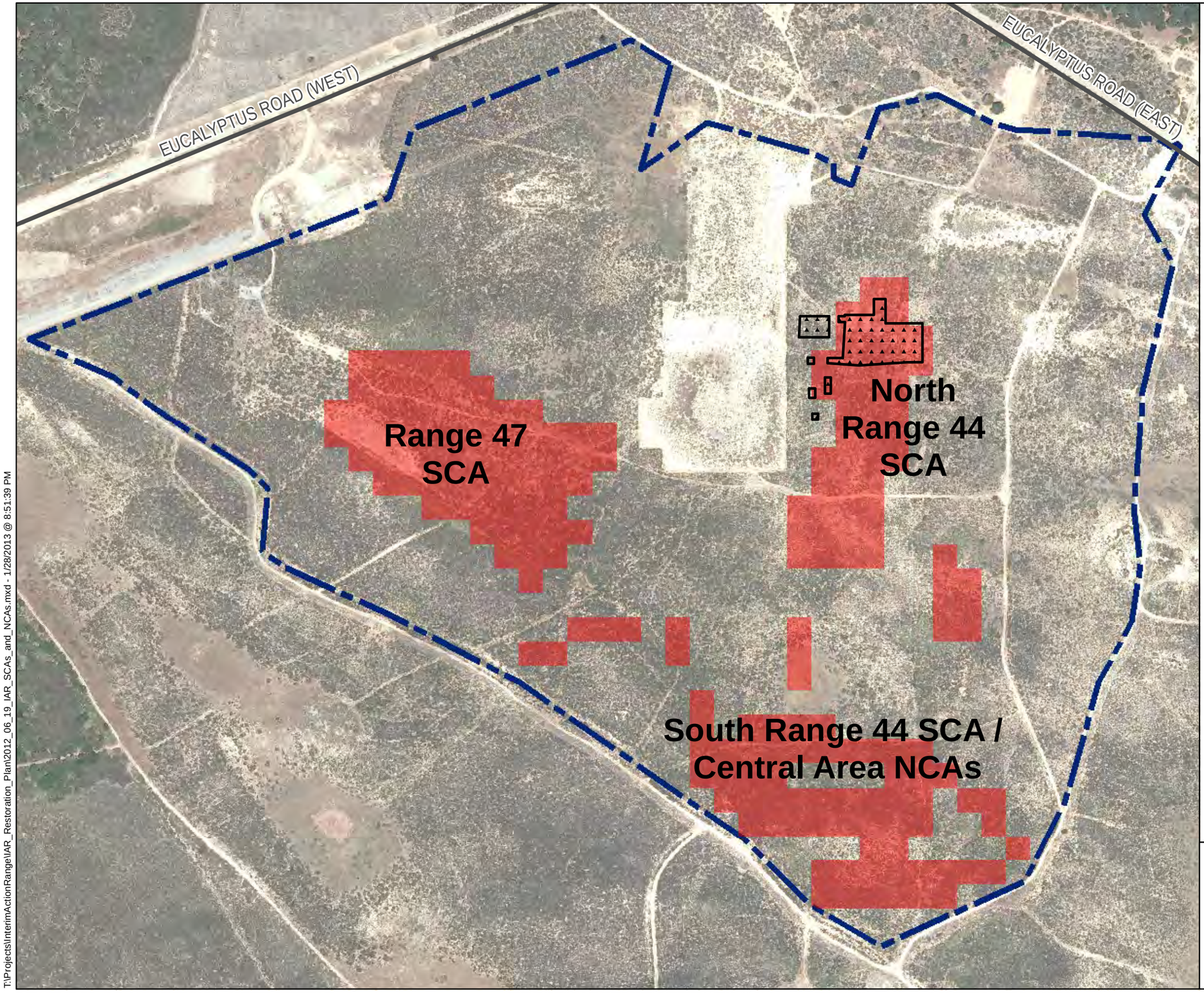
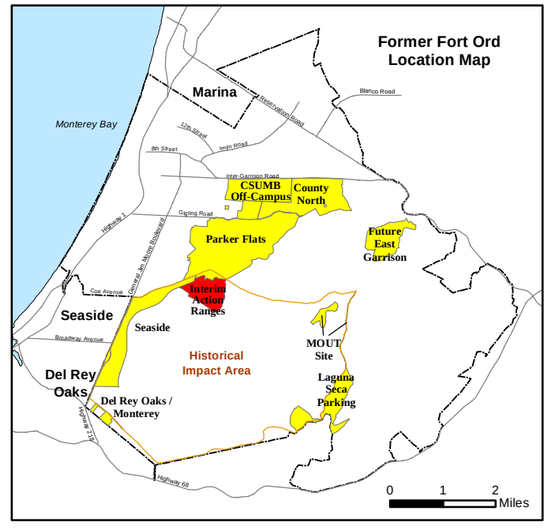


Legend

- Special Case Areas (SCAs) and Non-Completed Areas (NCAs)
- HA-44 Remediation Area (U.S. Army Action)
- Munitions Response Area
- Major Road



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Interim Action Ranges MRA
Special Case Areas (SCAs) and Non-Completed Areas (NCAs)

FORA ESCA RP
Monterey County, California

Figure 5

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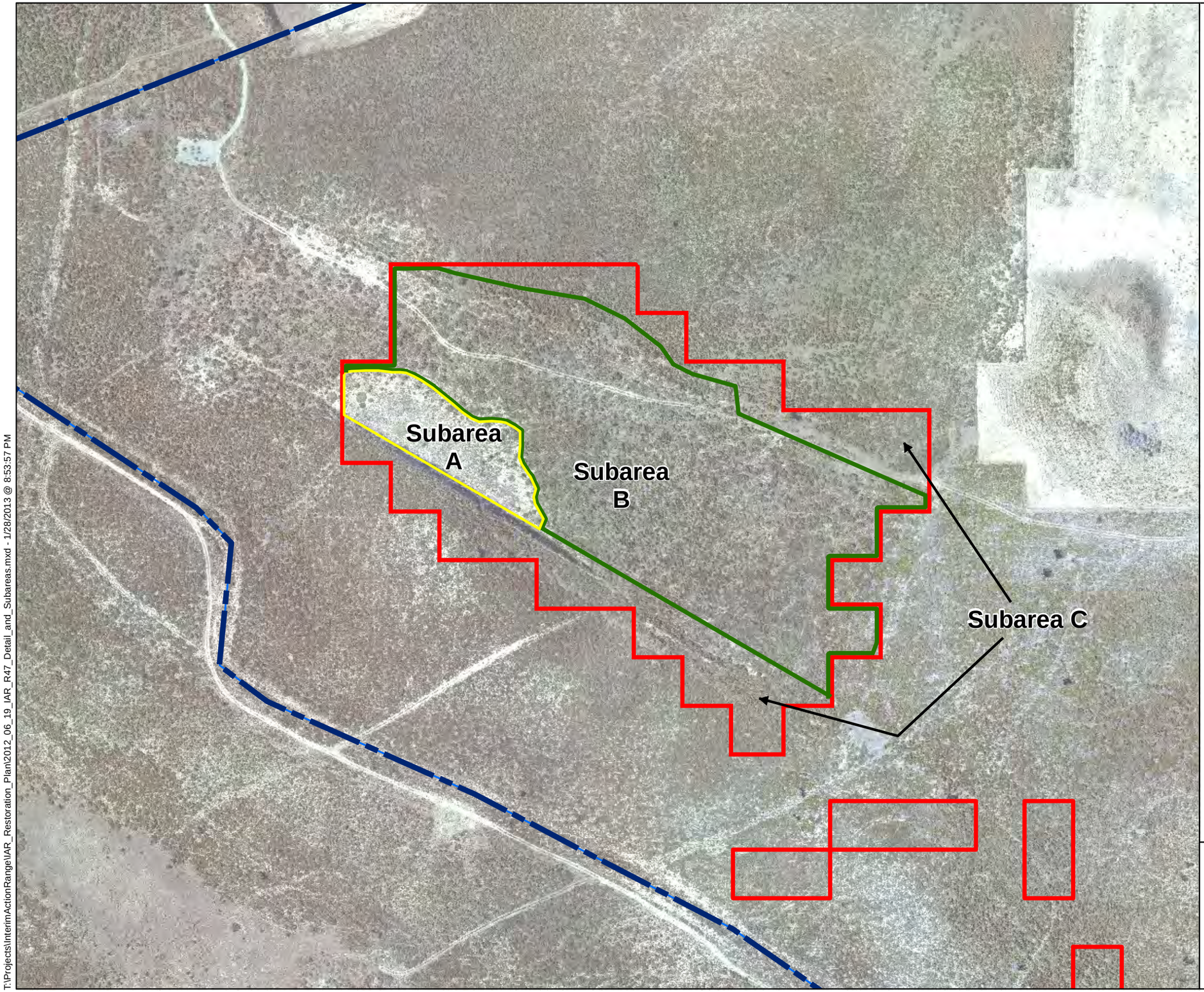
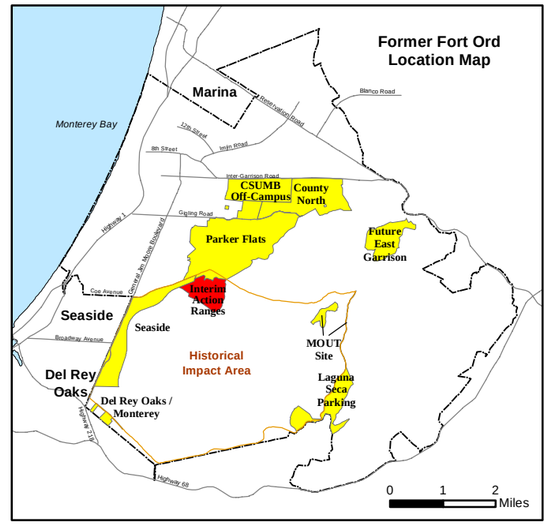
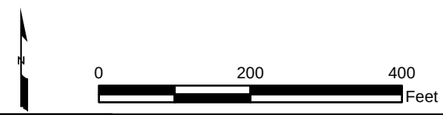


Legend

- Subarea A
- Subarea B
- Special Case Areas (SCAs) and Non-Completed Areas (NCAs)
- Munitions Response Area
- Munitions Response Site





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Interim Action Ranges MRA
Range 47 SCA
Subarea A, Subarea B, and Subarea C
FORA ESCA RP
Monterey County, California

Figure 6

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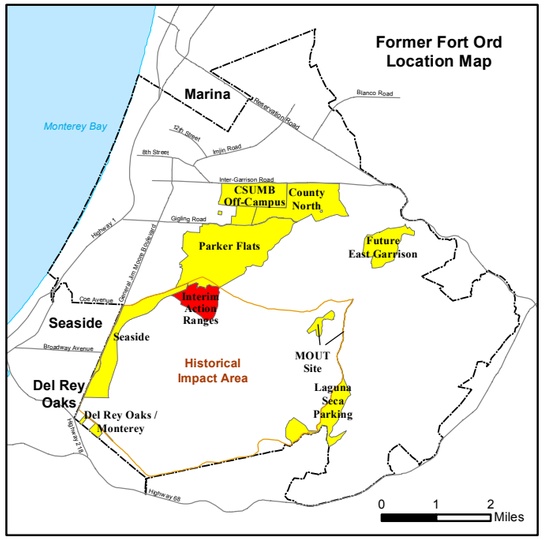
EUCALYPTUS ROAD (WEST)

EUCALYPTUS ROAD (EAST)

Legend

- Range 47 SCA - Subarea C, North Range 44 SCA, South Range 44 SCA, and Central Area NCAs
- Baseline Vegetation Transect for Range 47 SCA - Subarea C, North Range 44 SCA, South Range 44 SCA, and Central Area NCAs
- Range 47 SCA - Subarea A and Subarea B
- Baseline Vegetation Transect for Range 47 SCA - Subarea A and Subarea B
- Grassland
- 1/4-meter^2 Herbaceous Monitoring Plots
- Special Case Areas (SCAs) and Non-Completed Areas (NCAs)
- Munitions Response Area
- Major Road
- HA-44 Remediation Area (U.S. Army Action)



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Interim Action Ranges MRA
Vegatation Baseline Locations

FORA ESCA RP
Monterey County, California

Figure 7

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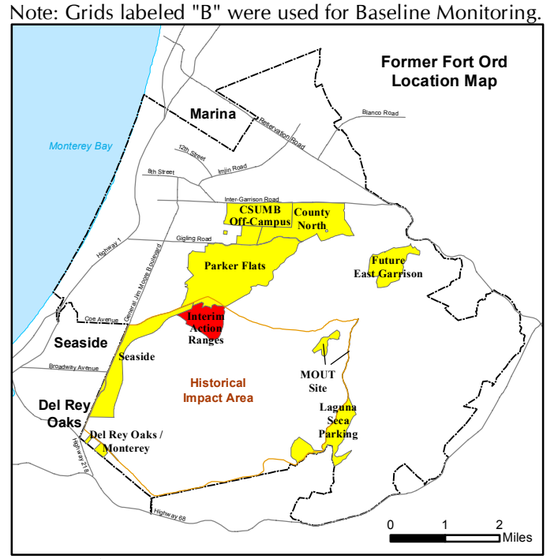
EUCALYPTUS ROAD (WEST)

EUCALYPTUS ROAD (EAST)

Legend

- FSB Grid for Range 47 SCA - Subarea A
- FSB Grid for Range 47 SCA - Subarea B
- FSB Grid for Range 47 SCA - Subarea C
- FSB Grid for North Range 44 SCA, South Range 44 SCA, and Central Area NCAs
- FSB Grid for Ingress/Egress
- FSB Grid for Grassland
- Range 47 SCA - Subarea A
- Range 47 SCA - Subarea B
- Range 47 SCA - Subarea C
- North Range 44 SCA, South Range 44 SCA, and Central Area NCAs
- Ingress/Egress FSB Monitoring Area
- Grassland
- Work Area Access Corridors/Roads
- SCA and NCA areas
- Munitions Response Area
- HA-44 Remediation Area (U.S. Army Action)

Note: Grids labeled "B" were used for Baseline Monitoring.



