Fort Ord

Multi-Species Habitat Conservation Plan

Volume 2: Appendices

FORA
Fort Ord Reuse Authority

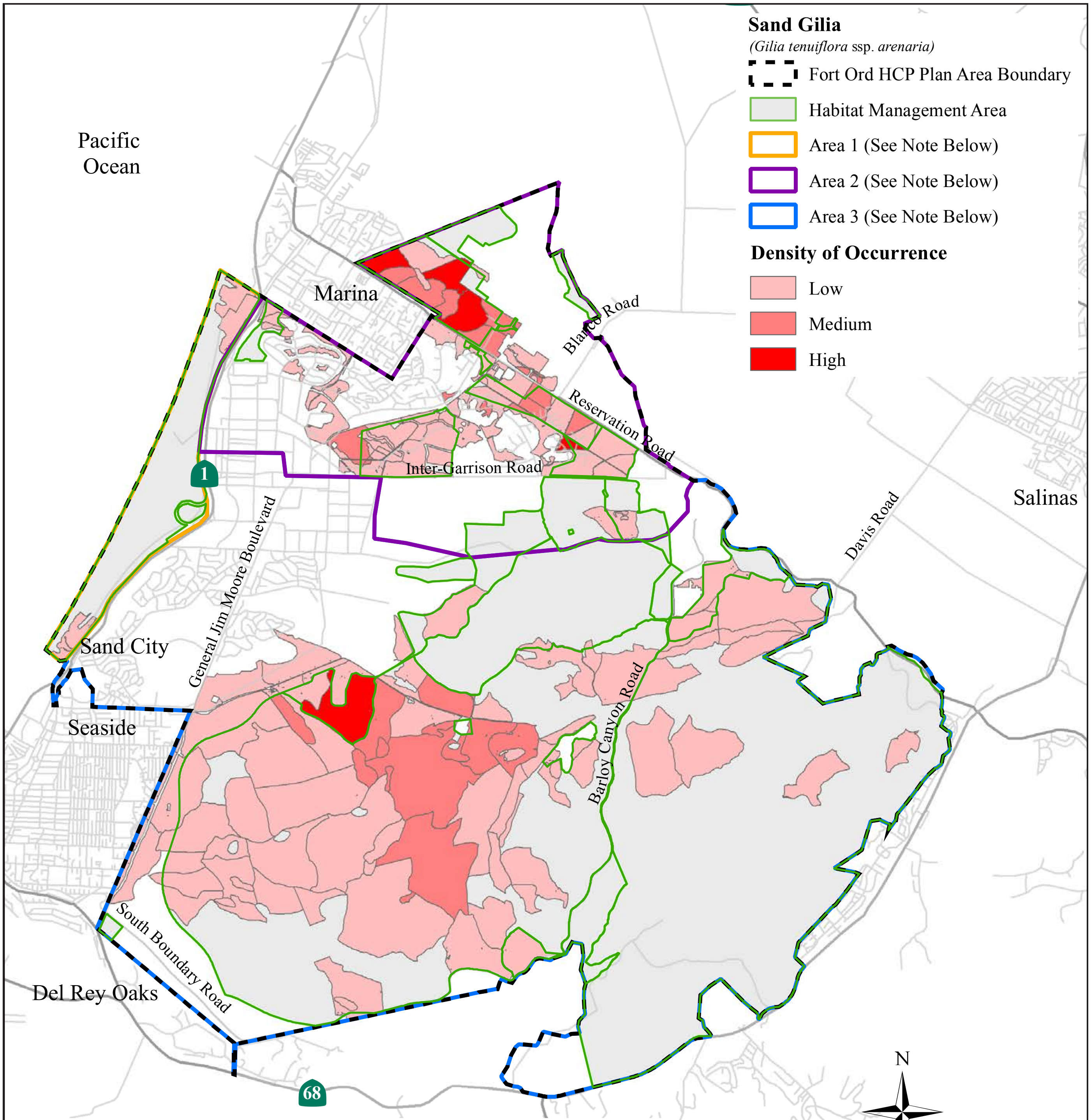
ICF

September 2019

Cover illustrations: Estelle DeRidder, 2018

List of Appendices

Appendix A
HCP Species Occurrence Maps



Note: At the request of CDFW, the effects on sand gilia were evaluated for three geographic areas in the Plan Area. Area 1 includes 147 acres (2%) of species occurrences and consists of the lands west of Highway 1 within the FODSP. Area 2 includes 1,700 acres (19%) of species occurrences and is comprised of lands in and around the City of Marina, including the FONR property. Area 3 includes 7,264 (80%) acres of species occurrences and encompasses the remainder of the Plan Area, including the NRMA.

Source: Denise Duffy and Associates

Graphics … 00533.07 HCP (4/19/2017) TG

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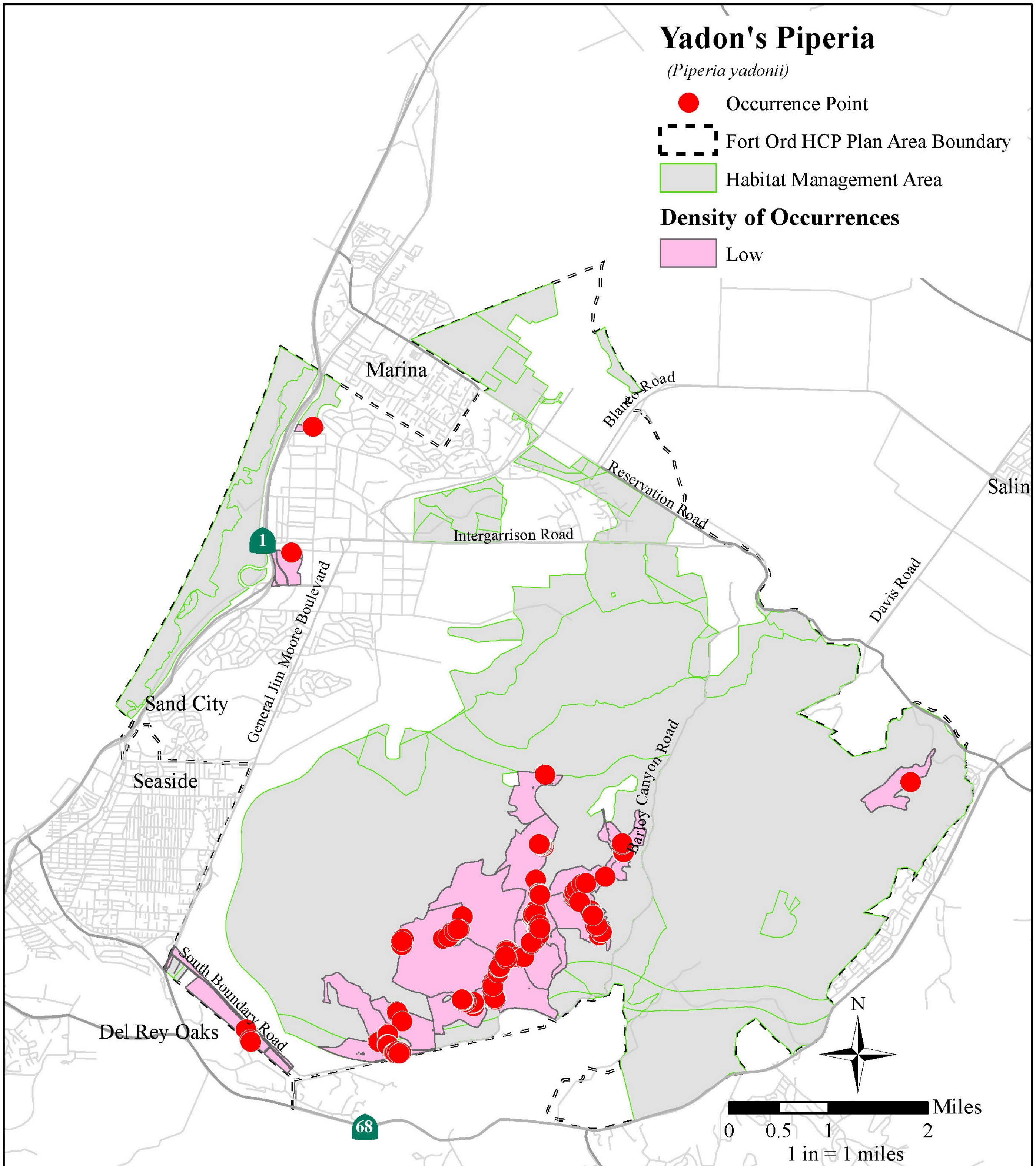
Figure A-1
Locations of Sand Gilia



D:\GIS\GIS_Projects\2444 FORAHCP\Final Products\Final Maps\Yadons Piperia JSA Polygons 20170203.mxd

Source: Denise Duffy and Associates

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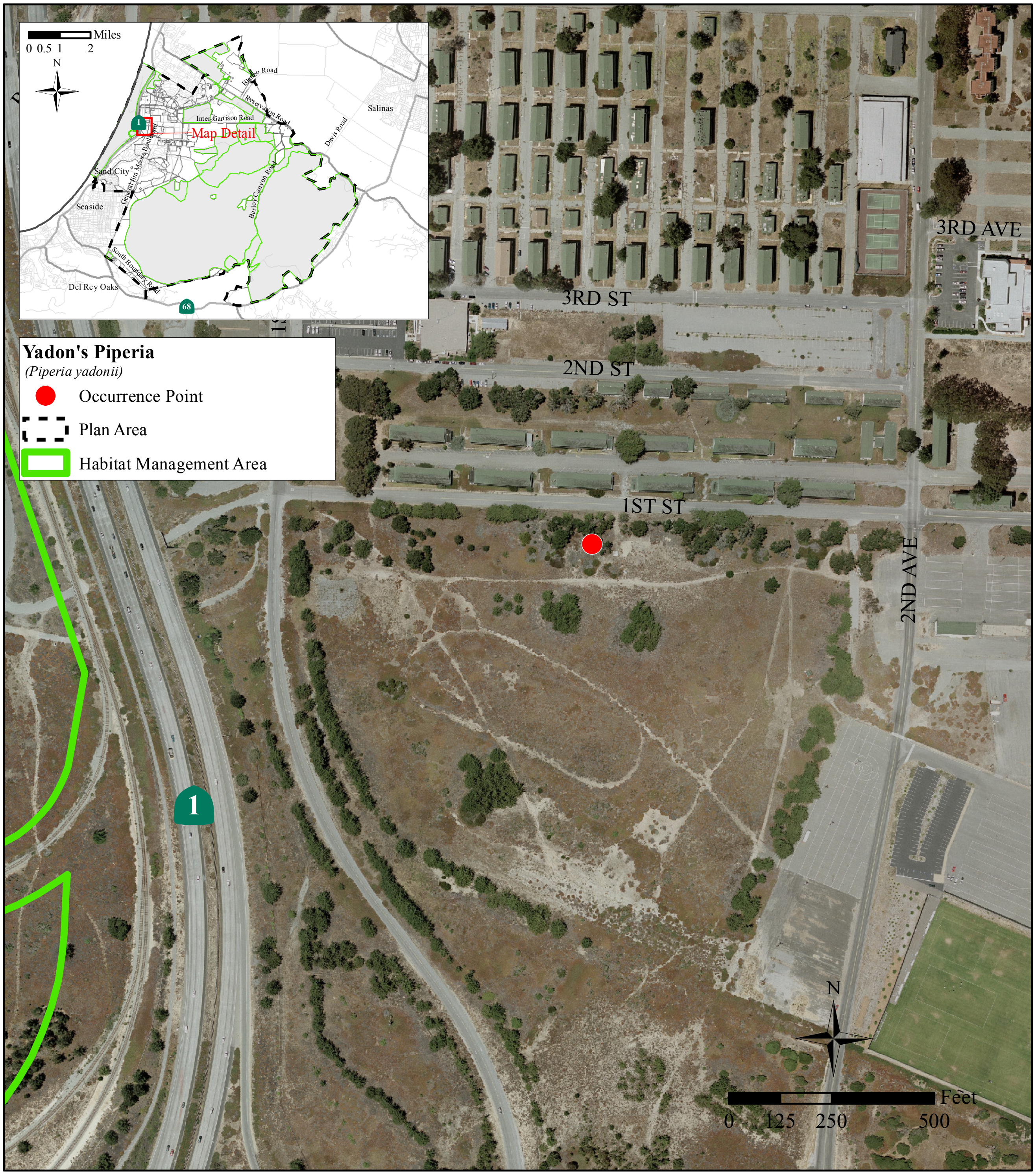
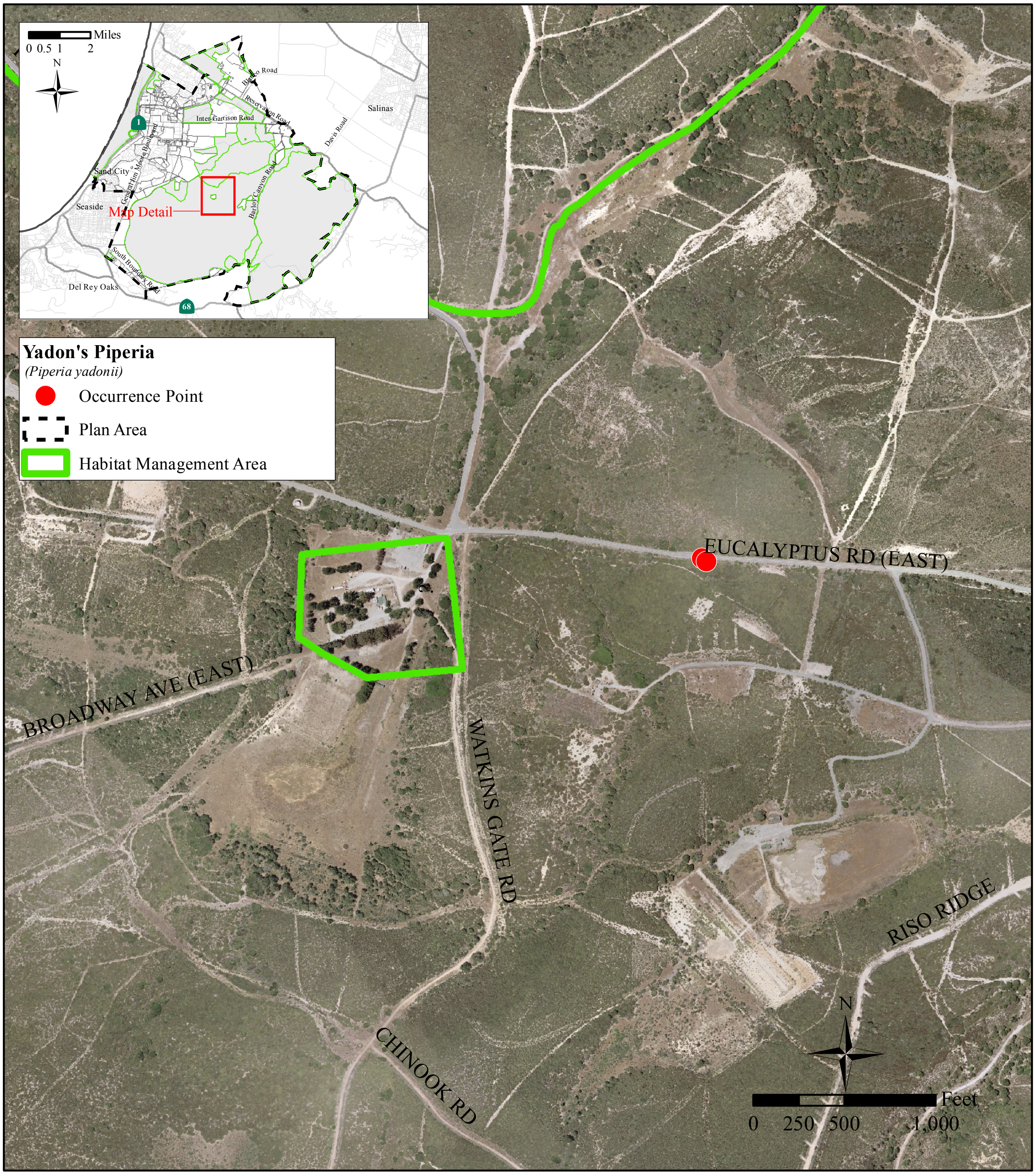
Figure A-2a
Location of Yadon's Piperia in the Plan Area



Source: Denise Duffy and Associates

Graphics … 00533.07 HCP (4/19/2017)

Figure A-2b
Location of Yadon's Piperia (1st Street)



Source: Denise Duffy and Associates

Graphics ... 00533.07 HCP (4/19/2017) TG

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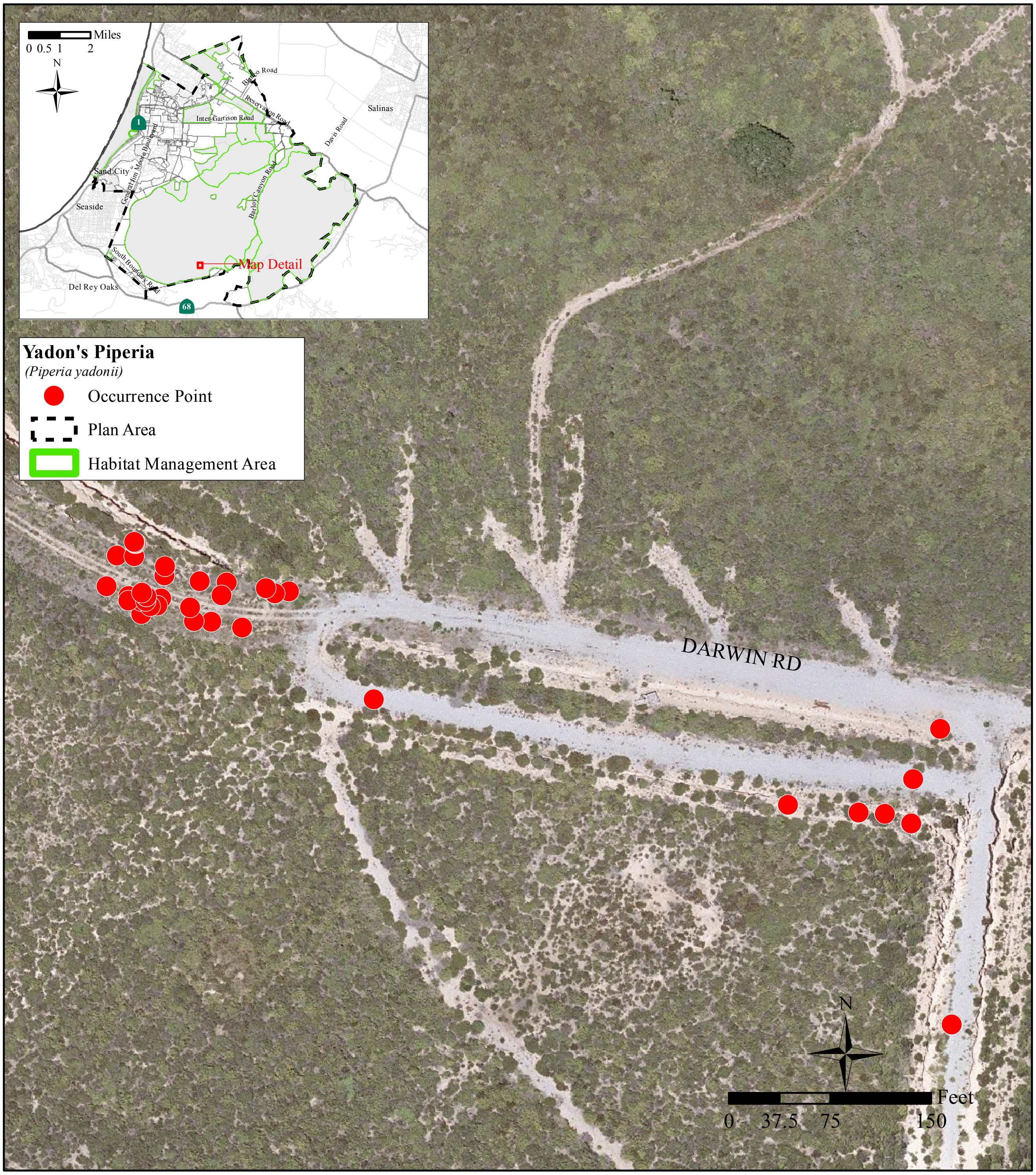
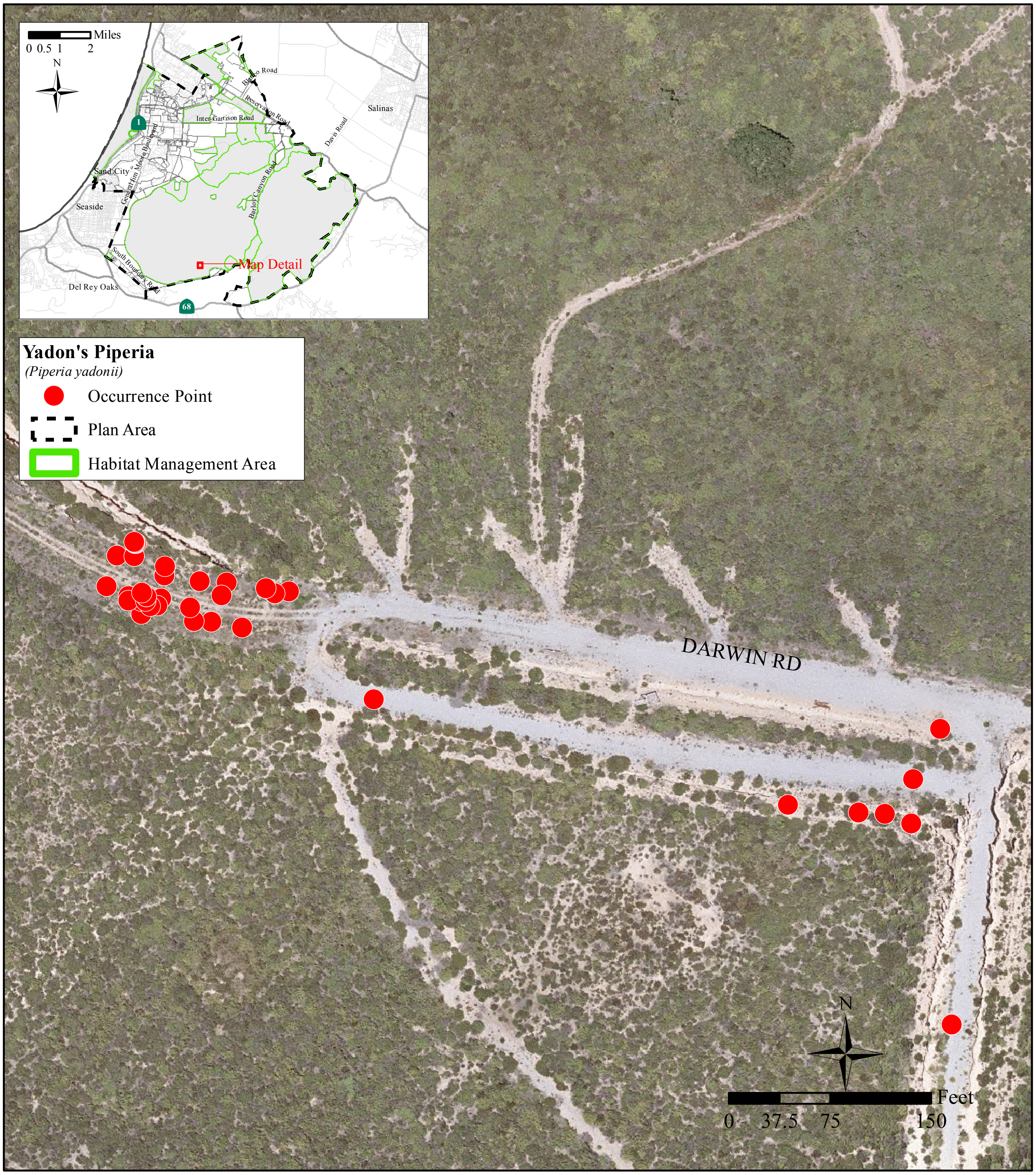
Figure A-2c
Location of Yadon's Piperia (BLM Office)



Source: Denise Duffy and Associates

Graphics … 00533.07 HCP (4/19/2017)

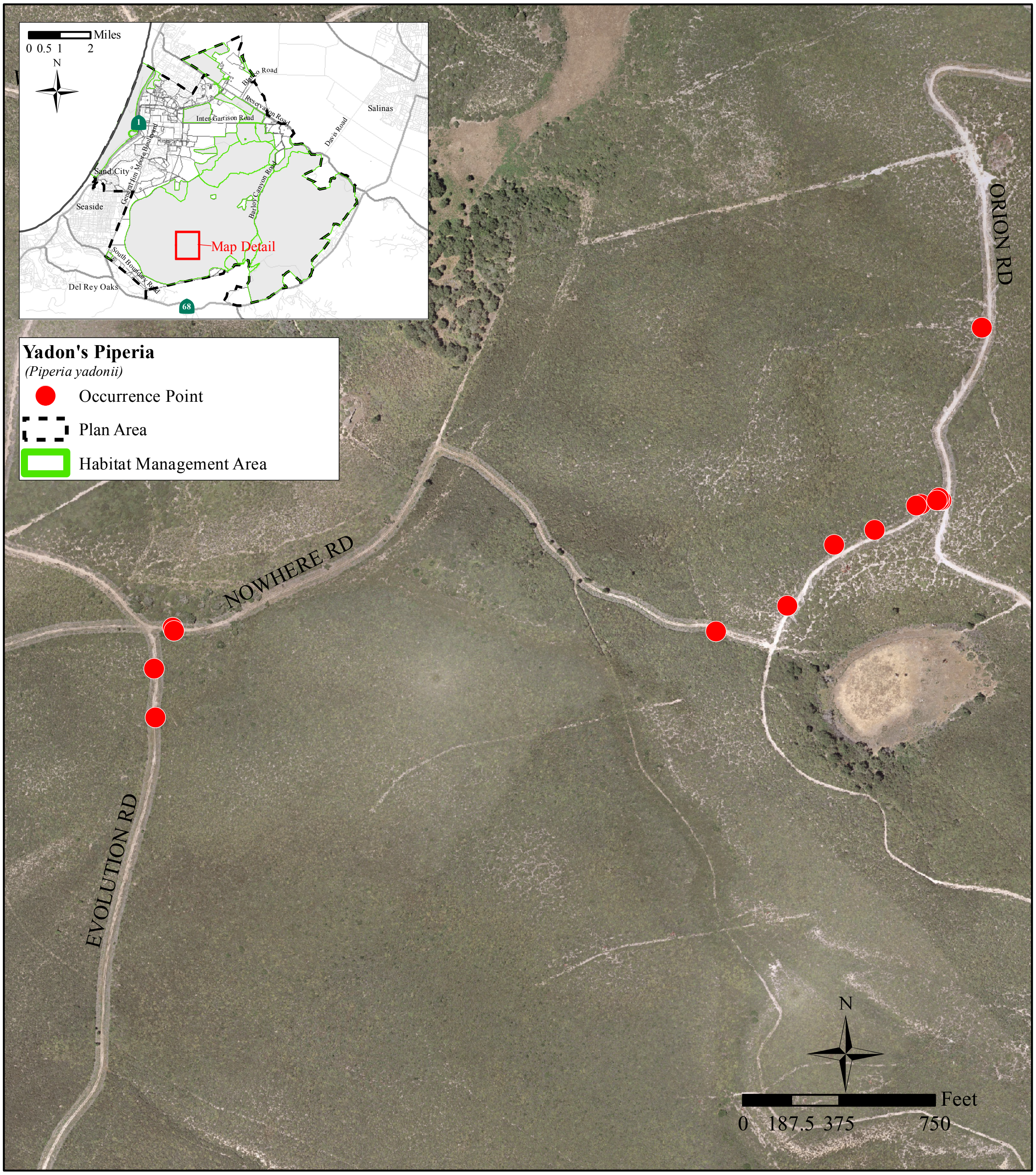
Figure A-2d
Location of Yadon's Piperia (Darwin Road)



Source: Denise Duffy and Associates

Graphics … 00533.07 HCP (4/19/2017) TG

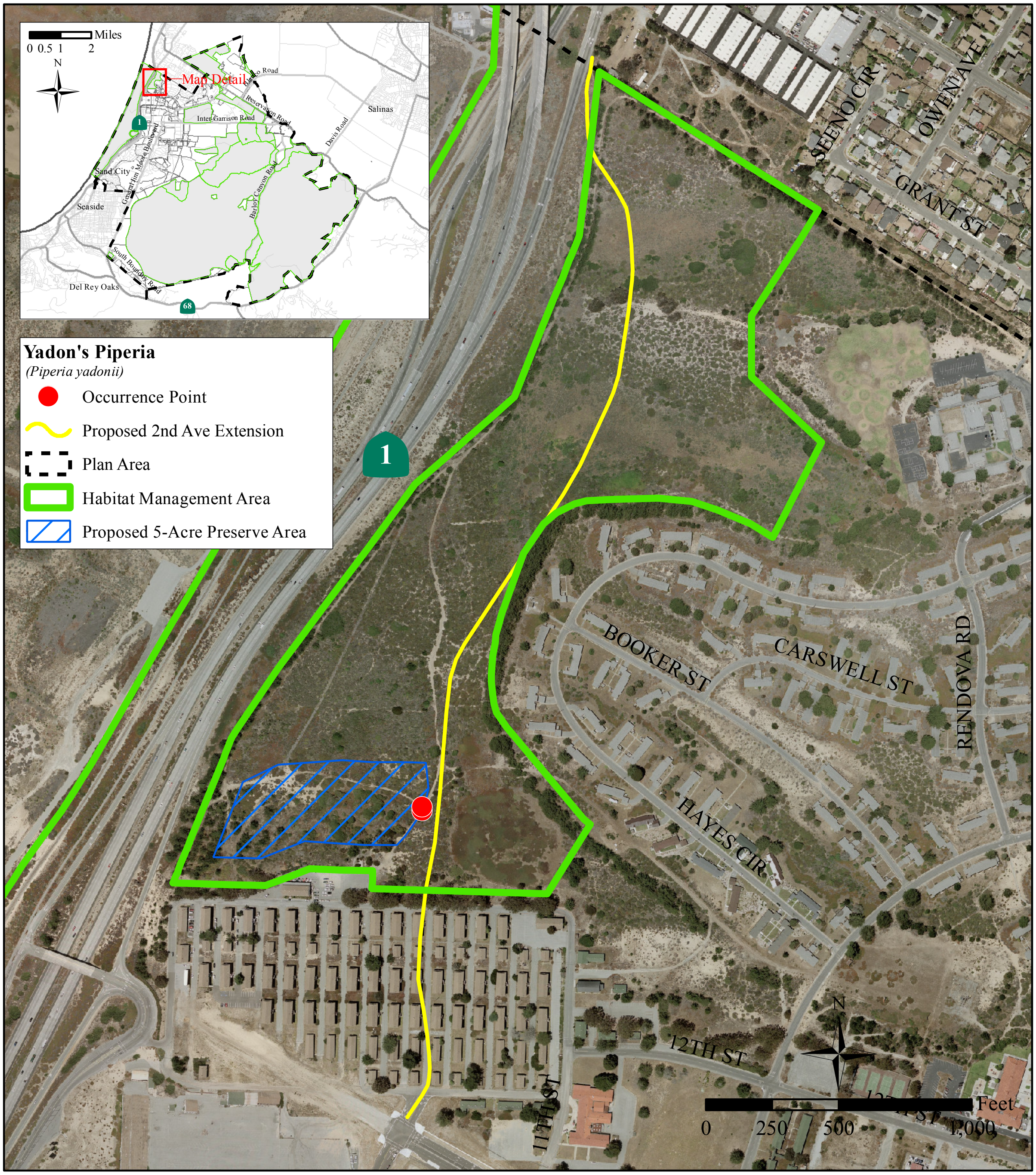
Figure A-2e
Location of Yadon's Piperia (Evolution Road)



Source: Denise Duffy and Associates

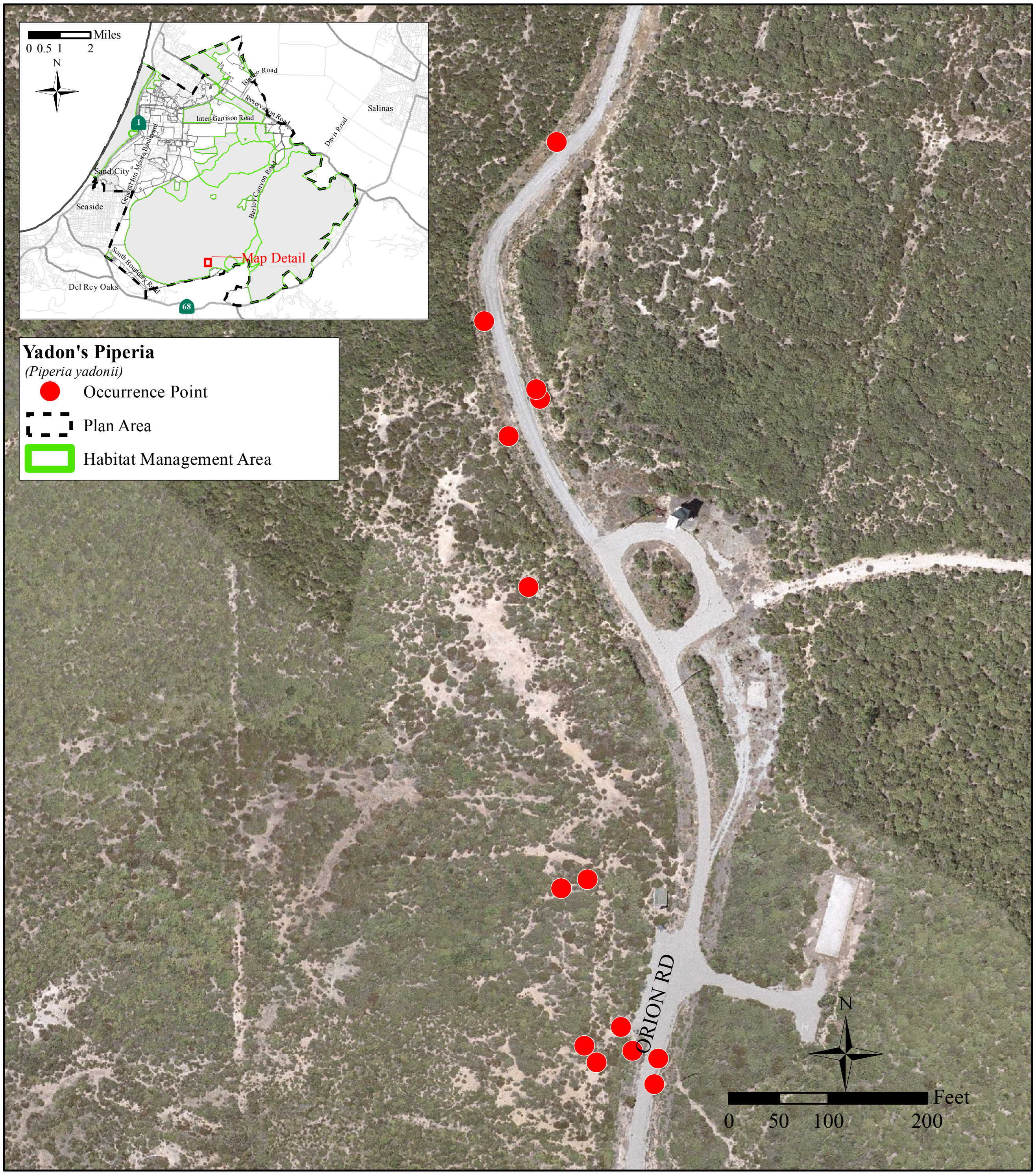
Graphics … 00533.07 HCP (4/19/2017)

Figure A-2f
Location of Yadon's Piperia (Nowhere Road)



Source: Denise Duffy and Associates

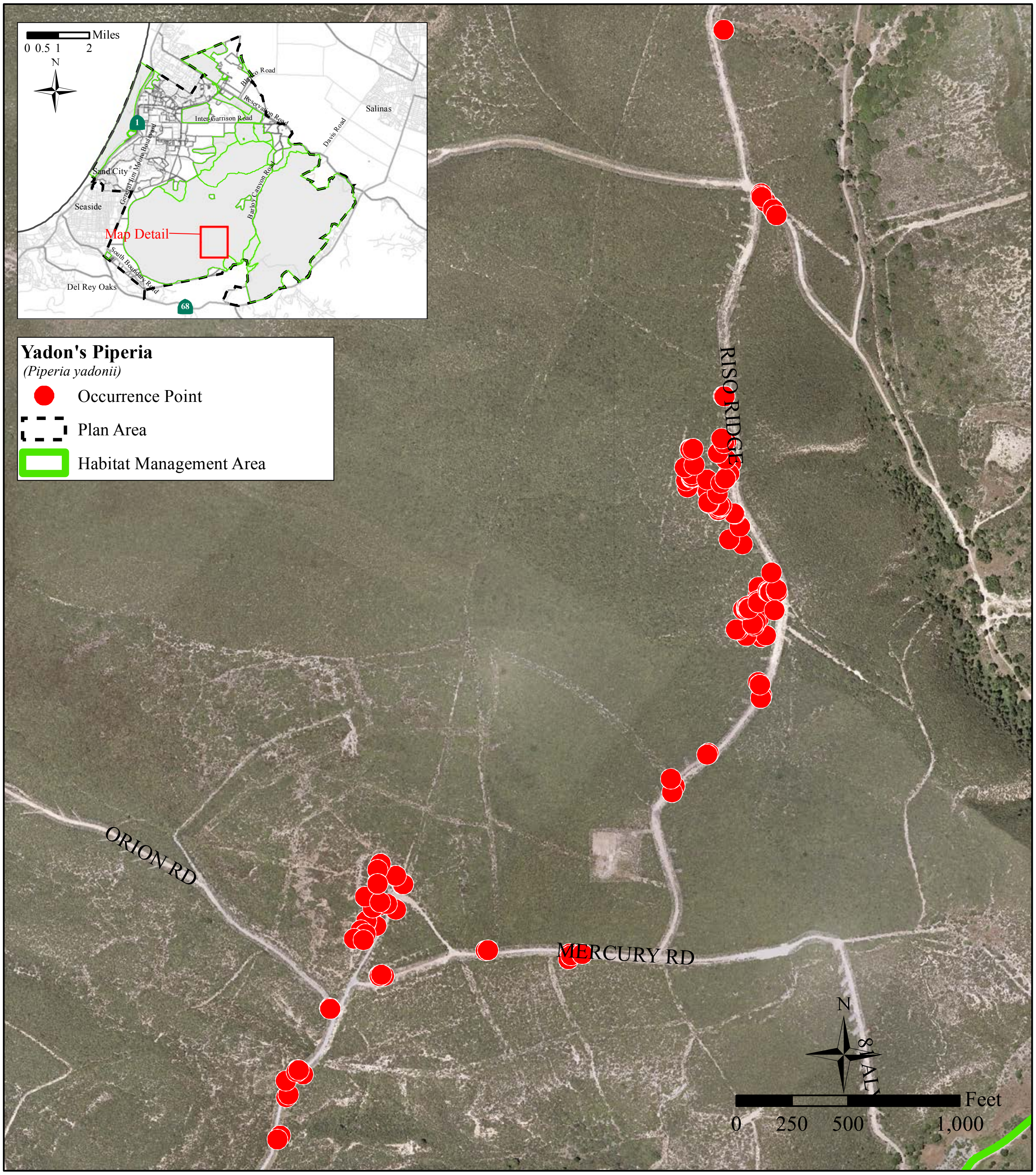
Figure A-2g
Location of Yadon's Piperia (Marina Northwest Corner)



Source: Denise Duffy and Associates

Graphics ... 00533.07 HCP (4/19/2017)

Figure A-2h
Location of Yadon's Piperia (Orion Road)



Source: Denise Duffy and Associates

Graphics … 00533.07 HCP (4/19/2017)

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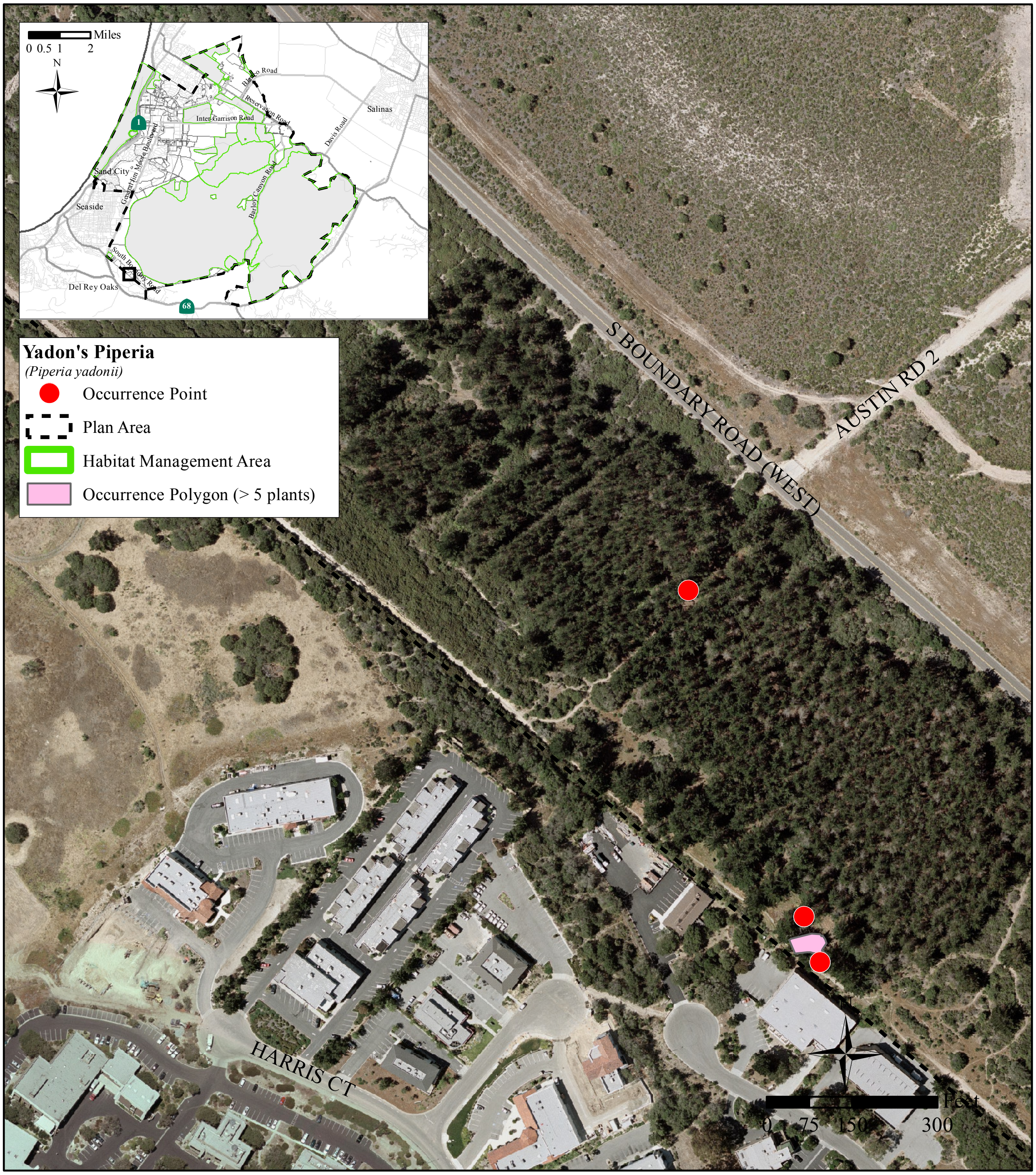
Figure A-2i
Location of Yadon's Piperia (Riso Ridge)



Source: Denise Duffy and Associates

Graphics ... 00533.07 HCP (4/19/2017)

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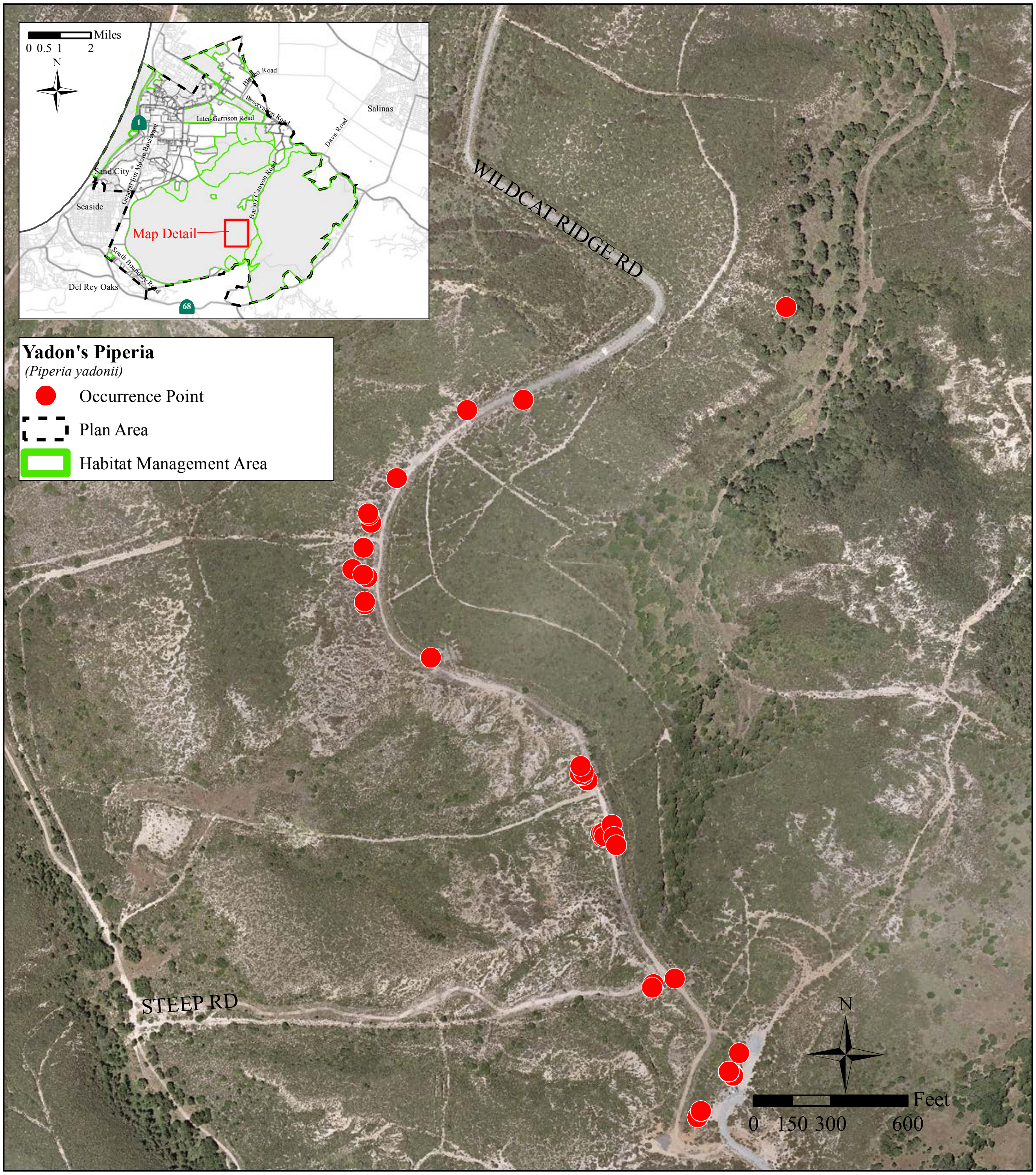
Figure A-2j
Location of Yadon's Piperia (South Boundary Road)



Source: Denise Duffy and Associates

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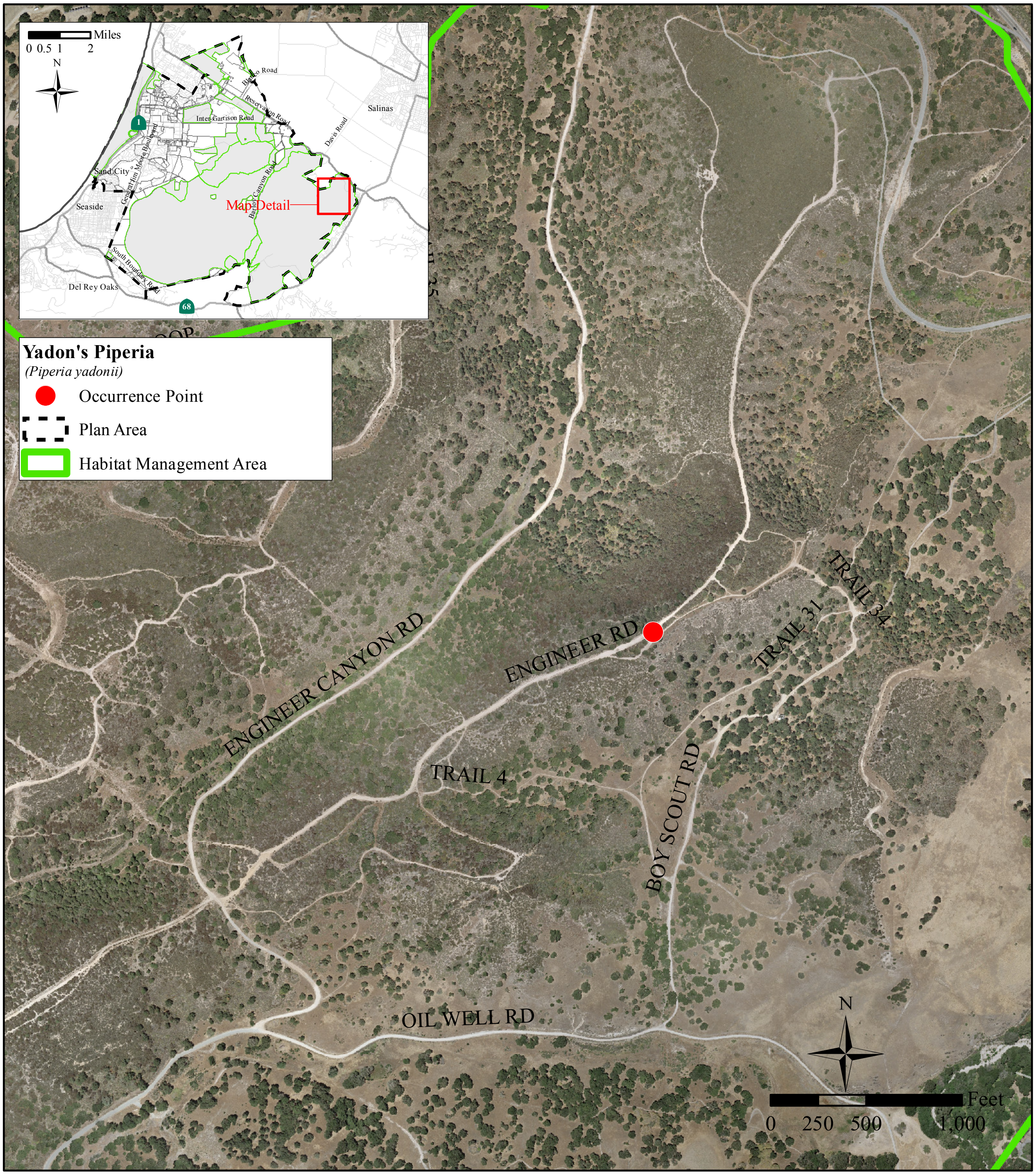
Figure A-2k
Location of Yadon's Piperia (Wildcat Ridge Road)



Source: Denise Duffy and Associates

Graphics ... 00533.07 HCP (4/19/2017) TG

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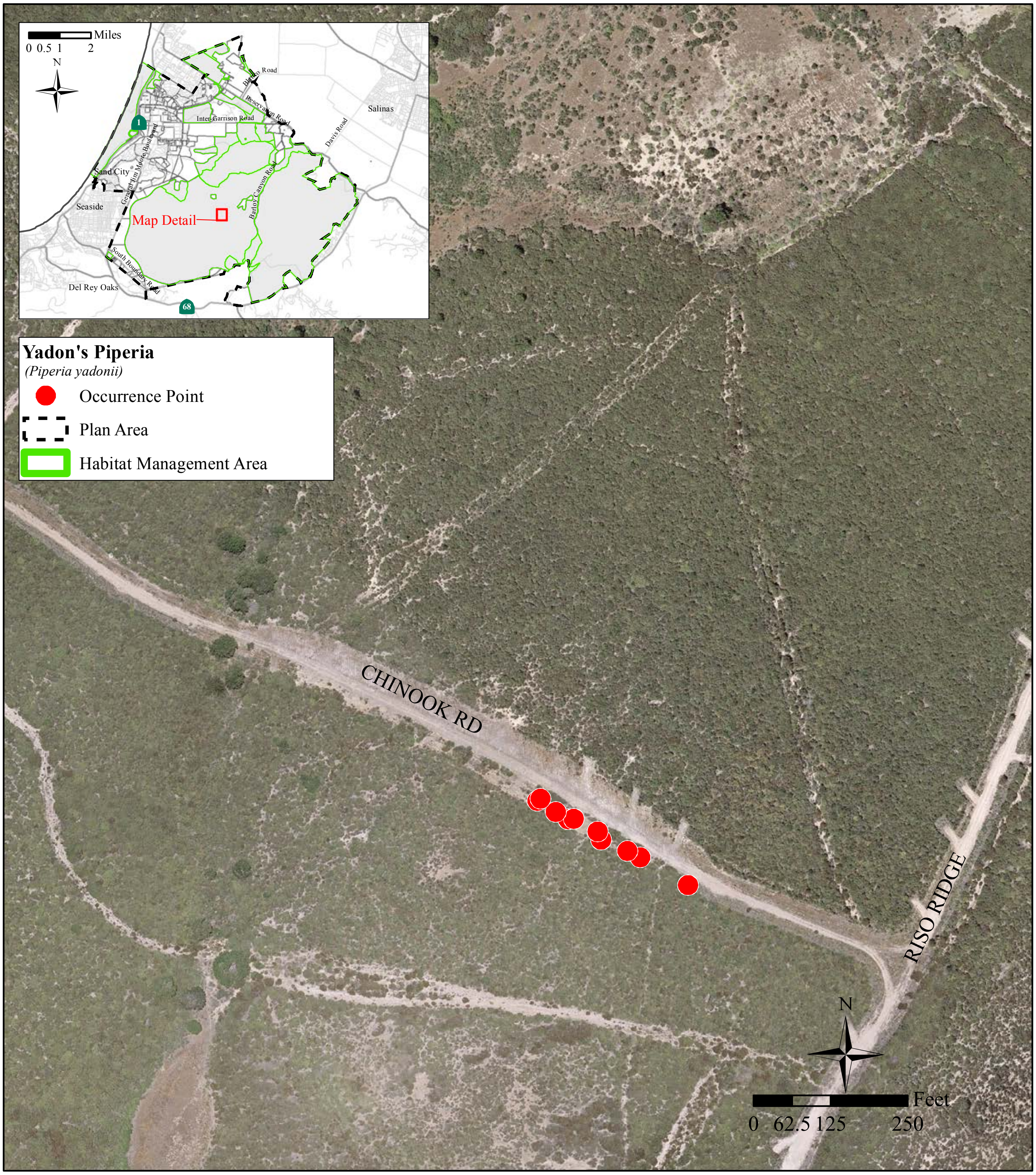
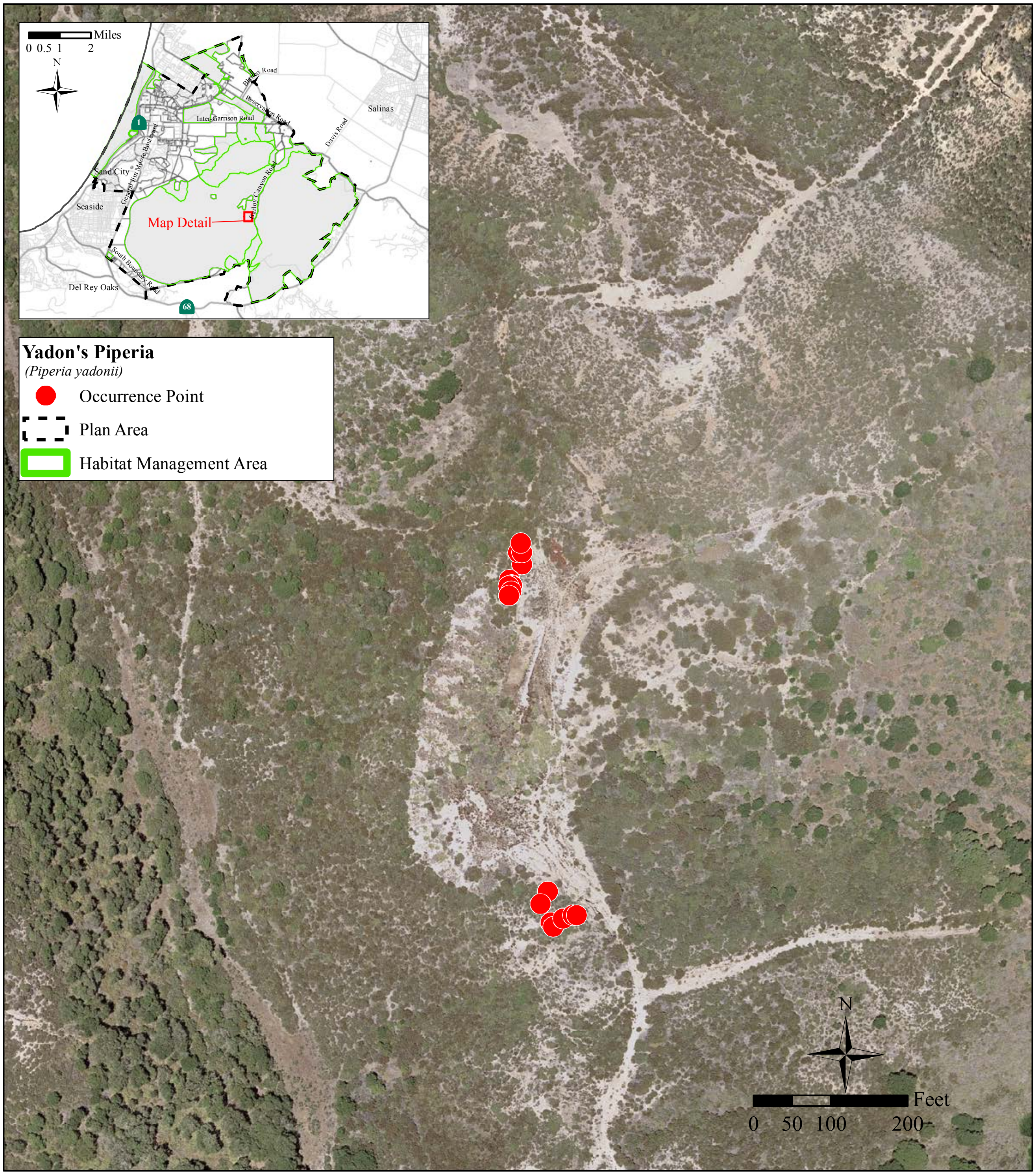
Figure A-2I
Location of Yadon's Piperia (Engineer Road)



Source: Denise Duffy and Associates

Graphics … 00533.07 HCP (4/19/2017) TG

Figure A-2m
Location of Yadon's Piperia (Chinook Road)



Source: Denise Duffy and Associates

Graphics ... 00533.07 HCP (4/19/2017) TG

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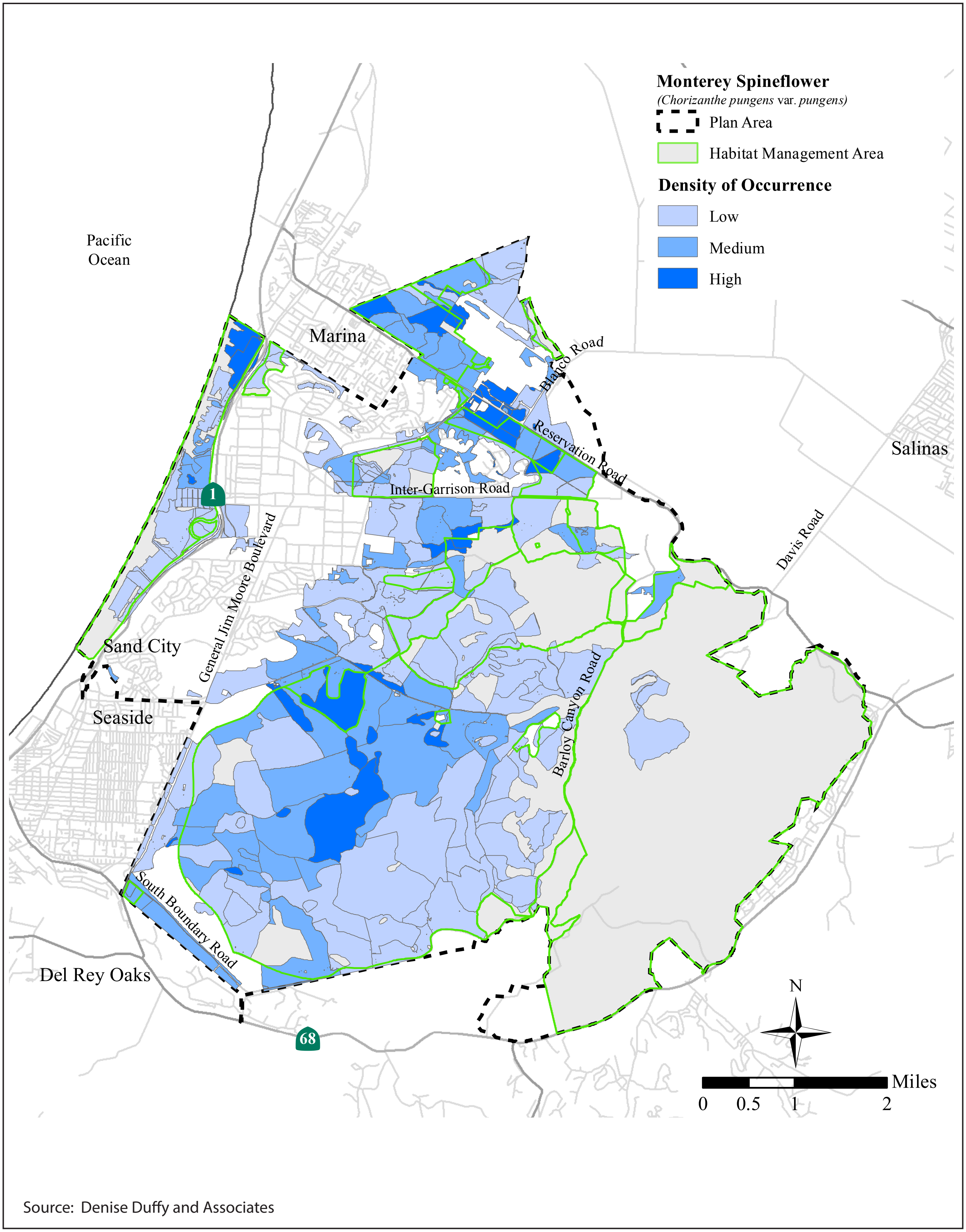
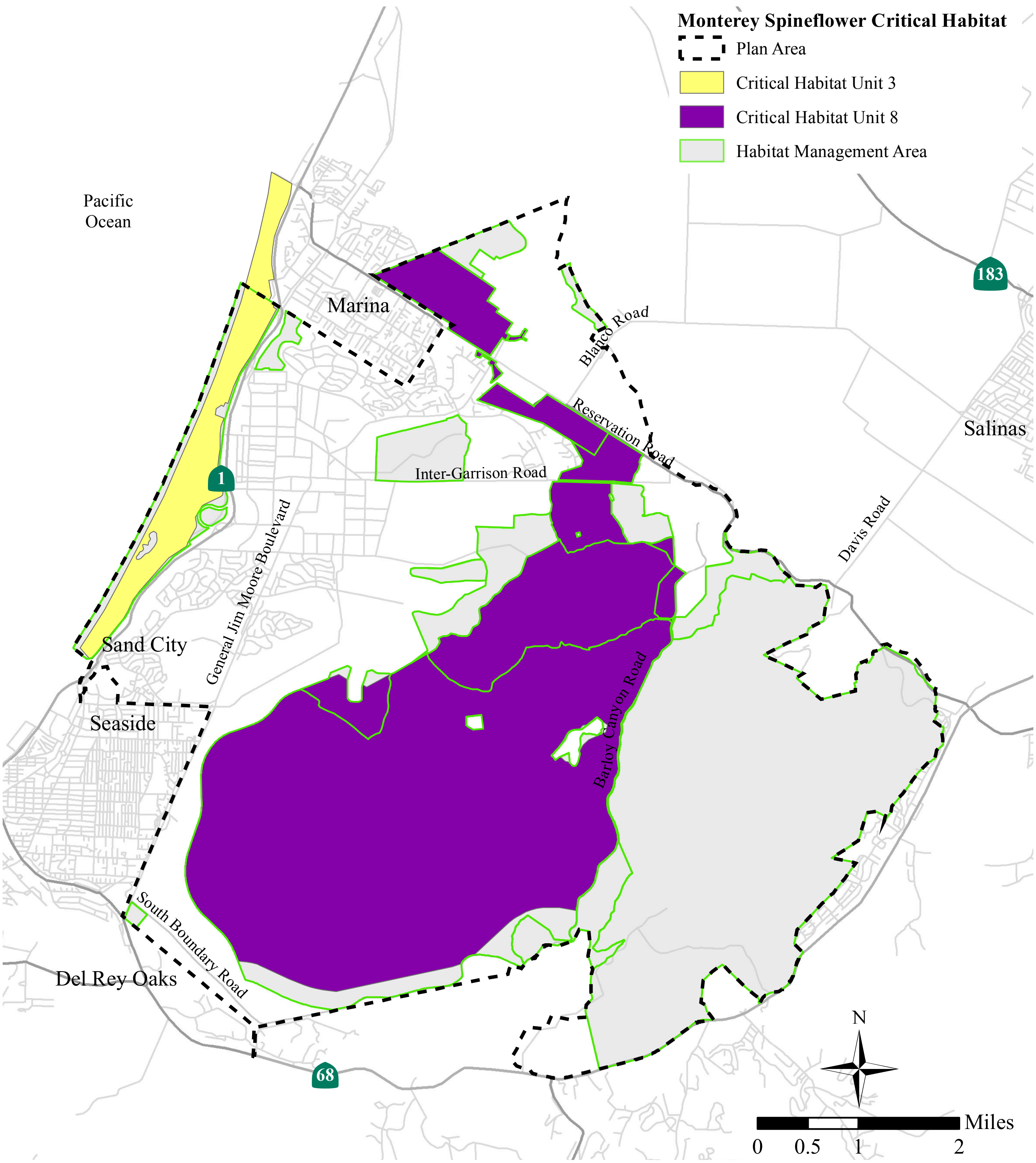
Figure A-2n
Location of Yadon's Piperia (Barloy Canyon)



Source: Denise Duffy and Associates

Graphics ... 00533.07 HCP (4/19/2017) TG

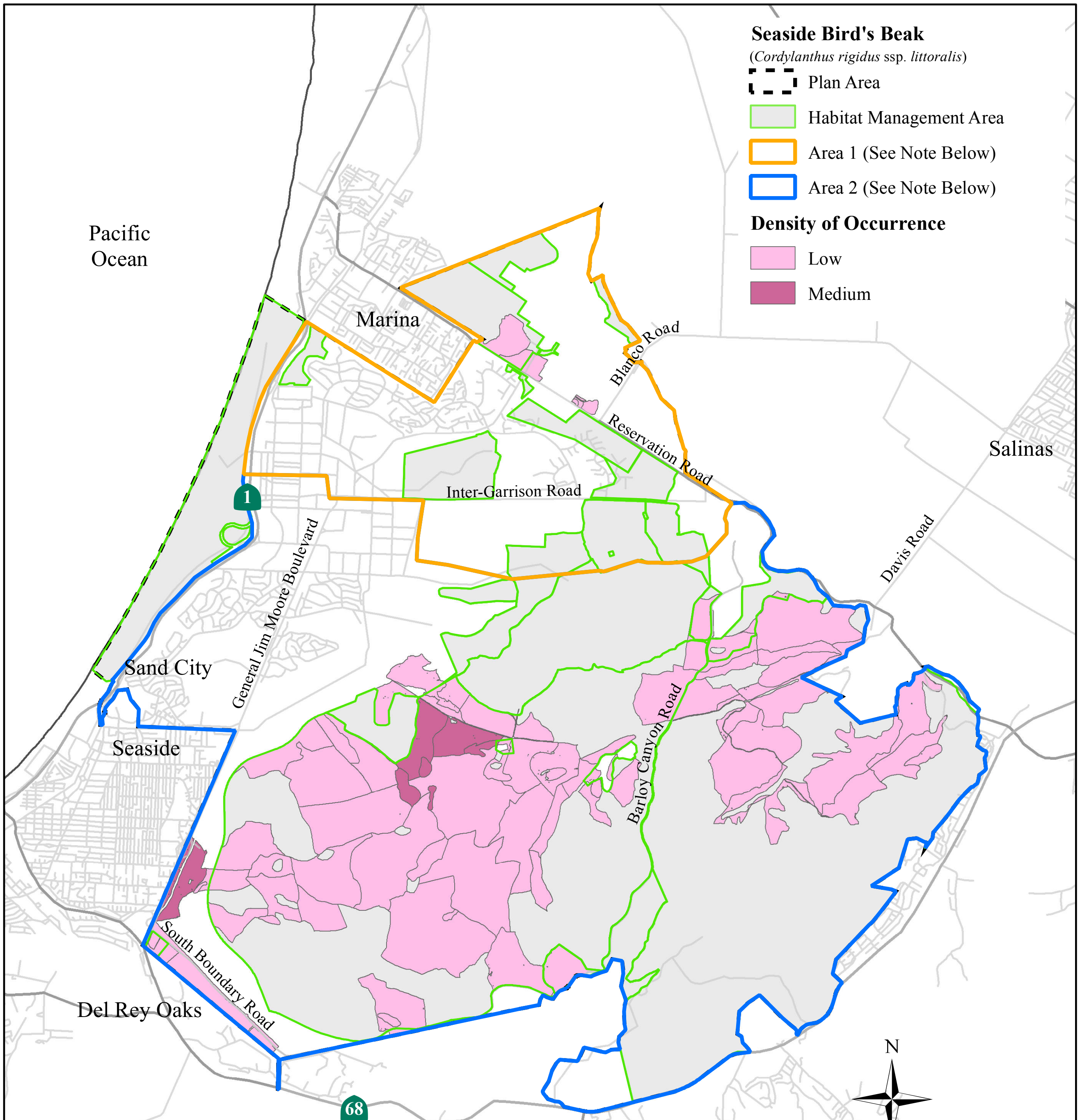
Figure A-3a
Locations of Monterey Spineflower



Graphics ... 00533.07 HCP (6/12/2017) TG

Source: Denise Duffy and Associates

Figure A-3b
Locations of Monterey Spineflower Critical Habitat

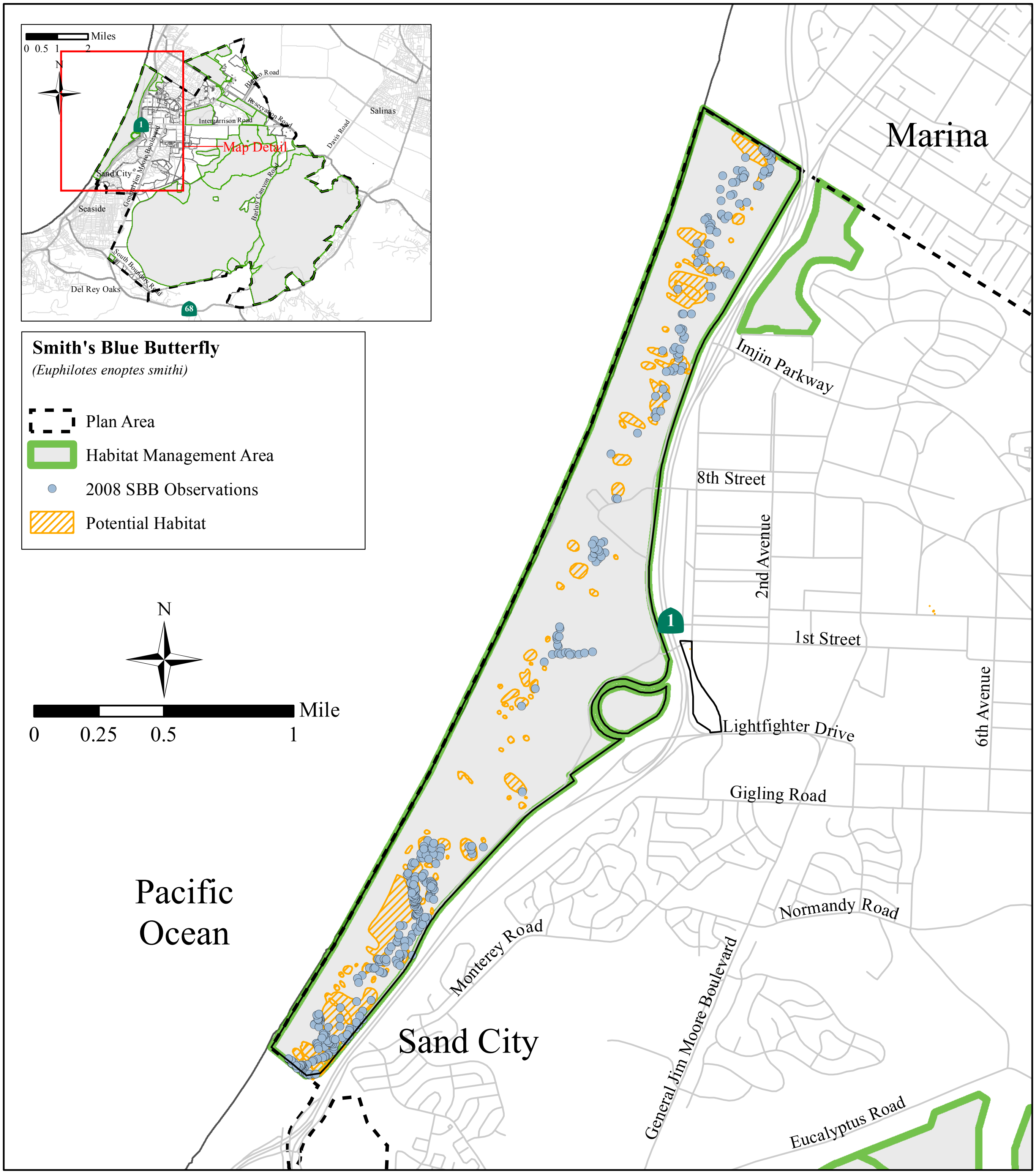


Note: At the request of CDFW, the effects on seaside bird's beak were evaluated for two geographic areas in the Plan Area. There are an estimated 6,850 acres of seaside bird's beak in the Plan Area; 130 acres (2%) are within Area 1 and 6,720 acres (98%) are within Area 2.