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Interim Action Ranges MRA Focus Species Baseline (FSB) Locations

FORA ESCA RP
Monterey County, California

Figure 8

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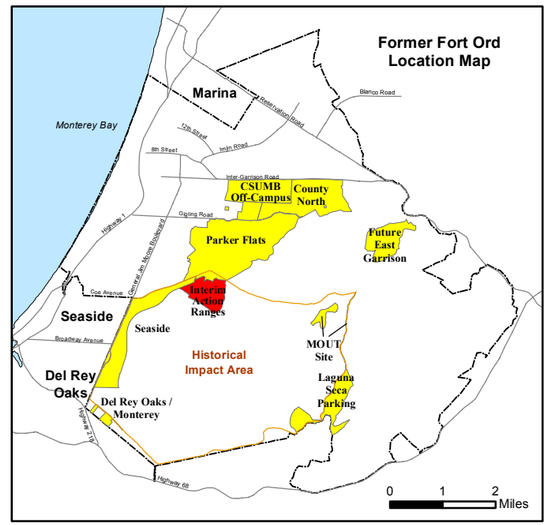
EUCALYPTUS ROAD (WEST)

EUCALYPTUS ROAD (EAST)

MRS-Ranges 44-48

Legend

- Ingress/Egress Routes - Activity A
- Above-Ground Vegetation Cutting and Target-Specific Excavation - Activity B
- 10-Foot Wide Strips (Above-Ground Vegetation Cutting and Target-Specific Excavation in Design Study Transects) - Activity B
- Small-Scale Soil Excavation - Acivity C
- Large-Scale Soil Excavation - Activity D
- Munitions Response Area
- Munitions Response Site
- Major Road
- Development Parcel Boundary
- HA-44 Remediation Area (U.S. Army Action)



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Interim Action Ranges MRA Activity Types

FORA ESCA RP
Monterey County, California

Figure 9

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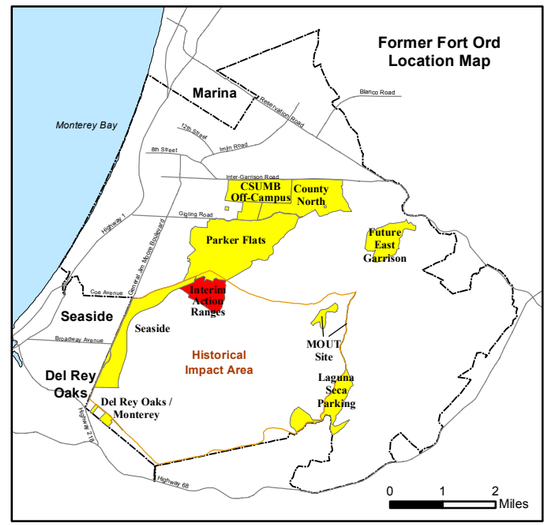
EUCALYPTUS ROAD (WEST)

EUCALYPTUS ROAD (EAST)

MRS-Ranges 44-48

Legend

- Monitoring Only
- Monitoring Only
- Monitoring Only
- Seeding
- Seeding and Container Planting
- Munitions Response Area
- Munitions Response Site
- Major Road
- Development Parcel Boundary
- HA-44 Remediation Area (U.S. Army Action)



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Interim Action Ranges MRA Restoration Strategies

FORA ESCA RP
Monterey County, California

Figure 10

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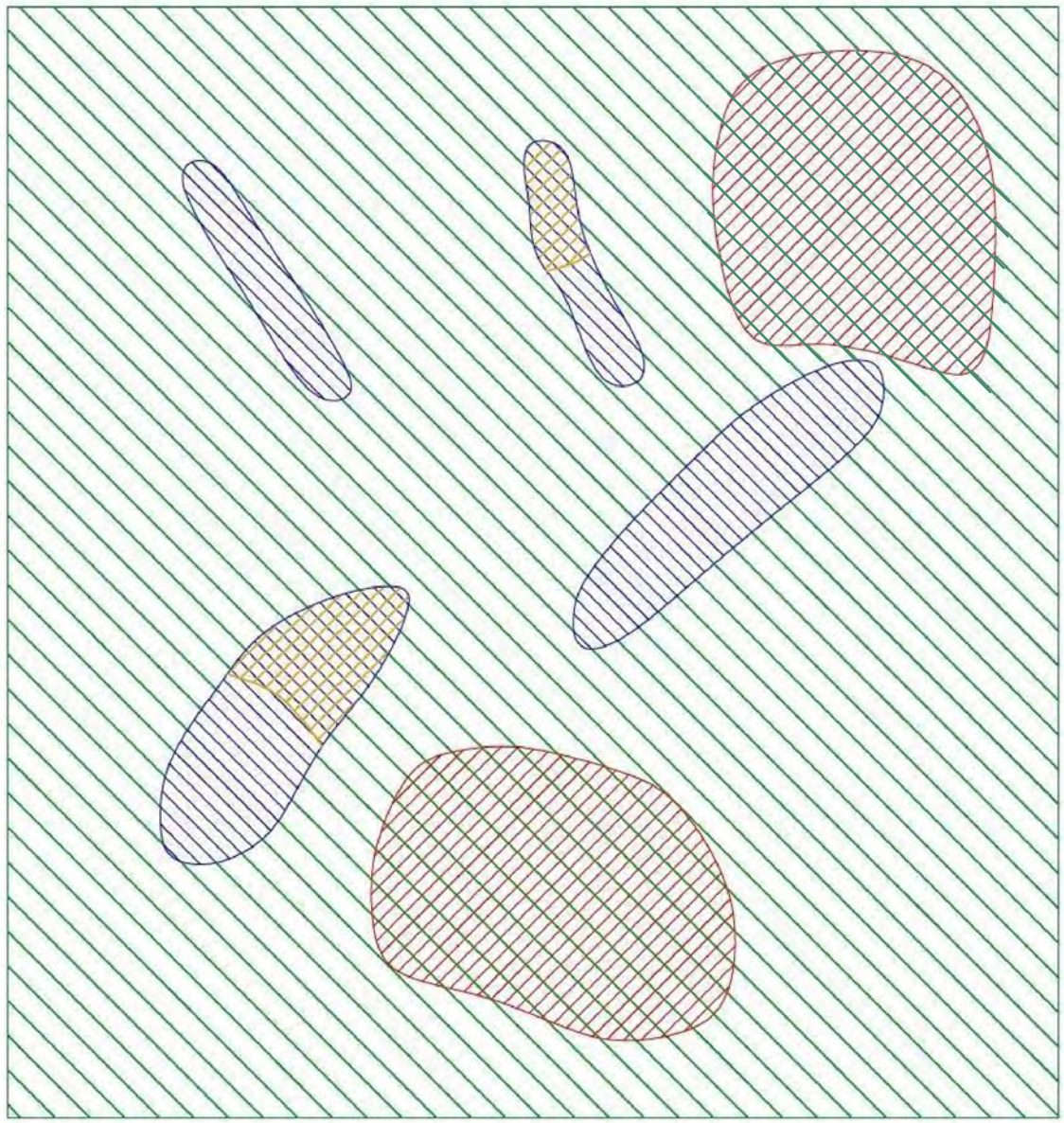

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Interim Action Ranges MRA
Generalized Restoration Concept Plan for Range 47 SCA Planting Areas

FORA ESCA RP
Monterey County, California

Figure 11

APPENDIX A

Literature Review on Ecological Factors Relevant to Restoration

FORA ESCA REMEDIATION PROGRAM

Draft Final

Appendix A. Literature Review of Ecological Factors Relevant to Restoration

Phase II Interim Action Work Plan Addendum
Habitat Restoration Plan
Interim Action Ranges Munitions Response Area

Former Fort Ord
Monterey County, California

February 1, 2013

Prepared for:

FORT ORD REUSE AUTHORITY

920 2nd Avenue, Suite A
Marina, California 93933

Prepared Under:

Environmental Services Cooperative Agreement
No. W9128F-07-2-01621
and
FORA Remediation Services Agreement (3/30/07)

Document Control Number: 09595-10-086-012

Prepared by:

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CONTENTS

FIGURE

ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

BLM	Bureau of Land Management
ENSO	El Nino-Southern Oscillation
ESA	Endangered Species Act
ESCA	Environmental Services Cooperative Agreement
FORA	Fort Ord Reuse Authority
HMP	Habitat Management Plan
HRP	Habitat Restoration Plan
IAR	Interim Action Ranges
MEC	munitions and explosives of concern
MRA	Munitions Response Area
RP	Remediation Program
SCA	Special Case Area
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

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1.0 INTRODUCTION

Virtually all of the sites to be restored under the Interim Action Ranges (IAR) Munitions Response Area (MRA) Habitat Restoration Plan (HRP) were occupied by central maritime chaparral prior to disturbance. Outcomes of restoration are optimized when restoration strategies and procedures facilitate the natural vegetative development and ecological processes of the community to be restored, while avoiding or minimizing conditions that retard it. This appendix provides a more in-depth summary of relevant literature that was reviewed on these subjects than that included in the main HRP text. Each section includes a discussion of the literature, followed by a synopsis of the findings that are relevant to the IAR MRA HRP.

2.0 PHYSICAL FACTORS

2.1 Topographic Heterogeneity

Topographic heterogeneity (on both macro- and micro-scales) is characteristic of natural ecological systems such as dunes and is considered to contribute to biological diversity (Larkin et al. 2006). Topography influences other site conditions such as soil moisture, detritus accumulation, seed trapping, etc., that characterize various species' "niches." Soil surface "roughness" mitigates erosion by retarding sheet flow in newly backfilled restoration sites (Law 1984). Elements used in restoration sites to increase topographic heterogeneity have included mounds, pits, furrows, catchments, and vegetative debris (e.g., branch piles).

Relevant Findings: Topographic elements should be incorporated into habitat restoration in order to facilitate re-establishment of species populations, biodiversity, and recovery of healthy maritime chaparral vegetation at the sites. These elements may include:

- re-contouring to re-establish the natural pre-existing site topography
- matching adjacent topography at the site boundaries ("smoothing")
- cross-slope contouring and terracing
- creation of topographic microhabitats

2.2 Edaphic (Soil) Factors

According to U.S. Army Corps of Engineers (USACE), soils at former Fort Ord are medium-grained sands of low organic content, low in fertility and water-holding capacity, highly erodible, and excessively well drained (USACE 1992). The western edge of the Range 47 Special Case Area (SCA) was mapped as Baywood Series soil, with a surface layer about 21 inches thick. Erosion potential is slight to moderate because of rapid permeability and the effective rooting depth is greater than 60 inches. The remainder of the Range 47 SCA and the other IAR MRA restoration sites were mapped as Arnold Series soil, which in the IAR MRA area is similar to the Baywood Series. Arnold Series has a surface layer of loamy sand about

8 inches thick. Erosion potential is slight to moderate because of rapid permeability except on steep slopes and the effective rooting depth is greater than 60 inches.

2.2.1 Moisture

Most upland native vegetation in California is adapted to a "Mediterranean-type" climate wherein virtually all rainfall occurs in the winter wet season, predominantly from October through March (Major 1988). Soils gradually desiccate following the last rain event and the summer to fall period prior to the first rain event of the fall season is referred to as the "summer drought" period. Poole and Miller (1975) reported that chaparral soils in southern California were depleted of moisture during the summer drought period, when chaparral plants exhibited very low water potential. Plants adapted to this condition by reducing transpiration rates and other metabolic changes. However, the severity of drought conditions (as well as aspect differences) was attenuated near the coast. Keeley (1992a) speculated that seedling recruitment in the absence of fire may be strongly influenced by drought tolerance. Low soil moisture and plant stress during the summer drought period should be substantially mitigated in the IAR MRA because the site is within the local summer fog belt (see discussion below). Soils in the IAR MRA restoration sites are highly permeable and drain rapidly (USACE 1992).

Within the same landscape, chaparral tends to occur in more mesic conditions than the more xeric conditions where coastal sage scrub typically occurs (Mooney 1988, Harrison et al. 1971). Factors influencing these conditions are local rainfall, slope and aspect, and edaphic properties. However, the relationship between these two vegetation types is complex at times because coastal sage scrub can be both pre-climax and successional to chaparral (Mooney 1988, Cooper 1922). Nevertheless, mature chaparral stands have been shown to be more tolerant of low moisture periods because they develop deeper and more extensive root systems than coastal sage scrub (Harrison et al. 1971) and because they are able to attain and survive lower water potentials (Jacobsen et al. 2010). Soil moisture content triggers growth in chaparral species as described in the section on phenology. Post-fire seedlings of chaparral may experience high mortality during the first summer dry period (Kummerow et al. 1985).

In Monterey gilia (*Gilia tenuiflora* ssp. *arenaria*), Dorrell-Canepa (1994, as sand gilia) reported that greenhouse germination of seeds was almost 100 percent, compared with 6-15 percent of seed sown in dunes. She attributed the low field germination rates to variability in rainfall. U.S. Fish and Wildlife Service (USFWS) reported that the presence of the species on microhabitats that are more xeric (i.e., south aspect) has been observed only in wetter years (USFWS 1998). Bainbridge et al. (1995) recommended sprinkler irrigation for restoration of annuals in arid regions.

Seeding success in restoration projects is particularly susceptible to drought conditions. Burkhart (1988) stated that mature-phase species are particularly susceptible to high mortality unless irrigated during their initial growth period. As Cione et al. (2002) demonstrated in a southern California coastal sage scrub community, in good rainfall years a seeding approach was successful; however, in poor rainfall years, there was complete failure. Similar survivorship results could be anticipated for outplants.

Burkhart (1988) recommended irrigation during the fall planting period to augment the highly variable rainfall that may occur during that season in California. Irrigation can enhance the successful establishment of native species during periods of low and unpredictable natural rainfall, but may also foster establishment of invasive weedy species (Padgett et. al 2000).

Discussion of the relationship between rainfall and population size of Monterey gilia (also known as sand gilia), Monterey spineflower (*Chorizanthe pungens* var. *pungens*), and seaside bird's-beak (*Cordylanthus rigidis* spp. *littoralis)* during the period from 2000 to 2008 was presented in the 2008 Vegetation Monitoring Report for the Interim Action Ranges MRA (ESCA RP 2009, Appendix C). Annual rainfall totals in the former Fort Ord area ranged from approximately 10- to 25 inches per year. Distribution of rainfall within a water year (which was defined in the report as the period from October 1 of the preceding year through September 30 of the current year) varied markedly from year to year. Abundant rainfall occurred in as few as one or as many as three months per water year. Rainfall amounts greater than 0.5 inches per month were typically recorded from November through March; however, in 2005 (the wettest year during the period) at least 0.5 inches per month was recorded from October through May.

Parsons (2005) speculated that Monterey spineflower "may depend less on rainfall for germination than either sand gilia or seaside bird's-beak," an idea supported by Fox et al. (2006). Fox et al. (2006) also suggested that the species population declines with the passage of time since the most recent El Nino-Southern Oscillation (ENSO) heavy rainfall season. Such events have occurred in the following recent rain seasons: 1997-1998, 2002-2003, 2004-2005, and 2006-2007. The IAR MRA monitoring data are consistent with the hypothesis of Fox et al. (2006): the 2005 population estimate (immediately after an ENSO event) was greater than the 2004 estimate (over a year after the previous ENSO; Parsons 2005).

Cowan (2005) reported that coastal fog in the Fort Ord area is common, especially during summer months (i.e., the season when precipitation is absent), which may mitigate water stress during this period. Adaptation to these site-specific coastal fog conditions may also indicate that the maritime chaparral community of the IAR MRA is less susceptible to plant disease that might be facilitated by overhead irrigation. Furthermore, irrigating consistent with an extended wet season may not adversely affect the plant community. .

Maintaining adequate soil moisture is also important when nutrient amendment (i.e., slow-release fertilizer) is added during planting (Burkhart 1988).

Relevant Findings: Annual rainfall totals in the former Fort Ord area ranged from approximately 10 to 25 inches per year from 2000 to 2008. Distribution of rainfall within a water year (October 1 to September 30) varied markedly from year to year, Abundant rainfall occurred in as few as one or as many as three months per water year. Rainfall amounts greater than 0.5 inches per month were typically recorded from November through March; however, in 2005 (the wettest year during the period) 0.5 inches per month were recorded from October through May. The IAR MRA is exposed to extensive coastal fog in summer. Chaparral populations occurring in the area experience wet foliage and high humidity under natural conditions in summer months when there is no rainfall. Risk of restoration failure (of

both seeds and installed plants) is substantial owing to the erratic rainfall pattern and summer drought periods.

Augmentation of natural rainfall by irrigation is recommended. Irrigation may benefit restoration by reducing mortality, increasing germination, facilitating annual plant production, encouraging robust development of perennials and shrubs, encouraging deep root development of shrub species, and enhancing the effects of soil amendments. Adverse effects of irrigation may include inappropriate root development and facilitation of weed populations. Careful management of irrigation can minimize these adverse effects. Increased risk of plant disease from moist conditions resulting from overhead irrigation may be minimal because the site is located in the summer coastal fog belt. Thus, the wet season and summer fog conditions naturally expose local populations to high humidity and wet foliage periodically throughout the year.

2.2.2 Nutrients

Gray (1983) reported that mature plants of chaparral species may be relatively nutrient "conservative" and less susceptible to nutrient deficiency than coastal sage scrub species. Gray and Schlesinger (1983) determined that growth of chaparral seedlings was "uncoupled" from nitrogen availability. Schlesinger and Hasey (1981) reported that litter decomposition in chaparral may be a substantial source of plant nutrients.

Soils in the IAR MRA restoration sites are low in fertility (USACE 1992), which may inhibit weed competition (see Section 3.6.3). Some studies of fire effects in chaparral have shown that nutrient cycling may be an important factor in ecosystem processes. Growth and survival of many chaparral species is thought to benefit greatly from increased nutrient levels derived from ash after fire and nutrient application may enhance restoration success (ESNERR 2003). DeBano and Conrad (1978) reported that fire events returned some but not all nutrients to the soil and they concluded that nitrogen-fixing micro-organisms are responsible for maintaining nitrogen availability in soil over the long-term in chaparral communities. The IAR MRA restoration site will not experience fire effects so nutrient input from this process will not occur. Burkhart (1988) recommended adding slow-release fertilizer in the soil immediately around and below planted stock.

Miller (1984) stated that soil disturbance (including stockpiling) disrupts nutrient cycling and alters soil nutrient and carbon compartments, which may adversely affect plant restoration efforts. Alteration of soil properties as a result of mechanical disturbance such as excavation can result in increases in availability of plant nutrients (St. John 1988). Zink and Allen (1995), St. John (1988), and Bainbridge et al. (1995) suggested that increased nutrients facilitate competition between natives and exotics.

Relevant Findings: Soils in the IAR MRA are low in nutrients. Temporarily increased nutrients in soil is a natural consequence of fire events in chaparral and plant community regeneration is thought to be adapted to this nutrient resource. Mechanical soil disturbance may also increase nutrient availability. However, increased competition by exotics may result from increased nutrients. Therefore, nutrient amendment of the excavated soil sites (i.e., fertilizer application) should be carefully evaluated and, if implemented at all, should be

limited to the immediate vicinity of container plants to encourage (deep) root growth while avoiding enhancement of exotic plant growth. It is important to include in the plant palette nitrogen-fixing symbionts to rapidly replenish soil nitrogen.

2.2.3 Physical Structure

Mechanical soil disturbance (including decompaction as a result of excavation) can alter a number of soil properties: aeration, rates of organic matter decomposition, nutrient availability, and micro-organism composition (St. John 1988). Increased aeration stimulates breakdown of organic matter. Nutrient and micro-organism effects are described in Sections 2.2.2 and 2.2.4, respectively.

Soil compaction may adversely affect re-establishment of plants in restoration sites and care must be taken to avoid and/or mitigate compaction from pre-existing conditions as well as from heavy equipment use during backfill operations (Bainbridge et al. 1995, Law 1984). The effects of soil compaction are also evident in vegetation patterns (e.g., track traces observed in aerial images of arid habitats [Bainbridge 2007]). Trails, unimproved roads, and other compacted areas in the IAR MRA often remain as open areas with limited re-colonization by shrub species. On the other hand, such areas are considered by some to be important microhabitats for opportunistic ephemeral federal Endangered Species Act (ESA)-listed species (e.g., Monterey spineflower, see Section 2.3 of this report).

Stockpiling of topsoil for more than 1 to 2 months has been shown to adversely affect the rate of plant community development and possibly the recruitment of late-seral stage species at restoration sites (Bainbridge et al. 1995, Jastrow 1984, Miller 1984). These effects are thought to be attributable to alteration of soil dynamics and degradation of soil properties under stockpile conditions (see Section 2.2.4).

Relevant Findings: Soil modification as a result of excavation may alter soil properties and have adverse effects on restoration processes. Backfilled soil properties should be evaluated and adverse effects should be mitigated. Excessive soil compaction can inhibit or modify vegetation development in arid regions, but on former Fort Ord compacted trails and unimproved roads are considered as important microhabitats for ESA-listed species. Steps should be taken to minimize and/or eliminate soil compaction to the extent feasible before seeding and planting in restoration sites. Stockpiled topsoil should be evaluated to determine the need for amendment during or after backfilling.

2.2.4 Microbiological Community

The microbiological community of soil may contain pathogens as well as beneficial organisms. Beneficial organisms may enhance soil physical structure, facilitate nutrient uptake by plants, and/or establish symbiotic relationships with plant roots (i.e., mychorrizae). Soils in the IAR MRA restoration sites are low in organic content (USACE 1992); therefore, the microbial community is likely relatively depauperate. St. John (1988) stated that mychorrizal organisms are exclusively dependent on their hosts and that when host root systems are destroyed (i.e., by soil excavation), mychorrizal symbionts also are lost from the soil. Miller (1984) stated that soil disturbance (including stockpiling) alters soil conditions,

which adversely affects mycorrhizal composition and abundance as well as soil algae, which are important in desert ecosystems. Ruotsalainen et al. (2009) concluded that ectomycorrhizal community diversity declined with increased abiotic stress, which correlated with reduced plant condition. Bainbridge (2007) indicated that disturbed soils (including stockpiled topsoil) experience substantial diminution of mychorrizal species especially when organic matter is not retained and/or the soil is exposed to adverse conditions in stockpiles. Plant restoration may be substantially impeded if suitable mychorrizal species are not present in the soil (Bainbridge 2007).

Relevant Findings: Native topsoil contains important plant recruitment (i.e., seedling survival) and plant growth factors (i.e., nutrients, organic matter, beneficial micro-organisms, etc.) and should be replaced at restoration sites wherever possible. Replacement of topsoil and addition of plant litter in the IAR MRA restoration sites will facilitate restoration success by providing the desired soil conditions and natural microbial inocula to facilitate initial recruitment/survival and growth of plants.

2.2.5 Plant Litter

Plant litter, or detached plant parts that have fallen on the ground, (also referred to as "duff," "mulch," "debris," etc.) is present in most natural plant communities, including chaparral. The organic material provides a number of benefits: soil water loss is reduced, erosion is retarded, seeds may be trapped, and (as a result of decomposition) organic material is added to the soil while encouraging development of soil biota (Law 1984). However, soils in the IAR MRA restoration sites are generally low in organic content (USACE 1992). Litter decomposition in chaparral may be a substantial source of plant nutrients (Schlesinger and Hasey 1981). Keeley (1992b) stated that litter cover may be necessary for seedling recruitment in chaparral. On the other hand, excessive litter may be detrimental because it can reduce or prevent recruitment by seeds.

Gray and Schlesinger (1981) reported that chaparral communities generated more litter than coastal sage scrub. Rokich et al. (2002), in a study of a fire-adapted shrubland in Western Australia with Mediterranean climate and sandy soils, determined that application of a very thin layer of canopy vegetation mulch (5-millimeter layer) after seeding produced optimal or neutral recruitment but did not produce a negative effect.

Thomas Reid Associates (1987) reported that litter accumulation was a feature of Monterey gilia habitats.

Relevant Findings: Plant litter is a natural element in maritime chaparral and should be considered as a surface amendment in restoration sites. Soil litter is correlated with Monterey gilia habitats. Surface application of litter at the restoration site, carefully managed to avoid inhibiting seed germination, will facilitate soil quality, seed trapping, microhabitat creation, and can also function as an erosion mitigation measure.

2.2.6 Allelopathy

Vogl (1982) reported that many chaparral shrubs produce chemicals that accumulate in the soil and inhibit recruitment by other species and such effects may persist for 20 years after the plant that produced them has been eliminated. McPherson and Muller (1969) reported that allelopathy was primarily responsible for absence of herbaceous species in chamise communities. However, Keeley (1984) and Keeley et al. (1985) obtained negative or equivocal results in testing allelopathic effects on seed germination and Keeley and Keeley (1989) concluded that seed dormancy rather than allelopathic effects were responsible for absence of germination in some chaparral species.

Relevant Findings: Allelopathy is a term that refers to chemicals produced by certain chaparral plants that accumulate in the soil and inhibit recruitment by other plants. If allelopathic effects are present, plant development could be inhibited in restoration sites. Allelopathic effects present in the pre-existing IAR MRA topsoil are likely to have been reduced as a result of the physical effects of soil excavation and backfill (e.g., dilution by soil mixing, volatilization, and degradation) and are less likely to have a negative effect on restoration success.

2.2.7 Seed Bank

No studies on seed banks in topsoil at former Fort Ord have been identified. According to USACE (1992), the surface layer of soil in the IAR MRA may range from 8 to 21 inches. Deveny and Fox (2006) observed that Monterey ceanothus (*Ceanothus cuneatus* var. *rigidus*) seeds were present in the top 2 centimeters of soil.

Relevant Findings: Seed banks occur in topsoil and separating topsoil from subsoil is a recommended practice where feasible. The surficial 0 to 12 inch layer is an approximation of the surface layer of soils in the IAR MRA; however, the seed bank may be limited to the upper portion of this horizon.

2.3 Microspatial Factors

Plant ecophysiological responses in restoration sites may be influenced by above-ground, air-soil interface, and below-ground conditions. The relatively simple vertical structure of maritime chaparral vegetation indicates that above-ground conditions are of less importance to restoration success in this community than air-soil interface and below-ground conditions. In this vegetation type, above-ground conditions are likely to be most influential over the entire restoration trajectory. Conditions in the air-soil interface are especially influential during the initial stage of active site restoration, when plant propagules (seeds and installed plants) are re-colonizing and establishing initial populations at the site. The interplay of wind, heating effects, and soil moisture in the shallow root zone is a major determiner of seed germination, plant development, plant condition, and survival (Ehleringer and Sandquist 2006).

USACE (1997) and USFWS (1998) reported that at Fort Ord, Monterey spineflower was observed in firebreaks, along trails and roads, in sandy openings between shrubs, in the

central portion of the firing range, and in areas where military activities resulted in frequent habitat disturbances. The preference of this species for gaps in the vegetation (i.e., bare soil) or sparsely vegetated areas on sandy substrate allows seedlings to establish in areas that are relatively free from other competing native species.

Monterey gilia occurs in specific microhabitat conditions. USFWS (1998) reported that suitable habitat usually has a north, east, or west aspect or, in wet years, even a south aspect. Although USFWS (1998) stated that the species occurs at elevations no higher than 30 meters (98+ feet), it is present in the IAR MRA where elevations range from approximately 370 to 530 feet above mean sea level. The species' preferred substrate is sand with some soil development and litter accumulation (Thomas Reid Associates 1987). It favors sites with limited exposure to strong winds, salt spray, and waves. It grows in open areas and wind-sheltered openings in the low-growing dune scrub vegetation and in areas where the sand has experienced some disturbance, such as along trails and roads. The species is usually tolerant of small amounts of drifting sand, but tends to occur in stable sites with minimal sand accretion or deflation.

ESCA RP biologists, in numerous field observations at former Fort Ord and other reference areas, have noted that the frequency of Monterey gilia populations in undisturbed open areas is low in the landscape and its presence is highly unpredictable. The species frequently does not occur in locations (including adjacent locations) that are visually indistinguishable from areas where populations occur. No exclusive habitat cues for species presence or abundance were recognized, despite intensive inspection in several locations. However, a population on a sloped area in the IAR MRA occupied by intermediate phase maritime chaparral was observed to exhibit a linear pattern that followed a downslope open corridor. Within the corridor, subpopulations occurred primarily on terraces (i.e., reduced gradient or level areas) and individual plants appeared to occur in association with litter lines and the margins of small-statured shrubs.

Microspatial differences in edaphic conditions may also contribute to the formation of microhabitats.

Seed predation by small mammals and browsing by small and large mammals may contribute to variation in vegetation (Vogl 1982) as well as micro-scale edaphic variability.

Relevant Findings: There are many microspatial factors that could influence restoration success: chaparral vegetation is adapted for near-soil surface conditions, focus species Monterey gilia and Monterey spineflower are adapted to "disturbance" or "open" areas (however, not to soil deflation/accumulation areas), and small rodent (i.e., seed predator or herbivore) activity. This HRP addresses these microspatial factors to enhance restoration success.

2.4 Physical Disturbance Factors

2.4.1 Fire

Fire is considered to be a characteristic natural disturbance factor in California chaparral communities (Vogl 1982). Fire events recycle soil nutrients (DeBano and Conrad 1978) but may also cause nutrient loss in the system. Extensive research has shown that heat and charred wood ("charate") are a prerequisite trigger for germination of certain California chaparral species (Keeley and Nitzberg 1984; Keeley 1986, 1987, 1991, 2007; Keeley et al. 1985, 2005a, 2005b). Aerosol smoke may also be effective in increasing recruitment from seeds of native shrubs as demonstrated by Rokich et al. (2002) in field tests of a fire-adapted shrubland in Western Australia. Keeley (1992b) indicated that chamise, *Arctostaphylos* spp and *Ceanothus* spp. are "fire-recruiters" with seedling recruitment restricted to first season post-fire. On the other hand, Keeley et al. (2005b) reported that refractory seeds of some chaparral species exhibited relatively high germination rates without fire treatments after residing in soil for one year. Their results appear to indicate that obligate refractory seeders may be able to recruit from existing seed bank in the absence of fire. Furthermore, not all chaparral species' germination rates are affected by fire-related triggers (Keeley 1984).

Relevant Findings: Extensive research has demonstrated that seed germination of many chaparral species is triggered by certain effects of fire events (i.e., heat, charred wood, etc.). Because the pre-existing vegetation of the IAR MRA was not burned immediately before the ESCA RP munitions and explosives of concern (MEC) clearance work, these germination triggers are likely absent and seed germination of certain species may fail to occur or be substantially retarded. Amending the soil with charate (i.e., charred wood) may facilitate seed germination of these chaparral species within the restoration sites. Seed aging in the stockpiled topsoil may reduce the need for fire effects triggers.

2.4.2 Erosion

Wind-caused erosion is characteristic of active dune areas and dramatic soil deflation (i.e., "blowouts") sometimes occurs in stabilized dunes. Shrubs, subshrubs, and herbaceous perennials that produce multiple stems from the crown may intercept wind-blown soil/sand. This phenomenon is sometimes referred to as "sand trapping" and it can be an important process in colonization and stabilization of habitats such as active and stabilizing sand dunes where plant species may have adapted to these conditions. In desert habitats, species adapted to this accretive process may form what are called "resource islands" (Bainbridge et al. 1995).

According to USFWS (1998), Monterey gilia is usually tolerant of small amounts of drifting sand, but tends to occur in stable sites with minimal sand accretion or deflation.

The landscape of the IAR MRA and vicinity appears to be relatively stable with no major blowouts evident. However, one small area in the development parcel where soil was removed during an earlier munitions clearance project exhibits substantial (localized) soil erosion. Sand trapping appears to lead to plant mortality in the few shrubs that are present.

Soil deflation at this location appeared to be coincident with a topographic configuration that funnels and accelerates prevailing ground-surface winds.

Relevant Findings: Maritime chaparral communities at the IAR MRA occur on relatively stable back dunes where erosion (wind- or water-caused) is infrequent, even following fire events. However, fires leave most of the root systems intact, whereas soil excavation destroys root systems that help to stabilize soil. Consideration of erosion risks and prevention is an important component of this HRP. After restoration plant establishment, the soils will be stabilized by native plant root systems.

3.0 BIOLOGICAL FACTORS

3.1 Vegetation Structure

Mature chaparral vegetation structure is highly simplified in that it consists of a single layer of canopy with no understory (Vogl 1982). During early growth and regrowth of chaparral, open areas are colonized by herbaceous and other smaller species that become excluded over time as the long-lived shrub species mature and extend their canopy. However, even in mature stands, small areas may not be covered by shrub canopy (such areas are referred to as "open or disturbed areas" in the Habitat Management Plan [HMP]; USACE 1997). Observations in some locations have shown that coastal sage scrub "islands" within chaparral can persist unchanged for decades (Bradbury 1974).

According to Mooney (1988) physical characteristics of chaparral differ from coastal sage scrub: plants have larger volumes, higher biomass densities, leaf lifespan of 2 to 3 years (less than 1 year for coastal sage scrub), much higher leaf area index, and deeper penetration of root systems. Mature chaparral stands are more tolerant of low moisture periods because they develop deeper and more extensive root systems than coastal sage scrub (Harrison et al. 1971). However, Schlesinger and Gill (1980) stated that many years may be required for plants to develop root systems that are extensive enough to mitigate water stress during summer drought periods in Southern California chaparral.

There is little information available on plant density in natural maritime chaparral communities at former Fort Ord. Davis (2009) stated that maritime chaparral shrubs are generally spaced 1 meter or more apart; however, no data were cited to support this statement. Keeley (1992b) studied two Marin County sites (located within the range of maritime chaparral) and reported that in mature communities (i.e., >50 years without fire) genet (i.e., individual shrub) density was 1.1 and 2.5 live genets/square meter. However, it is not known if these values are representative of central maritime chaparral communities at former Fort Ord.

Keeley (1992b) conducted a wide-ranging study of mature chaparral stands (i.e., >50 years without fire) across California. He reported that the mean bare ground cover was 12%.

Relevant Findings: Mature chaparral vegetation structure is relatively simple (single canopy) and does not involve the long-term development of complex plant structural relationships observed in some forest communities. As stands mature, herbaceous and smaller species tend

to be excluded ("out competed") by expanding canopies of the dominant shrubs; however, even in mature stands of chaparral, "open" areas may occur that are not dominated by shrub canopy. Individual plants of dominant chaparral shrub species are typically physically larger and more widely spaced than those of other shrub communities. Plant spacing in natural stands of maritime chaparral may be 1 meter or more. Bare ground in mature chaparral stands across California averages 12%. These variables have been taken into consideration for the proposed success criteria in this HRP.