Source: Denise Duffy and Associates

Graphics ... 00533.07 HCP (4/19/2017) TG

Figure A-4
Locations of Seaside Bird's Beak



Source: Denise Duffy and Associates

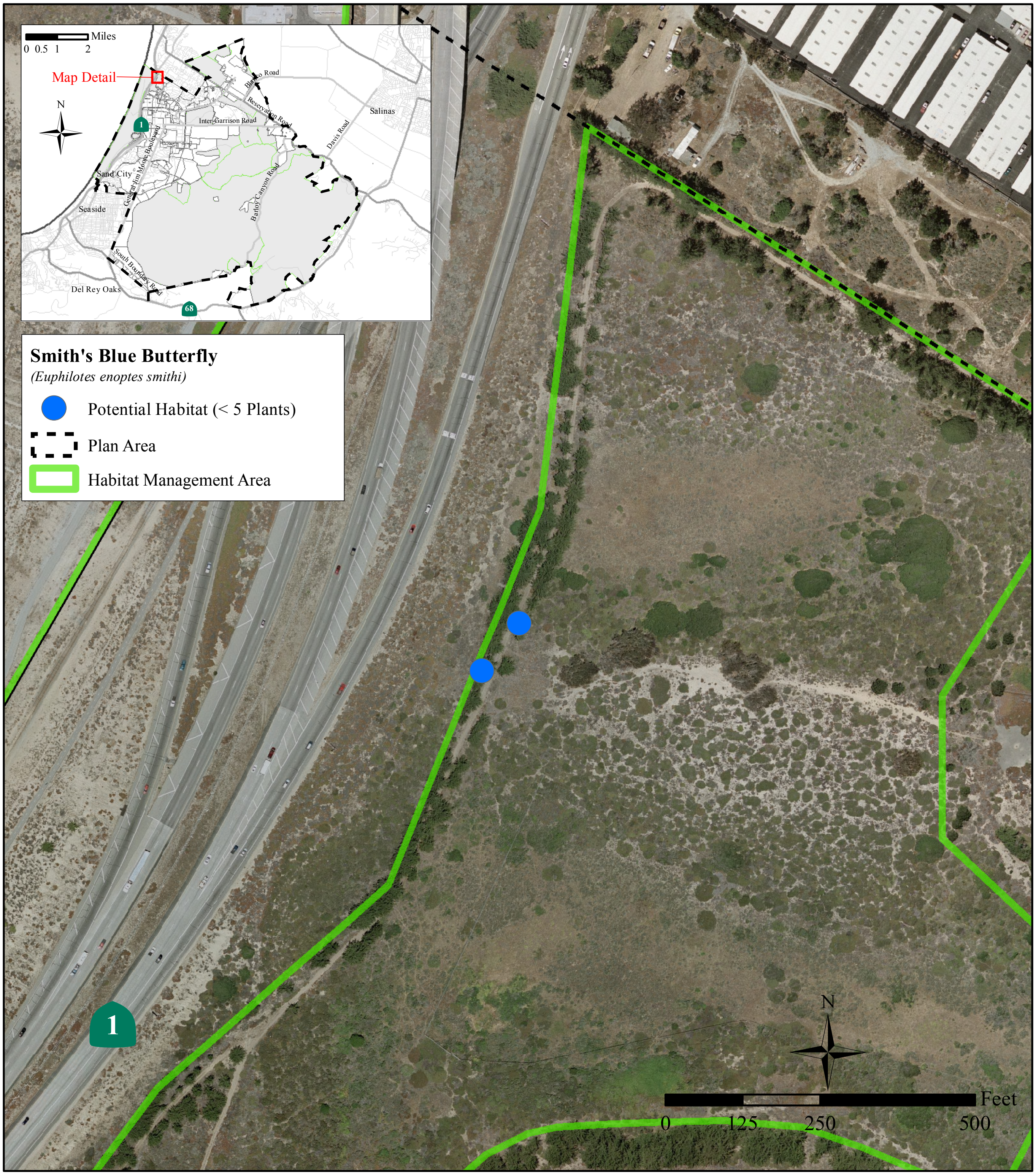
Graphics ... 00533.07 HCP (4/19/2017) TG

Figure A-5a
Potential and Occupied Smith's Blue Butterfly Habitat at FODSP

Source: Denise Duffy and Associates

Graphics ... 00533.07 HCP (4/19/2017) TG

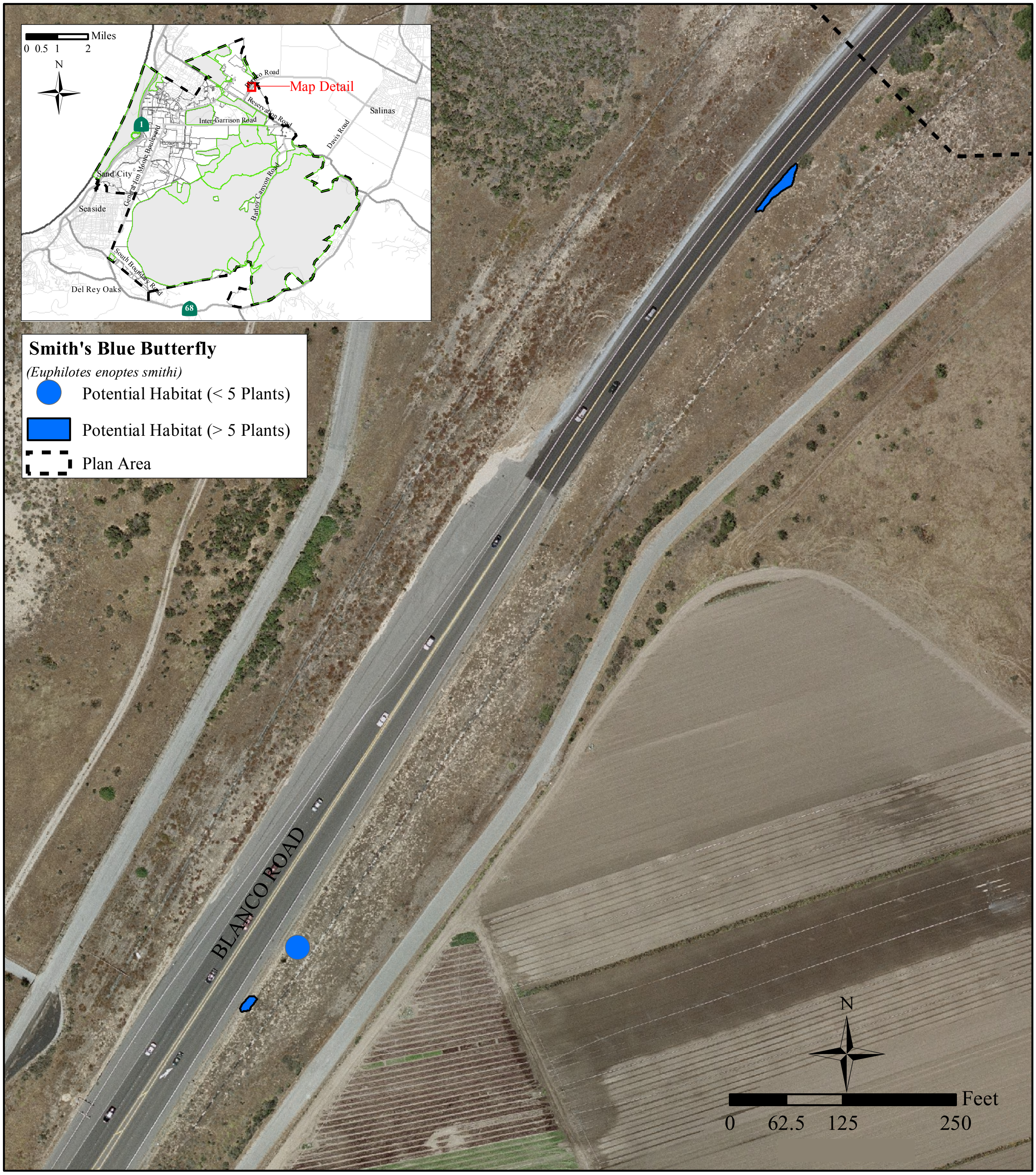
Figure A-5b
Smith's Blue Butterfly (FONR)



Source: Denise Duffy and Associates

ICF

Figure A-5c
Smith's Blue Butterfly (Marina Northwest)

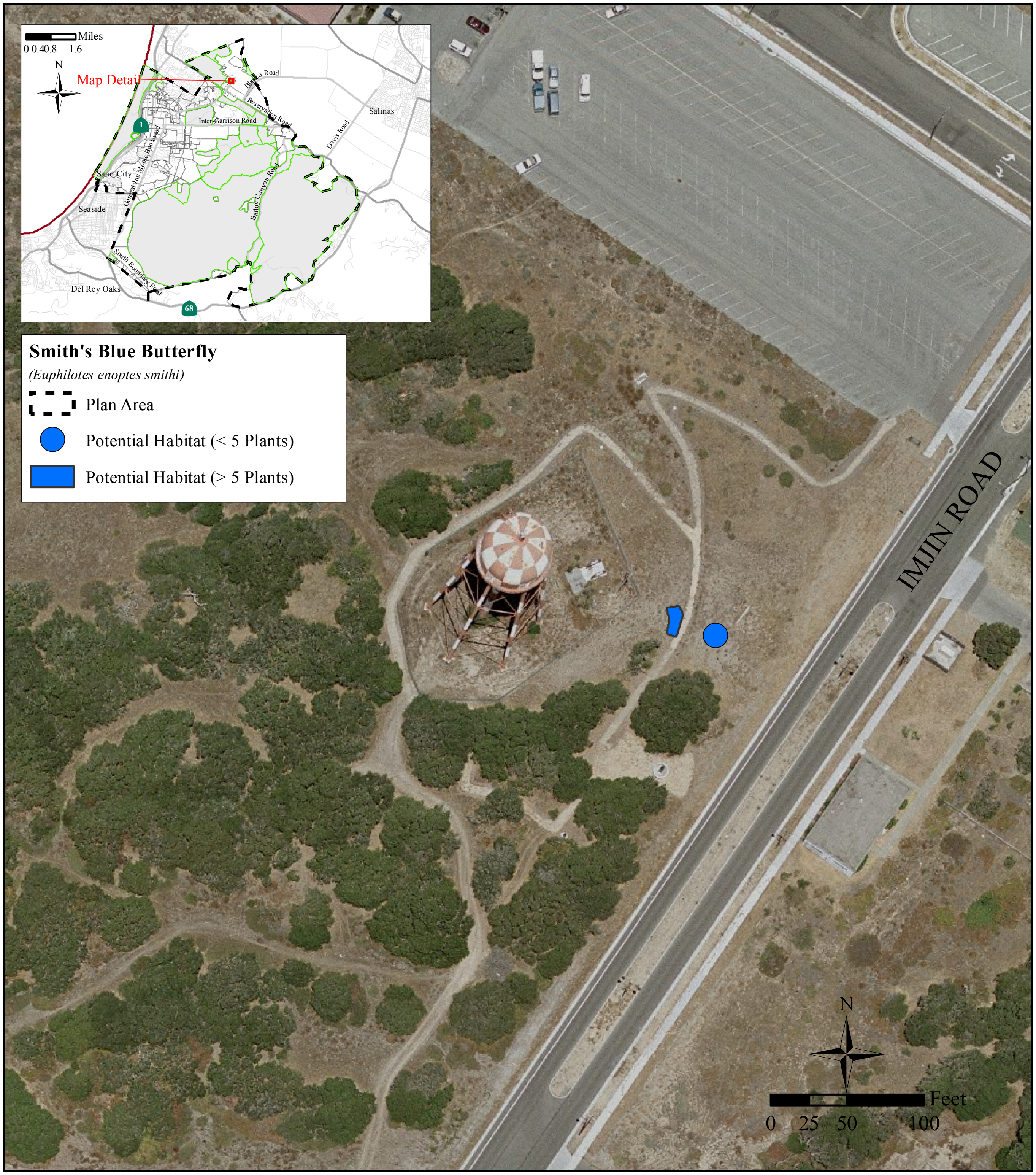


Source: Denise Duffy and Associates

Graphics … 00533.07 HCP (4/19/2017) TG

ICF

Figure A-5d
Smith's Blue Butterfly (Blanco Road)



Source: Denise Duffy and Associates

Graphics … 00533.07 HCP (4/19/2017) TG

ICF

Figure A-5e
Smith's Blue Butterfly (Marina Airport)

Source: Denise Duffy and Associates

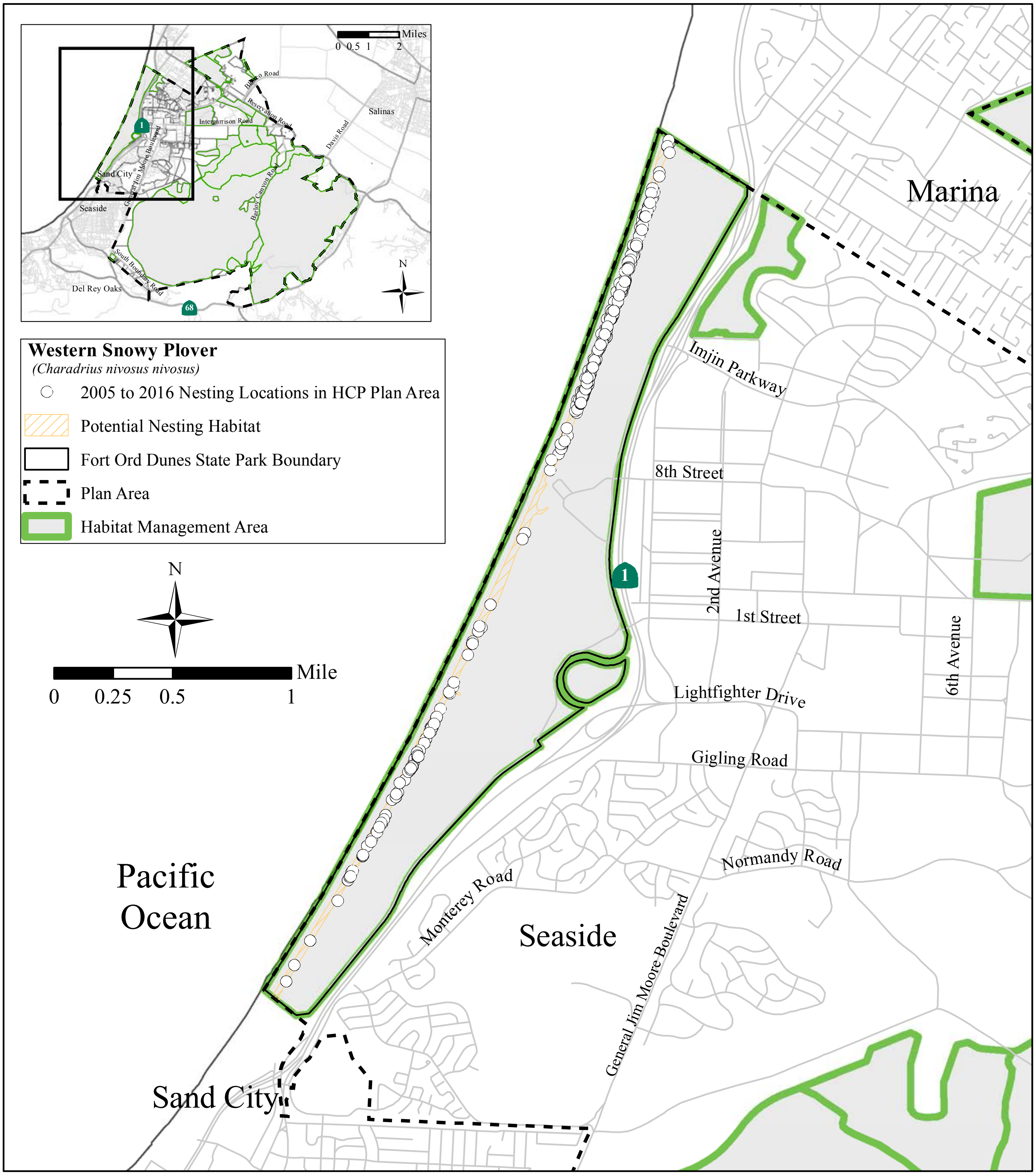
Graphics ... 00533.07 HCP (4/19/2017) TG

Figure A-5f
Smith's Blue Butterfly (1st Avenue)

Source: Denise Duffy and Associates

Graphics … 00533.07 HCP (4/19/2017) TG

Figure A-5g
Smith's Blue Butterfly (CSUMB)



Source: Denise Duffy and Associates

Graphics ... 00533.07 HCP (4/19/2017) TG

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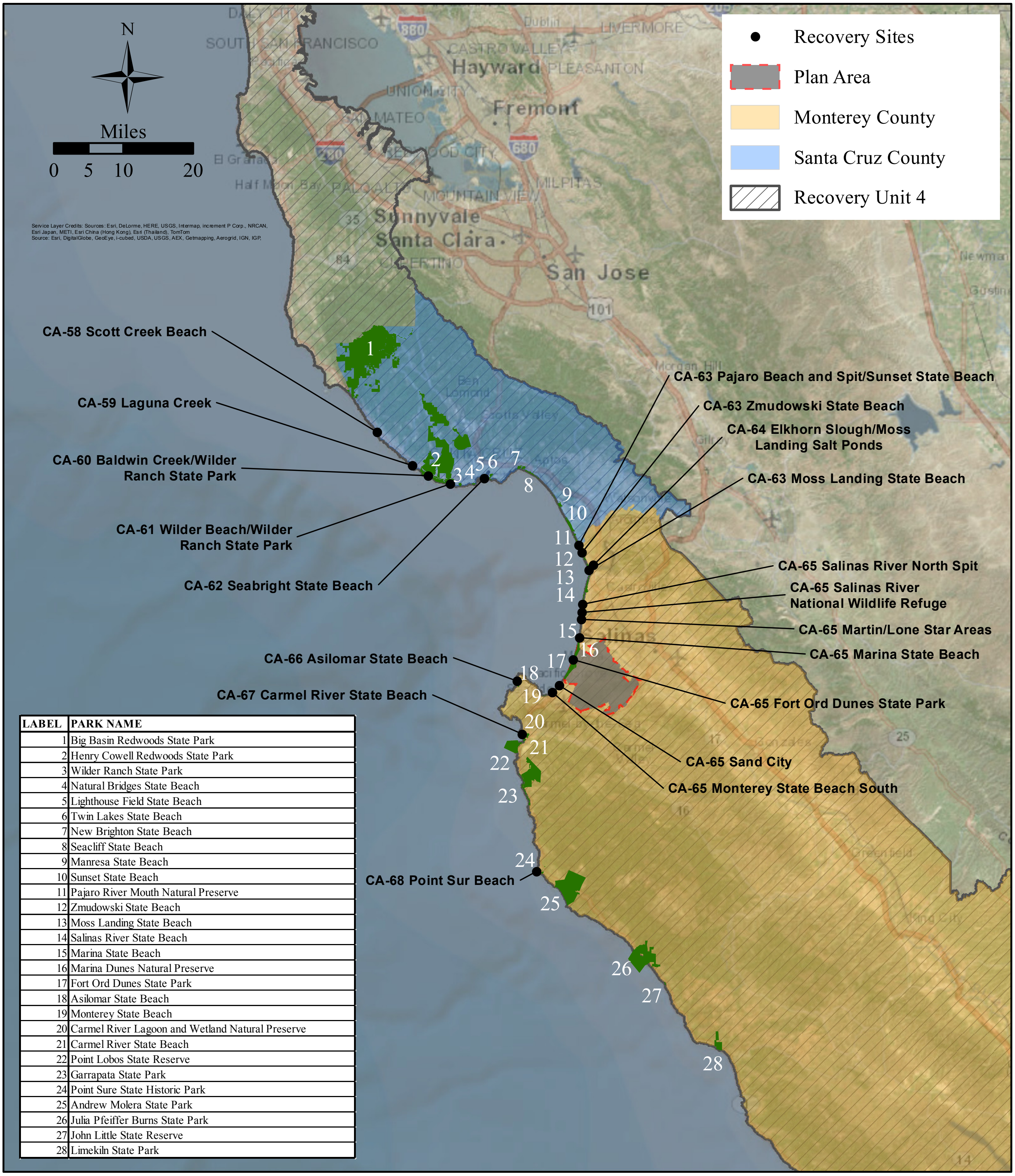
Figure A-6a
Habitat for Western Snowy Plover



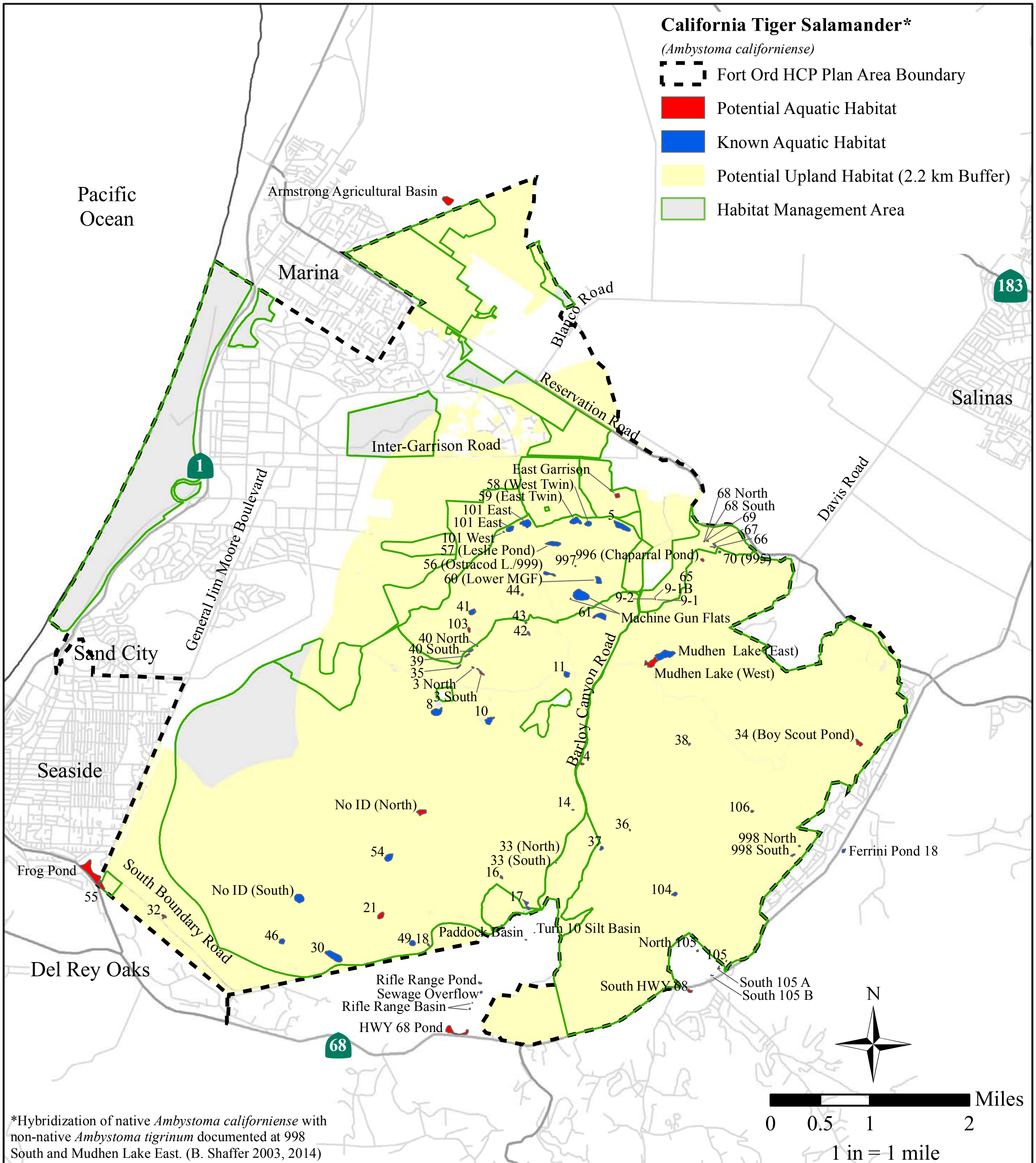
LABEL	PARK NAME
1	Big Basin Redwoods State Park
2	Henry Cowell Redwoods State Park
3	Wilder Ranch State Park
4	Natural Bridges State Beach
5	Lighthouse Field State Beach
6	Twin Lakes State Beach
7	New Brighton State Beach
8	Seacliff State Beach
9	Manresa State Beach
10	Sunset State Beach
11	Pajaro River Mouth Natural Preserve
12	Zmudowski State Beach
13	Moss Landing State Beach
14	Salinas River State Beach
15	Marina State Beach
16	Marina Dunes Natural Preserve
17	Fort Ord Dunes State Park
18	Asilomar State Beach
19	Monterey State Beach
20	Carmel River Lagoon and Wetland Natural Preserve
21	Carmel River State Beach
22	Point Lobos State Reserve
23	Garrapata State Park
24	Point Sure State Historic Park
25	Andrew Molera State Park
26	Julia Pfeiffer Burns State Park
27	John Little State Reserve
28	Limekiln State Park

Source: Denise Duffy and Associates

Graphics ... 00533.07 HCP (4/19/2017) TG

ICF

Figure A-6b
Designated Critical Habitat Unit CA22 for Western Snowy Plover



Source: Denise Duffy and Associates

Graphics ... 00533.07 HCP (4/19/2017) TG

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Figure A-7
Potential and Occupied Habitat for California Tiger Salamander

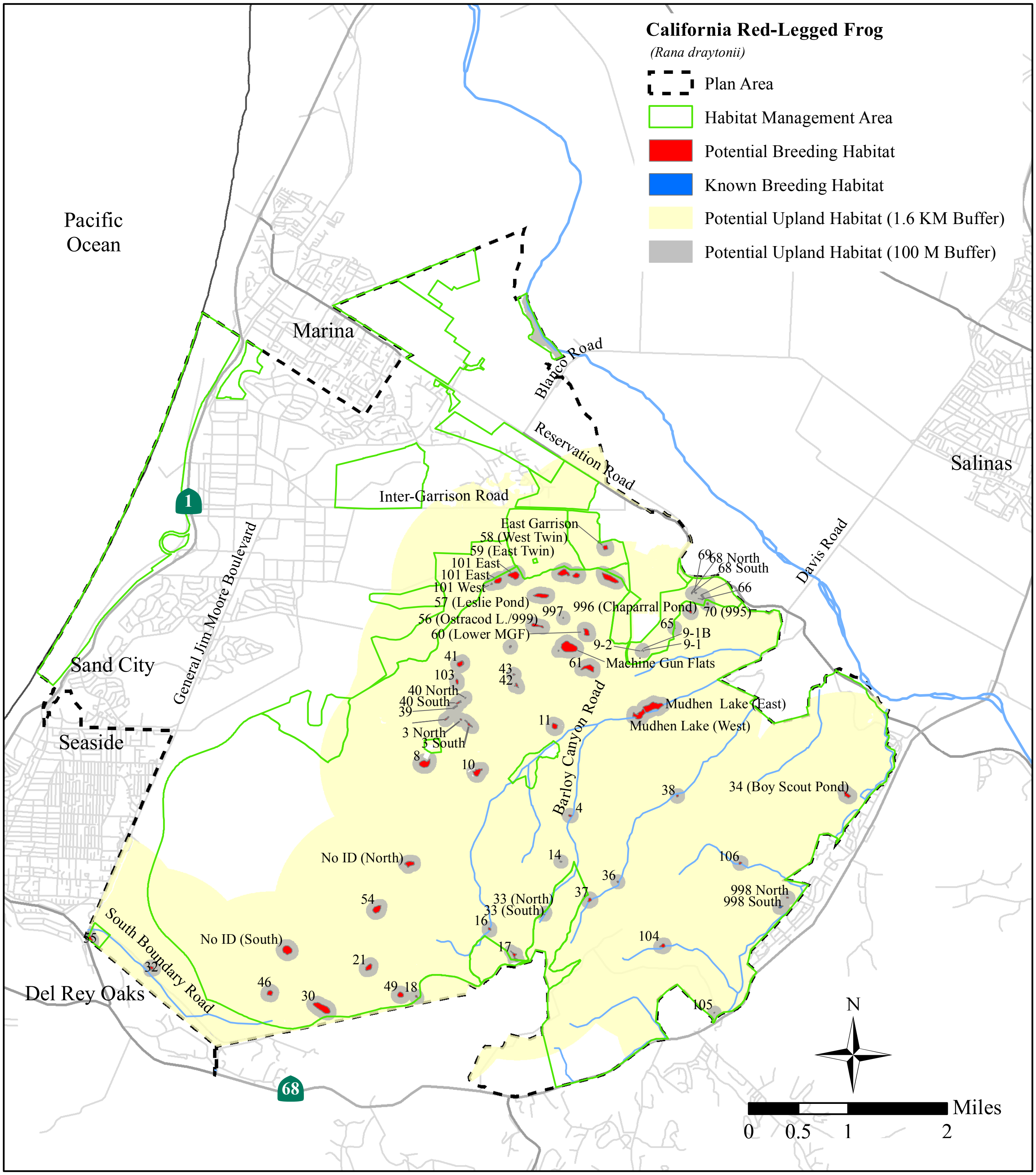
Pond #/Name	Known Aquatic Habitat for CTS	Potential Aquatic Habitat for CTS	Pond #/Name	Known Aquatic Habitat for CTS	Potential Aquatic Habitat for CTS
10			46		
101 East			49		
101 East			5		
101 West			54		
103			55 (NAE)		
104			56 (Ostracod L./999)		
105			57 (Leslie Pond)		
106			58 (West Twin)		
11			59 (East Twin)		
14			60 (Lower MGF)		
16			61		
17			65		
18			66		
21			67		
3 North			68 North		
3 South			68 South		
30			69		
32			70 (995)		
33 (North)			8		
33 (South)			996 (Chaparral Pond)		
34 (Boy Scout Pond)			997		
35			998 North		
36			998 South	X	
37			East Garrison		
38			Machine Gun Flats		
39			Machine Gun Flats		
4			Mudhen Lake (East)	X	
40 North			Mudhen Lake (West)		
40 South			No ID North		
41			No ID South		
42			9-1		
43			9-1B		
44			9-2		

Note:

X Hybridization of native *Ambystoma californiense* with non-native *Ambystoma tigrinum* documented at 998 South and Mudhen Lake East (B. Shaffer 2003, 2014)

Graphics ... 00533.07 HCP (4/19/2017) TG

Figure A-7.1
Potential and Known Aquatic Habitat for California Tiger Salamander



Source: Denise Duffy and Associates

Graphics ... 00533.07 HCP (4/19/2017) TG

Figure A-8
Potential and Occupied Habitat for California Red-Legged Frog

Appendix B

Letter from Caltrans Declining their Participation in HCP

DEPARTMENT OF TRANSPORTATION
50 HIGUERA STREET
SAN LUIS OBISPO, CA 93401-5415
PHONE (805) 549-3101
FAX (805) 549-3329
TDD (805) 549-3259
http://www.dot.ca.gov/dist05/

Flex your power!
Be energy efficient!

December 23, 2004

DEC 28 2004
FORA

Michael A. Houlemar., Executive Officer
Fort Ord Reuse Authority
100 Twelfth Street, Building 2880
Marina, CA 93933

Dear Mr. Houlemard:

FORT ORD HABITAT CONSERVATION PLAN

This is in response to your correspondence regarding the Department of Transportation's (Department) participation in the Fort Ord Habitat Conservation Plan (HCP). The Department has reviewed the Draft HCP and recognizes potential benefits associated with participation. However, based on our review of the Draft HCP, we have determined that the investment would far outweigh the benefits gained.

There are relatively few isolated areas within the Department's Highway 1 right of way that could support state or federally listed endangered species and we have no plans for major improvement to the Highway 1 six-lane facility through the Fort Ord area. While planning any future improvements we would strive to avoid areas that supported state and federally listed endangered species. Unavoidable impacts would be addressed through consultation under Section 7 of the Endangered Species Act and Section 2080.1 of the California Fish and Game Code. In addition, the Department's environmental planning staff currently works closely with the maintenance staff to identify sensitive areas that must be avoided during routine maintenance activities.

The Department believes that our current practices allow for the protection of endangered species within the existing Highway 1 right of way and that unavoidable endangered species impacts associated with any future projects will be adequately covered by the existing Section 7 and Section 2080.1 consultation processes. Therefore the extensive reporting and monitoring requirements of the HCP exceed any potential benefit from participation in the HCP.

We continue to support the proposed transfer of the Highway 1 easement through Fort Ord from the Army as identified in the Fort Ord Habitat Management Plan (HMP). As a signatory to the HMP the Department agreed to preserve existing patches of native coastal strand, dune scrub, and sand hill maritime chaparral habitat in the road shoulders and median areas that will not conflict with anticipated highway expansion, improvements, operations or maintenance. To date the Department has contributed $250,000 for the removal of "hardstand" areas in and around the proposed Highway 68 corridor as habitat restoration on Fort Ord lands, and $20,000 to the Department of Parks and Recreation for habitat restoration on State parkland adjacent to Highway 1.

Our maintenance staff has also worked to enhance native habitat within the Highway 1 right of way through the control of invasive vegetation. This effort has been hampered by not only the required statewide reduction in the use of herbicides, but by substantial reductions in our maintenance staff due to the State's budget crisis. However, the Department remains committed to meeting the requirements of the Habitat Management Plan.

Thank you for requesting the Department's participation in the Fort Ord HCP. While we must decline participation in the HCP, we look forward to the transfer of portions of the Highway 1 corridor from the Army to the Department and we will strive to implement the conditions of the HMP, within the Department's fiscal resources. If you have any questions or concerns, please contact David Murray at (805) 549-3168.

Sincerely,

R. GREGG ALBRIGHT
for District Director

Appendix C

Agreement for the Revised Habitat Management Plan

Development of the Revised Fort Ord Habitat Management Plan (HMP)

Representatives from the Army, USFWS, and Fort Ord Reuse Authority (FORA) met on March 15, 1996 to discuss modifications to the HMP. A telephone conference was held on March 28, 1996 which included a University of California (UC) representative. The discussion resulted in clarifications regarding revision of the HMP, including an agreement by UC or FORA to obtain the landfill parcel and manage a portion of it as habitat subject to review of liability and indemnification. Any final decision regarding acceptance of the landfill parcel is subject to approval by the respective governing body. A detailed amendment the HMP will be prepared by the Army and provided to affected parties for signature prior to publication. The following are the terms of the modifications for the Revised Habitat Management Plan.

a) The requirement for the landfill parcel to be included as an HMP habitat management area is revised from being an Army responsibility to being a University of California or FORA responsibility. The Army will not be required to restore habitat on the landfill cap nor will the Army be required to perform habitat management activities in the parcel while the landfill is being remediated or in caretaker status.

b) The University of California (if not UC, then FORA) will apply to obtain the landfill parcel as part of an Economic Development Conveyance (EDC) transfer under terms of an existing MOA between the U.S. Army and UC. Following land transfer from the Army, UC or FORA will manage seventy-five percent (75%) of the landfill parcel (including the completed landfill cap) as habitat. The remaining twenty-five percent (25%) of the parcel will be available for development. Other changes in boundaries and trade-offs of development and habitat areas will be made in the HMP as shown on the attached figure (Figure 5-11, Revised Habitat Management Plan for Former Fort Ord). This will satisfy basewide HMP habitat management requirements for all proposed development areas (shown as land areas with no HMP habitat preservation requirements on Figure 5-11).

c) The other development areas adjacent to the BLM Natural Resources Management Area (NRMA) will be obtained as part of the FORA EDC. In these areas of undeveloped habitat adjacent to the NRMA, FORA will either arrange to have existing native habitat managed or construct and maintain fire breaks and vehicle barriers to separate these areas from the NRMA until such time as roads and other developments are constructed in these locations. (See attached figure for locations of fire breaks along the edge of the NRMA). This will replace the individual development parcel descriptions contained in the original HMP. The revised HMP will rely on this measure to accomplish the desired separation of habitat areas from future development areas. The land use specific requirements for development parcels will be removed in the revised HMP.

The following Agencies indicate concurrence in the elements of the Revised HMP.

U.S. Fish and Wildlife Service

________________ Date: 4/9/96

U.S. Bureau of Land Management

Ed Hastey _____ Date: 4/10/96

Fort Ord Reuse Authority

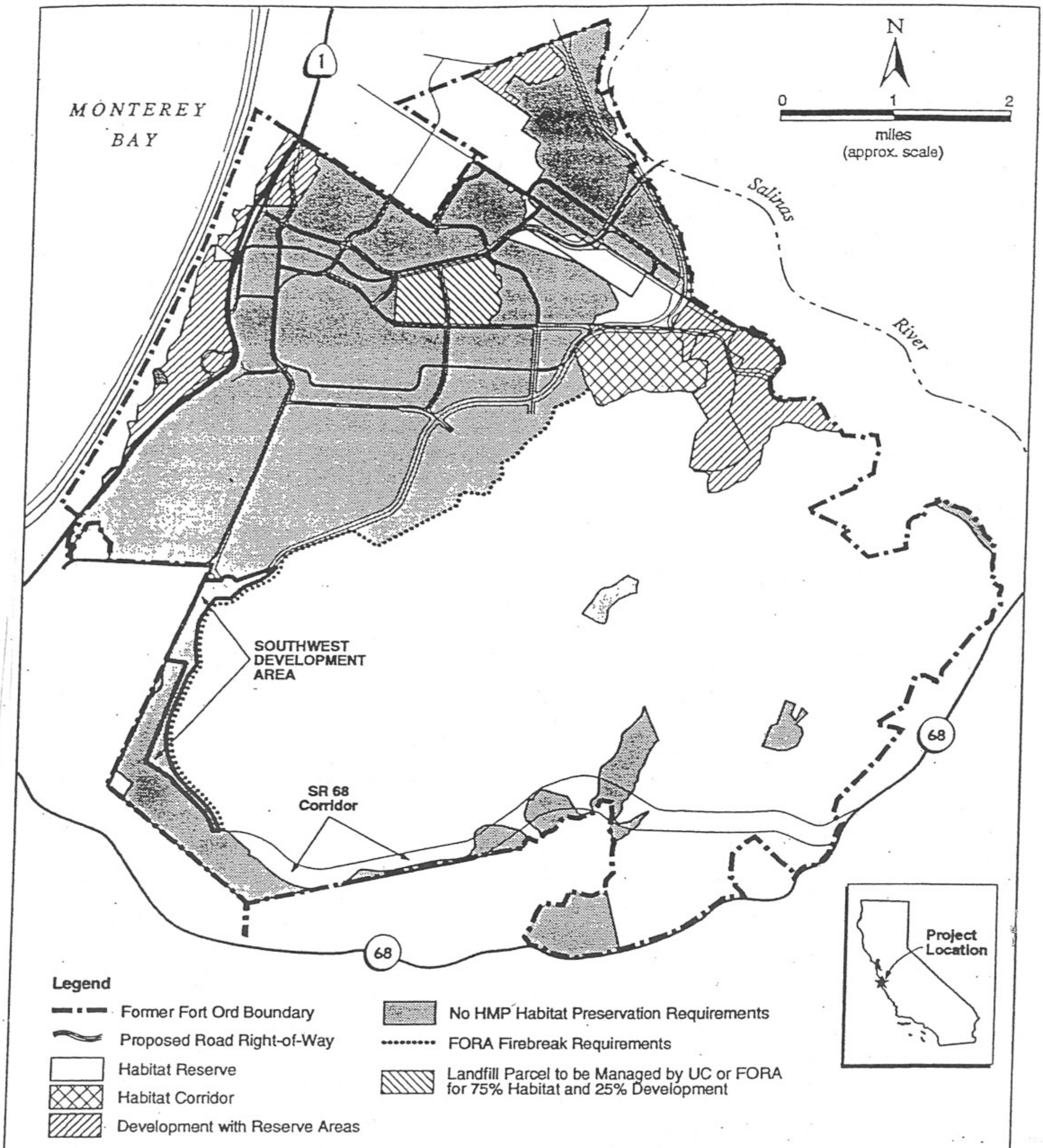
________________ Date: 4/3/96

U.S. Army

________________ Date: 4 IV 96

University of California

________________ Date: 4/3/96



Note: Based on FORA December 12, 1994 Final Fort Ord Base Reuse Plan (Fort Ord Reuse Authority 1994) with mitigations and modifications agreed on with USFWS, UC, and FORA on March 15 and 28, 1996.

Figure 5-11
Draft Revised Habitat Management Plan for Former Fort Ord

Appendix D

Marina Coast Water District Activities

MARINA COAST WATER DISTRICT FACILITIES

OPERATIONS & MAINTENANCE ACTIVITIES:

WELL OPERATIONS: Periodically, wells are taken out-of-service for repairs. Repair work may require equipment (e.g., crane, backhoe) be mobilized so that the motor, pump, pipe and related appurtenances, valves, and/or electrical equipment can be removed and/or serviced on-site. On-site service can include general cleaning of equipment to include light grease, painting, and mechanical repair, e.g., valve internals. Water may have to be disposed of to purge pipelines and/or well casing. Startup will be done in accordance with CA Department of Health Services requirements.

PIPELINE/SEWER REPAIRS: Typically involves equipment access, e.g., backhoe and trucks for excavation of damaged pipeline, valves and/or concrete structures; and placement of pipe bedding material, piping and pipeline related appurtenances, e.g., valves, air release valves, valve boxes. Sewer repair may require larger equipment to collect and remove sewage that has spilled and/or accumulated on-site. Initiation of service will be done in accordance with CA Department of Health Services requirements.

STORAGE TANKS: Periodically, tanks will be accessed for inspection and/or purposes. This work generally requires complete draining of tanks. Every effort will be made to use that water in the distribution system; however, some water will have to be disposed. The volume of water is dependent upon the tank size and the ability to use the water in the distribution system; however, it can be significant. Water would be disposed on-site. Tank work can include exterior/interior tank preparation and painting; concrete repair work to address spilling and/or cracks in the foundation; replacement or repair of tank appurtenances e.g., air vents, overflow piping, ladders/cages, etc.

Storage tanks are not designed to be operated under pressure. Such an operating condition can result in damage or in the most extreme case, tank failure. Therefore, overflow piping is provided for each and every tank. While this is not a normal occurrence, tanks will overflow for an unspecified period of time due to a system failure, i.e., a well does not shut off. An alarm is immediately sent to our operations center and action is taken as soon as possible to stop the overflow. This water is typically relieved on-site, but in some cases may be piped to a collection pond, if available.

BOOSTER/LIFT STATIONS: Periodically, booster/lift pumps are taken out-of-service for repairs. Repair work may require equipment, e.g., crane, backhoe be mobilized so that the motor, pump, pipe and related appurtenances, valves, and/or electrical equipment can be removed and/or serviced on-site. On-site service can include general cleaning of equipment to include light grease, painting, and mechanical repair, e.g., valve internals. Water may have to be disposed of to purge pipelines and/or well casing. Startup will be done in accordance with CA Department of Health Services requirements.

FUEL TANK/GENERATOR MAINTENANCE: Routine operations include refueling of storage tanks and general maintenance including replacement of filters, hoses, nozzles, and engine repair. Major service requires that the equipment be taken off-site. In such case, larger equipment would be required to access the site.

SITE MAINTENANCE: This description is for general maintenance activities which includes, but is not limited to, on-site grass cutting, weed abatement/control, sidewalk repair, road repair, storage of equipment, etc.

EMERGENCY PROJECTS: These would include work that is necessary to prevent the catastrophic failure of a facility(s). One such example would be a storage tank that with structural problems that necessitate the tank be taken off-line; however, that tank may not be actively failing.

UNANTICIPATED EVENTS: These would include active or imminent failures of a facility(s) which would cause serious disruption to the system's ability to provide service necessary for the public welfare, health or safety of the community.

CAPITAL IMPROVEMENT PROJECTS (by category):

All construction projects require equipment lay down areas, which are used to store equipment necessary for construction. An on-site location is preferred as it reduces traffic otherwise required to enter/egress the site. These locations may be temporarily fenced for safety reasons. The size of the lay down area is dependent upon the size and type of project, but typically ranges between 1 and 2 acres. In addition, all construction requires large equipment be used during construction such as cranes, backhoes, dump truck, grading equipment, pickup trucks, etc.

STORAGE TANKS (Reservoirs) Includes the construction and/or demolition of water storage tanks (identified as reservoirs on the CIP map). Work may include clearing, grading, excavation or placement of soil, concrete foundations, construction of pipelines including system connections, site drainage; and/or tank overflow.

PIPELINES: Includes the installation and/or demolition of pipelines and related appurtenances, e.g., valves, manholes, air release valves, etc. Most times pipes are installed in the streets, but not always. Pipeline construction requires concrete thrust blocks be placed below ground at key joints to prevent pipelines from rupturing. Pipeline installation requires pressure checking and disinfecting, which requires disposal of water at the completion of the test. These tests follow CA Department of Health Services and/or industry standards to assure the pipelines do not leak.

BOOSTER/LIFT STATIONS: Includes construction and/or demolition of new booster/lift stations. Stations may be buried or above ground, but in all cases will require buried pipelines to connect water or sewer lines into the station. Other work typically required includes construction of concrete foundations, small buildings to house the equipment, buried or above ground conduits/poles for electrical/instrumentation controls.

WELLS: Includes the installation of new well facilities including well, pump, pump house and related appurtenances. Work would also include access of construction equipment necessary to complete the installation, construction of a concrete slab. Repair/rehabilitated wells could require similar work.

Appendix E
Integrated Vegetation Management Protocols

Exhibit A: Synopsis of Statewide BLM Integrated Vegetative Management Protocol

Exhibit B: Land Manager's Guide to Developing an Invasive Plant Management Plan. Cal-IPC Publication 2018-01. National Wildlife Refuge System, Pacific Southwest Region, Inventory and Monitoring Initiative, Sacramento, CA.

Exhibit C: Preventing the Spread of Invasive Plants: Best Management Practices for Land Managers (3rd ed.). Cal-IPC Publication 2012-03. California Invasive Plant Council, Berkeley, CA.

Exhibit D: California Invasive Plant Council (Cal-IPC) Invasive Weed Inventory (online) https://www.cal-ipc.org/plants/inventory/

INTEGRATED VEGETATION MANAGEMENT PROTOCOL

The integrated vegetation management program guidelines established in BLMs programmatic Environmental Impact Statement for the California Vegetation Management Program (USDI 1897) include specific protocol regarding A) standard operating procedures for health and safety, B) protection of threatened, endangered, and other special-status species, C) soil disturbance, D) allow for the development of prescribed fire management plan, E) continue the use of livestock grazing for the control of invasive non-native grasses, and F) provide for adaptive management of non-native vegetation as new information becomes available. These protocol are discussed below.

A. Standard Operating Procedures for Health and Safety

All herbicide spraying would be administered by hand, using a backpack, slip-on, or trailer-mounted spray unit according to Roundup Pro label directions. Aerial spraying would be prohibited on Fort Ord Public Lands. All OSHA, EPA, state, and local agency rules and regulations regarding the application of herbicides would be followed. Herbicide would only be applied by a certified applicator or by other trained personnel under the direct supervision of a certified applicator. Herbicide mixing locations and equipment cleaning would be restricted to sites where any spillage could be contained. The Fort Ord Project Manager in consultation with the Field Office Safety Officer would select specific locations. Roundup Pro herbicide would be the only herbicide used on Fort Ord Public Lands. All personnel applying Roundup Pro would receive training targeted to the use of this herbicide. This training would include close review of the Fort Ord Weed Crew Health and Safety Plan, the Roundup Pro Material Safety Data Sheet (MSDS), the product label for Round-up Pro, and field training regarding the safe storage, handling, mixing, and application of herbicide on Fort Ord Public Lands. The Weed Crew Health and Safety Plan includes a comprehensive collection of protocol for the safe operation of hand and power tools and a weed management program that includes the use of Roundup Pro.

Since the Roundup Pro product label states that drift potential is lowest between wind speeds of 2-10 mph, the proposed action would restrict BLM personnel to a 10mph wind speed under which herbicide could be applied.

B. Protection of Federally-listed Plant Species

Measures to mitigate the potential adverse impacts to sand gilia, Monterey spineflower, and Contra Costa goldfields from weed abatement would include the following:

a. No herbicide applications would be conducted within known occupied habitat during the growing season.
b. All weed abatement done by staff or volunteers would be supervised by persons trained in the identification of federally listed species. If any federally-listed species were observed in work areas during weed abatement all weed abatement would cease until after seed set in any given year for the species observed at that site.
c. No spraying would take place in winds greater than ten miles per hour

in order to minimize impacts to non-target species from drifting herbicide.

C. Soil Disturbance

Soil disturbance of any kind (e.g. due to vehicle use, weed, removal, road grading, and fuel break maintenance) could encourage the spread of invasive weeds. In order to minimize soil disturbance vehicles would be restricted to existing road. Soil disturbance while using hand tools to abate invasive weeds would be minimized. Reclaimed areas and other disturbed areas such as fuel breaks, trails, developed sites, etc., would be monitored to eliminate minor infestations of non-natives prior to using herbicides. Disturbed areas identified as erosion problems would be covered with certified weed-free straw, water barred, and/or restored with native vegetation, thus dually supporting the goals of invasive weed eradication and enhancement of native communities. Certified weed-free straw would also be applied to areas susceptible to erosion following manual or mechanical removal of exotic species.

D. Prescribed Fire

The effects of fire on the eradication and/or spread of invasive non-native species would be evaluated, and goals for vegetation management (including noxious species eradication) would be incorporated into the development of fire management plans.

E. Livestock Management

Sheep grazing would be monitored to determine the extent that grazing is contributing to the spread of various invasive non-native species. Grazing management practices would be modified, as appropriate, to minimize the introduction and spread of non-native species, and to support eradication of target weed species by such means as judiciously bedding and grazing sheep in weed areas.

F. Adaptive Management:

All treatment areas would be systematically monitored following established Bureau procedures to assure that vegetation management goals were being achieved and that undesirable affects were not occurring. This would be achieved by updating databases for new weed occurrences and rare species, and for areas treated for control, as well as by preparing new maps and resource reports for field use as appropriate. All vegetation management actions would be evaluated at the end of three years to determine their effectiveness in reaching the goals of eradicating invasive non-natives, reducing herbicide usage, and minimizing long-term costs. The BLM would support and cooperate with inter-agency efforts to eradicate invasive non-native species in adjacent and/or nearby non-BLM lands that were providing a source for re-infestation on public lands at Fort Ord. The BLM would practice adaptive management by adjusting specific management actions for individual species in response to monitoring and/or new data.

Land Manager's Guide to Developing an Invasive Plant Management Plan

December 2018

ON THE COVER
Arctic National Wildlife Refuge—Alaska
Credit: USFWS

SUGGESTED CITATION:

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This guidance document is the product of a technical advisory committee of invasive plant management experts convened by the U.S. Fish and Wildlife Service and the California Invasive Plant Council.

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Abbreviations

BMP	best management practice
Cal-IPC	California Invasive Plant Council
EDRR	early detection and rapid response
Guide	*Land Managers Guide to Developing an Invasive Plant Management Plan*
IPM	integrated pest management
Plan	invasive plant management plan
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service

Chapter 1
Introduction

European beachgrass
Ammophila arenaria
CREDIT: USFWS

1.1 Purpose

The *Land Manager's Guide to Developing an Invasive Plant Management Plan* (Guide) is intended to help natural resource managers develop a strategic, integrative, and adaptive invasive plant management plan (Plan) (figure 1). More importantly, this guide covers the *process* of invasive plant management planning, whether you are developing a stand-alone Plan or integrating invasive plant management into other land management planning efforts such as vegetation management, fire management, species/ecosystem recovery planning, or climate change adaptation. The Guide is applicable at any scale, wherever invasive plants (terrestrial or aquatic) are a conservation concern and where resources will be expended to prevent, reduce, or eliminate them.

The Guide addresses topics common to many land management situations but also recognizes that each situation is unique given the diversity of environmental, legal, political, and other factors that can influence a site. Common constraints—such as limited staff or funds, site accessibility, spatial scale, sensitive resource concerns, and political or cultural issues—can impact where, when, and how we manage invasive plants and are addressed throughout the Guide, as applicable. This Guide is not intended to prescribe specific methods or techniques for invasive plant prevention, control, or inventory/monitoring. Furthermore, it does not address specific policies or regulations, as these can differ according to the agencies or organizations involved. Rather, it guides the process of decision-making to meet site-specific needs and conditions.

This Guide describes a step-wise process for developing and documenting an approach to managing invasive plants, and points to a wealth of freely available resources and examples. The intent is to help land managers develop effective Plans, even when management resources are limited and variable. Information in this Guide integrates and builds upon the best available information, including published and unpublished literature, decision-support tools, expert opinion, and past invasive plant management or integrated pest management (IPM) planning guides (such as Olkowski and Olkowski 1983; Tu and Meyers-Rice 2002; U.S. Fish and Wildlife Service [USFWS] 2004; IUCN 2018).

This Guide helps land managers address these key questions:

- Why is invasive plant management needed?
- What are the desired outcomes—management objectives?
- Which invasive plant species should be a management focus and where?
- What is the status (distribution, abundance) of invasive plants?
- What management strategies should be implemented? Who will implement? Where and when will they be implemented? Cost?
- How will the effectiveness of strategies be evaluated?
- What is the process for learning and adapting management strategies over time?

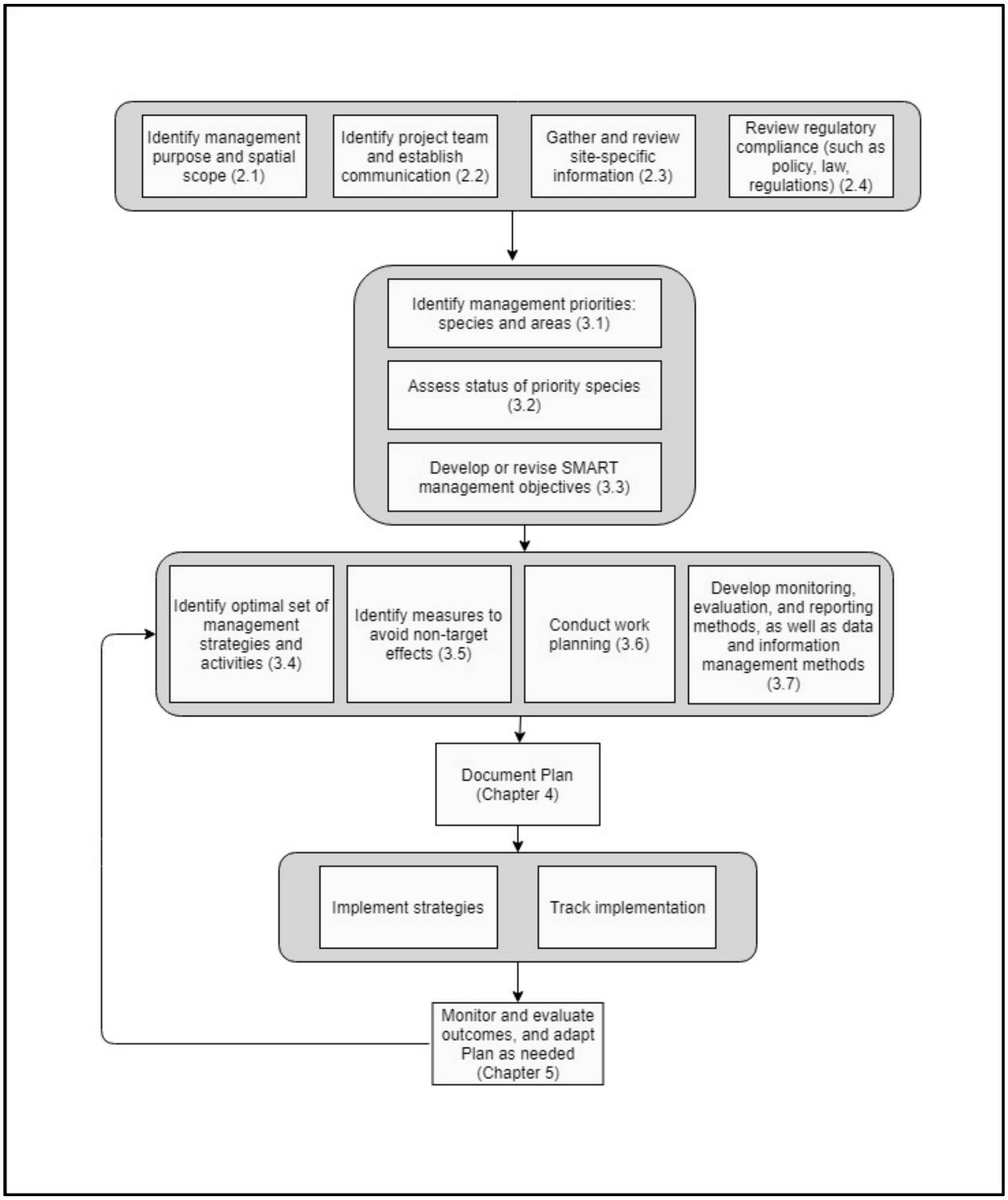

Figure 1. Strategic and adaptive invasive plant management cycle. Numbers in parentheses refer to sections of the Guide where information on that topic is located.

1.2 How to Use This Guide

This Guide is designed to take you through the major phases of developing a Plan (table 1): preparing to write the Plan (chapter 2), analyzing the situation and designing a management strategy (chapter 3), writing the Plan (chapter 4), and evaluating outcomes and adapting management strategies (chapter 5). A glossary follows chapter 5. Appendix A provides a list of useful online resources, appendix B provides plan examples, and appendix C provides a structured checklist of questions which serve as a Plan template.

Table 1. Steps for developing a strategic, integrative, and adaptive invasive plant management plan.

Step	*Description*	*Guide location*
Identify management purpose and spatial scope	The management purpose identifies the reasons why a Plan is needed, its intended audience(s), and how it will be used. The spatial scope identifies the geographic area where management activities prescribed by the Plan will occur and sets the stage for what types of information should be gathered to inform the Plan.	Section 2.1
Identify project team and establish communications	The project team is the larger group of people involved in your invasive plant management program, including land managers, stakeholders, researchers, governing boards, and other key players. The project team often includes a smaller core team who coordinates the planning effort and is ultimately responsible for developing and implementing the Plan. Identify the means for communication during the planning process, both within and outside your organization.	Section 2.2
Gather site-specific information	Gather basic information (plans, reports, data) for your sites, including organizational vision, conservation priorities, management goals and objectives, invasive plant issues, and management history. Identify gaps in information that need to be filled.	Section 2.3
Review regulatory compliance	Gather and review organizational policies and legislation that apply to invasive plant management planning or actions within your scope.	Section 2.4
Identify management priorities: species and areas	Select and document plant species that will be the focus of the Plan. A Plan may focus on a single species or address multiple species. If multiple species are being considered, prioritize which species are most critical to address. Define management areas within the Plan scope and prioritize where to focus management efforts.	Section 3.1
Evaluate the status of priority invasive plants in priority areas	Assess invasive plant abundance, distribution, pattern of spread, and spatial relationships with abiotic and biotic features in the environment.	Section 3.2
Develop SMART (specific, measurable, achievable, results-oriented, time-bound) management objectives	Develop statements that detail what success would look like as a result of your invasive plant management program.	Section 3.3
Develop optimal set of management strategies	Develop a suite of strategies to meet your SMART invasive plant management objectives using the best available information.	Section 3.4
Identify measures to avoid non-target effects	Use the best available information to develop measures to prevent, avoid, or mitigate any potential negative effects on humans, natural or cultural resources, or infrastructure as a result of invasive plant management activities.	Section 3.5
Work Planning	Describe who, what, where, and when invasive plant management activities will occur; this step guides on-the-ground implementation.	Section 3.6
Develop inventory, monitoring, and evaluation methods	Identify methods to track implementation of management activities, monitor plant community status and trends, and assess and report on progress in attaining invasive plant management objectives (or thresholds for management action).	Section 3.7
Develop data and information management methods	Develop data standards and structures for ensuring the data are easily accessed, understood, and utilized to their fullest potential.	Section 3.7
Write your Plan	Summarize your planning process and results of your analysis.	Chapter 4
Adapt your Plan (as needed)	After implementation, monitoring, and evaluation, revise your Plan at a regular interval to incorporate new information and other changes in approach.	Chapter 5

Terminology Matters

The language and terminology used to describe invasive species varies among countries, agencies, organizations, professionals, and members of the public. Terms like ***alien, non-native***, ***invasive***, ***pest***, and ***weed*** are often used interchangeably in scientific literature, confusing readers and even muddling the science (Lockwood et al. 2013). In this Guide, ***non-native species*** are defined as species found outside of their natural range, and ***invasive species*** are non-native organisms whose introduction causes or is likely to cause economic or environmental harm or harm to human, animal, or plant health (Executive Order No. 13751, 2016). It is important to emphasize that not all non-native species are invasive. Likewise, there may be native species that cause harm to ecosystems or human health (often referred to as ***native nuisance species***). Throughout this Guide we use the term ***invasive*** but recognize different terms may be preferred by different users and that planning efforts may also include native nuisance species.

alien: with respect to a particular ecosystem, an organism—including its seeds, eggs, spores, or other biological material capable of propagating that species—that occurs outside of its natural range (Executive Order 13751, 2016). Synonymous with ***non-native***, ***nonindigenous*** and ***exotic***.

aquatic nuisance species: a nonindigenous species that threatens the diversity or abundance of native species or the ecological stability of infested waters or commercial, agricultural, aquacultural, or recreational activities dependent on such waters (Nonindigenous Aquatic Nuisance Prevention and Control Act 1990).

noxious weed: any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment (Public Law 106-224).

pest: organisms that damage or interfere with desirable plants in our fields and orchards, landscapes, or wildlands, or that damage homes or other structures. Pests also include organisms that impact human or animal health (University of California Statewide IPM Program 2018).

weed: a plant that causes economic losses or ecological damage, creates health problems for humans or animals, or is undesirable where it is growing (Weed Society Science of America 2016).

1.3 Invasive Plant Management: An Overview

There are many reasons to manage invasive plants in natural areas. Most often cited are the threat invasive plants pose to native biodiversity and the alterations to natural processes. Many studies have demonstrated how invasive plants can alter ecosystem processes, structure, and composition, as well as the genetic makeup of native species populations through hybridization (Bossard et al. 2000; DiTomaso et al. 2013; Foxcroft et al. 2017; Hobbs and Humphries 1995; Lockwood et al. 2013). Invasive plants can also negatively impact infrastructure or other parts of the built environment (such as damaging irrigation systems) or pose harm to humans (such as increasing wildfire intensity or frequency). Finally, invasive plant encroachment may alter aesthetics or interfere with a recreational or cultural value of a place or property.

An important aspect of developing an invasive plant management plan is to make clear connections between the rationale(s) for managing invasive plants and your organization's mission, resources of conservation concern, and management goals. Such connections help land managers focus management efforts (set priorities), help stakeholders and others understand the motivation and need for management, and can ultimately increase management support. After addressing *why* your organization must manage invasive plants, the bulk of the planning process is focused on *how* your organization will manage those plants. The foundational principles for how to manage invasive plants is based on IPM, which is a decision-making process that integrates management goals, consensus building, pest biology, monitoring, environmental factors, and best-available technologies to achieve desired outcomes while minimizing unwanted effects.

Why Develop a Plan?

Successful invasive plant management is a lot more complicated than simply killing weeds—it requires a strategic and adaptive approach that is well-documented (figure 1). As Ben Franklin said, "if you fail to plan you are planning to fail." The planning process itself provides the opportunity for focused analysis, prioritization, and being clear about what you hope to achieve – your objectives. A well-crafted Plan provides guidance for a consistent management approach over time with parameters for adapting actions as environmental conditions or available resources change. It documents where you are now, where you would like to be, and how best to get there.

Almost all land managers can point to shortages of funding and resources as barriers to successful invasive plant management. A well-crafted Plan can help address these problems by identifying and documenting priorities for action in the face of limited and variable resources. A Plan can also help address other common barriers to successful invasive plant management, such as:

- **Lack of understanding about the impact of invasive plants.** The degree to which invasive plants harm priority conservation targets and impede the attainment of site goals may not be well-understood. This lack of understanding—especially among leadership within an organization or by important stakeholders—can lead to a lack of support and resources. The planning process itself provides a platform for building collective understanding, support, and consensus among management staff, leadership, partners, landowners, and local communities. Without consensus and support, a Plan simply becomes irrelevant.
- **Lack of prevention and early detection and rapid response (EDRR).** Despite the higher economic and ecological returns per unit effort they provide, prevention and EDRR are often overshadowed by already abundant and widespread invasive plant issues. Although there may exist a need to manage existing invasive plant infestations, placing little or no emphasis on preventing new invasions or further spreading can lead to economic and ecological harm (Cusack et al. 2009). The challenge is to balance managing well-established invasive plant infestations, preventing new infestations, and responding to new infestations before they become widespread. Plans should highlight the need for prevention and EDRR and detail exactly how these activities will actually be carried out.

- **Lack of inventory and monitoring of invasive plants.** Inventory and monitoring are essential to successful invasive plant management (DiTomaso 2000; Olkowski and Olkowski 1983; Stohlgren and Schnase 2006), but in the face of limited resources, managers often plan and implement their management strategies with little to no data about the status of the infestations they intend to manage or whether their strategies are actually working. This paradoxical dilemma is difficult to overcome, as many land managers feel the need to use limited resources on controlling invasive plants rather than on conducting inventory and monitoring. Without inventory and monitoring, we lack evidence that our strategies are creating the desired result, have no basis for learning and adapting, and leave no legacy of knowledge for those who come after us (or for communicating with the public), and therefore risk repeating failures.
- **Lack of an integrative approach.** A single-strategy approach, such as only using a chemical control method for long periods, can lead to species resistance, unintended non-target effects, and ultimately failure over the long term. Ideally, employing multiple management strategies that work together is more successful over the long-term than any one single strategy.
- **Lack of SMART (i.e., specific, measurable, achievable, results-oriented, time-bound) invasive plant management objectives and a built-in process for evaluation and feedback.** Without SMART objectives describing the expected result(s) of invasive plant management and a process for evaluation and feedback, managers lack a basis for evaluating progress, testing assumptions, learning, and adapting. We risk repeating practices of the past without regard to whether implemented strategies are working (or not) at different spatial and temporal scales.
- **Action is more reactive than proactive.** Ideally, the establishment of highly invasive species is wholly prevented, detected, or eradicated in the early phases of invasion. An introduced species can remain at low levels for a long period of time (such as years) before rapidly expanding. This is known as the *lag phase*. Whether or when a species leaves the lag phase and rapidly expands can depend on several factors including (1) development of genotypes that allow the species to spread, (2) changed environmental conditions that promote rapid population spread, or (3) continuous expansion of the species population that goes unnoticed until it becomes widespread (Hobbs and Humphries 1995). It is more cost-effective to remove or prevent establishment of invasive species before they become widespread and abundant—in other words, taking a more proactive than reactive approach.

Principles of Integrated Pest Management

The concept of IPM was first articulated by University of California entomologists in the 1950s, and in 1972, the concept of IPM became part of national policy with the establishment of an interagency IPM Coordinating Committee. While historically focused on insects and disease-causing organisms affecting agriculture, IPM now applies to all pest taxa and non-crop situations such as invasive plants in natural resource conservation areas.

The term *integrated* means to apply a combination of management techniques that work better together than separately. Using an integrated management approach increases the likelihood of success and reduces the likelihood that a pest will become immune (i.e., develop resistance) to a management technique, particularly in the case of herbicides.

Integrated Pest Management (IPM)

"A science-based decision-making process that incorporates management goals, consensus building, pest biology, monitoring, environmental factors, and selection of the best available technology to achieve desired outcomes while minimizing effects to non-target species and the environment and preventing unacceptable levels of pest damage" (USFWS 2010).

While the concept and policies surrounding IPM have evolved over time and vary across organizations and agencies, contemporary descriptions have common elements (for example, USFWS 2004; DiSalvo and Parson 2011; Flint and Gouveia 2014; UC-IPM 2018) such as:

- Know your resource (site description: ecosystems and landcover, infrastructure, conservation goals, etc.).
- Know your pest; identify priority pest species and understand their ecology and harm (or potential harm).
- Assess the status of pest populations.
- Prevent pest problems.
- Use a combination of techniques to control pest populations.
- Develop guidelines or thresholds for management action.
- Describe your expected management outcomes or results (objectives).
- Build consensus and regularly communicate with those who may be affected by your pest management program or who can contribute expertise.
- Monitor management outcomes, learn, and adapt management.

This Guide is designed to help you consider each of these elements as you develop your Plan.

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Chapter 2
Preparing to Write a Plan

This chapter is focused on laying the foundation of your Plan—its spatial scope, who should be involved in its development, understanding which invasive plant species occur (or could occur in the future), conservation focus, invasive plant management history, and regulatory considerations.

Purple loosestrife
Lythrum salicaria
CREDIT: ©2009 Barry Rice

2.1 Identify Plan Purpose and Spatial Scope

An essential first step in the planning process is to identify the Plan's purpose and its spatial scope. The Plan should present a compelling case for why invasive plant management is needed and how it is impeding your ability to achieve your organization's mission and conservation goals. The spatial scope identifies the broad geographic area where invasive plant management activities will occur and sets the stage for what types of information should be gathered to inform the plan (section 2.3), what laws or policies will govern invasive plant management activities (section 2.4), and who should be involved in strategic analysis for the Plan and the types of communication needed (section 2.2). The Plan may focus on a single, geographically distinct site such as a park, refuge, watershed, or forest, or a collection of sites within a large landscape. The scope could also be more thematic in nature, such as a particular ecosystem within a landscape.

2.2 Identify Project Team and Establish Communication

The project team is the group of people who are involved in developing a Plan. The project team can be a small group of people who do most of the work (core team), decision-maker(s), stakeholders (such as the public or adjacent landowners), invasive species experts, and others who will implement the Plan or who have a vested interest in conservation activities or outcomes at your site. It's worth carefully considering your project team's composition and, if needed, pushing your organization to recognize the importance of this step. The ultimate utility of a Plan can depend heavily on who is involved in its development. Project team members will likely include representatives from the implementing organization but may include others outside the organization. Being outside the organization might mean these individuals play different roles on the team, but they may still be essential for successfully implementing your invasive plant management program.

The core planning team—those who will be closely involved with moving the process forward—should form at the start of Plan development and then promptly identify everyone who should be involved within the broader project team and revisit the Plan scope. The composition of the project team may change as you move through Plan implementation, although it is usually helpful to maintain continuity. Once you have identified the project team, identify and communicate roles. Begin communicating with your team early in the planning process to help everyone understand the planning process, their roles, and how information will be shared.

It is critical that communication continues throughout the planning process to help build consensus, ensure the time and resources you spend on planning are not wasted, and the team is connected and supportive of the final product. While some Plans will be primarily internal, for others the external use will be just as important. Near urban areas, or in high-use areas, land management decisions may be politically charged, and a great deal of public review and participation may be needed to develop a Plan that reflects the interests of all stakeholders. Political leaders may need help in understanding the factors that go into developing a Plan, and a communication strategy for outreach to the broader community may be needed. Beyond their perspective as stakeholders, community members can also be a great resource for ideas and assistance. General tips for improving communication during the planning process are listed below:

Who Should Be on the Project Team?

- People who will develop the Plan
- People who will implement the Plan
- Key decision-makers
- Partners or other important stakeholders
- Technical advisors

- Design the Plan to suit the needs of the target audience(s).
- Make the Plan readable; minimize jargon and technical details that are not explained.
- Communicate early and often with all levels of management in your organization on the need for the Plan.
- Anticipate potential internal and external concerns; develop a communications approach to address these concerns.
- Design an ongoing process for building consensus between technical experts, decision-makers, and stakeholders.

2.3 Gather and Review Site-Specific Information

Gathering and reviewing information relevant to the Plan scope will provide a foundation for developing your Plan and increase how efficiently it is developed. Information should be gathered to answer questions such as:

- What is the focus of conservation at the site, and what are the associated conservation goals?
- What are current and potential invasive plant species that prevent attainment of conservation goals, and how do they prevent attainment of goals?
- What is the current distribution and trend of each invasive plant species?
- What strategies have been employed to manage species currently and previously, and how effective have they been?
- From whom is support needed for Plan development and implementation? Where might obstacles and resistance to invasive plant management support be likely to materialize?

Table 2 lists information that would typically be gathered and used to inform development of a Plan.

Table 2. Common types of information to support invasive plant management planning.