3.2 Phenology

Evergreen chaparral species often produce flowers during winter and early spring months but do not initiate new vegetative growth until more extensive precipitation results in moisture percolation to deeper soil layers, principally in spring (Mooney 1988). These phenological characteristics have been attributed to the deep root structure present in evergreen chaparral species (see Section 3.1).

Relevant Findings: Seasonal growth of dominant chaparral shrub species is initiated only after substantial moisture penetrates into deeper soil layers (i.e., not following initial rain events but only after extensive rainfall has occurred). To facilitate initial (i.e., years 1 to 3 post-installation) robust growth for longer periods in the initial restoration years, irrigation will be managed to provide adequate deep-soil penetration over an extended wet season period.

3.3 Recruitment, Regeneration, and Community Trajectory

Many dominant woody chaparral species crown-sprout after fire (Mooney 1988).

In dune systems such as those predominating at former Fort Ord, the more-or-less fixed pattern of plant zonation observed across the gradient from beach to inland habitats is superficially similar in some respects to the succession of vegetation that occurs further inland when sites become open for re-colonization (i.e., in "blow-outs").

Burleson (2010), biologists from the Bureau of Land Management (BLM), and other local biologists with experience on the former Fort Ord agree that natural recruitment, wherever it can be encouraged, may contribute most effectively to vegetation recovery by establishing robust individuals of the desirable species assemblage from the surrounding plant community.

Terminology employed in describing the processes involved in temporal changes in chaparral vegetation varies somewhat in the literature. One description of the general pattern of succession on inland dune formations (variously termed "back dunes," "relict dunes," etc.) in the Monterey area was provided by Barbour and Johnson (1988). Pioneer herbaceous species are succeeded by coastal sage scrub. Chaparral may or may not succeed coastal sage scrub before the climax tree species (coast live oak or less frequently at former Fort Ord, Monterey pine) become dominant. As the canopy of the climax species develops, the canopy becomes closed and underlying shrubs are excluded. The HMP (USACE 1997), Shaw and DDA (2009), and Burleson (2009, 2010) also refer to seral stages of chaparral vegetation.

Disturbance factors may prevent progression to the climax stage and maintain subclimax vegetation (i.e., coastal sage scrub and/or chaparral) for extended periods. The principal natural disturbance factor at former Fort Ord is considered to be fire; however, grazing pressure (especially from deer) may also be important in maintaining subclimax vegetation (Vogl 1982).

A different terminology was applied by Vogl (1982). "Primary" succession occurs at sites newly exposed for chaparral colonization (e.g., landslides, erosional areas) whereas "secondary" succession occurs at sites with pre-existing chaparral vegetation that are subject to disturbance (typically fire in chaparral vegetation). In both primary and secondary "successional" areas, classic seral stages of succession are not evident in chaparral (i.e., "climax" or shrub species usually recruit simultaneously with "pioneer" or herbaceous species and there is little evidence that pioneer species facilitate recruitment of climax species). Therefore, Vogl (1982) concluded that vegetational changes in chaparral vegetation are best described as a series of simple repetitive cycles of shrub growth (or regrowth) and maturation. Vogl's perspective was supported by Keeley and Keeley (1981) who reported that chaparral shrub cover increased annually in the early years of recovery post-fire. Such stages are also termed "young," "adolescent," and "mature" (ESNERR 2003). USFWS in biological opinions associated with Fort Ord has not used the successional term "seral" when referring to maritime chaparral. It referred to chaparral "patches of different ages" (USFWS 1999) or "stands" (USFWS 2005). Hanes (1982) agreed in part with Vogl's characterization of chaparral maturation but pointed out that in some habitats (e.g., broken rock slopes, alluvial fans [which are not present in the IAR MRA restoration sites]) certain species may be initial colonizers. He concurred with Vogl that there is little if any increase in species diversity as the stand matures; on the contrary, there is a dramatic reduction in species diversity within the first five years after fire. Dyke et al. (2002) reported substantial decrease in diversity and increase in shrub cover over time in a Monterey County stand of maritime chaparral where fire had been suppressed for 70 years. Keeley (1992b) investigated the hypothesis that chaparral may transition to oak woodland or other vegetation type in 100-year periods without fire disturbance, but obtained no evidence to support vegetation type change. These observations reveal that the revegetation trajectory of chaparral (i.e., community development following wholesale above-ground biomass removal) does not appear to proceed in a manner consistent with classical plant community succession, where somewhat exclusive seral stages are required precursors that occur in a generally fixed sequence from initial seral stage to climax stage.

ESCA RP biologists' observations of vegetational changes as revealed by stands of various ages at former Fort Ord are consistent with Vogl's (1982) description. The terminology employed in this plan for the phases of this trajectory is presented in Table 5 of the HRP. The anticipated trajectory for the IAR MRA restoration project is patterned on the natural processes associated with chaparral communities: the primary sequence of phases is from initial to intermediate to mature, which reflects the underlying process of shrub maturation (i.e., recruitment, growth, expansion of cover, and competitive exclusion) culminating in a closed canopy (except possibly for limited open areas) unless/until a fire event resets the community to its initial phase.

Suding and Gross (2006) referred to the type of restoration trajectory expected at the site is as a "single equilibrium endpoint" trajectory. At such sites, disturbance is limited and it is anticipated that such sites will experience a relatively steady progression toward a recovered biological community.

Relevant Findings: The chaparral community development trajectory is a maturation-based process in which dominant shrub species (which appear among initial site recruits) gradually exclude smaller species as their canopy extends to dominate the site. This type of restoration trajectory is one that has been shown to proceed in a steady progression toward the mature chaparral stage. The terms employed in this plan for the phases of this trajectory are: initial, intermediate, and mature. The trajectory established from the percentage cover values of the growth phases is illustrated on Figure A-1. Also shown on this figure are the total live vegetative percentage cover values obtained in the IAR MRA following the 2003 burn. These two trajectories are in agreement. The temporal success criteria (i.e., the predicted restoration trajectory) for percentage cover of live vegetation in this HRP are patterned on the trajectories shown on Figure A-1. However, the initial (i.e., 1 to 3 years post-installation) restoration period may exhibit a slightly retarded trend in percentage cover when compared with that of the burn recovery, because of the rapid production of plant cover produced by stump-sprouting plants that occurs immediately after a burn.

3.4 Microhabitats

During early growth phases of chaparral vegetation, extensive open areas provide a variety of microhabitats where numerous herbaceous species develop. However, even in late growth stages, gaps in the shrub canopy are often present (Vogl 1982; such areas are referred to as "open or disturbed areas" in the HMP). The persistence of such areas may result from soil disturbance from animal activity and/or allelopathic effects (Vogl 1982). Microspatial soil conditions may also be responsible for the presence of open areas.

Relevant Findings: The microhabitat most discussed in maritime chaparral is often referred to as "open or disturbed areas," particularly areas occupied by Monterey gilia and to some extensive those occupied by Monterey spineflower. Their persistence may be affected by chaparral growth stage, animal activity, allelopathy, or other factors. To facilitate initial establishment of these species, habitat restoration will include creation of such habitats in a portion of the site.

3.5 Genetic Fidelity

"Genetic fidelity" in this plan refers to the criteria established regarding genetic composition of plant materials that will be placed at the site during the restoration effort. Obtaining the appropriate genetic fidelity of populations at a restoration site is important to ensure maintenance of genetic adaptation to local conditions and to avoid deleterious effects of inbreeding (Falk et al. 2006).

Relevant Findings: The genetic makeup of species in part reflects their adaptation to local habitats and these subpopulations are thought to be the most "fit" for a particular location.

Plant materials used in this HRP to restore the IAR MRA sites will be obtained from areas as close to the sites as possible.

3.6 Biological Interactions

3.6.1 Competition and Facilitation

Competition is a primary ecological factor in habitats where one or more resources are limited. For example, high seeding density along with high germination rates can lead to poor vegetative development owing to early competitive effects (Cade and Guo 2000). In their study, lower seeding densities were shown to be more successful in producing a healthy vegetative community. Keeley et al. (1981) reported that competition from artificial seeding with *Lolium* reduced native plant cover during post-fire recovery, especially for annuals. Frazer and Davis (1988) and Schultz et al. (1955) reported that competition caused high mortality in post-fire seedlings. Competition from exotic invasive species is discussed in Section 3.6.3. Harlacher (1988) reported that high planting densities in restoration sites may increase mortality as a result of competition for limited resources.

Facilitation is a phenomenon that recently has been demonstrated at certain restoration sites. This term refers to the increase in survival and development of plants of certain species that are in the immediate vicinity of other plants. Plants that "facilitate" are referred to as "nurse" plants. Padilla and Pugnaire (2006) reported that this effect is evident at sites where abiotic factors are highly stressful (e.g., arid restoration sites that are not irrigated). Facilitation may arise from shading, wind protection, water "lifting" by roots, obstruction of grazing, nutrient transfer (legumes), and pollinator attraction. Facilitation has occurred primarily when nurse plants (shrubs) are larger than and provide some degree of canopy over other plants. Many factors determine whether "nurse" plants are beneficial or detrimental to survival and establishment of other plants. Species that exhibit allelopathy are not appropriate for consideration as nurse plants.

Relevant Findings: Seeding densities to be employed in this plan have been calculated to maximize sufficient recruitment in the restoration site while avoiding adverse effects of seedling overcrowding, Container plants should be spaced apart so as to reduce potential competition for moisture and nutrients in the first 1to 3 years following planting. Facilitation by nurse plants likely would not occur in IAR MRA sites where relatively small plants are installed and/or irrigation is applied.

3.6.2 Grazing and Herbivory

Grazing may contribute to maintenance of "subclimax" (i.e., younger stand) vegetation in chaparral (Barbour and Johnson 1988). Klug et al. (2005) concluded that herbivory can be significant in small chaparral restoration sites that are surrounded by undisturbed vegetation. Herbivory of seedlings in maritime chaparral can be intense and can prevent certain species from becoming established when relatively small restoration sites are surrounded by undisturbed vegetation that harbors herbivores (ESNERR 2003). Mills (1983) reported that post-fire seedlings may experience high mortality as a result of herbivory. According to Deveny and Fox (2006), black-tailed deer (*Odocoileus hemionus columbianus* [Rafinesque])

and brush rabbits (*Sylvilagus bachmani* [Waterhouse]) are the major browsers in former Fort Ord plant communities. Sommer et al. (2007) reported that forage quality for deer is higher during early to intermediate growth stages of chaparral, and lower during late stages. Keeley (1992b) reported that stunting of saplings of certain species of chaparral by grazing was frequent.

Intensive grazing of Monterey gilia plants in certain locations (presumably by rodents) has been observed frequently by ESCA RP biologists in the IAR MRA and vicinity, in agreement with reports in the literature. According to USFWS (1998) rabbit herbivory significantly affected the survival of young seedlings and adult plants. Mice or voles may also graze the species, but if the basal rosette is not entirely taken, the plant often recovers and sets seeds. In 1995 after heavy rains, herbivory was severe enough that many plants did not grow back (Dorrell-Canepa 1994).

Seed predation in chaparral communities may occur by insects, birds, and small mammals as well as collateral seed loss from browsing by mammals (Vogl 1982); on the other hand, some of these activities may benefit the affected species by dispersing their seeds and enhancing germination (Wilson and Thomas 1999). Herbivory by insects may substantially reduce seed output, which is of particular concern for annual plants such as spineflower species (Barron and Bros 2005) because recruitment could decrease in subsequent years. However, Deveny and Fox (2006) reported that few chaparral shrub seeds were harvested by seed-harvesting ants and birds at former Fort Ord and (DiGirolamo and Fox 2006) reported that the abundance of seed harvesting ants at former Fort Ord is relatively low.

Relevant Findings: The relatively high abundance of herbaceous biomass in the initial growth phase of the restoration site may attract large mobile grazers such as deer. In a relatively large restoration site such as the Range 47 SCA, grazing by rodents may be reduced initially owing to a limited foraging range and exposure to avian and reptile predation in relatively open sites. Success of microhabitats created for Monterey gilia may be enhanced by placing them at some distance from the margin of the restoration site and avoiding dense shrub plantings at their periphery (such plantings could serve as rodent grazer refuge). Seed predation by ants at former For Ord may be at relatively low rates compared with similar plant communities elsewhere.

3.6.3 Susceptibility to Invasion by Exotics

"Exotics" is a term generally employed by botanists to refer to non-native species. Although the term "weeds" is commonly used, under certain circumstances it can refer to native species. Soils in the IAR MRA restoration sites are low in fertility (USACE 1992), which may reduce competitive pressures from weed populations because weed competitive pressure is generally enhanced under high-nutrient conditions.

St. John (1988) stated that mechanical soil disturbance alters soil properties such that nutrients become more available for uptake by plants and that such alterations tend to favor weedy species, increasing competitive pressures on native species during the initial phases of restoration. Jacobsen et al. (2010) and Zink and Allen (1995) indicated that chaparral vegetation is less susceptible than coastal sage scrub to invasion by exotics.

Use of irrigation could contribute to increased exotic recruitment and growth. Eliason and Allen (1997) suggested that irrigation schedules could be adjusted to take advantage of the phenology of exotics to reduce their vigor and increase native species success.

One of the focus weed species on former Fort Ord is *Cortaderia jubata* (jubatagrass or pampas grass). According to Drewitz and DiTomaso (2004) seeds of this species have a low germination rate and viable seeds do not persist in soil longer than six months.

Winters and Lipson (2003) reported that invasive species may alter soil conditions, including nutrients, pH, and micro-organisms.

Relevant Findings: Invasion by exotic plants into restoration sites is a common problem. The low nutrient levels in IAR MRA soils may reduce weed competitive pressure. Therefore, pre-emptive exotic plant control is not proposed, but the sites should be monitored carefully to control exotics if they invade the sites and impede restoration progress.

3.6.4 Seed Dispersal

According to USFWS (1998), seed dispersal of Monterey spineflower is facilitated by the involucral spines, which attach the seed to passing animals. Dorrell-Canepa (1994) reported that seeds of Monterey gilia are wind-dispersed but limited in dispersal range. The limited dispersal observed by Dorrell-Canepa is likely attributable to the small stature of the plants.

Wildlife, such as the gray fox (*Urocyon cinereoargenteus*), may disperse and enhance germination of seeds of chaparral by consumption and passage through the gut (Wilson and Thomas 1999).

Relevant Findings: Seed dispersal is affected by many factors, including plant stature, microhabitat, dispersal mechanisms (e.g., wind, animals, etc.), and other factors. Seeds of maritime chaparral species are known to be dispersed by wind (e.g., the small-statured Monterey gilia) whereas others may be dispersed by attaching to passing animals (e.g., Monterey spineflower) or passage through the gut. Large-scale restoration sites will be sown with seeds of the less-dispersive species. All sites adjacent to healthy maritime chaparral will receive naturally dispersed seeds of most species over time.

3.6.5 Hemi-parasitism

Seaside bird's-beak (an HMP species) is a hemi-parasite (Hickman 1993) that occurs in the eastern portion of IAR MRA. According to Hayes and Taylor (2007), the subspecies is presumably hemi-parasitic on annual dicots and graminoids.

According to Marvier and Smith (1997), restoration of parasitic plant populations may involve three steps: identification of suitable hosts, establishment and maintenance of healthy host populations, and finally reintroduction of the parasites.

Delgado (2011) reported that BLM performed road and erosion (gulley) maintenance on former Fort Ord in a small area that was immediately adjacent to a plant community with

seaside bird's-beak present. During grading, living root systems present in the area were removed/destroyed and topsoil was replaced. Subsequently, seaside bird's-beak seedlings were observed to be present along with seedlings of other species that had germinated from the topsoil seed bank (and/or natural seeding). This observation indicates that pre-existing (i.e., mature) host root systems are not required for seaside bird's-beak seed germination and initial seedling development.

Chuang and Heckard (1971) reported on laboratory experiments of root parasitism in eight species of bird's beak (*Cordylanthus).* One of the species was stiffbranch bird's beak (*C. rigidus*) and they included seaside bird's beak (*C. rigidus* var. *littoralis*) by reference; however, the material was from Santa Clara County and the (putative) associated host was oak (*Quercus*). Because the IAR MRA populations of seaside bird's-beak are not associated with oaks, the bird's beak material included in their study may not be directly relevant to the IAR MRA populations. Nonetheless, all eight species grew successfully under greenhouse conditions, indicating that they are facultative parasites.

Watts et al. (2010) studied the ecology of seaside bird's-beak populations at two locations on former Fort Ord with maritime chaparral vegetation. They observed that seed production varied substantially from year to year, that seed viability and germination rates were low (0 to 17.8%), proximity to certain hosts appeared to triple reproduction although host effects were variable depending on location, both mammalian and insect herbivory may be substantial, and charate application did not affect seed germination rates.

Relevant Findings: One of the HMP species (seaside bird's-beak) is a hemi-parasite. The degree to which recruitment and initial development in this species is dependent on development of its attachment to hosts is unknown. The requirements associated with conditions suitable for and mechanisms by which host attachment occurs and the degree of initial dependence of the species on such conditions introduce substantial uncertainty as to the probability of success of restoring this species. However, one report indicated that re-colonization by the species may be rapid. Historical data on seaside bird's-beak in the IAR MRA indicate that its primary population occurs consistently in the eastern portion of the MRA. Therefore, this HRP recommends seeding of this species in areas where it has been shown to occur and success criteria are tempered to reflect the uncertainties regarding restoration procedures suitable for establishing vigorous populations.

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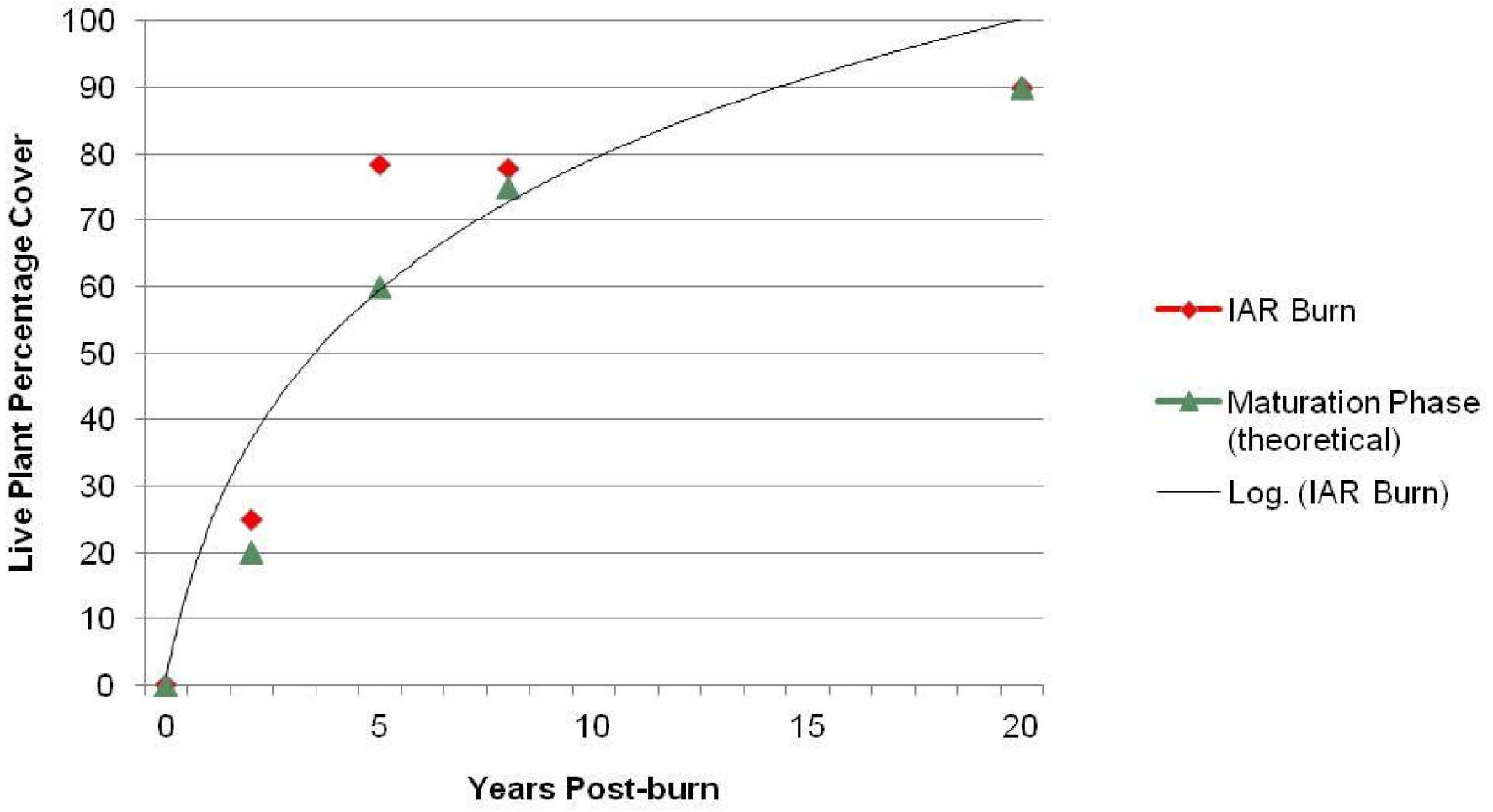

Interim Action Ranges MRA
Habitat Restoration Plan
Chaparral Plant Cover Trajectory in Burn Area
FORA ESCA RP
Monterey County, California

Figure A-1

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APPENDIX B

Review of Relevant Restoration Projects

FORA ESCA REMEDIATION PROGRAM

Draft Final

Appendix B. Review of Relevant Restoration Projects

Phase II Interim Action Work Plan Addendum
Habitat Restoration Plan
Interim Action Ranges Munitions Response Area

Former Fort Ord
Monterey County, California

February 1, 2013

Prepared for:

FORT ORD REUSE AUTHORITY

920 2nd Avenue, Suite A
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Prepared Under:

Environmental Services Cooperative Agreement
No. W9128F-07-2-01621
and
FORA Remediation Services Agreement (3/30/07)

Document Control Number: 09595-10-086-012

Prepared by:

ARCADIS

WESTON SOLUTIONS

WESTCLIFFE | ENGINEERS

CONTENTS

ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

ESCA	Environmental Services Cooperative Agreement
FORA	Fort Ord Reuse Authority
IAR MRA	Interim Action Ranges Munitions Response Area
in/hr	inches per hour
kg/ha	kilograms per hectare
m^2	square meters
mg/kg	milligrams per kilogram
outplant	grown in nursery and transplanted to site
RP	Remediation Program
volunteer	naturally recruiting plants

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1.0 INTRODUCTION

A review was conducted to identify ecological restoration projects relevant to maritime chaparral restoration on the Interim Action Ranges Munitions Response Area (IAR MRA). Relevant restoration experience can inform successful approaches, factors to consider, and procedures to avoid.

The most relevant restoration experience was a small-scale restoration study conducted on former Fort Ord to evaluate soil remediation methods (see Section 2.1). To our knowledge, there have been no successfully completed large-scale maritime chaparral restoration projects on former Fort Ord.

Beyond former Fort Ord, restoration experience most relevant to this project was from maritime chaparral projects in the Monterey Bay area; however, maritime chaparral occurs from Sonoma to Santa Barbara counties and on the Channel Islands (ESNERR 2005) and information from those more distant maritime chaparral populations may also be relevant. Additionally, some maritime chaparral species occurring on former Fort Ord also occur in the active dune vegetation to the west. Therefore, local dune restoration projects may provide additional information. Project descriptions and summaries of the findings that are most relevant to the IAR MRA restoration effort are presented below.

2.0 CHAPARRAL RESTORATION PROJECTS

2.1 Fort Ord - Chaparral

Detka (2005) evaluated revegetation of two soil remediation sites, Range 18 and 19, where the seed bank was depleted from either excavation of soil (~12-inch lift) followed by off-site disposal, or by processing excavated soil with one of two treatments (dry or wet) and returning the processed topsoil to the site.

The study areas were selected based on the following criteria:

- At least 10% of the site was covered in spent ammunition.
- Considerable areas of the range exceeded the 400 milligrams/kilogram (mg/kg) lead treatment criterion for the project.

Range 18 Site 1 received the dry treatment. Dry treatment soil returned to the Range 18 revegetation study area was processed as follows:

- Large pieces of organic material and debris were removed using 4-inch grizzly and ½-inch screen. Large material was stockpiled.
- Screened soil was dried in a heated rotary trommel. Trommel was under vacuum from attached baghouse to control dust and remove fine lead-containing fragments and organics.

- Dry soil was screened through a 14-mesh vibratory sieve to remove bullets and other metallic debris under vacuum and returned to the site.

Range 18 Site 1 covered approximately 300 square meters (m^2) and 300 quadrats corresponding to 1-m^2 locations for plant installation. The slope was 17% with an aspect of 319 degrees (Table B-1). Habitat was characterized by intermediate oak woodland and transitional maritime chaparral with severe levels of disturbance and invasion by non-native iceplant (*Carpobrotus edulis*).

Range 19 Site 1 received the wet treatment (i.e., washing). Wet treatment soil returned to the Range 19 revegetation study area was processed as follows:

- Wet screened with triple deck vibratory sieve to separate material into three fractions: large (> 1 inch), coarse (< 1 inch and >10 mesh), and < 10 mesh material. Large material was stockpiled.

- Coarse material was conveyed to mineral jigs to separate bullets, fragments, and large particulates.

- Resulting fractions from coarse material and < 10 mesh soil was dewatered to separate sand from fines so that water could be used.

- All < 10 mesh material was sent to pug mill where apatite was added at 3% weight to weight. This soil was returned to the site.

Range 19 Site 1 covered approximately 270 m^2 and contained 270 one-m^2 quadrats for plant installation. The slope was 3% with an aspect of 212 degrees (Table B-1). The habitat was predominately undisturbed maritime chaparral habitat dominated by mature stands of recently burned shaggy-barked manzanita (*Arctostaphylos tomentosa*). Range 19 Site 2 covered approximately 134 m^2. Here, soil was not treated and instead excavated topsoil was transported offsite prior to restoration. The slope was 3 to 7% with an aspect of 180 degrees with comparable habitat to Range 19 Site 1 (Table B-1).

Both treatments succeeded in removing lead from soil. Soil returned to the Range 18 study area contained lead averaging 156 mg/kg, which was below the 400 mg/kg action level. The soil returned to the Range 19 study area contained lead averaging 271 mg/kg.

Quarterly monitoring between February 3, 2004 and August 16, 2005 examined the survival of installed native species from 1-gallon containers and re-colonization by "volunteers" (i.e., naturally recruiting plants). Monitoring consisted of evaluating plant "health" and "coverage" and assessing whether any volunteer plants had emerged within 10% of randomly selected quadrats."Health" is a qualitative assessment of the color green, expressed as:

- 0: 0 to <10% green

- 1: 10% to 25% green

- 2: >25% to 50% green
- 3: >50% to 75% green
- 4: >75 to 100% green

Thus, if the health of a species changed from 2.4 to 3.8, an improvement of 1.4 would result. "Cover" is a measurement of how much of the quadrat is covered by above-ground vegetation. Individuals with greater than 25% green cover were categorized as alive.

A total of 704 1-gallon plants indigenous to the Fort Ord ecosystem (11 species) were installed on the sites on January 19, 2004. Of the 300 potted plants installed on Range 18 Site 1, 194 (65%) survived through August 2005. Plant mortality was highest in western wildrye (*Elymus glaucus*), California coffeeberry (*Frangula [Rhamnus]californicus*), purple needlegrass (*Stipa [Nassella] pulchra*), coastal bush lupine (*Lupinus arboreus*), manzanita (*Arctostaphylos*) species, and wedge-leaved horkelia (*Horkelia cuneata*). In contrast black sage (*Salvia mellifera***)**, California sagebrush (*Artemisia californica*), and coyote bush (*Baccharis pilularis* ssp. *consanguinea*) had much lower mortality rates (Table B-2). Mule Deer (*Odocoileus hemionus*) browsed on California coffeeberry, coastal bush lupine, and western wild rye, suggesting the need for herbivore exclusion, although all species recovered; western wildrye recovered especially quickly. Interestingly, health values for manzanita species reflected growth from new stems; above-ground growth at the time of planting died back. Weed management focused on iceplant, yellow star thistle (*Centaurea solstitialis*), sheep sorrel (*Rumex acetosella*), and horseweed (*Erigeron [Conyza] canadensis*) on Range 18, which were managed as soon as they were detected; horseweed is a native species.

Installed plants on Range 19 Site 1 decreased the most in health (i.e., reduction in green above-ground vegetation). Of 270 potted plants, 37 survived (14%). Detka (2005) hypothesized the wet treatment was less supportive of installed plant growth, in part due to the observation that plants appeared to grow better where the depth of treated soil was thinner. The exception to this observation was the emergence of purple needlegrass volunteers. Otherwise, invasion by sow-thistle (*Sonchus*) was evident on Range 19 treated soil. It was hypothesized that sow-thistle was introduced via potted plant soil or from mammal feces.

With the exception of coyote bush, installed plants in Range 19 Site 2 decreased in health. Although the number of survivors was relatively small, surviving plants increased in cover. Non-native invaders consisted of iceplant, filaree, and several unidentifiable fescue (*Fesctuca)* species. Minimal hand-pulling (< 10 minutes labor) was conducted to control iceplant.

The absence of paired treatments and control sites precluded an explanation for trends observed across Ranges 18 and 19 following the two soil treatments. Site effects related to differences in abiotic and biotic variables were also suspected to influence observed differences. The north-facing slope of Range 18 Site 1 was shaded on all sides by established coast live oak (*Quercus agrifolia*). Thus, existing patches of chaparral may have been more

supportive of installed plants compared to conditions on Range 19 Site 2 based on proximity to native vegetation, and natural variation in light, for example.

Relevant Findings: Detka (2005) conducted a revegetation study on sites (total of approximately 0.5 acre) in Ranges 18 and 19 (1 to 2 miles, respectively, west southwest of the Range 47 SCA in the IAR MRA). The study objective was to determine efficacy of revegetation where the seed bank had been depleted by topsoil removal or processing. Site treatments and characteristics are tabulated in Table B-1. At Range 18 Site 1 and Range 19 Site 1, a 1-foot lift was removed, screened, and returned to the site. The soil at Range 18 Site 1 was subject to a heating process. The soil at Range 19 Site 1 was subject to washing with water. At Site 2 in Range 19, a 9- to 12-inch lift was removed; the topsoil was not returned to the site and revegetation occurred on native subsoil. Nursery-grown plants (gallon size) were planted on square meter quadrats. Revegetation species from Detka (2005) and corresponding survival rates are compared to the IAR MRA Habitat Restoration Plan planting palette in Table B-2. Data were also collected on seedlings that recruited into the sites ("volunteers").While installed plants in the dry treatment grew better than plants grown in wet treatment soil, natural variation in environmental factors alone could explain the differences in success across sites.

2.2 Other Monterey County Sites - Maritime Chaparral

There were no examples of maritime chaparral being effectively restored through planting in Monterey County as of 2003 (ESNERR 2003). Two sites where maritime restoration was attempted either failed or were only partially successful.

Relevant Findings: The results indicated that successful experience restoring maritime chaparral in Monterey County is lacking and thoughtful effort will be required to increase plant survival in the IAR MRA sites.

2.3 Prunedale Sandhills - Chaparral

An observational study of chaparral succession in north Monterey County assessed long-term changes in chaparral communities following approximately 70 years of fire suppression. Six locations observed by Griffin (1978) in north Monterey County's Prunedale sandhills were re-sampled in 2000 to document changes in community composition, canopy cover, and seedling abundance (Dyke et al. 2001).

To replicate observations made by Griffin (1978), Dyke et al. (2001) established 47 – 10 × 10 meter plots and identified all vascular plant species. Additionally, tree height was divided into three layers: 1) rising above the shrub canopy, 2) the shrub layer (i.e., the chaparral canopy), and 3) the herb layer, or understory.

Compared to 20 tree and shrub layer species observed in the 1975 to 1976 survey, 19 species were present in 2000. While overall species richness in the tree and shrub layers was similar in 2000 compared to 1975 to 1976, combined tree and shrub cover increased from 86 to 99%. In particular, cover of *Arctostaphylos pajaroensis* increased from 58 to 82%. Cover of *Quercus agrifolia* and *Heteromeles arbutifolia* also increased, but percentage cover for most

shrub species decreased. Notably, seedlings were rare under the dense canopy; however, seedling abundance for *Q. agrifolia* and *Mimulus aurantiacus* increased. Observations from Dyke et al. (2001) indicated that maritime chaparral stands reaching 70 years of age without fire disturbance may be dominated by one or two species with a gradual transition from chaparral to oak woodland.