Item	*Source*	*Rationale*
Personal knowledge or expertise	Interviews with leadership, invasive plant program staff, adjacent land owners, and local (or regional) invasive species experts.	Increases understanding about current invasive plant issues, future potential invasive plant issues (early detection), management history, management effectiveness, and potential barriers to successful management.
Site surveys	Tours of management areas with staff familiar with the areas and history of invasive plant management efforts.	Increases understanding about conservation targets, sensitive species issues, invasive plant threats, stress, status, and trends; informs invasive plant management strategies.
Management plans and records	Site-specific or surrounding landscape conservation plans; past invasive plant management plans, reports, or management records; and stakeholder lists.	Identifies conservation targets, goals, or existing invasive plant management objectives within the spatial scope or in the surrounding landscape. Increases understanding about the status and trends of invasive plant threats and the harm they cause as well as understanding of potential management strategies. May identify restrictions on management methods.
Spatially referenced information	Maps or spatial data: site boundaries, management units, landcover, vegetation communities, hydrology, roads/trails, infrastructure, cultural resources, sensitive species locations, and invasive species distribution.	Increases understanding about the status and trends of invasive plants, relationships with other environmental features (biotic and abiotic). Informs priorities for invasive plant management (what species and where) and strategy development.
Invasive plant lists	Site-specific invasive plant lists, management plans, natural resource reports, and outside databases (from state invasive species councils, natural heritage programs, NatureServe Explorer, EDDMapS, herbaria, etc.).	Informs what species should be the focus of management. If there are multiple plant lists for a single site, compile into one list and standardize taxonomy (such as to the International Integrated Taxonomic Information System standard, available at *www.itis.gov*).
Early detection plant lists	Web-based species occurrence databases like EDDMapS and CalWeedMapper and information from early detection networks, county agricultural extension agents, and weed management areas.	Informs what species should be the focus of early detection efforts.
Non-native plant invasiveness rankings and legal status	Invasive species risk assessments conducted by larger landscape agencies or organizations, such as invasive plant councils; includes federal and state noxious weed lists.	Informs prioritization of non-native plants species for management.

2.4 Review Regulatory Compliance

Compliance with regulations (acts, laws, policies, regulations, permits, certifications, etc.) is always a component of developing and implementing invasive plant management programs and may ultimately influence the types, location, and timing of invasive plant management activities at your site. While regulatory compliance is an important component of planning, it is not a focus of this Guide, as requirements can vary geographically (such as by state) and across private and public organizations.

We recommend consulting within your organization to gain a clear understanding of the policies, laws, permits, required training, and other regulatory compliance applicable to invasive plant management activities within the Plan's scope. If your organization has limited knowledge or experience with regulatory compliance issues, reach out to similar organizations in your area who may have more expertise. In the case of federal or state agencies or for Plans that encompass public lands, be sure to review your agency's regulatory framework. It is always useful to reach out to invasive species experts, within or outside your organization, to better understand the regulatory framework that will influence invasive plant management planning and implementation.

Chapter 3

Analyzing the Situation and Designing a Management Strategy

This chapter guides you through analysis of information gathered (chapter 2) to identify your priorities, define what you want to achieve (objectives), and design a management strategy. *Strategies* here refers to a collection of activities that work together to achieve a particular outcome—the objective(s). Ultimately, the level of detail provided about strategies and associated activities should be tailored to the situation and intended users of the Plan. For example, if the Plan is intended to direct on-the-ground management activities, then a high level of detail is warranted.

Section 3.1 covers identifying priority species and areas, and section 3.2 covers evaluating the status (abundance and distribution) of priority species in priority areas. Setting invasive plant management objectives and establishing strategies are discussed in sections 3.3 and 3.4, respectively. Section 3.5 covers how to avoid non-target effects, or the unintended impacts of carrying out invasive species management. The final two sections—section 3.6 and 3.7—discuss how you will implement your plan. Section 3.6 addresses work planning, a critical step in which you will document what needs to get done, where, and when, as well as how much it will likely cost; work planning is an essential step in ensuring that your Plan is implemented effectively and consistently over time. Section 3.7 discusses establishing inventory, monitoring, and evaluation procedures.

Water hyacinth
Eichhornia crassipes
CREDIT: USFWS

3.1 Identify Management Priorities: Species and Areas

One key aspect of any invasive plant management planning process is prioritization: selecting which species to work on, where, and when. Ideally, prioritization is conducted before significant resources are invested in invasive plant inventories, early detection, or management actions. Managing for all non-native species everywhere within a site is impractical. Natural resource managers are often constrained by funding, available resources, time, and personnel, and several have developed credible ways to make decisions about which invasive plants to focus on and where (such as Hiebert and Stubbendieck 1993; Randall 2000; Skurka Darin et al. 2011; USFWS and Utah State University 2018).

The prioritization process (shown schematically in figure 2 below) is an opportunity to develop or refine the focus of invasive plant management activities, ensuring resources are dedicated where they are most needed. Ideally, decisions about what invasive species to focus on and where should be transparent, repeatable, and defensible (Hiebert and Stubbendieck 1993; Randall et al. 2008; Warner et al. 2003). This approach helps build consensus and support, fosters continuity in management over time as people or conditions change, and builds in management flexibility as funding and staff levels change. Prioritization does not mean that a species or area identified as "low priority" should never be addressed; even low priority species and areas may be addressed at some point in the future. Alternatively, it is worth evaluating if there are invasive plant species currently under management that shouldn't be. It's important to remember prioritization is intended to inform decision-making rather than to make decisions directly. Prioritization results should be discussed among your project management team to make final decisions.

While most teams find both species and area prioritizations useful, there may be cases where there are few (such as fewer than five) invasive plants of concern within or adjacent to the Plan's spatial scope, negating the need for species prioritization. Here, the decision process may shift to where invasive plant management should be focused, especially when the scope encompasses thousands or millions of acres.

The following sections describe the general process and tools for prioritization. Also, see appendix A for tools and resources for prioritization and appendix B for links to reports or plans that contain invasive plant prioritization examples.

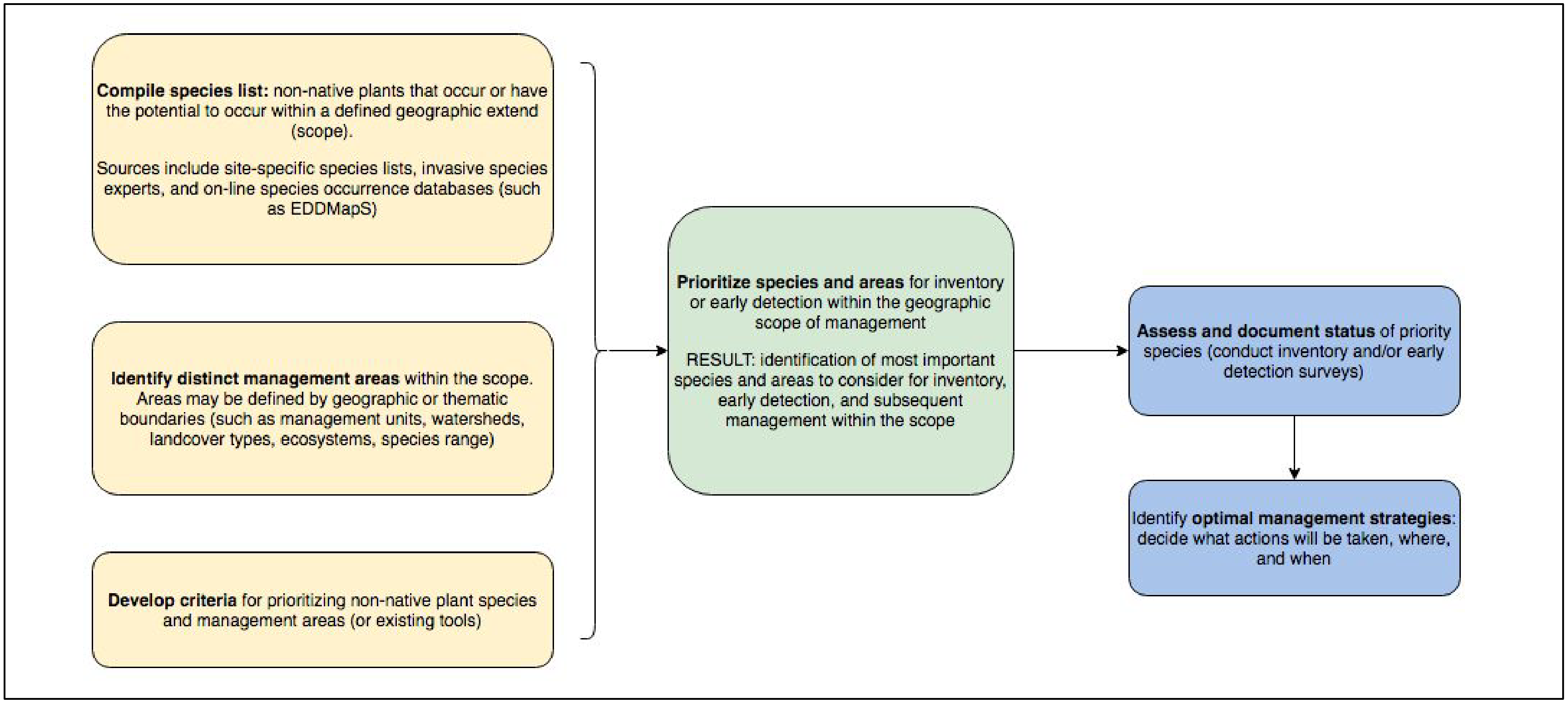

Figure 2. Generalized work flow for prioritizing species and areas for management. Initial prioritization informs what species and where inventories or early detection surveys should be focused and more generally where management efforts should focus. Subsequent inventory or early detection surveys provide details to inform and direct on-the-ground management action (what to do, where/what populations, and when). Survey data also provide a basis for evaluating progress over time.

3.1.1 Identify and Prioritize Plant Species

The first step in species prioritization is to compile a list of non-native plant species known to occur within the Plan spatial scope as well as species with the potential to occur in the future. Ideally, a list of current and potential species is compiled from available sources and scientific names are standardized to your preferred taxonomic standard (such as the International Taxonomic Information System). Once compiled, the lists can then be prioritized by the project team using one or more criteria (table 3).

Many larger landscape organizations such as the U.S. Department of Agriculture (USDA) and state invasive plant councils have assessed invasiveness or "noxiousness" of non-native plant species to wildlands across large landscapes of the United States (see table 4 for examples). These assessments are based on risk assessment criteria such as the NatureServe *Invasive Species Assessment Protocol* (Morse et al. 2004), and they often rely on scientific literature and expert knowledge to provide a comprehensive review of species ecology, biology, distribution, and impacts on the environment. While these larger landscape lists can be a useful tool in identifying management priorities, when used alone, they may not provide enough information to identify local scale priorities. For example, when many of the species on your list are found on one of these larger landscape lists, management priorities may be less apparent. In such cases, it may be useful to apply additional criteria (table 3) or use a tool (table 5) to help identify site-specific priorities. A more structured approach can help teams come to consensus on which species should be a focus of management as well as provide a legacy of information about how decisions were made. An example of a species prioritization exercise from the Klamath National Wildlife Refuge Complex is provided in figure 3.

3.1.2 Identify and Prioritize Management Areas

A first step in prioritizing areas for management is to define the areas of your Plan's spatial scope that are under management consideration. Over the long term, the intent may be to manage invasive plants across all areas within the Plan's spatial scope, but when resources are limited, area priorities help inform where to use those resources. Areas should have clear boundaries defined by one or a combination of features such as jurisdictional management boundaries, ecosystem types, vegetation communities, sensitive species populations/habitat, watersheds/hydrology, soils, or topography. Several criteria can be used to help decide which areas within the Plan's spatial scope are a priority for managing invasive plants. These include the current level of infestation, risk of invasion, and importance to high value conservation resources; table 6 provides a list of criteria often used to prioritize areas, and table 5 provides a list of prioritization tools. An example of an area prioritization from the National Park Service Golden Gate Recreation Area is provided in figure 4.

Table 3. Criteria commonly used to prioritize species for invasive plant management.

Category	*Criteria*
Larger Landscape Invasiveness	The degree to which a species is likely to cause harm to wildlands or overall biodiversity. Invasiveness rankings have been developed for larger landscapes and are based on expert opinion and comprehensive review of the scientific literature (see table 5).
Status and Habitat Suitability	Characteristics of the species within the Plan's spatial scope. Includes criteria such as presence or proximity, abundance, distribution, and habitat availability/potential to spread.
Ecological Impacts	The severity of current or potential impacts the plant causes (or could cause) on conservation targets within the Plan's spatial scope.
Difficulty of Control	The difficulty of managing the species within the Plan's spatial scope. Includes criteria such as cost, time, and technical difficulty.
Larger Landscape Importance	The degree to which the species is a priority for management on adjacent lands or in the larger landscape.
Other	The degree to which a species is important for management because of political, public, cultural, or other reasons (defined by the user).

Table 4. Examples of invasive plant ranking systems.

System title	*Species ranking criteria*	*Web link*
Alaska Invasiveness Ranking System	Preliminary climate screening to identify species that could invade environments found in Alaska or areas with similar climate; includes ecological impact, biology, management difficulty, and distribution.	*http://accs.uaa.alaska.edu/invasive-species/non-native-plant-species-list*
California Invasive Plant Inventory	Species ecological impact, ecosystems or communities invaded, invasive potential, documentation level, and distribution.	*http://www.cal-ipc.org/plants/inventory/*
Federal and State Noxious Weed Lists	Criteria vary across states.	*https://plants.usda.gov/java/noxComposite*
Invasive Non-Native Plants That Threaten Wildlands in Arizona	Species ecological impacts, invasiveness, ecological amplitude, and distribution.	*http://www.swvma.org/invasive-non-native-plants-that-threaten-wildlands-in-arizona/*
Hawaii Weed Risk Assessment	Species ecological impact, ecosystems or communities invaded, invasive potential, documentation level, and distribution.	*https://sites.google.com/site/weedriskassessment/home*
NatureServe I-ranks	Species ecological impact, biology, abundance, management difficulty, non-target management impacts, diversity of habitats or ecological systems invaded, and distribution.	*http://explorer.natureserve.org/servlet/NatureServe?init=Species*
New York State Ranking System for Evaluating Non-Native Plant Species for Invasiveness	Species ecological impact, biology, abundance, management difficulty, and distribution.	*https://www.conservationgateway.org/Documents/New-York-State-Invasive-Plant-Ranking-System.doc*
Virginia Invasive Plant Ranking System	Species ecological impact, abundance, biology, management difficulty, and distribution.	*www.dcr.virginia.gov/natural-heritage/document/nh-invasive-plant-list-2014.pdf*

Table 5. Examples of tools for prioritizing invasive plant species and areas for management, organized from low to high levels of technical expertise required.

Tool	*Prioritization focus*	*Level of expertise required*	*Description*
Invasive Plant Inventory and Early Detection Prioritization Tool (IPIEDPT)	Species and Areas	Low	The IPIEDPT is a Microsoft Access tool that integrates larger landscape invasive plant rankings and local knowledge to generate a prioritized list of species and areas for inventory and early detection, and ultimately management. Species criteria include larger landscape invasiveness rankings, impacts (known or probable), proximity, potential for spread, and abundance/distribution. Area criteria include ecological integrity (health), level of infestation, density of vector pathways, frequency and intensity of vector events, and disturbance. Source: USFWS and Utah State University (2018). Web link: *https://catalog.data.gov/dataset/an-invasive-plant-inventory-and-early-detection-prioritization-tool*
Spreadsheet	Species and Areas	Low	Prioritization of species or areas can be done with an Excel spreadsheet. User defines criteria and scoring for species or area rankings.
CalWeedMapper*	Species and Areas	Low	Provides statewide (California) distribution data (via *calflora.org*) for invasive plants and generates a management opportunities report for user-defined areas (e.g., a National Forest, National Wildlife Refuge, ecoregion, or a county). Results from CalWeedMapper should be combined with local knowledge to set site-specific priorities. Web link: *https://calweedmapper.cal-ipc.org/*
Weed Heuristics: Invasive Population Prioritization for Eradication Tool (WHIPPET)*	Species and Areas	Moderate	WHIPPET prioritizes spatially referenced (mapped) invasive plant populations for eradication based on potential impact, potential spread, feasibility of control, and location (outlier status, proximity to vector pathways, and accessibility). Source: Darin 2008; Skurka Darin et al. 2011. Web link: *https://whippet.cal-ipc.org/pages/view/guide*
ArcGIS	Species and Areas	High	Spatial data such as invasive plant locations and environmental features (such as roads, trails, hydrology, soils, topography, ecosystem/communities, and sensitive resource locations) are overlaid and analyzed (user defined attributes) to identify priority areas and/or species (if spatial data are available) for management. Example area prioritization: National Park Service's early detection protocol (Williams et al. 2009), available at *www.sfnps.org/download_product/1256/0*

Tool	*Prioritization focus*	*Level of expertise required*	*Description*
NatureServe Invasive Species Assessment Protocol	Species	High	The protocol is a multi-criteria tool for assessing, categorizing, and listing non-native invasive vascular plants according to their impact on native species and natural biodiversity in a large geographical area such as a nation, state, province, or ecological region. The tool has typically been used to develop larger landscape invasive plant rankings but can be adapted and used at a local scale. Requires in-depth knowledge about plant ecology and impacts or an in-depth literature search. Web link: *http://explorer.natureserve.org/servlet/NatureServe?init=Species*
Alien Plant Ranking System	Species	High	The system guides users through 25 questions in three sections relating to individual species: (1) current level of impact, (2) potential of a species to become a problem, and (3) feasibility of control. The sections include questions about the distribution and abundance of species, the number of seeds they produce, and their dispersal capabilities. There are also questions about whether a species is known to seriously impact other sites. The tool has typically been used to develop larger landscape invasive plant rankings (such as for Alaska) but can be adapted and used at a local scale. Requires in-depth knowledge about plant ecology and impacts or an in-depth literature search. Source: Hiebert and Stubbendieck (1993). Web link: *http://hear.org/articles/cip_winter2002v2n1_prioritizing_weeds.pdf*

*Note: WHIPPET and CalWeedMapper are specific to California, but their algorithms may be useful for others. Both were designed and built with funding from the USDA Forest Service, State & Private Forestry.

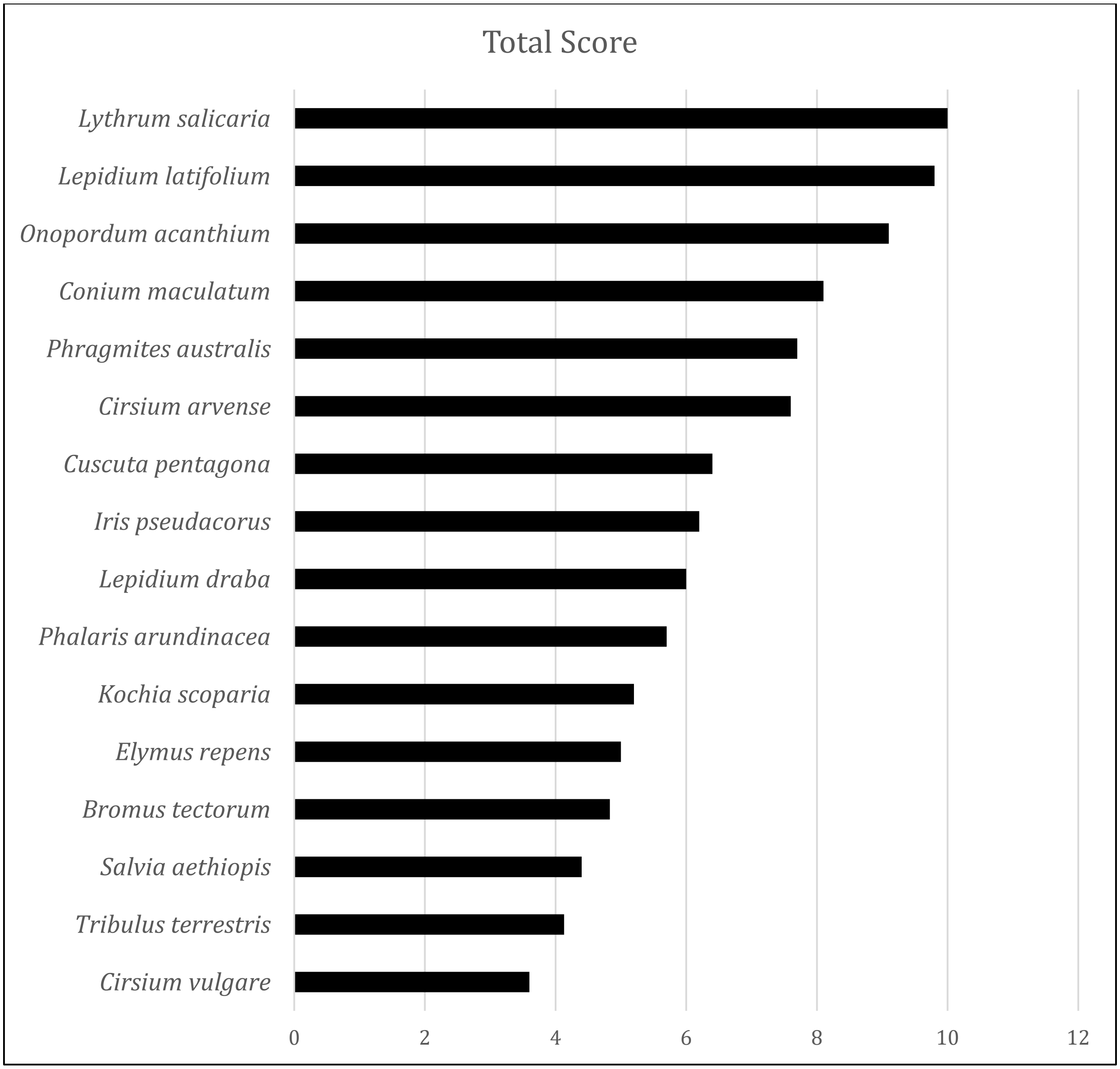

Figure 3. Invasive plant species prioritization results for Lower Klamath and Tule Lake National Wildlife Refuges: species present on-refuge (USFWS in prep.). The larger the total score, the higher the priority for management. Species prioritized using the Invasive Plant Inventory and Early Detection Prioritization Tool (IPIEDPT) (USFWS and Utah State University 2018).

Table 6. Criteria commonly used to prioritize areas for invasive plant management.

Category	*Criteria*
Importance to Conservation Targets	The importance of the area to natural resources of priority conservation concern (conservation targets) as it relates to the presence or proximity of a natural, cultural, or other important resource. Areas important to resources of conservation concern are often a high priority for detecting and removing invasive plants. These are often species, species alliances/guilds/communities, or ecosystems but can include other resources of concern, such as cultural resources.
Integrity or "Intactness" of Resources	The degree to which an area is believed to be healthy, intact, or unimpaired, with major ecological (or cultural) attributes functioning within the bounds of natural disturbance regimes. For example, ecosystem structure and processes are intact and function within their natural ranges of variation. Areas with relatively high integrity often have high conservation value and are a priority for preventing or reducing anthropogenic threats such as introduction of invasive plants.
Innate Resistance to Invasion	The innate capacity of an ecosystem (or other system) to resist establishment and spread of invasive plant species. Environmental factors that can influence innate resistance include resident native plant diversity, density of native vegetative cover, abiotic conditions such as nutrient levels, soil or water quality, and natural disturbance regimes such as flooding and wildfire.
Risk of Invasion: Invasion Pathways and Vectors	Invasion pathways and vectors provide the means for invasive plant transport from one location to another. Here, *pathways* are transportation pathways such as roads, trails, levees, waterways, etc. *Vectors* are the vehicles for transmitting or carrying invasive plant propagules along pathways, specifically human-based vectors such as hikers, cars, boats, or machinery. Criteria for assessing risk of spread from pathways and vectors include assessing the density of vector pathways (both terrestrial and aquatic) and the types, frequency, and intensity of vector events—opportunities for vectors to transmit invasive plants (such as from high recreation use or frequent management activity). Areas where terrestrial pathways are widely distributed and occur at high densities are at greater risk for invasion. Areas that experience frequent vector events (such as recreational areas) are also at risk.
Risk of Invasion: Anthropogenic Disturbance	*Disturbance* facilitates invasive plant invasions and can be described as a "relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment" (Lockwood et al. 2013; White and Pickett 1985). Here, we are focused on anthropogenic disturbances such as restoration/enhancement activities, regular maintenance activities, resource extraction, and toxic spills. Consider the intensity, duration, and frequency of human-caused disturbance events. Areas that are exposed to intense, frequent, or long-duration disturbance events are at high risk for invasion.
Infestation Level	This category considers the richness and abundance of invasive plant species within an area. Areas considered "clean" of invasive plants are often a higher priority than areas already heavily infested.
Investments	Degree of previous investment in invasive plant removal efforts.

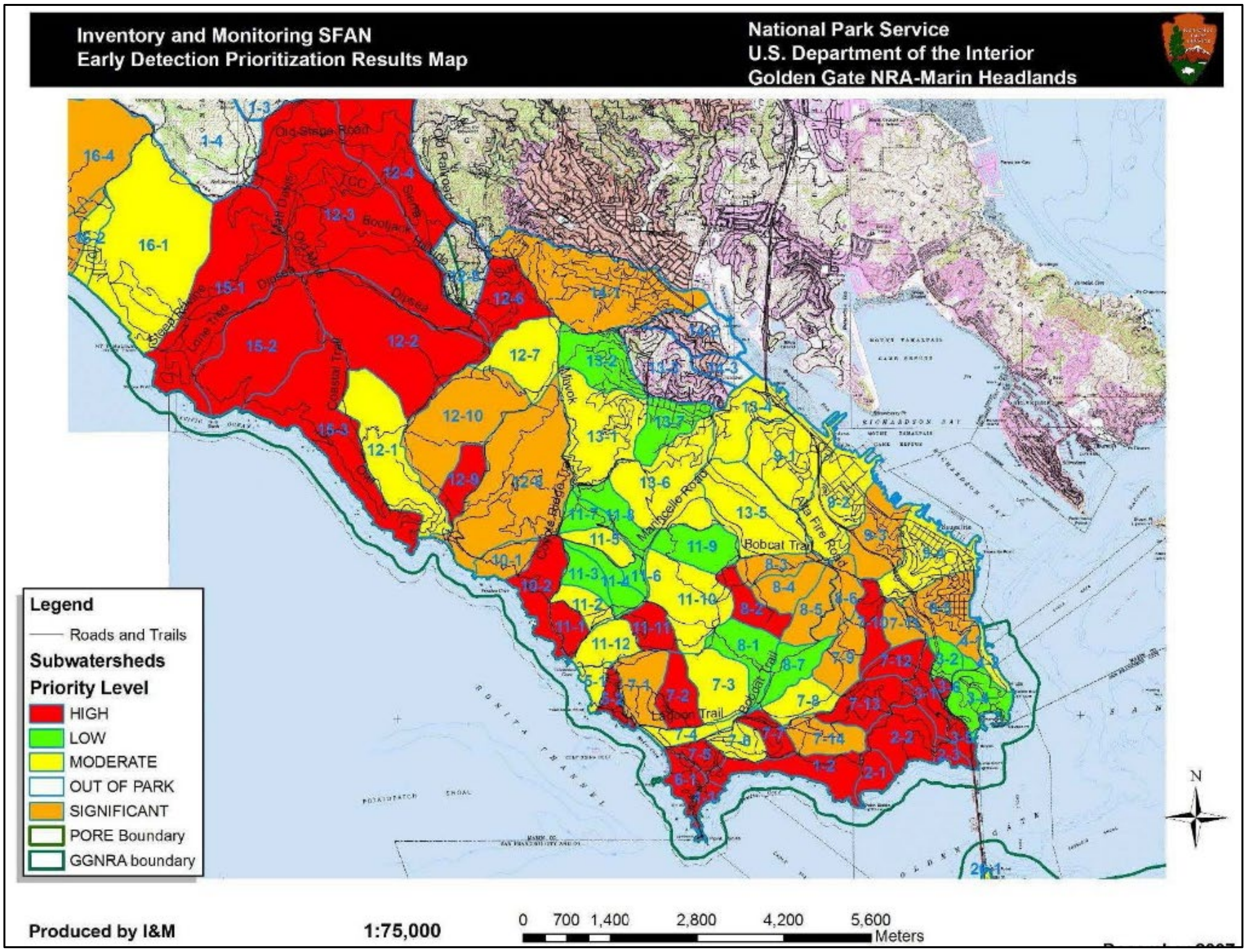

Figure 4. Map of prioritized areas (subwatersheds) for invasive plant early detection in the Golden Gate National Recreation Area, Marin Headlands, California. Hydrologic units (at a variety of scales) were used to define areas. Subwatershed prioritization criteria included abundance of rare or at-risk native species or species alliances, current level of invasive plant species richness and abundance, risk of invasion, and level of previous investment. Source: Williams et al. 2009.

3.2 Evaluate the Status of Priority Species and Areas

Some of the most important pieces of information that help managers develop an effective and efficient Plan is an understanding of the ecology as well as the status of the species they intend to manage. *Status* here refers to the location, distribution, and abundance of invasive plant species obtained through invasive plant inventories or early detection surveys. Data obtained from these surveys are used to:

- Develop specific and measurable objectives (section 3.3)—in order to ask, *where are we now?*, there must be a clear and definitive answer to the question, *where did we start*?
- Understand patterns of invasive plant introduction and spread.
- Inform the development and prioritization of management strategies.
- Guide on-the-ground management activities.
- Evaluate management effectiveness, learn, and adapt (section 3.7).

In addition, data and visualizations of invasive species status (such as species occurrence maps) can increase understanding of the invasive plant problem and may, as a result, lead to increased support. Decision-makers, the private sector, and the general public often have limited understanding of the threats posed by invasive species to the environment, economies, human health, and cultural values. Invasive species management competes for funding with many other interests. Lack of awareness, support, and funding often constrain adequate invasive species management.

If quantitative data concerning the status of priority invasive plants within the Plan's spatial scope are lacking, we recommend these surveys are conducted before developing management objectives and strategies. If this is not possible, consider the following: conducting interviews with field staff or local invasive species experts, mining online species occurrence databases, or reviewing reports or papers that contain information about vegetation within the Plan's spatial scope. Ideally, inventory and monitoring of invasive plants (or vegetation as a whole) becomes an integral component of your Plan (see section 3.7).

3.2.1 Inventories

An inventory is a type of survey that is used to determine the location or condition of a resource at a specific time. In this Guide, *inventory* refers to a catalogue of invasive species that includes information on their location, abundance, and distribution in a defined location (see the examples in figures 5–8). Inventories provide a snapshot of the distribution and abundance of invasive plants across a landscape and are critical for understanding the invasion problem, patterns of spread, and impacts (economic and ecological) and ultimately building a strategic and adaptive Plan (Rew and Pokorny 2006). When resources are limiting, consider inventorying the highest priority areas first and phasing inventory of lower priority areas over time.

"An inventory serves to diagnose the weed problems within a landscape, and not until the diagnosis is complete can comprehensive and complete management actions be taken. In a sense, weed inventories [or early detection] are as critical to land health as medical exams are to human health, and a tangible weed map is just as vital to a land manager as an x-ray would be to a medical professional."

Andersen and Dewey 2007

3.2.2 Early Detection

Early detection monitoring consists of systematic and repeated surveys of areas deemed high-risk for becoming infested with new invaders and is typically focused along likely routes of invasion and in areas believed to be un-infested ("clean" areas). Early detection surveys are focused on detecting the location of invasive species that are not yet established within a defined area, but the potential for establishment exists (Olsen et al. 2015). Early detection is critical for documenting new and highly invasive species for eradication before they become established, widespread, and abundant and cause both economic and ecological harm.

3.2.3 Inventory and Early Detection Methods

Aerial invasive plant survey

CREDIT: Wildlands Conservation Science, LLC.

There is not a prescriptive, "one-size-fits-all" method or approach for invasive plant inventories or early detection. The methods will vary depending on survey objectives, species detectability (influenced by abundance, phenology, color, or size), spatial scale, ecosystem type, budget, and available expertise.

In the broadest sense, there are two basic approaches to inventory and early detection surveys: (1) ground-based and (2) remote. Below we provide a summary of these two approaches adapted from the USFWS's *Invasive Plant Inventory and Early Detection Guide* (USFWS in prep.).

As the name implies, *ground-based inventory methods* are those in which the surveyor is observing and recording the location of invasive plant infestations from the ground. Depending on the terrain and accessibility of the site, many of these ground-based methods can be carried out on foot or with the aid of vehicles such as trucks, ATVs, boats, etc., that can enhance the efficiency of the survey. Ground-based methods include corridor surveys, grid-based surveys, full coverage swaths, opportunistic sampling, line transects, belt transects, permanent plot monitoring, and photo points.

As compared to ground-based methods, *remote methods* are generally accomplished by sensors deployed on planes, helicopters, and drones from which visual data are collected (collectively referred to as *remote sensing*). Remote methods also include aerial mapping of invasive plant populations by human observers from a helicopter.

The ability to detect weeds remotely depends on the unique properties of the weed of interest, the size or extent of the infestation, and the spectral and spatial resolution of the sensors employed (Bradley 2014). In some cases, the spatial extent or size of the images available is in direct conflict with image resolution. For example, flying at a lower altitude to capture more detail will require more passes to cover a given area. An integral part of remote sensing is performing a field-based accuracy assessment to ground-truth results.

There are many remote sensing methods that have been used to survey invasive plants. Excellent descriptions of different techniques as well as examples of how those techniques have been used have been published by several authors (Bradley 2014; Huang and Asner 2009; Lass et al. 2005; Madden 2004) and should be read by those considering remote sensing approaches to invasive plant inventory; many of these reviews are summarized in table 2 of USFWS (2018). The U.S. Forest Service Remote Sensing Applications Center website (*https://www.fs.fed.us/eng/rsac/*) also provides excellent guidelines on plant characteristics needed to employ remote sensing techniques as well as criteria for selecting the best approach for a given survey objective.

The USFWS's *Invasive Plant Inventory and Early Detection Guide* (2018) summarizes factors to consider when planning these surveys and points to existing survey methods, protocols, and mapping guides.

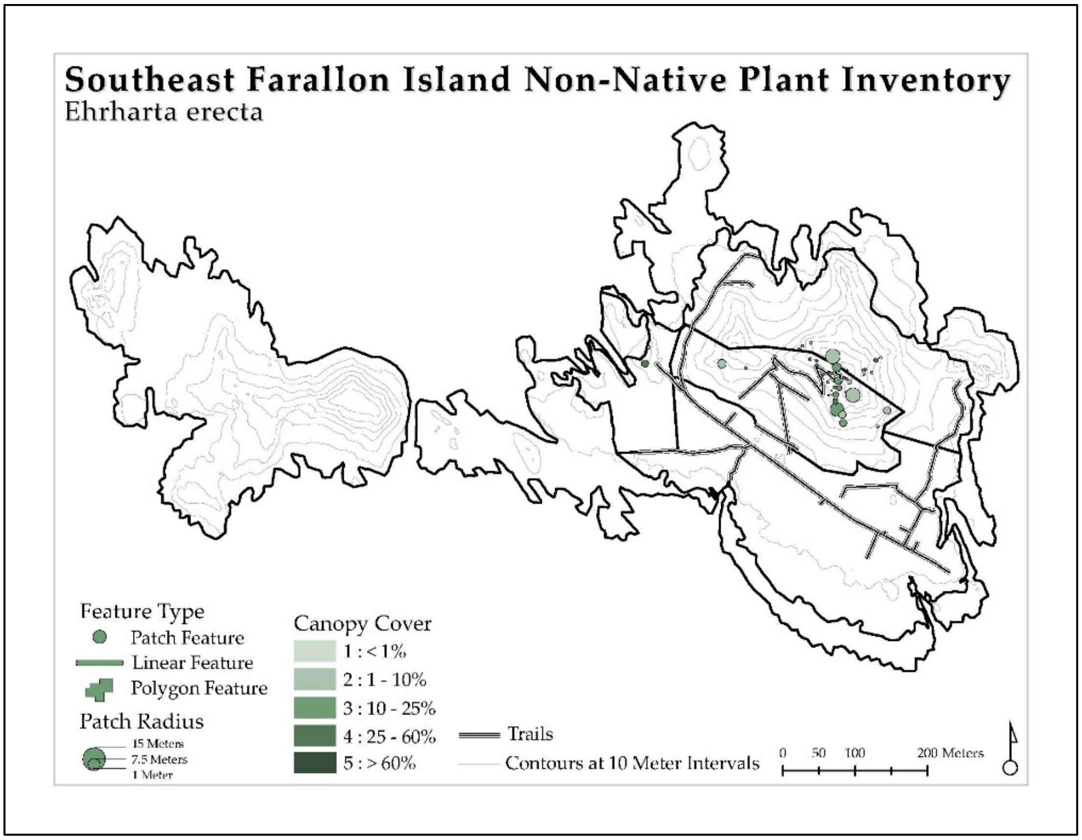

Figure 5. Farallon Island National Wildlife Refuge invasive plant inventory map: *Erharta erecta*. Results of island-wide inventory using field-based mapping methods. Source: Holzman et al. 2016.

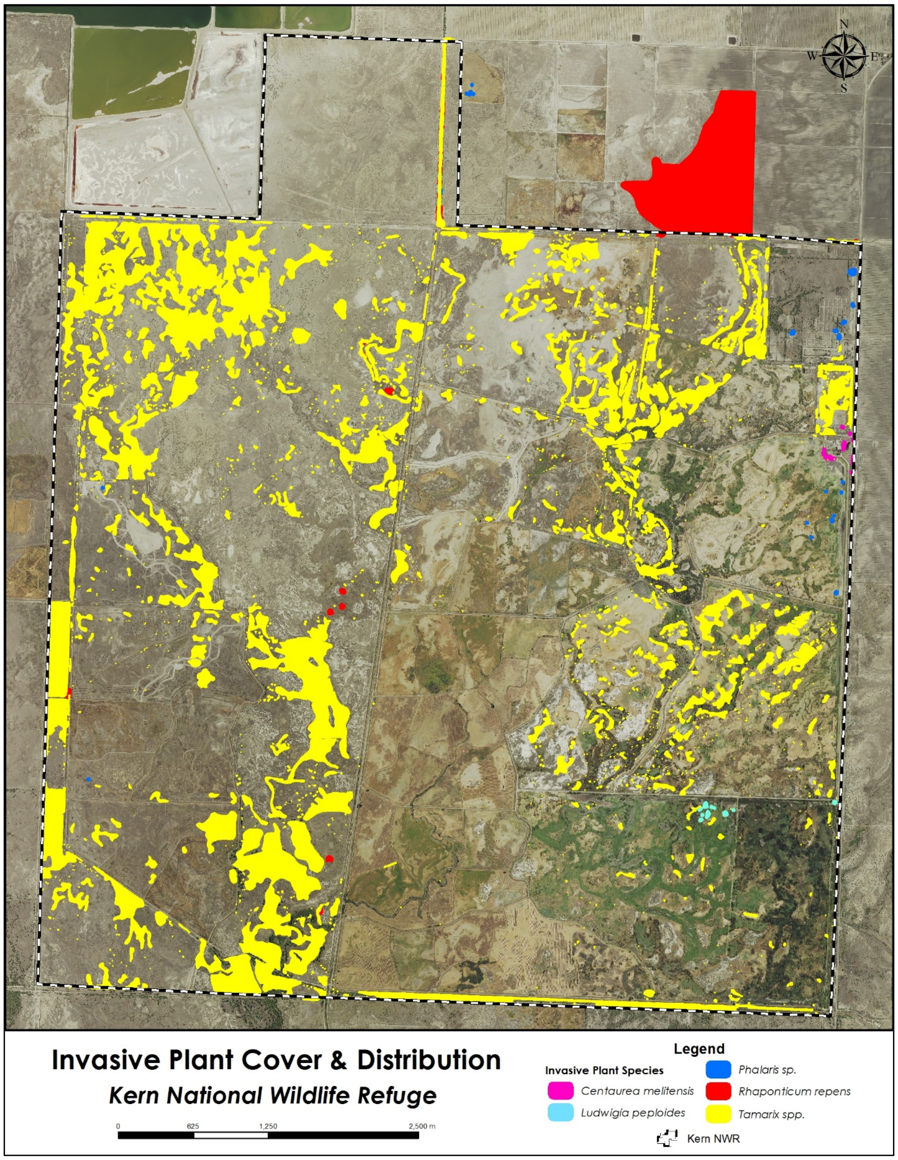

Figure 6. Kern National Wildlife Refuge invasive plant inventory map. Inventory conducted using aerial (helicopter) field-based mapping methods. Source: Ball and Olthof 2017.

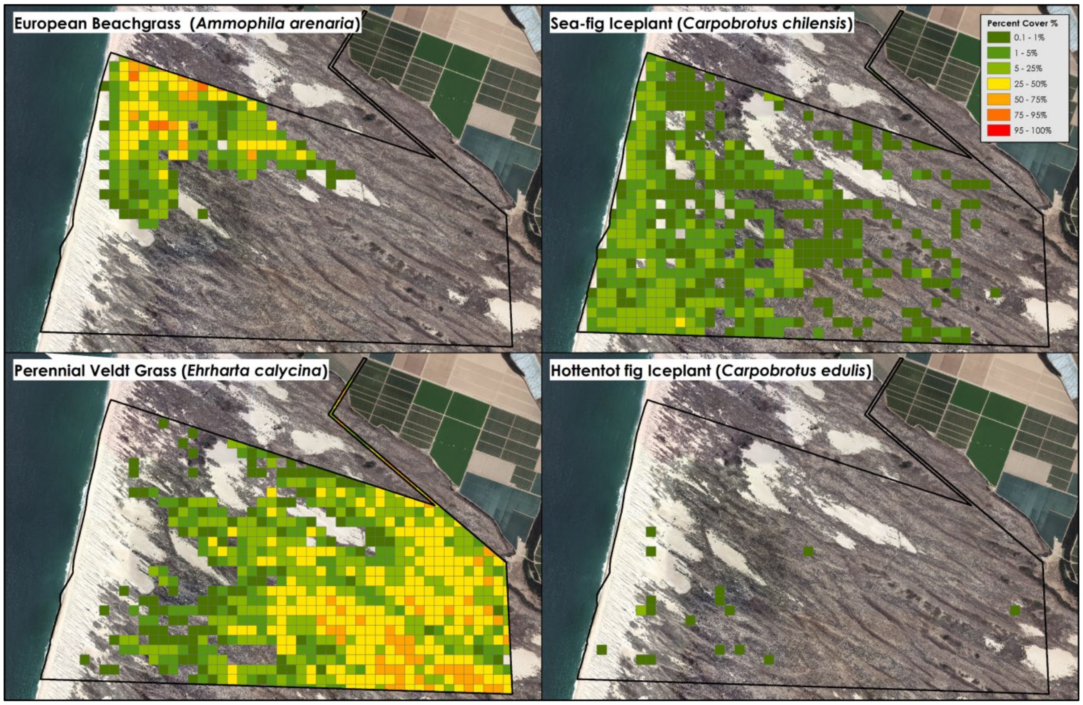

Figure 7. Guadalupe-Nipomo Dunes National Wildlife Refuge invasive plant inventory map. Inventory conducted using aerial (helicopter) grid-based mapping methods. Source: Ball and Olthof 2017.

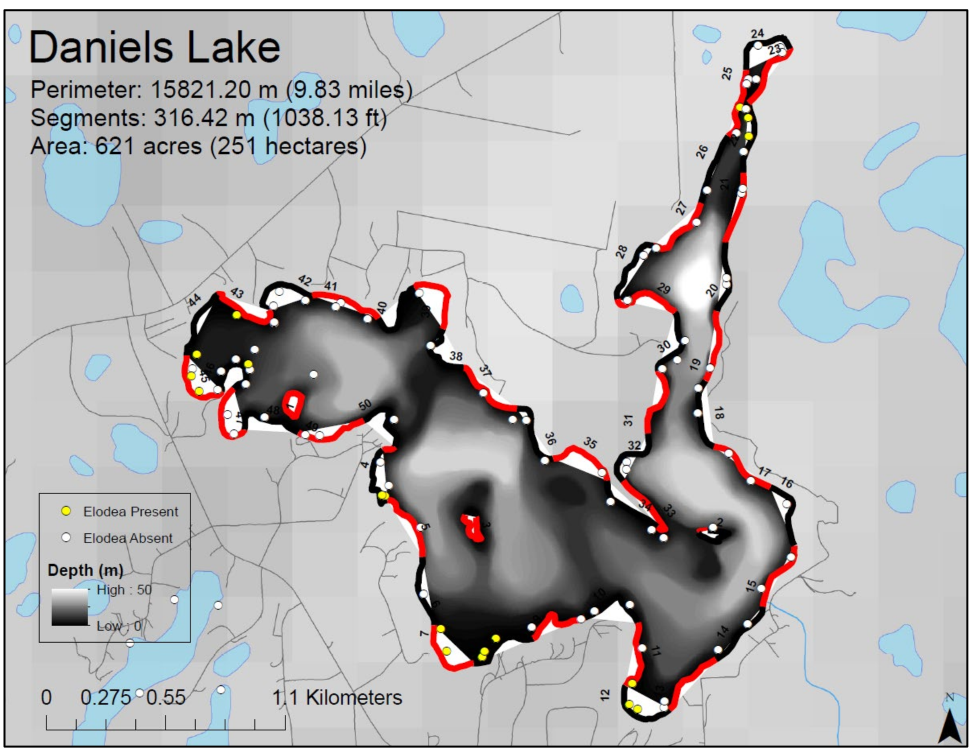

Figure 8. Results of early detection surveys for the aquatic plant Elodea (cross between *E. canadensis* and *nuttallii*) at Daniels Lake, Kenai Peninsula, Alaska. Field-based survey. Source: Bella n.d.

3.3 Develop Invasive Plant Management Objectives

Put simply, an *objective* is a statement detailing the desired outcome or result of management—what success looks like. Depending on the invasive plant management situation, expected outcomes likely fall into one or more of the categories below:

- Preventing introduction of new and highly invasive species
- Containing the extent/preventing further spread of existing infestations
- Reducing the cover of existing infestations
- Eradicating species

Four questions an objective should answer:

1. What is the expected change and where?
2. How much change do you want to see, and in what direction?
3. What needs to be measured to evaluate change?
4. Over what time period is change expected to occur?

Although mentioned previously, it's worth repeating here the importance of well-crafted objectives; they provide the foundation for evaluation, learning, and adaption of management to ultimately improve outcomes. They help us answer the following questions: *is our management program working?* and *if not, why not?*

To answer these questions, we first need to know what the desired impact is—the objective. Second, we need to track whether strategies were implemented or not. Third, we need to monitor attribute(s) of invasive plants (spelled-out in the objective).

A well-crafted objective meets the following SMART criteria (Foundations of Success 2009).

- Specific—*what is expected* and *where* are clearly defined so that all people involved in the project have the same understanding of what the terms in the objective mean.
- Measurable—definable in relation to some standard scale (numbers, percentage, fractions, or all/nothing states).
- Achievable—achievable and appropriate within the context of the project site and available resources. Considerations: people, technical capacity, funding, and political, economic, and other constraints.
- Results-oriented—focuses on the result of management actions, not the actions themselves.
- Time-bound—specifies when results are expected.

Avoid ambiguity by wording objectives clearly. A clearly worded objective is easy to understand and difficult to misinterpret. Avoid or minimize using words and terms that are subject to interpretation without numeric/measurable values attached, such as *high quality*, *reduce*, *enhance*, and *restore*. Objectives should contain a measurable element that can be monitored to evaluate progress; it should be clear from the objective what needs to be measured.

Objectives—no matter how measurable or clearly written—must be achievable. Avoid setting your program up for failure. If you cannot resolve constraints on achieving an objective, then consider discarding or rewriting it. Consider both short- and long-term objectives. Be realistic about what is required to successfully achieve an objective, and use sound professional judgment to develop reasonable expectations of time, staff, and funds available to pursue the objective. Objectives should specify an end result rather than state the action(s) that will be taken; when reading a results-oriented objective, it should be clear what success looks like in terms of the result, not the actions taken (such as how many gallons of herbicide sprayed in a given year). Examples of objectives and how well they pass the "SMART test" are provided in table 7.

Table 7. Examples of invasive plant management objectives and the degree to which they are SMART (specific, measurable, achievable, results-oriented, and time-bound). Generic area names are provided in cases where objectives are drawn from existing plans.

Objective	*S*	*M*	*A**	*R*	*T*	*Notes*
Broom-free by 2003!	N	Y	Y	Y	Y	Lacks specificity: which broom species? Where?
Decrease the abundance and extent of target invasive species in management areas A and B.	N	N	Y	N	N	What are the target invasive species? By when?
Eradicate high-priority species from high-quality habitats.	N	Y	Y	Y	N	Lacks specificity about what species, where eradication will occur, and by when.
Reduce cover of non-native species in Area C by 10% by 2020.	N	Y	Y	Y	Y	Which non-native species are being referred to? Plants?
Conduct EDRR surveys on an annual basis for yellow starthistle along all road within District X.	Y	Y	Y	N	N	Statement about actions that will be taken rather than the result.
Annually spray all known populations of Elodea in Refuge X.	N	Y	Y	N	Y	What species of Elodea? Specifies the management action that will be taken rather than the result of the management action.
Eradicate barbed goatgrass from Area D by 2020, defined as finding no evidence of plants for a period of five growing seasons.	Y	Y	Y	Y	Y	SMART objective
Reduce cover of French broom in Area E to 5% by 2019.	Y	Y	Y	Y	Y	SMART objective
Populations of Spotted Knapweed at Areas B and C will decrease at a rate of 25% per year until eradicated by 2010.	Y	Y	Y	Y	Y	SMART objective

*Note: We assume objectives were written to be achievable.

Developing objectives that are achievable over the life of your Plan requires examining several key pieces of information including:

- What species and areas are a focus of management?
- What is the status of priority species within the Plan scope?
- What are the major constraints: accessibility, spatial scale, availability of people or funding, technical capacity, regulations, politics, etc.?

3.4 Develop Invasive Plant Management Strategies

An *invasive plant management strategy* is a collection of activities or projects aimed at preventing, eradicating, containing, and/or suppressing (asset-based protection) targeted invasive plant species. Deciding which activities to employ and where can be a complex process because there are many factors to consider, such as species abundance and ecology; site characteristics such as scale, sensitive resources, and accessibility; capacity to implement (people, funding, and technical expertise); and socio-political issues. If you have completed the initial planning steps—gathering site specific information, prioritizing, assessing status, and developing SMART objectives (chapter 2 and sections 3.1–3.3)—you are well-positioned to design an effective and achievable strategy.

In this section, we summarize the four basic approaches to invasive plant management (prevention, eradication, containment, and control) (figures 9 and 10) and point to techniques and resources to help you design an optimal invasive plant management strategy. In addition, appendix A lists other resources for understanding invasive plant ecology, imagery, and management techniques (prevention and control). Appendix B points to publicly available Plans and the types of information they contain; these Plans serve as examples of information discussed in this section.

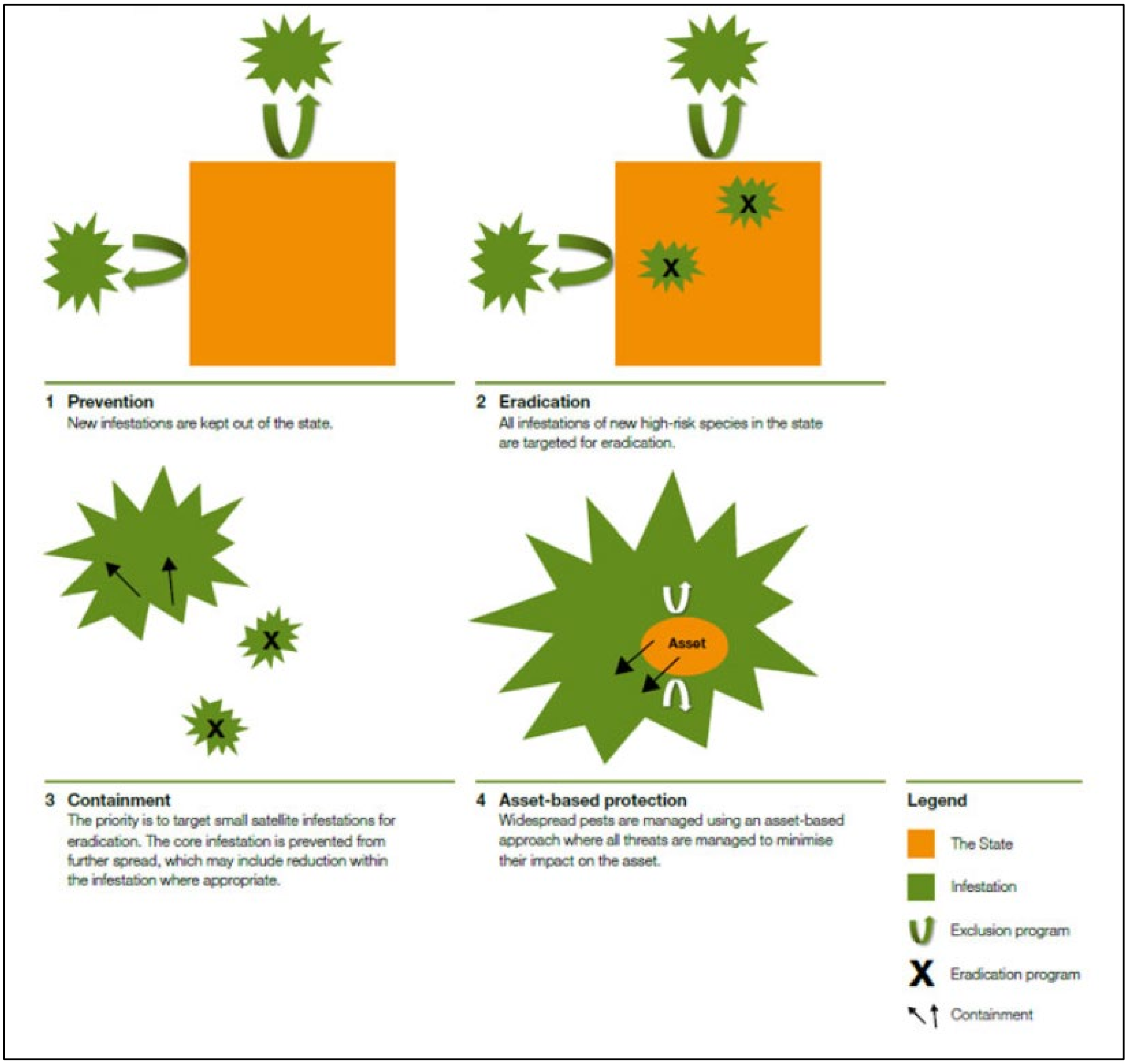

Figure 9. Approaches to invasive plant management at different stages of invasion. Source: Agriculture Victoria 2002.

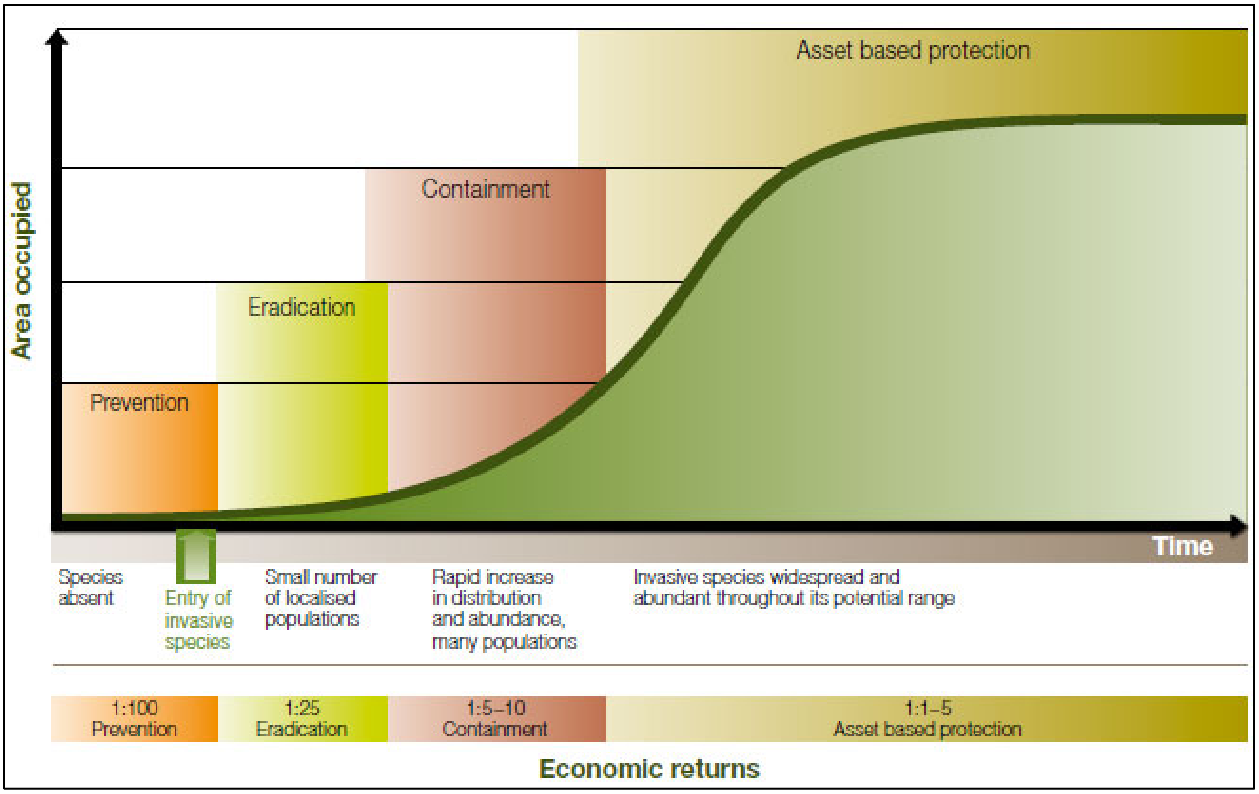

Figure 10. Generalized species invasion curve (the S-curve) and associated management approaches and cost-benefit ratios as area occupied increases. The amount of benefit for every dollar spent decreases as the area occupied increases. Source: Agriculture Victoria 2002.

3.4.1 The Four Basic Approaches to Invasive Plant Management

Prevention (or Biosecurity)

Preventing the introduction of invasive plant species is the first line of defense against invasive species (figures 9 and 10). Together, prevention with EDRR is the most cost-efficient way of reducing the economic and ecological costs of invasive species. Once established, invasive species can be extremely difficult and costly to remove. Even after successful removal, damage to food web dynamics, nutrient flow mechanisms, and other intricacies of the original ecosystem may persist.

Invasive plants are introduced (and spread) by vectors. A vector is the conveyance that moves a non-native propagule to its novel location (Lockwood et al. 2013). Invasive plants can be transported by natural means such as wildlife, wind, and water. Transport also occurs by anthropogenic means; human activities that can inadvertently lead to invasive plant introductions include:

- Importation of contaminated materials such as plants, mulch, wood, soil, gravel, or animal feed.
- Recreational activities such as hiking, biking, boating, and camping.
- Land management activities (carried out by staff, volunteers, partners, and contractors) that involve movement of people, vehicles, or tools. Examples include inventory and monitoring, routine maintenance activities (such as mowing), restoration activities, fire management activities, and invasive plant management activities.
- Other human activities that lead to disturbance or disruption of ecological processes, thereby creating novel situations and opportunities for invasion.

Examples of locations that are vulnerable to invasion include:

- **Vector pathways**. A *vector pathway* is the route between the non-native propagule source and release location (Lockwood et al. 2013). Common vector pathways include roadsides, trails, waterways, and utility corridors.
- **Areas where humans and their vehicles/tools frequent or congregate** such as buildings, boat launch sites, campsites, and vehicle or tool storage areas.
- **Areas of high intensity or frequent disturbance (natural and anthropogenic).** Disturbance facilitates invasion and can be described as a "relatively discrete events in time that [disrupt] ecosystem, community, or population structure and [change] resources, substrate availability, or the physical environment" (Lockwood et al. 2013; White and Pickett 1985). Examples of anthropogenic disturbances include restoration or enhancement activities, regular maintenance activities (such as mowing), resource extraction, and toxic spills. Examples of natural disturbance events include floods, tides, fire, and erosion.

Understanding the likely means of introduction and transport of invasive plants at your site is key to developing prevention or biosecurity strategies.

Eradication

Eradication is the complete removal of an invasive plant species (including reproductive propagules) from a defined area (figures 9 and 10). Eradication is most feasible when an infestation is small.

To understand how the size of an infestation affects whether eradication is an achievable objective, Rejmanek and Pitcairn (2002) analyzed decades of eradication efforts by the California Department of Food and Agriculture and found that eradication of infestations smaller than 1 hectare (2.5 acres) was usually successful, while only a third of infestations between 1 and 100 hectares (2.5 and 250 acres) and a quarter of all infestations between 101 and 1,000 hectares (250 and 2,500 acres) were eradicated (figure 11). Costs associated with eradication increase dramatically with size of infestation.

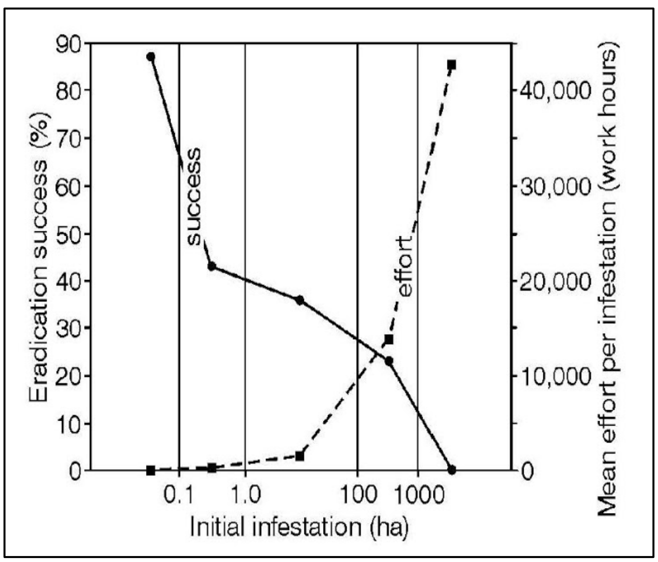

Figure 11. The dependence of the eradication success (%) and the mean eradication effort per infestation (work hours) on the initial size of infestations. Source: Rejmanek and Pitcairn 2002.

Successful eradication projects require (1) having adequate resources and commitment to see the project through to completion; (2) having an entity with authority to implement eradication; (3) fully understanding the biology of the species; (4) having the ability to detect the target species at low densities; and (5) having capacity for subsequent restoration of the system (Simberloff 2003).

Eradicating invasive plant populations when they are small requires that we first detect them and then eradicate them quickly before they become widespread and abundant—a concept commonly referred to as EDRR. Early detection involves systematic and repeated surveys for new species. Early detection surveys are commonly focused in areas at high risk of invasion such as vector pathways, areas where vectors congregate or frequent, and disturbance areas (see *Prevention* section above for more detail on this topic). USFWS's *Invasive Plant Inventory and Early Detection Guide* (2018) summarizes factors to consider when planning early detection surveys and points to existing survey methods and protocols. For example, the National Park Service has developed invasive plant early detection protocols for several of its park networks (*https://www.nps.gov/im/networks.htm*).

Along with formal early detection surveys, an organization should also have a structure in place for reporting incidental observations of potentially new and harmful invasive plant species. Observations should be confirmed by an expert, and then the priority of the species for eradication should be evaluated.

Containment

Containment is defined as any action taken to prevent establishment or to control a plant species beyond a predefined area known as the *containment unit. Control* is defined as the act of reducing the occurrence or abundance of invasive plants using one or more IPM chemical, biological, cultural, or mechanical removal techniques.

The containment unit comprises the area where the species currently exists (occupied zone) plus a surrounding buffer zone that is free from plants but can receive propagules (such as seeds) (Fletcher et al. 2015). Containment is typically undertaken when eradication fails or is infeasible (figures 9 and 10). Containment involves repeated searching and removal of individuals (EDRR) that arise within the buffer zone, but it can also encompass prevention activities to slow the rate of spread into the buffer zone as well as suppression of populations within the occupied zone. Containment must continue indefinitely unless the means to suppress and ultimately eradicate the core infestation become available. Given this reality, it is worth examining the cost of eradication versus long-term containment.

Containment may be a viable option (over eradication) wherever a species occupies a large area, has small dispersal distances, and has long-lived seed banks (Fletcher et al. 2015). In addition, the longer an infestation has been established and the further it has spread, the more likely containment will be cheaper than eradication (Fletcher et al. 2015). Containment may also be a viable option in the short term when resources are extremely limited. As additional resources become available, reducing—and ultimately eradicating—the extent and abundance of plants in the occupied zone may become more feasible. If containment of a species is the desired approach, your Plan should clearly define the containment strategy, including what species will be contained, how, under what conditions, and where (defining the containment unit or area). See Fletcher et al. (2015) for more information on how to assess whether containment can outperform eradication, and under what conditions it is a valid management approach.

Asset-Based Protection

Asset-based protection means limiting invasive plant control activities to portions of an infestation that directly threaten high-value conservation targets (such as areas supporting a high-valued species, community, ecosystem, or culturally significant asset) (figure 9, 10). Asset-based protection is commonly practiced when an invasive species is widespread and abundant and there is little hope of eradication. As with eradication and containment, a variety of techniques can be used to control invasive plants (see section 3.4.2).

3.4.2 Prevention and Control Techniques

Prevention Techniques

Identifying the most appropriate techniques for preventing the introduction or spread of invasive plants requires:

1. Clear objectives—knowing what you want to prevent and where.
2. Site-specific knowledge about risk—areas within your spatial scope at high risk of invasion and human activities that are likely to lead to invasion.

This information will directly inform the types of techniques and best management practices (BMPs) to reduce risk of invasive plant introduction and spread. Useful references for conducting invasive species risk assessments and identifying prevention techniques suited to your situation are listed below:

- *Preventing the Spread of Invasive Plants: Best Management Practices for Land Managers* (California Invasive Plant Council [Cal-IPC] 2012). This resource includes helpful BMPs for a range of activities. Web link: *https://www.cal-ipc.org/docs/bmps/dd9jwo1ml8vttq9527zjhek99qr/BMPLandManager.pdf*
- *Compendium of Recommended Procedures and Best Management Practices Relevant to Minimizing the Introduction of Invasive Species by Service Activities* (USFWS 2016). Covering all taxa, this resource points to a wealth of information about risk assessment methods, prevention techniques and practices, and outreach and communication materials. Web link: *https://ecos.fws.gov/ServCat/Reference/Profile/105555* (Appendix 2)
- *Guide to Noxious Weed Prevention Practices* (USDA Forest Service 2001). This guide includes helpful BMPs for a range of activities. Web link: *https://www.fs.fed.us/invasivespecies/documents/FS_WeedBMP_2001.pdf*

Ideally, a formal invasive plant risk assessment is conducted as part of the planning process. If time does not allow for an assessment, it should be called out as an activity so that prevention measures are focused on the highest-risk areas and activities.

Control Techniques

As noted above, invasive plant control is the act of reducing the occurrence or abundance of invasive plants using one or more techniques (such as chemical, biological, mechanical, or cultural removal). Several factors should be considered when selecting control techniques, including:

- Management objectives—what you are trying to achieve (see section 3.3)
- Target species ecology, distribution, and abundance
- Capacity to implement—people, cost, and technical capacity
- Site characteristics such as scale, accessibility, and politics
- Potential non-target effects
- Likelihood of success

Ideally, multiple techniques are employed for a given species or species group to avoid development of resistance (figure 12). *Resistance* is a decline in effectiveness of a particular control technique over time. Reliance on any single technique to control weeds results in selection for species or populations that can survive that practice (Coble and Schroeder 2016). A clear sign that resistance is occurring is a decline in effectiveness over time. Invasive plants can develop resistance to any type of control technique (such as mechanical, chemical, or biological), but it is more commonly associated with herbicide use. The International Survey of Herbicide Resistant Weeds (2018) reports there are currently 496 unique cases (species x site of action) of herbicide-resistant weeds globally, with 255 species (148 dicots and 107 monocots). Further, weeds have evolved resistance to 23 of the 26 known herbicide sites of action and to 163 different herbicides.

Figure 12. The process of selection for herbicide resistance. Resistance individuals (blue) increase in number over time as a result of herbicide selection pressure. Source: USA Herbicide Resistance Action Committee 2018.

Table 8 below summarizes invasive plant control techniques and related advantages and disadvantages in their use. Each technique can be carried out using a variety of methods. A review of species-specific control information (published literature, books, invasive species websites, local experts) is a necessary step in developing your overall strategy (section 3.4.3). There is no single resource for invasive plant control techniques. Appendix A provides a wealth of online resources for invasive plant management, many of which lead to species-specific control information.

Table 8. Summary of invasive plant control techniques (adapted from Tu and Robinson 2013).

Technique	*Advantages*	*Disadvantages*
Manual: physical removal of invasive plants using non-mechanical tools such as hands, shovels, picks, axes, hand-saws, or machetes	Little training is needed for safe use of many tools, and they can be used in a variety of situations; hand tools are relatively low cost and can provide very specific and targeted control. Ideal for smaller infestations.	May be time- and labor-intensive for moderate to large infestations. Some manual tools may be dangerous to use. Potential non-target effects: inadvertent disturbance to or removal of non-target species.
Mechanical: physical removal of invasive plants using mechanized tools such as mowers, brush-cutters, chainsaws, or earth-moving equipment	Many tools/equipment can be used in a variety of situations and have low implementation costs. Can provide very specific and targeted control. Ideal for small infestations.	May be time- and labor-intensive for moderate to large infestations. May require qualified individuals or training to operate some mechanized tools or equipment. Potential non-target effects: inadvertent disturbance to or removal of non-target species.
Cultural: land management practices such as grazing, prescribed fire, or irrigation/flooding	Control of moderate to large infestations may be possible. Can be low effort and cost per unit acre relative to other techniques. In some cases, may lead to positive response by native plants.	In some cases, may lead to an increase in invasive plants if not used appropriately. Often will not completely eliminate the target species from an area. Potential non-target effects: inadvertently disturbs or removes non-target species and promotes invasive plant spread.
Biological: introduction of novel predators, parasites, and pathogens such as insects, fungi, or microbes, to attack an invasive plant species	Relatively low cost per unit acre. May keep invasive plants at a low level across large landscapes. Long-term effectiveness is limited; must repeatedly treat invasive plant infestations once biocontrol agents are established.	May be expensive to develop. Often does not lead to eradication of the target invasive species. High risk of unintended consequences to native species and communities.
Chemical: application of herbicides to kill invasive plants	May be a cost-effective approach for larger infestations and lead to effective control when used appropriately. Often a variety of application mechanisms available (ground and aerial).	High risk of unintended consequences to native species and communities. Unintended consequences may include contamination of soil or water, harm to or removal of non-target species, human exposure, and health issues for applicators. May be expensive to obtain and/or apply chemicals. Often more regulatory requirements to apply. May be controversial in some areas.
Restoration of ecosystem processes or composition	Works to bring the project site to a desired and/or native state that is more resistant to invasion over the long term.	High cost. There may be a time lag to realized benefits. May not lead to elimination of the target invasive species.

3.4.3 Selecting an Optimal Set of Strategies

An invasive plant management strategy encompasses species or area-specific activities to achieve your objectives and avoid unintended harm to natural or cultural resources (non-target effects). Developing an optimal strategy requires evaluating the impact and feasibility of different combinations of approaches, techniques, and methodologies (we refer to these combinations collectively as *activities*). We suggest brainstorming potential activities with your objectives in mind, and then selecting a portfolio of feasible activities that is most likely to help you attain your objectives. It's worth emphasizing here that objectives should be the major factor driving the brainstorming process. Other factors used to evaluate the value of different invasive plant management activities are presented in table 9.

Tools and approaches for selecting an optimal set of strategies range from simple to complex, but most involve answering questions about the performance of a project or activity relative to your objectives, the feasibility of carrying it out, and the likelihood of non-target effects. Regardless of the method, involving your project team to build consensus around decisions is important. Tables 10 and 11 provide simple examples of evaluating alternative activities. Decision trees (figure 13) can also be a useful approach. The *Invasive Plant Management Decision Analysis Tool* (*https://ipmdat.org/ipmdat.html*) is an online decision support tool for evaluating different approaches to managing particular species. This tool does not tell you what to do; rather, it helps you evaluate various alternatives you have brainstormed.

Whether your approach is simple or complex, brainstorming and evaluating impacts and feasibility lead to more objective and transparent decisions, help teams reach consensus, provide a record of how decisions were made, and increase the likelihood that the strategy is implemented and successful.

Table 9. Factors to consider when developing an invasive plant management strategy.

Factor	*Description*
Management objective(s)	The degree to which an activity will lead to achieving a management objective
Species or species group characteristics	The degree to which the activity is well-suited to the species ecology, distribution, and abundance within the management scope
Non-target effects	The likelihood and degree to which the activity will result in unintended negative impacts on the environment or humans
Likelihood of success	The level of certainty that the activity can be successfully implemented and will work as expected
Feasibility of implementing	Cost and duration; technical expertise required and available; sociopolitical concerns; training or certifications required. Your organization may have sophisticated cost-estimating software, but in many cases a simple spreadsheet will do. Inventory data, if available, can be used to estimate costs. Cost per unit area can be derived from past management onsite or from interviews with others who have implemented similar activities.

Table 10. Simplified example of evaluating alternative invasive plant management activities for objectives focused on preventing establishment of new invasive plant populations (Objective 1), eradicating Species A from the entire site (Objective 2), containment of Species B to current extent (Objective 3), and suppressing Species C (Objective 4). Objectives drove the development of activities.