Results from Dyke et al. (2001) suggested reintroduction of wildfire may promote the long-term survival of maritime chaparral by opening the canopy, facilitating seedling establishment, and slowing the advancement of oaks. Also, enhancement of the seed bank with stockpiled chaparral soil, in conjunction with burning, may be necessary in degraded areas (Odion 1995).

Relevant Findings: Ecological succession in chaparral communities was inferred from observations made after 70 years of fire suppression compared to 45 years of fire suppression (a 25-year span).Tree and shrub layer species richness changed little, but their cover increased from 86% to 99% in the 25-year period. A few trees and one manzanita species increased in percent cover, whereas most other species declined. Herbaceous species percent cover also declined. These results indicated a trend of gradual domination by a few species and a very gradual transition to an oak woodland community.

2.4 Rice Ranch Maritime - Maritime Chaparral

For the past 10 years, ARCADIS has conducted all ecological work for Rice Ranch, the largest residential development project in Santa Barbara County (~ 600 acres). Development of a cohesive Open Space and Habitat Management Plan both reduced impacts to native vegetation, and implemented 10.2 acres of restoration to date to mitigate development impacts, including restoration of riparian scrub, native grassland, and central maritime chaparral vegetation (ARCADIS 2010). The maritime chaparral restoration area (0.91 acre) is surrounded on all sides by open space and was selected based on its proximity to existing maritime chaparral and environmental characteristics. Prior to restoration activities, this area was dominated by non-native grasses and a mix of native and non-native forbs.

Naturally occurring central maritime chaparral plant species are dominated by native shrubs such as shagbark manzanita (*Arctostaphylos rudis*), La Purisima manzanita (*Arctostaphylos purissima*), Lompoc ceanothus (*Ceanothus cuneatus* var. *fascicularis*), California coffeeberry, Lompoc monkeyflower (*Mimulus aurantiacus* subsp. *lompocense*), black sage, toyon (*Heteromeles arbutifolia*), California sagebrush, coyote bush, and dune-heather (*Ericameria ericoides*), as well as one tree, coast live oak. Herbaceous perennials include wedge-leaved horkelia, peak rush-rose (*Helianthemum scoparium*), and round-fruited sedge (*Carex globosa*). Both manzanita species as well as Lompoc ceanothus are endemic to the sand sheets of northern Santa Barbara and southern San Luis Obispo Counties.

Container plants were propagated at a local restoration nursery from seeds and cuttings collected on site in 2007. In January 2008, over 2,600 central maritime chaparral container plantings were installed in the fenced restoration area; trees and shrubs were planted from 1-gallon containers and tree pots and herbaceous species were planted in groupings from

plugs. Irrigation was employed via overhead aluminum pipes and sprinkler heads through fall 2009. Additional maintenance tasks included fence repair, gopher trapping, and routine weed abatement.

As of fall 2010, survival of container plantings averaged 69% (77% if new recruits from fruiting container plants are inventoried). Survival exceeded 75% for coast live oak, shagbark manzanita, California sagebrush, California coffeeberry, and black sage. The lowest survival rates are exhibited by peak rush-rose and round-fruited sedge, with 38.3% and 41.2% survival, respectively. Native species that occur naturally at the restoration site or have volunteered include purple needlegrass, California aster (*Corethrogyne filaginifolia*), winecup clarkia (*Clarkia purpurea*), amole (*Chlorogalum pomeridianum* var. *pomeridianum*), doveweed, lupines, and others.

Cover by native species during 2010 sampling was 73%, well above the 60% five-year cover target. Over 60% of the native vegetative cover total was provided by planted trees, shrubs, and subshrubs. More than 95% of all planted shrubs on site also exceeded performance criteria for shrub height and diameter and all of the coast live oak saplings exceeded tree size performance targets. Cover by weedy species during the 2010 sampling was a negligible 0.9%, consisting of storkbill filaree (*Erodium botrys*), rattail fescue (*Festuca myuros*), and soft chess (*Bromus hordeaceus*).

Relevant Findings: ARCADIS managed a 0.9-acre maritime chaparral restoration site at Rice Ranch in Santa Barbara County. Container plants were installed in January 2008. The site was supplied with overhead irrigation and container plant survival averaged 69% (range by species: 38 to 100%). The site was surrounded by a deer fence to reduce herbivory. In 2010, two years after installation, live plant percentage cover was over 73%. This project demonstrated that irrigation and deer fencing facilitated successful outcomes in maritime chaparral restoration sites and should be considered for the IAR MRA sites.

2.5 Bluffs at Mesa Oaks - Maritime Chaparral

Bluffs at Mesa Oaks is a residential development in Lompoc, California where a small isolated patch of central coastal scrub and maritime chaparral were disturbed by housing development. To mitigate this damage, ARCADIS managed a restoration effort (5.3 acres) on the southern side of the residential development and a small isolated area located between two residential areas; the restoration areas had been subject to varying degrees of ongoing disturbance, including pipe installation and construction activities. Because of the close proximity of the restoration area to residential structures, the restoration areas are located in fuel modification zones because of combustion fuel build-up (i.e., aged and dense vegetation).

Seeds and cuttings from the site were utilized to populate container plants for the restoration effort including coast live oak, Lompoc ceanothus, La Purisima manzanita, shagbark manzanita, Lompoc monkeyflower, and California spineflower (*Mucronea californica*). During the winters of 2004/2005 and 2005/2006, over 2,700 central maritime chaparral container plants were installed in the restoration areas on site. Trees and shrubs were planted primarily from 1-gallon containers and tree pots. A portion of the sensitive species were

protected with deer cages. In addition, native annuals, particularly California spineflower, were seeded in open areas between container plantings, and successfully established. A drip irrigation system was utilized to provide supplemental water until fall 2009 (four years). Additional maintenance tasks included deer cage removal, irrigation system repair, gopher trapping, and routine weed abatement.

A total of 3,078 native plants were counted in 2011 in the restoration areas, exceeding the number planted due to natural recruitment or seeding efforts that were indistinguishable from container plantings. The majority of volunteer recruits consisted of California sagebrush, deerweed, coast buckwheat (*Eriogonum parvifolium*), and coast horkelia. Survival of individual shrubs such as La Purisima manzanita and shagbark manzanita ranged from 68 to 70%, whereas survival of California coffeeberry was 27%, much lower than the 98% survival rate at Rice Ranch. No cover performance targets were established for the Bluffs project, in part due to the low shrub cover desired near structures.

Relevant Findings: ARCADIS managed a 5.3-acre maritime chaparral restoration site at Bluffs at Mesa Oaks in Santa Barbara County. The area was a narrow corridor around a residential development. Plants propagated from seeds and cuttings were installed from 2004 to 2006 and seeds of some forbs were sown in open areas. Drip irrigation was used for four years. Herbivore protection was installed for individual plants. Shrub survival was approximately 70%.

This project demonstrated that irrigation and herbivore protection facilitated successful survival outcomes in maritime chaparral restoration sites and should be considered for the IAR MRA active restoration sites. Additionally, forb seeding in open areas was successful.

2.6 Burton Mesa - Chaparral

Science Applications International Corporation reported on restoration efforts in an area of Burton Mesa chaparral following a State Water Project (SAIC 2004). Off-site mitigation requirements for impacts to Burton Mesa chaparral totaled 22.7 acres. At the time of restoration, the site was dominated by non-native annual grassland species. Site selection was based on proximity to the pipeline corridor, large tracts of similar habitat, suitability for habitat restoration, and likelihood of long-term protection from development. Historical site conditions were indicated by aerial photographs and interviews. In general, the project plan included herbivore exclusion, management of non-native grasses by burning or mowing, enhancing the seed bank with native shrubs representative of nearby habitats, and establishing patches (enclaves) of native trees and shrubs with container plants grown from local seed or cuttings. Enclaves were dispersed over the site and expected to expand into surrounding areas. In some cases, two or three enclaves were grouped to create larger islands.

Full restoration would be expected about 20 to 30 years from initiation. At the 5-year mark, it was expected that the enclave plantings would be spreading, with the faster-maturing species producing seed. Having survived 3 years without irrigation, they were expected to no longer require protection from herbivores (i.e., tree shelters or mesh cages). The perimeter fence would be left up for 10 years, however, to minimize deer and cattle damage to the recovering vegetation.

A 1-acre reference area was identified immediately northeast of the mitigation site in grassland habitat against which project results were compared. Also, a "target area" was identified to provide an example of mature chaparral (Table B-3). Soil samples were taken from the mitigation site and from nearby areas supporting chaparral vegetation for comparison.

A controlled burn was attempted prior to planting, but ultimately was not implemented. The main planting effort in 1997 employed the California Conservation Corps from San Luis Obispo. The 1997 planting effort required about 1,725 hours, a third of which was spent commuting. In addition, the supervisor worked 27 10-hour days at the site. A total of 4,095 plants were installed (2.8 plants per hour per person); however, the following factors should be taken into consideration when evaluating this level of effort:

- The site was sandy and consequently digging holes for planting was very easy.
- Vehicles were not permitted on the site and all materials had to be carried from the northern end of the site to the planting location (as far as 0.25 miles). Wheelbarrows and a rock carrier that resembled a stiff stretcher were used to increase the load that could be carried in one trip.
- Plants were grown in either plant bands or bullet tubes that are easier to transport than 1-gallon containers because many plants can be carried by one person at one time (about 12 to 26 plants).
- Additional time was required to plan and monitor to make sure that plants were installed with the specified plant protective devices.

Besides the level of effort related to herbivore exclusion (i.e., the double fence), a variety of types of bird perches were installed to attract birds that would prey on small mammals that damage young plants, and to attract birds that disperse seed. Other devices related to plant maintenance included tree shelters, mesh (Vexar) cages, weed mats, mulch, and gopher cages.

A drip irrigation system was originally designed for the project. However, after examining cost of the equipment coupled with concern over rodent damage, another method of irrigation was selected, being sure to avoid methods that would either be inefficient with water (i.e., runoff), or have the potential to damage plants (e.g., dragging hoses). The system was designed as follows:

- A flexible 1-inch irrigation hose to transmit water to the mitigation site.
- A 2-inch PVC line to carry water from the northern end of the site to the southern end.
- 1-inch PVC feeder lines to connect to the 2-inch line at various locations and carry water to groups of enclaves.
- Hose bibs to dispense water, typically within about 20 feet of each enclave.

- From the hose bib, small 0.25-inch irrigation lines, similar to what is used for drip irrigation systems, were used and transported water from plant to plant.

Monitoring visits were conducted approximately monthly during the first several years following planting. Generally, project biologists accompanied laborers to conduct watering or maintenance, and therefore, a biologist was on the site frequently.

While the fence designed to limit use by deer was apparently effective at the outset of the program, deer use of the site was abundant in the final years of the project. In addition, cottontail rabbits browsed under many establishing shrubs and pocket gophers killed many establishing shrubs and trees.

The importance of watering was tested by not watering some enclaves. Only species that had reasonably high survival rates (oaks, coffeeberry, coast ceanothus, and black sage) could be tested and none of those species showed a significant difference in survival or growth between watered and no water enclaves.

Relevant Findings: A restoration project involving Burton Mesa chaparral was conducted in Santa Barbara County in a pipeline right-of-way. Irrigation was used at the site. A key lesson from this site is that restoration success may be substantially reduced where very high levels of herbivory occur in sites that are easily accessible from nearby undisturbed habitat supporting abundant grazers. Results from this project reinforce the benefits of installing herbivore controls (e.g., Table B-4), such as a deer fence, at the IAR MRA active restoration sites.

3.0 MONTEREY BAY COASTAL DUNE RESTORATION PROJECTS

Maritime chaparral of former Fort Ord occurs on stable coastal (back) dunes and has some species in common with the active dune vegetation to the west. Therefore, local dune restoration projects may provide relevant information for some of the species to be restored at the IAR MRA sites.

3.1 Spanish Bay (Pebble Beach)

In 1984, a Spanish Bay dune restoration program commenced to test habitat restoration and sand stabilization techniques on an experimental dune (Guinon and Allen 1987; Guinon 1988; Guinon and Allen 1990). Implementation programs included sand dune construction, local seed collections and plant propagation, hydromulching and erosion control, exotic species eradication, whole plant salvage, outplanting (grown in nursery and transplanted to site), and sensitive species management.

Hydromulching was used to establish a native plant cover and stabilize the sand dunes with consideration for exposure to wind and salt. Thus, planting groups were designed according to foredune, middune, and back dune associations (Table B-5). Native plant seed was collected from 14 species and applied to experimental strips on the test dune. The following locations were utilized for seed collection activities in the Monterey Bay Area: Moss Landing State Beach, Zmudowski State Beach, Salinas River State Beach, El Sur Ranch (private

property), Lonestar Lapis Quarry (private property), and Spanish Bay. Seed was immediately dried on nursery benches covered with chicken-wire. Shade cloth and nets were used to catch the seed. Seed generally dried in two weeks, after which most species required the removal of seed chaff to facilitate the hydromulching process. The fruits were broken apart by hand then placed into a seed cleaning machine that performed the winnowing. Clean seed was collected as was the chaff which still contained some seed. Seed cleaning time varied between species (Table B-6).

Combinations of excelsior blankets, jute netting, straw tacked beneath plastic netting, woodchips, hydroseeding, hydromulching, and handseeding were employed to seed the test dune. A mulch rate of 368 kilograms per hectare (kg/ha) was used almost exclusively. The mixture of the nurse crop (zorro fescue *[Festuca myuros],* blando brome [*Bromus horceaceus],* and crimson clover [*Trifolium incarnatum])* remained constant and the density of the nurse crop was set at 269 plants/m^2. Fertilizer was generally applied at 49 kg/ha. The nurse crop was intended to exist for only one or two seasons; however, germination was high (90-100%) and mortality was low (50%). As a result, native plants were less successful than anticipated; where the nurse crop was thin, the native species succeeded.

Beach morning glory *(Calystegia soldanella)* and coffeeberry were the only two species that required scarification. Sea rocket *(Cakile maritima)* and beach-primrose *(Camissoniopsis cheiranthifolia)* successfully reestablished from the hydromulching. Mock-heather *(Ericameria ericoides)* and liveforever *(Dudlea farinosa)* were relatively slow growing. Sand-verbena *(Abronia* spp.), poppy *(Eschscholzia californica* var. *maritima),* and beach pea *(Lathyrus littoralis)* required the most space for root development. The buckwheats *(Eriogonum* spp.) and beach sagewort *(Artemisia pycnocephala)* had high germination rates. Seaside painted cup (*Castilleja latifolia)* is a partial parasite and was seeded both by itself and with other species in flats; both flats grew well. *Carex* spp. grew well vegetatively. Rare plants including Tidestrom's lupine (*Lupinus tidestromii*), sand gilia (*Gilia tenuiflora* ssp. *arenaria*), and Menzies' wallflower (*Erysimum menziesii*) had a limited seed source, but all were easily propagated. Tidestrom's lupine grew well from cuttings. Overall, beach sagewort, yarrow, the buckwheats, and lizardtail were particularly successful. In sample quadrats, 89 native seedlings/m^2 were reported (range: 22 to 228).

Three rare plant species were propagated to either enhance or create new populations on the dunes surrounding Spanish Bay. The seeds were collected locally at Asilomar State Beach and propagated paying attention to day length and temperature. Outplanting took place during the rainy season, and plantings were fenced off and marked as sensitive restoration areas. A boardwalk directed foot traffic outside of the planting area and weeding was regularly scheduled for maintenance. Replanting was scheduled for the following year if survivorship was below 70% in any specific area.

Several invasive non-native plant species were removed, including ice plant and its hybrid with the non-native sea fig (*Carpobrotus chilensis*), pampas grass (*Cortaderia jubata, C. selloana*), kikuyu grass (*Pennisetum clandestinum*), acacia (*Acacia longifolia* and *Acacia verticillata*), French broom (*Cytisus mononspessulanus*), and a number of herbaceous species, including cut-leaf plantain (*Plantago coronopus*). During the first three years of the maintenance program, young ice plant seedlings were eradicated as frequently as every two

months. Likewise, pampas grass was eradicated in the juvenile growth stage. Pampas grass tassels were cut before seed dispersal for individuals that were not successfully killed. Eradication efforts occurred twice per year until pampas grass was completely eradicated. French broom required similar treatment to pampas grass. The remaining exotics were either eradicated by using Roundup, a surfactant and dye, or by hand weeding. Note pre-emergent or selective herbicides should not be applied on the dunes.

Unfortunately, native plant species did not tolerate trampling at the site by visitors utilizing the site's public access etc., thus establishing habitat at this site was questionable.

Relevant Findings: Monterey gilia (and other species) were successfully restored at this site in Monterey County. Seeds were collected locally and grown in a nursery. Stratification and scarification were successfully employed, as was irrigation and fertilizer. Seedlings were planted in the winter and had 80% survival after one year.

3.2 Monterey Interceptor

Thirteen acres of chaparral habitat were disturbed by construction at the Monterey Sewage Treatment Facility (Murray 1981 in Pickart 1985). A heterogeneous planting plan was adopted to match dune ecology involving a few species in common with the IAR MRA sites. The non-native European beachgrass (*Ammophila arenaria*) was planted on windward slopes and crests of dunes. Other patches were populated with nursery-grown non-native Australian cushion bush (*Leucophyta brownii*), and native Monterey cypress (*Cupressus microcarpa*) and coastal bush lupine. Finally, a hydroseed mix of yellow sand-verbena (*Abronia latifolia*), coast live-forever (*Dudleya caespitosa*), seaside buckwheat (*Eriogonum latifolium*), mock-heather, coastal bush lupine, beach-primrose, and sand dune bluegrass (*Poa douglasii*) was applied. Overhead impact sprinklers were installed on part of the site, and operated between April and October for one day a week for 30 minutes (0.44 inch per hour [in/hr]). Exposed areas were managed with snow fencing and jute matting.

Relevant Findings: A dune restoration in Carmel that involved a few species in common with the IAR MRA sites successfully employed overhead impact sprinklers on part of the site, between April and October for one day a week for 30 minutes (0.44 in/hr). This irrigation schedule may be considered in developing the irrigation management process.

3.3 Asilomar State Beach

A dune encroaching on Asilomar State Beach was bulldozed back and recontoured (Cowan 1975, Pickart 1985). A slope of thirty degrees or less was recommended for the west or windward side of dunes where stabilization is more difficult. On the leeward slopes of each dune the angle may be steeper in places. The greatest effort at stabilization was directed at slopes above or below roadways where sand might otherwise slip or shift.

For seeds to establish in moving sand, non-native grasses were recommended to provide immediate stabilization prior to succession by native vegetation, which was achieved with hydroseeding. The area was hydromulched with a mix of annual and perennial rye grass at 2 pounds/1,000 square feet, which is roughly one-third the density typically recommended for

lawns. The reduced density is used to avoid overcrowding and provide space for development of healthy individual grass plants. Osmocote fertilizer was included in the mix.

Irrigation was temporarily installed while the non-native grasses were becoming established (if grass is seeded during fall, winter rain will provide the best chance of success). Following establishment by non-native grasses, irrigation was eliminated and the non-native grasses died off leaving a native seedbank to repopulate the stabilized dune. Cassa (1993) indicated that an expert on this project stated that irrigation is required for success of hydroseeded and straw-plug methods.

Beach sagewort was easily transplanted and acted as a native dune stabilizer following the initial stabilization by non-native grasses. Divisions with roots, or even cuttings, can be inserted into a moistened sand dune, and with irrigation or rainfall they established themselves within two or three months. Sagewort also grows readily from seed, which may be collected from drying stalks in late September and October; however, seedling success was enhanced if the ryegrass first senesced to avoid competition.

The non-native iceplant is another readily propagated dune plant, although it is invasive. Likewise, while mock-heather is relatively slow growing, it ultimately attains a larger size and is perennial. Moreover, this species normally succeeds sagewort in secondary dunes and, if undisturbed, eventually becomes the dominant shrub. Other native species planted at the site included beach sagewort, yellow sand-verbena, purple sand-verbena (*Abronia umbellata*), and mock-heather. Wire cages were used to exclude grazers from the relatively sensitive coastal bush lupine seedlings.

Propagation of purple and yellow sand-verbenas required greater effort than taking them from cuttings, which exhibit a low success rate. Also, the winged seeds have a low germination rate; however, a large number of seeds can be collected in early fall by scooping sand around patches with a one-eighth inch mesh strainer. Additionally, germination was increased if the winged husks were removed from seeds before planting, but this was a labor-intensive task. Finally, seeds were scattered on the surface. Overall, beach sagewort, both plugged and seeded, exhibited the highest survival rates, whereas coast bush lupine showed low survival. Mock-heather and dune bush lupine (*Lupinus chamissonis*) exhibited moderate rates of survival and growth.

Relevant Findings: A dune restoration project at Asilomar State Beach that involved a few species in common with the IAR MRA sites successfully employed overhead sprinklers and fertilizer to naturally stabilize the dune with non-native grasses prior to establishing native species. Dune bush lupine was seeded with moderate success.

4.0 OTHER CALIFORNIA RESTORATION PROJECTS

The following projects illustrate the effectiveness of certain restoration procedures that could be beneficially employed for the IAR MRA restoration sites.

4.1 Pismo Dunes

Two reports (Trent and Frey 1984; Frey 1983) provided summaries of propagation procedures for dune plant species. Few species required any seed treatment. Growth media were not particularly important to seed germination. Production of seedlings was most efficient when seeds were planted in Super Cells. A pinch of microporous seed or 2 to 3 macroporous seeds were planted in each cell. Seedlings were subsequently thinned from the parent cell and the root and top growth pruned. Using thinned seedlings from these cells to refill blank cells proved successful for every species. These transplants were kept in a mist house for approximately two weeks at Native Sons Wholesale Nursery in Arroyo Grande.

The objective of this project was to determine efficient methods for the propagation of California dune plant species (Table B-7), by either sexual or asexual means. Composites that had a pappus on the achene responded best without any treatment. Fresh seed was slow and uneven in germinating. Success of lupine propagation was the same regardless of treatments that involved heat and scarification. Pacific wax-myrtle (*Morella [Myrica]californica*) responded best to cold stratification for 40 days. California croton (*Croton californicus*) did not do well regardless of treatment but fair success was obtained from cuttings.

Sand-verbena was also given special attention. It was found that no special treatment was necessary. Seed could be planted as cleaned from the aggregate fruit structure (the anthocarp) or planted with the anthocarp still intact. Because the seed is attached to the ovary within the anthocarp, removing the seed is time consuming. Obtaining the desired quantity of sand-verbena seed was difficult; most of the anthocarps examined were empty.

Relevant Findings: Greenhouse plant propagation techniques for several species (occurring at or similar to those in the IAR MRA sites, e.g., coyote bush, mock-heather, wedge-leaved horkelia, dune bush lupine, etc.) were studied and evaluated for dune restoration in San Luis Obispo County. These procedures will assist in the propagation effort for the IAR MRA.

4.2 Huntington Beach

LSA (1990) described a dune restoration project adjacent to the Pacific Coast Highway between Brookhurst Street and the California Edison Power Plant in the City of Huntington Beach, California. This project created sand dune types that are analogous to naturally occurring formations, including a stabilized ridge with a swale between the ridge and the roadway and a deflation plain where the dune complex widens. The dune restoration plan increased the height of the dune, and vegetative cover was increased (Tables B-8, B-9, and B-10). Weed control was accomplished using a combination of horticultural, mechanical, and chemical methods, depending on the target species and the extent to which the plant was established.

Early successional plant species (i.e., foredune communities) in the Orange County area included sand-verbena, evening primrose, and beach bur. This community is often replaced during succession by dune scrub association of seep willow, buckwheat, goldenbush, lupine, and lemonade bush. Hind dune associations may be forested, and except for a sandy substrate may not be intuitively recognizable as a dune to the untrained observer.

Relevant Findings: A detailed irrigation strategy was developed for a coastal restoration site near Huntington Beach. This strategy will be reviewed and appropriate aspects of it will be employed in the irrigation management plan for the active restoration sites at the IAR MRA.

The goal of this dune restoration project was to achieve within five years vegetative cover and species diversity that is similar to existing occurrences of these habitats. Non-native species were to contribute no more than 20% of vegetative cover.

4.3 Coastal Sage Scrub Restoration

Padgett et al. (2000) tested whether supplemental irrigation was essential for successful restoration in coastal sage scrub of southern California. Alternatively, availability of water through irrigation might cause poor adaptation to arid conditions or produce only temporary success followed by failure once supplemental water is withdrawn.

Coastal sage scrub was the original vegetation type at the University of California's Agricultural Research Station in Riverside (the study site), but the site has been in agricultural production for more than 50 years. An experiment was conducted from November 1995 through June 1997 to test the effects of irrigation on revegetation of six coastal sage shrub species using broadcast seed. The field was graded smooth in preparation for planting; no furrows were created. Seeding densities conformed to those used by the California Department of Transportation in standard restoration efforts (Table B-11). The field study compared four irrigation methods: no irrigation, spring irrigation only, summer irrigation only, and irrigation year round (as needed).

Mean germination rates of California sagebrush, chaparral sunflower *(Encelia californica*), and sage (*Salvia*) were 50% and indicated a successful match between seed application and growing conditions. Poor germination for coyote bush and deerweed (*Acmispon glaber*) suggested either a poor match between seedling requirements or that the seeds of these species were less viable or not well represented in the seed mix that was used. In plots where water was applied all year long a single species, California sagebrush, represented nearly 100% of the species present at the end of two growing seasons; survival of buckwheat (*Eriogonum*) was 0% in the continuous water plots. Overall, irrigation resulted in short-lived differences in the timing of germination among the six species. Irrigation may speed revegetation under some conditions, but was not very effective in establishing natural vegetation structure. However, earlier emergence enabled by irrigation may be highly advantageous where slope stabilization and erosion control are important.

Relevant Findings: A seed mixture of six native shrub species was broadcast to test the efficacy of irrigation for restoration of coastal sage scrub. The field study compared four irrigation methods: no irrigation, spring irrigation only, summer irrigation only, and irrigation year round as needed. With irrigation, germination was accelerated by about one month. Spring or summer irrigation did not improve overall survival.

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Table B-1
Habitat Restoration Plan
Interim Action Ranges Munitions Response Area
FORA ESCA RP

Fort Ord Re-Vegetation Study Site Characteristics[a]

Range	Site	Pre-remediation Vegetation	Slope (%)	Aspect (compass degrees)	Soil Lift Depth	Soil Treatment	Soil Replacement
18	1	Intermediate oak woodland and maritime chaparral transition with severe levels of disturbance and invasion by non-native *Carpobrotus edulis*	17	319	12"	dry screening, heating	yes
19	1	Undisturbed maritime chaparral habitat dominated by mature stands of recently burned *Arctostaphylos tomentosa*	3	212	9-12"	soil washing, phosphate stabilizer	yes
19	2	Undisturbed maritime chaparral habitat dominated by mature stands of recently burned *Arctostaphylos tomentosa*	3-7	180	9-12"	Not Applicable	no

[a] Tabluated from Detka (2005).

Table B-2
Habitat Restoration Plan
Interim Action Ranges Munitions Response Area
FORA ESCA RP

Fort Ord Re-Vegetation Species[a]

Common Name	Latin Name	Species Proposed in IAR HRP Plant Palette?	# Plants Installed	# Plants Surviving	Survivability (%)	# Plants Installed	# Plants Surviving	Survivability (%)	# Plants Installed	# Plants Surviving	Survivability (%)
			Range 18 Site 1 (Dry Separation)			Range 19 Site 1 (Wet Separation)			Range 19 Site 2 (Excavation)		
Blue Wild Rye	*Elymus glaucus*	*N*	28	16	43%	21	1	95%	10	3	70%
Black Sage	*Salvia mellifera*	*Y*	21	19	10%	21	2	90%	9	7	22%
California Coffeeberry	*Rhamnus californica*	*Y*	35	13	63%	32	3	91%	18	9	50%
Coyote Brush	*Baccharis pilularis*	*Y*	25	23	8%	34	9	74%	12	9	25%
Mock Heather	*Ericameria ericoides*	*Y*	33	25	24%	21	3	86%	14	4	71%
Purple Needlegrass	*Nasella pulchra*	*N*	36	21	42%	22	3	86%	15	10	33%
Wedge-leaf Horkelia	*Horkelia cuneata*	*Y*	30	20	33%	32	2	94%	12	6	50%
Bush Lupine	*Lupinus arborius*	*N*	35	18	49%	39	0	100%	19	3	84%
California sagebrush	*Artemesia californica*	*N*	31	28	10%	30	13	57%	18	17	6%
Manzanita	*Arctostaphylos species*	*Y*	26	11	58%	18	1	94%	7	3	57%
Total Plant Count			**300**	**184**	**39%**	**270**	**37**	**86%**	**134**	**71**	**47%**

[a] Tabluated from Detka (2005).

Table B-3
Habitat Restoration Plan
Interim Action Ranges Munitions Response Area
FORA ESCA RP

Native Perennial Plant Species Observed at the Mitigation Site and at the Target Area [a]

Species	Observed	
Scientific Name (Common Name)	Mitigation Site	Target Area
Adenostoma fasciculatum (Chamise)	X	X
Artemisia californica (California sagebrush)	X	X
Artemisia dracunculus (Tarragon)	X	
Baccharis pilularis (Coyote brush)	X	X
Ceanothus cuneatus (Coast ceanothus)	X	X
Croton californicus (Croton)	X	
Distichlis spicata (Salt grass)	X	
Ericameria ericoides (Mock heather)	X	X
Eriogonum fasciculatum (Buckwheat)		X
Horkelia cuneata (Horkelia)		X
Lessingia filaginifolia (California aster)	X	X
Lotus scoparius (Deerweed)	X	
Lupinus chamissonis (Dune lupine)	X	
Nassella pulchra (Purple needlegrass)	X	
Penstemon centranthifolius (Scarlet buglar)	X	
Prunus fasciculatum (Sand almond)	X	
Quercus agrifolia (Coast live oak)	X	X
Rhamnus californica (Coffeeberry)	X	X
Rhamnus crocea (Redberry)	X	X
Salvia mellifera (Black sage)	X	X
Sambucus mexicana (Elderberry)	X	
Toxicodendron diversilobum (Poison oak)	X	X
Total Number of Plants	20	13

[a] Tabulated from Science Applications International (2004).

Plant Protective Devices Recommended for Species Planted at the Burton Mesa Mitigation Site [a]

Species	Devices Suggested	Notes
Chamise	Mesh cage, weed mat	Gopher cages should also be considered in areas with high levels of gopher activity.
Coast Live Oak	Tree shelter OR mesh cage, weed mat, gopher cage	Tree shelters or mesh cages should be used depending on the goals of the project.
Coffeeberry	Mesh cage, weed mat, gopher cage	
Redberry	Mesh cage, weed mat, gopher cage	
Black Sage	Weed mat, gopher cage	

[a] Tabulated from Science Applications International (2004).

Hydromulching Species Groups at Spanish Bay Dune Restoration.[a]

Foredune[1]	Middune	Hinddune
Abronia latifolia	*Achillea borealis*	*Achillea borealis*
Artemesia pycnocephala	*Armeria maritima*	*Camissonia cheiranthifolia*
Baccharis pilularis	*Artemesia pycnocephala*	*Corethrogyne californica*
Cakile maritima	*Baccharis pilularis*	*Dudleya farinosa*
Camissonia cheiranthifolia	*Camissonia cheiranthifolia*	*Eriogonum latifolium*
Castilleja latifolia	*Castilleja latifolia*	*Eriophyllum staechadifolium*
Corethrogyne californica	*Corethrogyne californica*	*Eschscholzia californica*
Erigeron glaucus	*Dudleya farinosa*	*Franseria chamissonis*
Franseria chamissonis	*Eriogonum parvifolium*	*Haplopappus ericoides*
Haplopappus ericoides	*Franseria chamissonis*	*Lupinus chamissonis*
Lathyrus littoralis	*Lupinus chamissonis*	

[1] At Spanish Bay the foredunes are further inland from what would normally be considered true foredunes, therefore additional species were utilized here.

[a] Tabluated from Allen and Guinon (1987).