Activity	*Objective(s) addressed category*	*Impact*	*Feasibility*	*Non-target effects*
Develop and provide staff and contractor training for preventing the spread of invasive plants (BMPs); implement BMPs	1–4	High	High	Low
Develop and implement early detection protocol focused on priority early detection species	1	High	Low	Low
Eradicate all early detection species, if found, using non-chemical methods	1	High	Medium	Low
Eradicate Species A from all management areas using herbicides (alternating Herbicides X and Y)	2	Medium	High	Medium
Eradicate Species A from all management areas using mechanical (mowing) and chemical methods (Herbicide X)	2	High	High	Medium
Contain current extent of Species B using chemical control (alternating Herbicides X and Y)	3	High	High	Low
Contain current extent of Species B using manual or mechanical methods (hand pulling and mowing)	3	Medium	Low	Low
Flood areas infested with Species C, followed by active native plant restoration	4	High	Medium	Medium
Use fire to suppress abundance of Species C within areas containing rare plants	4	Medium	Medium	Low
Use grazing and Herbicide Z to suppress abundance of Species C within areas containing rare plants	4	High	Medium	Low

Notes: impact = the degree to which the action will help meet one or more invasive plant management objectives; feasibility = degree to which activity is financially, technically, and politically feasible; non-target effects = potential for harm to natural or cultural resources as a result of invasive plant management activities.

Table 11. Simplified example of evaluating alternative invasive plant management activities for objectives focused on preventing establishment of new invasive plant populations (Objective 1), keeping clean areas clean from priority invasive plants (Objective 2), eradicating Species A (Objective 3), preventing spread and reducing extent of cover of current infestations of Species B (Objective 4), and understanding distribution of priority invasive plants and using this information to refine objectives (Objective 5). Objectives drove the types of activities proposed.

Activity	*Objective(s) addressed*	*Impact*	*Feasibility*	*Non-target effects*
Conduct invasive plant risk assessment (identify high risk areas and activities)	1, 2, 3, 4	High	High	Low
Develop and provide staff and contractor training for prevention and avoiding the spread BMPs; implement BMPs	1, 2, 3, 4	High	Medium	Low
Develop and implement ED protocol focused on priority early detection species. Surveys conducted annually in high priority areas (clean areas, wetlands, areas containing rare species) and every 2–3 years in lower priority areas.	1, 2	High	Medium	Low
Eradicate Species A using a combination of non-chemical methods (hand pulling, mowing)	3	Medium	Medium	Medium
Eradicate Species A from all management areas using manual (hand pulling), mechanical (mowing), and chemical methods (Herbicide X)	3	High	High	Medium
Contain current extent of Species B and reduce abundance of infestations in high priority areas using Herbicides X and Y.	4	High	Low	Medium
Contain current extent of Species B and reduce abundance of infestations in high priority areas using goats or other herbivores.	4	High	Medium	Medium
Use fire to suppress abundance of Species B within areas containing rare plants	4	Medium	Medium	High
Conduct inventory of priority invasive plants	5	High	Medium	Low

Notes: impact = the degree to which the action will help meet one or more invasive plant management objectives; feasibility = degree to which activity is financially, technically, and politically feasible; non-target effects = potential for harm to natural or cultural resources as a result of invasive plant management activities.

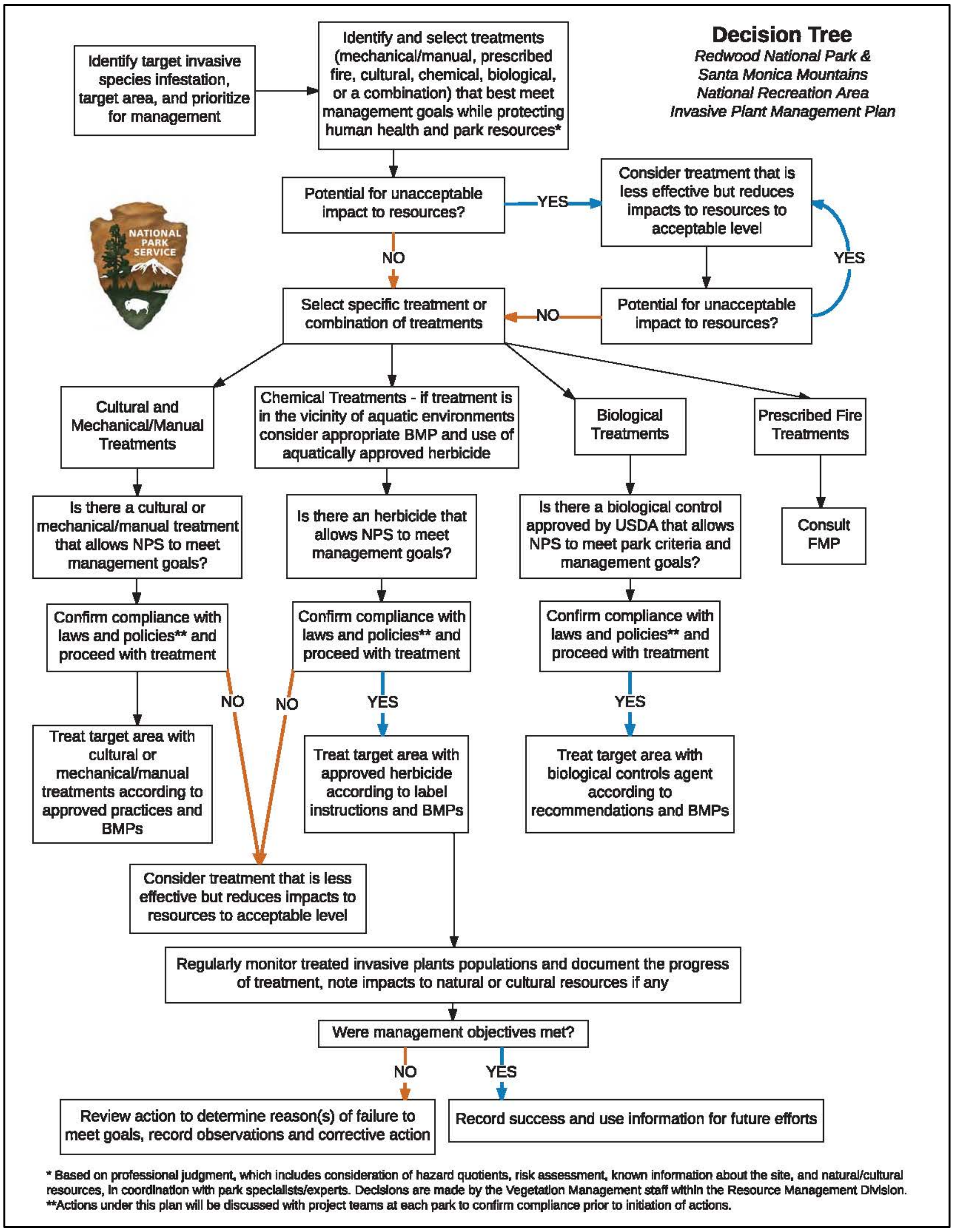

Figure 13. Invasive plant management decision tree for Redwood National Park and Santa Monica Mountains National Recreation Area. Source: National Park Service 2017.

3.5 Avoid Unintended Impacts of Invasive Plant Management

Although the purpose of invasive plant management is to prevent and reduce harm to important natural and/or cultural resources, unintended negative consequences (non-target effects) can result such as soil erosion, loss of native species or species habitat, reinvasion, secondary invasions, or further spread of invasive plants (table 12) (Zarnetske et al. 2010; Cal-IPC 2015; Pearson et al. 2016).

Table 12. List of commonly cited unintended consequences of invasive plant management activities. Many of the consequences listed here are possible with any invasive plant management activity.

Unintended consequence	*Description*
Soil disturbance, compaction, or erosion	Equipment use results in soil disturbance or compaction. Removal of plants and creation of bare ground can lead to erosion.
Water quality impacts	Chemicals or other introduced materials (such as sediment) can impair water quality.
Harm to non-target plants	People, equipment, or materials result in impairment or mortality of native plants.
Direct harm to wildlife	People, equipment, or materials result in wildlife displacement, impairment, or mortality.
Indirect harm to wildlife	People, equipment, or materials result in alteration of wildlife habitat.
Direct or indirect harm to cultural resources	People, equipment, or materials result in cultural resource damage or loss.
Further spread of invasive plants	People and/or equipment become vectors of invasive plant spread.
Create conditions for reinvasion	Activity results in soil disturbance or creation of open areas that are re-infested.
Human safety risk	Activity poses a risk to human safety.

Steps to reduce the likelihood of non-target effects include:

1. Assess the types and magnitude of non-target effects from proposed invasive plant management activities.
2. To the extent feasible, choose a portfolio of invasive plant management activities with the lowest likelihood of non-target effects.
3. Integrate BMPs into your invasive plant management program to avoid non-target effects.
4. In cases where non-target effects cannot be avoided, develop measures to help mitigate the non-target effect. This is a typical requirement of environmental permitting, which may contain specific restrictions based on the invasive plant management work in relation to high-value resources such as special-status species, sensitive species habitats, or wetlands.

A useful resource for developing BMPs to avoid non-target effects from invasive plant management activities is:

- *Best Management Practices (BMPs) for Wildland Stewardship: Protecting Wildlife When Using Herbicides for Invasive Plant Management* (Cal-IPC 2015). Among other information, the manual contains risk charts for potential impacts on wildlife for commonly used herbicides. Many of the BMPs in this document are applicable for other invasive plant management activities other than herbicide use.

Also see section 3.4.2 for a list of resources that include BMPs for preventing the spread of invasive plants and appendix B for examples of BMPs in existing Plans.

3.6 Conduct Work Planning

Up to this point, you have identified priorities, developed objectives, and devised a set of strategies to achieve your objectives. The information generated so far does not provide the specificity for implementation—this is the job of *work planning* (often referred to as *implementation planning* or *operational planning*). The purpose of an operational plan is to provide those responsible for implementing your strategy (and associated activities) with a clear picture of what needs to get done, where, and when, as well as how much it will likely cost over a specified period of time. Commonly, organizations develop 2- to 5-year operational plans that guide annual work. Without an operational plan, it is highly likely your invasive plant management strategy will not be implemented.

The level of detail needed in an operational plan depends on the intended purpose and audience. In general, a multi-year operational plan should be developed that specifies:

- Tasks and locations associated with Plan activities
- Who is responsible for carrying out activities
- Costs associated with activities
- Performance measures or indicators—in other words, a means for assessing the degree to which an activity or task was carried out.

Because conditions change over time, such as fluctuations in funding and/or staff, the operational plan will change and should be revisited frequently (such as annually). This information is critical to informing your organization's work on an annual basis. See appendix B for examples of Plans with work planning.

3.7 Monitor and Evaluate

Following implementation of invasive plant management strategies, managers should be able to answer these key questions:

1. Were activities implemented as planned? If not, why not?
2. Are we achieving our management objectives (or moving towards achievement)?

Answering these questions requires monitoring. *Monitoring* is the periodic process of gathering data to assess outcomes relative to your actions *and* your objectives. If you intend to practice adaptive management, monitoring should be conducted so that your organization can understand whether your program is on track and identify adjustments to improve outcomes. Other important benefits include:

- Enhancing accountability, credibility, and transparency with external donors, policymakers, and the public.
- Strengthening ownership of the work by partners and stakeholders, thereby improving the sustainability of the work.
- Capturing lessons to share with the broader conservation community, thereby improving learning beyond your organization.

> "Monitoring should be done for learning, adapting, and improving. As such, it is important to collect the right information that will help you learn the most about your project site and the effectiveness of your interventions."
> Foundations of Success 2009

3.7.1 Protocol Development

Regardless of the survey purpose, any natural resource survey effort, such as monitoring invasive plants, requires a set of instructions or a protocol. A protocol should include enough detail so that someone unfamiliar with the survey understands what, why, where, by whom, when, and how a survey is conducted (USFWS 2013). This includes identification of the management objective the survey will inform, what will be measured, how measures will be taken, considerations and costs for data collection, data management, analysis, and reporting of results.

Before investing in protocol development, determine if an existing protocol could be adapted to meet your needs by searching online databases (such as the National Park Service Data Store [*https://irma.nps.gov/DataStore/*] or the USFWS Service Catalog *[https://ecos.fws.gov/ServCat/*]) or talking with local organizations involved in vegetation and invasive plant management. More detailed information about developing monitoring protocols can be found in *How to Develop Survey Protocols: A Handbook* (USFWS 2013), *Guidelines for Long-term Monitoring Protocols* (Oakley et al. 2003), and *Guidance for Designing an Integrated Monitoring Program* (National Park Service 2012). A good resource for developing survey designs is *Measuring and Monitoring Plant Populations* (Elzinga et al. 1998). In addition, USFWS recently completed an *Invasive Plant Inventory and Early Detection Guide* (USFWS in prep.). Lastly, examples of invasive plant inventory and monitoring protocols and reports are provided in appendix B.

3.7.2 Data Management

Invasive plant management involves the collection and management of data about (1) management actions (when, where, what, by whom) and (2) the status and trends of plants. Good management of data, whether they be spatial or non-spatial data, makes the data easier to access, understand, use, and share, but is one of the most commonly overlooked aspects of invasive plant management. Over time, poor data management can result in wasted time and money because the data cannot be found or understood. Ideally, a Plan should emphasize the importance of data management and describe basic data management practices that should be followed, such as:

- Metadata standards that should be used, such as the Federal Geographic Data Committee geospatial metadata standards or the North American Invasive Species Management Association standards (for invasive plant surveys).
- Describing how data will be organized and stored (such access databases, geodatabases, or established data management systems).
- Describing naming standards for species, such as the International Taxonomic Information System.
- Establishing file naming conventions.

Well-developed data management systems and workflows can save an organization significant amounts of time and money, provide continuity of work despite staff turnover, and provide a strong legacy of information to guide future decisions. Examples of Plans with data management elements are identified in appendix B.

3.7.3 Evaluation

Evaluation here refers to the regular assessment of outcomes. Such information is used to adjust your management strategies, as needed, to achieve your management objectives. Organizations should identify a mechanism for regularly checking in to assess outcomes. Evaluation should be conducted by people who are implementing the Plan as well as those who direct or planned the work. This may include annual evaluation and work planning as well as longer-term-interval (such as 5-year) Plan updates.

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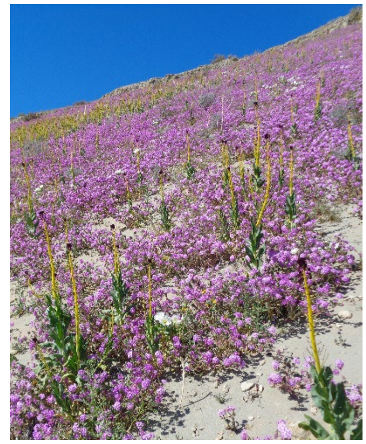
Chapter 4
Writing Your Plan



Sahara mustard
Brassica tournefortii
CREDIT: ©Ryan O'Dell

This chapter describes the suggested elements and associated content of a Plan. It parallels the content generated in chapter 3 and follows the Plan template in appendix C. Appendix B also points to publicly available Plan examples. The level of detail a Plan contains depends on its audience and intended use. For example, if the Plan's purpose is to guide on-the-ground invasive plant management activities, then a high level of detail may be needed to increase the likelihood that the Plan is carried out as intended, especially as staff change over time.

4.1 Plan Introduction

The introductory sections of a Plan state its purpose and need and provide an overview of the management context. Further topics include the spatial scope, environmental and/or cultural setting, conservation targets, existing management goals and objectives, history of invasive plant issues and management, and regulatory context. These topics are summarized below and appear in the Plan template (appendix C).

4.1.1 Plan Purpose and Need

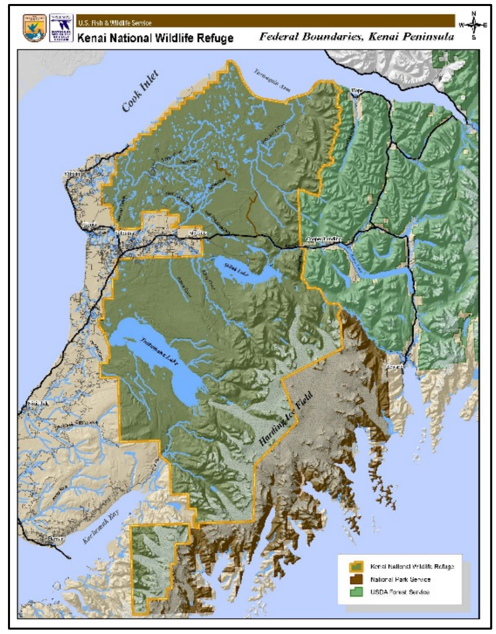
Your Plan should identify the purpose and need for an invasive plant management program, clearly articulating why the organization must take action. Plans often start by describing how invasive plants currently (or have the potential to) decrease biodiversity, degrade habitat, decrease water availability, or threaten recreational uses or infrastructure. Some also detail how invasive plant management is important for meeting the organization's conservation vision and goals. The more links you can draw between site conservation goals and how invasive plants impede those goals, the better. Doing so increases the likelihood that the need for invasive plant management is understood by leadership and other stakeholders and is ultimately supported. You may also want to consider linking invasive plant management at your site to other local, regional, or national efforts aimed at reducing harm from invasive plants.

Ideally, this section of the Plan also describes the intended audience and how the Plan should be used (and adapted) over time.

4.1.2 Spatial Scope and Setting

A clear spatial scope shows the rough geographic boundaries where invasive plant management will occur. To orient readers, it is useful to include in your Plan a text description of the spatial scope as well as maps showing boundaries, management units, and place names. Other relevant spatially referenced information may include topography, watersheds, hydrology, soils, ecosystems, vegetation communities, roads, trails, and/or infrastructure.

The setting should provide a brief background on site establishment and governance. It should also provide an overview of major environmental features such as ecosystems, landcover (such as hydrology, soils, or vegetation communities), important ecological features or functions, sensitive biological resources such as federal or state-listed endangered species, important cultural resources, and any other defining characteristics of the site that should be considered in the context of invasive plant management. This information helps to ground invasive plant management in the larger context of your organization's work. It may also point to particular challenges that should be considered when developing or implementing invasive plant management strategies.



Example of a spatial scope map: Kenai National Wildlife Refuge

SOURCE: USFWS

4.1.3 Conservation Assets and Goals

Conservation Assets

The term *conservation assets* here refers to species, communities, or ecosystems that are the focus of conservation efforts within the Plan's spatial scope. Conservation assets may also include important physical, cultural, or paleontological resources. Although you may want to conserve all biodiversity or other important features of a site, focusing explicitly on protecting all high-valued assets of a site from invasive plants is usually infeasible because of constraints on time, funding, and staff.

Channel Islands fox
Urocyon littoralis

SOURCE: https://www.nps.gov/chis/learn/nature/island-fox.htm

Your Plan should identify and describe the most valued or representative conservation assets because that effort informs (1) the species and locations on which invasive plant management should be focused, (2) the types of strategies to implement, and (3) the assessment of whether invasive plant management efforts are achieving the desired effect on assets over the long term.

It is also useful to describe how invasive plants will harm conservation assets if they were to spread and how they may cause harm in the future if invasive plant management does not occur. Specific examples will help readers understand the consequences of not adequately addressing invasive plant threats and will reinforce the need for management. Examples include how an invasive plant may outcompete native plant communities, increase fire frequency, lead to vegetation type conversions, or alter wildlife diversity.

Conservation Goals

It is important to identify and review existing conservation goals and objectives of the Plan scope (and consider including them in the Plan introduction) because they provide context, rationale, and focus for invasive plant management efforts and will help inform what species are a priority for management, where management should be focused, and the types of strategies that may be appropriate. This information is often found in conservation plans developed for the site and may be very broad or quite specific.

Existing site-specific management or conservation plans ideally contain goals or objectives that describe the desired state of resources (such as species, natural resource communities, ecosystems, or cultural resources). They may also contain specific objectives related to invasive plants, such as prevention or eradication of a particular species or a decrease in the overall extent or abundance of invasive plants. In many cases, invasive plant objectives may not yet exist or, even if they do, they may need refinement and should be re-examined as part of the planning process. Sections 3.3 and 4.4 address development and refinement of invasive plant management objectives.

Below is an example of a conservation target and related conservation goal and invasive plant management objective.

- **Conservation target**: tidal marsh ecosystem
- **Conservation goal**: By FY 2025, extent of high quality tidal marsh within Refuge X increases to 14,500 acres. High quality = unimpaired hydrology, dominated by native tidal-marsh associated plant species.
- **Invasive plant management objective**: By 2022, eradicate Algerian sea lavender at Refuge X.

4.1.4 Invasive Plant Management History

In cases where invasive plant management has occurred or is ongoing within the Plan scope, it is useful to describe management history, including focal species and locations, strategies employed, and successes and failures. This overview helps readers understand what has come before and what can be and was learned. This may include efforts to prevent, eradicate, control, study, inventory, or monitor invasive plants. When possible, cite sources of information, such as personal communications, pesticide use reports, maps, or reports.

4.1.5 Relevant Invasive Species Laws and Policies

Most Plans include a description of the legal (and sometimes political) context of invasive plant management at the site, including laws and policies governing invasive plant management planning and implementation. The level of detail here depends on the organization. Often times, relevant laws, policies, and regulations are summarized.

4.2 Methods

The methods chapter identifies who was involved in developing the Plan; information resources and processes used to inform its design; the people (public, leadership, others) or organizations who were informed of its development or engaged in the planning process; and how decisions were made. Use of a Plan by its intended audience will depend in large part on the readers' confidence that (1) the right people were involved in designing the Plan and (2) that its contents were developed using the best available information and processes. The methods chapter should describe any tools or processes that were used or developed to make decisions such as which species to focus on, which areas to focus on, and what strategies and activities to employ. This may be as simple as citing existing tools or describing new processes that were developed as part of the planning process. Lastly, it's useful to describe how the public, stakeholders, or others were informed about or engaged in the planning process. This helps readers understand how much others already know about what has been planned, whether or not they support those actions, and any considerations that need to be kept in mind as Plan implementation begins.

4.3 Invasive Plant Priority Species and Areas

A Plan should identify and describe the species and areas that are the focus of invasive plant management efforts within the spatial scope.

4.3.1 Species Descriptions

Describe the species, or species groups, that are the focus of the Plan. These can include current invasive plant species or species that have the potential to occur in the future (early detection). A *species description* (also known as a *species account*) is basically a written summary of a species, or group of similar species, and includes the following information:

- Plant ecology
  - Plant life cycle: annual, perennial, biennial
  - Growth form: herb, shrub, tree, vine, aquatic
  - Reproduction
  - Seed longevity, dispersal distance
  - Phenology such as blooming time and best time for detection
  - Habitat
  - Dispersal mode(s)
  - Spread rates
- History of management
- Current status within the scope and/or the larger landscape, including data and maps if available
- Impacts on natural resources, ecological processes, or human infrastructure: current or potential future
- Visuals such as photos

There is a wealth of information available online to help describe invasive plant species ecology, known impacts on wildlands or agriculture, and management. A few freely available online resources are highlighted below and others can be found in appendix A:

- Global Invasive Species Database (*http://www.iucngisd.org/gisd/*)
- Invasive.org (*www.invasive.org)*
- National Association of Invasive Plant Councils (*www.na-ipc.org)*. This site provides links to invasive plant councils and weed management areas throughout the United States, each of which can provide useful species-specific information. Example: Cal-IPC maintains a detailed database of the state's top invasive plant species (*http://www.cal-ipc.org/plants/inventory/*)
- USDA National Agricultural Library (*https://www.invasivespeciesinfo.gov/plants/main.shtml*)
- USDA PLANTS Database (*https://plants.usda.gov/java/*).
- Invasive Plant Atlas of New England (*https://www.eddmaps.org/ipane/)*
- Weed Research and Information Center (*http://wric.ucdavis.edu)*

It is always a good idea to consult with local weed experts, weed management areas, or invasive species councils to identify local or region-specific resources (such as books and scientific papers). Appendix A points to several other resources, and appendix B provides a list of Plans with examples.

4.3.2 Area Descriptions

If distinct management areas have been defined for the Plan scope, provide a map showing these areas with a brief description. Types of information to consider include:

- Plant communities or ecosystems
- Sensitive resources
- Abiotic features such as hydrology, soils, or topography
- Size
- Invasive plant status: the degree to which the area is invaded by one or more invasive plant species
- Vectors or vector pathways, roadway locations and types
- Level of anthropogenic disturbance
- Maps showing area boundaries and other environmental features of importance

4.4 Objectives, Strategies, and Activities

This section of a Plan is where (1) SMART invasive plant management objectives or overall vegetation management objectives are presented and (2) strategies and associated activities to help achieve them are described in enough detail to be useful for the intended audience. Appendix B presents several Plans from a variety of agencies, providing ideas on how to craft this element of your Plan that meets your needs. Below is a list of the types of information to consider including.

- Strategy description—each strategy should be described in enough detail so that people who are expected to implement understand what needs to happen. This can include descriptions of the following:
  - Objective(s) it supports
  - The approach(es) it involves: prevention, containment, control
  - Techniques/tactics it involves such as education, research, assessments, chemical/physical/biological/cultural control
  - Where it will be implemented
  - When (years, seasonality) or how frequently it will be implemented
  - Specific activities to be implemented
  - Who will be involved with implementation
  - Training or certifications required
  - Equipment and supplies needed
  - Expected costs

Strategies can be presented in table form by species and then areas or by distinct areas.

4.5 Measures to Avoid Non-Target Effects

Most invasive plant management programs employ BMPs internally to minimize the non-target effects of their activities, but these may not be formally documented. This section provides a place to summarize the potential non-target effects of your invasive plant management activities and measures or BMPs to avoid or mitigate them. BMPs may be presented as a checklist for specific management strategies or activities and included as an appendix to your Plan to be used in the field. This section may also cite laws or policies applicable to your situation.

4.6 Work Planning and Reporting

This section of your Plan should provide enough detail for the people or organizations who must carry out the Plan. Information to include is listed below:

- A multi-year timeline for activities and surveys
- Expected annual costs
- Timing of management activities (relative to phenology of target plants and other applicable factors)
- Roles: generally who is involved in carrying out activities and surveys
- How annual evaluation and work planning will happen
- Reporting (if needed): content, format, frequency, storage, and sharing

Because annual work planning is dynamic, it can be helpful to use spreadsheets or some other data system to handle changes through time following development of the initial Plan.

4.7 Monitoring and Evaluation Methods

The monitoring and evaluation portion of your Plan should contain information about what types of surveys are needed to inform you work, links to Plan objectives or activities they support, expected frequency, and information on how they will be carried out (protocols). If a protocol exists, they can be included as an appendix or cited. If protocol development is needed, specify when and how a protocol will be developed.

This section can also include information about software or data system(s) that will be used to manage invasive plant data (spatial and non-spatial) as well as how information (files) will be organized and stored.

Chapter 5
Adapting Your Plan

It is important to remember that a Plan is not static—it should set the stage for a dynamic and flexible process of doing, evaluating, learning, and adapting. To be successful, any conservation program or project must evaluate progress and adjust to improve outcomes. This adaptive management process should ideally be built into your Plan. For instance, your Plan may specify that every 5 years your organization will revisit objectives, strategies, and other key provisions of the Plan. Additional revisions may be dictated by external forces. And the development of annual workplans will necessarily incorporate lessons learned from the previous year's experiences. The key is to provide a mechanism to periodically re-examine assumptions as well as implementation effectiveness.

A successful plan must be based on both sound project assumptions and good implementation. An adaptive management approach helps teams plan their projects such that they will be able to trace their failures back to poor assumptions, poor implementation, or a combination of the two (Salafsky et al. 2001). Otherwise, when projects do not produce desired results, the conclusion is often that strategies were not implemented as planned or the project team did not do a good job with implementation. In some cases, the same strategy may be implemented year after year without anyone really questioning whether it is achieving the intended result.

The intention of this Guide is to promote a more adaptive approach to invasive plant management, regardless of the organization or agency involved, scale, environment, or socio-political environment. We expect that new information on how to improve the practice of invasive plant management will continue to grow. We encourage you to continue to explore new and improved invasive plant management techniques and practices and to share what you learn with the larger conservation community.

New Zealand spinach
Tetragonia tetragonioides
CREDIT: ©Jean Pawek

Adaptive management is a structured process that promotes flexible, informed decisions that allow us to make adjustments as we better understand outcomes from management actions and other events. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process (USFWS 2013).

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Glossary

action: an activity designed to apply a particular strategy to a specific situation in order to help achieve an objective. Also called a *tactic*.

adaptive management: a structured process that promotes flexible, informed decisions that allow us to make adjustments as we better understand outcomes from management actions and other events. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process (USFWS 2013).

alien: with respect to a particular ecosystem, an organism, including its seeds, eggs, spores, or other biological material capable of propagating that species, that occurs outside of its natural range (Executive Order 13751 [2016]). Considered synonymous with *exotic* and *non-native*, the latter of which is used in this Guide.

aquatic nuisance species: a nonindigenous species that threatens the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural, or recreational activities dependent on such waters (Nonindigenous Aquatic Nuisance Prevention and Control Act [1990]).

asset-based protection: a strategy in which control activities for a widespread invasive species is focused on those areas where the control protects high-priority conservation assets.

best management practices (BMPs): methods or techniques found to be the most effective and practical in achieving an objective, such as preventing or reducing invasive plant spread, while making optimal use of resources (Cal-IPC 2012).

conservation target: the focus of conservation within a specified area. Conservation targets may be biological in nature (species, communities, or ecosystems) or reflect human well-being (such as culture, recreation, infrastructure, or safety). Often, a limited number of conservation targets are identified to collectively represent the full suite of biodiversity or values within a specified area (Foundations of Success 2009).

containment: actions taken to prevent establishment and reproduction of an invasive plant species beyond a predefined area or the *containment unit*. The containment unit comprises the area where the species currently exists (occupied zone) plus a surrounding buffer zone that is free from plants but can receive propagules (such as seeds) (Panetta and Cacho 2014).

control: the act of reducing the occurrence or abundance of invasive plants using one or more integrated pest management techniques (such as chemical, biological, mechanical removal techniques).

drone: An aerial machine that can be used for remote mapping. Also known as *unmanned aerial vehicle (UAV)* or *unmanned aerial system (UAS)*.

early detection: a type of survey focused on detecting the location and abundance of highly invasive species that are not yet established within a defined area (but the potential for establishment exists) or occur in small isolated populations within a defined spatial scope (Olsen et al. 2015). A process of surveying for, reporting, and verifying the presence of a non-native species before the founding population becomes established or spreads so widely that eradication is no longer feasible (U.S. Department of the Interior 2016).

eradication: the complete removal of an invasive plant species (including reproductive propagules) from a defined area.

integrated pest management (IPM): a science-based decision-making process that incorporates management goals, consensus building, pest biology, monitoring, environmental factors, and selection of the best available technology to achieve desired outcomes while minimizing effects on non-target species and the environment and preventing unacceptable levels of pest damage (USFWS 2010).

indigenous: see *native species*.

introduced: see *alien*.

invasive species: a non-native organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health (Executive Order 13751 [2016]).

inventory: a type of survey that is used to determine the location or condition of a resource (e.g., presence, abundance, distribution, status) at a specific time. Inventories may also establish a beginning time-step (baseline) or reference information for subsequent monitoring (USFWS 2013). In this Guide, an *inventory* refers to a catalogue of invasive species that can include information on their location, abundance, and distribution in a defined region.

monitoring: consists of repeated survey efforts and is more complex than inventories because it is conducted to understand how resources vary over time (e.g., months to years) and space. *Baseline monitoring* can be used to produce a time series of indicators such as water salinity or fish survival. Results from this type of monitoring can be used to assess changes in a system or to develop models of system function. *Monitoring to inform management* is the other type of monitoring for which a survey protocol is developed and has the additional purpose of directly influencing a management decision. This form of monitoring may be used to evaluate model values and performance in adaptive management projects or used to identify effects on trends in attributes produced by quasi-experiments (USFWS 2013).

native nuisance species: a native species that causes harm to the environment or human health.

native species: with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem (Executive Order 13112 [1999]).

non-native species: see *alien*.

noxious weed: any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment (Public Law 106 – 224 [2000]).

objective: a concise statement of desired outcomes that specifies what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for achieving it. A meaningful objective will be SMART—specific, measurable, achievable, results-oriented, and time-bound (USFWS 2013).

prevention: the act of preventing the introduction and spread (transmission) of invasive species. Also referred to as *biosecurity*.

pest: organisms that damage or interfere with desirable plants in our fields and orchards, landscapes, or wildlands, or damage homes or other structures. Pests also include organisms that impact human or animal health (UC-IPM 2018).

protocol: detailed instructions for conducting a survey. This includes information on sampling procedures, data collection, management and analysis, and reporting of results (USFWS 2013).

strategy: a group of actions with a common focus that work together to reduce threats, capitalize on opportunities, or restore conservation targets. Strategies include one or more activities and are designed to achieve specific objectives and goals (Foundations of Success 2009).

survey: a specific data-collection effort to complete an inventory or conduct monitoring of biotic or abiotic resources (USFWS 2013).

vector (or transport vector): the conveyance (e.g., wind, water, animal, human, mechanical, etc.) that moves a non-native propagule to its novel location (Lockwood et al. 2013).

vector pathway (or transport pathway): the route between the non-native propagule source and release location (Lockwood et al. 2013).

weed: a plant that causes economic losses or ecological damage, creates health problems for humans or animals, or is undesirable where it is growing (Weed Society Science of America 2016).

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Appendix A

Invasive Plant Information: Online Resources

Below is an alphabetized list of online invasive species information resources. There are many more resources than we could ever list here. We chose to highlight a few of the most resources—many of them point to species or location-specific resources. The U.S. Department of Agriculture (USDA) National Invasive Species Information Center maintains a list of invasive species resources by state (*https://www.invasivespeciesinfo.gov/resources/orgstate.shtml*) as well as resources by species (*https://www.invasivespeciesinfo.gov/plants/main.shtml*). We encourage users to seek out additional local or regional resources.

Center for Invasive Plant Management (CIPM) (*www.weedcenter.org)*. Though no longer funded, the CIPM remains a useful resource for information about invasive plant biology, management, and education and outreach. The site provides numerous links to other web-based sources of invasive plant-related information across the United States.

Center for Invasive Species and Ecosystem Health (CISEH) (*https://www.bugwood.org/*). The mission of the CISEH is to serve a lead role in development, consolidation, and dissemination of information and programs focused on invasive species, forest health, natural resource, and agricultural management through technology development, program implementation, training, applied research, and public awareness at the state, regional, national and international levels. The site hosts a database of imagery, provides links to publications on invasive species management, and lists websites related to invasive plant management across the United States.

Invasive.org (*www.invasive.org)*. Run by the Center for Invasive Species and Ecosystem Health at the University of Georgia, this site provides a wealth of information including an easily accessible archive of high quality images of invasive and exotic species of North America with identifications, taxonomy, and descriptions for use in educational applications and species-specific control information.

National Association of Invasive Plant Councils (NAIPC) (*www.na-ipc.org)*. NAIPC comprises state and multi-state organizations that coordinate invasive plant managers and information. Each entity typically maintains an invasive plant list and holds an annual conference. The site provides links to state invasive plant councils.

National Invasive Species Council (NISC) (*www.invasivespecies.gov)*. The NISC was established to ensure that federal programs and activities to prevent and control invasive species are coordinated, effective, and efficient. The national invasive species management plan can be found on this site.

New York Invasive Species Research Institute (*http://www.nyisri.org/*). To improve the scientific basis of invasive species management, the New York Invasive Species Research Institute serves the scientific research community, natural resource and land managers, and state offices and sponsored organizations by promoting information-sharing and developing recommendations and implementation protocols for research, funding, and management.

North American Invasive Species Management Association (NAISMA) (*https://www.naisma.org/*). NAISMA is a network of professionals—land managers, water resource managers, state, regional, and federal agency directors and staff, and nonprofit organizations—challenged by invasive species. This website lists standards (weed-free forage and gravel, mapping), invasive plant management online training, and a variety of other resources useful to managers.

USDA Forest Service Invasive Species Program (*www.fs.fed.us/invasivespecies)*. This site links to the agency's policy framework for invasive species as well as its management activities, with information on research, management planning, and pest-specific control techniques.

USDA National Invasive Species Information Center (*https://www.invasivespeciesinfo.gov/index.shtml*). This is a gateway to invasive species information covering federal, state, local, and international sources. The resource library provides links to many of the sites listed in this appendix plus many more resources for managers.

USDA PLANTS Database (*https://plants.usda.gov/java/*). The PLANTS Database provides standardized information about the vascular plants, mosses, liverworts, hornworts, and lichens of the United States and its territories. It includes names, plant symbols, checklists, distributional data, species abstracts, characteristics, images, crop information, automated tools, onward web links, and references. It also includes links to federal and state noxious weed lists.

U.S. Fish and Wildlife Service: Invasive Species (*www.fws.gov/invasives)*. The website provides background on a range of invasive species topics and points to a variety of resources for land managers.

Weed Research and Information Center (*http://wric.ucdavis.edu)*. The Weed Research and Information Center is an interdisciplinary collaboration that fosters research in weed management and facilitates distribution of associated knowledge for the benefit of agriculture and for the preservation of natural resources. This is an excellent resource for control techniques by weed species.

Weed Science Society of America (WSSA) (*http://wssa.net*). The WSSA is a non-profit professional society that promotes research, education, and extension outreach activities related to weeds; provides science-based information to the public and policy-makers; and fosters awareness of weeds and their impacts on managed and natural ecosystems. WSSA publishes three professional journals: *Weed Science*, *Weed Technology*, and *Invasive Plant Science and Management*. The website provides a variety of resources—including invasive plant images, identification resources, and a list of resources for biological control—and covers the topic of weed resistance.

Appendix B

Examples: Plans, Reports, and Protocols

The tables below list invasive plant management plans, inventory or monitoring protocols, and other related guidance documents and the topical areas they address (designated by an "X"). Full citations and web links are provided at the end of this appendix.

Invasive Plant Management Planning Documents

Author, date, and title	*Species prioritization*	*Area prioritization*	*Area or species descriptions*	*SMART objectives or thresholds for action*	*Species or area specific strategies*	*Prevention*	*Inventory or monitoring*	*Work planning*	*BMPs to avoid non-target effects*
Dendra (2012). *Management Priorities for Invasive Non-native Plants: A Strategy for Regional Implementation, San Diego County, California.*	X			X	X				
Evans et al. (2003). *Invasive Plant Species Inventory and Management Plan for the Hanford Reach National Monument.*	X	X	X		X		X	X	
Hall (2015). *Integrated Vegetation Management Plan for Open Space Lands of the City of San Luis Obispo.*	X		X	X	X		X		X
Hogle et al. (2007). *San Pablo Bay National Wildlife Refuge* Lepidium latifolium *Control Plan.*		X	X		X		X		X
Marriott et al. (2013). *South San Francisco Bay Weed Management Plan.*	X		X		X	X			X
May and Associates (2015). *Vegetation and Biodiversity Management Plan: Marin County Parks and Open Space District.*	X	X	X		X	X	X	X	X

Author, date, and title	*Species prioritization*	*Area prioritization*	*Area or species descriptions*	*SMART objectives or thresholds for action*	*Species or area specific strategies*	*Prevention*	*Inventory or monitoring*	*Work planning*	*BMPs to avoid non-target effects*
Midpeninsula Regional Open Space District (2014). *Midpeninsula Region Open Space District Integrated Pest Management Program Guidance Manual.*					X	X	X		
National Park Service (2003). *Rocky Mountain National Park Invasive Exotic Plant Management Plan and Environmental Assessment.*	X	X	X	X			X		
National Park Service (2008). *Lassen Volcanic National Park Weed Management Plan and Environmental Assessment.*	X		X	X	X		X		X
National Park Service (2010). *Yosemite National Park Invasive Plant Management Plan Update Environmental Assessment.*	X		X	X	X	X			X
National Park Service (2018). *Yosemite Invasive Plant Management Program 2018 Work Plan.*	X				X	X	X	X	
National Park Service (2017). *Invasive Plant Management Plan and Environmental Assessment for Redwood National Park and Santa Monica Mountains National Recreation Area.*	X	X	X			X			X

Author, date, and title	*Species prioritization*	*Area prioritization*	*Area or species descriptions*	*SMART objectives or thresholds for action*	*Species or area specific strategies*	*Prevention*	*Inventory or monitoring*	*Work planning*	*BMPs to avoid non-target effects*
Shelterbelt Builders and MIG/TRA Environmental Sciences (2016). *Integrated pest management plan for the Bear Creek Redwoods Open Space Preserve.*	X				X			X	
U.S. Fish and Wildlife Service (2012). *Integrated Pest Management Plan for Chesapeake Marshlands National Wildlife Refuge Complex.*			X		X		X		

Notes: species or area prioritization = reference uses multiple criteria used to prioritize species or areas; SMART objectives = reference contains objectives that are focused on vegetation and are specific, measurable, achievable, results-oriented, and time-bound; prevention = reference identifies specific prevention practices or activities; inventory or monitoring = reference has an inventory or monitoring element; work planning: reference contains one or more elements that will inform implementation, such as specific tasks and when they will be carried out, costs, how new activities or projects will be evaluated, and who will implement the work.

Examples of invasive plant prioritization reports and survey protocols.

Author, date, and title	*Species prioritization*	*Area prioritization*	*SMART objectives*
Ball and Olthof (2017). *Aerial Invasive Plant Survey: Guadalupe-Nipomo Dunes National Wildlife Refuge.*	X	X	
Holzman et al. (2016). *Farallon National Wildlife Refuge Southeast and West End Islands 2016 Invasive Plant Inventory.*	X	X	X
Keefer et al. (2014). Early Detection of Invasive Species—Surveillance, Monitoring, and Rapid Response: Version 2.0.	X		X
Rew and Pokorny (2006). *Inventory and Survey Methods for Nonindigenous Plant Species.*	X		X
Williams et al. (2009). *Early Detection of Invasive Plant Species in the San Francisco Bay Area Network: A Volunteer-Based Approach.*	X	X	X

Notes: species or area prioritization = reference uses multiple criteria used to prioritize species or areas; SMART objectives = reference contains objectives that are focused on vegetation and are specific, measurable, achievable, results-oriented, and time-bound; prevention = reference identifies specific prevention practices or activities.

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Appendix C

Plan Template

This template provides an outline of the contents that should be considered for inclusion in your Plan and hyperlinks to sections of the Guide where information on that topic is located.

Chapter 1: Introduction (Chapter 2 and Section 4.1)

- Plan Purpose and Need

  Why is this Plan needed?

  Why are invasive plants a concern?

  Who is the intended audience?

- Spatial Scope and Setting

  What is the geographic scope where management activities are prescribed?

- Conservation Assets and Goals

  What are the ecological/environmental characteristics of the scope and associated conservation goals?

- History of Invasive Plant Management

  What is the history of invasive plant management within the scope?

- Regulatory Context

  What are the relevant organizational policies and legislation that apply to invasive plant management within the Plan scope?

Chapter 2: Methods (Chapter 2 and Section 4.2)

- Project Team

  Who coordinated the planning effort and wrote the Plan?

  Who else was involved in the planning process (internal and external)

- Internal and External Communication, Outreach, and Engagement

  What were the methods of communication and engagement during the planning process?

- Information Gathering

  What information was gathered and used to inform the planning process?

- Prioritization of Species and Management Areas

  What methods were used to identify priority species and areas?

- Identifying Management Strategies

  What methods were used to identify and rank alternative management strategies?

Chapter 3: Species and Area Priorities (Sections 3.1, 3.2, and 4.3)

- Species Priorities

  What plant species (one or multiple) are a priority to manage? Include ranked list of species if a prioritization process was conducted

Priority species characteristics? Such as ecology, status within the scope and surrounding areas (abundance/distribution), history of invasion, maps, imagery. Use existing species profiles for basic characteristics (if available)

- Area Priorities

  What areas are a priority to manage? Include ranked list of areas if a prioritization process was conducted

  Priority area characteristics? Such as ecological characteristics, invasion status, history of invasion, maps, imagery.

Chapter 4: Work Plan (Sections 3.3–3.6 and 4.6)

- SMART Invasive Plant Management Objectives

  What would success look like as a result of your invasive plant management program?
- Management Strategies and Activities

  What are the invasive plant strategies and associated activity (or activities)?

  When should they be implemented?

  Thresholds for implementation?

  Where will they be implemented?

  Who is responsible for implementation?

  Budget and operational requirements?

  Required training, certification, or permits
- Best Management Practices for Avoiding Non-Target Effects

  Are there any potential negative effects on humans, natural/cultural resources, or infrastructure because of invasive plant management activities?

  What measures will be implemented to prevent, avoid, or mitigate potential negative impacts?

Chapter 5: Monitoring and Evaluation (Sections 3.7 and 4.7)

- Monitoring and Evaluation

  What methods will be used to evaluate progress in implementing strategies and achieving SMART objectives?

  When and how should progress on implementing strategies and achieving objectives be evaluated?
- Adaptation

  How will monitoring and evaluation used to revise the work plan?

  How often should the work plan be evaluated and by whom?
- Data Management

  What standards or systems will be used to manage invasive plant program data?

Preventing the Spread of Invasive Plants:

Best Management Practices for Land Managers

3rd Edition

California Invasive Plant Council

Cite this report as: Cal-IPC. 2012. Preventing the Spread of Invasive Plants: Best Management Practices for Land Managers (3rd ed.). Cal-IPC Publication 2012-03. California Invasive Plant Council, Berkeley, CA. Available at www.cal-ipc.org.

This report was funded through the American Recovery and Reinvestment Act, with funding provided by the USDA Forest Service, State and Private Forestry, through the California Department of Agriculture as well as direct funding from the USDA Forest Service, State and Private Forestry.

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In 2011, the California Invasive Plant Council formed a technical advisory team comprising land management experts in the state. The technical advisory team guided the development of a set of voluntary invasive plant prevention best management practices (BMPs) for land management.

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Contents

Introduction

Purpose Statement

The goal of this manual is to present voluntary guidelines that help those managing wildlands in California to prevent the accidental spread of terrestrial invasive plants.

Invasive Plants

Federal Executive Order 13112 defines an invasive species as an alien (non-native) species whose introduction does or is likely to cause economic or environmental harm, or harm to human health. While the majority of non-native plants do not pose a threat to natural or human systems, the Cal-IPC Invasive Plant Inventory identifies 200 species, approximately 3% of the plant species growing in the wild in California, as invasive (Cal-IPC 2006). These plants have the capacity to alter native ecosystems, with potential detrimental implications for wildlife communities, fire regimes, water flow, and nutrient cycling.

Background

Invasive plants can degrade the ecological integrity of wildlands, and land managers employ a range of tactics to reduce this damage. Controlling already established invasive plant infestations is important. However, stopping the introduction and spread of new invasive plant infestations is the most cost-effective approach to reducing this damage. Prevention is a key aspect of invasive plant management that deserves more attention.

Revegetate or mulch disturbed areas to prevent invasive plants from establishing. Photo: David Chang, Santa Barbara County Agricultural Commissioner

Land managers must have a good understanding of ways to avoid accidentally spreading invasive plants through their work. Such work often involves travel from one worksite to another. Tools, equipment, vehicles, animals, clothing, boots, and project materials moved between worksites can become potential vectors for the spread of invasive plants. Generally speaking, soil and vegetation disturbance, including construction and maintenance activities, can also create suitable conditions for the establishment of invasive plants.

This manual was developed by a technical advisory team made up of land management experts in the state, organized by the nonprofit California Invasive Plant Council (Cal-IPC) and funded by the USDA Forest Service, State & Private Forestry. The team reviewed existing resources to develop an accessible overview of key prevention measures that can be used by all land managers. References to source documents, some of which include extensive detail, can be found in the References section at the end of this manual.

Terminology

In this manual, we occasionally use the term "weed" to mean "invasive plant", such as when referring to "weed-free straw" for erosion control. We also use the general term invasive plant "spread" to mean introduction of invasive plants to a new area, establishment of new invasive plant populations, or spread of existing invasive plant populations. The Glossary at the end of the manual lists terms used in this text.

Best Management Practices (BMPs)

Best Management Practices are methods or techniques found to be the most effective and practical in achieving an objective, such as preventing or reducing invasive plant spread, while making optimal use of resources.

Prevention BMPs that reduce invasive plant spread can help:

- Reduce future maintenance needs and cost
- Reduce fire hazards
- Reduce herbicide use
- Enhance access and safety
- Limit liability for the governing agency or lessee
- Maintain good public relations
- Protect existing wildlife habitat, native plant populations, beneficial insects, as well as threatened and endangered species.

Target Audience

This manual was developed for those managing wildlands, and includes guidelines for those involved in wildland fire management. The manual can be used in a number of ways. For instance, land managers can use the material in the manual to conduct trainings for work crews. The manual can help land managers by providing language for contractor specifications for work on their land. Managers can also use the manual to develop educational materials for the public.

Scope

The primary focus of this manual is preventing the spread of terrestrial invasive plants. Therefore this manual does not focus on invasive plant control methods; however, control measures are discussed insofar as they relate to prevention. For example, mowing as a control method is not discussed, but because timing of mowing relates directly to potential for invasive plant spread, this aspect is included. Invasive aquatic plants are outside the scope of this manual.

Implementation of BMPs

Effective implementation of prevention BMPs requires a process of continuous learning. These voluntary BMPs were developed with the understanding that each situation and entity has different needs, constraints and resources. The applicability and effectiveness of BMPs will vary with existing land uses, degree of human disturbance, the objectives of the land owners, and the resources available for management activities. For example, programmatic planning BMPs may be less applicable to smaller restoration groups, as these BMPs are more suited for large agencies. A discussion of Prioritizing BMP Implementation appears later in this section on page 5 of this draft to help determine which BMPs to emphasize depending on situational factors. Some BMPs may be able to be implemented with existing resources, while others may only be possible pending allocation of additional resources.

Conducting a thorough pre-activity assessment will help to identify which tasks can spread invasive plants (See Pre-Activity Assessment Outline on page 6 of this draft). Many of these BMPs may overlap with existing practices or standard mitigations, such as those for Storm Water Pollution Prevention, clean air regulations, pest quarantines, or rare species protections.

Using This Manual

This manual provides BMPs to aid in preventing the introduction and spread of invasive plants. Its recommendations are voluntary; each organization can choose how to best incorporate and phase this information into their operations.

Section I includes overview information on what BMPs are, why they are important, and how to best implement them. This section also provides recommendations for BMP prioritization.

Section II provides detail on a wide range of topic-specific BMPs for preventing the spread of invasive plants. Each BMP is appropriate for particular situations; users can select those that are suitable for their use.

The BMPs described in Section II are structured as follows:

> **BMP Statement: Prevention BMP statements, in bold font, describe practices that can prevent the introduction and spread of invasive plants.**
>
> **Considerations:**
>
> a. BMP Considerations are listed below the BMP Statement\
> b. BMP Considerations give more information about why the BMP is important, and may include details, suggestions, examples, and issues to consider when applying the BMP.

Section III presents ready-to-use checklists which contain only the BMP statements to provide a quick and portable reference for field activities. The checklists are divided into five categories:

- Site Assessment, Field Mapping and Monitoring
- Routine Vegetation Management
- New Project – Planning
- New Project – Implementation
- Inspection and Cleaning

These checklists can be used as templates and be modified based on your needs.

Section IV has additional resources and information, a glossary, and other references.

Definition and Categorization of Activities

Definition and categorization of activities may vary among agencies and organizations. For this reason, the definition and scope of each activity and how it may spread invasive plants is described in the introduction of each chapter. When using this manual, consider your activity's scope and potential impact as it relates to the potential to introduce or spread invasive plants. Refer to BMPs in related chapters to customize your prevention practices.

Overall Prevention Principles

Take time to plan. Proper planning can reduce future maintenance costs by reducing the potential for invasive plant introduction and spread. A good first step is to conduct a pre-activity assessment of the work area to determine which activities could spread weeds and which BMPs are applicable.

Stop movement of invasive plant materials and seeds. The movement of workers, materials and equipment can carry weeds between sites. This manual identifies potential vectors of spread and how to eliminate them or reduce their effects.

Reduce soil and vegetation disturbance. Disturbance can allow invasive plants to colonize a new area. When disturbance is unavoidable, managers should conduct follow-up monitoring to ensure early detection of any invasive plants that may have been introduced.

Maintain desired plant communities. A healthy plant community with native and desirable species provides resistance to invasive plant establishment.

Practice early detection and rapid response (EDRR). Early detection and eradication of small populations helps prevent the spread of invasive plants and significantly reduces weed management costs. Regular monitoring increases the chances of success.

Prioritizing BMP Implementation

The prevention BMPs in this manual are developed with the understanding that each situation and entity has different needs and resources. This outline can help you select which areas and species to prioritize when integrating BMPs into management activities.

1. **Management costs. Prioritize:**
   - Areas where future control costs will be high if invasive plants become established
   - Areas where fire risk is high
   - BMPs with approaches that are measurable in cost and effectiveness

2. **Ecological value of habitats. Prioritize:**
   - Areas with threatened or endangered species and habitat
   - Areas of high ecological or conservation value
   - Areas where invasive plants have not invaded

3. **Context of the area being managed. Prioritize:**
   - Wildland and natural areas
   - Areas with new construction or disturbance
   - Areas containing water bodies
   - Areas with important scenic or recreational resources
   - Areas where adjacent land owners are cooperative
   - Areas where wildland interfaces with urban areas
   - Wildland areas frequented by vehicles, equipment and foot traffic

4. **Treatment of invasive species. Prioritize:**
   - Species known or suspected to be invasive but still in small numbers
   - Species that can alter ecosystem processes
   - Species with the potential to alter fire regimes
   - Species that occur in areas of high conservation value
   - Species with the potential to require high management costs
   - Species that are likely to be controlled successfully
   - Species determined to be of regional concern as identified through regional partnerships

Pre-Activity Assessment Outline

This assessment outline can help you proactively address activities that have the potential to spread invasive plants. A site assessment and a description of planned activities will need to be completed as part of this pre-activity assessment.

1. **Conduct a site assessment to ascertain:**
   - A list of invasive plant species found in route to and within worksites. Include exact locations and densities, and the species' dispersal mechanisms.
   - A list of priority areas for implementing prevention BMPs. Refer to Prioritizing BMP Implementation on the previous page for guidance on prioritization.

2. **Describe each activity (e.g. roadside mowing, facility inspection, access road grading and maintenance, and pole/tower repair) to ascertain:**
   - Location(s) of the activity
   - Location(s) of access routes
   - Timing for the activity
   - Tools and equipment to used
   - Materials to be moved, imported or exported
   - Expected alteration of existing vegetation and soil

3. **List the sequence of tasks that are included in the activity. Identify which tasks can be altered to reduce the likelihood of invasive plant spread based on:**

   Task location

   a. Is there a location for this task with less potential to spread invasive plants?

   b. Can access routes be changed to avoid traveling through invasive plant populations?

   c. If materials are being moved, is there a better location for materials to be stored?

   Task timing

   a. Can the task be performed in a different time (earlier/later in the season) or in a different sequence (e.g. spraying after mowing)?

   b. Can invasive plant populations be treated before project tasks commence to reduce the spread of invasive plant parts and seeds?

   Task method

   a. Is there a different method of performing the task that can reduce the risk of spread?

   b. Could using different tools/equipment/materials reduce the risk of spread?

   c. Are weed-free materials available?

4. **Select BMPs from the following chapters to address the potential introduction and spread of invasive plants.**

List of Best Management Practices

Chapter 1: Planning BMPs

Programmatic Planning

- PL1: Adopt official policy to prevent invasive plant introduction and spread.
- PL2: Include invasive plant risk evaluation as a component of initial project planning.
- PL3: Integrate invasive plant prevention BMPs into design, construction, vegetation management and maintenance planning activities.
- PL4: Coordinate invasive plant prevention efforts with adjacent property owners and local agencies.
- PL5: Develop monitoring plans for BMP implementation and effectiveness.

Activity Planning

- PL6: Provide prevention training to staff, contractors and volunteers prior to starting work.
- PL7: Conduct a site assessment for invasive plant infestations before carrying out field activities.
- PL8: Schedule activities to minimize potential for introduction and spread of invasive plants.
- PL9: Integrate cleaning BMPs into planning for land management activities.
- PL10: Prepare worksite to limit the introduction and spread of invasive plants.
- PL11: Monitor the site for invasive plants after land management activities.

Chapter 2: Project Material BMPs

- PM1: Use a weed-free source for project materials.
- PM2: Prevent invasive plant contamination of project materials when stockpiling and during transport.

Chapter 3: Travel BMPs

- TR1: Plan travel to reduce the risk of invasive plant spread.
- TR2: Integrate cleaning activities into travel planning.

Chapter 4: Tool, Equipment and Vehicle Cleaning BMPs

- TE1: Designate cleaning areas for tools, equipment, and vehicles.
- TE2: Inspect tools, equipment, and vehicles before entering and leaving the worksite.
- TE3: Clean soils and plant materials from tools, equipment, and vehicles before entering and leaving the worksite.
- TE4: Clean pack, grazing and support animals.

Chapter 5: Clothing, Boots and Gear Cleaning BMPs

- CB1: Wear clothing, boots and gear that do not retain soil and plant material.
- CB2: Designate cleaning areas for clothing, boots and gear.
- CB3: Clean clothing, footwear and gear before leaving the worksite.

Chapter 6: Waste Disposal BMPs

- WD1: Designate waste disposal areas for invasive plant materials.
- WD2: Render invasive plant material nonviable when keeping it on-site.
- WD3: When disposing of invasive plant material off-site, contain it during transport.

(continued)

List of Best Management Practices *(continued)*

Chapter 7: Soil Disturbance BMPs

SD1: Minimize soil disturbance.

SD2: Implement erosion control practices.

SD3: Manage existing topsoil and duff material to reduce contamination by invasive plants.

Chapter 8: Vegetation Management BMPs

VM1: Schedule vegetation management activities to maximize the effectiveness of control efforts and minimize introduction and spread of invasive plants.

VM2: Manage vegetation with methods favorable to desirable vegetation.

VM3: Retain existing desirable vegetation and canopy.

Chapter 9: Revegetation and Landscaping BMPs

RL1: Develop revegetation and landscaping plans that optimize resistance to invasive plant establishment.

RL2: Acquire plant materials locally. Verify that species used are not invasive.

RL3: Revegetate and/or mulch disturbed soils as soon as possible to reduce likelihood of invasive plant establishment.

Chapter 10: Fire and Fuel Management BMPs

Fire Management Planning BMPs

FP1: Consider wildfire implications when setting overall priorities for invasive plant management programs.

FP2: Integrate invasive plant prevention into fire management plans.

FP3: Provide training in preventing the spread of invasive plants.

FP4: Plan to utilize weed-free materials for post-fire activities.

Fuel Management BMPs

FM1: Incorporate invasive plant considerations when developing fuel management programs.

FM2: Maintain active management of invasive plants on fuel management sites.

FM3: Reduce disturbance when implementing fuel management activities.

FM4: Incorporate invasive plant considerations when using prescribed fire.

Fire Suppression BMPs

FS1: Develop operational procedures related to fire suppression to reduce the spread of invasive plants.

FS2: Locate indirect fire lines to reduce additional disturbance and invasive plant spread where feasible.

FS3: Locate fire activity areas in locations free of invasive plants where feasible.

FS4: Clean vehicles, equipment, clothing and gear before arriving and leaving fire activity areas.

FS5: Use water sources free of invasive plants for fire suppression when feasible.

Post-Fire Activities BMPs

PF1: Manage access to burned areas.

PF2: Use weed-free materials for post-fire activities.

PF3: Cover and rehabilitate soil disturbed by suppression activity.

PF4: Develop and implement post-fire integrated invasive plant management prescriptions.

PF5: Revegetate burned areas to reduce the spread of invasive plants.

Chapter 1: Planning BMPs

Integrating prevention BMPs into land management can significantly minimize the introduction and spread of invasive plants. Effective planning reduces costs and enhances project success. This chapter addresses how and when to integrate prevention BMPs into planning and management, and highlights the importance of communication among staff, adjacent property owners and local agencies.

Identifying invasive plant risks early in the planning process helps organizations develop strategies to prioritize prevention measures, allocate resources, and incorporate prevention costs into budgets throughout the project life cycle. Additionally, tracking the costs and results of implementing prevention BMPs will provide references for future projects.

Planning includes developing schedules, budgets, and strategies as well as identifying critical control points for carrying out preventation BMPs. Identifying and mapping invasive plants at worksites is critical for evaluating threats. This helps determine high-risk spots for potential establishment and spread, and helps land managers select appropriate prevention practices.

Map invasive plants before starting work to designate work routes and detect invasive plant infestations early. Photo: Arpita Sinha, Cal-IPC

This chapter includes two sections on planning: programatic planning and activity planning. **Programmatic Planning BMPs** are critical because they lay the framework for prevention BMPs to be integrated into all activity planning and land management. **Activity Planning BMPs** focus on limiting the introduction and spread of invasive plants during each stage of land management. These BMPs start on page 11.

PROGRAMMATIC PLANNING BMPs:

PL1: Adopt official policy to prevent invasive plant introduction and spread.

a. Adopt an environmental stewardship policy that encourages preventing the introduction and spread of invasive plants.

b. Increase organization/agency-wide awareness of invasive plant impacts.

c. Consider using multi-disciplinary teams to address site-specific invasive plant prevention and control challenges.

d. Identify funding, priorities, and personnel assignments for invasive plant prevention. Consider having a dedicated invasive plant contact person.

PL2: Include invasive plant risk evaluation as a component of initial project planning.

a. Integrate invasive plant identification and risk analysis as a part of NEPA/CEQA processes.

b. Evaluate invasive plant spread risks and the long-term maintenance consequences with natural resource managers. Determine project alternatives and management needs based on a pre-activity assessment. See Pre-Activity Assessment Outline on page 6.

c. Incorporate invasive plant prevention measures into project layout, design, and project decisions.

d. Develop mitigation plans for areas where avoidance of invasive plants is not possible.

e. Designate known invasive plant occurrences in maintenance plans and any associated contracts.

PL3: Integrate invasive plant prevention BMPs into design, construction, vegetation management and maintenance planning activities.

a. Include BMP costs in all budgets, estimates and bid packages. Include costs for prevention training for staff and contractors, cleaning routines for clothing, tools, equipment and vehicles, and site preparation and monitoring.

b. Track cost and results of implementing BMPs as a reference for future project planning and cost estimates.

c. Integrate cleaning routines into all land management activities. For detailed cleaning protocol see Checklist E on page 49.

d. Develop incentive programs among staff and volunteers to encourage invasive plant detection and reporting.

e. Include invasive plant prevention measures as part of contract notes and specifications.

f. Develop plant lists and design guidelines for revegetation and landscaping that will optimize resistance to invasive plant establishment. For details see RL1 on page 31.

g. Plan to minimize soil and vegetation disturbance during activities. For details see SD1 on page 27 and VM3 on page 30.

h. When designing vegetation management projects, consider the life cycle and dispersal mechanisms of the invasive plant species within and/or adjacent to the worksite.

i. Acquire documentation of invasive plants along roadways and address treatment strategies in the course of road maintenance activities.

PL4: Coordinate invasive plant prevention efforts with adjacent property owners and local agencies.

a. Coordinate prevention efforts with adjacent property owners to ensure their activities will minimize the introduction or spread of invasive plants into the worksite or neighboring properties.

b. Coordinate with local and state agencies to streamline record keeping systems of invasive plant infestations. Incorporate updates into appropriate databases such as CalWeedMapper (www.calweedmapper.calflora.org) and share with local and state agencies.

c. Coordinate new research on invasive plant prevention and technology with Cal-IPC, agencies, and universities. Share findings with public and private partners.

PL5: Develop monitoring plans for BMP implementation and effectiveness.

a. Establish a periodic monitoring program based on knowledge of high priority invasive plant life cycles (ideally three times a year and during growth periods).

b. Identify and monitor sites that are susceptible to invasion, such as post construction areas and roadsides (from the edge of pavement extending a minimum of fifteen feet), pull outs, trailheads, campgrounds and parking lots.

c. Define "zero tolerance" zones in critical habitats. Commit to keeping these areas free of invasive plants through frequent monitoring and control efforts.

d. Track results of implementing BMPs as a reference for future project planning and cost estimates.

e. Develop follow-up treatments as needed based on monitoring results.

f. Consider modifying BMP implementation based on the following questions:
   - Were invasive plant populations reduced or adequately suppressed thus preventing spread?
   - Was the planned procedure used? If not, why did it vary from the original plan?
   - Were invasive plant prevention costs equal to, less than, or more than projected prevention costs?
   - What was the effect on the targeted invasive plant species?
   - Were there any side-effects on non-target organisms from implementing prevention measures?
   - Was available funding and manpower adequate?
   - Was personnel training adequate?

ACTIVITY PLANNING BMPs:

In addition to the following BMPs, also refer to related BMPS in:

- Chapter 2: Project Materials for procuring and managing erosion and project materials.

PL6: Provide prevention training to staff, contractors and volunteers prior to starting work.

a. Provide pre-work training on invasive plants and prevention BMPs to staff, contractors and volunteers. Training should include:
   - Field identification of invasive plants in the work area
   - Reproductive biology of invasive plants
   - Ecological and economic impacts of invasive plants
   - Invasive plant prevention BMPs
     - Inspection and cleaning protocols for vehicles, tools, equipment, clothes and personal gear
     - When and how to record and report occurrences for invasive plants
     - How to use prevention resources (reporting websites, checklists, etc.)
     - How to treat materials infested with invasive plant propagules.

Photo: John Luker, California State Parks, Angeles District

Train staff and contractors in prevention measures.

b. Provide additional training to staff and contractors managing project materials. Training should include:
   - How to acquire weed-free materials
   - Project material inspection protocols

c. Ensure staff and contractors understand provisions for invasive plant prevention throughout the project. Invasive plant considerations should be routinely addressed during pre-bid, pre-work and meetings, as appropriate.

d. Identify and train personnel responsible for inspection of cleaned tools, equipment and vehicles at facilities and worksites. Require an inspection form or checklist be used to document tools, equipment and vehicles are cleaned before leaving an infested worksite and are clean upon arrival at a clean/uninfested worksite.

e. Provide invasive plant identification guides, prevention BMPs, activity, and cleaning and inspection checklists (see Checklists on page 53) to staff, contractors, and volunteers. Provide these resources in other languages when appropriate. Also have these resources available at highly visible locations such as:
   - Access points
   - Field stations and work trailers

f. Educate all site users about preventing invasive plant spread.
   - Post invasive plant prevention messages using signs and posters at prominent locations such as visitor centers, campgrounds, trailheads. Provide informational materials to site users at visitor centers and events.
   - Install prevention equipment such as boot brushes and washing stations at trailheads.

PL7: Conduct a site assessment for invasive plant infestations before carrying out field activities.

a. A site assessment for invasive plant infestations includes scouting for invasive plants found within the worksite (including the exact locations and densities), and determining priority areas for implementing prevention BMPs.

b. Scout for invasive plants at likely introduction sites such as roadsides, trailheads, campgrounds, staging areas, and other disturbed areas. Wet areas may also be especially susceptible.

c. Scout not only within the worksite but nearby as well.

d. Gauge the extent and intensity of scouting based on:
   - Threat of invasive plants to critical habitats
   - Size of the worksite
   - Type of activity (whether the activity disturbs ground or vegetation, and the degree of the disturbance)
   - Adjacent environment

e. Be especially aware of invasive plant species that are not widespread in the work area and can be controlled using early detection and rapid response. Flag areas infested with invasive plants that are not widespread in the work area. Either avoid disturbance in those areas, or identify and

Photo: Martin Hutten, Yosemite National Park

Evaluate invasive plant risk as a part of project planning and environmental analysis.

isolate contaminated soils during construction or other disturbance. Isolated contaminated soils should be either placed back in the original location or disposed of appropriately to avoid spreading isolated populations of invasive plants throughout the worksite.

f. Review internal documentation and consult local groups and online resources for information on existing and potential invasive plant infestations on and near worksites.
   - Weed Management Areas (WMAs), County Agricultural Commissioner offices, and Resource Conservation Districts are key local groups that have broad awareness of infestations in a given area. Cal-IPC currently maintains an online list of WMAs (www.cal-ipc.org/WMAs).
   - Cal-IPC works with a range of partners to map invasive plants across the state. Occurrence data for invasive plants can be found online at CalWeedMapper (www.calweedmapper.calflora.org), Calflora (calflora.org) and on the California Department of Fish & Game's BIOS viewer (www.bios.dfg.ca.gov).
   - Specimen data can also be found at the California Consortium of California Herbaria (http://ucjeps.berkeley.edu/consortium/), which houses data for over 20 California herbaria including the California Department of Food and Agriculture Weed Laboratory.

g. Document invasive plant findings and communicate them to resource or facility managers.

h. Incorporate findings into a database (e.g. www.calweedmapper.calflora.org) and project drawings or maps.

i. Evaluate invasive plant risks. Determine invasive prevention and management needs at the onset of activity planning. Prioritize treatment of invasive plants based on guidelines in Prioritizing BMP Implementation on page 4.

PL8: Schedule activities to minimize potential for introduction and spread of invasive plants.

a. Prioritize reducing invasive plant seed production along roadsides (edge to fifteen feet along roadway edge) to reduce seed movement by vehicles.

b. Conduct work under conditions that minimize the risk of spread (e.g. frozen ground, snow cover, seed absence).

c. Avoid working during rain events and high winds. Wet conditions make it easier for seeds to be picked up by a vehicle and spread miles down the road.

d. Develop site-specific plans for controlling existing invasive plants before ground-disturbing activities begin.
   - Control invasive plants along access roads before moving equipment into the worksite.
   - Manage invasive plants three to five years prior to the planned disturbance to minimize invasive plant seeds in the soil, when feasible.

e. For details on scheduling vegetation management see VM1 on page 29.

PL9: Integrate cleaning BMPs into planning for land management activities.

a. Determine cleaning needs for tools, vehicles, equipment, clothing, boots and gear in conjunction with each activity and worksite. Include these cleaning needs in project plans, and make prior arrangements for any special needs identified. For details on cleaning see Chapters 4 and 5 on pages 21 and 23.

b. Include cleaning costs in project budgets.

c. Acquire necessary cleaning tools.

d. Designate sites for cleaning vehicles, equipment, pack animals, clothing and gear.

e. Identify cleaning facilities (such as car washes) near the worksite, in the event that cleaning on-site is not an option.

f. Use inspection checklists to ensure comprehensive cleaning. See Checklist E on page 59.

PL10: Prepare worksite to limit the introduction and spread of invasive plants.

a. Protect likely introduction sites such as pull-outs, trailheads, campgrounds, and parking lots from invasive plant introductions by paving, deep mulching, or planting a dominant non-invasive groundcover.

b. Periodically inspect areas of concentrated use, such as staging areas, parking areas, trailheads, or campgrounds, and keep them free of invasive plants.

c. Treat invasive plants at access roads and staging areas before using them.

d. Control invasive plants in areas adjacent to worksites. This prevents seeds or other reproductive structures from moving into the worksite. If removing plants is not feasible, stopping seed set can be an effective way to reduce the potential for spreading the plant.

e. Position activity boundaries to exclude areas infested with invasive plants. Activity boundaries include staging areas, timber harvest landings, skid trails, access roads and other temporary facilities. If this is not possible, control invasive plants in infested areas prior to their use.

PL11: After land management activities, monitor worksites for invasive plants.

a. Carry out the established monitoring plan. Partner with local WMAs (www.cal-ipc.org/WMAs), agencies and organizations to help with monitoring when possible.

b. Train staff to recognize and report invasive plants as part of ongoing monitoring.

c. Monitor areas including:
   - On-site cleaning area
   - Waste disposal area
   - Areas where project materials are stored
   - Access routes, roads and other areas of concentrated use
   - Areas near salt licks, watering sites, loading/unloading areas and corrals for animals

d. Monitor and maintain revegetation and landscaping to ensure long-term establishment of desired plant species.

e. Monitor during multiple growing seasons, especially at times of germination and flowering, for a minimum of three years after project completion to ensure that any invasive plants are promptly detected and controlled. If three years is not sufficient to control invasive plants, monitoring and treatment should be continued until confident that invasion has been controlled.

f. For on-going projects, continue to monitor until reasonably certain that invasive plants will not reappear. Plan for follow-up treatments based on presence of invasive plants.

Photo: Martin Hutten, Yosemite National Park

Monitor worksite for invasive plant infestations after activities.

Chapter 2: Project Materials BMPs

Project materials are common vectors of invasive plant introduction into new areas. Infested project materials that are imported to worksites can introduce invasive plant propagules and lead to new infestations. This chapter includes practices for minimizing the spread of invasive plants from project materials.

Effective project material management can prevent invasive plant spread at the source and minimize contamination during transport and stockpiling. Because project materials are often managed by different entities or departments during different project phases, developing a procedure for procuring, storing, and inspecting materials at critical control points will streamline materials management and minimize contamination. Additionally, developing relationships with suppliers and requesting that they supply weed-free materials can help to increase demand and availability of these materials.

Project materials include:

- Erosion control materials (silt fences, fiber roll barriers, straw wattles, mulch and straw)
- Soil and aggregate (topsoil, fill, sand, and gravel)
- Landscape materials (plants, seed, sod, mulch, and soil amendments)
- Animal/livestock feed
- Water (for cleaning or irrigation)
- Construction/building materials

Project materials contaminated with invasive plant seeds and parts and spread invasive plants. Use weed-free materials to prevent spreading invasive plants. Photo: Martin Hutten, Yosemite National Park

PM1: Use a weed-free source for project materials.

a. Develop a procedure for procuring and storing weed-free materials and inspecting material sources. Cultivate relationships with suppliers to streamline sourcing of weed-free materials.

b. Select materials based on the environmental needs of the worksite. Understand how weed-free materials are produced, whether the screening criteria is based on noxious weeds or wildland invasive plants. Weed-free materials may not be 100% weed-free, but using weed-free materials can reduce the probability of exposure to invasive plant parts and seeds.
   - Noxious weeds are agricultural weeds listed by the California Department of Food and Agriculture. www.cdfa.ca.gov/plant/ipc/weedinfo/winfo_list-pestrating.htm
   - California Invasive Plant Council's inventory lists wildland invasive plants. www.cal-ipc.org/ip/inventory/

c. Determine the degree to which weed-free project materials are needed for each worksite. Materials from an infested site may be suitable for a worksite that is already infested with the same species. Excavated material from areas containing invasive plants may be reused within the limits of the infestation.
   - For example, materials from a yellow starthistle infested site could be reused in areas already infested by yellow starthistle, but not in areas free of yellow starthistle.
   - Unused excavated material contaminated with invasive plants should be stockpiled on an impervious surface and managed until all invasive plant material is non-viable. For details on managing stockpiled materials see PM2 on page 18.

d. Use weed-free materials for erosion control and soil stabilization.
   - When available, use weed-free straw certified by a county agriculture department, coconut fiber, rice straw and/or native grass straw. These types of erosion control material have limited quantities of invasive plants or contain wetland species that may not survive in dry upland conditions. See Cal-IPC (www.cal-ipc.org/ip/prevention) for a Weed-Free Forage & Straw Supplier List.

Photo: Marla Knight, USDA Forest Service

Contaminated project materials, like this gravel pile, can spread invasive plants to worksites.

   - Perform follow-up inspections at sites where erosion control materials have been used to ensure that any invasive plant introductions are caught early and treated.

e. Use weed-free sand and gravel.
   - Any fill material brought on-site should be clean, debris-free, and devoid of invasive plant parts or seeds. Do not borrow fill from weed-infested stockpiles, road shoulders or ditch lines.
   - Inspect aggregate material sources (including but not limited to surrounding ditches, topsoil piles, gravel/sand piles or pits). See Cal-IPC (www.cal-ipc.org/ip/prevention) for information about procuring weed-free sand and gravel.

f. Use weed-free seed. Verify seed mix to ensure it does not contain invasive plants.
   - Use local seeding guidelines for your county to determine procedures and appropriate seed mixes.
   - A certified seed laboratory should test each lot according to Association of Seed Technologists and Analysts (AOSTA) standards (which include a statewide invasive plant list) and provide documentation of the seed inspection test. Check state, federal, and California Invasive Plant Council lists to see if any local weeds need to be added prior to testing. For more information on locating lists of invasive plants, see PM1d on page 16.

- Seed purchased commercially should have a label that states the following:
  - Species
  - Purity: Most seed should be no less than 75% pure and preferably over 85% pure. The rest is inert matter, weed seed, or other seed.
  - Weed seed content: The tag should state NO invasive plants are present. Only certified weed-free seed should be used. Note that seed is usually certified to be “noxious weed free”, referring to the California Department of Food and Agriculture noxious weed list, and may still contain seeds of wildland invasive plant species not included on the noxious weed list.
  - Germination of desired seed: Germination generally should not be less than 50% for most species, although some shrubs and forbs will have lower percentages.

g. Keep and reuse on-site weed-free materials rather than importing new materials to limit contamination.
   - Stockpile topsoil along perimeter of project for later use rather than importing topsoil. For details on topsoil management, see SD3 on page 28.
   - Consider using mulch from non-invasive plant species chipped on site when feasible.

h. Find local sources when off-site weed-free project materials are needed. Inspect project material suppliers as appropriate to determine if the source is weed-free. Weed-free materials may not be 100% weed-free, but using these materials can reduce the probability of exposure to invasive plant contamination.

i. Designate and use weed-free water sources for each project.
   - Inspect water sources to prevent introduction of invasive plants or animals.
   - Designate weed free pathways to water sources.

j. Provide weed-free feed for livestock and pack animals before and after project use to limit invasive plant seed transport via manure.

k. If unable to obtain materials from a weed-free source:
   - Work with a local weed specialist to sterilize or treat materials and provide results of post-treatment inspection. Monitor application areas. For monitoring protocol see PL11 on page 14.
   - If soil sources are infested, treat the invasive plants, then strip the infested topsoil and stockpile the contaminated material for several years to further deplete the soil seed bank. Check regularly for re-emergence of invasive plants and treat as needed.
   - Inspect the area where material from weed-infested sources were used annually for at least three years after project completion to ensure that any invasive plants transported to the site are promptly detected and controlled. For monitoring protocol see PL11 on page 14.

l. Inspect project materials, sources, and storage areas for invasive plants annually and prior to each use to ensure that no invasive plants have invaded since the last inspection. Record inspection results. Continue to monitor worksites for three year after project completion.

m. When feasible, include penalties, performance standards, or withholding provisions in contract specifications by which a contractor is assessed monetary damages for importing invasive plants as a result of non-compliance with contract specifications.

Photo: Mona Robison, California State Parks

These certified weed-free rice straw wattles are contained in plastic packaging to protect them from invasive plant establishment.

PM2: Prevent invasive plant contamination of project materials when stockpiling and during transport.

a. Move only weed-free materials into uninfested areas. Moving materials from one infested location to another within a particular zone may not cause contamination, but moving materials from infested to uninfested areas could lead to the introduction and spread of invasive plants.

b. Clean transport vehicles before and after loading project materials.

c. Encourage log yard and biomass plant operators to maintain weed-free yards, equipment parking areas, off-loading areas, and staging areas. This will reduce the likelihood of invasive plant spread from yard to worksite.

d. During transport, cover exposed piles of materials with geotextile fabric or impermeable material to prevent contamination of weed-free materials or spread of infested materials.

e. Cover exposed piles of project materials with impermeable material to protect materials from wind and rain, and reduce germination of invasive plants.

f. Cover active and inactive soil stockpiles with soil stabilization material or a temporary cover:
   - Soil stabilization used on bare slopes can be used for stockpiled soils. Temporary soil stabilization materials include:
     - Hydroseed (tackifier, fiber or seed)
     - Erosion control blanket (jute mesh or netting)
     - Mulch
     - Soil binder
     - Geosynthetic fabric
   - Surrounded with a linear sediment barrier (e.g. fiber roll).

g. For managing existing topsoil and duff materials see SD3 on page 28.

h. Frequently monitor stockpiles, materials storage areas and borrow pits. Quickly treat new invasive plant populations prior to seed production.

Photo: Ramona Robison, California State Parks

Cover soil stockpiles to prevent invasive plant establishment. Monitor worksites for invasive plants following activities.

Chapter 3: Travel BMPs

Land managers traveling between worksites can become vectors for the spread of invasive plants. For instance, driving a truck along an infested road can pick up seeds and carry them to a worksite. This chapter includes practices for minimizing the introduction of invasive plants by equipment, vehicles, animals and people.

It is important to be aware of travel routes. While cleaning vehicles, equipment, pack animals, clothing and gear is essential; land managers' travel practices can reduce the amount of plant reproductive material that gets transported in the first place.

Vehicles traveling through areas infested with invasive plants can spread viable plant material. Photo: Peter Schuyler, ecological consultant

TR1: Plan travel to reduce the risk of invasive plant spread.

a. Consider the scale of infestation at worksites and travel routes. Typically not all areas are infested to the same degree with the same plants; this may affect the type and degree of prevention measures implemented.
b. Avoid driving off-road whenever possible.
c. When driving off-road, avoid patches of invasive plants.
d. Exclude areas infested with invasive plants from equipment travel corridors and staging areas.
e. Avoid parking on the side of the road in areas infested with invasive plants.
f. Prevent animals (pack and grazing) from entering areas infested with invasive plants.
g. When traveling through infested areas cannot be avoided:

- Consider the sequence of operations. Arrange travel routes from uninfested areas to infested areas. Work first in uninfested areas when vehicles and equipment are free from invasive plant material.
- Control invasive plants at access roads and staging areas before using them.
- Clean your vehicle before leaving the infested area.
- Travel under dry conditions when feasible. Traveling under wet conditions, particularly along unpaved roads, greatly elevates the risk of picking up invasive plant seeds and transporting them.
- Restrict travel to those periods when spread of seed is least likely, such as just prior to flowering or late in the season when seeds have already dropped.

h. Limit the number of roads traveled to minimize soil disturbance and the risk of unintentionally transporting invasive plant parts and seeds on equipment into uninfested areas.

i. Close or reroute public roads or trails in areas infested with invasive plants. Where appropriate, ask user groups to become actively involved to help control an infestation so the trail can be reopened.

j. Perform road maintenance such as road grading, brush clearing, and ditch cleaning from uninfested to infested areas. If possible, schedule such activities when seeds or propagules are least likely to be viable.

Photo: Noa Rishe, California State Parks, Angeles District

Clean seeds and plant parts from vehicles before leaving worksites infested with invasive plants.

TR2: Integrate cleaning activities into travel planning.

a. Include cleaning when planning travel time.

b. Set up cleaning operations to be efficient and effective to have minimal impact on travel time.

c. Remove soil and plant materials from tools, vehicles, equipment, clothing, boots and gear before entering and leaving a worksite.

d. Refer to an inspection checklist to ensure comprehensive cleaning of vehicles, equipment, pack animals, clothing and gear. See Checklist E on page 59.

e. Avoid traveling through areas infested with invasive plants when collecting water for dust abatement or cleaning.

Chapter 4: Tool, Equipment and Vehicle Cleaning BMPs

Tools, equipment and vehicles used for land management activities are potential vectors for invasive plant spread. For example, a mower used at a site infested with yellow starthistle can trap seeds in the mower deck and deposit them at the next worksite. This chapter presents ways to prevent the spread of invasive plants by cleaning hand tools, power tools, construction equipment, vehicles, and pack and grazing animals. For a detailed cleaning protocol see Checklist E in the checklists section of this manual on page 59.

TE1: Designate cleaning areas for tools, equipment, and vehicles.

a. Tools, equipment, and vehicles should be cleaned in areas that are:
   - Easily accessible for monitoring and control
   - Located away from waterways
   - Located away from areas of sensitive habitats or species
   - Near areas already infested with invasive plants
   - Contained with silt fences or soil berms
   - Paved or have sealed surfaces to avoid re-accumulation of soil and plant material on cleaned vehicles and equipment

TE2: Inspect tools, equipment, and vehicles before entering and leaving the worksite.

a. Consider the extent of infestation at worksites. Typically not all areas are infested to the same degree with the same plants, and this may affect the type and degree of inspection needed.

b. Prior to entering an uninfested area, inspect vehicle and equipment undercarriages and tires for seeds or plant parts.

c. Refer to an inspection checklist to ensure comprehensive inspection. See Checklist E on page 59.

Clean tools, equipment, and vehicles to reduce the spread of invasive plants. Photo: Martin Hutten, Yosemite National Park

d. Train staff, contractors and volunteers to inspect for seeds, seed heads, plant material, soil and mud.

e. Procure appropriate equipment for inspections, such as flashlights, portable lighting if night-time inspections are necessary, and under-vehicle mirrors.

f. Inspect areas where tools, equipment and vehicles are stored for invasive plants. Maintain these facilities as weed-free.

g. Ensure that rental equipment is free of invasive plant material before accepting it.

TE3: Clean soils and plant materials from tools, equipment, and vehicles before entering and leaving the worksite.

a. Clean tools, equipment, and vehicles if soil and plant materials are found during inspections.

b. Remove soil, seeds and plant parts from tools, the undercarriage, tires, sideboards, tailgates, and grills of all vehicles and equipment. Wash tires and under carriage if the travel route is muddy. For detailed cleaning protocol see Checklist E on page 59. Cleaning methods are divided into two categories:

- Cleaning without water:
    - Bristle brushes, brooms, scraper and other hand tools (to remove heavy accumulation of soil and debris prior to washing with other tools)
    - High pressure air devices
    - Vacuum cleaner
    - Hand removal
- Cleaning with water:

Wash on a paved surface to avoid creating mud. Contain waste water and splash to prevent invasive plant parts and seed from spreading through runoff. Berms or silt fences installed along perimeters of work areas can aid in preventing the spread of contaminated materials outside the cleaning area.

- High pressure washers (preferably with 2,000-psi): wash once for six minutes or two to three times for three minutes for best results.
- Portable cleaning station with undercarriage washers and pressure hoses (useful during maintenance of multiple sites).

c. Dispose of propagule-containing water from equipment washing at a waste management facility or incinerator; not a wastewater treatment plant.

d. Clean carpet, rubber, nylon or plastic materials using:

- A vacuum cleaner
- A variety of brushes with bristles of varying length and texture.

e. Frequently wash vehicles, especially after driving off-road or along roads bordered by a high density of invasive plants, and after traveling under wet conditions.

f. Include cleaning as part of routine maintenance activities for tools, equipment and vehicles. This is in addition to regular cleaning on site.

TE4: Clean pack, grazing and support animals.

a. Brush and clean animals — especially their hooves and legs — before leaving areas infested with invasive plants. For detailed cleaning protocol see Checklist E on page 59.

b. Provide weed-free forage or pelletized feed for livestock (preferably for three days or more) before and after project use to limit invasive plant seed transport via manure.

c. Consider using transitional pastures when moving livestock from invasive plant infested areas.

- Allow animals to graze invasive plants only before they flower or set seed. If this is impossible, contain animals in a weed-free holding area (preferably for three days or more) before moving them into uninfested areas.

Photo: Marla Knight, USDA Forest Service

Contain waste water when washing vehicles to prevent spreading invasive plant parts.

Chapter 5: Clothing, Boots and Gear Cleaning BMPs

Land managers have the potential to be a vector of seed dispersal through what they wear and what they carry into the field. The tendency for a fabric to attract and hold seeds and other plant material varies significantly depending on its texture. This chapter presents prevention practices that can minimize the spread of invasive plant material via clothing, boots, and gear. For a detailed cleaning protocol see Checklist E on page 59.

Wear fabric that does not retain plant material to reduce the spread of invasive plants. Photo: Martin Hutten, Yosemite National Park

CB1: Wear clothing, boots and gear that do not retain soil and plant material.

a. Wear fabrics that do not retain invasive plant propagules:
   - Cotton duck (canvas),
   - Nylon
   - Leather
   - Fabrics such as Para-aramid Kevlar®[1] and Meta-aramid Ripstop Nomex®[2]

b. Avoid brushed cotton, netting, Velcro, and bulky knits like wool and fleece

c. Use special gear as appropriate:
   - Nylon gaiters to cover socks and laces
   - Leather laces on leather boots
   - Rubber boots

d. Consider dedicating a pair of shoes or boots for use only in infested sites.

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1. DuPont™ and Kevlar® are registered trademarks of DuPont
2. DuPont™ and Nomex® are registered trademarks of DuPont

CB2: Designate cleaning areas for clothing, boots and gear.

a. Select cleaning areas that are:
   - Easily accessible for monitoring and control
   - Located away from waterways
   - Located away from sensitive habitats or species
   - Near areas already infested with invasive plants

CB3: Clean clothing, boots and gear before leaving worksite.

a. Carry appropriate equipment to help remove soil, seed, and plant parts. This may include wire brushes, small screwdrivers, boot brushes, extra water free of invasive species, and bags for plant material.

b. Remove soil, mud, seeds, and any plant material from clothing, boots and gear before leaving a worksite infested with invasive plants.

c. Clean clothing, boots and gear at the designated cleaning area or at location of exposure to invasive plant seeds or material. In some cases it may be appropriate to bag seeds and plant parts for off-site disposal.

d. Inform coworkers about possible seeds or other propagules carried on their clothing, footwear and gear.

e. For a detailed cleaning protocol see Checklist E on page 59.

Photo: Jen Stern, Cal-IPC

Clean clothing, boots and gear to reduce the spread of invasive plants.

Chapter 6: Waste Disposal BMPs

After removing invasive plants, land managers need to decide what to do with the resulting plant biomass. Our definition of waste includes invasive plant biomass, seeds and contaminated materials such as soil and mulch. These materials may spread invasive plants if they are left viable and uncovered or are transported without containment. This chapter presents guidelines for proper waste disposal to prevent the spread of viable plant material and seeds.

Prevent invasive plant materials from contacting soil when disposing of materials on-site. Photo: Cindy Roessler, Midpeninsula Regional Open Space District

WD1: Designate waste disposal areas for invasive plant materials.

a. Select disposal areas where viable invasive plant materials will be contained, buried or destroyed.

b. Locate debris burn piles in areas that minimize the possibility of invasive plant establishment.

c. Do not dispose of viable invasive plant material that has the ability to resprout or spread at a facility that produces mulch or chipped products.

d. Do not dispose of soil, seeds, or plant material down a storm drain. This action may promote the spread of invasive plants downstream.

e. Develop a monitoring plan for waste disposal areas, including burn piles, to prevent the introduction and spread of invasive plants.

WD2: Render invasive plant material nonviable when keeping on-site.

a. When composting invasive plants on site, consider the reproductive biology of the invasive plants:
   - Composting will render invasive plant material nonviable only if compost piles reach very high temperatures. Finished compost should be monitored for invasive plant emergence.
   - For large amounts of invasive plant material or for invasive plants with rigid stems, contain plant materials by placing them on asphalt or black plastic (4-mm-thickness minimum), covering with black plastic (4-mm-thinkness minimum), and securing the edges with landscaping staples, large rocks or sand bags. Effectiveness of this method varies by plant species.
   - For smaller amounts of plant material or for plants with pliable stems, bag the material in heavy-duty (3-mm or thicker) garbage bags. Keep plant material bagged for at least one month. Effectiveness of this method varies by plant species.
   - Keep covered or bagged materials in the sun, preferably on a dark surface such as asphalt, to accelerate the decomposition process. Material is nonviable when partially decomposed, very slimy or brittle. Once material is nonviable, it can be disposed of in a landfill or brush pile.
   - Monitor the bagged or covered material to ensure the plants do not escape through rips, tears or seams in the plastic.

b. When drying out invasive plants in piles:
   - Prevent cut surfaces of invasive plant stems from contacting soil, to avoid root growth and reestablishment.
   - Invasive plants with viable seeds or fruit attached should not be left on-site to dry out in an exposed manner.

c. When burying invasive plants on-site:
   - Contain all invasive plant material in an excavated pit, cover with woven geotextile, and cover with a minimum of 3 feet of uncontaminated fill material. Effectiveness of this method varies by plant species.
   - This method is best used on a worksite that already has disturbed soil.

d. Burn plant material after obtaining necessary permits.

e. Monitor all disposal sites for emergence of new invasive plants. Locate disposal sites so that they are easy to monitor.

WD3: When disposing of invasive plant material off-site, contain it during transport.

a. Contain invasive plant material in heavy-duty (3-mm or thicker, contractor quality plastic) garbage bags. Securely tie the bags and transport under tarps or in an enclosed truck to an appropriate disposal area.

b. Clean vehicles after transporting invasive plant material. For detailed cleaning protocol see Checklist E on page 59.

c. If invasive plant material has the ability to re-sprout or spread by seed, do not dispose of it at a facility that produces mulch or chip products. Contact your local solid waste authority for additional details.

Photo: Courtesy of Mario Abreu, California Native Plant Society

Contain invasive plant material in heavy-duty garbage bags when disposing of materials off-site.

Chapter 7: Soil Disturbance BMPs

Soil disturbance includes contouring, grubbing, logging, moving, removing, excavating and cutting. Soil disturbance destabilizes and exposes soil, which can impact water and air movement, biological activity, root growth and seedling emergence. Disturbed soil provides an opportunity for invasive plants to establish and spread, to compete with native species, and to colonize new areas.

Soil disturbance often occurs during:

- Road maintenance
- Timber harvesting
- Soil excavation
- Vegetation clearing
- Movement of vehicles and heavy equipment

Minimize soil disturbance by selecting low impact equipment. Photo: Martin Hutten, Yosemite National Park

Soil disturbance should be minimized to the extent practical. Disturbed soil should be stabilized and covered as soon as possible to prevent the germination and growth of invasive plants. If a worksite is infested with invasive plants, schedule treatment of these plants prior to ground disturbance to minimize spread of invasive plants into other uninfested areas. Project materials such as fill, aggregate and erosion control materials can also carry invasive plant seeds, which further increase the risk for infestation after soil disturbance.

In addition to the following BMPs, also refer to related BMPS in:

- Chapter 2: Project Materials for procuring and managing erosion and project materials.

SD1: Minimize soil disturbance.

a. Retain soil and desirable vegetation in and around the activity area as much as possible to prevent the introduction and spread of invasive plants.

b. Minimize ground disturbance, as increased bare ground creates suitable habitat for invasive plant germination.

c. Consider the impacts of different types of equipment. Choose equipment that minimizes soil disturbance.

d. Minimize the frequency of soil disturbance. If a site has to be cleared of vegetation regularly (such as brush clearing), consider paving or otherwise protecting the site with weed-free materials (gravel, mulch, decomposed granite), deep mulching or planting non-invasive groundcover, or sealing bare surface with soil stabilizer. For more information on soil stabilizers see PM2f on page 18.

e. Limit the number of roads and access points used to help minimize soil disturbance, and to limit the risk of unintentionally transporting invasive plants into uninfested areas.

SD2: Implement erosion control practices.

a. Promptly revegetate and/or mulch disturbed soil after ground disturbing activities. This will stabilize soils and reduce the likelihood of invasive plant establishment. For more details on revegetation and erosion control see RL3 on page 33.

b. Use weed-free mulch, logging slash, native plant seed or a native or non-persistent cover crop as temporary cover during the delay between soil disturbance and revegetation.

c. Contain and manage water runoff, which may carry soil, seeds and plant material. Silt fences installed along perimeters of worksites can aid in preventing the spread of infested materials.

SD3: Manage existing topsoil and duff material to reduce contamination by invasive plants.

a. Save local existing topsoil for reuse. Plan topsoil management prior to soil disturbance.
   - Develop topsoil management plans on all projects that include grading or earthwork unless the topsoil and duff material are determined to be contaminated with invasive plants.
   - Identify on the plans where local topsoil and duff material, within the worksite, should be:
     - Removed or excavated
     - Stockpiled
     - Reapplied

b. When excavating local topsoil and removing duff material, minimize handling of the material to reduce detrimental impacts to soil microorganisms.

c. Stockpile local topsoil and duff material in windrows no taller than ten feet for local topsoil and five feet for duff. Implement temporary erosion control measures to reduce the likelihood of invasive plant establishment and loss of material. For erosion considerations see PM2 on page 18.

d. Seed local topsoil stockpiles that will remain in place for over six months with a fast-growing non-invasive native plant species to maintain soil microorganisms. Covering topsoil stockpiles with impermeable barriers such as plastic sheeting may destroy living soil microorganisms. For information on temporary cover materials see PM2f on page 18.

e. Monitor stockpiles of topsoil and duff material regularly as they are highly susceptible to invasion by invasive plants. Determine management needs based on presence of invasive plants.

Photo: Cindy Roessler, Midpeninsula Open Space District

Install wattles or erosion control mats to reduce soil erosion.

Chapter 8: Vegetation Management BMPs

Integrating prevention BMPs into vegetation management can greatly minimize the introduction and spread of invasive plants. For example, scheduling vegetation management activities prior to seed production can reduce the spread of invasive plants. Life cycles of both invasive and desirable plants should be considered when scheduling activities. Mowing invasive plants after seed production will promote seed dispersal and increase the size of infestations.

Vegetation management activities may include but are not limited to: mowing, manual clearing, trimming, mechanized clearing and trimming, herbicide application, prescribed grazing and burning.

VM1: Schedule vegetation management activities to maximize the effectiveness of control efforts and minimize introduction and spread of invasive plants.

a. Consider the timing of invasive plant control efforts based on the plant's life cycle.
   - Schedule land-disturbing activities to occur prior to seed set to minimize spreading seeds. Keep in mind that seeds may be present in the soil.
   - Consider invasive plant reproductive biology and response to fire when planning prescribed burns.
   - Coordinate the timing of maintenance activities and invasive plant control activities. For example, delay mowing until two weeks after herbicide application and delay spraying after mowing until vegetative regrowth has occurred.

Schedule mowing of invasive plants to minimize impact on desirable plants.
Photo: Noa Rishe, California State Parks, Angeles District

- Before excavating invasive plants from drainage ditches, treat the entire infestation to ensure that the plant parts will not spread to adjacent and downstream areas. Avoid side casting (piling excavated soil on either side of a trench when digging a drainage ditch) of accumulated road materials infested with invasive plants. Stockpile in one area that can be monitored.

b. For more details on scheduling see PL8 on page 13.

VM2: Manage vegetation with methods favorable to desirable vegetation.

a. Coordinate management of invasive plants and desirable plants.
   - Schedule mowing, clearing, trimming or grazing of desirable plants for after seed maturation, ensuring desirable plants grow unrestricted and produce seed.
   - Schedule management of invasive plants at early flowering stage (or well before seed development) to avoid spreading viable invasive plant seeds.

b. Limit mowing and other mechanical control to the minimum needed to control invasive plants.
   - To reduce plant shock and root dieback of desirable plant species, mowing height should not be less than six inches. Mowing too low during the growing season will increase soil exposure to sun, soil temperatures and erosion risks, and encourage invasive plant growth.

c. Identify conditions under which invasive plants should not be mowed to avoid spreading them. Some invasive plants have the ability to sprout from stem and root fragments. Mowing these plants should be avoided.

VM3: Retain existing desirable vegetation and canopy.

a. Identify and protect desirable vegetation on site to increase competition with invasive plants. Desirable vegetation should be non-invasive and suitable for the conditions.

b. Train personnel to identify invasive and non-invasive plants on-site. Provide identification guides to field staff.

c. Minimize clearing large amounts of vegetation and creating canopy openings. Increased sunlight and bare ground creates suitable habitats for invasive plant germination.

d. Consider the impacts of different types of equipment. Choose equipment that minimizes vegetation disturbance.

Photo: Noa Rishe, California State Parks, Angeles District

Flag native plants for avoidance before treating invasive plants.

Chapter 9: Revegetation and Landscaping BMPs

Revegetation and landscaping work is often derived from different needs and carried out by different staff or contractors. Revegetation is the process of replanting and rebuilding the vegetated community on disturbed land. Landscaping modifies land to meet functional, aesthetic and regulatory requirements. Despite the differences, revegetation and landscaping share the fundamental goal of creating weed-resistant plant communities.

Creating weed-resistant plant communities requires planning and a thorough understanding of site ecology including: existing soil condition, hydrology, exposure, existing plant community and habitat, invasive plant risk assessment, human impact, and the surrounding environment.

Plant native or desirable non-invasive plants to optimize resistance to invasive plant establishment. Photo: Jack Broadbent, California Department of Transportation

Plant selection is critical to successful revegetation projects. Revegetation and landscaping with desirable non-invasive plants suitable for local conditions can create weed-resistant communities that prevent or slow the establishment, growth, and reproduction of invasive plants. The following prevention BMPs are for revegetation and landscaping projects.

In addition to the following BMPs, also refer to related BMPS in:

- Chapter 2: Project Materials for procuring and managing erosion and project materials.

RL1: Develop revegetation and landscaping plans that optimize resistance to invasive plant establishment.

a. Identify areas where revegetation or landscaping is needed to improve invasive plant resistance of plant communities. Determine the goal of vegetation coverage. Evaluate annually for three years to determine if vegetation establishment is successful.

- Develop weed-resistant plant communities in disturbed areas such as roadsides. Consider using plants that have low growth forms, require no mowing, establish well, and are well adapted to disturbance.
- Revegetate or landscape with local native plants or appropriate non-invasive plants to prevent invasive plant introduction. Native species grown outside of the region may not establish well.

b. Evaluate existing soil type, texture and health to determine vegetation selection, fertilization and maintenance needs.
   - Improve unhealthy soil by adding healthy topsoil, compost, fertilizer and/or using aeration to incorporate oxygen into the soil.
   - Fertilization, if done improperly, can encourage weed growth and reduce the ability to establish native plants. Organic fertilizers are better suited for native plants because they release nitrogen at a very slow and stable rate.
   - Do not fertilize areas treated with compost as the compost will provide the plants with the necessary micro-nutrients to support healthy growth. Compost should be supplied by participants in the US Compost Council's Seal of Testing Assurance Program. A list of current STA program participants is available at: http://compostingcouncil.org.
   - If improving soil health is not possible, choose vegetation with low soil-nutrient requirements.

c. Develop a plant palette that will occupy various planting zones/ecological niches in order to create a weed-resistant landscape.
   - Select plants, with the aid of a revegetation/landscaping specialist, based on existing soil conditions, drainage patterns, amount of rainfall or irrigation available, exposure and adjacent environment.
   - Use native material to the greatest extent possible.

d. Encourage passive regeneration of native plant cover where site conditions permit and where the risk of introducing invasive plants is low.

e. Design irrigation systems with attention to irrigation timing, coverage and quantity to encourage the growth of desirable plants and discourage the growth of invasive plants. Too much water can stunt the growth of drought-tolerant plants and encourage undesirable invasive plants.

RL2: Acquire plant materials locally. Verify that species used are not invasive.

a. Identify sources of native and appropriate nonnative plant materials. Specify and use weed-free locally appropriate seed mixes that will occupy various niches in order to create weed-resistant plant communities.

b. Check seed label for purity, composition, source and germination. Confirm consistency with specifications. For seed label details see PM1 on page 16.

c. Use local native ecotypes when feasible. Native species grown outside of the region may not establish well. Consider contract growing of local native plants.

d. When using local native species is not feasible and the risk of invasive plant infestation is high, use locally grown, non-invasive species proven to grow well locally.

e. Do not plant invasive plants. Verify plant lists do not contain invasive plant species by checking Cal-IPC's invasive plant inventory (www.cal-ipc.org/ip/inventory/weedlist) and the local Agricultural Commissioner's Office.

f. Confirm that only selected plant species are used in the planting, especially when naming inconsistencies are possible.

g. Have extra plant materials on hand. Plan for mortality of 20-30% percentage of container plants.

RL3: Revegetate and/or mulch disturbed soils as soon as possible to reduce likelihood of invasive plant establishment.

a. Promptly revegetate and/or mulch disturbed areas, including new forest openings, with local native or non-invasive plants. For details on acquiring plant materials see RL2 on page 32.

b. Use proper horticultural practices to promote healthy root and foliage growth that will aid in the vegetation's ability to withstand adverse conditions and to compete with invasive plant growth.
   - Avoid use of fertilizer in areas with high infestations of invasive plants where fertilizer may favor growth and spread of invasive plants over desirable species.
   - Consider using compost or organic slow release fertilizer when planting native species. Excessive nitrogen availability promotes the growth of weedy annual grasses, which can dry out the site and crowd out slow-growing perennials.
   - Consider soil inoculation to improve establishment success for planted species. Inoculation refers to the adding of "inoculants" which are mycorrhizal fungi that help with moisture retention and soil/root relationships in the first year of establishment.

c. When revegetation is impossible, consider limited and judicious use of paving/hardscape or otherwise protecting the site using weed-free materials (gravel, logging slash, long-fiber mulch, decomposed granite), deep mulching or using a soil stabilizer. For more information on soil stabilizers see PM2f on page 18.

d. When using mulch:
   - Use weed-free mulch. For information on weed-free mulch see PM1 on page 16.
   - Consider fire risk at the application site. Some long-fiber mulches such as shredded redwood bark (gorilla hair) are highly flammable.
   - Apply mulch at the recommended thickness to suppress the establishment and growth of invasive plants. Ensure mulch remains on-site. Lighter mulches will blow away in areas prone to heavy wind; mulches can move if watering results in surface flow. Consider the use of tackifiers or biodegradable netting.
   - Supplement with additional mulch to retain thickness and effectiveness after it begins to decompose.

Photo: Jim Dempsey, California State Parks

Select plant materials from local sources. Verify that all plants selected are not invasive.

Chapter 10: Fire and Fuel Management BMPs

Wildfire is a natural part of California ecosystems, and the structure and composition of most of California's plant communities are dependent on the periodic occurrence of fire. However, it also has significant potential for creating conditions that aid the establishment or spread of invasive plants which can damage the state's ecosystems. Disturbance created by wildfire suppression activities and pre-fire fuel treatments can also inadvertently contribute to the spread of invasive plants. This chapter addresses the many steps that can be taken to limit invasive plant establishment or spread. However, it must first be stated that **in wildfire suppression, protection of life is the foremost goal. Implementation of the prevention measures described in this manual should not interfere with this goal.** As stated in federal policy, "the safety of firefighters and the public is the first objective on all fire management activities, followed by the protection of property and minimizing impacts to natural and cultural resources."

In addition to the prevention measures summarized in previous chapters, this chapter provides measures specific to wildfire management activities, with sections on: **1) fire management planning, 2) fuel management, 3) fire suppression,** and **4) post-fire activities**. These prevention measures should be considered even for prescribed burns, since they can also inadvertently contribute to the spread of invasive plants.

Fires can result in reduced competition for light, water and nutrients; invasive plants are poised to take advantage of such conditions. In the worst cases, fire and invasive plants form a positive feedback loop where wildfire increases invasive plants, which then alter the fire regime in ways that favor further invasive plant spread (e.g. increasing fire frequency or intensity). An example is the shift seen in some locations in Southern California, where invasive annual grasses are replacing native chaparral. Such major changes in vegetation can also greatly impact

Invasive plants can spread following the disturbance of fire. Photo: Garrett Dickman, Yosemite National Park hydrology, erosion, nutrient levels, and wildlife habitat. There is a strong tie between disturbance and invasive plant establishment and spread. Activities associated with fire and fuel management (for instance, cutting fuel breaks) can be a cause of disturbance, potentially facilitating the spread of invasive plants. Vehicles, personnel and materials (such as hay used for erosion control), can act as vectors for spreading invasive plant seeds. Fire managers working for land management organizations and agencies share the responsibility of managing public and private lands with other resource professionals and can play a key role in reducing the spread of invasive plants associated with fire management.

Photo: S. Kocher, UC Cooperative Extension

Wildfire is a natural part of California ecosystems. The structure and composition of most California plant communities are dependent on the periodic occurrence of fire.

Preventing the spread of invasive plants by fire and fire-related management activities requires an assessment of land management goals and an understanding of how resident plant communities and species (both native and non-native) will respond to fire and the post-fire environment. Tools such as the Fire Effects Information System website (www.fs.fed.us/database/feis/) and the *A Manual of California Vegetation* and *Fire in California's Ecosystems* can help land managers learn the specific invasive plants of their region and how they are likely to interact with fire in California ecosystems. Additional resources are listed in the Fire and Fuel Management Resources on page 63.

10.1 Fire Management Planning BMPs

Fire management activities include fuel management, fire suppression, and post-fire activities. A fire management plan provides the basis for communication, coordination, and project planning with partner agencies. Because fire, fire management, and invasive species all impact each other, natural resource managers should consider wildfire implications when designing invasive plant management programs, and consider invasive plant implications when designing wildfire management programs.

Because agencies conducting fire management activities do not always have jurisdictional authority over all of the properties that are relevant to fire management, it is important for all entities involved to work together in developing integrated fire and land management plans. Cooperative Agreements can be an effective way to establish allowable techniques for each property and include property owners in planning efforts.

It is essential that land managers understand the relationship between fire, plant communities and invasive plants in order to effectively integrate fire management activities into overall land management planning. Awareness building and training on invasive plant prevention can be integrated into fire management planning without interfering with fire management priorities.

In addition to the following BMPs, also refer to related BMPs in:

- Chapter 1: Planning BMPs for integrating prevention BMPs into land and fire management activities.

Coordinate mapping efforts for invasive plant management with mapping efforts for wildfire management to the extent possible. Photo: Forest Schafer, North Lake Tahoe Fire Protection District

FP1: Consider wildfire implications when setting overall priorities for invasive plant management programs.

a. Identify areas most susceptible to future wildfires and identify invasive plant populations within these areas. Evaluate the likely effects of wildfire on invasive plant populations and invasive plants on wildfires in these areas. Utilize this information in setting invasive plant management priorities with the intent to prevent future spread of existing populations.

- To the extent feasible, coordinate mapping efforts for invasive plant management with mapping efforts for wildfire management.
- For fire effect information for specific species, see the USDA Forest Service's Fire Effect Information System (FEIS) website (www.fs.fed.us/database/feis/).
- Identify priority areas for invasive plant management. Refer to the Prioritizing BMP Implementation on page 5.

Evaluate high-potential wildfire areas where prescribed burns can be used to benefit native plant communities and species while proactively reducing the threat of invasive plant spread following a wildfire in that area.

FP2: Integrate invasive plant prevention into fire management plans.

a. Use an interdisciplinary team when developing fire management plans, in order to address preventing the spread of invasive plants. Include those versed in other disciplines, such as botanists, endangered species specialists, soil scientists, hydrologists, and GIS specialists.

b. Include invasive plant prevention priorities identified in land management plans when developing fire management plans. These priorities should ideally be coordinated with existing local invasive weed committees and incorporated into an Integrated Pest Management (IPM) plan.

c. Include actions to prevent invasive plant spread in all levels of fire and fuel planning documents where appropriate. For instance, integrate appropriate measures into:

Photo: Athena Demetry, Sequoia and Kings Canyon National Parks

Fire crew staging at a low elevation site for mobilization to wildfire at higher elevation. Helibases, fire camp and staging areas infested with invasive plants can be a vector of spreading invasive plants.

- Fire and fuel management plans
- Suppression Repair Plans
- Burned Area Emergency Response (BAER) plans
- Burned Area Rehabilitation (BAR) plans
- Wildland Fire Decision Support System (WFDSS) protocol
- Community Wildfire Protection Plans (CWPPs) for private lands in the Wildland-Urban Interface (WUI)
- Minimum Impact Suppression Tactics (MIST).

d. Ensure wildfire infrastructure areas (existing or planned) are invasive plant free.

- Initiate the establishment of a network of helibases and potential fire camp and staging areas that can be maintained in an acceptably invasive plant-free condition. Identify potential cleaning stations for those entering and leaving these areas.
- Identify water sources infested and uninfested with aquatic and terrestrial invasive plants. Map acceptable and contaminated water sources and ensure this information is available to resource advisors and fire personnel.

e. Integrate equipment cleaning BMPs into planning for fire management activities. See PL9 on page 13.

f. Encourage sound forestry and range management practices to maintain healthy, vigorous overstory vegetation (where appropriate), which generally tends to "shade out" invasive species. Healthy forest and rangeland is typically less susceptible to intense burning conditions in the event of wildfire.

Photo: Forest Schafer, North Lake Tahoe Fire Protection District

Incorporate invasive plant information in existing fire and fuel management training.

g. Ensure that the use of fire retardant is discussed within the fire management plan. Consider the impacts of fire retardant on soil fertility.

FP3: Provide training in preventing the spread of invasive plants.

a. Include invasive plant awareness and prevention in existing fire and fuel management training.. Consider the best ways to provide information to Resource Advisors, Incident Management Teams, and agency leadership. Include information in regular trainings such as employee orientation and annual refresher courses.

b. Include consideration of invasive plant risk factors and implementation of prevention practices in Resource Advisor duties on all Incident Management teams and Burned Area Emergency Response teams.

FP4: Plan to utilize weed-free materials for post-fire activities.

a. See Chapter 2: Project Materials on page 15.

b. Consider development of as-needed contracts for weed-free materials. For example, contracting for specialized weed-free materials can take weeks to months—a timeframe that exceeds most fire emergency rehabilitation and suppression repair projects. If contracts are in place prior to fire suppression, it is more likely that weed-free materials can be effectively acquired. As-needed contracts are commonly used in other fire management activities (e.g. water tankers, helicopters, fuel management crews).

c. Consider stockpiling native and appropriate nonnative seed for use in post-fire activities. Like weed-free materials, the time needed for contracting and acquisition of seed can exceed the timeframe of most fire emergency rehabilitation and suppression repair projects.

Photo: S. Kocher, UC Cooperative Extension

Have weed-free materials ready for use in post-fire activities.

10.2 Fuel Management BMPs

Fuel management is designed to change future fire behavior, to contain fires, or to reverse negative ecosystem changes. Fire-adapted ecosystems, like those in California, will change in unnatural ways when fire is excluded. Fuel management can be used to counteract these changes so that fires are less destructive. Fuel management activities typically involve the thinning or removal of understory vegetation and the rearrangement or removal of surface fuels. Methods used in fuel management include prescribed fire, mechanical or hand thinning, mechanical mastication, machine piling, pile burning, and chipping. This work happens in both wildlands and the Wildland-Urban Interface (WUI), where property owners are often required to maintain significant safe space around structures.

Fuel management activities, themselves a type of disturbance, can potentially impact the introduction, establishment and spread of invasive plants. Vegetation clearing and soil disturbance can provide openings for invasive plants. Thus it is important to include an assessment of this potential when designing fuel management activities. There is significant variability in impact depending on ecosystem. Fuel management that reduces disturbance while meeting overall fuel management objectives can reduce the risk of introduction or spread of invasive plants. It is important to consider both human-caused factors and environmental conditions that influence invasive plant spread when developing fuel management plans.

The best management system for maintaining native plant diversity is likely one that mimics natural disturbance processes (including the characteristic fire regime) of the frequency, intensity, and duration of fire with which native species evolved. When this is not possible (such as when the natural disturbance is stand-replacing fire and the area is in the WUI), managing for general resiliency to climate change, fire, and invasion may be the best option. The complex and diverse ecosystems in California may require a mosaic of diagnostic and prescriptive actions to effect best management results.

When planning fuel management activities, consider environmental conditions that influence invasive plant spread. Photo: Forest Schafer, North Lake Tahoe Fire Protection District

In addition to the following BMPs, also refer to related BMPs in:

- Chapter 8: Vegetation Management for general prevention measures.
- Chapter 6: Waste Disposal for managing invasive plant disposal on-site and off-site.

FM1: Incorporate invasive plant considerations when developing fuel management plans.

a. Use an interdisciplinary team when developing fuel management plans, in order to address preventing the spread of invasive plants. Include those versed in other disciplines, such as botanists, endangered species specialists, soil scientists, hydrologists, and GIS specialists that are knowledgeable about invasive plants and native plant life histories. This may necessitate partnering with other agencies or organizations.

b. Survey for invasive plants to create baseline data for fuel treatments. Make sure survey data from local and state resource agencies is available and integrated.

c. Have a set of clear target conditions for vegetation and fuel. When developing these target conditions, consider both the effects of fuel treatments on invasive plants and native plants, and the effects of invasive plants on fuel treatments.

d. Assess both human-caused factors and environmental conditions that influence invasive plant spread when developing fuel management plans.

Photo: Kathy VanZuuk, National Forest

Invasive plants can spread after implementing fuel reduction/prescribed burn in areas where invasive plants were initially present.

Photo: Forest Schafer, North Lake Tahoe Fire Protection District

Include invasive plant considerations as a part of community outreach for fuel reduction projects.

- Human-caused factors include:
  - Fuel break construction methods
  - The scale of fuel breaks
  - Maintenance methods
  - Maintenance frequency
  - Connectivity to roads and trails (e.g. distance to roads and road level)
  - Extent of private inholdings in a given area
  - Fire regime changes
- Environmental conditions:
  - Proximity to populations of invasive plants
  - Overstory canopy cover
  - Litter cover, rock cover, duff depth, and bare ground
  - Vegetation type
  - Elevation
  - Slope
  - Fire regime
  - Climate change
- For information on conducting a site assessment on invasive plant infestation, see PL7 on page 12.

e. In prioritizing fuel treatment activities, consider site-specific information on the following in addition to target conditions like habitat integrity and fuel load:
- The role of invasive plants in preventing the achievement of target conditions (or vegetation management goals)
- The role of invasive plants in affecting the fire regime.

Photo: Forest Schafer, North Lake Tahoe Fire Protection District

Burned and unburned areas after a prescribed burn. Fuel management activities are themselves a type of disturbance, which can create openings for invasive plants.

f. For details on preventing invasive plant spread during vegetation management, see Chapter 8: Vegetation Management on page 29.

g. For all types of fuel treatment projects (e.g., prescribed burning, thinning and pile burning) where the potential for introduction or spread is moderate to high as a result of implementation, remove high risk areas from the project footprint, develop a pre-fire treatment prescription (including any post-fire mitigation/follow-up), or incorporate project design features to reduce the risk of spreading or introducing invasive plants.
   - Focus on invasive plant species that have been identified as local early detection priorities. For more information, see CalWeedMapper (www.calweedmapper.calflora.org).
   - Learn about how fire affects the particular species of interest. For more information, see FEIS (www.fs.fed.us/database/feis/).

h. Develop outreach and education information for adjacent property owners and fire safety councils about the effects of fuel treatments on invasive plants, and BMPs to reduce spread of invasive plants on their own property and nearby wildlands.

FM2: Maintain active management of invasive plants on fuel management sites.

a. Implement ongoing Integrated Pest Management (IPM) activities for all fuel management sites to keep invasive plants from spreading.

b. Capitalize on opportunities for coordinating efforts with those focusing on invasive plant management. There may be opportunities for supporting invasive plant management goals as well as fuel reduction goals through the efforts of multiple parties. Any activities that are counterproductive to one set of goals can be identified and revised.

FM3: Reduce disturbance when implementing fuel management activities.

a. Maintain shaded fuel breaks, where appropriate, in key fire suppression areas to reduce the need for bulldozing and cutting operations during emergency fire suppression.

b. To prevent the spread of invasive plants, remove only enough vegetation and ground cover to accomplish the fuel management and resource objectives.
   - Construct fuel breaks no wider than necessary to accomplish fuel reduction and resource objectives.
   - Remove vegetation adjacent to prescribed fire control lines only as needed to prevent additional fire spread or for safety and access.
   - For more information on preventing invasive plant spread during vegetation management, see Chapter 8: Vegetation Management on page 29.

c. Favor thinning techniques that do not result in ground disturbance—such as hand thinning, thinning using a chainsaw, mowing, or mastication—over techniques that result in ground disturbance—such as grapple piling or blading, whenever this can be done with no loss in fuel management effectiveness.
   - Ground disturbance can promote invasive plant establishment and spread. Reduce soil disturbance. See Chapter 7: Soil Disturbance on page 27.

Photo: Forest Schafer, North Lake Tahoe Fire Protection District

If heavy equipment is required, use equipment with less exerted ground pressure per square inch to reduce soil compaction.

- If heavy equipment is required for thinning, use alternative mechanized equipment with greater reach or less exerted ground pressure per square inch to reduce soil compaction or the total area disturbed.
- Mow fuel breaks before invasive plants set seeds to prevent spread. For details on mowing, see VM2 on page 30.

d. Transition vegetation (trees or shrub) removal in such a way that invasive plants are less likely to become established in the interior of the fuel break or fuel management unit. For instance, when working along roads, thin vegetation in the fuel break to a minimum level in order to meet fuel objectives, thus providing a potential vegetative barrier (i.e., competition) to reduce the spread of invasive plants from the roadside to the interior.

e. Where fuel reduction and resource objectives necessitate ground disturbance and soil exposure, or substantial ground cover and canopy removal, include appropriate revegetation or invasive plant management strategies in the fuel treatment plan.
   - Rehabilitate/restore or treat disturbed areas after fuel management activities and conduct follow up monitoring on these areas susceptible to invasive plant spread.
   - Cover and reduce exposure of bare ground. Use on-site chipping or treated fuels from mastication.

FM4: Incorporate invasive plant considerations when using prescribed fire.

a. Use both invasive species-specific and site-specific knowledge when assessing the use of fire on invasive plants. Consider invasive plant biology/life cycle, site conditions, plant community composition and distribution, and fire regime.

b. Consider follow-up treatments including mechanical, chemical or re-vegetating areas treated with fire.

c. When feasible, reduce the amount of control line construction and associated soil disturbance during prescribed burning, and plan for rehabilitation where necessary. For details on control line construction, see FM3 on page 42.

d. Incorporate invasive plant information into pre-burn briefings when needed.

e. When using prescribed fire to control invasive plants, burning should be integrated into an Integrated Pest Management (IPM) prescription. Evaluate the potential impact when using fire to control invasive plants. When planning to use herbicide treatments in concert with the burn, submit pesticide use permit applications with enough lead time to secure permission prior to implementing a prescribed burn.

10.3 Fire Suppression BMPs

Firefighter and public safety is the first priority in every fire management activity. Along with resource management objectives and the ability to hold a fire line, human safety should dictate fire suppression strategy and tactics including line placement. After human safety has been accounted for, land managers should attempt to incorporate invasive plant prevention measures into fire suppression activities in order to reduce post-fire resource impacts. Fire suppression activities can spread and promote the establishment of invasive plants by disturbing soil, dispersing plant parts and seeds, and altering plant nutrient availability. For example, simple prevention practices include cleaning vehicles, equipment, clothing and gear between activity areas and avoiding invasive plant populations when constructing indirect fire lines or locating activity areas, such as staging areas.

After human safety has been accounted for, attempt to incorporate invasive plant prevention measures into fire suppression activities. Photo: Martin Hutten, Lassen National Park

In addition to the following BMPs, also refer to related BMPs in:

- Chapter 4: Tool Equipment and Vehicle Cleaning for cleaning protocols.
- Chapter 5: Clothing, Boots and Gear Cleaning for cleaning protocols.
- Chapter 7: Soil Disturbance for erosion control measures.

FS1: Develop operational procedures related to fire suppression to reduce the spread of invasive plants.

a. Incorporate the following into the Delegation of Authority given to the Incident Commander:
   - The importance of invasive plant prevention
   - The techniques to be used to prevent the spread of invasive plants

b. Incorporate prevention awareness information and operational practices in the Incident Action Plan (IAP).

c. Encourage Resource Advisors to consider invasive plant issues as part of their focus on every incident.

d. When feasible, plan travel routes to avoid spreading invasive plants from infested to non-infested areas. For details on travel route planning, see Chapter 3: Travel on page 19.

e. Develop standardized invasive plant prevention direction for use in the Wildland Fire Decision Support System (WFDSS) and make it readily available to Agency Representatives. Ensure that the direction is consistent with relevant resource and wildland fire management plans. Include incident-specific invasive plant information in the WFDSS, as needed.

FS2: Locate indirect fire lines to reduce additional disturbance and invasive plant spread where feasible.

a. Safety and holding ability remain the priority motivation for any fire line location; however, when feasible, place indirect fire lines in areas free of invasive plants.

b. Provide the Resource Advisors, the Field Observer or other appropriate personnel (crew bosses, Incident Commander, Division Supervisors, etc., depending on the size of the incident organization) with priority invasive plant identification aids and maps.

c. Tie fire lines into pre-existing fuel breaks and managed fuel zones. Use existing natural and man-made breaks (lakes, streams, roads, trails, etc.) when feasible.

d. As feasible, keep ground disturbance to a minimum.

Photo: Jeanne Pincha-Tulley, Tahoe National Forest

Soil disturbance can facilitate invasive plant spread. Where feasible, locate indirect fire lines to reduce additional disturbance.

FS3: Locate fire activity areas in locations free of invasive plants where feasible.

a. Fire activity areas include:
- Incident Base Camp and staging areas
- Fire crew camps, including spike camps
- Helibases
- Drop points
- Parking areas

b. Coordinate with the Resource Advisor in choosing fire activity areas with the most reasonable qualities of resource protection and safety concerns.
- Use pre-approved infrastructure when available. For details, see FP2d on page 38.
- Map fire activity areas for post-fire invasive plant monitoring.

c. Keep fire activity areas free of invasive plants.
- Incorporate cleaning stations in fire activity areas for equipment, personnel and vehicles.
- For BMPs on keeping activities areas clean, see PL9 and PL10 on page 13 and 14.

d. Where situations dictate that the fire activity areas must be located on a site infested with invasive plants, take actions to reduce the spread of invasive plant seeds. Examples include:
- Consider flagging, fencing, or placing cones at the perimeters of invasive plant populations to keep people out.
- Consider mowing or otherwise treating invasive plants.
- Designate travel routes to avoid invasive plants.
- Clean equipment before leaving infested sites.

e. For more information on worksite management, see PL10 on page 14.

FS4: Clean vehicles, equipment, clothing and gear before arriving and leaving fire activity areas.

a. For detailed recommended cleaning protocols, see:

- Chapter 4: Tool Equipment and Vehicle Cleaning on page 21
- Chapter 5: Clothing, Boots and Gear Cleaning on page 23
- Checklist E: Inspection and Cleaning on page 43

Photo: Garrett Dickman, Yosemite National Park

Clothing, personal protective equipment, and hand tools can spread invasive plants. Clean them between fire activity areas when feasible.

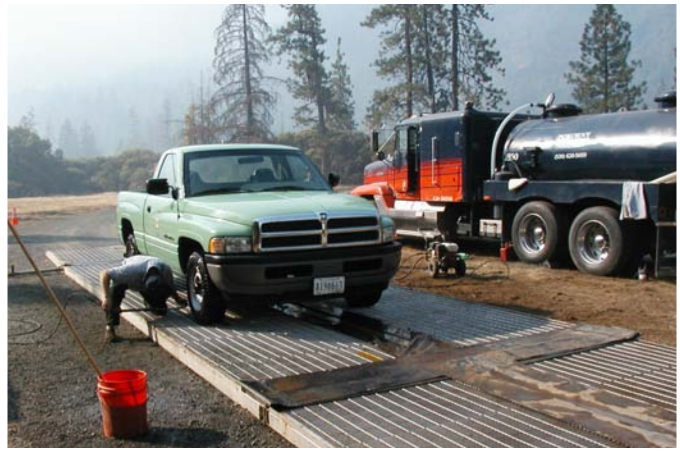

Photo: Julie Nelson, Shasta-Trinity National Forest

Remove dirt from the undercarriage of vehicles prior to entering and existing fire activity areas.

b. Inspect and clean equipment and vehicles during check-in and before demobilization from fires, especially if vehicles have been traveling from out-of state, off-road, or through areas infested with invasive plants. The following are examples only and don't represent the entire list of equipment that potentially could need to be cleaned:
   - Keep fire hoses clean and free from invasive plant parts when feasible.
   - Inspect helicopter nets for invasive plant parts and seeds. Bundle and store nets in areas free of invasive plants. Consider spreading nets on clean tarps or concrete/asphalt pads, so nets can be inspected, loaded and bundled up for storage in a weed-free state.
   - Inspect and remove weed seed and plant parts from cargo nets and other external loads.

c. Prior to arriving and leaving a fire, clean equipment. For example:
   - Personal belongings (e.g., boots, clothes, sleeping bag, tent)
   - Personal Protective Equipment (PPE) (e.g., gloves, helmet, goggles, fire pack, fire shelter)
   - Back-pack pumps
   - Hand tools (e.g., shovels, pulaskis, axes, fire rakes, and hoes).

FS5: Use water sources free of invasive plants for fire suppression when feasible.

a. Avoid use of water sources known to contain aquatic invasive plants to prevent the spread of aquatic invasive plants to other water bodies.

b. Avoid moving water on the surface of vehicles, tools and equipment from infested water sources to water sources that are not infested with invasive plants. Inspect and clean equipment prior to use in another water body.

c. Any equipment that draws water from one water source should not be drained into another water source. Flush equipment, such as portable pumps and hoses, with clean water between

Photo: Athena Demetry, Sequoia and Kings Canyon National Parks

Stage gear on tarps to avoid contact with invasive plants prior to loading and transport.

Photo: Jeanne Pincha-Tulley, Tahoe National Forest

Aquatic invasive plants can spread through water-drafting equipment, tools and vehicles. Use water sources free of invasive plants and clean equipment between water bodies when feasible.

10.4 Post-Fire Activity BMPs

Cover bare ground with non-invasive plants or weed-free erosion control materials as soon as possible following a fire. Photo: S. Kocher, UC Cooperative Extension

uses and between fire activity areas.

Post-fire activities include four phases: Suppression damage repair, burned area emergency response (BAER), burned area rehabilitation (BAR), and restoration.

- Suppression damage repair is focused on restoring fire lines and features that were damaged by the fire suppression activities. Activities include rehabilitating fire line and staging areas, fixing roads and fences, etc.
- BAER is aimed to protect life and property from post-fire events. BAER is implemented to prevent erosion, stabilize soil, and minimize damage from post-fire flooding immediately after wildfires to prevent further damage to life, property, water quality and deteriorated ecosystems.
- BAR is implemented to restore ecosystems and repair damage caused by fire. Activities include the repair or improvement of fire-damaged lands that are unlikely to recover naturally, or repair of minor facilities damaged by fire.
- Restoration is the long term land management program.

Activities conducted for these purposes can result in invasive plant spread. Vehicles, equipment, erosion control, revegetation materials, humans, livestock, and support animals, can inadvertently spread invasive plant parts and seeds.

The effects of fire on invasive plant spread can also vary depending on the biology of the native vegetation, the level of disturbance, and the habitat condition. A ready-to-use burned-area integrated invasive plant management plan that is consistent with long term land management objectives will help identify priority areas for invasive plant monitoring, the appropriate treatments and prevention measures for post-fire activities.

In addition to the following BMPs, also refer to related BMPs in:

- Chapter 2: Project Materials for procuring and managing erosion control and revegetation materials on page 15.
- Chapter 4: Tool, Equipment and Vehicle Cleaning for cleaning protocols on page 21.
- Chapter 5: Clothing, Boots and Gear Cleaning for cleaning protocols on page 23.
- Chapter 9: Revegetation and Landscaping for general prevention measures on page 31.

PF1: Manage access to burned areas.

a. Use an interdisciplinary team to determine when activities (including public access, agency work, and grazing, etc.) may resume in burned areas. The team should include natural resource staff knowledgeable about invasive plants.

b. Consider how vehicles can spread invasive plants and how to reduce their risk. For example, close public access to burned areas temporarily to reduce the risk of introduction and spread of invasive plants.

c. Restrict travel to established roads and trails to avoid compacting soil. Off-road travel could reduce the recovery of desired plants and will create additional disturbance or act as invasive plant vectors.
   - Examples include: Block access to fire lines to prevent vehicles from traveling on them. Place sufficient soil, downed trees, slash, root wads, or boulders to block vehicle access and to slow the flow of water, both of which may carry seeds of invasive plants.

d. Manage human, pack animal, and livestock entry into burned areas until desirable vegetation has recovered sufficiently to resist invasive plant establishment.

e. Consider deferring livestock grazing in burned areas until vegetation has successfully reestablished.
   - Grazing removes plant biomass, reduces levels of competition, and increases the availability of soil nutrients, thus increasing the potential for invasive plant establishment. Grazing also increases soil disturbance, thus creating a seed bed for invasive plants.
   - Grazing Management Plans and permits should emphasize the potential recovery times for burned areas to reduce conflict with permitees.

f. For additional information on access, see Chapter 3: Travel on page 19.

PF2: Use weed-free materials during post-fire activities.

a. When procuring seeds, soil stabilization and revegetation materials, see Chapter 2: Project Materials on page 15.

b. When acquiring local plant materials, see Chapter 9: Revegetation and Landscaping on page 31.

Photo: S. Kocher, UC Cooperative Extension

Use local native plant materials for revegetation.

PF3: Cover and rehabilitate soil disturbed by suppression activity.

a. Cover bare soil that results from fire lines by pulling duff, litter, and cut material back over lines as soon as possible, or by using weed-free mulch (e.g., hydromulch, chipped fuels).

b. Implement erosion control practices. See SD2 on page 28.

c. Encourage the reestablishment of native vegetation by limiting soil disturbance and ensuring invasive plants do not become established.
   - Consider planting locally collected, genetically appropriate, native species to compete with invasive plants.
   - For details, see Chapter 9: Revegetation and Landscaping on page 31.

d. Limit soil disturbance during post-fire activities.

Photo: S. Kocher, UC Cooperative Extension

Erosion control with weed-free materials post-fire is important for reducing invasive plant spread.

e. For details on rehabilitating disturbed soil, see RL3 on page 33.

PF4: Develop and implement post-fire integrated invasive plant management prescriptions.

a. Develop both short-term and long-term treatment prescriptions (including monitoring) to manage invasive plants.

b. Work with a local invasive plant specialist to develop and review BAER reports.

c. Concentrate prevention efforts in high risk areas:

- Areas highly susceptible to invasive plants establishment and spread include:
    - Areas where invasive plants are already present
    - Wet areas (creeks, seeps, meadows, and seasonal streams)
    - High severity burn areas (high overstory mortality, exposed mineral soil)
    - Burn areas adjacent to roads and trails
- Areas disturbed by fire suppression activities:
    - Dozer/hand lines (especially where they intersect pre-existing roads or trails)
    - Drop points/sling sites
    - Retardant drops
    - Fire activity areas
- Transportation corridors
    - Roads and trails
- Perpetually disturbed areas
    - Campgrounds, dumpsters, and parking lots
    - Residential areas

d. Secure funding to inventory and treat invasive plants, such as BAER and BAR funding.

e. Inspect, evaluate, control and monitor invasive plants at all fire activity areas as needed.

- Inspect for and map establishment and spread of invasive plants:
    - At fire access roads, cleaning sites, fire lines, staging areas, observation points, sling road sites, safety zones, and within areas affected by fire suppression activity (e.g., riparian areas, fire activity areas, etc.).
    - For more information on conducting a site assessment for invasive plant infestations, see PL7 on page 12.
- Evaluate invasive plant status and risks.
    - For additional suggestions on areas and species to prioritize, see Prioritizing BMP Implementation on page 5.
- Control invasive plants.
    - Practice early detection and rapid response

Photo: Garrett Dickman, Yosemite National Park

Practice early detection and rapid response during the first 5-10 years following fire to detect and control new populations of invasive plants within the fire area.

during the first 5-10 years following fire to detect and control new populations of invasive plants within the fire area.

  - Control infestations to prevent spread within burned areas; control nearby infestations to prevent spread into burned areas.
  - For a list of reference on invasive plant control and management, see General Resources on page 61.

- Monitor for new infestations of invasive plants.
  - Monitoring needs to determine whether objectives of the management actions have been achieved and the retreatments if objectives have not been met.
  - Monitoring will sometimes extend to secondary effects (i.e., the influence of fuel management on fuel characteristics, and ultimately on fire behavior and fire regimes).

Photo: Garrett Dickman, Yosemite National Park

Determine soon after a fire whether revegetation is needed to speed recovery of a desirable native plant community, or whether desirable plants in the burned area will recover naturally.

PF5: Revegetate burned areas to reduce the spread of invasive plants.

a. Determine soon after a fire whether revegetation is needed to speed recovery of a desirable native plant community, or whether desirable plants in the burned area will recover naturally.

b. Secure funding and revegetate areas vulnerable to invasive plants (e.g. areas that are near existing populations of invasive plants, intersections of dozer lines with road systems).

c. Avoid use of fertilizer. Supplemental nutrients may favor growth and spread of invasive plants.

d. For details, see Chapter 9: Revegetation and Landscaping, on page 31.

e. Create a monitoring plan for revegetation.
  - Monitor burned areas until desirable vegetation is established. Burned areas may be susceptible to weed infestation for 5-10 years or more.
  - For more details on monitoring, see PL11 on page 14.

Checklist Introduction

The following checklists contain only the BMP statements to provide a quick and portable reference for field activities. Checklists A, B, C and D are organized by land management activities, and Checklist E is organized by items to inspect and clean. These checklists can be attached to a field notebook, clipboard, or corkboard in an office for easy reference. BMP selection depends on the particular nature of the project or conditions. Land managers are encouraged to modify and develop their own invasive plant prevention checklists according to their specific needs.

Checklist A: Site Assessment, Field Mapping & Monitoring
This checklist is designed for those who perform site assessments, field mapping and monitoring.

Checklist B: Routine Vegetation Management
This checklist is designed for those who perform routine vegetation management.

Checklist C: New Project - Planning
This checklist is designed for those who perform planning tasks for new projects.

Checklist D: New Project - Implementation
This checklist is designed for those who perform pre-activity and implementation tasks for new projects. Some of these tasks include pre-work training, scheduling and revegetation and landscaping.

Checklist E: Inspection & Cleaning
This checklist is designed for use before entering and leaving worksites and should be used when acquiring inspection and cleaning equipment.

Key to BMP Chapter Acronymns

Checklist A: Site Assessment, Field Mapping & Monitoring

BMP #	Best Management Practice	Project Manager	Field Supervisor	Crew	Contractor	Completed	Comments
BEFORE YOU START							
Planning							
PL6	Provide prevention training and appropriate invasive plant identification resources to staff and contractors prior to starting work.						
PL7	Review internal documentation and consult local groups and online resources for information on existing invasive plant infestations on and near worksite.						
PL8	Schedule activities to minimize potential for introduction and spread of invasive plants.						
PL9	Integrate cleaning BMPs into planning for land management activities.						
PL10c	Treat invasive plants at access roads and staging areas before using them.						
CB1	Plan to wear clothing, boots and gear that do not retain soil and plant material.						
Travel							
TR1	Plan travel to reduce the risk of invasive plant spread (avoid travel through infested areas, and travel from clean to infested worksites).						
TR2	Integrate cleaning activities into travel planning.						
Inspection & Cleaning							
TE1 & CB2	Designate cleaning areas for tools, equipment, vehicles, clothing, boots and gear.						
TE2 & TE3	Inspect and clean soil and plant materials from tools, equipment, and vehicles before entering the worksite.						
DURING							
Inspection & Cleaning							
TE2 & TE3	Inspect and clean soil and plant materials from tools, equipment, and vehicles before leaving the worksite.						
CB3	Clean clothing, footwear and gear before leaving the worksite.						
TE4	Clean livestock and support animals.						
Soil Disturbance							
SD1	Minimize soil disturbance.						

Checklist B: Routine Vegetation Management							
BMP #	**Best Management Practice**	Project Manager	Field Supervisor	Crew	Contractor	Completed	Comments
BEFORE YOU START							
Planning							
PL6	Provide prevention training and appropriate invasive plant identification resources to staff and contractors prior to starting work.						
PL7	Conduct a site assessment for invasive plant infestations before carrying out field activities.						
VM1	Schedule vegetation management activities to maximize the effectiveness of control efforts and minimize introduction and spread of invasive plants.						
PL9	Integrate cleaning BMPs into planning for land management activities.						
PL10c	Treat invasive plants at access roads and staging areas before using them.						
CB1	Plan to wear clothing, boots and gear that do not retain soil and plant material.						
Travel							
TR1	Plan travel to reduce the risk of invasive plant spread (avoid travel through infested areas, and travel from clean to infested worksites).						
TR2	Integrate cleaning activities into travel planning.						
Inspection & Cleaning							
TE1 & CB2	Designate cleaning areas for tools, equipment, vehicles, clothing, boots and gear.						
TE2 & TE3	Inspect and clean soil and plant materials from tools, equipment, and vehicles before entering the worksite.						
Waste Disposal							
WD1	Designate waste disposal areas for invasive plant materials.						

Checklist B: Routine Vegetation Management *(continued)*

BMP #	Best Management Practice	Project Manager	Field Supervisor	Crew	Contractor	Completed	Comments
DURING							
Inspection & Cleaning							
TE2 & TE3	Inspect and clean soil and plant materials from tools, equipment, and vehicles before leaving the worksite.						
CB3	Clean clothing, footwear and gear before leaving the worksite.						
TE4	Clean livestock and support animals.						
Vegetation Management							
VM2	Manage vegetation with methods favorable to desirable vegetation.						
VM3	Retain existing desirable vegetation and canopy.						
Soil Disturbance							
SD1	Minimize soil disturbance.						
SD2	Implement erosion control practices.						
Waste Disposal							
WD2	Render invasive plant material nonviable when keeping it on-site.						
WD3	When disposing of invasive plant material off-site, contain it during transport.						
Monitoring							
PL11	Monitor the site for invasive plants after land management activities.						

Checklist C: New Project - Planning							
BMP #	**Best Management Practice**	Project Manager	Field Supervisor	Crew	Contractor	Completed	Comments
PL2	Include invasive plant risk evaluation as a component of initial project planning and environmental analysis.						
PL3	Integrate invasive plant prevention BMPs into design, construction, vegetation management and maintenance planning activities.						
PL4	Coordinate invasive plant prevention efforts with adjacent property owners and local agencies.						
PL5	Develop monitoring plans for BMP implementation and effectiveness.						
PL9	Integrate cleaning BMPs into planning for land management activities.						
PL11	Designate staff to monitor the worksite for invasive plants after land management activities.						
RL1	Develop revegetation and landscaping plans that optimize resistance to invasive plant establishment.						
PM1	Plan to use a weed-free source for project materials.						

Checklist D: New Project - Implementation

BMP #	Best Management Practice	Project Manager	Field Supervisor	Crew	Contractor	Completed	Comments
BEFORE YOU START							
Training & Scheduling							
PL6	Provide prevention training and appropriate invasive plant identification resources to staff and contractors prior to starting work.						
PL8	Schedule activities to minimize potential for introduction and spread of invasive plants.						
TR1	Plan travel routes to reduce the risk of invasive plant spread.						
TR2	Integrate cleaning activities into travel planning.						
Site Preparation							
PL7	Refer to site assessment for locations of invasive plant infestations before carrying out field activities.						
PL10a	Protect likely invasive plant introduction sites such as pull-outs, trailheads, campgrounds and parking lots by mulching, planting or paving.						
PL10c	Treat invasive plants at access roads and staging areas before using them.						
Project Materials							
PM1	Acquire weed-free project materials.						
PM2	Prevent invasive plant contamination of project materials during transport.						
RL2	Acquire plant materials locally. Verify that species used are not invasive.						
Inspection & Cleaning							
CB1	Select clothing, boots and gear that do not retain soil and plant material.						
TE1 & CB2	Designate cleaning areas for tools, equipment, vehicles, clothing, boots and gear.						
TE2 & TE3	Inspect and clean soil and plant materials from tools, equipment, and vehicles before entering the worksite.						
Waste Disposal							
WD1	Designate waste disposal areas for invasive plant materials.						

Checklist D: New Project - Implementation *(continued)*

BMP #	Best Management Practice	Project Manager	Field Supervisor	Crew	Contractor	Completed	Comments
DURING							
Inspection & Cleaning							
TE2 & TE3	Inspect and clean soil and plant materials from tools, equipment, and vehicles before leaving the worksite.						
TE4	Clean pack, grazing and support animals.						
CB3	Clean clothing, footwear and gear before leaving the worksite.						
Project Materials							
PM1	Use a weed-free source for project materials.						
PM2	Prevent invasive plant contamination of project materials when stockpiling and during transport.						
Vegetation Management							
VM2	Manage vegetation with methods favorable to desirable vegetation.						
VM3	Retain existing desirable vegetation and canopy.						
Soil Disturbance							
SD1	Minimize soil disturbance.						
SD2	Implement erosion control practices.						
SD3	Manage existing topsoil and duff material to reduce contamination by invasive plants.						
Revegetation & Landscaping							
RL3	Revegetate and/or mulch disturbed soils as soon as possible to reduce likelihood of invasive plant establishment.						
Waste Disposal							
WD2	Render invasive plant material nonviable when keeping it on-site.						
WD3	When disposing of invasive plant materials off-site, contain it during transport.						
Monitoring							
PL11	Monitor the site for invasive plants after land management activities.						

Checklist E: Inspection & Cleaning

Clothing and Gear:

Check for soil, seeds, and plant material	Inspected	Cleaned
1. Hats		
2. Hoods		
3. Collars and cuffs		
4. Clothing folds or flaps		
5. Ventilation openings		
6. Pockets		
7. Zippers		
8. Straps or Velcro grips		
9. Belts or buckles		
10. Buttons, fasteners, and rivets		
11. Laces or ties		
12. Gloves		
13. Pant cuffs		
14. Socks		

Boots or Shoes:

Check for soil, seeds, and plant material	Inspected	Cleaned
1. Shoelaces or ties		
2. Straps or Velcro grips		
3. Shoe tongues		
4. Treads		

Hand and Power Tools:

Check for soil, seeds, and plant material	Inspected	Cleaned
1. Chainsaw chain		
2. Hand saw blades		
3. Mower deck and blades		
4. Weed-eater blades		
5. Crevices on other tools		

Hand and Power Tools:

Check for soil, seeds, and plant material	Inspected	Cleaned
1. Chainsaw chain and body		
2. Hand saw blades		
3. Mower deck and blades		
4. Weed-eater blades and guard		
5. Crevices on all other tools		

Checklist E: Inspection & Cleaning *(continued)*

Vehicles and Large Equipment (including ATVs, OHVs, motorcycles and bikes):

Check for soil, seeds, and plant material	Inspected	Cleaned
1. Truck bed		
2. Exhaust systems		
3. Vent openings		
4. Grills: Front and back		
5. Tray under radiator		
6. Top of transmission		
7. Stabilizer bar		
8. Shock absorber joint with axles		
9. Front and rear axles		
10. Top of front suspension units		
11. Wheel well/quarter panels		
12. Ledges under bumper (front and rear)		
13. Tire rims and treads		
14. Between rear wheel brake drums and the rim of the wheel		
15. At the bend in the fuel inlet tube		
16. Spare tire and mounting area		
17. Under the floor mat (inside cab)		
18. Under the seat (inside cab)		
19. Upholstery (inside cab)		
20. Beneath foot pedals (inside cab)		
21. Gear shift cover folds (inside cab)		

Livestock and Support Animals:

Check for soil, seeds, and plant material	Inspected	Cleaned
1. Underbelly		
2. Legs		
3. Hooves		
4. Coat or wool		
5. Ears		
6. Tack (saddles, blankets, panniers)		

General Resources

The following are websites that contain, and link to, significant amounts of information on invasive plant management.

California Invasive Plant Council
http://www.cal-ipc.org
This site provides a wide range of invasive plant information specific to California. Resources include prevention, invasive plant inventory, CalWeedMapper, invasive plant profiles with links to articles, publications, reports, and educational brochures.

California Department of Food and Agriculture Integrated Pest Control Branch
http://www.cdfa.ca.gov/plant/ipc/index.html
The Integrated Pest Control Branch conducts a wide range of pest management and eradication projects as part of the Division of Plant Health and Pest Prevention Services Pest Prevention Program. This site provides the Encycloweedia, noxious weeds and weed ratings, and the CalWeed Database.