Relative Seed Cleaning Time for Spanish Bay Dune Restoration Species.[a]

Time	Species	Common Name
Maximum	*Lathyrus littoralis*	Beach Pea
↑	*Lupinus chamissonis*	Lupine
↑	*Armeria maritima*	Sea Pink
↑	*Camissonia cheiranthifolia*	Beach Evening Primrose
↑	*Castilleja latifolia*	Seaside Painted Cup
↑	*Haplopappus ericoides*	Mock Heather
↑	*Erigeron glaucus*	Seaside Daisy
↑	*Cakile maritima*	Sea Rocket
↑	*Eriogonum ssp*	buckwheat
↑	*Dudleya ssp*	Liveforever
↑	*Achillea borealis*	Yarrow
↑	*Eriophyllum staechadifolium*	Lizard Yail
↑	*Artemisia pycnocephala*	Beach Sagewort
↑	*Franseria chamissonis*	Beach Bur
Minimum	*Convolvulus soldanella*	Beach Morning Glory

[a] Tabluated from Allen and Guinon (1987).

Restoration Species Analyzed for Germination Rates.[a]

Abronia latifolia	*Ericameria ericoides (Haplopappus)*
Abronia maritima	*Erigeron foliosus blochmaniae*
Abronia umbellata	*Erigeron glaucus*
**Ambrosia chamissonis*	**Erioqonum parvifolium*
Atriplex leucophylla	*Eriophyllum staechadifolium artimisiaefolium*
Baccharis pilularis consanguinea	**Erysimum insulare*
Calystegia soldanella	*Isocoma veneta*
**Camissonia cheiranthifolia*	*Juncus leseurii*
Castilleja miniata	**Lupinus arboreus*
Cirsium loncholepis	**Lupinus chamissonis*
Cirsium rhothophilum	*Malacothrix incana*
Coreopsis gigantia	**Monardella crispa*
**Corethrogyne filanginifolia robusta*	**Monardella undulata frutescens*
Croton californicus	*Myrica californica*
Dithyrea maritima	**Oenothera hookeri*
Elymus mollis	*Potentilla kelloggii cuneata (Horkelia cuneata}*
Elymus multinodus	**Senecio blochmaniae*
Elymus pacificus	**Solidaqo guiradonis luxurians (S. confinis)*

*microporous seeds usually germinated in about one week

[a] Tabluated from Trent and Fay (1984).

Representative Plant Species at Huntington Beach, CA.[a]

	Scientific Name	Common Name
*	*Juncus acutus var. sphaerocarpus (J. a. var.leopoldii)*	Spiny Rush
	Juncus balticus	Wire Rush
*	*Lupinus chamissonis*	Purple Bush lupine
+	*Myoporum laetum*	Myoporum
+	*Nicotiana glauca*	Tree Tabacco
+	*Olea europaea*	Olive
	Phacelia ramosissima	Branching Phacelia
*	*Pluchea purpurascens (odorata)*	Marsh Fleabane
+	*Raphanus sativus*	Wild Radish
*	*Rosa californica*	California Rose
*	*Rhus integrifolia*	Lemonadeberry
	Salicornia cf. virginica	Pickleweed
*	*Salix hindsiana*	Sandbar Willow
*	*Salix lasiolepis*	Arroyo Willow
+	*Salsola australis*	Russian Thistle
+	*Schinus molle*	Pepper Tree
	Scirpus californicus	California Bulrush
	Scirpus olneyi (americanus)	Alkali Bulrush
	Scirpus robustus	Alkali Bulrush
	Suaeda sp.	Sea Blite
	Typha angustifolia	Narrowleaf Cattail
+	*Xanthium cf. strumarium*	Cocklebur

*Primary revegetation species.

+Non-native and other weedy plant species to be removed

[a] Tabluated from LSA (1990).

Hydroseed mixes at Huntingotn Beach, CA.[a]

Windward Side Mix	Leeward Side Mix
Abronia maritima	Atriplex canescens
Abronia umbellata	Baccharis douglassii
Camissonia cheiranthifolia	*Camissonia cheiranthifolia
Convolvulus soldanella	*Encelia californica
*Encelia californica	Eriogonum fasciculatum
Eriogonum fasciculatum	*Eriogonum parvifolium
*Eriogonum parvifolium	*Franseria chamissonis
*Franseria chamissonis	Heliotropium curassavicum
Heliotropium curassavicum	Isomeris arborea
Isomeris arborea	Lupinus bicolor
Lathyrus littoralis	*Lupinus chamissonis
Lupinus bicolor	
*Lupinus chamissonis	

*Emphasis species

[a] Tabluated from LSA (1990).

Native Plant Cover Goals at Huntington Beach, CA[a].

Location on Dune	Percent Total Cover				
	Year 1	Year 2	Year 3	Year 4	Year 5
Soft Shoulder	5	10	15	15	15
lower Windward Side	30	45	55	55	55
Upper Windward Side	30	45	55	55	55
Upper lee Side	30	50	60	60	60
Lower Lee Side	35	50	65	75	75
Dune-Marsh Transition	40	55	70	80	80
Deflation Plain	30	45	60	75	95

[a] Tabluated from LSA (1990).

Seeding densities for the individual species (percent live seed and number of seeds per gram was as indicated by the seed vendor). [a]

Species	Seeding rate (g m^{-1})	Pure live seed (%)	Seed/g (# g^{-1})	Live seed (# m^{-2})
Artemisia californica	1.1	10.1	12,277	1364
Encelia californica	0.7	32.3	391	88
Eriogonum fasciculatum	2.65	7.1	1,004	189
Lotus scoparius	0.74	86	1,004	639
Salvia mellifera	1.28	20.5	1,395	366
Baccharis pilularis	0.4	2	11,161	89

[a] Tabulated from Padgett et al. (2000).

APPENDIX C

ESCA RP Seed Collection, Processing, and Storage Protocol

FORA ESCA REMEDIATION PROGRAM

Draft Final

Appendix C. Seed Collection, Processing, Drying, and Storage

Phase II Interim Action Work Plan Addendum
Habitat Restoration Plan
Interim Action Ranges Munitions Response Area

Former Fort Ord
Monterey County, California

February 1, 2013

Prepared for:

FORT ORD REUSE AUTHORITY

920 2nd Avenue, Suite A
Marina, California 93933

Prepared Under:

Environmental Services Cooperative Agreement
No. W9128F-07-2-01621
and
FORA Remediation Services Agreement (3/30/07)

Document Control Number: 09595-10-086-012

Prepared by:

ARCADIS

WESTON SOLUTIONS

WESTCLIFFE | ENGINEERS

CONTENTS

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ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

ESCA	Environmental Services Cooperative Agreement
FORA	Fort Ord Reuse Authority
HMP	Habitat Management Plan (USACE 1997)
IAR	Interim Action Ranges
MRA	Munitions Response Area
RP	Remediation Program
USACE	U.S. Army Corps of Engineers

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1.0 INTRODUCTION

This plan addresses the activities and protocols associated with the 1) collection, 2) processing, 3) drying, and 4) storage of native seed for use in the restoration areas associated with investigation for munitions and explosives of concern in the Interim Action Ranges (IAR) Munitions Response Area (MRA). It also discusses collection and handling for cuttings and soil seed bank.

Seeds are collected directly from plants and/or their surroundings primarily within the IAR and other Environmental Services Cooperative Agreement Remediation Program (ESCA RP) MRAs at the former Fort Ord and transported to the ARCADIS Marina office or Future East Garrison MRA soil seed bank storage building for processing, drying, and storage. This protocol covers these activities.

2.0 COLLECTION

Native seeds and cuttings collected in ESCA RP parcels will be collected as per requirements in the Installation-Wide Multispecies Habitat Management Plan (HMP; USACE 1997), standard seed handling practices in Propagation of Native California Plants (Emery 1988), and guidance from Monterey Bay Area nurseries who grow container plants from seeds and cuttings. The ESCA RP guidelines for collection of seeds and cuttings are the following:

- Seed or cutting collection of HMP species (*Arctostaphylos pumila*, *Ceanothus rigidus*, *Chorizanthe pungens* var. *pungens*, *Cordylanthus rigidus* ssp. *littoralis*, *Ericameria fasciculata*, and *Gilia tenuiflora* ssp. *arenaria*) will be limited to no more than 5% of the seeds/cuttings of any given population, and no more than 5% of the seeds/cuttings from any individual plant. There is no limit on the amount of seed or plant material that may be collected if the area is permitted for removal or obliteration ("salvage").
- Seed or cutting collection on non-HMP species will be limited to no more than 10% of the seeds/cuttings of any given population, and no more than 10% of the seeds/cuttings from any individual plant. There is no limit on the amount of seed or plant material that may be collected if the area is permitted for removal or obliteration ("salvage").
- Collect from different areas (within required collection range) to increase genetic diversity.
- Collect from parent plants of different size and shapes in an effort to increase genetic variability.
- Do not collect from plants with observed pests, fungus, or other illness.
- Collect seeds in paper bags or open buckets.
- Perform cursory cleaning in the field to maximize the number of seeds and minimize the amount of chaff brought into the office.
- Cuttings will be collected in the early morning and delivered to nurseries by midday to ensure freshness.

- Cuttings will not be taken when plants are covered in frost.
- Field staff will coordinate with each nursery to ensure that cuttings are suitable to the individual nursery propagator. Each nursery may have different approaches that require young or mature wood, soft or hard wood, new growth or old growth, etc.

2.1 Soil Seed Bank Collection for HMP annuals

Soil seed bank for HMP annuals will only be collected as salvage. It will be collected by initially removing surrounding surface vegetation then using a flat headed shovel to remove the top 2 inches of soil around the target plant species. For Monterey gilia (*Gilia tenuiflora* subsp. *arenaria*), the radius of the area removed around a single plant is the height of the plant based on the assumption that taller plants disperse seeds further.

Soil seed bank is collected on dry days when the soil is dry, such as during the late spring and summer after plants have matured. The soil is shoveled into 5-gallon buckets and placed in storage.

2.2 Seed Collection Documentation

Seed and cutting collection activities will be recorded in field books, including: species, approximate location of collection (range/road), approximate number of plants collected from, collectors name(s), and notes (status of fruiting, etc). Areas where seeds or cuttings have been collected should be thoroughly documented on maps to avoid repeatedly collecting genetic material in the same location. Seed collectors will label collection bags/containers with the date, collection location, collector's initials, and species name or four-letter acronym.

3.0 PROCESSING

3.1 Seed Processing

Seeds need to be processed to remove as much non-seed material (i.e., "chaff" and/or other plant material) as possible prior to drying. Seed processing is performed manually and involves hand sorting and/or sieving. Some seeds require crushing the seed 'pod' with a wooden roller and extracting the seed (e.g., Monterey ceanothus [*Ceanothus rigidus*]). Other seeds require mashing the seeds to break the fleshy fruit and then soaking the seeds in a bucket of water to separate the viable seeds from the fruit and the unviable seeds (e.g., California coffeeberry [*Frangula californica*]). A separate phase of the processing occurs after the drying (below) in which all seeds are treated with a commercial larvicide (moth balls) to kill possible larvae in the seed or chaff. This involves putting seeds in a closed 5-gallon bucket with 3 moth balls for at least two days. Because of the strong odor all work with moth balls is done in the open air. After adding larvicide, the buckets are tightly sealed with a lid and stored for two days during the treatment period. After the two days, they are taken outside again to remove the larvicide in open air and transferred to tightly closing plastic containers for refrigerated or non-refrigerated storage as described below.

3.2 Cuttings Processing

Cuttings will be bundled so all the cut ends are together, like a floral bouquet. The cut ends will be wrapped in moist burlap so it holds the 'bouquet' together and placed in a plastic bag. These bags are then clearly marked with the name of the nursery contracted to grow them, scientific name of the species, "ARCADIS", an identifying bag number, and the date of collection. Cuttings will be stored in white plastic bags and immediate delivered to nurseries. All of the above documentation will also be recorded in field notes and on a spreadsheet and will include the exact location of the cuttings, characteristics of the plants in the area, and environmental conditions.

4.0 SEED DRYING

Seed drying is done to reduce seed moisture just enough to avoid decay during storage. Seeds will be dried on an open seed drying rack or cookie sheet in an enclosed area at 80º Fahrenheit until there is no clear sign of moisture such as green leaves or stems. This usually takes 24 to 48 hours. Coffee berry (*Frangula* [*Rhamnus*] *californica*) does not need to be dried if it can be sown fresh shortly after collection.

5.0 SEED STORAGE

Seeds will be stored in tightly closing Tupperware containers in refrigerators. A desiccant pack will be included in each container to avoid decay. All stored seeds will be inspected every 3 months for any signs of decay or degradation. Desiccant packs will be changed if necessary. Do not store seeds in closed plastic bags or buckets unless seeds are thoroughly dried.

Soil seed bank will be collected when the soil is dry. It will be stored at a moderate temperature (without large temperature fluctuations) in a dry place in barely open 5-gallon buckets to allow any trapped moisture to escape as needed and prevent decay. A nail or small stick can be used to leave a small crack that doesn't allow rodents to enter the bucket.

6.0 REFERENCES

Emery, Dara. 1988. Seed Propagation of Native California Plants. Santa Barbara Botanic Garden. 115pp.

U.S. Army Corps of Engineers (USACE). 1997. Installation-Wide Multispecies Habitat Monitoring Plan for Former Fort Ord, California. April. Sacramento, California.

APPENDIX D

Response to Comments on Draft IAR MRA Habitat Restoration Plan

Response to Comments
DRAFT Phase II Interim Action Work Plan Addendum, Habitat Restoration Plan, Interim Action Ranges Munitions Response Area, dated August 23, 2012
Review comments provided by Ed Walker of the DTSC, dated November 21, 2012

No.	Comment Type / Report Section	Comment / Response
1	General	**Comment:** The Habitat Management Plan should meet all State regulations for protection of threatened and endangered species. **Response:** The Interim Action Ranges Habitat Restoration Plan complies with the requirements of the Installation-Wide Multispecies Habitat Management Plan (HMP) and applicable Biological Opinions. The Army, in coordination with the California Department of Fish and Game, has developed the mitigation measures included in the HMP to protect state and federal rare, threatened, and endangered species. These mitigation measures will be implemented as part of the munitions response action.
2	General	**Comment:** DTSC would like to emphasize this is an Interim Action and a site safety plan should accommodate all work performed in the Interim Action Ranges. DTSC recommends that a site safety plan be attached to the final work plan or be referenced and adhered to during all field activities. **Response:** A Site Safety and Health Plan (SSHP) will be submitted as an attachment to a Field Variance Form (FVF) to the Phase II Interim Action Work Plan. The SSHP will be added to the work plan as an additional appendix to include field activities associated with habitat restoration operations.

Department of Toxic Substances Control

Matthew Rodriquez
Secretary for
Environmental Protection

Deborah O. Raphael, Director
8800 Cal Center Drive
Sacramento, California 95826-3200

Edmund G. Brown Jr.
Governor

November 21, 2012

Mr. Stan Cook
Fort Ord Reuse Authority
920 2nd Avenue, Suite A
Marina, California 93933

DRAFT PHASE II INTERIM ACTION WORK PLAN ADDENDUM, HABITAT RESTORATION PLAN, INTERIM ACTION RANGES RESPONSE AREA, FORMER FORT ORD, MONTEREY COUNTY, CALIFORNIA, AUGUST 23, 2012

Dear Mr. Cook:

The Department of Toxic Substances Control (DTSC) has reviewed the Draft Phase II Interim Action Work Plan, Habitat Restoration Plan, Interim Action Ranges Response Area, Former Fort Ord, Monterey County, CA, dated August 23, 2012. DTSC concurs that the Habitat Restoration Plan meets or exceeds the expectations specified in the Interim Action Ranges Habitat Management Plan for the Former Fort Ord (U.S. Army Corps of Engineers 1997). DTSC requests that the following comments be addressed in the draft final version of this document:

1. The Habitat Management Plan should meet all State regulations for protection of threatened and endangered species.

2. DTSC would like to emphasize this is an interim action and a site safety plan should accommodate all work performed in the interim action ranges. DTSC recommends that a site safety plan be attached to the final work plan or be referenced and adhered to during all field activity.

If you have any questions regarding this letter, please contact me at (916) 255-4988 or through e-mail at ed.walker@dtsc.ca.gov.

Sincerely,

Ed Walker
Military Sites and Corrective Action Unit
Brownfields and Environmental Restoration Program

cc (via e-mail):

Mr. Noel Shrum, DTSC