Center for Invasive Plant Management
http://www.weedcenter.org
The Center for Invasive Plant Management (CIPM) is a hub for management information in the western U.S. Includes plant biology and management information; education information; and publications. CIPM also provides grants to weed projects in western states. Grant information is available at this site.

Invasive.org: Center for Invasive Species and Ecosystem Health
http://www.invasive.org
This site provides an easily accessible archive of high quality images of invasive and exotic species of North America with identifications, taxonomy and descriptions for use in educational applications.

Invasive Species Council of California
http://www.iscc.ca.gov
The invasive Species Council of California provides general information on invasive species in California including animals, plants, insects, and plant and animal disease.

National Invasive Species Council
http://www.invasivespecies.gov
The National Invasive Species Council (NISC) was established by Executive Order (EO) 13112 to ensure that Federal programs and activities to prevent and control invasive species are coordinated, effective and efficient.

National Invasive Species Information Center
http://www.invasivespeciesinfo.gov
This site is a gateway to invasive species information; covering Federal, State, local and international sources. The information center is maintained by the U.S. Department of Agriculture's National Agricultural Library.

USDA Forest Service Invasive Species Program—Control and Management http://www.fs.fed.us/invasivespecies/controlmgmt/index.shtml
This page provides links for more information on research, management planning, Forest Service activities, and pest-specific control and management.

Weed Research and Information Center
http://wric.ucdavis.edu
The University of California's Weed RIC provides control notes and photos for invasive plants as well as agricultural weeds.

Prevention Resources

A Builder and Contractor's Guide to Preventing the Introduction and Spread of Invasive Weeds
http://ucanr.org/sites/csnce/files/57340.pdf
El Dorado County's Invasive Weed Management Group provides an illustrated pamphlet with tips and considerations that contractors and landscapers can integrate into their general practice in order to stop unsightly and costly invasive plant infestations before they begin.

Hazard Analysis and Critical Control Point (HACCP) Planning for Natural Resource Pathways
http://nctc.fws.gov/EC/Resources/pdf/HACCP%20Manual.pdf
The HACCP plan is a structured process that assesses a natural resource management activity, identifies possible risks, and facilitates the removal or reduction of non-target (i.e. invasive) species. The five-step process records important elements of who, what, where, when, how and why of each activity to help manage target problems and improve best management practices.

Inspection and Cleaning Manual for Equipment and Vehicles to Prevent the Spread of Invasive Species
http://www.usbr.gov/mussels/prevention/docs/EquipmentInspectionandCleaningManual2010.pdf
The U.S. Bureau of Reclamation has developed a set of procedures to address the transport of invasive species and pests through equipment movement. This manual provides guidance for inspecting and cleaning vehicles and large equipment.

Storm Water Quality Handbook: Project Planning and Design Guide http://www.dot.ca.gov/hq/oppd/stormwtr/ppdg/swdr2010/PPDG-July-2010-r2.pdf
This handbook provides guidance on the process and procedures for evaluating project scope and site conditions to determine the need for and feasibility of incorporating BMPs into projects. The key objective of this guide is to provide the overall process for selecting and designing BMPs within the Caltrans planning and design processes and incorporating those BMPs into the appropriate documents.

USDA Forest Service. The Early Warning System for Forest Health Threats in the United States
http://www.fs.fed.us/foresthealth/publications/EWS_final_draft.pdf
This is a monitoring framework for early detection and response to environmental threats (e.g., insects, diseases, invasive species, and fire) to forest lands. The framework is based on the following steps: 1) identify potential threats, 2) detect actual threats, 3) assess impacts, and 4) respond.

USDA Forest Service—Dangerous Travelers: Controlling Invasive Plants along America's Roadsides (Video)
http://www.fs.fed.us/invasivespecies/
The video outlines the best management practices that road crews should be following in their day-to-day operations. This is the first in a series on "Best Management Practices for Invasive Species Prevention." Ordered on DVD by contacting: USDA Forest Service; San Dimas Technology and Development Center; 444 East Bonita Avenue; San Dimas, CA 91773; (909) 599-1267.

Fire and Fuel Management Resources

A Manual of California Vegetation, 2nd Edition
http://www.cnps.org/cnps/vegetation/manual.php
Sawyer, J.O., Keeler-Wolf, T., and Evens, J. 2009. California Native Plant Society Press.

California Native Plant Society has adopted a definitive system for describing vegetation statewide. This standard vegetation classification has been accepted by state and federal agencies. The principal vegetation unit is called "Alliance" (or series), which is a floristically defined vegetation type identified by its dominant and/or characteristic species.

Emergency Stabilization/Burned Area Rehabilitation
http://www.fws.gov/fire/ifcc/esr/home.htm
DOI National Burned Area Emergency Stabilization and Rehabilitation Group provides policy, guidance, and reference materials on BAER, BAR and incident business management.

Fire Ecology by USGS Western Ecological Research Center (WERC)
http://www.werc.usgs.gov/ResearchTopicPage.aspx?id=6
To restore more normal fire dynamics to a particular region, managers need to know how fire has historically affected the local system, and how it functions today. Researchers at the (WERC) are making contributions to this effort through detailed studies of fire history and fire ecology in the Sierra Nevada forests, California shrublands, and Mojave and Sonoran deserts.

Fire in California's Ecosystems
http://www.ucpress.edu/book.php?isbn=9780520246058
Sugihara, N.G., Van Wagtendonk, J.W., Fites-Kaufman, J., Shaffer, K., and Thode, A. Klinger, R.C. ML. Brooks, and Randall, J.M. (eds.) 2006. The University of California Press. Berkeley, California.

Written by many of the foremost authorities on the subject, this book synthesize the knowledge of the science, ecology, and management of fire in California. It introduces the basics of fire ecology, including an historical overview of fire and vegetation in California; an exploration of the history and ecology of fire in each of California's nine bioregions; an examination of fire management in California; and discussion on current issues related to fire policy and management.

USDA Forest Service's Fire Effect Information System website (FEIS)
http://www.fs.fed.us/database/feis/
FEIS summarizes and synthesizes research about living organisms in the United States—their biology, ecology, and relationship to fire.

Wildland Fire Decision Support Systems (WFDSS)
https://wfdss.usgs.gov/wfdss/WFDSS_Home.shtml
The US Geological Survey hosts a web-based decision support system that assists fire managers and analysts in making strategic and tactical decisions for fire incidents and provides a record of these decisions.

Glossary

Ankle-gaiters: a protective covering for the lower leg and ankle designed to prevent snow, mud, gravel, or seeds from entering the top of the boot. Gaiters can also prevent seeds from adhering to pants, socks, boots and laces.

Best management practices: methods or techniques found to be the most effective and practical in achieving an objective, such as preventing or minimizing invasive plant spread, while making the optimum use of resources.

Burned Area Emergency Response (BAER): an emergency risk management action taken within one year of wildfire containment to stabilize and prevent unacceptable degradation to natural and cultural resources, to minimize threats to life or property resulting from the effects of a fire, or to repair/replace/construct physical improvements necessary to prevent degradation of land or resources. BAER should be a part of all Fire Management Plans. It should cover acceptable methods, techniques, and materials to stabilize and rehabilitate soils, native vegetation, and prevention of further damage.

Burned Area Rehabilitation (BAR): efforts undertaken within three years of wildfire containment to repair or improve fire-damaged lands unlikely to recover naturally to management approved conditions, or to repair or replace minor facilities damaged by fire. The process concludes with long-term restoration.

CEQA: California Environmental Quality Act. A statute passed in 1970 to institute a statewide policy of environmental protection. http://ceres.ca.gov/ceqa

Clean: not contaminated with viable invasive plant propagules.

Contaminated: contains viable invasive plant propagules.

Control line: an inclusive term for all constructed or natural barriers used to control a fire.

Critical control point: the best point, step, or procedure at which significant hazards can be prevented or reduced to minimum risk. Source: USFWS-NCTC. 2004. Hazard Analysis and Critical Control Point (HACCP) Planning for Natural Resource Pathways.

Delegation of Authority: an instrument signed by both the Incident Commander and Agency Administrator which identifies the acceptable methods of fire suppression and rehabilitation, notes any specific concerns (such as prevention of invasive plant spread), and names an Agency Representative that will speak for the Agency regarding resource matters.

Desiccate: to kill a plant by drying it thoroughly.

Disturbance: any activity leading to increased sunlight and bare ground, conditions that can be suitable for invasive plant introduction.

Duff: partially decomposed organic matter lying beneath the litter layer and above the mineral soil. It includes the humus and fermentation layers of the forest floor.

Early detection and rapid response (EDRR): a cost-effective approach to invasive plant management that aims to detect newly established invasive plant infestations early and to remove them before they spread.

Environmental stewardship: responsible use and protection of the natural environment through conservation and sustainable practices.

Equipment: machinery such as mowers and bulldozers used during land management activities.

Eradicate: the complete elimination of an invasive plant population, including all viable propagules.

Field Observer (FOBS): this Incident Command System position is responsible for collecting and reporting situation information for an incident through personal observations and interviews and reports to the Situation Unit Leader.

Fire activity areas: an inclusive term for areas used for fire suppression activities, which include incident areas, Incident Base Camp, staging areas, fire crew camps, spike camps, helibases, drop points, parking areas, etc.

Fire frequency: the recurrence of fire in a given area over time, stated as number of fires per unit time.

Fire line: A line to break up fire fuels. Also known as a control line, a fire line is scraped or dug, by hand or mechanically, into mineral soil.

Fire Management Plan (FMP): a plan which identifies and integrates all wildland fire management and related activities within the context of approved land/resource management plans. It defines a program to manage wildland fires (wildfire, prescribed fire, and wildland fire use). The plan is supplemented by operational plans, including but not limited to preparedness plans, preplanned dispatch plans, and prevention plans. Fire Management Plans assure that wildland fire management goals and components are coordinated.

Fire Management Unit (FMU): a land management area definable by objectives, management constraints, topographic features, access, values to be protected, political boundaries, fuel types, major fire regime groups, etc., that set it apart from the characteristics of an adjacent FMU. The FMU may have dominant management objectives and pre-selected strategies assigned to accomplish these objectives.

Fire regime: characteristic pattern of burning over large expanses of space and long periods of time. Fire regimes are described for a specific geographic area or vegetation type by the characteristic fire type (ground, surface, or crown fire), frequency, intensity, severity, size, spatial complexity, and seasonality.

Fire suppression: all work and activities connected with fire-extinguishing operations, beginning with discovery and continuing until the fire is completely extinguished.

Fuel break: a generally wide (60 to 1000ft. or 18 to 305m) strip of land on which native vegetation has been permanently modified so that a fire burning into it can be more readily controlled.

Fuel treatment: manipulation or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control (e.g., lopping, chipping, crushing, piling and burning).

Fuel zone: a defined area within which fuels are managed to influence fire behavior and/or fire regimes.

Fuel: living and dead vegetation that can be ignited.

Hand line: fire line constructed with hand tools.

Impact: the cumulative effect, economic and ecological, of an invasive plant population on natural resources.

Incident Action Plan (IAP): contains objectives reflecting the overall incident strategy and specific tactical actions and supporting information for the next operational period. The plan may be oral or written. When written, the plan may have a number of attachments, including: incident objectives, organization assignment list, division assignment, incident radio communication plan, medical plan, traffic plan, safety plan, and incident map. Formerly called shift plan.

Incident Base Camp: location at the incident where the primary logistics functions are coordinated and administered. (Incident name or other designator will be added to the term Base.) The incident command post may be collocated with the base. There is only one Base per incident.

Incident Commander: this Incident Command System position is responsible for overall management of the incident and reports to the agency administrator for the agency having incident jurisdiction. This position may have one or more deputies assigned from the same agency or from an assisting agency(s).

Incident Management Team: the incident commander and appropriate general and command staff personnel assigned to an incident.

Indirect attack: A method of suppression in which the control line is located at some considerable distance away from the fire's active edge. Generally done in the case of a fast-spreading or high-intensity fire and to utilize natural or constructed firebreaks, fuel breaks and favorable breaks in the topography. The intervening fuel is usually backfired; but occasionally the main fire is allowed to burn to the line, depending on conditions.

Indirect fire line: fire line built for implementing indirect attack during fire suppression.

Infested: populated by invasive plants.

Invasive plants: non-native plants that cause economic or ecological harm. Used interchangeably with "weeds".

Land management plan: a document prepared with public participation and approved by an agency administrator that provides general guidance and direction for land and resource management activities for an administrative area. The plan identifies the need for fire's role in a particular area and for a specific benefit. The objectives in the plan provide the basis for the development of fire management objectives and the fire management program in the designated area.

Land manager: a person who manages public or private land.

Management unit: see Fire Management Unit (FMU).

Minimum Impact Suppression Tactics (MIST): the concept of using actions with a minimum amount of impact to effectively achieve the fire management protection objectives consistent with land and resource management objectives.

Monitoring: evaluating the success of prevention measures and management actions; including regular inspection of worksites to detect change, in this case the presence or absence of invasive plants.

Native plants: plants that evolved in a particular region. Plants that evolved without human intervention in a particular region, such as a California bioregion or watershed. These are usually species that occurred naturally before European colonization of North America.

NEPA: National Environmental Policy Act. A national law that established a U.S. national policy promoting the enhancement of the environment. http://ceq.hss.doe.gov

Nonviable: when a plant propagule is not able to produce a new plant.

Pathways: processes through which invasive plants can be introduced or spread.

Prescribed fire: a fire ignited on purpose, with planned oversight and specific management goals. The fire is applied to fuels in specified environmental conditions that allow the fire to be confined to a predetermined area and, at the same time, to produce fire behavior that will attain the planned management objectives.

Project materials: materials that soil and invasive plant parts and seeds can adhere to. These materials include soil, mulch (woody and straw), aggregate (sand and gravel), wood products (firewood and brush), landscape material (plants and seed), erosion control materials (silt fence, straw bales, straw wattles, geotextiles, and rip rap), pack animal feed, and packing/shipping materials.

Propagule: plant reproductive material, such as seeds, rhizomes or stolons.

Pulaski: a hand tool used in wildland fire suppression for construction firebreaks. The tool combines an axe and an adze in one head, and it can be used to both dig soil and chop wood.

Resource Advisor: personnel primarily responsible for identifying and evaluating potential impacts and benefits of fire operations (wildfire or prescribed fire) on natural and cultural resources. The Resource Advisor anticipates impacts on resources as suppression or prescribed fire operations evolve; communicates requirements for resource protection to the Incident Commander (IC) or Incident Management Team (IMT); ensures that planned mitigation measures are carried out effectively; and provides input in the development of short- and long-term natural resource and cultural rehabilitation plans.

Retardants: any substance except plain water that by chemical or physical action reduces flammability of fuels or slows their rate of combustion.

Scout: the act of searching for, locating, and documenting invasive plants on a worksite.

Seed set: the plant reproductive stage during which seeds mature.

Site assessment: the act of scouting for invasive plant species found within the worksite, including documentation of exact locations and densities of invasive plants, and determining priority areas for implementing prevention BMPs

Slash: debris resulting from such natural events as wind, fire, or snow breakage, or such human activities as road construction, logging, pruning, thinning, or brush cutting. Slash includes logs, chunks, bark, branches, stumps, and broken understory trees or brush.

Source populations: infestations of invasive plants which produce seed or other reproductive plant parts that can spread to new areas.

Spike camp: remote camp usually near a fire line, and lacking the logistical support that a larger fire camp would have.

Staging areas: locations where tools, equipment and vehicles are assembled before and during projects.

Sterile: not able to reproduce.

Support animals: dogs that provide hearing or seeing assistance.

Suppression: all the work of extinguishing a fire or confining fire spread.

Target conditions: land or resource conditions that are expected to result if goals and objectives are fully achieved.

Tools: implements used during land management activities, such as shovels and chainsaws.

Transitional pastures: designated areas where grazing animals can graze before and after being used for vegetation management.

Vectors: people or things that can carry invasive plants or their propagules from one place to another inadvertently.

Vehicle: cars, trucks, and all terrain vehicles used during land management activities.

Viable: when a propagule is able to produce a new plant.

Waste-disposal areas: locations where waste can be disposed without the risk of spreading invasive plant materials.

Water sources: natural and man-made water bodies. Water sources do not include equipment.

Weed-free forage: hay, oats, and other feed for pack and grazing animals from a clean source (not contaminated with viable invasive plant propagules).

Weed-free materials: project materials from a clean source (not contaminated with viable invasive plant propagules).

Weeds: used interchangeably with "invasive plants" (non-native plants that cause economic or ecological harm). Not all weeds are considered invasive plants, but for the purpose of this document the two terms are used interchangeably.

Wildfire: a wildland fire whose ignition is unplanned, such as a fire caused by lightning, volcanoes, unauthorized and accidental human-caused fires, and escaped prescribed fires.

Wildland Fire Decision Support Systems (WFDSS): a web-based decision support system that assists fire managers and analysts in making strategic and tactical decisions for fire incidents and provides a record of these decisions.

Wildland Fire: a general term describing any non-structure fire that occurs in wildlands. Wildland fires include wildfires and prescribe fires.

Wildland Urban Interface (WUI): the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildlands.

Worksites: locations or properties where land management activities occur.

Definitions of fire and fuel management terms in this glossary are adapted from the following references:

- Guidance from Implementation of Federal Wildland Fire Management Policy http://www.nifc.gov/policies/policies_documents/GIFWFMP.pdf
- National Wildfire Coordination Group website http://www.nwcg.gov/pms/pubs/glossary/index.htm
- The Bureau of Land Management Fire Management Glossary website http://www.blm.gov/wy/st/en/programs/Fire/glossary.2.html

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Exhibit D: Online Cal-IPC Inventory
https://www.cal-ipc.org/plants/inventory/

Appendix F

FONR Authorized User Guidelines

FONR AUTHORIZED USER GUIDELINES

The NRS reserve use application process general guidelines and process as stated in the NRS Administrative handbook (http://nrs.ucop.edu/Admin-Handbook.htm).

"GENERAL GUIDELINES. Each reserve has been established to support the University of California's research and teaching mission and, where appropriate, public service programs. Use of a reserve will be allowed if the proposed activity and level of use, after careful review by the reserve manager (or other designated University official), are deemed to be consistent with the NRS Reserve Use Guidelines and with regulations and management plans for that particular reserve. General Systemwide guidelines are set by the NRS Director in consultation with the Systemwide NRS Advisory Committee, and more reserve specific guidelines emerge from discussions among campus NRS administrators, reserve managers, and the campus NRS advisory committee. Activities that will or are highly likely to irrevocably harm the natural values, ecosystem functions and native biodiversity of the reserve, or preclude its possible future use for University level research or instruction, will not be allowed. Thus, the number and duration of stay by visiting researchers, classes, and members of the public will necessarily be limited at each reserve. Similarly, facility development at each reserve may be allowed only in designated areas, and may be limited in size so that natural and cultural values are not adversely affected.

PROCESS. The reserve manager has primary responsibility for approving proposed uses under the NRS Use Guidelines and applicable reserve guidelines, and will coordinate management and all other uses of the reserve. In difficult cases, the reserve manager will consult the faculty reserve manager or other faculty with appropriate areas of expertise before approving or rejecting an application. If a user fails to comply with any of the requirements, the reserve manager, after proper consultation, could restrict or terminate on-going reserve use, and the user's subsequent use applications may be rejected. Each campus will establish an appeals process to deal with disputes between potential or current users and reserve managers regarding reserve use. This appeals process may consist of dispute resolution by an informed, ad hoc board consisting of faculty members with appropriate areas of expertise."

THE GUIDELINES FOR THE FORT ORD NATURAL RESERVE. FONR. Users of the FONR must apply and be approved through the NRS application system. The requirements for use are based on the general NRS guidelines (above) and on the specific terms of this Fort Ord Habitat Conservation Plan (HCP). Use guidelines will be presented to potential users via the NRS application process and each users agree and comply with the guidelines relevant to their specific use. The guidelines cover general user provisions and special provisions for research on listed species. There are three types of NRS reserve uses, Public Service, Teaching, and Research.

<u>Public Service</u>. FONR is not open for public access. Public uses include mandated remediation by U. S. Army contracted programs, investigations by authorized public agencies (i.e. USFWS, CDFG), and others as authorized or required by law or policy.

Public education programs for FONR will take place outside the boundaries of the FONR through brochures, lectures, and interpretive sinage. Hence there will be no impact to the FONR from these uses.

Teaching. Classes and authorized student projects will use FONR and will be required to obtain permission via the NRS application process and agree to all of the terms pertaining to entry into the FONR. Any reports prepared by classes or individual students will be submitted to the FONR and made available to interested parties. Classes and independent student projects will not be permitted to collect any plant or animal materials without special permits or direct association with a permitted research activity. Hence teaching uses will abide by the general use guidelines but will not directly impact listed species or the plant community overall.

Research. Qualified research users might include but not necessarily be limited to college and university faculty researchers, post doctoral and graduate students, and qualified researchers from outside agencies (i.e. USFWS, CDFG, BLM, CDPR, etc.) or other organizations supporting appropriate research (CNPS, etc.). All research must conform to the use guidelines (below) and be specifically approved by the FONR Director or a delegated NRS authority. Copies of reports and publication will be submitted to the UCSC NRS office, included in the NRS research database, and be made available to interested parties.

FONR APPLICATION GUIDELINES FOR USE. Failure to agree to these guidelines during the application process or failure to comply with these guidelines during use will result in revocation of any use privilege.

General Guidelines. These guidelines apply to all users and are provided to assure no unintentional or incidental take of listed (HCP) species. All approved users must comply with the following guidelines (these do not apply to emergencies or Army authorized OU1 cleanup operations).

- All users will sign in each time of entry at the sign in boxes and supply all requested data.
- Driving on the Reserve. Users are restricted to driving on the designated perimeter road of the north reserve and South County Rd. on the south reserve. There is no vehicle access to the corridor reserve. Vehicles will drive at 20 mph or less. Vehicles will avoid turns and spinning wheels to protect the patches of listed species seed banks[1] known to exist along the roads.
- Accessing the interior of the Reserve. User will walk on the paths, avoiding disturbance of growing annuals and the seed bank. If vehicle access is required to move heavy equipment or provide access to persons who cannot walk the distance users will drive the FONR Kawasaki mule which does not generate disturbance of the upper layers of soil. Reserve personnel will demonstrate the use of the mule.
- NO disturbance of native plants or know or suspected native plant seed banks.

[1] Seedbanks of sand gilia and spineflower have been shown to occur only in the top 1-2 centimeters of soil. Therefore any disturbance beyond that depth would be potentially harmful and should be avoided.

- NO collection of plant or animal materials.
- NO smoking.
- NO use of the Reserve as a toilet facility.
- NO trash is to be left on the Reserve.
- NO pets. Dogs are especially dangerous as they attract mountain lions.

Guidelines for research involving direct use of listed HCP species (most especially sand gilia, Monterey spineflower, and Seaside bird's beak). In addition to the general guidelines above researchers working with HCP listed species in such a way as to produce take will have additional requirements that avoid or fully mitigate for any take.

Research conducted by FONR personnel or NRS approved researchers on HCP/NCCP preserves is covered by the Section 10(a)(1)(B) permit as long as the research projects have negligible effects on populations of covered species. NRS approval covers fully mitigated take of sand gilia, Monterey spineflower, and Seaside bird's beak. Projects involving seed, cutting or whole plant collection of less than 2% of any population or occurrence of seed production may be approved with appropriate monitoring and mitigation if needed. All such research activity consistent with this HCP is covered by the ESA and NCCP Permits. Any projects with projected take above that level must obtain appropriate research permits from USFWS and/or CDFG as appropriate. Such permits must be obtained by the principal investigator (PI) prior to receiving NRS approval for the project.

Such researchers must comply with the following requirements.

- The Principal Investigator (PI) must submit, via the NRS application process, a research proposal fully explaining the project and clearly stating what type and degree of manipulation, collection, and/or take will occur and what mitigations will be insured. The proposal will be reviewed for compliance with the HCP and must be approved prior to initiation of the work.
- The project area will be added to the FONR GIS database with the use of GPS.
- The project description will contain measures to mitigate for any loss of HCP listed species, any increase in coverage of invasive weed species, and any other potentially long term damage to the Reserve's natural systems.
- If animal use is proposed the proposal must be approved by the UCSC Campus Animal Review Committee (CARC).
- An appropriate quantitative survey of all HCP species in the designated area of the research project will be completed and submitted to the FONR Director. This survey will be repeated by monitoring the area for 5 years after the termination of the research project.
- The PI is responsible for the conduct of all participants in the research project.
- The PI is responsible to execute or fund the execution of any required monitoring or mitigation.
- The PI will submit copies of all research reports and publications to the NRS database, which will be made available to the public via the NRS website.

Appendix G

Plant Monitoring Program for the Fort Ord Multispecies Habitat Conservation Plan

PLANT MONITORING PROGRAM FOR THE FORT ORD MULTISPECIES HABITAT CONSERVATION PLAN

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August 19, 2005

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INTRODUCTION

Biological resources monitoring will be used to evaluate the success of habitat preservation, restoration, and management efforts conducted as part of the Fort Ord Multispecies Habitat Conservation Plan (Fort Ord HCP, or FOHPC). This document describes the monitoring program that will be used to evaluate success toward the biological goals and objectives for the twelve covered plant species of the Fort Ord HCP. It was developed by Jodi M. McGraw, a population and community ecologist, in coordination with Coordinated Resources Management Program (CRMP), through consideration of available data about the system, covered species, and the FOHCP.

The program is described in six sections. The first briefly outlines the importance and challenges of monitoring and the goal of the monitoring program. The second section describes how monitoring will be integrated within a coordinated adaptive management program. Section 3 describes the components and processes of an adaptive monitoring program, and how the effectiveness of monitoring will be evaluated. The fourth section outlines the elements of the monitoring protocols and provides the rationales for their common elements. Section 5 describes the specific monitoring protocols designed to track populations of the twelve covered plants. The sixth and final section provides some preliminary recommendations for implementation of the monitoring program.

SECTION 1: GOAL OF THE COVERED PLANT MONITORING PROGRAM

Monitoring is an essential component of any adaptive management program, as it provides information about the system through time that is needed to evaluate the success of the conservation strategy and inform changes, as needed. Several different types of monitoring will be used to evaluate the conservation program for the Fort Ord HCP (Zander Associates 2004). They include compliance monitoring, project monitoring, and biological effectiveness monitoring.

Compliance monitoring will be used to track implementation of various components of the conservation strategy. Specifically, it will be used to ensure that the preservation, management, and restoration projects include within the HCP are indeed implemented as described.

Project monitoring will be used to evaluate the impacts of specific projects, such as controlled burns, exotic plant control treatments, and trail closures. Give the size of the installation and the number of covered species, it is not feasible to examine the impacts of all management projects on all of the covered species as part of the HCP. Instead, project monitoring will be conducted for a subset of the management projects to evaluate their effectiveness and inform future management as part of an adaptive conservation strategy (Figure 1). The types of management projects that might be monitored include:

1. *Large projects*, such as controlled burns or widespread weed abatement treatments, which by virtue of their large spatial impacts, are hypothesized to have potential large impacts on one or more of the covered species

2. *Species-specific significant projects*, which might be small in spatial scale, but have significant impacts on one or more covered species (incl. especially rare species such as seaside bird's beak)
3. *Ecologically informative projects*, which are designed and implemented to provide information regarded as essential to informing long term management

The third main type of monitoring that will occur as part of the Fort Ord HCP is biological effectiveness monitoring, which is designed to evaluate the success of the overall conservation program toward attaining its goals and objectives, as outlined in the HCP. Especially important to adaptive management programs designed to facilitate persistence of endangered species, biological effectiveness monitoring is essential to detecting population declines that could threaten population persistence and to developing the information needed to inform management designed to prevent potentially disastrous extirpations (local extinctions).

This program describes the biological effectiveness monitoring that will be conducted for the covered plants. Compliance monitoring and project monitoring are described in the FOHCP (Zander Associates 2004).

Challenges of Biological Effectiveness Monitoring

Biological Effectiveness monitoring can present many challenges to adaptive management programs designed to facilitate persistence of endangered species. Some of the challenges include:

1. Identifying and effectively tracking monitoring targets (i.e. variables) that accurately represent or indicate species persistence
2. Discerning biologically meaningful changes amidst the natural fluctuations many populations exhibit
3. Linking species performance to management in order to accurately evaluate management and inform potentially necessary changes to the program

Effective monitoring of the covered plants of the Fort Ord HCP will present additional challenges due to the following:

1. The large number of plant species to be monitored (12)
2. The varied ecologies and life histories of the plant species
3. The large area of habitat to be monitored (over 16,000 acres)
4. The heterogeneous conditions of the multiple areas to be monitored (incl. size, habitat conditions, distributions of covered plants, etc.)
5. The multiple organizations involved in land management and monitoring
6. The high inter-annual variability in aboveground populations of some herbaceous species
7. The effects of significant landscape events (e.g. fire) on herbaceous and woody species

These challenges can be addressed through a variety of approaches, methods, and techniques which have been developed in the fields of population and conservation biology to facilitate effective monitoring of endangered species. These components require resources, including time, skills, and in some cases equipment. These resources increase the costs of the monitoring program. As a result, a variety of trade-offs are confronted in attempts to develop both a successful and cost effective monitoring program.

Goal of the Biological Effectiveness Monitoring

In consideration of this, the goal of this biological effectiveness monitoring program for the covered plants of the Fort Ord HCP is:

To provide objective, repeatable methods for collecting, analyzing, and interpreting ecologically meaningful information about the covered species that can be used to evaluate the status of the populations, the effectiveness of the conservation strategy, and the design of future management and monitoring, using the most cost-effective methods possible.

SECTION 2: MONITORING AS PART OF A COORDINATED ADAPTIVE CONSERVATION PROGRAM

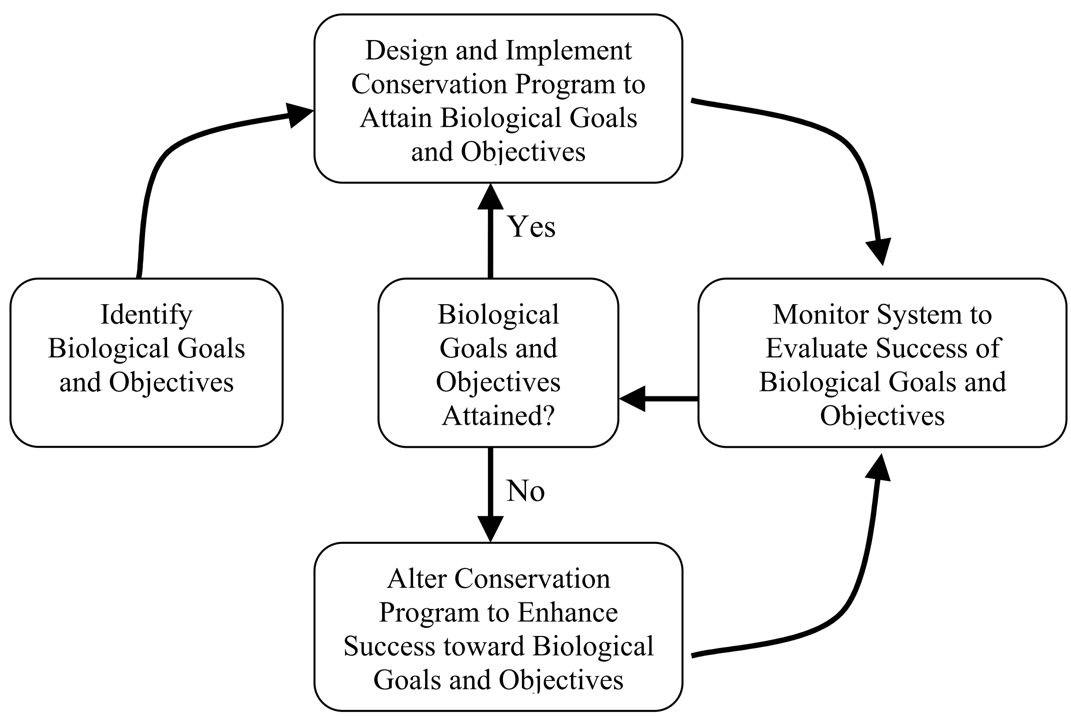
To be effective, this monitoring program must be integrated within the overall conservation program of the Fort Ord HCP, through a coordinated Adaptive Management and Monitoring Program. In such a program, monitoring is used to evaluate whether the conservation program, which includes the preservation, restoration, and management elements, is successful at attaining the biological goals and objectives of the Fort Ord HCP. This section describes this monitoring program is designed to facilitate the biological goals and objectives of the Fort Ord HCP.

2.1 OVERVIEW

Within an overall adaptive conservation program, monitoring is used to evaluate the program's success toward its biological goals and objectives (Figure 1; Elzinga et al. 2001). The following sections briefly outline the three main components:

1. Biological goals and objectives
2. Conservation Program
3. Monitoring protocols

Figure 1: Components and processes of an adaptive conservation program (adapted from (Elzinga et al. 2001).



Biological Goals and Objectives

Biological goals describe the desired conditions of the covered plant species populations. The biological objectives describe specific steps that are designed to attain the goals. To enhance success of an adaptive conservation program, it is important that the monitoring protocols be directly linked to the biological goals and objectives. It is for this reason that this monitoring program proposes specific biological goals and objectives for the covered plants of the Fort Ord HCP (Section 4).

Conservation Program

The FOHCP conservation program describes the preservation and management (restoration, enhancement, and maintenance) steps that will be taken to attain the biological goals and objectives for the covered plants (Zander Associates 2004). It is important to note that the monitoring program described here is designed to evaluate success of the conservation program at achieving the biological goals and objectives monitoring program of the Fort Ord HCP, not success of *specific management projects*. The Conservation Program of the Fort Ord HCP incorporates a variety of management strategies to address the anthropogenic stresses impacting the covered plants, including management of recreation, exotic plants, and fire. The management projects will be implemented across varying temporal and spatial scales. In some rare cases, the monitoring data derived from this program *may* provide information that can be used to evaluate the effects of specific management project (e.g. a large prescription burn). However, in most cases, directed studies developed in consideration of the management treatments and goals will be needed to effectively evaluate the management project effects. While this plan outlines many of the important factors that should be considered when collecting data on the covered plant populations, it does not prescribe management project monitoring, which should instead be developed as part of a coordinated Adaptive Management and Monitoring Plan for the HCP.

Monitoring Protocols

The monitoring protocols describe the methods that will be used to evaluate success of the conservation program toward attaining each of the biological goals and objectives. As outlined in Section 4, monitoring protocols describe the type of information that will be collected, how it will be collected, how it will be analyzed, and how it will be interpreted to evaluate success toward the biological goals and objectives.

2.2 PROGRAM COMPONENTS AND PROCESSES

The monitoring studies in this program are designed to answer the question: Is the conservation program attaining its biological goals and objectives? If it is, management and monitoring are to continue as outlined in the Fort Ord HCP. If not, actions may be needed to enhance success (Figure 1).

Accurately detecting declines in plant populations that can threaten persistence and should therefore initiate remedial efforts can be difficult, largely because plant populations naturally shift in abundance through space and time, but also because management projects designed to enhance plant populations will also cause changes. Devising and implementing remedial management to reverse natural declines from which the populations will recover, even without intervention, can cause unnecessary costs and perhaps undue harm to the species and communities. At the same time, failing to intervene when population declines are caused by anthropogenic factors, or perhaps even natural factors which could result in declines that can reduce population viability, can also have disastrous consequences.

This monitoring program provides for the results of monitoring studies to be evaluated in such a way as to determine the need for remedial management as part of a coordinated adaptive management process. The process involves four main steps:

1. Establish an adjusted baseline
2. Develop thresholds for declines
3. Analyze Monitoring Data and Interpret Results
4. Prescribe Remedial action

<u>Establish the Adjusted Baseline</u>

The first step in establishing a monitoring program designed to inform adaptive management is to establish baseline information about the plant populations to which the results of future monitoring will be compared. In the Fort Ord HCP (Zander Associates 2004), this information is referred to as the "adjusted baseline" to differentiate it from previous studies conducted in 1992 which evaluated plant populations for purposes of impact analysis, but are not suitable for ongoing monitoring (Engineers 1992, USACE and Associates 1992). In this program, the Adjusted Baseline will be established through implementation of the monitoring protocols once their effectiveness has been evaluated through a pilot study and changes made, as necessary. Greater detail regarding establishment of the Adjusted Baseline is provided in Section 3.

<u>Develop Thresholds for Declines</u>

For each biological objective, a quantitative threshold identifies a population level below which the need for remedial management will be evaluated. Based on the current knowledge of the population biology of the species, the thresholds proposed in this monitoring program were designed to identify levels of decline beyond which future persistence could be negatively affected. As with all aspects of this monitoring program, the thresholds should be adjusted based on results of the pilot study and monitoring protocol implementation to establish the Adjusted Baseline. However, declines should not be allowed to exceed that from which the populations can recover.

<u>Analyze Monitoring Data and Evaluate Results</u>

Once monitoring data are collected, analyses are used to examine the changes in the population parameters relative to data collected using the same protocol in prior monitoring intervals. If declines are observed in data obtained from a sampling study, inferential statistical analyses are required to determine whether the changes are statistically significant—that is, likely to represent real changes, rather than resulting from chance alone, as can occur with any sampling. Appropriate inferential statistical tests used to evaluate statistical significance are identified in each of the monitoring protocols that involve quantitative sampling.

Using hypothetical data for sand gilia density, Figure 2 illustrates how results of monitoring data based on sampling would be evaluated to determine the need for remedial action. As depicted, remedial action will be required in the event that statistically significant declines exceeding the established threshold are observed (Figure 2e). Dramatic declines that are not statistically significant can be biologically significant, and thus will also trigger evaluation of remedial action (Figure 2c). In these cases, the retrospective power analyses should be used to determine whether the monitoring protocol is robust enough and, if not, changes should be made. Section 3 provides more information about power analyses. Finally, steady declines in populations that do not yet exceed established thresholds (Figure 2d) will also initiate evaluation of remedial action through a decision tree, as described below.

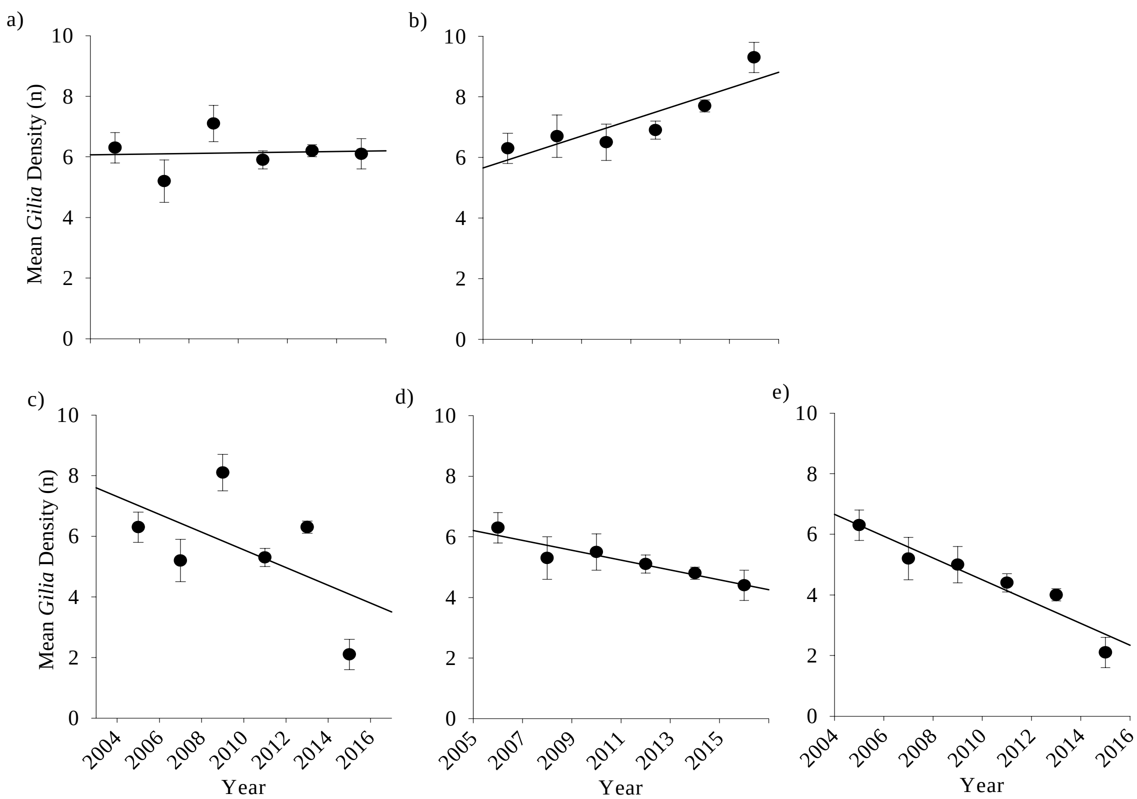


Figure 2: Hypothetical sand gilia abundance data illustrating how statistically significant declines in the rare plant population exceeding the establish threshold (e.g. 20%) could be used to trigger remedial action. Points are mean values of sand gilia density sampled during six sampling studies conducted at two-year interval, with bars representing the standard error of the mean. The trend line is the least squares regression line. Five scenarios are presented. a) no trend, b) significant increase, c) non-significant decline, d) significant decline not exceeding threshold, and e) significant decline exceeding threshold. Remedial action will be evaluated in scenarios c and d, and triggered in scenario e.

Monitoring results can reveal two main types of declines: those observed during a single monitoring interval (Figure 3a), and those observed as part of a trend of at least five monitoring steps (Figure 3b). Natural factors such as climate (e.g. drought), increases in the abundance of an herbivore, predator, or competitor, or other stochastic events can cause short-term population decreases which exceed the threshold. In many cases, populations will increase when conditions change and growth rates increase. In contrast, the degradation of habitat conditions which can present a greater challenge to long-term species persistence oftentimes causes protracted declines. It is important to note that not all single interval declines exceeding a threshold will be followed by natural recovery, as unfortunately, declines toward extirpation can occur rapidly. The life history of the species and the ecology of the system will be used to evaluate the threat presented by declines exceeding the thresholds, and determine the necessary remedial measures.

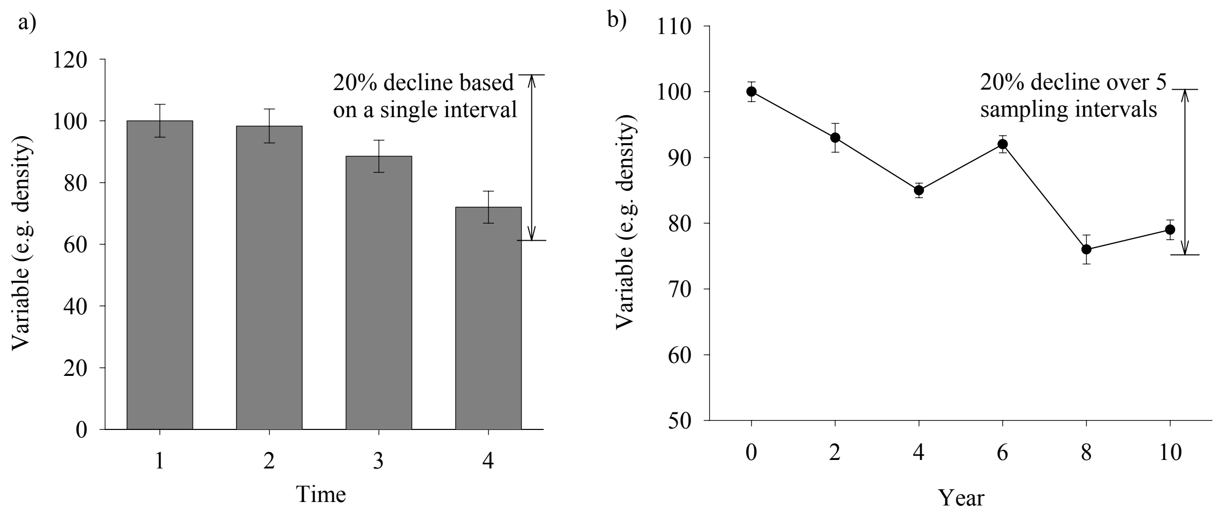


Figure 3: Hypothetical monitoring data showing a) a significant single interval decline exceeding a hypothetical threshold of 20%, and b) trend analysis revealing a statistically significant decline exceeding 20% over a 10 year period, during which sampling occurred at two year intervals.

<u>Prescribe Remedial Action</u>

If monitoring studies reveal that population parameters have experienced 'real' declines below the established thresholds and thus the biological goals and objectives of the conservation program are not being met, then remedial action will be initiated to enhance success. Because the factors affecting the distribution and abundance of the covered species are poorly understood, and because it is difficult to anticipate potential future changes to the populations and communities, remedial measures will be developed based on the details of the situation. This program outlines a series of general steps that should be taken (Figure 4).

If the cause of the decline is unknown, additional analyses of existing information and/or new research will be used to determine potential causes. Known or hypothesized causes for declines will be classified as either natural or anthropogenic, considering the full range of both proximate and ultimate impacts of human activity on the system. If the putative causes for decline are anthropogenic, experimental management will be conducted to remove the stress to the system. If the decline is not anthropogenic in nature, the determination will be made as to whether it is important to intervene within the system to protect remaining populations. If the cause of decline is known and is deemed anthropogenic in origin, for example in the case of arson, then management should be implemented within an adaptive management framework.

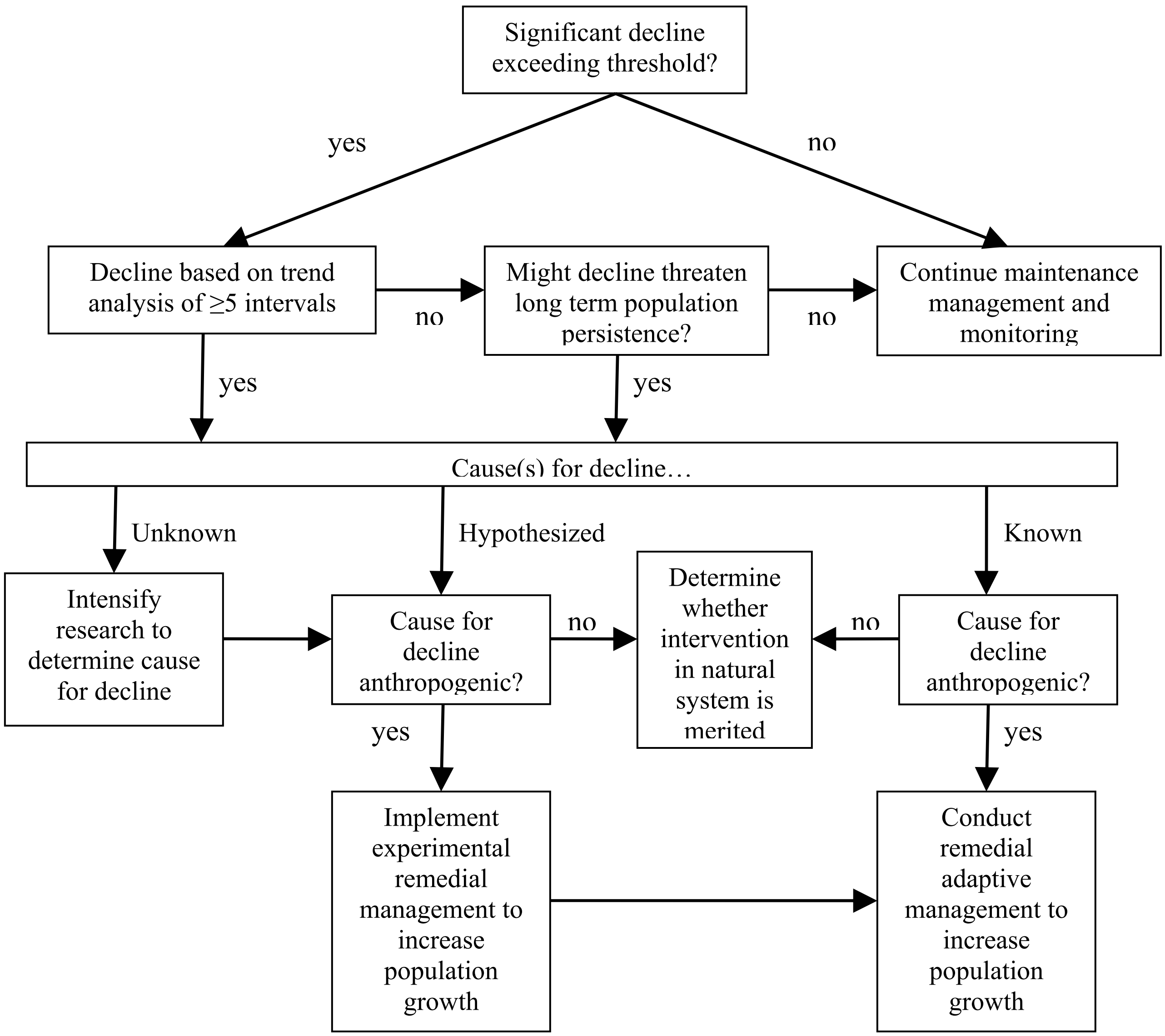


Figure 4: Decision tree to trigger remedial management based on monitoring results.

The following are examples of remedial efforts that could be initiated if monitoring revealed declines in sand gilia populations, of which two components will be measured: distribution (areal extent) and abundance (density; Section 5.1).

Declines in Distribution

Distribution monitoring for sand gilia is designed to detect declines in the areal extent of the rare annual plant that could result from landscape-level reductions in the availability of suitable habitat, such as might occur as a result of succession, which reduces gaps in the shrub canopies in maritime chaparral, the invasion and spread of aggressive exotic plants, which compete with sand gilia, and degradation of habitat due to recreational use and associated soil erosion (Section 4.2.4). However, declines in aboveground expression of sand gilia (i.e. abundance) due to inter-annual variability in climate could result in reduced patch area as measured using distribution monitoring.

The following series of additional analyses and associated remedial actions are recommended in the event that total sand gilia patch area declines beyond 20% (the threshold). They are designed to first assess the potential that declines are due to natural fluctuations. If there is no evidence for this, the subsequent steps are designed to assess potential anthropogenic causes and prescribe remedial management actions.

1. **Determine the proportion of Conserved Habitat Areas (CHAs) in which a decline in areal extent (distribution) was observed**

   Natural fluctuations in sand gilia abundance due to climate are more likely to result in installation-wide distribution declines, whereas declines in habitat quality are likely to result in patchy declines in distribution. If declines are observed only in a fraction of the previously occupied areas (polygons, CHAs, etc.), efforts will be initiated to identify potential causes of habitat degradation in those areas.

2. **Evaluate whether recent declines were observed in sand gilia abundance and, if so, in what proportion of the CHAs.**

   Declines in sand gilia abundance observed in most of the CHAs would most likely be caused by declines in aboveground expression resulting from climate, rather than loss of available habitat, as it is less likely that an anthropogenic stress such as exotic plants and/or soil erosion would simultaneously impact many areas.

3. **If declines in abundance were not observed, and declines in distribution were only observed in some of the CHAs, the available data on threats should be examined to determine whether new or persistent threats might be causing declines in distribution in the CHAs where they occurred.**

   Overlay analysis using GIS should be used to determine whether the declines in distribution are spatially correlated with new or persisting anthropogenic threats. If so, management should be conducted to remove them and repair the habitat, as needed.

4. **If no threats were observed in areas where sand gilia distribution declined, then the aerial images should be compared to determine whether the canopy cover of woody vegetation increased during the interval.**

   Reductions in the open sand habitat due to canopy closure during the course of succession could decrease sand gilia distribution. If these are observed, management should be initiated to increase availability of open sand habitat through prescription fire or fire surrogates.

Declines in Abundance

Declines exceeding the threshold for sand gilia density might be observed through abundance sampling (Section 5.1.1), which is designed to detect reductions in the suitability of habitat, such as might occur due to encroachment in woody plant canopies in maritime chaparral, the invasion and spread of aggressive exotic plants, and degradation of habitat due to recreational use and associated soil erosion.

The following are a series of additional analyses and associated remedial actions that could be followed in the event that trend analysis reveals significant declines in sand gilia density of 20% (the threshold), and persistent trends toward such a decline. They are designed to first determine the likelihood that the decline is anthropogenic and, if so, determine appropriate remedial management actions.

1. **Determine whether the decline might be due to prolonged drought.**

   Sand gilia abundance is reduced in low rainfall years (Fox et al. *in review*), and a series of drought years as have historically occurred in central coastal California could cause a prolonged decline in aboveground abundance. If declines in abundance were observed installation-wide (or at least in most CHAs), then rainfall and temperature data should be examined to evaluate the extent to which declines are correlated with climate.

2. **Evaluate whether habitat degradation might have caused abundance declines.**

   Multiple regression can be used to test the hypotheses that increases in exotic plants, soil disturbances/erosion, or woody plant encroachment contributed to observed declines in sand gilia density, by regressing the percent change in abundance of sand gilia on the percent change in the cover of each of the threats. Management should be initiated to reduce and repair the effects of any detected threats to sand gilia abundance.

3. **If population declines are not linked to climate or increases in currently known anthropogenic threats, research will be initiated to explore potential causes.**

   Even though the declines in abundance may not be attributable to anthropogenic factors, they might still influence persistence and thus merit concern. Additional monitoring and/or research should be initiated to examine potential causes for the declines. This may be facilitated by partnering with Universities and other local researchers.

SECTION 3: COMPONENTS AND PROCESSES OF AN ADAPTIVE MONITORING PROGRAM

For monitoring to be an effective component of an overall adaptive conservation program of the Fort Ord HCP, it must itself be conducted within an adaptive framework. Just as the lack of certainty regarding the effects of management necessitate careful monitoring of the covered plants to evaluate success of management toward the biological goals and objectives, the lack of certainty regarding the effectiveness of monitoring necessitates careful evaluation of the monitoring objectives to ensure that monitoring is an effective component of the conservation program. This section outlines the components of the process through which monitoring protocols will be implemented in an adaptive program (Figure 5).

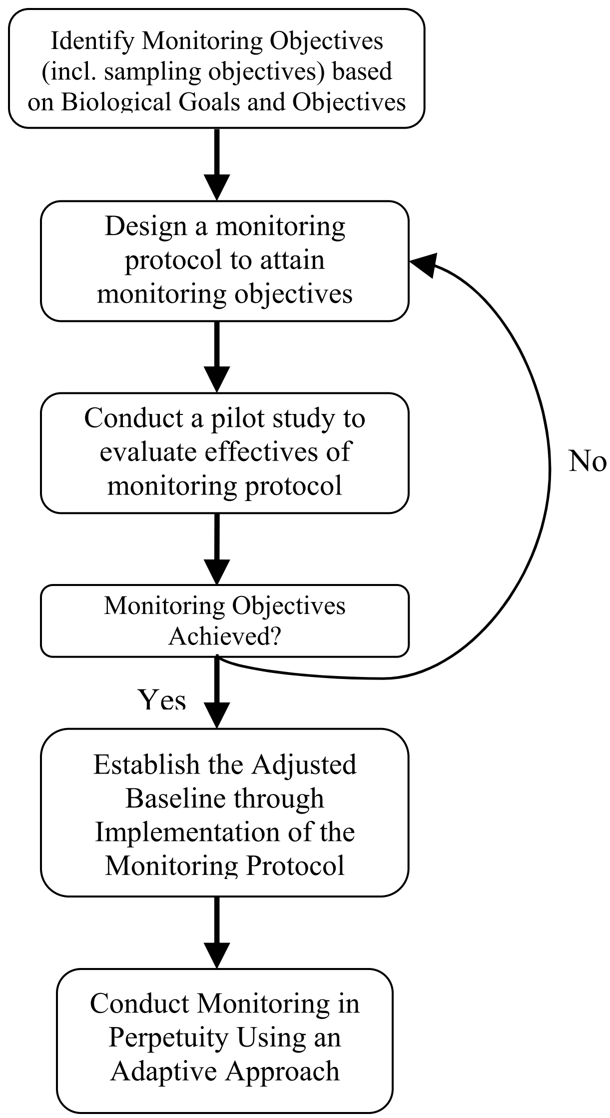


Figure 5: Processes that will be used to facilitate effective monitoring as part of an adaptive conservation program.

3.1 Monitoring Objectives

Monitoring objectives link the monitoring protocol to the biological objective it is designed to track, thus tying monitoring to the adaptive conservation program. Monitoring objectives identify the aim of the protocol. For example, the objectives of the areal extent monitoring for coast wallflower are to determine the distribution of the rare plant and track its changes through time in a spatially explicit manner that can aid design of management and monitoring projects.

<u>Sampling Objectives</u>

Monitoring protocols involving quantitative sampling will have specific objectives related to the sampling effort, which describe the characteristics of a sampling study deemed to accurately and precisely represent the entire population. Sampling objectives identified in the protocols of this monitoring program describe the minimum detectable change, statistical power, and false-change error rate (Elzinga et al. 2001).

The *minimum detectable change* (MDC) is the minimum level of change in the population parameter that the monitoring protocol is designed to detect. The smaller the MDC, the more intensive the sampling effort required. In the monitoring protocols in this program, the MDC has been set at the threshold—the level of decline in the population parameter beyond which remedial efforts will be initiated. This ensures that significant declines below the threshold will be detected, while reducing costs associated with more intensive monitoring to detect smaller changes (Elzinga et al. 2001).

The *false-change error rate* (α) is the probability that the monitoring protocol will indicate that a statistically significant decline exceeding the threshold has occurred when one, in fact, has not. Though the false change error rate used in scientific research is often set at α=0.05, it is recommended that α=0.1 in monitoring studies for endangered species (Elzinga et al. 2001), such that there is a 10% chance that a statistically significant finding will be in error.

The statistical *power* is the ability of the monitoring protocol to detect statistically significant declines at or beyond the MDC when they actually occur. Often expressed as a percentage, the power of monitoring protocols in this program was set at 80%, a level deemed acceptable for monitoring other endangered species (Hayes and Steidl 1997, Reed and Blaustein 1997). This means that 80% of the time that the population experiences a decline exceeding the threshold (i.e. MDC), the monitoring protocol will be able to detect it.

3. 2 Monitoring Protocols

Once monitoring objectives have been identified, a monitoring protocol is designed to attain the monitoring objectives. Monitoring protocols contain the critical details needed to implement a monitoring study designed to attain the monitoring objectives. However, they are not a ‘cook book’ or ‘how to manual’. It is assumed that those implementing the monitoring program will be familiar with the techniques and approaches to quantitative sampling, which are beyond the scope of this document (but see (Hayek and Buzas 1997, Krebs 1999, Southwood and Henderson 2000, Elzinga et al. 2001).

The details of the proposed monitoring protocols are described in four main sections, which are described in greater detail in Section 4.

1. **Study Design:** The study design describes the critical elements of the study, including: the method, the universe of interest (statistical population), the variables measured, the sample units, the sample size and shape, the manner in which samples are allocated, the sample size, and the frequency and duration of resampling.

2. **Implementation**: This section provides guidelines for implementing the monitoring studies, including the seasonality, frequency, and personnel.

3. **Analysis:** This section outlines how the data from the finalized monitoring protocol will be analyzed and evaluated, including the appropriate statistical tests for each monitoring protocol.

3.3 Pilot Studies

Pilot studies will be used to evaluate the ability of the proposed monitoring protocols to attain their objectives and identify potential modifications prior to their use in establishing the Adjusted Baseline and long term monitoring.

3.3.1 Types of Pilot Studies

Listed in order of the level of effort required, the three main types of pilot studies distinguished for purposes of illustrating their utility in this monitoring program are: exploratory studies, small-scale implementation, and full implementation.

<u>Exploratory Studies</u>

Exploratory studies are designed to examine specific components of the monitoring protocol that are potentially problematical, in that they influence the accuracy, repeatability, and ease of implementation of the monitoring protocol. For example, to evaluate the effectiveness of an areal mapping protocol for Monterey spineflower, one might implement the patch mapping protocol in different vegetation types, or in other areas which differ in a way that might influence the ease with which patches are delimited in the field and ability of the patches to represent the distribution of the annual plant. Though the monitoring protocol might recommend that plants within 5m be considered within the same patch, the exploratory pilot study might find that this creates far too many small patches, many of which are separated by just over 5m, and opt instead for a 10m separation distance.

Exploratory studies can be used to evaluate plot size and/or dimensions that can influence variability and thus power, methods of sampling (line intercept vs. quadrat), precision of cover estimates using classes based on multiple observes, and other potentially problematical components of the monitoring protocol.

Exploratory studies can be effectively combined with small-scale and full implementation, as described below. The use of exploratory studies alone as a means of evaluating a monitoring protocol is recommended only in the case that unpiloted aspects of the monitoring protocol are known to be effective as a result of previous successful monitoring studies using the same or similar protocol in similar situations.

Small–Scale Implementation

It is often advantageous to implement all of the steps of the monitoring protocol, from data collection to data analysis and evaluation; however, reduce the level of effort by limiting the area over which it is applied (i.e. for areal mapping) or the number of replicates sampled. Such small-scale implementation of the monitoring protocol can be effectively combined with an exploratory study to enhance the utility of many pilot studies. For example, quantitative sampling of seaside bird's beak could be conducted in 30 of the 60 proposed replicates, with plot size varied from $5m^2$ to $20m^2$ at each site. Then, with the aid of power analyses, the optimal sample size and plot size can be evaluated, such that though the original monitoring protocol might recommend 60, $5m^2$ quadrats, results of the pilot study might indicate that 30, $10m^2$ attain the monitoring objectives in a more cost effective manner (McGraw 2004b).

Small-scale implementation facilitates evaluation of all components of the monitoring protocol, while reducing the costs required for the pilot study. As in all sampling, care should be taken when selecting the areas in which to implement the protocol to ensure that the test areas will be representative of the entire installation. For example, a monitoring protocol to examine coast wallflower density might be successful based on piloting in high density populations at Fort Ord Dunes State Park; however, it may prove unsuccessful when applied to the interior dune areas of Fort Ord Natural Reserve. If sample size is to be reduced in small-scale implementation, it should be spread throughout the areas in order to incorporate the variation that will ultimately influence its effectiveness installation-wide.

Full Implementation

Full implementation of the monitoring protocol through the pilot study is ideal for examining effectiveness, as *all* components are evaluated at the full level of effort. This will be the best way to determine whether the sampling objectives can be attained. In addition, it is important to determining the overall time and costs associated within the monitoring protocol, which might be overlooked if the study is only tested partially.

3.3.2 Power Analysis

A critical component of the assessment of a monitoring protocol's effectiveness will be power analyses, which determine the characteristics of the sampling study that will be able to attain the sampling objectives (Hayes and Steidl 1997, Thomas 1997). A particular concern is that the monitoring studies will not have sufficient power—the ability to detect biologically significant declines in the population when they occur. This can occur in monitoring protocols based on sampling when a decline is observed, but it is found to be statistically insignificant, leaving the observer to wonder whether the decline was real or a result of statistical sampling, yet having no way to differentiate these two scenarios.

Once the minimum detectable change (i.e. threshold) and the false-change error rate (α=0.10) have been set, the power of a study is primarily determined by the variability in the population (i.e. variance) and the sample size of the monitoring protocol: the greater the variance, the lower the power. The greater the sample size, the greater the power. These principles guide design of the sampling studies, as estimates of variance can be used to determine the sample size needed to have sufficient power to detect the changes below the thresholds. However, in the absence of real data, these are only estimates.

A main objective of using power analysis to evaluate the abundance sampling protocols proposed in this program is to determine the sample size needed to attain the power designated given the variance observed in the pilot study. If power analysis reveals that the monitoring protocol has sufficient power to detect a 20% decline in Contra Costa goldfields abundance based on 30 quadrats, and 45 were collected during the pilot study, then the sample size can be reduced in the monitoring protocol that will be implemented in the long term, thus reducing monitoring costs. Alternatively, the analysis may indicate that 120 quadrats are needed to attain the specified power. Because it would likely be infeasible to sample this intensively, direction can be turned to methods of reducing the variance, by altering plot size and shape, methods of data collection, etc. (McGraw 2004b).

Separate power analyses must be conducted for the statistical test to detect changes over single intervals and through trend analysis. To conduct power analysis based on single interval changes detected through permanent plots, as prescribed within this program, it is necessary to obtain an estimate of the variance between plots among sampling intervals (i.e. the standard deviation of the mean difference between sampling intervals). This can only be obtained by implementing the monitoring protocol for two time periods, necessitating a two year pilot study.

In trend analysis, it is necessary to have an estimate of the variance in the population through time. As a result, retrospective power analysis (Thomas 1997) requires implementation of the protocol four or more time periods. Analytical software available provides simple methods of simulating power based on estimates of the variability, in the case that variance estimates are not available (e.g. (Hintze 2001). It is recommended that such simulations be used to evaluate the ability of the monitoring protocols to detect declines based on trends, as it would be costly to implement the protocols as a pilot over five or more years.

3.3.3 Pilot Study Recommendations

The following are recommendations for pilot studies and power analysis based on consideration of the potential costs associated with failure of the monitoring protocols and the costs of implementing pilot studies and associated power analyses.

All monitoring protocols should be examined through pilot studies. In the case of non-sampling studies, such as censuses and areal mapping, small-scale implementation may be sufficient to evaluate the ability of the monitoring protocol to attain its objectives in a cost effective manner. In the case of monitoring protocols based on sampling, such as abundance sampling, it is recommended that pilot studies be fully implemented. Furthermore, it is recommended that components of the monitoring protocol thought to influence power, including plot size and shape, be incorporated into the pilot so that power analyses based on single interval changes can be used to determine the most cost effective way of attaining the necessary power (McGraw 2004b). Simulations should be used to evaluate the likely effectiveness of the quantitative sampling protocols at achieving the necessary power during trend analysis, rather than delaying the establishment of the Adjusted Baseline and the onset of monitoring by having a five -year or more pilot period. Retrospective power analysis should be conducted once the sampling protocols have been implemented five or more times.

Establishing the Adjusted Baseline

In order to effectively compare the monitoring results to the Adjusted Baseline, it is important that both studies use the same methods. For that reason, it is recommended that the Adjusted Baseline for each biological objective be established by implementing the monitoring protocol *after* it has been finalized based on results of the pilot study.

In most cases, the Adjusted Baselines will be determined based on a single time interval. Exceptions include creating an Adjusted Baseline for the abundance of herbaceous species that can exhibit high inter-annual variability due to climate (e.g. sand gilia), and areal mapping to establish the distribution of Yadon's piperia, which exhibits dormancy.

The following is designed to address concern raised by members of the CRMP during development of this plan that the Adjusted Baseline for abundance might be established in years that are abnormal due to stochastic factors such as climate, and therefore not be representative of the target conditions to be maintained. After 10 years of abundance sampling, analysis will be conducted to determine whether the year (or series of three years) for which the Adjusted Baseline was established represented excessively good or poor years for abundance due to climate conditions. Analysis of variance (ANOVA) will be used to test the hypothesis that abundance during the first three years differed significantly from abundance during the entire 10 years. If analyses reveal that the first three years had significantly lower abundance, and the climate during theses years is the likely cause, then the 10 year average will be used as the Adjusted Baseline. If the first one or three years have significantly greater abundance than the first 10 years, and this is tied to abnormally good years for abundance, then the 10 year average will similarly be used as the Adjusted Baseline. It is important to note that Adjusted Baseline will be replaced by the 10 year average only in the case that climate or other stochastic factors are deemed to be the cause of the abnormally low or high abundance during the first one or three years.

Conduct Long Term Monitoring Using an Adaptive Approach

After the Adjusted Baseline is established, monitoring will ideally be conducted at the prescribed intervals using the identical protocol to that which was used to establish the adjusted baseline. However, changes in the program may be necessary. Where possible, attempts should be made to avoid changes that reduce the ability of the monitoring results to be reliably compared to the adjusted baseline in order to evaluate success toward the biological goals and objectives. Changes that should not substantially affect this include: loss of a subset of the replicate samples, perhaps due to vandalism and substitution of new replicates if loss is substantial, and increase in the sample size to increase power.

Altering the sampling methods, such as switching from quadrat to transect sampling for abundance estimation, would prevent comparison of the monitoring results to the adjusted baseline include alteration of the sampling methods. If such changes which prevent reliable comparisons are necessary, both sampling methodologies should be implemented during the same year and the results compared to create a conversion factor which relates the new measures to that observed using the methods used to establish the adjusted baseline. Such alterations from the monitoring program should be discussed with and recommended by the Coordinated Resources Management Planning Program (CRMP) and may require an amendment to the HCP.

SECTION 4: MONITORING PROTOCOLS

This section describes the components of the monitoring protocols that have been developed to track success toward each of the biological goals and objectives for the covered plants of the Fort Ord HCP. It also provides background regarding the types of monitoring techniques proposed, and some of the important considerations in designing and implementing monitoring protocols involving quantitative sampling. It is designed to aid understanding of the details and rationale behind the monitoring protocols outlined in Section 5, and to avoid redundancy in that section.

4.1 MONITORING PROTOCOL ELEMENTS

The headings of this section correspond to those found within monitoring protocols in Section 5. They are: Biological Goals and Objectives, Background, Monitoring Program. Each monitoring program consist of one or more monitoring protocols, each of which is described in four main sections: monitoring objectives, study design, implementation, and analyses.

Biological Goals and Objectives

As described previously, in order for monitoring to be an effective component of the conservation program for the Fort Ord HCP, it must be directly tied to the conservation program's biological goals and objectives. To facilitate this, the biological goals and objectives contained in the most recent draft of the Fort Ord HCP (Zander Associates 2004) have been restated here, without altering their substance.

The goals and objectives developed for each of twelve covered species are similar, as are their rationales. The goals specify the desired conditions for the populations and the objectives provide steps for attaining the goals. They are as follows.

Goal: Preserve or enhance the covered species' populations within the Conserved Habitat Areas of the Fort Ord HCP.

The conservation program outlined in the Fort Ord HCP uses management to maintain the viability of covered species populations within the Conserved Habitat Areas, which are comprised of the Habitat Reserves, Habitat Corridors, and remaining habitat areas with the Development with Reserve Areas (Zander Associates 2004). Proactive management, as outlined in the plan, may in fact enhance populations, given that the populations have likely been reduced by anthropogenic stresses that management is designed to alleviate.

> **Objective 1:** Maintain or increase the distribution of the covered species within each Conserved Habitat Area at which they are known to occur at the time of the Adjusted Baseline.
>
> In general, persistence of endangered plant populations is enhanced when it occupies a larger geographic area. This is because it is less likely that localized chance events such as wildfire, pest outbreaks, or disease will remove the entire population within the installation.

Sampling studies will be implemented throughout the Conserved Habitat Areas to determine the distribution of the species and establish their Adjusted Baselines. To track success toward this objective, subsequent monitoring will be used to evaluate the species distribution with respect to quantitative thresholds for declines relative to the Adjusted Baseline.

It is anticipated that maintaining or increasing the covered species within each of the Conserved Habitat Areas at which it occurs at the time of the Adjusted Baseline will reduce the probability that foreseen and unforeseen changes in habitat conditions will result in population declines that could threaten persistence throughout the installation.

Objective 2: Maintain or increase the abundance of the covered species within each Conserved Habitat Area at which they are known to occur at the time of the Adjusted Baseline.

In general, more abundant populations (i.e. those supporting more individuals) will have a greater probability of persisting and maintaining genetic diversity necessary to adapt to a changing environment than smaller (less abundant) populations. Anthropogenic alterations to the Conserved Habitat Areas may have reduced the abundance of the covered plant species. These include unrestricted recreational use, which removes populations directly and causes soil erosion which can prevent recolonization; the invasion of exotic plants, which likely compete with the covered plants for scarce soil resources where they co-occur; the exclusion of recurring fire, which may reduce available habitat and/or preclude regeneration; and the clean up of soil contaminants and ordnance from past use by the Army.

Sampling studies will be implemented to determine the abundance of the species and establish their Adjusted Baselines. To track success toward this objective, subsequent monitoring will be used to evaluate the species abundance with respect to quantitative thresholds designed to detect declines relative to the Adjusted Baseline. For species with known seed banks, consideration will also be given to maintaining conditions conducive to persistence of viable seed banks which are essential to long term population persistence.

Objective 3: Reduce or prevent the increase of anthropogenic factors which negatively impact the covered species, including exotic plants and unnatural disturbances and erosion.

Exotic plants and unnatural disturbance and erosion caused by vehicles and recreation are known or at least hypothesized to negatively impact populations of the covered plants. The impacts of these and other human-caused factors on the covered species should be reduced over time and eliminated where possible. At a minimum, management should prevent an increase in the area that anthropogenic factors impact.

The occurrence of anthropogenic factors that influence the covered plants will be tracked as part of the protocols described in this biological effectiveness monitoring program in order to evaluate their role in potential observed declines in the distribution and abundance of the covered plants. Because these monitoring protocols will not evaluate exotic plant abundance installation-wide, additional compliance monitoring may be needed to evaluate the extent to which specific goals for exotic plant management described in the FOHCP are being met (Zander Associates 2004).

Objective 4: Increase understanding of the ecological factors influencing the distribution, abundance, and population persistence of the covered species within the Conserved Habitat Areas in order to inform management and monitoring.

Many gaps remain in knowledge of the covered species' ecologies, making it difficult to devise management strategies to prevent their extirpations, and to design the most efficacious monitoring protocols. Monitoring protocols will be designed to increase information about the covered species needed to increase the effectiveness of monitoring and inform habitat management, thus facilitating Objectives 1 and 2. For example, increasing understanding of the ecological factors that influence sand gilia distribution (i.e. habitat characteristics) and demographic performance can facilitate targeted monitoring and the accuracy of monitoring and facilitate effective management.

Background

This section provides relevant background information about the covered species being monitored, including their life history, distribution within the installation, and aspects of their ecology that influenced monitoring protocol design. Rather than an exhaustive assessment of the species, the background section provides only information that is critical to comprehending the monitoring program. Readers are referred to the Fort Ord HCP for more details about the species (Zander Associates 2004).

Monitoring Program

This section describes the elements of the monitoring program. In most cases, separate though complementary monitoring protocols have been developed to track the three quantitative objectives for each goal. In some cases, monitoring protocols are tiered, such that one or more protocols are implemented based on the results of initial protocols. The monitoring program section links each protocol to the biological objective it is designed to track.

Monitoring Protocol

The following sections are used to describe each monitoring protocol (i.e. study) within the monitoring program.

<u>Monitoring Objectives</u>

These identify the specific objectives of the monitoring protocol, thus linking the sampling design to the biological objective(s) toward which it is designed to track success. For protocols involving sampling, this section includes sampling objectives that identify the minimum detectable change, statistical power, and false-change error rate of the study (Elzinga et al. 2001; Section 3).

Study Design

The study design describes the critical elements of the study, including: the general methods, the universe of interest (statistical population), the variables measured, the sample units, the sample size and shape, the manner in which samples are allocated, the sample size, and the frequency and duration of resampling.

Implementation

This section provides specific guidelines for implementing the monitoring studies, including the seasonality, frequency, and personnel.

Analysis

This section outlines how the data will be analyzed and evaluated, including the appropriate statistical tests for each monitoring protocol. As part of the pilot study, the effectiveness of these analyses should be evaluated and changes made, as necessary. In addition, the analyses may need to be modified during the course of implementation of the monitoring program, as the datasets build and/or new statistical tests are developed.

In its design, this program sought to balance two potentially conflicting goals with regards to statistical analyses. The first goal was to harness the power pf statistical tests that have the ability to increase the accuracy and precision of the estimates, and increase power to detect biologically and statistically significant changes amidst the background variation inherent in biologically systems. The second goal was to facilitate ease of implementation and interpretability of results by prescribing simpler, more familiar statistical analyses.

4.2 Monitoring Techniques

Monitoring will be conducted through a variety of different methods, each of which involves the systematic observation and recording of species populations. The methods used to monitor differ in the information they provide, and the effort, skills, and other resources that they require. The goals in developing this biological effectiveness monitoring program were to:

- Monitor indicators that provide accurate representations of the characteristic identified by the objective
- Accurately detect the status of the indicators and identify real and biologically meaningful trends in their values
- Maximize efficacy while minimizing the resources required for monitoring

Four main techniques are incorporated within this monitoring program: 1) reconnaissance surveys, 2) census, 3) abundance sampling, 4) areal extent mapping. Table 1 summarizes the characteristics of these monitoring techniques. More information about these and other techniques to survey populations can be found in sampling and ecological methods references (Hayek and Buzas 1997, Krebs 1999, Southwood and Henderson 2000, Elzinga et al. 2001).

4.2.1 Reconnaissance Surveys

Purpose

The purpose of a reconnaissance survey is to determine presence of a plant species within a given area. The reconnaissance survey, as defined in this program, only determines whether a species is present and does not attempt to describe its distribution or abundances qualitatively or quantitatively.

Use in this Program

In this monitoring program, reconnaissance surveys are proposed as the first tier of tiered monitoring programs for two covered species whose presence within the Conserved Habitat Areas is presently in question: Yadon's piperia and robust spineflower. The purpose of the reconnaissance survey is to determine whether the species are indeed present before more costly Tier 2 protocols are initiated to monitor their distribution and abundance.

Methods

In reconnaissance surveys prescribed in this program, biologists trained to identify the covered species will search the designated area. To ensure a thorough search, especially in larger areas, a systematic approach is recommended in which the search area is divided into sectors, each of which is searched and checked off. Sectors can be delineated based on landmarks within the site that are visible to the surveyors, such as trails, roads, utility poles, and tall trees, among others. Alternatively, the search area can be divided into equal sized sectors by overlaying a grid onto an aerial photograph. Such a map can be taken into the field as a print or digitally, as with a hand held computer equipped with ArcPad. Regardless of the method to create the sectors, surveys should be sure to thoroughly search each sector and check it off once searched.

Reconnaissance surveys should be conducted throughout the area within each sector and site. Though efficiency of the search can be aided through consideration of the specific habitat conditions under which a given species is typically found and available information about its prior location, the entire area should be searched and other steps taken to avoid reporting a false negative finding.

4.2.2 Census

Purpose

In a census, all of the individuals in a population are counted, yielding a measure of abundance. Because there is no sampling, inferential statistics are not needed to evaluate changes. Instead, the number of individuals counted is simply compared through time. Census alone provides no information about the distribution of the population, but can be combined with areal mapping or other steps to describe distribution.

Census can provide a straightforward method of examining plant performance for very small populations (low abundance). For larger populations, censuses can be time consuming, inaccurate, and ineffective for tracking trends.

Use in this Program

Census is proposed as an initial Tier 2 monitoring methodology for Yadon's piperia. As described above, it is currently not known whether the species is present in the Conserved Habitat Areas of the Fort Ord HCP; thus reconnaissance surveys are the first step. Assuming that if Yadon's piperia is discovered it occurs at low abundance, census has been tentatively prescribed as the means of monitoring abundance (Section 5.6). Due to the large size of the installation, populations of most of covered plants cannot be censused and instead will require sampling to monitor abundance.

General Methods

The techniques used to count individuals may vary depending on the species habit (life form). Herbaceous plants are counted in the field, while shrubs can be counted in the field or in high resolution aerial images, assuming that their signature (appearance) is readily discernable (e.g. *Arctostaphylos pumila*). The accuracy of the count in a census will depend on many factors, including the visibility of the species being counted, and the time and skill of the observers. For species that are hard to detect and/or occur at high density, such as herbaceous plants, a systematic approach should be used to ensure that each individual is counted once and only once. If there is substantial error in the counts, such that a repeat count of the population during the same effort yields substantially different results, then abundance sampling should be used to increase repeatability and thus precision of monitoring, even if no time savings is realized.

4.2.3 Abundance Sampling

Purpose

In abundance sampling, a species cover or density is measured in a sample, from which the overall abundance is extrapolated. Because the abundance is estimated based on a sample of the larger population, inferential statistical tests are needed to evaluate the precision of the estimate and to determine to what extent changes in the estimate reflect actual changes in abundance versus the error associated with sampling a portion of the population. Abundance sampling provides little information about the distribution of the population, but can be combined with areal mapping or other methods to assess plant distributions.

Use in this Program

Abundance sampling is prescribed to track populations of the ten covered plant species which are known with confidence to occur within the Conserved Habitat Areas. The populations of all of these species are too large too reliably and cost-effectively monitor through census; hence the need for quantitative sampling to track their abundance.

It has been argued abundance sampling is ineffective for tracking annual plants and species that exhibit dormancy, such as those with seed banks or that persist through belowground storage organs such as tubers (Elzinga et. al. 2001). This is because large interannual variability in abundance due to plant responses to a host of factors can make it difficult to discern overall trends. Though acute for short time scales, this concern is less of an issue for monitoring programs over long time periods, such as that proposed for the Fort Ord HCP (i.e. in perpetuity). Long term monitoring programs provide the opportunity to quantify the interannual variability in abundance. With each sample point, there is greater ability to distinguish prolonged population declines perhaps due to declining habitat conditions from short term drops due to natural factors (e.g. drought). This is accomplished through the use of statistical tests (e.g. General Linear Models) which can partition the variability due to time from that due to time interacting with the individual plots, and thus test hypotheses that, on average, declines are occurring. When coupled with distribution monitoring, as in this program, abundance sampling can be an effective means of detecting long term declines in abundance that can threaten population persistence.

General Methods

Depending on the plant's habit, life history and/or habitat, abundance can be measured as density, which is the number of plants within the sampled area, or cover, the percent of the area which the canopy of the species occupies. Abundance can be estimated through a variety of field techniques which involve counting the number of individuals or estimating their cover using quadrats, line intercepts, and point intercepts (Elzinga et al. 2001). In this monitoring program, density and cover are sampled in permanent quadrats.

As in all sampling, numerous characteristics of the sampling design can influence the precision of the abundance estimate, including the size and shape of the sample unit, the method of allocating samples (randomly, stratified randomly, etc.), whether the samples are temporary (re-allocated each interval) or permanent (resampled each interval), and most importantly, the number of samples taken (Hayek and Buzas 1997, Krebs 1999, Southwood and Henderson 2000, Elzinga et al. 2001). Current information about the abundance and distribution of the covered species was used to inform these and other aspects of the abundance sampling protocols. However, as described previously, it is essential to evaluate the effectiveness of the sampling design using a 'pilot study'.

A variety of statistical analyses will be used to evaluate the status and trends in the abundance of the covered species. Single interval declines can be tested using paired t-tests. Trends can be evaluated using a form of regression known as route regression. Analysis of covariance will be used to incorporate climatic data (e.g. annual rainfall) that is known or hypothesized to influence abundance of herbaceous plants. General linear models will allow maximum inference from the data sets, as they can identify the role of a variety of factors that will influence abundance, including site (e.g. CHA), year, and climate, and thus more accurately identify trends amidst this variation. More information about abundance analyses are provided in the monitoring protocols, and in statistical references (Winer et al. 1991, Zar 1996, Underwood 1997, Nyberg 1998, Dytham 1999, Piepho and Ogutu 2002)

4.2.4 Areal Extent Mapping

<u>Purpose</u>

In areal extent mapping, the perimeter of patches of plants is delimited, allowing monitoring of the distribution of plants through time. When incorporate into a GIS, patch polygons can also be used to evaluate changes in the area occupied. In addition, numerous analyses can be conducted to evaluate the association of the plant patches with abiotic and biotic characteristics of the environment (soils, vegetation types, topography) to evaluate the habitat characteristics, and in response to different management treatments and regimes.

<u>Use in this Program</u>

Areal mapping is prescribed to monitor the areal extent and location of the five herbaceous plants known to occur within the CHAs. In addition, this monitoring program proposes areal mapping for the maritime chaparral community in the CHAs in order to facilitate monitoring of the five covered shrubs. In addition to providing a spatially explicit means of tracking the distribution and areal extent of the covered species, the results of the areal mapping studies will be used to design and implement abundance sampling as part of this monitoring program. Furthermore, such readily available information about the location and area occupied by the rare plants can aid design and implementation of management projects, as well as the evaluation of management effects.

Repeated areal extent mapping will be used to evaluate the status and trends of the covered plant distributions installation-wide and within each of the four management entity regions: Fort Ord Reuse Authority (FORA), Bureau of Land Management (BLM), California Department of Parks and Recreation (CDPR), and the University of California Natural Reserve System (UCNRS). It will be used to evaluate declines in the distribution of the covered species compared to the Adjusted Baseline, which will be based on the initial implementation of the areal extent mapping protocols.

<u>General Methods</u>

Field Work

The areal mapping protocols described in this program rely on delineating patches of each of the covered plant species by ‘connecting the dots’ of the outermost individuals within a patch. The term ‘patch’ is clearly and objectively defined based on the location of the next nearest plant. That is, one or more plants that exceed a certain, pre-specified distance from the next nearest plant are defined as occurring in a separate patch and mapped accordingly. Individual plants that are more than the pre-determined distance from all other plants are simply mapped as points.

Quantitative and clear mapping rules are essential to the effective use of areal mapping to monitor the distribution of plants through time as they provide a means in which the location and areal extent of the plant patches can be mapped repeatably. Mapping rules are needed to determine what constitutes a single large patch versus two separate smaller patches, as these decisions determine calculations of area occupied. Mapping rules based on the distance between individuals have proven effective in a previous study of *Piperia yadonii* (McGraw 2004c).

Mapping and subsequent analyses can be greatly aided by delimiting polygons in the field on a hand-held computer equipped with ArcPad software and recent, high resolution aerial imagery. Following field assessment, the polygons can be downloaded directly into GIS software for analysis, thus removing the time and costs associated with digitizing from paper maps. Linking the hand held computer (wearable PC, or tablet PC) to a GPS (global positioning system) can further enhance the ease and precision of areal mapping by allowing points and the vertices of polygons to be directly recorded.

Analysis

Areal extent mapping is designed to detect shifts in occupied habitat of species due primarily to changes in plant distributions resulting primarily from alterations in habitat suitability at the landscape level, such as occur due to succession or the invasion of exotic plants. As such, the frequency of implementation should be a minimum of 5 years, with 10 years recommended. For annual species which exhibit dramatic inter-annual variation in aboveground expression due to climate, areal extent mapping should be conducted in what are known to be ‘good years’ and where appropriate, using mapping rules that account for the fact that plants may be present belowground (i.e. larger maximum distances to define common patch occurrence).

With the aid of GIS software, descriptive statistics can be generated to describe the area of occupied habitat, number of patches, and mean and variance of the patch size, among other aspects of the population which can be compared through time and evaluate with respect to established thresholds. If a random subsample of the population is mapped, as may be necessary to track the distribution of potentially widespread species such as the Monterey spineflower (Section 5.2.1), then inferential statistics can be used to determine whether observed changes in the areal extent are statistically significant.

Measurement Error

There will inevitably be some measurement error when mapping the plant distributions. For each of the covered species monitored using areal extent mapping, this error will be quantified first during the pilot study, in an attempt to reduce it, and then during establishment of the Adjusted Baseline, so that it can be considered when evaluating observed changes. To quantify error, two observes will be asked to independently delimit the distribution of a plant within a series of test areas. The measurement error will be determined as the average percent difference in the size of the polygons, where difference is a positive number calculated as follows:

$$\text{Difference} = \text{Area}_1 – \text{Area}_2)/\text{Area}_1$$

where subscript 1 indicates the greater of the two values and subscript 2 indicates the lesser of the two values.

The measurement error will be taken into account when evaluating whether observed declines in the areal extent of a covered species compared to the Adjusted Baseline exceed the established thresholds and thus should trigger remedial action.

Sampling

This program proposes that the species distributions be monitored in CHAs installation-wide. Pilot studies may reveal that this is unfeasible for some widely distributed covered species, such as Monterey spineflower. If this is the case, areal extent mapping can be conducted within a sample of the area of CHAs.

In order to use results of the sample to infer the status and trend of the species distribution within the installation, it is essential that the sample areas be chosen. Polygons defined by Jones and Stokes Associates (1992) based on roads and prominent trails which criss-cross the installation could be randomly selected for areal extent mapping. If, due to management and habitat restoration, the polygon boundaries will not be readily distinguishable in the future, sampling could instead be conducted within new, randomly located macroplots. These areas could be permanently marked and their locations georeferenced using a GPS, such that observers equipped with GPS receivers implementing areal extent mapping would know whether they are indeed within the boundaries of the sample area.

To obtain the information about plant distribution status and trend within each of the management entity regions that is needed to evaluate success of the biological goals and objectives, it may be necessary to use a stratified-random method of locating the sample areas for areal extent mapping, as described in Section 4.3.

Use in Triggering Remedial Action

Plant distribution data obtained from areal extent mapping will be used to evaluate the success of individual management entity regions in attaining the biological goals and objectives of the FOHCP. Specifically, it will be used to evaluate whether the species distribution has declined relative to the Adjusted Baseline, and thus trigger remedial action by the management entity.

4.2.5 Other Monitoring Techniques

In addition to the four described above, other techniques can be used to monitor rare plant populations. Some of the methods carefully considered in devising this monitoring program which were not ultimate incorporated include photoplots, habitat-based monitoring, frequency sampling, and demographic monitoring (Hayek and Buzas 1997, Krebs 1999, Southwood and Henderson 2000, Elzinga et al. 2001). These approaches were not initially prescribed for use in this program because they were deemed to provide less valuable and/or reliable information and/or incur greater costs than the methods described above. They should be evaluated as potential additions or substitutions for the prescribe methods, however, should population conditions, monitoring objectives, or funding change, or the results of monitoring indicate that the prescribed methods are not effective.

Table 1: Characteristics of four monitoring techniques incorporated in the monitoring program for the covered plants of the Fort Ord HCP. (Details in Section 4.2)

Characteristics		Reconnaissance Surveys	Census	Abundance sampling	Areal mapping
Technique	**Data Collected**	Specified area(s) evaluated solely for presence/absence of a species, which, once identified, complete the survey	The number of individuals in a population is counted, providing a measure of its abundance. Additional information about the population can be collected (e.g. age structure, plant vigor).	Cover, density, or another appropriate measure of abundance of one or more species is sampled within randomly located, permanent or temporary quadrats or transects	Field and/or aerial image evaluation used to delimit patches of occupied habitat of one or more species based on quantitative, repeatable mapping rules
	Application	Systematic search aided by dividing specified area into sectors or cells and searching for a pre-specified amount of time to prevent false negative findings	Depending on the size of the population and habit of the plant (i.e. shrub or herb), a systematic walk through the population, and/or analysis of high resolution aerial imagery can be used to count individuals.	Quadrats can be located completely randomly *or* within a narrower area such as a specific habitat type, depending on the universe of interest	Usually conducted throughout the range of a species, but can be sampled
Information Provided	**Distribution**	No	No	Partial, based on sample	Yes, spatially explicit
	Location	No	No	Partial	Yes
	Abundance	No	Yes	Yes	No (except as abundance is correlated with distribution)
	Descriptive Analysis	Summary of results (presence/absence) by area (sectors, cells) searched	The number of individuals is compared through time.	Abundance can be evaluated through time, with declines used to indicate reductions in population persistence	Overlay analyses used to evaluate changes in distribution spatially (with maps) or descriptively by characterizing the plant distribution (total area occupied, mean patch size, number of patches)
	Frequency	variable	variable	1-3 years	5-10 years

Table 1: Characteristics of four monitoring techniques incorporated in the monitoring program for the covered plants of the Fort Ord HCP. (continued)

Characteristics		Reconnaissance Surveys	Census	abundance sampling	areal extent mapping
Inferential statistical techniques to evaluate changes	**Based on Single-Interval Changes**	not applicable	not applicable	t-tests (temporary plots), paired t-test (permanent plots), or ANOVA (if stratified by site) used to detect changes	Statistics are not needed if the entire population is evaluated. If sub-sampled areas are chosen randomly, a t-test can be used to test for changes, with individual areas providing the replicates.
	Based on Trend Analysis	not applicable	not applicable	Repeated measures ANOVA (for 3 or more intervals) and route regression (for 5 or more intervals) to evaluate changes in abundance through time	Regression can be used to evaluate changes in areal extent after implementation five or more times
Effectiveness in Monitoring Effects of Management	**Overall (installation wide)**	Could be first step to determine effects of management if a species was not present in an area prior	Only effective for very small populations.	Trend analysis can be used to detect prolonged changes over time in response to the overall management program	Can examine changes in distributions with respect to locations of management (proposed, implemented)
	Specific Management Projects	Could be first step to determine effects of management if a species was not present in an area prior	Can be effective way to evaluate project effects on very small populations.	Data might be used to detect changes in abundance due to specific management projects; however, sample size in the project area likely insufficient, necessitating additional plots or a separate study.	Not especially useful/powerful technique for statistically evaluating effect of a project on plant population
Relative Skill Level	**Field**	low	low	low-moderate	low-moderate
	Analysis	low	low	moderate	low-moderate
Relative Effort and Costs	**Field**	low	proportional to population size	moderate	proportional to distribution
	Analysis	low	low	low-moderate	moderate

Table 1: Characteristics of four monitoring techniques incorporated in the monitoring program for the covered plants of the Fort Ord HCP. (continued)

Characteristics		Reconnaissance Surveys	Census	abundance sampling	areal extent mapping
Overall Assessment	**Advantages**	● Cost effective approach to determining presence *before* initiating more costly monitoring	● Provides quantitative estimate of species abundance ● Straightforward analysis ● Low cost for small populations	● Provides quantitative, statistically analyzable assessment of species abundance and frequency, two important indicators of population persistence	● Provides spatially explicit information about population distribution that can be compared to habitat conditions, management ● Skill level requirements modest
	Disadvantages	● Cannot be used to track population persistence	● Time intensive for large populations and/or species that are difficult to located ● Systematic error can be introduced between years if observers fail to detect individuals (don't have search image, don't look long enough)	● Statistical analyses required	● Can be time consuming for large populations ● Interannual variability in herbaceous plant populations could inhibit ability to longer term changes in distribution ● Sampling error due to lack of adhesion to mapping rules can reduce ability to detect real changes
Use in Covered Plant Monitoring Program for Fort Ord HCP		First step in tiered monitoring for species not positively known to occur in Conserved Habitat Areas	Use to monitor extremely small populations	Used to track abundance of all covered plants	Used to track location, distribution, and area of occupied habitat of most covered species

4.3 CONSIDERATIONS FOR SAMPLING STUDIES

Many of the proposed monitoring protocols are based on quantitative sampling, in which the abundance (density, cover) of the entire population is inferred based on statistical analysis of a random sample from the population. Sampling can provide a cost effective and accurate means of detecting and tracking biologically meaningful changes in the population, and is an essential component of monitoring the covered plants within Fort Ord due to the large area to be monitored. To be effective, sampling studies must be carefully planned and implemented considering valid sampling techniques, the biology of the species, and the monitoring goals and objectives. These protocols should be refined based on the results of a monitoring pilot study and efforts to establish the Adjusted Baseline, as well as new information (e.g. scientific studies).

Though a complete discussion of sampling techniques is beyond the scope of this document, the following section addresses several important considerations in development of the sampling monitoring protocols. Additional information about sampling studies can be found in several sources (Hayek and Buzas 1997, Krebs 1999, Southwood and Henderson 2000, Elzinga et al. 2001).

4.3.1 Monitoring Targets

In monitoring plant abundance, the decision must be made whether to track density, cover, or both measures of abundance. For each plant species in this monitoring program, this decision was based on the extent to which the measure accurately represents plant population dynamics and persistence, feasibility of the measurements, and the precision and thus repeatability of the measure. The following examples are used to illustrate how these considerations influenced the abundance measure prescribed.

<u>Cover</u>

Monterey spineflower is an annual plant. It typically occurs in dense patches of numerous individuals, the inflorescences of which often overlap. Thus counting individuals can often be difficult, imprecise, and time consuming. Moreover, density is arguably a poor indicator of population performance and persistence. Like its conspecific the Ben Lomond spineflower (*Chorizanthe pungens* var. *hartwegiana*), the Monterey spineflower may responds to beneficial habitat conditions by increasing plant growth (McGraw 2004a). Since plant size is highly correlated with seed production in *Chorizanthe* spp. (McGraw and Levin 1998, McGraw 2004a, Baron and Bros *in press.*), canopy cover may prove a more representative measure of plant population performance. It is also more likely to reflect habitat conditions, as McGraw (2004a) found that the Ben Lomond spineflower cover was highly influenced by canopy cover and exotic plants, two factors which are likely to influence Monterey spineflower.

<u>Density</u>

Density was selected as the variable to track abundance of seaside bird's beak for several reasons designed to increase precision and representation of the estimate. First, unlike Monterey spineflower, seaside bird's beak does not grow in dense aggregations within which individual canopies are not discernable. Thus, counting individual plants is feasible. Indeed, it will likely be more accurate, as the "canopy" created by seaside bird's beak when in flower is diffuse, such that estimating its cover would be difficult.

Cover and Density

In another example, this monitoring program proposes to track both the cover and density of the five chaparral shrubs. This is proposed because neither canopy cover nor density alone is representative of their population performance and likelihood of persistence through time. The chaparral shrub species, like Monterey spineflower, likely exhibit greater fecundity when they are larger. As a result, plant cover is a good measure of population status.

However, the canopy cover of all five plants will necessarily decline dramatically following a fire. As fire is required to facilitate regeneration of these species, such declines in canopy cover should clearly not be used trigger remedial management action. In order to evaluate whether populations are persisting, it is important to examine density (number of individuals), which unlike canopy cover, would be expected to increase following a fire that is successful in regenerating the population.

Given that recording density as well as canopy cover requires minimal additional effort while providing important information, this monitoring program recommends tracking both measures for the covered shrubs.

Seed Banks

Finally, it is important to recognize that the monitoring protocols within this program track solely aboveground populations of the covered plants. Many of the covered plants exhibit seed dormancy and have viable seed on or below the soil surface in what are typically referred to as 'seed banks'. This belowground component of the population can be important for species persistence. This is true for populations of herbaceous plants, such as sand gilia, which rely on seed banks to persist during periods which are unfavorable for aboveground demographic performance (survivorship, reproduction). Seed bank dynamics can also prove essential to long term persistence of the chaparral shrubs, which are obligate seeders and require presence of a viable seed bank to regenerate following fire.

Unfortunately, it is very difficult to accurately sample and thus monitor the status and trends of seed banks (Elzinga et al. 2001). For this reason, only aboveground populations are proposed for monitoring. However, the status of seed banks will be considered when evaluating observed population changes and in prescribing remedial actions in response to declines exceeding the established thresholds. Examination of belowground populations through seed bank studies and monitoring may be merited as part of the remedial action to enhance success toward the biological goals and objectives.

4.3.2 Spatial Considerations in Sampling Design

Regardless of what is actually being monitored, it is important that results are accurate and generalizable to the larger system. Accuracy measures the extent to which the value measured reflects the actual sampled population. Generalizability refers to the degree to which the sampled population reflects the larger system to which the sample is being extrapolated. Both accuracy and generalizability are influenced by many aspects of the monitoring methods, including the number of samples, the method of allocating samples, the 'universe of interest', among other factors, as described below (Hayek and Buzas 1997, Krebs 1999, Southwood and Henderson 2000, Elzinga et al. 2001).

Number of Samples

All else being equal, the more samples that are taken, the greater is the accuracy of the sample in representing the actual conditions. There are no magic numbers for accurate sampling. Instead, the more variable the samples, the more samples are required to accurately depict the mean value and the variability around the mean. One key advantage of power analyses is that they can be used to determine the sample needed to attain the sampling objectives, including statistical power to detect real declines amidst the background variability, thus avoiding implementation of insufficient monitoring studies and the extra costs associated with excess sampling.

Allocation of Samples

There are many methods of allocating samples. As a first comparison, they fall into two categories: subjective and objective. Subjective allocation occurs when the observer deliberately chooses samples. Most often samples are chosen because they are deemed 'representative of the population'; however, in some cases they are chose for strictly logistical reasons, such as they are closer to the road or trail.

In objective allocation methods, samples are not chosen, but rather identified using a randomization procedure. In complete random sampling, the location of each sample is completely random with respect to other samples. In systematic sampling, the location of the first sample is determined randomly; however, all subsequent samples are located using a standard system, typically based on the fixed distance from each other. As a result, most systematic sampling methods result in plots being located in a grid

Allocating samples objectively increases accuracy and generalizability compared to subjective allocation, in which observer bias inevitably influences the outcome of the sample. In addition, objective sampling is needed to meet the assumption within inferential statistical analyses that samples are random. Therefore, this program only incorporates objective methods of locating samples. Samples should never be subjectively located (Elzinga et al. 2001).

This program proposes that samples be located randomly; however, if maximizing spatial coverage of sampling is identified as an important objective of the monitoring, systematic sampling can be used without violating the assumptions of the statistical analyses, provided that a random start is used to initiate location of the systematic samples (Elzinga et al. 2001).

Universe of Interest

The so called 'universe of interest' is the system which sampling is designed to represent. For example, if monitoring is designed to track the abundance of sand gilia within the Conserved Habitat Areas, then the latter represents the universe of interest. In order for results of monitoring to be generalizable to the universe of interest, the 'sample population' within which samples are allocated must be the same as the universe of interest. For example, if sand gilia was sampled only within the Fort Ord Natural Resource Management Area, then results of monitoring would apply only to there, and not the other CHAs were the rare plant occurs. As another example, if sand gilia abundance was sampled only within maritime chaparral gaps, because perhaps that is where it is known to primarily occur, then the results of the monitoring study would not apply to the entire universe of interest (Conserved Habitat Areas) but instead only to maritime chaparral gaps.

If research has shown that sand gilia does not occur in annual grasslands or coastal sage scrub, then the universe of interest could be defined as the area within the CHAs *excluding* those communities. As a result, allocation of the same number of samples within this new sample population would result in increased precision of the abundance estimate, as there would be fewer zeros associated with sampling inappropriate habitat.

In species-specific abundance sampling protocols outlined in this program, the universe of interest is patches of occupied habitat. That is, quadrats used to sample abundance will be randomly located in the patches delimited during the areal mapping for the species. This is designed to reduce the variability associated with randomly locating quadrats throughout the CHAs or even areas deemed to be suitable habitat (e.g. maritime chaparral gaps), which typically results in a large number of 'zeros' (i.e. no plants occurring). Such restricted sampling narrows the universe of interest to 'occupied habitat', which increases the precision of the abundance estimate.

Stratification of Sampling

It may be advantageous in certain circumstances to use stratified sampling, in which the universe of interest is broken up into separate areas, or strata, within which samples are randomly or systematically located. Though stratification can be done for many purposes (Elzinga et al. 2001), its primary utility in the FOHCP would be to allocate samples to each of the four Management Entity Regions (MERs) according to the area of occupied habitat (Table 2).

For example, sample sites to track the abundance of covered species within the maritime chaparral sampling protocol (Section 5.8.2) will be allocated within the maritime chaparral polygons mapped as part of areal extent mapping (Section 5.8.1). To ensure that the sampling intensity within each MER is proportional to the area of habitat it contain, the number of samples located in each MER will be determined by multiplying the total number of samples (e.g. n=100) by the proportion of occupied habitat each MER contains (Table 2).

Table 2: Hypothetical examine of how stratified sampling would be used to allocate maritime chaparral sampling sites to each of the four Management Entity Regions (MER) based on the proportion of maritme chaparral habitat within each MER. (Details descri

Management Entity Region	Total Area of Occupied Habitat (Acres)	Proportion of total Occupied Habitat	Number of the 100 replicates
Bureau of Land Management	220	0.47	47
University of California	189	0.41	41
California Department of Parks and Recreation	27	0.06	6
Fort Ord Reuse Authority[1]	30	0.06	6
Total	466	1.00	100

[1] FORA managed CHAs include: Monterey County, City of Marina, Monterey Peninsula College, and Monterey Peninsula Parks District.

4.3.3 Temporal Considerations in Sampling Design

At their simplest, monitoring studies are sampling studies that are implemented repeatedly through time. As a result, monitoring protocols must address temporal aspects of implementation, including the frequency and the duration of data collection within sample sites.

Frequency

All else being equal, the accuracy of trend estimates increases with increasing frequency of measurement of the site, with two important caveats: 1) There is typically no added benefit of sampling plant populations more than once a year, as there can be with animals owing to variability in detectability through a season, and 2) Annual monitoring of long lived species, such as the covered shrubs, provides little additional information relative to less frequent monitoring (e.g. 5 years), as populations typically do not change appreciably during such short time periods.

Costs of the monitoring program are very closely determined by the frequency of monitoring. Therefore, benefits of more frequent monitoring were weighed against their costs in designing this program.

As described in Section 5, it was determined that the herbaceous species abundance should be monitored annually, to aid detection of real trends amidst the interannual variability in abundance that primarily results from climatic variability. For the covered shrubs, a frequency of 5 years is recommended for monitoring abundance.

Duration of Sample Site Use

Sample sites for plant abundance can be either permanent, in that they are revisited during each sampling interval, or temporary, in that they are visited only once, such that new samples are randomly located during each new sample interval.

For the same sampling effort (i.e. number of sample sites), permanent plots provide greater power for detecting changes and trends than temporary plots (Elzinga et al. 2001, McDonald 2003). However, long term monitoring protocols using permanent plots face two disadvantages. First, permanent plots can suffer ‘response fatigue’, in which repeated sampling (i.e. trampling, etc.) alters the measurements and thus biases the estimate such that it is no longer representative of the entire population the status of the sample (McDonald 2003). Second, revisiting the same plots through time necessarily reduces the overall proportion of the population examined compared to temporary plots, which are more effective at accurately reflecting the status of the population (McDonald 2003).

A recent development in long term ecological monitoring is the use of panel designs, which are designed to increase the area monitored and reduce the influence response fatigue. In panel designs, sample plots (sites) are grouped within panels, within which all sites are sampled at the same interval. The sites within a panel can be permanent (sampled throughout the life of the monitoring study), temporary (sampled only once), or sampled for a limited duration, such as 10 years. In designing panel-based monitoring studies, one also determines the frequency with which panels will be sampled. In a rotating panel design, for example, three panels each containing 50 sample sites could be sampled once every three years, with Panel 1 sampled in years 1,4,7, 10, and so on, Panel 2 sampled in years 2,5,8, and 11, and so on, and Panel 3 sampled in years 3,6,9,and 12 and so on. In such a monitoring program, the annual effort is constant (50 plots/year); however, three times the proportion of the population is sampled compared to if the same 50 plots were sampled each year.

In split panel monitoring designs, the revisit schedule, or frequency of resampling, is different for one or more of the panels. One split panel design balances the objective of trend detection with that of accurate status estimation. In this design, one panel is comprised of permanent plots that are always revisited. The other panel (or series temporary panels) is comprised of sites that are randomly located each sample period (McDonald 2003).

Panel designs offer a lot of advantages to long term monitoring, however one disadvantage is that slightly more complicated statistical approaches are required for data analysis. Mixed linear models are needed to partition the variance associated with the different factors and thus discern changes and trends in population parameters.

SECTION 5: MONITORING PROGRAMS FOR THE COVERED PLANTS OF THE FORT ORD HCP

This section describes the monitoring protocols recommended for tracking success toward the biological goals and objectives of the Fort Ord HCP. They were developed to achieve the following goal of this biological effectiveness monitoring program:

> *To provide objective, repeatable methods for collecting, analyzing, and interpreting ecologically meaningful information about the covered species that can be used to evaluate the status of the populations, the effectiveness of the conservation strategy, and the design of future management and monitoring, using the most cost-effective methods possible.*

Pilot studies will be needed to evaluate the effectiveness of each of the monitoring protocols, and make necessary changes. Each protocol recommends important elements of pilot studies. Monitoring must also be adaptive through time, to ensure that the data collected can be used to evaluate success of the adaptive conservation program (Section 2.1; Figure 1).

The covered species differ in characteristics that influence the design of monitoring protocols, including in habit (life form), life history, distribution, and abundance. In addition, they vary in their known or hypothesized threats to persistence and ecological responses to fire, soil disturbance, and exotic plants. These differences are addressed in the design of the following monitoring protocols.

5.1 Sand gilia
5.2 Monterey spineflower
5.3 Seaside bird's beak
5.4 Contra Costa goldfields
5.5 Coast wallflower
5.6 Yadon's piperia
5.7 Robust spineflower
5.8 Maritime chaparral species monitoring

Tables and figures referenced within the protocols are located at the end of this section. Background information about monitoring techniques and approaches that may be necessary to understand the details and rationales of the monitoring protocols is provided in previous sections.

5.1 Sand Gilia (*Gilia tenuiflora* ssp. *arenaria*)

Biological Goals and Objectives

Goal: Preserve or enhance sand gilia populations within the Conserved Habitat Areas of the FOHCP.

Objective 1: Maintain or increase the distribution of sand gilia within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 2: Maintain or increase the abundance of sand gilia within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 3: Reduce or prevent the increase of anthropogenic factors which negatively impact sand gilia, including exotic plants and unnatural disturbances and erosion.

Objective 4: Increase understanding of the ecological factors influencing the distribution, abundance, and population persistence of sand gilia within the Conserved Habitat Areas in order to inform management and monitoring.

Background

Sand gilia is an annual herb that occurs on stabilized coastal dunes and in canopy gaps in maritime chaparral. It is known to occur in all four of the management entity regions (Tables 3, 4).

The distribution of sand gilia could be reduced due to fire exclusion, which increases shrub and tree cover; trampling and habitat degradation due to unnatural disturbance including recreation; and the invasion and spread of large, highly competitive exotic plants (e.g. *Cortaderia jubata, Carpobrotus chilensis, Genista monspessulana*). Its abundance could be reduced by the invasion and spread of European annual plants and perhaps unnaturally high levels of deer herbivory (Table 3). Sand gilia abundance and small-scale distribution patterns of sand gilia are influenced by interannual variability in climate (Fox et al. *in review*).

Sand gilia exhibits seed dormancy, such that viable seed exists within a soil seed bank. This belowground component of the population of sand gilia may play an essential role in facilitating population persistence, by precluding extirpation caused by failure of the aboveground population to reproduce during one or more 'bad' years'. More information is needed about the demography and ecology of the sand gilia seed bank to understand its role in population dynamics and growth. Because monitoring belowground populations is very difficult, this program monitors aboveground populations, the status and trends of which are assumed to reflect persistence of the overall population, until such time that research indicates otherwise.

Monitoring Program

The monitoring program for sand gilia incorporates two monitoring protocols:

1. Areal mapping to determine and monitor sand gilia distribution
2. Abundances sampling to estimate and monitor sand gilia density

The complementary monitoring protocols will track success toward the first three biological objectives for sand gilia, as well as increase understanding of the rare plant's ecology needed to inform management (Objective 4).

Monitoring of the maritime chaparral species is anticipated to provide additional information about the abundance of sand gilia and the factors affecting its populations within this community (Section 5.8). However, due to the rarity of the covered herb, it is presently assumed that it will not be observed within a sufficient number of the sample plots located within maritime chaparral to provide the sample size needed to evaluate abundance. Should the pilot study for the maritime chaparral monitoring prove this assumption incorrect, separate abundance monitoring for sand gilia described below could be eliminated.

5.1.1 Areal Mapping for Sand Gilia

Monitoring Objectives

The objectives of areal mapping are:

1. To identify and track the location and areal coverage of sand gilia patches within the Conserved Habitat Areas
2. To allow spatially explicit examination of the distribution that will facilitate the design of management and other monitoring studies (incl. quantitative sampling below), and provides insight into the factors affecting the population distribution and persistence.

Monitoring Design

Field Survey

Location: Areal mapping of sand gilia will occur in the Conserved Habitat Areas (CHAs) where it is known to occur, and in any other CHAs that may provide suitable habitat (Table 4). During the first implementation, the entire installation will be searched. In subsequent implementations, time and costs will be reduced by examining areas as follows: 1) re-examine areas where it is known to occur, either from prior mapping, or identification of new patches during the course of management and monitoring efforts, 2) examine areas that have experienced management that could result in establishment of new populations, such as burned or cleared areas, and 3) re-examine areas where it was not known to occur, but for which habitat appears suitable.

Patch Delimitation: Each patch of sand gilia will be delimited by 'connecting the dots' between outermost individual plants, with plants more than 5m apart included in separate patches. Isolated patches (i.e. two or more plants) that occupy $1m^2$ or less will be mapped as points and assigned an area of $1m^2$. Individual plants (i.e. those greater than 5m from other aboveground individuals) will be mapped as points. Dense patches of large woody vegetation (chaparral shrubs and trees) or other factors such as paved roads which are clearly *not* occupied by sand gilia will be excluded from the mapped patches, even if they are flanked by sand gilia which are less than 5m apart.

Anthropogenic Factors: Within the delimited polygons, the occurrence of the following will also be recorded: 1) aggressive exotic plants (*Cortaderia jubata, Carpobrotus edulis or* other large exotics), 2) dense infestations of European annual plants, 3) erosion caused by roads or recreational use (historical or current).

Implementation

Seasonality: Field surveys must occur during the flowering period of the species, which varies in both its timing and duration. Sand gilia typically flowers in April; however, flowering may occur as early as late March, and as late as mid May. As a result, flowering period duration ranges from 3-8 weeks, depending on annual climate. Beginning in March, bi-weekly reconnaissance surveys will be used to track the phenology of sand gilia and determine the onset of areal mapping.

Frequency: Areal mapping of sand gilia will occur approximately every 10 years. To reduce the potential for inter-annual variability in density to influence areal extent, areal mapping will be conducted in years when aboveground expression is high. Research to date indicates that abundance is greater in wetter years; thus, areal extent mapping should be conducted in the first year with rainfall exceeding the mean + 1SD of the mean (determine this; e.g. El Niño years) beginning 8 years following the previous mapping effort. Aerial imagery that is no more than 3 years old should be used; thus, the availability of aerial imagery will also determine when repeat monitoring is conducted.

Personnel: Areal extent mapping of sand gilia will be completed by a team of individuals trained to identify the rare plant and delineate patch perimeters following the mapping rules described above. Individuals will be trained and required to pass a field test which will establish their qualification for the field component of areal mapping.

Analyses

Descriptive: Through GIS, the patch (polygons) layer will be used to calculate total patch area, the number of patches, and mean patch size for sand gilia, and for anthropogenic factors. These statistics will be computed by CHA, by management entity region, and for the installation as a whole.

Single Interval Comparisons: Calculate change in sand gilia and anthropogenic factor areal coverage as:

$$\Delta = \frac{\text{Area}(t) - \text{Area}(ab)}{\text{Area}(ab)}$$

where *t* is the current time period, and *ab* is the adjusted baseline.

Extra-curricular: In support of Objective 4, the spatial and tabular data should be used in additional analyses designed to increase knowledge of sand gilia biology. For example, overlay analyses can be used to evaluate the occurrence of patches within different vegetation types or in response to management (e.g. fire). Though encouraged, these additional analyses are not a requisite component of the monitoring program unless required as part of remedial action (Section 2.2).

Pilot Study

Exploratory studies should be used to evaluate the effectiveness of the mapping rules in delineating patch polygons. Specifically, the nearest neighbor rule for patch inclusion (i.e. 5m) and rules for excluding areas of non-habitat between sand gilia separated by less than 5m should be evaluated. Exploratory studies should occur in several sites exhibiting a range of sand gilia densities, distributions, and other conditions such as vegetation conditions which would influence the accuracy and repeatability of the protocol (Section 3.3).

If sand gilia distribution cannot be feasibly mapped in one year, then the distribution of sand gilia could be monitored in a subset of the CHAs, JSA polygons, or macroplots, which would be randomly selected, as described in Section 4.2.4.

Establishing the Adjusted Baseline

The Adjusted Baseline for sand gilia distribution will be established through implementation of areal mapping during the first high rainfall year following permit issuance through the Fort Ord HCP. Provided that the sampling protocol meets the monitoring objectives, the total patch area will be used as the Adjusted Baseline for sand gilia distribution. Due to the extensive nature of the field survey effort in areal extent mapping, it would be cost-prohibitive to use multiple years of data to establish the distribution baseline.

Ideally, the areal mapping will be conducted for the entire installation within a given year. However, because the Conserved Habitat Areas comprise a large area (16,195 acres), much of which contains maritime chaparral gaps and therefore will need to be surveyed, the Adjusted Baseline may require more than one year for completion Though natural fluctuations in sand gilia demographic performance during this time will cause variability in aboveground population expression among years, the large threshold for distinguishing unoccupied habitat (i.e. 5m) will reduce the variability among sites caused by the temporal shift in surveys.

Thresholds and Evaluation

Due to the low frequency at which areal mapping will be conducted, thresholds used to trigger remedial efforts for sand gilia area based on single intervals (i.e. 2015 compared to 2005). At this time, recommended thresholds are as follows:

- A 10% decline in total areal coverage compared to the Adjusted Baseline for each Conserved Habitat Area, management entity region, or installation-wide.
- A 10% increase in the total areal coverage of anthropogenic factors which negatively impact sand gilia distribution, including exotic plants and unnatural disturbances and erosion caused by recreation

These thresholds may need to be revised per results of the Adjusted Baseline.

5.1.2 Abundance Sampling for Sand Gilia

The abundance of sand gilia will be monitored by repeatedly sampling sand gilia density within patches of occupied habitat identified in the areal mapping in each of the Conserved Habitat Areas.

Monitoring Objectives

The objective of quantitative abundance sampling is to accurately track the density of sand gilia plants within the Conserved Habitat Areas in order to:

1. Detect biologically meaningful declines in density amidst the background fluctuations in abundance, and
2. Link declines to changes in habitat conditions to inform remedial efforts.

Sampling Objectives

The objectives of the monitoring protocol are to have 80% power to detect 20% declines in sand gilia over at least 5 sampling intervals, with a 10% chance of indicating a statistically significant change has occurred when one has not.

Monitoring Design

Field Methods

Sampling Design: Sand gilia abundance will be sampled using 1m x 5m quadrats randomly located within the areal extent mapping polygons for sand gilia. Monitoring will be conducted using a split panel design designed to balance the power to detect trends derived from permanent plots, with the power to estimate the status of the populations that comes from randomly locating plots (Table 6). Panel 1 will consists of 30 plots randomly located within the areal extent mapping polygons used to establish the Adjusted Baseline for the plant’s distribution. This panel will be sampled annually beginning after the areal extent mapping is completed and continuing in perpetuity.

In addition, rotating panels consisting of 15 plots will be randomly located within the sand gilia patch polygons each time the areal extent mapping is conducted. The sites within each panel will be sampled until the areal extent mapping is conducted again, after which time a new panel of 15 sites will be established, and the prior pane retired (Table 6).

Within each 1m x 5m sample plot, the number of sand gilia individuals will be counted.

Plot Monumenting: To increase the repeatability of counts between sampling intervals, the four corners of the quadrat will be permanently monumented using 75cm long pieces of metal conduit (approx. ½" diameter). The markers should be placed 50cm into the ground. In areas where vandalism is not a concern, the tops of the markers can be painted to facilitate detection. The coordinates of the north corner stake will be recorded using a survey grade GPS, which will facilitate relocation of the plot should the corner stakes be removed.

Measurements: To conduct the count, a 30m transect tape should be pulled taught around the outside of the corner stakes to delimit the perimeter of the quadrat, with the tape oriented perpendicular to the soil surface to create a boundary of minimal width. Only sand gilia individuals that are rooted within the quadrat will be counted. Plants rooted on the border will be counted.

In addition to the number of sand gilia, the following will be visually estimated using cover classes (below):

- the percent cover of exotic plants by species
- the percent cover of woody plants (subshrubs, shrubs, and trees)
- the percent cover of unnatural soil disturbance and/or erosion

Cover classes, in percentages, will be: <1, 1-5, 6-25, 26-50, 51-75, 76-95, and 96-100.

Implementation

To provide accurate information about the abundance of sand gilia that can be compared through time, abundance sampling must be implemented following these considerations.

Seasonality: Field surveys must occur during the flowering period of sand gilia, which varies in both its timing and duration. Sand gilia typically flowers in April; however, flowering may occur as early as late March, and as late as mid May. The timing of flowering is likely greatly influenced by spring rainfall, with later flowering periods occurring in years with abundant and prolonged spring rain, and earlier flowering occurring in years with reduced and earlier spring rain. The duration of the flowering ranges from 3-8 weeks and is also tied to spring rainfall, with more abundant spring rain prolonging the flowering period.

Beginning in March, bi-weekly reconnaissance surveys to track the phenology of sand gilia will be used to determine the onset of abundance sampling.

Personnel: Sand gilia density sampling will be completed by a team of individuals trained to identify the rare plant, accurately count individuals, and provide repeatable visual estimates of habitat factors using cover classes. Individuals will be trained and required to pass a field test which will establish their qualification for the field sampling.

Pilot Study to Evaluate Monitoring

To evaluate the ability of the density sampling protocol to attain the monitoring objectives, a pilot study should be conducted. The monitoring protocol must be implemented for two years in order to evaluate the variation in the difference between plots between years (i.e. the standard deviation of the mean difference in density), which will be crucial in determining the sample size necessary to attain the power to detect significant changes. Exploratory studies within the pilot should include evaluation of different plot sizes (i.e. lengths) and shapes (McGraw 2004b), which may need to be adjusted depending on the size of sand gilia patches (Section 3.3).

Establishment of the Adjusted Baseline

The Adjusted Baseline for sand gilia density will be established through implementation of the abundance sampling protocol during three consecutive years after areal extent mapping is conducted for sand gilia. The Adjusted Baseline for abundance will be calculated as the average of the three-year, installation-wide mean density. After 10 years of abundance monitoring, ANOVA will be used to evaluate whether the three year average was abnormally high or low as a result of climate or other stochastic factors during the first three years of abundance sampling, and the Adjusted Baseline corrected for such factors, as needed (Section 3.3.3).

Evaluating Thresholds based on Long Term Monitoring

The following thresholds are proposed to trigger remedial efforts based on the results of the sand gilia density sampling:

- 20% decline in density relative to the Adjusted Baseline
- 10% increase in the percent cover of anthropogenic factors that negatively impact sand gilia

These thresholds will be evaluated using trend analysis. After data are available from five iterations of the sampling data (and every year thereafter), route regression will be used to examine the mean trend in sand gilia density and cover of anthropogenic factors across all permanent quadrats (Elzinga et al. 2001) within each management entity region and installation wide. The mean slope will be weighted by the average cover in each quadrat, to accurately depict overall changes in abundance. Trends toward persistent decline, even if not exceeding the threshold, will trigger evaluation of remedial action (Section 2.2), including additional analyses.

Mixed linear models will be needed to partition the variance among multiple factors inherent in sampling using a split panel design (Urquhart et al. 1998, Piepho and Ogutu 2002, McDonald 2003).

Single interval declines in sand gilia density and/or increases in the cover of anthropogenic factors can be evaluated using paired t-tests. Though this might be a reliable indicator of changes in the cover of exotic plants, soil disturbance/erosion, and/or the cover of woody species, changes in sand gilia abundance detected over single sampling intervals should be cautiously interpreted, owing to the potential for natural variability in abundance due to climate and sampling error to result in such changes.

Extra Curricular Analyses

Data generated by this monitoring protocol should be made available to managers, regulators, researchers, and others interested in conducting additional analyses which can enhance understanding of the ecology of the system and species. These include:

- sand gilia density with cover of the anthropogenic factors
- analyze the relationship between sand gilia density and patch size (and how they change through time)
- examine patterns of sand gilia density with respect to climate, management, vegetation type, etc.

Though encouraged, these additional analyses are not required components of the monitoring program unless required as part of remedial action (Section 2.2).

5.2 Monterey spineflower (*Chorizanthe pungens* var. *pungens*)

Biological Goals and Objectives

Goal: Preserve or enhance Monterey spineflower populations within the Conserved Habitat Areas of the FOHCP.

Objective 1: Maintain or increase the distribution of Monterey spineflower within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 2: Maintain or increase the abundance of Monterey spineflower within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 3: Reduce or prevent the increase of anthropogenic factors which negatively impact Monterey spineflower, including exotic plants and unnatural disturbances and erosion.

Objective 4: Increase understanding of the ecological factors influencing the distribution, abundance, and population persistence of Monterey spineflower within the Conserved Habitat Areas in order to inform management and monitoring.

Background

Monterey spineflower is an annual herb. It occurs on stabilized coastal dunes and in canopy gaps in maritime chaparral and is known to occur in all 8 management entity regions, and in most of the Conserved Habitat Areas (Tables 3,4).

The distribution of Monterey spineflower could be reduced trampling and loss of habitat due to unnatural disturbance including recreation; the invasion and spread of large, highly competitive exotic plants (e.g. *Cortaderia jubata, Carpobrotus chilensis, Genista monspessulana*); and by fire exclusion, which increases shrub and tree cover within maritime chaparral. Its abundance is likely reduced by the competition from European annual plants (Table 3). Monterey spineflower abundance (density and cover) is influenced by interannual variability in climate (Fox et al. *in review*). There is no strong evidence suggesting that Monterey spineflower has a seed bank (Fox et al. *in review); however,* more research is needed to evaluate this.

Monitoring Program

The monitoring program for Monterey spineflower incorporates two monitoring protocols:

1. Areal mapping to determine and monitor Monterey spineflower distribution
2. Abundances sampling to estimate and monitor Monterey spineflower cover

The complementary monitoring protocols will track success toward the first three biological objectives for Monterey spineflower, as well as increase understanding of the rare plant's ecology needed to inform management (Objective 4).

Monitoring of the maritime chaparral species is anticipated to provide additional information about the abundance of Monterey spineflower and the factors affecting its populations within this community (Section 5.8). However, due to the rarity of the covered herb, it is presently assumed that it will not be observed within a sufficient number of the sample plots located within maritime chaparral to provide the sample size needed to evaluate abundance. Should the pilot study for the maritime chaparral monitoring prove this assumption incorrect, separate abundance monitoring for Monterey spineflower described below could be eliminated.

5.2.1 Areal Mapping for Monterey spineflower

Monitoring Objectives

The objectives of areal mapping are:

1. To identify and track the location and areal coverage of Monterey spineflower patches within the Conserved Habitat Areas
2. To allow spatially explicit examination of the distribution that will facilitate the design of management and other monitoring studies (incl. quantitative sampling below), and provides insight into the factors affecting the population distribution and persistence.

Monitoring Design

Field Survey

Location: Areal mapping of Monterey spineflower will occur in all of the Conserved Habitat Areas (CHAs) where it is known to occur, and in any other CHAs that may provide suitable habitat (Table 4). During the first implementation, the entire installation will be searched. In subsequent implementations, time and costs will be reduced by examining areas as follows: 1) re-examine areas where it is known to occur, either from prior mapping, or identification of new patches during the course of management and monitoring efforts, 2) examine areas that have experienced management that could result in establishment of new populations, such as burned or cleared areas, and 3) re-examine areas where it was not known to occur, but for which habitat appears suitable.

Patch Delimitation: Each Monterey spineflower patch will be delimited by 'connecting the dots' between outermost individual plants, with plants more than 5m apart included in separate patches. Isolated patches (i.e. two or more plants) that occupy $1m^2$ or less will be mapped as points and assigned an area of $1m^2$. Individual plants (i.e. those greater than 5m from other aboveground individuals) will be mapped as points. Dense patches of large woody vegetation (chaparral shrubs and trees) or other factors such as paved roads which are clearly *not* occupied by Monterey spineflower will be excluded from the mapped patches, even if they are flanked by patches of the rare plant which are less than 5m apart.

Anthropogenic Factors: Within the delimited polygons, the occurrence of the following will also be recorded: 1) aggressive exotic plants (*Cortaderia jubata, Carpobrotus edulis or* other large exotics), 2) dense infestations of European annual plants, 3) erosion caused by roads or recreational use (historical or current).

Implementation

Seasonality: Field surveys will occur during the flowering period, which varies but primarily occurs between mid-March and early June. Beginning in March, bi-weekly reconnaissance surveys will be used to track the phenology of Monterey spineflower and determine the onset of areal mapping.

Frequency: Areal mapping of Monterey spineflower will occur approximately every 10 years. To reduce the potential for inter-annual variability in density to influence areal extent, areal mapping will be conducted in years when aboveground expression is high. Research to date indicates that abundance is greater in wetter years. Aerial imagery that is no more than 3 years old should be used; thus, the availability of aerial imagery will also determine when repeat monitoring is conducted.

Personnel: Areal extent mapping of Monterey spineflower will be completed by a team of individuals trained to identify the rare plant and distinguish it from co-occurring congeners, including *C. robusta* var. *robusta, C. diffusa* and *C. douglasii*. Individuals will also be trained to delineate patch perimeters following the mapping rules described above. Individuals will be trained and required to pass a field test which will establish their qualification for the field component of areal mapping.

Analyses

Descriptive: Through GIS, the patch (polygons) layer will be used to calculate total patch area, the number of patches, and mean patch size for Monterey spineflower, and areal coverage of anthropogenic factors. These statistics will be computed by CHA, by management entity region, and the installation as a whole.

Single Interval Comparisons: Change in Monterey spineflower and anthropogenic factor areal coverage can be calculated as:

$$\Delta = \frac{\text{Area}(t) - \text{Area}(ab)}{\text{Area}(ab)}$$

where t is the current time period, and ab is the adjusted baseline.

Extra-curricular: In support of Objective 4, the spatial and tabular data should be used in additional analyses designed to increase knowledge of Monterey spineflower biology.

For example, overlay analyses can be used to evaluate the occurrence of patches within different vegetation types or in response to management (e.g. fire). Though encouraged, these additional analyses are not a requisite component of the monitoring program unless required as part of remedial action (Section 2.2).

Pilot Study

Exploratory studies should be used to evaluate the effectiveness of the mapping rules in delineating patch polygons. Specifically, the nearest neighbor rule for patch inclusion and rules for excluding areas between Monterey spineflower separated by no more than 5m should be evaluated. Exploratory studies should occur in several sites exhibiting a range of Monterey spineflower densities, distributions, and other conditions such as vegetation conditions which would influence the accuracy and repeatability of the protocol (Section 3.3).

If Monterey spineflower distribution cannot be feasibly mapped in one year, then the distribution of Monterey spineflower could be monitored in a subset of the CHAs, JSA polygons, or macroplots, which would be randomly selected, as described in Section 4.2.4.

Establishing the Adjusted Baseline

The Adjusted Baseline for Monterey spineflower distribution will be established through implementation of areal mapping during a high rainfall year soon following permit issuance through the Fort Ord HCP. Provided that the sampling protocol meets the monitoring objectives, the total patch area will be used as the Adjusted Baseline for Monterey spineflower distribution. Due to the extensive nature of the field survey effort in areal extent mapping, it would be cost-prohibitive to use multiple years of data to establish the distribution baseline.

Ideally, the areal mapping will be conducted for the entire installation within a given year. However, because the Conserved Habitat Areas comprise a large area (16,195 acres), much of which contains maritime chaparral gaps and therefore will need to be surveyed, the Adjusted Baseline may require multiple years for completion. Though natural fluctuations in Monterey spineflower demographic performance during this time will cause variability in aboveground population expression among years, the large threshold for distinguishing unoccupied habitat (i.e. 10m) will reduce the variability among sites caused by the temporal shift in surveys.

Thresholds and Evaluation

Due to the low frequency at which areal mapping will be conducted, thresholds used to trigger remedial efforts for Monterey spineflower area based on single intervals (i.e. 2015 compared to 2005). At this time, recommended thresholds are as follows:

- A 10% decline in total areal coverage compared to the Adjusted Baseline for each Conserved Habitat Area, management entity region, or installation-wide.

- A 10% increase in the total areal coverage of anthropogenic factors which negatively impact Monterey spineflower distribution, including exotic plants and unnatural disturbances and erosion caused by recreation

These thresholds may need to be revised per results of the Adjusted Baseline.

5.2.2 Abundance Sampling for Monterey Spineflower

The abundance of Monterey spineflower will be monitored by repeatedly sampling Monterey spineflower cover within patches of occupied habitat identified in the areal mapping in each of the Conserved Habitat Areas.

Monitoring Objectives

The objectives of abundance sampling are to accurately track the cover of Monterey spineflower within the Conserved Habitat Areas in order to:

1. Detect biologically meaningful declines in density amidst the background fluctuations in abundance, and
2. Link declines to changes in habitat conditions to inform remedial efforts.

Sampling Objectives

The objectives of the monitoring protocol are to have 80% power to detect 20% declines in Monterey spineflower cover over at least 5 sampling intervals, with a 10% chance of indicating a statistically significant change has occurred when one has not.

Monitoring Design

Field Methods

Sampling Design: The percent cover of Monterey spineflower will be visually estimated in 1m x 5m quadrats randomly located within the areal extent mapping polygons for Monterey spineflower. Monitoring will be conducted using a split panel design designed to balance the power to detect trends derived from permanent plots, with the power to estimate the status of the populations that comes from randomly locating plots (Table 6). Panel 1 will consists of 30 plots randomly located within the areal extent mapping polygons used to establish the Adjusted Baseline for the plant's distribution. This panel will be sampled annually beginning after the areal extent mapping is completed and continuing in perpetuity.

In addition, rotating panels consisting of 15 plots will be randomly located within the Monterey spineflower patch polygons each time the areal extent mapping is conducted. The sites within each panel will be sampled until the areal extent mapping is conducted again, after which time a new panel of 15 sites will be established, and the prior pane retired (Table 6).

Within each 1m x 5m sample plot, the absolute canopy cover (percent) of Monterey spineflower individuals will be visually estimated using 5% increments from 10% to 90%, and 1%, 3%, 5%, 8% as values below 10%, and 91%, 93%, 05%, and 98% as values above 90%.

<u>Plot Monumenting:</u> To increase the repeatability of measurements between sampling intervals, the four corners of the quadrat will be permanently monumented using 75cm long pieces of aluminum conduit (approx. ½" diameter). The markers should be placed 50cm into the ground. In areas where vandalism is not a concern, the tops of the markers can be painted to facilitate detection. The coordinates of the north corner stake will be recorded using a survey grade GPS, which will facilitate relocation of the plot should the corner stakes be removed.

<u>Measurements</u>: A 30m transect tape will be pulled taught around the outside of the corner stakes to delimit the perimeter of the quadrat, with the tape oriented perpendicular to the soil surface to create a boundary of minimal width. Absolute percent cover of Monterey spineflower will be estimated using 5% increments from 10% to 90%, and 1%, 3%, 5%, 8% as values below 10%, and 91%, 93%, 05%, and 98% as values above 90%.

In addition to the cover of Monterey spineflower, the following will be visually estimated using separate cover classes (below):

- the percent cover of exotic plants by species
- the percent cover of woody plants (subshrubs, shrubs, and trees)
- the percent cover of unnatural soil disturbance and/or erosion

Cover classes, in percentages, will be: <1, 1-5, 6-25, 26-50, 51-75, 76-95, and 96-100.

Implementation

To provide accurate information about the abundance of Monterey spineflower that can be compared through time, abundance sampling must be implemented following these considerations.

<u>Seasonality</u>: To facilitate comparable cover estimates, field surveys must occur during the peak portion of the flowering period, which differs each year by is typically in late-April or early May. Beginning in April, bi-weekly reconnaissance surveys will be used to track the phenology of Monterey spineflower and determine the onset of abundances sampling.

<u>Personnel:</u> Monterey spineflower cover sampling will be completed by a team of individuals trained to identify the rare plant and distinguish it from co-occurring congeners (*C. robusta* var. *robusta*, *C. diffusa*, and *C. douglasii*). Field staff will be able to provide repeatable visual estimates of habitat factors using cover classes. Individuals will be trained and required to pass a field test which will establish their qualification for the field sampling.

Pilot Study to Evaluate Monitoring

To evaluate the ability of the cover sampling protocol to attain the monitoring objectives, a pilot study should be conducted. The monitoring protocol must be implemented for two years in order to evaluate the variation in the difference between plots between years (i.e. the standard deviation of the mean difference in cover), which will be crucial in determining the sample size necessary to attain the power to detect significant changes (Section 3.3).

Establishment of the Adjusted Baseline

The Adjusted Baseline for Monterey spineflower cover will be established through implementation of the abundance sampling protocol during three consecutive years after areal extent mapping. The Adjusted Baseline will be calculated for each Conserved Habitat Area, management entity region, and installation-wide as the average of the three year mean cover for each quadrat. After 10 years of abundance monitoring, ANOVA will be used to evaluate whether the three year average was abnormally high or low as a result of climate or other stochastic factors during the first three years of abundance sampling, and the Adjusted Baseline corrected for such factors, as needed (Section 3.3.3).

Evaluating Thresholds based on Long Term Monitoring

The following thresholds are proposed to trigger remedial efforts based on the results of the Monterey spineflower cover sampling:

- 20% decline in cover relative to the Adjusted Baseline
- 10% increase in the percent cover of anthropogenic factors that negatively impact Monterey spineflower

These thresholds will be evaluated using trend analysis. After data are available from five iterations of the sampling data (and every year thereafter), route regression will be used to examine the mean trend in Monterey spineflower abundance and the cover of anthropogenic factors across all permanent quadrats (Elzinga et al. 2001) within each management entity region and installation wide. The mean slope will be weighted by the average cover in each quadrat, to accurately depict overall changes in abundance. Trends toward persistent decline, even if not exceeding the threshold, will trigger evaluation of remedial action (Section 2.2), including additional analyses.

Single interval declines in Monterey spineflower cover and/or increases in the cover of anthropogenic factors can be evaluated using paired t-tests. Though this might be a reliable indicator of changes in the cover of exotic plants, soil disturbance/erosion, and/or the cover of woody species, changes in sand gilia abundance detected over single sampling intervals should be cautiously interpreted, owing to the potential for natural variability in abundance due to climate and sampling error to result in such changes.

<u>Extra Curricular Analyses</u>

Data generated by this monitoring protocol should be made available to managers, regulators, researchers, and others interested in conducting additional analyses which can enhance understanding of the ecology of the system and species. These include:

- examine potential relationships between the cover of Monterey spineflower and the cover of European annuals, to develop hypotheses for the impacts of exotic plant spread
- evaluate Monterey spineflower cover in different habitat conditions
- examine patterns of Monterey spineflower cover with respect to climate and management.

Though encouraged, these additional analyses are not required components of the monitoring program unless required as part of remedial action (Section 2.2).

5.3 Seaside bird's-beak (*Cordylanthus rigidus* ssp. *littoralis*)

Biological Goals and Objectives

Goal: Preserve or enhance seaside bird's-beak populations within the Conserved Habitat Areas of the FOHCP.

Objective 1: Maintain or increase the distribution of seaside bird's-beak within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 2: Maintain or increase the abundance of seaside bird's-beak within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 3: Reduce or prevent the increase of anthropogenic factors which negatively impact seaside bird's beak, including exotic plants and unnatural disturbances and erosion.

Objective 4: Increase understanding of the ecological factors influencing the distribution, abundance, and population persistence of seaside bird's-beak within the Conserved Habitat Areas in order to inform management and monitoring.

Background

Seaside bird-s beak is an annual herb. It occurs on sandy soils in stabilized coastal dunes and in canopy gaps in maritime chaparral and is known to occur in only four Conserved Habitat Areas: the BLM Natural Resource Management Area, the UC Natural Reserve, and two Fort Ord Reuse Authority CHAs: Monterey Peninsula College and the Monterey Peninsula Regional Parks District (Tables 3,4).

Little is known about the ecological factors which influence the distribution and abundance of seaside bird-s beak (but see Marvier and Nuccio 2004). Like other annual herbs with which it co-occurs, seaside bird's-beak could be reduced due to fire exclusion, which increases shrub and tree cover; trampling and loss of habitat due to unnatural disturbance including recreation; and the invasion and spread of large, highly competitive exotic plants (e.g. *Cortaderia jubata, Carpobrotus chilensis, Genista monspessulana*). Its abundance may also be reduced by the competition from European annual plants (Table 3). Seaside bird-s beak may also be influenced by interannual variability in climate. It is a hemi-parasite; however, its host specificity unknown and more research would be needed to determine whether host availability may influence the distribution and abundance of seaside bird's-beak (Marvier and Nuccio 2004).

Monitoring Program

The monitoring program for seaside bird's-beak incorporates two monitoring protocols:

1. Areal mapping to determine and monitor seaside bird's-beak distribution
2. Abundances sampling to estimate and monitor seaside bird's-beak density

The complementary monitoring protocols will track success toward the first three biological objectives for seaside bird's-beak, as well as increase understanding of the rare plant's ecology needed to inform management (Objective 4).

Monitoring of the maritime chaparral species is anticipated to provide additional information about the abundance of seaside bird's beak, and the factors affecting its population (Section 5.8). However, due to the rarity of the covered herb, it is presently assumed that it will not be observed within a sufficient number of the sample plots located within maritime chaparral to provide the sample size needed to evaluate abundance. Should the pilot study for the maritime chaparral monitoring prove this assumption incorrect, separate abundance monitoring for seaside bird's beak described below could be eliminated.

5.3.1 Areal Mapping for Seaside Bird's Beak

The distribution of seaside bird's-beak will be determined and monitored within each of the Conserved Habitat Areas using areal extent mapping, in which the area and location of seaside bird's-beak patches are mapped using field surveys.

Monitoring Objectives

The objectives of areal mapping are:

1. To identify and track the location and areal coverage of seaside bird's-beak patches within the Conserved Habitat Areas
2. To allow spatially explicit examination of the distribution that will facilitate the design of management and other monitoring studies (incl. quantitative sampling below), and provides insight into the factors affecting the population distribution and persistence.

Monitoring Design

Field Survey

Location: Areal mapping of seaside bird's-beak will occur in all of the Conserved Habitat Areas (CHAs) where it is known to occur, and in any other CHAs that may provide suitable habitat (Table 4). During the first implementation, the entire installation will be searched. In subsequent implementations, time and costs will be reduced by examining areas as follows: 1) re-examine areas where it is known to occur, either from prior mapping, or identification of new patches during the course of management and monitoring efforts, 2) examine areas that have experienced management that could result in establishment of new populations, such as burned or cleared areas, and 3) re-examine areas where it was not known to occur, but for which habitat appears suitable.

Patch Delimitation: Each seaside bird's-beak patch will be delimited by 'connecting the dots' between outermost individual plants, with plants more than 5m apart included in separate patches. Isolated patches (i.e. two or more plants) that occupy $1m^2$ or less will be mapped as points and assigned an area of $1m^2$. Individual plants (i.e. those greater than 5m from other aboveground individuals) will be mapped as points. Dense patches of large woody vegetation (chaparral shrubs and trees) or other factors such as paved roads which are clearly *not* occupied by seaside bird's-beak will be excluded from the mapped patches, even if they are flanked by patches of the rare plant which are less than 5m apart.

Anthropogenic Factors: Within the delimited polygons, the occurrence of the following will also be recorded: 1) aggressive exotic plants (*Cortaderia jubata, Carpobrotus edulis or* other large exotics), 2) dense infestations of European annual plants, 3) erosion caused by roads or recreational use (historical or current).

Implementation

Seasonality: Field surveys will occur during the flowering period, which primarily occurs between July and September. Beginning in early July, bi-weekly reconnaissance surveys will be used to track the phenology of seaside bird's-beak and determine the onset of areal mapping.

Frequency: Areal mapping of seaside bird's-beak will occur approximately every 10 years. Aerial imagery that is no more than 3 years old should be used; thus, the availability of aerial imagery will influence when repeat monitoring is conducted.

Personnel: Areal extent mapping of seaside bird's-beak will be completed by a team of individuals trained to identify the rare plant and delineate patch perimeters following the mapping rules described above. Individuals will be trained and required to pass a field test which will establish their qualification for the field component of areal mapping.

Analyses

Descriptive: Through GIS, the patch (polygons) layer will be used to calculate total patch area, the number of patches, mean patch size, and frequency of anthropogenic factors. These statistics will be computed by CHA, by management entity region, and the installation as a whole.

Single Interval Comparisons: Change in seaside bird's-beak and anthropogenic factor areal coverage can be calculated as:

$$\Delta = \frac{\text{Area}(t) - \text{Area}(ab)}{\text{Area}(ab)}$$

where *t* is the current time period, and *ab* is the adjusted baseline.

Extra-curricular: In support of Objective 4, the spatial and tabular data should be used in additional analyses designed to increase knowledge of seaside bird's-beak biology. For example, overlay analyses can be used to evaluate the occurrence of patches within different vegetation types or in response to management (e.g. fire). Though encouraged, these additional analyses are not a requisite component of the monitoring program unless required as part of remedial action (Section 2.2).

Pilot Study

Exploratory studies should be used to evaluate the effectiveness of the mapping rules in delineating patch polygons. Specifically, the nearest neighbor rule for patch inclusion and rules for excluding areas between seaside bird's-beak separated by no more than 5m should be evaluated for their accuracy and repeatability. Exploratory studies should occur in several sites exhibiting a range of seaside bird's-beak densities and other conditions such as vegetation characteristics which would influence the accuracy and repeatability of the protocol (Section 3.3).

Establishing the Adjusted Baseline

The Adjusted Baseline for seaside bird's-beak distribution will be established through implementation of areal mapping early following permit issuance through the Fort Ord HCP. Provided that the sampling protocol meets the monitoring objectives, the total patch area will be used as the Adjusted Baseline for seaside bird's-beak distribution. Due to the extensive nature of the field survey effort in areal extent mapping, it would be cost-prohibitive to use multiple years of data to establish the distribution baseline.

Thresholds and Evaluation

Due to the low frequency at which areal mapping will be conducted, thresholds used to trigger remedial efforts for seaside bird's-beak area based on single intervals (i.e. 2015 compared to 2005). At this time, recommended thresholds are as follows:

- A 10% decline in total areal coverage compared to the Adjusted Baseline for each Conserved Habitat Area, management entity region, or installation-wide.
- A 10% increase in the total areal coverage of anthropogenic factors which negatively impact seaside bird's-beak distribution, including exotic plants and unnatural disturbances and erosion caused by recreation

These thresholds may need to be revised per results of the Adjusted Baseline.

5.3.2 Abundance Sampling for Seaside Bird's Beak

The density of seaside bird's-beak will be monitored by repeatedly sampling seaside bird's beak density within patches of occupied habitat identified in the areal mapping in each of the Conserved Habitat Areas.

Monitoring Objectives

The objective of quantitative abundance sampling is to accurately track the density of seaside bird's-beak plants within the Conserved Habitat Areas in order to:

1. Detect biologically meaningful declines in density amidst the background fluctuations in abundance, and
2. Link declines to changes in habitat conditions to inform remedial efforts.

Sampling Objectives

The objectives of the monitoring protocol are to have 80% power to detect 20% declines in seaside bird's-beak over at least 5 sampling intervals, with a 10% chance of indicating a statistically significant change has occurred when one has not.

Monitoring Design

Field Methods

Sampling Design: Seaside bird's beak abundance will be sampled using 1m x 10m quadrats randomly located within the areal extent mapping polygons for seaside bird's beak. Monitoring will be conducted using a split panel design designed to balance the power to detect trends derived from permanent plots, with the power to estimate the status of the populations that comes from randomly locating plots (Table 6). Panel 1 will consists of 30 plots randomly located within the areal extent mapping polygons used to establish the Adjusted Baseline for the plant's distribution. This panel will be sampled annually beginning after the areal extent mapping is completed and continuing in perpetuity.

In addition, rotating panels consisting of 15 plots will be randomly located within the seaside bird's beak patch polygons each time the areal extent mapping is conducted. The sites within each panel will be sampled until the areal extent mapping is conducted again, after which time a new panel of 15 sites will be established, and the prior pane retired (Table 6).

Within each 1m x 10m sample plot, the number of seaside bird's-beak individuals will be counted.

Plot Monumenting: To increase the repeatability of counts between sampling intervals, the four corners of the quadrat will be permanently monumented using 75cm long pieces of metal conduit (approx. ½" diameter). The markers should be placed 50cm into the ground. In areas where vandalism is not a concern, the tops of the markers can be painted to facilitate detection. The coordinates of the north corner stake will be recorded using a survey grade GPS, which will facilitate relocation of the plot should the corner stakes be removed.

Measurements: To conduct the count, a 30m transect tape should be pulled taught around the outside of the corner stakes to delimit the perimeter of the quadrat, with the tape oriented perpendicular to the soil surface to create a boundary of minimal width. Only seaside bird's-beak individuals that are rooted within the quadrat will be counted. Plants rooted on the border will be counted.

In addition to the number of seaside bird's-beak, the following will be visually estimated using cover classes (below):

- the percent cover of exotic plants by species
- the percent cover of woody plants (subshrubs, shrubs, and trees)
- the percent cover of unnatural soil disturbance and/or erosion

Cover classes, in percentages, will be: <1, 1-5, 6-25, 26-50, 51-75, 76-95, and 96-100.

Implementation

Seasonality: Field surveys will occur during the flowering period, which primarily occurs between July and September. Beginning in early July, bi-weekly reconnaissance surveys will be used to track the phenology of seaside bird's-beak and determine the onset of areal mapping.

Personnel: Seaside bird's-beak density sampling will be completed by a team of individuals trained to identify the rare plant, accurately count individuals, and provide repeatable visual estimates of habitat factors using cover classes. Individuals will be trained and required to pass a field test which will establish their qualification for the field sampling.

Pilot Study to Evaluate Monitoring

To evaluate the ability of the density sampling protocol to attain the monitoring objectives, a pilot study should be conducted. The monitoring protocol must be implemented for two years in order to evaluate the variation in the difference between plots between years (i.e. the standard deviation of the mean difference in density), which will be crucial in determining the sample size necessary to attain the power to detect significant changes. Exploratory studies within the pilot should include evaluation of different plot sizes (i.e. lengths) and shapes (McGraw 2004b), which may need to be adjusted depending on the size of seaside bird's-beak patches (Section 3.3).

Establishment of the Adjusted Baseline

The Adjusted Baseline for seaside bird's-beak density will be established through implementation of the abundance sampling protocol during three consecutive years after areal extent mapping is conducted for seaside bird's-beak. The Adjusted Baseline for abundance will be calculated as the average of the three-year, installation-wide mean density. After 10 years of abundance monitoring, ANOVA will be used to evaluate whether the three year average was abnormally high or low as a result of climate or other stochastic factors during the first three years of abundance sampling, and the Adjusted Baseline corrected for such factors, as needed (Section 3.3.3).

Evaluating Thresholds based on Long Term Monitoring

The following thresholds are proposed to trigger remedial efforts based on the results of the seaside bird's-beak density sampling:

- 20% decline in density relative to the Adjusted Baseline
- 10% increase in the percent cover of anthropogenic factors that negatively impact seaside bird's-beak

These thresholds will be evaluated using trend analysis. After data are available from five iterations of the sampling data (and every year thereafter), route regression will be used to examine the mean trend in sand gilia density and cover of anthropogenic factors across all permanent quadrats (Elzinga et al. 2001) within each management entity region and installation wide. The mean slope will be weighted by the average cover in each quadrat, to accurately depict overall changes in abundance. Trends toward persistent decline, even if not exceeding the threshold, will trigger evaluation of remedial action (Section 2.2), including additional analyses.

Single interval declines in seaside bird's beak density and/or increases in the cover of anthropogenic factors can be evaluated using paired t-tests. Though this might be a reliable indicator of changes in the cover of exotic plants, soil disturbance/erosion, and/or the cover of woody species, changes in seaside bird's beak abundance detected over single sampling intervals should be cautiously interpreted, owing to the potential for natural variability in abundance due to climate and sampling error to result in such changes.

Mixed linear models will be needed to partition the variance among multiple factors inherent in sampling using a split panel design (Urquhart et al. 1998, Piepho and Ogutu 2002, McDonald 2003).

Extra Curricular Analyses

Data generated by this monitoring protocol should be made available to managers, regulators, researchers, and others interested in conducting additional analyses which can enhance understanding of the ecology of the system and species. These include:

- seaside bird's-beak density with cover of the anthropogenic factors
- analyze the relationship between seaside bird's-beak density and patch size (and how they change through time)
- examine patterns of seaside bird's-beak density with respect to climate, management, vegetation type, etc.

Though encouraged, these additional analyses are not required components of the monitoring program unless required as part of remedial action (Section 2.2).

5.4 Contra Costa goldfields (*Lasthenia conjugens*)

Biological Goals and Objectives

Goal: Preserve or enhance Contra Costa goldfields populations within the Conserved Habitat Areas of the FOHCP.

> **Objective 1:** Maintain or increase the distribution of Contra Costa goldfields within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.
>
> **Objective 2:** Maintain or increase the abundance of Contra Costa goldfields within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.
>
> **Objective 3:** Reduce or prevent the increase of anthropogenic factors which negatively impact Contra Costa goldfields, including exotic plants and unnatural disturbances and erosion.
>
> **Objective 4:** Increase understanding of the ecological factors influencing the distribution, abundance, and population persistence of Contra Costa goldfields within the Conserved Habitat Areas in order to inform management and monitoring.

Background

Contra Costa goldfields is an annual herb that occupies vernal pools and mima mound areas. As described in the Fort Ord HCP (Zander Associates 2004), Contra Costa goldfields is only known from one Conserved Habitat Area, the Fort Ord Natural Resource Management Area, where it occupies approximately 5 acres. However, the Army identified 31 additional areas, comprising approximately 61 acres, on former Fort Ord that contain suitable habitat for Contra Costa goldfields (Monterey 2004) and the US Fish and Wildlife Service designated 6,874 acres on former Fort Ord as critical habitat for Contra Costa goldfields (USFWS 2003). Given that the plant was only discovered within the NRMA in 1998, it is possible that other currently unknown populations exist within the installation.

Contra Costa goldfields may be negative impacted by the invasion and spread of competitive exotic plants, especially European annual grasses and forbs with which it co-occurs. Changes in hydrology and unnatural soil disturbance and erosion, including recreation, could also impact Contra Costa goldfields populations within the installation. Research is needed to determine the ecological factors affecting the distribution, abundance, and population persistence of Contra Costa goldfields.

Monitoring Program

Contra Costa goldfields will be monitored using three complementary monitoring protocols:

1. Reconnaissance surveys to identify new populations of Contra Costa goldfields

2. Areal extent mapping to determine and monitor the distribution of Contra Costa goldfields
3. Abundances sampling to estimate and monitoring the cover of Contra Costa goldfields

The monitoring protocols will track success toward the first three biological objectives for Contra Costa goldfields, as well as increase understanding of the rare plant's ecology needed to inform management (Objective 4).

5.4.1 Reconnaissance Surveys

Monitoring Objectives

Reconnaissance surveys are designed to identify additional populations of Contra Costa goldfields within the Conserved Habitat Areas.

Monitoring Design

Field Methods

Location: Reconnaissance surveys will be used to search the 31 areas identified as potential habitat for Contra Costa goldfields (Monterey 2004).

Search: Systematic searching will be conducted by dividing the potential habitat into sectors or cells (e.g. as created by overlaying a 50m x 50m grid upon a recent aerial photograph). Once each cell has been thoroughly searched, the observer(s) can move onto the next cell. Areas surveyed with negative findings will be re-examined during subsequent years of reconnaissance surveys in case small populations were perhaps missed.

Implementation

Seasonality: Reconnaissance surveys for Contra Costa goldfields will occur in the flowering season, approximately March-May. The phenology of the known populations at the BLM NRMA should be used to determine the onset of reconnaissance surveys.

Frequency: Reconnaissance surveys will be implemented annually for 10 years.

Personnel: Reconnaissance surveys will be conducted by individuals with an acute search image for Contra Costa goldfields.

Pilot Studies

Exploratory studies can be used to evaluate techniques designed to increase effectiveness and cost effectiveness of the search for Contra Costa goldfields during reconnaissance surveys, including methods of delineating sectors to divide the search area into discrete patches, and the optimal number of searchers, among other factors. However, reconnaissance surveys are fairly straightforward and will not require full implementation as a pilot study prior to establishment of the adjusted baseline.

Establishing the Adjusted Baseline

New populations of Contra Costa goldfields identified during the course of 10 years of reconnaissance surveys will be included in the Adjusted Baseline, which will be based on areal mapping and abundance sampling, as described in the following sections.

5.4.2 Areal Mapping for Contra Costa Goldfields

The distribution of Contra Costa goldfields will be determined and monitored using areal extent mapping, in which the area and location of Contra Costa goldfields patches are mapped using field surveys.

Monitoring Objectives

The objectives of areal mapping are:

1. To identify and track the location and areal coverage of Contra Costa goldfields patches within the Conserved Habitat Areas
2. To allow spatially explicit examination of the distribution that will facilitate the design of management and other monitoring studies (incl. quantitative sampling below), and provides insight into the factors affecting the population distribution and persistence.

Monitoring Design

Field Survey

Location: Areal mapping of Contra Costa goldfields will occur in all CHAs in which the species is known to occur (Table 4), including areas added as a result of reconnaissance surveys. During the first implementation, the entire installation will be searched. In subsequent implementations, time and costs will be reduced by examining areas as follows: 1) re-examine areas where it is known to occur, either from prior mapping, or identification of new patches during the course of management and monitoring efforts, 2) examine areas that have experienced management that could result in establishment of new populations, such as burned or cleared areas, and 3) re-examine areas where it was not known to occur, but for which habitat appears suitable.

Patch Delimitation: Each Contra Costa goldfields patch will be delimited by 'connecting the dots' between outermost individual plants, with plants more than 5m apart included in separate patches. Isolated patches (i.e. two or more plants) that occupy $1m^2$ or less will be mapped as points and assigned an area of $1m^2$. Individual plants (i.e. those greater than 10m from other aboveground individuals) will be mapped as points. Paved roads or other areas which clearly are *not* occupied by Contra Costa goldfields will be excluded from the mapped patches, even if they are flanked by patches of the rare plant which are less than 5m apart.

Anthropogenic Factors: Within the delimited polygons, the occurrence of the following will also be recorded: 1) aggressive exotic plants, 2) soil disturbance or compaction associated with recreation (e.g. wheel ruts), 3) sedimentation or altered hydrology.

Implementation

Seasonality: Field surveys will occur during the flowering period, which primarily occurs between March and June. Beginning in early March, bi-weekly reconnaissance surveys will be used to track the phenology of Contra Costa goldfields and determine the onset of areal mapping.

Frequency: Areal mapping of Contra Costa goldfields will occur approximately every 10 years. Aerial imagery that is no more than 3 years old should be used; thus, the availability of aerial imagery will influence when repeat monitoring is conducted. Areal extent mapping may be needed every 5 years, if results of abundance sampling or observations indicate that habitat conditions that may influence the species distribution, such as changes in hydrology, are occurring on shorter time scales.

Personnel: Areal extent mapping of Contra Costa goldfields will be completed by a team of individuals trained to identify the rare plant and delineate patch perimeters following the mapping rules described above. Individuals will be trained and required to pass a field test which will establish their qualification for the field component of areal mapping.

Analyses

Descriptive: Through GIS, the patch (polygons) layer will be used to calculate total patch area, the number of patches, and mean patch size for Contra Costa goldfields, and areal coverage of anthropogenic factors. These statistics will be computed by CHA, by management entity region, and the installation as a whole.

Single Interval Comparisons: Change in Contra Costa goldfields and anthropogenic factor areal coverage can be calculated as:

$$\Delta = \frac{\text{Area}(t) - \text{Area}(ab)}{\text{Area}(ab)}$$

where t is the current time period, and ab is the adjusted baseline.

Extra-curricular: In support of Objective 4, the spatial and tabular data should be used in additional analyses designed to increase knowledge of Contra Costa goldfields. For example, overlay analyses can be used to evaluate the occurrence of patches within different vegetation types or in response to management (e.g. exotic plant control). Though encouraged, these additional analyses are not a requisite component of the monitoring program unless required as part of remedial action (Section 2.2).

Pilot Study

Exploratory studies should be used to evaluate the effectiveness of the mapping rules in delineating patch polygons. Specifically, the nearest neighbor rule for patch inclusion and rules for excluding areas between Contra Costa goldfields separated by no more than 5m should be evaluated for their accuracy and repeatability. Exploratory studies should occur in several sites exhibiting a range of Contra Costa goldfields densities and other conditions such as vegetation characteristics which would influence the accuracy and repeatability of the protocol (Section 3.3).

Establishing the Adjusted Baseline

The Adjusted Baseline for Contra Costa goldfields distribution will be established through implementation of areal mapping early following permit issuance through the Fort Ord HCP. Provided that the sampling protocol meets the monitoring objectives, the total patch area will be used as the Adjusted Baseline for Contra Costa goldfields distribution.

Thresholds and Evaluation

Due to the low frequency at which areal mapping will be conducted, thresholds used to trigger remedial efforts for Contra Costa goldfields area based on single intervals (i.e. 2015 compared to 2005). At this time, recommended thresholds are as follows:

- A 10% decline in total areal coverage compared to the Adjusted Baseline for each Conserved Habitat Area, management entity region, or installation-wide.
- A 10% increase in the total areal coverage of anthropogenic factors which negatively impact Contra Costa goldfields distribution, including exotic plants and unnatural disturbances and erosion caused by recreation

These thresholds may need to be revised per results of the Adjusted Baseline.

5.4.3 Abundance Sampling for Contra Costa Goldfields

The abundance of Contra Costa goldfields will be monitored by repeatedly sampling Contra Costa goldfields density within patches of occupied habitat identified in the areal mapping in each of the Conserved Habitat Areas.

Monitoring Objectives

The objective of quantitative abundance sampling is to accurately track the density of Contra Costa goldfields within the Conserved Habitat Areas in order to:

1. Detect biologically meaningful declines in density amidst the background fluctuations in abundance, and
2. Link declines to changes in habitat conditions to inform remedial efforts.

Sampling Objectives

The objectives of the monitoring protocol are to have 80% power to detect 20% declines in Contra Costa goldfields over at least 5 sampling intervals, with a 10% chance of indicating a statistically significant change has occurred when one has not.

Monitoring Design

Field Methods

Sampling Design: Contra Costa goldfields will be sampled using 0.25m x 4m quadrats randomly located within the areal extent mapping polygons for Contra Costa goldfields. Monitoring will be conducted using a split panel design designed to balance the power to detect trends derived from permanent plots, with the power to estimate the status of the populations that comes from randomly locating plots (Table 6). Panel 1 will consists of 30 plots randomly located within the areal extent mapping polygons used to establish the Adjusted Baseline for the plant's distribution. This panel will be sampled annually beginning after the areal extent mapping is completed and continuing in perpetuity.

In addition, rotating panels consisting of 15 plots will be randomly located within the Contra Costa goldfields patch polygons each time the areal extent mapping is conducted. The sites within each panel will be sampled until the areal extent mapping is conducted again, after which time a new panel of 15 sites will be established, and the prior pane retired (Table 6).

Within each 0.25m x 4m sample plot, the number of Contra Costa goldfields individuals will be counted.

Plot Monumenting: To increase the repeatability of counts between sampling intervals, the four corners of the quadrat will be permanently monumented using 75cm long pieces of metal conduit (approx. ½" diameter). The markers should be placed 50cm into the ground. In areas where vandalism is not a concern, the tops of the markers can be painted to facilitate detection. The coordinates of the north corner stake will be recorded using a survey grade GPS, which will facilitate relocation of the plot should the corner stakes be removed.

Measurements: To conduct the count, a 10m transect tape should be pulled taught around the outside of the corner stakes to delimit the perimeter of the quadrat, with the tape oriented perpendicular to the soil surface to create a boundary of minimal width. Only Contra Costa goldfields individuals that are rooted within the quadrat will be counted. Plants rooted on the border will be counted.

In addition to the number of Contra Costa goldfields, the following will be visually estimated using cover classes (below):

- the percent cover of exotic plants by species
- the percent cover of woody plants (subshrubs, shrubs, and trees)

- the percent cover of unnatural soil disturbance and/or erosion

Cover classes, in percentages, will be: <1, 1-5, 6-25, 26-50, 51-75, 76-95, and 96-100.

Implementation

Seasonality: Field surveys will occur during the flowering period, which is approximately March-June. Beginning in early March, bi-weekly reconnaissance surveys will be used to track the phenology of Contra Costa goldfields and determine the onset of density sampling.

Personnel: Contra Costa goldfields density sampling will be completed by a team of individuals trained to identify the rare plant, accurately count individuals, and provide repeatable visual estimates of habitat factors using cover classes. Individuals will be trained and required to pass a field test which will establish their qualification for the field sampling.

Pilot Study to Evaluate Monitoring

To evaluate the ability of the density sampling protocol to attain the monitoring objectives, a pilot study should be conducted. The monitoring protocol must be implemented for two years in order to evaluate the variation in the difference between plots between years (i.e. the standard deviation of the mean difference in density), which will be crucial in determining the sample size necessary to attain the power to detect significant changes. Exploratory studies within the pilot should include evaluation of different plot sizes (i.e. lengths) and shapes (McGraw 2004b), which may need to be adjusted depending on the density and size of Contra Costa goldfields patches (Section 3.3).

Establishment of the Adjusted Baseline

The Adjusted Baseline for Contra Costa goldfields density will be established through implementation of the abundance sampling protocol during three consecutive years after areal extent mapping is conducted for Contra Costa goldfields. The Adjusted Baseline for abundance will be calculated for each Conserved Habitat Area, management entity region, and installation-wide as the average of the three year mean densities for each quadrat. After 10 years of abundance monitoring, ANOVA will be used to evaluate whether the three year average was abnormally high or low as a result of climate or other stochastic factors during the first three years of abundance sampling, and the Adjusted Baseline corrected for such factors, as needed (Section 3.3.3).

Evaluating Thresholds based on Long Term Monitoring

The following thresholds are proposed to trigger remedial efforts based on the results of the Contra Costa goldfields density sampling:

- 20% decline in density relative to the Adjusted Baseline

- 10% increase in the percent cover of anthropogenic factors that negatively impact Contra Costa goldfields

These thresholds will be evaluated using trend analysis. After data are available from five iterations of the sampling data (and every year thereafter), route regression will be used to examine the mean trend in Contra Costa goldfields density and cover of anthropogenic factors across all permanent quadrats (Elzinga et al. 2001) within each management entity region and installation wide. The mean slope will be weighted by the average cover in each quadrat, to accurately depict overall changes in abundance. Trends toward persistent decline, even if not exceeding the threshold, will trigger evaluation of remedial action (Section 2.2), including additional analyses.

Single interval declines in Contra Costa goldfields density and/or increases in the cover of anthropogenic factors can be evaluated using paired t-tests. Though this might be a reliable indicator of changes in the cover of exotic plants, soil disturbance/erosion, and/or the cover of woody species, changes in Contra Costa goldfields abundance detected over single sampling intervals should be cautiously interpreted, owing to the potential for natural variability in abundance due to climate and sampling error to result in such changes.

Mixed linear models will be needed to partition the variance among multiple factors inherent in sampling using a split panel design (Urquhart et al. 1998, Piepho and Ogutu 2002, McDonald 2003).

<u>Extra Curricular Analyses</u>

Data generated by this monitoring protocol should be made available to managers, regulators, researchers, and others interested in conducting additional analyses which can enhance understanding of the ecology of the system and species. These include:

- Contra Costa goldfields density with cover of the anthropogenic factors (e.g. exotic plants)
- examine patterns of analyze the relationship between Contra Costa goldfields density with respect to climate, management, microhabitat conditions (vernal pools vs. mima mounds) etc.
- analyze the relationship between Contra Costa goldfields density and patch size (and how they change through time)

Though encouraged, these additional analyses are not required components of the monitoring program unless required as part of remedial action (Section 2.2).

5.5 Coast wallflower (*Erysimum ammophilum*)

Biological Goals and Objectives

Goal: Preserve or enhance coast wallflower populations within the Conserved Habitat Areas of the FOHCP.

Objective 1: Maintain or increase the distribution of coast wallflower within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 2: Maintain or increase the abundance of coast wallflower within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 3: Reduce or prevent the increase of anthropogenic factors which negatively impact coast wallflower, including exotic plants and unnatural disturbances and erosion.

Objective 4: Increase understanding of the ecological factors influencing the distribution, abundance, and population persistence of coast wallflower within the Conserved Habitat Areas in order to inform management and monitoring.

Background

Coast wallflower is an annual or biennial plant. It is found in open sandy areas in the stabilized dunes and coastal scrub habitats and is known to occur in four of the Conserved Habitat Areas: BLM's Natural Resource Management Area, UC's Natural Reserve, and FORA's landfill parcel and Marina Northwest Corner (Tables 3,4).

As with other disturbance-dependent herbaceous plants, including other wallflowers (*Erysimum* spp.), coast wallflower populations could be reduced due to fire exclusion, which increases shrub and tree cover; trampling and loss of habitat due to unnatural disturbance including recreation; and the invasion and spread of large, highly competitive exotic plants (e.g. *Cortaderia jubata, Carpobrotus chilensis, Genista monspessulana*). Its abundance is also likely reduced by the competition from European annual plants (Table 3). Coast wallflower abundance (density) is likely influenced by interannual variability in climate, particularly if the biennial life history is common, as first year rosettes may experience high mortality during the summer in low precipitation years, as has been observed for Santa Cruz wallflower (McGraw 2004a). Like Santa Cruz wallflower, coast wallflower may have a relatively large and long-lived seed bank (McGraw 2004a, McGraw 2004d); however, research is needed to examine this.

Monitoring Program

The monitoring program for coast wallflower incorporates two monitoring protocols:

1. Areal extent mapping to determine and monitor coast wallflower distribution
2. Abundance sampling to estimate and monitor coast wallflower density

The complementary monitoring protocols will track success toward the first three biological objectives for coast wallflower, as well as increase understanding of the rare plant's ecology needed to inform management (Objective 4).

5.5.1 Areal Mapping of Coast Wallflower

The distribution of coast wallflower will be determined and monitored using areal extent mapping, in which the area and location of coast wallflower patches are mapped using field surveys.

Monitoring Objectives

The objectives of areal mapping are:

1. To identify and track the location and areal coverage of coast wallflower patches within the Conserved Habitat Areas
2. To allow spatially explicit examination of the distribution that will facilitate the design of management and other monitoring studies (incl. quantitative sampling below), and provides insight into the factors affecting the population distribution and persistence.

Monitoring Design

Field Survey

Location: Areal mapping of coast wallflower will occur in four CHAs in which the species is known to occur (Table 4). During the first implementation, the entire installation will be searched. In subsequent implementations, time and costs will be reduced by examining areas as follows: 1) re-examine areas where it is known to occur, either from prior mapping, or identification of new patches during the course of management and monitoring efforts, 2) examine areas that have experienced management that could result in establishment of new populations, such as burned or cleared areas, and 3) re-examine areas where it was not known to occur, but for which habitat appears suitable.

Patch Delimitation: Each coast wallflower patch will be delimited by 'connecting the dots' between outermost individual plants, with plants more than 5m apart included in separate patches. Isolated patches (i.e. two or more plants) that occupy $1m^2$ or less will be mapped as points and assigned an area of $1m^2$. Individual plants (i.e. those greater than 10m from other aboveground individuals) will be mapped as points. Paved roads or other areas which clearly are *not* occupied by coast wallflower will be excluded from the mapped patches, even if they are flanked by patches of the rare plant which are less than 5m apart.

Anthropogenic Factors: Within the delimited polygons, the occurrence of the following will also be recorded: 1) aggressive exotic plants (*Cortaderia jubata, Carpobrotus edulis or* other large exotics), 2) dense infestations of European annual plants, 3) erosion caused by roads or recreational use (historical or current).

Implementation

Seasonality: Field surveys will occur in the latter portion of the flowering period (e.g. May to June) when adults are still visible and juveniles will be more likely to be observed.

Personnel: Areal extent mapping of coast wallflower will be completed by a team of individuals trained to identify the rare plant both in its adult and juvenile stages (i.e. seedlings and rosettes) and delineate patch perimeters following the mapping rules described above. Individuals will be trained and required to pass a field test which will establish their qualification for the field component of areal mapping.

Frequency: Areal mapping of coast wallflower will occur approximately every 10 years. Aerial imagery that is no more than 3 years old should be used; thus, the availability of aerial imagery will influence when repeat monitoring is conducted.

Analyses

Descriptive: Through GIS, the patch (polygons) layer will be used to calculate total patch area, the number of patches, and mean patch size for coast wallflower, and areal coverage of anthropogenic factors. These statistics will be computed by CHA, by management entity region, and the installation as a whole.

Single Interval Comparisons: Change in coast wallflower and anthropogenic factor areal coverage can be calculated as:

$$\Delta = \frac{\text{Area}(t) - \text{Area}(ab)}{\text{Area}(ab)}$$

where t is the current time period, and ab is the adjusted baseline.

Extra-curricular: In support of Objective 4, the spatial and tabular data should be used in additional analyses designed to increase knowledge of coast wallflower. For example, overlay analyses can be used to evaluate the occurrence of patches within different vegetation types or in response to management (e.g. fire, recreation management). Though encouraged, these additional analyses are not a requisite component of the monitoring program unless required as part of remedial action (Section 2.2).

Pilot Study

Exploratory studies should be used to evaluate the effectiveness of the mapping rules in delineating patch polygons. Specifically, the nearest neighbor rule for patch inclusion and rules for excluding areas between coast wallflowers separated by no more than 5m should be evaluated for their accuracy and repeatability. Exploratory studies should occur in several sites exhibiting a range of coast wallflower densities and other conditions such as vegetation characteristics which would influence the accuracy and repeatability of the protocol (Section 3.3).

Establishing the Adjusted Baseline

The Adjusted Baseline for coast wallflower distribution will be established through implementation of areal mapping early following permit issuance through the Fort Ord HCP. Provided that the sampling protocol meets the monitoring objectives, the total patch area will be used as the Adjusted Baseline for coast wallflower distribution.

Thresholds and Evaluation

Due to the low frequency at which areal mapping will be conducted, thresholds used to trigger remedial efforts for coast wallflower area based on single intervals (i.e. 2015 compared to 2005). At this time, recommended thresholds are as follows:

- A 10% decline in total areal coverage compared to the Adjusted Baseline for each Conserved Habitat Area, management entity region, or installation-wide.
- A 10% increase in the total areal coverage of anthropogenic factors which negatively impact coast wallflower distribution, including exotic plants and unnatural disturbances and erosion caused by recreation

These thresholds may need to be revised per results of the Adjusted Baseline.

5.5.2 Abundance Sampling for Coast Wallflower

The abundance of coast wallflower will be monitored by repeatedly sampling coast wallflower density within patches of occupied habitat identified in the areal mapping in each of the Conserved Habitat Areas.

Monitoring Objectives

The objective of quantitative abundance sampling is to accurately track the density of coast wallflower within the Conserved Habitat Areas in order to:

1. Detect biologically meaningful declines in density amidst the background fluctuations in abundance, and
2. Link declines to changes in habitat conditions to inform remedial efforts.

Sampling Objectives

The objectives of the monitoring protocol are to have 80% power to detect 20% declines in coast wallflower over at least 5 sampling intervals, with a 10% chance of indicating a statistically significant change has occurred when one has not.

Monitoring Design

Field Methods

Sampling Design: Coast wallflower abundance will be sampled using 1m x 5m quadrats randomly located within the areal extent mapping polygons for coast wallflower. Monitoring will be conducted using a split panel design designed to balance the power to detect trends derived from permanent plots, with the power to estimate the status of the populations that comes from randomly locating plots (Table 6). Panel 1 will consists of 30 plots randomly located within the areal extent mapping polygons used to establish the Adjusted Baseline for the plant's distribution. This panel will be sampled annually beginning after the areal extent mapping is completed and continuing in perpetuity.

In addition, rotating panels consisting of 15 plots will be randomly located within the coast wallflower patch polygons each time the areal extent mapping is conducted. The sites within each panel will be sampled until the areal extent mapping is conducted again, after which time a new panel of 15 sites will be established, and the prior pane retired (Table 6).

Within each 1m x 5m sample plot, the number of coast wallflower individuals will be counted.

Plot Monumenting: To increase the repeatability of counts between sampling intervals, the four corners of the quadrat will be permanently monumented using 75cm long pieces of metal conduit (approx. ½" diameter). The markers should be placed 50cm into the ground. In areas where vandalism is not a concern, the tops of the markers can be painted to facilitate detection. The coordinates of the north corner stake will be recorded using a survey grade GPS, which will facilitate relocation of the plot should the corner stakes be removed.

Measurements: To conduct the count, a 30m transect tape should be pulled taught around the outside of the corner stakes to delimit the perimeter of the quadrat, with the tape oriented perpendicular to the soil surface to create a boundary of minimal width. Only coast wallflower individuals that are rooted within the quadrat will be counted. Plants rooted on the border will be counted.

In addition to the number of coast wallflower within each stage class, the following will be visually estimated using cover classes (below):

- the percent cover of exotic plants by species
- the percent cover occurrence of unnatural soil disturbance and/or erosion

Cover classes, in percentages, will be: <1, 1-5, 6-25, 26-50, 51-75, 76-95, and 96-100.

Implementation

Seasonality: Field surveys will occur during the height of the flowering period, which April. Beginning in early March, bi-weekly reconnaissance surveys will be used to track the phenology of coast wallflower and determine the onset of density sampling.

Personnel: Coast wallflower density sampling will be completed by a team of individuals trained to identify the rare plant both as an adult and as a juvenile (seedling, basal rosette), accurately count individuals, and provide repeatable visual estimates of habitat factors using cover classes. Individuals will be trained and required to pass a field test which will establish their qualification for the field sampling.

Pilot Study to Evaluate Monitoring

To evaluate the ability of the density sampling protocol to attain the monitoring objectives, a pilot study should be conducted. The monitoring protocol must be implemented for two years in order to evaluate the variation in the difference between plots between years (i.e. the standard deviation of the mean difference in density), which will be crucial in determining the sample size necessary to attain the power to detect significant changes. Exploratory studies within the pilot should include evaluation of different plot sizes (i.e. lengths) and shapes (McGraw 2004b), which may need to be adjusted depending on the density and size of coast wallflower patches (Section 3.3).

Establishment of the Adjusted Baseline

The Adjusted Baseline for coast wallflower density will be established through implementation of the abundance sampling protocol during three consecutive years after areal extent mapping is conducted for coast wallflower. The Adjusted Baseline for abundance will be calculated installation-wide as the average of the three year mean densities. After 10 years of abundance monitoring, ANOVA will be used to evaluate whether the three year average was abnormally high or low as a result of climate or other stochastic factors during the first three years of abundance sampling, and the Adjusted Baseline corrected for such factors, as needed (Section 3.3.3).

Evaluating Thresholds based on Long Term Monitoring

The following thresholds are proposed to trigger remedial efforts based on the results of the coast wallflower density sampling:

- 20% decline in density relative to the Adjusted Baseline
- 10% increase in the percent cover of anthropogenic factors that negatively impact coast wallflower

These thresholds will be evaluated using trend analysis. After data are available from five iterations of the sampling data (and every year thereafter), route regression will be used to examine the mean trend in coast wallflower density and cover of anthropogenic factors across all permanent quadrats (Elzinga et al. 2001) within each management entity region and installation wide. The mean slope will be weighted by the average cover in each quadrat, to accurately depict overall changes in abundance. Trends toward persistent decline, even if not exceeding the threshold, will trigger evaluation of remedial action (Section 2.2), including additional analyses.

Single interval declines in coast wallflower density and/or increases in the cover of anthropogenic factors can be evaluated using paired t-tests. Though this might be a reliable indicator of changes in the cover of exotic plants, soil disturbance/erosion, and/or the cover of woody species, changes in coast wallflower abundance detected over single sampling intervals should be cautiously interpreted, owing to the potential for natural variability in abundance due to climate and sampling error to result in such changes.

Mixed linear models will be needed to partition the variance among multiple factors inherent in sampling using a split panel design (Urquhart et al. 1998, Piepho and Ogutu 2002, McDonald 2003).

Extra Curricular Analyses

Data generated by this monitoring protocol should be made available to managers, regulators, researchers, and others interested in conducting additional analyses which can enhance understanding of the ecology of the system and species. These include:

- Examine variability in coast wallflower density in coastal versus inland habitats
- Correlate coast wallflower density with cover of the anthropogenic factors (e.g. exotic plants)
- Examine patterns of analyze the relationship between coast wallflower density with respect to climate or management (exotic plant management, recreation management).
- Analyze the relationship between coast wallflower density and patch size (and how they change through time)

Though encouraged, these additional analyses are not required components of the monitoring program unless required as part of remedial action (Section 2.2).

5.6 YADON'S PIPERIA (*PIPERIA YADONII*)

Biological Goals and Objectives

Goal: Preserve or enhance Yadon's piperia populations within the Conserved Habitat Areas of the FOHCP.

Objective 1: Maintain or increase the distribution of Yadon's piperia within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 2: Maintain or increase the abundance of Yadon's piperia within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 3: Reduce or prevent the increase of anthropogenic factors which negatively impact Yadon's piperia, including exotic plants and unnatural disturbances and erosion.

Objective 4: Increase understanding of the ecological factors influencing the distribution, abundance, and population persistence of Yadon's piperia within the Conserved Habitat Areas in order to inform management and monitoring.

Background

Yadon's piperia is a perennial herb that exhibits dormancy through which plants can remain alive, underground and not emerge in a given year. It occurs along the edge of shrubs in maritime chaparral and in the understory of Monterey pines (USFWS 2004b). As described in the Fort Ord HCP (Zander Associates 2004), Yadon's piperia is only known from one Conserved Habitat Area, Marina Northwest Corner, where Randy Morgan observed six to ten individuals within an approximately 1-2 acre area during his surveys in 1993 and 1994. There have been no confirmed reports of this occurrence since that time, despite surveys by Jones and Stokes Associates in 1995 and David Allen in 1996, which identified a more common congener (*P. michaeli*) in the area (Tables 3,4).

Little is known about the ecological factors influencing the distribution, abundance, and population persistence of Yadon's piperia, or its threats. Like other herbaceous plants, it may be impacted by trampling and unnatural soil disturbance caused by recreation, and the invasion and spread of exotic plants. Yadon's piperia may require some aspect of fire or similar disturbance for regeneration. Herbivory or inflorescences by deer may also reduce populations (Doak and Graff 2001, USFWS 2004b). More research is needed to inform successful management of this rare orchid.

Monitoring Program

A tiered approach is recommended for monitoring Yadon's piperia. The first tier will consist of reconnaissance level surveys to determine whether the species occurs within the installation. The positive identification of Yadon's piperia within the CHAs will trigger second tier monitoring, the details of which should be developed based upon the population characteristics, but could include two complementary monitoring protocols: areal mapping to identify the location and distribution of Yadon's piperia, and census or abundance sampling to track its abundance.

If Yadon's piperia is indeed present, the monitoring protocols will be designed to track success toward the first three biological objectives, as well as increase understanding of the rare plant's ecology needed to inform management (Objective 4).

5.6.1 Reconnaissance Surveys (Tier 1)

Monitoring Objectives

Reconnaissance surveys are designed to identify potential populations of Yadon's piperia within the Conserved Habitat Areas.

Monitoring Design

Field Methods

Reconnaissance surveys will be used to identify whether Yadon's piperia is present in areas of known appropriate habitat, which be characterized as adjacent to shrubs in maritime chaparral and underneath the canopy of Monterey pines (Doak and Graff 2001, USFWS 2004b). To cover as much of the potential appropriate habitat during the course of the up to 10 years of implementation, surveys will be sequential. They will begin in the area where the species was reported to have been located during the 1992 baseline survey—Marina Northwest Corner (Zander Associates 2004). To aid a thorough initial survey, systematic searching will be conducted by dividing the potential habitat into sectors or cells (e.g. as created by overlaying a 50m x 50m grid upon a recent aerial photograph). Once each cell has been thoroughly searched, the observer(s) can move onto the next cell. Areas surveyed with negative findings will be re-examined during subsequent years of reconnaissance surveys because Yadon's piperia exhibits dormancy which could potentially prevent populations being detected in any given year.

Implementation

To provide accurate information about the distribution of the species that can be compared through time, the census and areal mapping must be implemented following these considerations.

Seasonality: Reconnaissance surveys for Yadon's piperia must occur in two phases. First, a reconnaissance survey in conducted between mid-January and early April will be used to search for vegetative rosettes of the genus *Piperia*. Areas featuring rosettes will be caged to prevent herbivory and revisited in the flowering season (July-August) to determine whether they are *P. yadonii*. Summer surveys can also facilitate detection of Yadon's piperia that may have been missed during the vegetative stage.

Frequency: Tier 1 reconnaissance level monitoring will be implemented annually for 10 years. Once Yadon's piperia is positively identified within a Conserved Habitat Area, Tier 2 monitoring will be initiated and the reconnaissance surveys will continue for 10 years.

Personnel: Reconnaissance surveys will be conducted by individuals familiar with the morphological characters that distinguish *Piperia yadonii* from conspecifics with which it co-occurs in the region.

Pilot Studies

Exploratory studies can be used to evaluate techniques designed to increase effectiveness and cost effectiveness of the search for Yadon's piperia during reconnaissance surveys, including methods of delineating sectors to divide the search area into discrete patches, and the optimal number of searchers, among other factors. However, reconnaissance surveys are fairly straightforward and will not require full implementation as a pilot study prior to establishment of the adjusted baseline (Section 3.3).

Establishing the Adjusted Baseline

The Adjusted Baseline for Yadon's piperia will be established through implementation of monitoring protocol annually for 10 years. This extended period is required because this species exhibits dormancy, in which individuals persist belowground through corms (storage organs) which may or may not produce aboveground structures in any given year. This may explain the inability to detect the species at the Marina Northwest Corner since the baseline surveys. Alternatively, the species may have been extirpated from the site or may have been mistakenly identified during the 1993-94 surveys.

If Yadon's piperia is detected during the course of the reconnaissance surveys, the Adjusted Baseline will be developed based on the results of the Tier 2 monitoring studies. If, however, the species is not observed during the course of 10 years of annual reconnaissance surveys, the Adjusted Baseline will be presumed to be zero, and Yadon's piperia will be removed from future monitoring (incl. reconnaissance surveys) unless and until it is located within the CHAs.

5.6.2 Areal Extent and Abundance Sampling (Tier 2)

It would be difficult at this time to develop monitoring protocols to track the distribution and abundance of Yadon's piperia. This is because details of such protocols should be based on the distribution and abundance patterns of the species within the Conserved Habitat Areas, which are at present unknown. However, based its (presumed) limited distribution and abundance within the CHAs, Yadon's piperia might be effectively monitored using a combination of areal extent mapping and census. Depending on its rarity within the CHAs, however, Yadon's piperia may require a more targeted effort that that described for the other covered herbs.

5.7 Robust spineflower (*Chorizanthe robusta* var. *robusta*)

Biological Goals and Objectives

Goal: Preserve or enhance robust spineflower populations within the Conserved Habitat Areas of the FOHCP.

Objective 1: Maintain or increase the distribution of robust spineflower within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 2: Maintain or increase the abundance of robust spineflower within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 3: Reduce or prevent the increase of anthropogenic factors which negatively impact robust spineflower, including exotic plants and unnatural disturbances and erosion.

Objective 4: Increase understanding of the ecological factors influencing the distribution, abundance, and population persistence of robust spineflower within the Conserved Habitat Areas in order to inform management and monitoring.

Background

Robust spineflower is a prostrate winter-spring annual herb (Table 3). It is found in open sandy areas away from dense competitive plants in active dunes and stabilized ancient dune areas, primarily north of the Former Fort Ord in Santa Cruz County (Murphy 2003, USFWS 2004a, Baron and Bros *in press*.). The baseline surveys identified robust spineflower as occurring in one Conserved Habitat Area—Fort Ord Dunes State Park—where it has not been relocated since the 1992 survey (Zander Associates 2004; Table 4).

Like other diminutive annual herbs, robust spineflower persistence is threatened by the invasion and spread of exotic plants, trampling and excessive erosion associated with recreation (Table 3). Inland populations may also be in decline due to fire exclusion, which allows woody vegetation to colonize canopy gaps occupied by the robust spineflower (USFWS 2004a). As with all of the covered plants, greater understanding about the ecology or robust spineflower would facilitate efforts to design and implement management.

Monitoring Program

A tiered approach is recommended for monitoring robust spineflower. The first tier will consist of reconnaissance level surveys to determine whether robust spineflower occurs within the CHAs of the installation. The positive identification of robust spineflower within the CHAs will trigger second tier monitoring, the details of which should be developed based upon the population characteristics, but could include two complementary monitoring protocols: areal mapping to identify the location and distribution of robust spineflower, and cover sampling, to track its abundance.

If robust spineflower is indeed present, the monitoring protocols will be designed to track success toward the first three biological objectives, as well as increase understanding of the rare plant's ecology needed to inform management (Objective 4), as for the other covered herbs.

5.7.1 Reconnaissance Surveys (Tier 1)

Monitoring Objectives

Reconnaissance surveys are designed to identify potential populations of robust spineflower within the Conserved Habitat Areas.

Monitoring Design

Field Survey

Reconnaissance surveys will be used to identify whether robust spineflower is present in areas of known appropriate habitat, which can characterized as open, sandy areas associated with active dunes and inland stabilized dunes that feature low cover of shrubs and trees (or gaps within such dominant vegetation; USFWS 2004).

To cover as much of the potential appropriate habitat during the course of the up to 10 years of implementation, surveys will be sequential. They will begin in the area where the species was reported to have been located during the 1992 baseline survey—the Fort Ord Dunes State Park south of Stilwell Hall (Zander Associates 2004). To aid a thorough initial survey, systematic searching will be conducted by dividing the potential habitat into cells created by overlaying a 50m x 50m grid upon a recent aerial photograph (either paper or digital, as through a hand held computer or tablet PC). Once each cell has been thoroughly searched, the observer(s) can move onto the next cell. Areas surveyed with negative findings will be re-examined only briefly during subsequent years of reconnaissance surveys, allowing the larger area within the CHAs to be examined.

Implementation

To provide accurate information about the distribution of the species that can be compared through time, the reconnaissance surveys, as well as subsequent Tier 2 monitoring protocols, will be implemented following these considerations.

Seasonality: Reconnaissance surveys for robust spineflower must be during the flowering season, which is typically between April and June. Bi-weekly assessments of phenology of *Chorizanthe* spp. can be used to target peak flowering for the plant; however, in most years, an early May survey will be appropriate.

Frequency: Tier 1 reconnaissance level monitoring will be implemented annually for 10 years. Once robust spineflower is positively identified within a Conserved Habitat Area, Tier 2 monitoring will be initiated and the reconnaissance surveys will continue for 10 years.

Personnel: Due to the close relationships and variable morphologies of the several species of *Chorizanthe* in the *Pungentes* section (incl. robust spineflower and Monterey spineflower, it can be difficult to differentiate specimens of this group. As a result, it will be necessary for the individual(s) conducting the survey to be very familiar with *Chorizanthe* morphological characters that distinguish the taxa (Ertter 1996, USFWS 2004a).

Pilot Studies

Exploratory studies can be used to evaluate techniques designed to increase effectiveness and cost effectiveness of the search for robust spineflower during reconnaissance surveys, including methods of delineating sectors to divide the search area into discrete patches, and the optimal number of searchers, among other factors. An exploratory study may also be needed to determine whether there is a reliable method for distinguishing *C. robusta* var. *robusta* from *C. pungens* var. *pungens* and other species of *Chorizanthe* which may co-occur. However, reconnaissance surveys are fairly straightforward and will not require full implementation as a pilot study prior to establishment of the adjusted baseline (Section 3.3).

Establishing the Adjusted Baseline

The Adjusted Baseline for robust spineflower will be established through implementation of monitoring protocol annually for 10 years. If robust spineflower is detected during the course of the reconnaissance surveys, the Adjusted Baseline will be developed based on the results of the Tier 2 monitoring studies. If, however, the species is not observed during the course of 10 years of annual reconnaissance surveys, the Adjusted Baseline will be presumed to be zero, and robust spineflower will be removed from future monitoring (incl. reconnaissance surveys) unless and until it is located within the CHAs.

5.7.2 Areal Extent and Abundance Sampling (Tier 2)

It would be difficult at this time to develop monitoring protocols to track the distribution and abundance of robust spineflower. This is because details of such protocols should be based on the distribution and abundance patterns of the species within the Conserved Habitat Areas, which are at present unknown. However, based upon its (presumed) limited distribution within the CHAs and annual life history, robust spineflower might be effectively monitored using a combination of areal extent mapping and abundance sampling. Protocols for coast wallflower and Contra Costa goldfields abundance could be readily modified to track abundance of robust spineflower. Depending on its rarity within the CHAs, however, robust spineflower may require a more targeted effort that that described for the other covered herbs.

5.8 Maritime Chaparral Monitoring

Biological Goals and Objectives

Goal: Preserve or enhance populations of each of the eight species occurring within maritime chaparral within the Conserved Habitat Areas of the FOHCP.

Objective 1: Maintain or increase the distribution of each of the eight species within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 2: Maintain or increase the abundance of each of the eight species within each Conserved Habitat Area at which it is known to occur at the time of the Adjusted Baseline.

Objective 3: Reduce or prevent the increase of anthropogenic factors which negatively impact the eight species, including exotic plants, unnatural disturbances and erosion, and inappropriate management techniques.

Objective 4: Increase understanding of the ecological factors influencing the distribution, abundance, and population persistence of the eight species within the Conserved Habitat Areas in order to inform management and monitoring.

Background

Maritime chaparral supports eight of the twelve covered plants of the FOHCP (Table 3). They are three of the covered herbaceous plants:

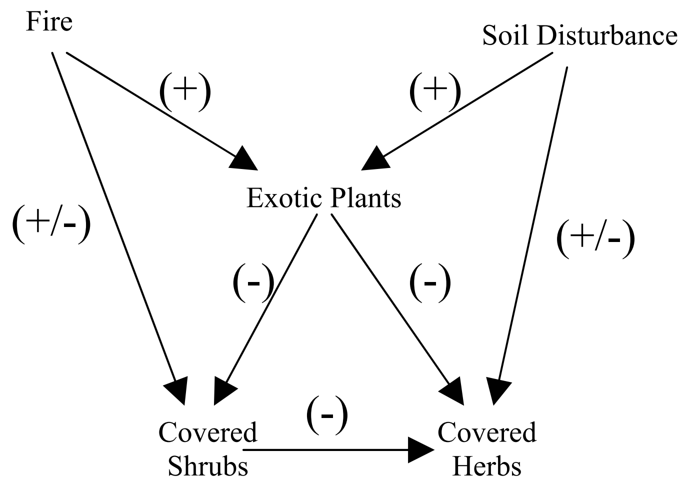
- sand gilia (*Gilia tenuiflora* ssp. *arenaria*)
- Monterey spineflower (*Chorizanthe pungens* var. *pungens*)
- seaside bird's beak (*Cordylanthus rigidus* ssp. *littoralis*)

and all five of the covered shrubs:

- Toro manzanita (*Arctostaphylos montereyensis*)
- sand mat manzanita (*Arctostaphylos pumula*)
- Hooker's manzanita (*Arctostaphylos hookeri*)
- Monterey ceanothus (*Ceanothus cuneatus* var. *rigidus*)
- Eastwood's ericameria (*Ericameria fasiculata*)

Maritime chaparral covers a large portion of the acreage of the Conserved Habitat Areas. It is a dynamic system which requires active management using prescribed fire to simulate the natural disturbance regime and facilitate persistence of the native species adapted to recurring fire. Like other communities within the installation, maritime chaparral has been degraded by the invasion and spread of exotic plants and soil disturbances, due to historical and current vehicle and recreational use. Management proposed in the HCP focuses on the importance of maintaining natural community structure including populations of the covered species within this important community. Through a variety of direct and indirect mechanisms, fire, soil disturbances, and exotic plant species have independent and interactive effects on populations of the eight covered species, which are themselves ecologically related (Figure 6).

Figure 6: Simplified ecological model for the maritime chaparral ecosystem of Fort Ord, showing the direct effects of fire, soil disturbance, and exotic plants on the covered herbs and shrubs of the Fort Ord HCP. Positive signs indicate direct positive effects, minus signs indicate direct negative effects, and both signs indicate both positive and negative direct effects on populations. To simplify the illustration, indirect effects are not shown, but can be inferred. For example, soil disturbances can have an indirect negative effect on covered herbs by enhancing populations of exotic plants.



Given the ecological interrelationships between the covered herbs and covered shrubs within the maritime chaparral community, integrating monitoring for the co-occurring species and the factors that influence their populations will greatly enhance ability to evaluate observed declines within the context of management and the ecology of the system. For example, if abundance of one or more of the covered herbs declines, it will be possible to evaluate the extent to which increases in shrub canopy cover, including that of the covered shrubs, is correlated with the decline, and weigh the relative ecological benefits of management action. Because the eight covered herbs and shrubs co-occur within maritime chaparral, it is possible to collect data on multiple species within common sample plots, adding to the cost-effectiveness of the coordinated monitoring program.

Monitoring Program

The monitoring program for the covered species of maritime chaparral consists of two components:

1. Areal extent mapping to determine and monitor the distribution of maritime chaparral
2. Quantitative field sampling to monitor the abundance of the covered species and the occurrence of factors which degrade their habitat within maritime chaparral

Together, these complementary monitoring protocols address the questions:

1. What is the status and trend of the distribution of maritime chaparral habitat within the Conserved Habitat Areas?
2. Within the maritime chaparral, what is the status and trend of the covered plant populations and factors which degrade their habitat?

5.8.1 Areal Mapping of Maritime Chaparral

The distribution of maritime chaparral communities will be determined and monitored using areal mapping, in which maritime chaparral patches are mapped using a combination of aerial image interpretation and field surveys.

<u>Monitoring Objectives</u>

The objectives of areal mapping are:

1. To identify and track the location and areal coverage of maritime chaparral patches within the Conserved Habitat Areas
2. To allow spatially explicit examination of the distribution that will facilitate the design of management and other monitoring studies (incl. quantitative sampling below), and provides insight into the factors affecting the distribution and persistence of the community.

<u>Monitoring Design</u>

Field Survey

<u>Location:</u> Areal mapping of maritime chaparral will occur throughout the Conserved Habitat Areas. During the first implementation, the entire installation will be searched. In subsequent implementations, time and costs will be reduced by examining areas as follows: 1) re-examine areas where maritime chaparral is known to occur, either from prior mapping, or identification of new patches during the course of management and monitoring efforts, 2) examine areas that have experienced management that could result in establishment of new patches of maritime chaparral, such as burned or cleared areas, and 3) re-examine areas where it was not known to occur, but for which habitat appears suitable.

<u>Patch Delimitation:</u> The areal extent of maritime chaparral will be determined within the Conserved Habitat Areas by mapping polygons delimiting patches of the rare community onto aerial images using GIS. Van Dyke and Holl (2003) completed this task for the Monterey Bay region, including Fort Ord, and found that the textural differences between maritime chaparral and other communities such as oak woodland and annual grassland were large enough to allow the maritime chaparral 'signature' to be readily discerned on 2001 aerial images of 0.6m pixel resolution. They report low classification error and suggest the resulting polygons have 10m accuracy (Van Dyke and Holl 2003).

In the future, it might be possible to use multi- or hyperspectral analysis of aerial images to perform the same task with the aid of computer algorithms, which analyze and classify the pixels according to various spectra. This newly available technology, including the hyperspectral aerial imagery computer software to aid analysis, could potentially increase the speed and accuracy with which polygons of maritime chaparral are delimited.

Implementation

Seasonality: There is no special seasonality to areal mapping based on GIS; however, there may be a season during which aerial photographs should be taken to maximize the ability of the observer to discern maritime chaparral from other communities. This should be investigated through a pilot study examining available aerial images of maritime chaparral communities taken during different seasons.

Frequency: Areal mapping of maritime chaparral will occur in the Covered Habitat Areas approximately every 10 years. Areal mapping is designed to detect changes in the areal extent of the sensitive community such as might occur due to one or more of the following factors: 1) succession to oak woodland, resulting from increased cover and canopy dominance of oaks, *or* reversion of oak woodland to maritime chaparral following fire, 2) type conversion to annual grassland due to invasion of exotic plants following fire, *or* restoration of annual grassland patches to maritime chaparral, and 3) large scale soil disturbance (e.g. landslides or wide fuel breaks) *or* establishment of maritime chaparral on formerly eroded areas and decommissioned roads. These factors are expected to alter maritime chaparral areal extent over the landscape scale that this monitoring is designed to detect over the course of 10 to 100 years. Though the new maritime chaparral GIS layer could be created following the occurrence of a specific event that causes change, such as a fire, installation-wide monitoring will be conducted only every 10 years, assuming new aerial imagery is available for the region.

Personnel: Areal extent mapping of maritime chaparral will be completed by personnel trained in GIS and aerial image analysis and able to identify maritime chaparral both in aerial images (either manually or using spectral analysis) and ‘on the ground’, where some ‘truthing’ will be needed.

Analyses

Descriptive: Through GIS, the patch (polygons) layer will be used to calculate total patch area, the number of patches, and mean patch size for maritime chaparral, and areal coverage of anthropogenic factors. These statistics will be computed by CHA, by management entity region, and the installation as a whole.

Single Interval Comparisons: Overlay analysis using intersection should be used to identify areas where shifts have been detected. Attempts should be made to correct or account for errors associated with the polygons, including those caused by image rectification, and classification error. Areas where shifts are identified should be reexamined, using ground truthing as needed, to determine whether changes have indeed occurred, or whether the shift might be attributable to errors in the analysis.

Extra-curricular: In support of Objective 4, the spatial and tabular data should be used in additional analyses designed to increase knowledge of maritime chaparral ecology. For example, overlay analyses can be used to evaluate the occurrence of the community relative to soils, topography, microclimatic variables, management, and fire regimes (e.g. return interval), among other available data. Though encouraged, these additional analyses are not a requisite component of the monitoring program unless required as part of remedial action (Section 2.2).

Pilot Study

Areal mapping of maritime chaparral based on aerial image interpretation has been conducted by Van Dyke and Holl (2003), who provided a qualitative assessment of the error. As part of a pilot study, the error associated with maritime chaparral could be quantified to evaluate the ability of areal mapping based on aerial images to accurately and repeatably determine the location and acreage of the community (Section 3.3).

Establishing the Adjusted Baseline

The above areal mapping protocol should be implemented soon following permit issuance through the Fort Ord HCP. Data on the areal extent of maritime chaparral will be combined with the abundance data to create the Adjusted Baseline for each covered species, as described in the section following the abundance sampling protocol.

Thresholds and Evaluation

There are no specific thresholds established for the areal extent of maritime chaparral, as there are no biological goals and objectives at the community-level. Instead, areal mapping will be used to provide information about the distribution of maritime chaparral that will be combined with the abundance sampling (below) to establish the baseline and evaluate thresholds for the five covered shrubs.

5.8.2 Sampling within Maritime Chaparral

Monitoring Objectives

Plot sampling within maritime chaparral is designed to accomplish the following objectives:

1. Monitor the abundance of the covered plants
2. Monitor the occurrence of factors which degrade the habitat of the covered plants, including exotic plants, soil disturbance, and canopy closure resulting from fire exclusion
3. Aid evaluation of the effectiveness of the management program and inform future management projects
4. Increase understanding of the ecology of the system and species

Sampling Objectives

The objectives of the monitoring protocol are to have 80% power to detect 20% declines in the abundance of each covered species, with a 10% chance of indicating a statistically significant decline has occurred when one has not.

Monitoring Design

Field Methods

Sampling Design: The universe of interest of the sampling study is maritime chaparral as mapped through the areal extent mapping (Section 5.8.1). Within maritime chaparral, sample sites will be located randomly. At each sample site, two permanent, nested plots will be established to monitor the abundance of the covered species and the occurrence of factors that degrade their habitat within maritime chaparral (Table 7; Figure 7).

Sampling will be conducted using a split panel design (Table 8). The first panel will be comprised of 50 sample sites which will be sampled in perpetuity. Subsequent rotating panels will be comprised of 50 sample sites which will be sampled within each interval between maritime chaparral areal extent mapping (Section 5.8.1), which is approximately 11 years. After the maritime chaparral has been re-mapped, a new panel containing 50 sample sites will be allocated to replace the previous temporary panel. A total of 100 plots will be sampled each year, except during the year following updating of the maritime chaparral areal extent mapping when both temporary panels as well as the permanent panel will be sampled, for a total of 150 plots.

Data will be collected within the 10m x 10m plots every year a site is sampled. Data to be collected within the larger 30m x 30m plot will only be collected every five years (Table 7).

Plot Monumenting: To increase the repeatability of measurements between sampling intervals, the four corners of each of the two nested plots will be permanently monumented using 75cm long pieces of metal conduit (approx. ½” diameter). The markers should be placed 50cm into the ground. In areas where vandalism is not a concern, the tops of the markers can be painted to facilitate detection. The coordinates of the north corner stake will be recorded using a survey grade GPS, which will facilitate relocation of the plot should the corner stakes be removed.

Measurements:

30 x 30m Quadrat

Two 100m transect tapes will be used to delimit the boundaries of the 30m x 30m quadrat. All individuals of each of the five covered shrub species will be permanently marked with unique, numbered tags, so that their fate can be followed through time. Newly recruited individuals (i.e. seedlings) of the covered shrubs will similarly be marked as they are observed. Observers will record the number of individuals of each of the five species within each of three age classes: seedling (first year), juvenile (>1 year but not reproductive) and adult (reproductive).

Observers will visually estimate the canopy cover of the five covered shrubs by age class, the cover of each exotic plant species, and the percent area of the plot disturbed by soil disturbance/erosion, using the following cover classes (percentages): <1, 1-5, 6-25, 26-50, 51-75, 76-95, and 96-100.

10m X 10m Quadrat

A 50m transect tape will be used to delimit the perimeter of the 10m x 10m subplot, located within the center of the 30m x 30m plot. Observers will record the number of sand gilia and seaside bird's beak plants within the plot, and visually estimate the canopy cover of Monterey spineflower. Observers will also record litter depth in five randomly located points; visually estimate the cover of plant litter; visually estimate the cover of each exotic plant species; and visually estimate the canopy of woody plants (trees and shrubs), all using the following cover classes (percentages): <1, 1-5, 6-25, 26-50, 51-75, 76-95, and 96-100.

Implementation

To provide accurate information that can be compared through time, sampling will be implemented following these considerations.

Seasonality: Field surveys will occur when sand gilia and Monterey spineflower are in flower during the spring, between April and May. Though not in flower during this season, the covered shrubs and seaside bird's beak individuals can be observed and counted.

Personnel: Sampling will be completed by a team of individuals trained to identify the five covered species, even when they are not in flower, to provide repeatable visual estimates using cover classes. Individuals will be trained and required to pass a field test which will establish their qualification for the field sampling.

Frequency: As described under "Sampling Design" above, sampling will be conducted using a split panel design (Table 8) in which data will be collected within the 10m x 10m plots each year a site is visited, and data collected within the 30m x 30m plots every fifth year.

Analyses

Descriptive Statistics: In any one sampling interval, the data available from the areal mapping of maritime chaparral will be combined with that of the maritime chaparral field sampling to determine the abundance of the covered species within each of the three management entity regions (MERs) and installation wide. This will be conducted through the following two steps.

1. Determine the mean density (or cover) of each of the covered species within each of the three MERs. Due to the variation in the distribution of the covered shrubs within the distributions, it is hypothesized that the density and cover of each of the covered species

will differ significantly among the MERs. To test this hypothesis, analysis of variance (ANOVA) will be used with MER as a fixed factor.

2. The next step will be to calculate the areal coverage of each of the covered species within each of the management entity regions by multiplying the areal extent of maritime chaparral in the MER by the percent cover of the species within the MER. The number of each covered shrub can similarly be estimated across the area by multiplying the areal coverage of maritime chaparral in the MER by the density (number/area) in that MER.

Inferential Statistics: To examine potential changes in the abundance of the covered chaparral shrubs through time, a series of analyses will be required for the different variables. Individual analyses will be conducted for each species. For each species, separate analyses will also be conducted for cover and density. Density will be analyzed separately for each life history stage. Finally, changes in the cover of factors that degrade maritime chaparral (exotic species, erosion) will be evaluated separately.

Mixed linear models will need to be constructed to partition the variance observed in the abundance data among the various factors inherent in using a split panel design. Simpler tests, including paired t-tests and route regression, can be applied to data collected solely from the permanent panel to evaluate changes through time relative to the adjusted baseline.

Pilot Study to Evaluate Monitoring

A pilot study will be needed to evaluate the ability of the maritime chaparral sampling protocol to attain the monitoring objectives (Section 3.3). Of particular importance is determining the covered species occur within the randomly located sample plots at a frequency necessary to obtain a sufficient sample size for each. If not, the universe of interest of the monitoring protocol could be restricted to areas of maritime chaparral supporting the covered species, such that only randomly located sample sites that contain at least one of the eight covered species will be monitored. In addition, plot sizes could be increased, and/or plot shape altered, as feasible, to increase the frequency of occurrence of the covered species.

If a covered shrub species occurs with insufficient frequency within the sample plots to allow effective abundance monitoring, a separate abundance monitoring study could be implemented for the species. At the same time, if one of the covered herbs (e.g. Monterey spineflower) occurs with sufficient frequency within this protocol to evaluate its abundance, and the CRMP agrees that monitoring its occurrence within maritime chaparral is sufficient, then the separate abundance protocol described in previous sections could be dropped from the program.

Once plot sizes, shapes, and locations have been finalized, the monitoring protocol should be implemented for two years in order to obtain the standard deviation of the difference in abundance for the herbaceous plants, which should be examined via power analysis to determine the sample size necessary to attain the power to detect significant changes.

Establishment of the Adjusted Baseline

The Adjusted Baseline will be calculated based on results of the areal extent mapping of maritime chaparral and the maritime chaparral field sampling protocol, using the following formulas:

Adjusted Baseline $_{(cover)}$ = areal extent of maritime chaparral (acres) x mean cover (%)

Adjusted Baseline $_{(abundance)}$ = areal extent of maritime chaparral (acres) x density (number/acre)

The Adjusted Baseline will be based on the sample sites comprising the permanent panel (Panel 1 in Table 8) and calculated for management entity region and installation-wide. For the herbaceous plants, the adjusted baseline will be the mean of the three-year averages for each sample site. After 10 years of abundance monitoring, ANOVA will be used to evaluate whether the three year average was abnormally high or low as a result of climate or other stochastic factors during the first three years of abundance sampling, and the Adjusted Baseline corrected for such factors, as needed (Section 3.3.3).

Evaluating Thresholds based on Long Term Monitoring

The following thresholds are proposed to trigger remedial efforts based on the results of the maritime chaparral sampling:

- 20% decline in abundance (density or cover) relative to the Adjusted Baseline
- 10% increase in the percent cover of anthropogenic factors that negatively impact maritime chaparral species.

These thresholds will be evaluated using trend analysis. After data are available from five iterations of the sampling data (and every year thereafter), route regression will be used to examine the mean trend in covered species abundance and cover of anthropogenic factors across all permanent quadrats (Elzinga et al. 2001) within each management entity region and installation wide. The mean slope will be weighted by the average cover in each quadrat, to accurately depict overall changes in abundance. Trends toward persistent decline, even if not exceeding the threshold, will trigger evaluation of remedial action (Section 2.2), including additional analyses.

Single interval declines in covered species abundance and/or increases in the cover of anthropogenic factors can be evaluated using paired t-tests. Though this might be a reliable indicator of changes in the cover of exotic plants, soil disturbance/erosion, and/or the cover of woody species, changes in herbaceous plant abundance detected over single sampling intervals should be cautiously interpreted, owing to the potential for natural variability in abundance due to climate and sampling error to result in such changes.

Mixed linear models will be needed to partition the variance among multiple factors inherent in sampling using a split panel design (Urquhart et al. 1998, Piepho and Ogutu 2002, McDonald 2003).

Observed declines in the abundance of the covered species should be evaluated within the context of the ecological model for maritime chaparral system (Figure 6), using the additional data obtained from the sample plots. For example, if sand gilia abundance is found to decline by 20% over a 5 year period, additional analyses should be used to determine whether the decline is biological significant and, if so, whether anthropogenic factors contributed to the decline (Figure 4).

Extra Curricular Analyses

Data generated by this monitoring protocol should be made available to managers, regulators, researchers, and others interested in conducting additional analyses which can enhance understanding of the ecology of the system and species. These include:

- habitat characteristics correlated with the abundance each of the covered species, to generate hypotheses for management projects to enhance their populations
- relationships between abundance and short and long term climate conditions

Though encouraged, these additional analyses are not required components of the monitoring program unless required as part of remedial action (Section 2.2).

Table 3: Characteristics of the covered plant species of the Fort Ord Multispecies Habitat Conservation Plan

Species	Percent of Range in the Former Fort Ord[a]	Within Former Fort Ord Assessment of Species Relative				Potential Threats within Protected Habitat of the Former Fort Ord				
		Distribution	Abundance	Habitat specificity	Life history	Fire exclusion	Exotic plants	Recreation/ Erosion	Deer herbivory	Other
Chorizanthe pungens var. *pungens*	75-95	widespread	moderate-high	narrow	annual	Yes: canopy closure	Yes	Yes		
Chorizanthe robusta var. *robusta*	<1	very limited	very low	very narrow	annual	Yes: canopy closure	Yes	Yes		Allee effects
Cordylanthus rigidus var. *littoralis*	60-80	limited	low	narrow	annual	Yes: canopy closure	Yes	Yes	Yes	
Gilia tenuiflora ssp. *arenaria*	50-70	moderate	low-moderate	narrow	annual	Yes: canopy closure	Yes	Yes	Yes	
Lasthenia conjugens	<1	limited	low	narrow	annual	no	Yes	Yes		
Erysimum ammophilum	10-30	limited	low	narrow	annual or biennial	Yes: canopy closure	Yes	Yes	Yes	
Piperia yadonii	<1	very limited	very low	very narrow	perennial herb	no	Yes	Yes	Yes	Allee effects
Arctostaphylos pumila	70-90	widespread	moderate-high	moderate	perennial shrub	Yes: inhibit regeneration	Yes			
Arctostaphylos hookeri	15-35	moderate	moderate	moderate	perennial shrub	Yes: inhibit regeneration	Yes			
Ceanothus cuneatus var. *rigidus*	50-70	widespread	moderate	moderate	perennial shrub	Yes: inhibit regeneration	Yes		Yes (?)	
Ericameria fasciculata	70-90	moderate	low	moderate	perennial shrub	Yes: inhibit regeneration	Yes			

[a] based on US Army Corp of Engineers maps within Zander Associates 2004

Table 4: Known covered plant occurrences within each of the Conserved Habitat Areas managed by eight entities as proposed in the Fort Ord HCP (Zander Associates 2004).

	Conserved Habitat Areas		Covered Plant Species Observed Within CHA										
Management Entity	**Name**	**Acreage**	**Yadon's piperia**	**robust spineflower**	**coast wallflower**	**Sand gilia**	**Monterey spineflower**	**seaside bird's beak**	**sand mat manzanita**	**Hookers manzanita**	**Toro manzanita**	**Monterey Monterey**	**Eastwood's ericameria**
Bureau of Land Management	Natural Resource Management Area	15,000				X	X	X	X	X	X	X	X
University of California	Fort Ord Natural Reserve	606			X	X	X	X	X		X	X	X
CA. Dept. Parks and Recreation	Natural Resource Zone	837		X	X	X	X		X			X	
Fort Ord Reuse Authority	East Garrison (North and South)	422				X	X		X	X	X	X	X
	Habitat Corridor/Youth Camp	398				X	X		X				
	Parker Flats Habitat Reserve	379				X	X		X	X	X	X	X
	Oak Oval Reserve	73					X						
	Landfill Parcel	232			X	X	X		X			X	
	Salinas River Habitat Area	43					X						
	Marina Airport Habitat Reserve	130					X						
	Marina Northwest Corner[1]	63	X		X	X	X		X			X	X
	MPC Firing Range	206					X	X	X			X	X
	Natural Area Expansion	?					X	X	X			X	X
CA Dept. Transportation	Highway 1 Corridor	?	X			X	X		X			X	

[1]Only a CHA if the presence of Yadon's piperia is confirmed.

Table 5: Summary of the attributes of the monitoring protocols for the 12 covered plants of the Fort Ord HCP (Details provided in text.)

	sand gilia		Monterey spineflower		seaside bird's-beak		Contra Costa goldfields		
Monitoring Characteristics	**Distribution**	**Abundance**	**Distribution**	**Abundance**	**Distribution**	**Abundance**	**Presence**	**Distribution**	**Abundance**
Monitoring Type	areal mapping	density sampling	areal mapping	cover sampling	areal mapping	cover sampling	recon. survey	areal mapping	cover sampling
Patch definition (areal mapping)	5m between plants	na	5m between plants	na	5m between plants	na	na	5m between plants	na
Sampling objectives									
Minimum detectable change	-10% area	-20% density	-10% area	-20% cover	-10% area	-20% density	na	-10% area	-20% cover
false change error (α)	na	0.10	na	0.10	na	0.10	na	na	0.10
missed change error (β)	na	0.20	na	0.20	na	0.20	na	na	0.20
power	na	80%	na	80%	na	80%	na	na	80%
Sampling Design (abundance)									
Universe of Interest	CHAs	patches in CHAs	CHAs	patches in CHAs	CHAs	patches in CHAs	31 areas identified by Army	CHAs	patches in CHAs
sample unit	na	quadrat	na	quadrat	na	quadrat	na	na	quadrat
unit size	na	1 m x 5 m	na	1 m x 5 m	na	1 m x 10 m	na	na	0.025 m x 4 m
allocation	na	random	na	random	na	random	na	na	random
sample size (n)	na	45	na	45	na	45	na	na	45
Implementation							na		
season	mid-March to mid-May		April to early June		July-September			March to June	
special timing considerations	high rainfall year	none	high rainfall year	none		none	none	high rainfall year	none

Table 5 (cont.): Attributes of the biological effectiveness monitoring protocols for the LOHCP Preserve System (Details provided in text.)

	coast wallflower		Yadon's piperia			Robust spineflower			Covered Shrubs	
			Tier 1:	Tier 2:		Tier 1:	Tier 2:			
Monitoring Characteristics	**Distribution**	**Abundance**	**Presence**	**Distribution**	**Abundance**	**Presence**	**Distribution**	**Abundance**	**Distribution**	**Abundance**
Monitoring Type	areal mapping	cover sampling	recon. survey	areal mapping	density sampling	recon. survey	areal mapping	cover sampling	areal mapping of maritime	density and cover
Patch definition (areal mapping only)	5m between plants	na	na	5m between plants	na	na	5m between plants	na	aerial photo interp.	na
Sampling objectives										
Minimum detectable change	-10% area	-20% cover	na	-10% area	-20% density	na	-10% area	-20% density	na	-20% density -20% cover
false change error (α)	na	0.10	na	na	0.10	na	na	0.10	na	0.10
missed change error (β)	na	0.20	na	na	0.20	na	na	0.20	na	0.20
power	na	80%	na	na	80%	na	na	80%	na	80%
Sampling Design										
Universe of Interest	CHAs	patches in CHAs	Marina Northwest Corner	CHAs	patches in CHAs	Fort Ord Dunes S.P.	CHAs	patches in CHAs	CHAs	maritime chaparral in CHAs
sample unit	na	quadrat	na	na	quadrat	na	na	quadrat	na	quadrat
unit size	na	1 m x 5 m	na	na	TBD	na	na	TBD	na	10 m x 10 m
allocation	na	random	na	na	TBD	na	na	TBD	na	random
sample size (n)	na	45	na	na	TBD	na	na	TBD	na	100
Implementation										
season	March to June		basal rosettes: January - April; flowering: July-August			April to early June			April-May	
special timing considerations	high rainfall year	none	none			none			new aerial imagery	

Table 6: Split panel design for sampling the abundance of sand gilia, Monterey spineflower, seaside bird's beak, Contra Costa goldfields, and coast wallflower. The symbol (●) indicates that the plots within the panel will be sampled in the year indicated. Additional details are provided in the text of the sampling protocols.

	Sample	Year																																								
Panel	**Size**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**…**
1	30	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
2	15	●	●	●	●	●	●	●	●	●	●																																
3	15											●	●	●	●	●	●	●	●	●	●																						
4	15																					●	●	●	●	●	●	●	●	●	●												
5	15																															●	●	●	●	●	●	●	●	●	●		
⋮	15																																									●	…

Table 7: Variables monitored within two nested plots located at each sample site in the maritime chaparral sampling protocol. (Details provided in text).

Plot Size	Species/Factor	Variable(s) Monitored	Measurement Methods
30m x 30m	Five covered shrubs	Density (n) by species by age class[1]	Counts of permanently marked plants
	Five covered shrubs	Canopy cover[2] by species	Visual estimate using cover classes
	Exotic plants	Canopy cover by species	Visual estimate using cover classes
	Soil disturbance	Percent of plot with soil disturbance or erosion	Visual estimate using cover classes
10m x 10m	sand gilia	Density	Counts
	seaside birds beak	Density	Counts
	Monterey spineflower	Canopy cover	Visual estimate using cover classes
	woody plants	Canopy cover of all shrubs and trees	Visual estimate using cover classes
	litter cover	Percent of soil surface covered by litter (leaves etc.)	Visual estimate using cover classes
	litter depth	Depth	mean of five random points
	exotic plant cover	Canopy cover by species	Visual estimate using cover classes

[1] Age classes: seedling (first year plant), juvenile (pre-reproductive plant greater than one year old), and adult (reproductive plant)

[2] Cover classes (percentages): <1, 1-5, 6-25, 26-50, 51-75, 76-95, and 96-100.

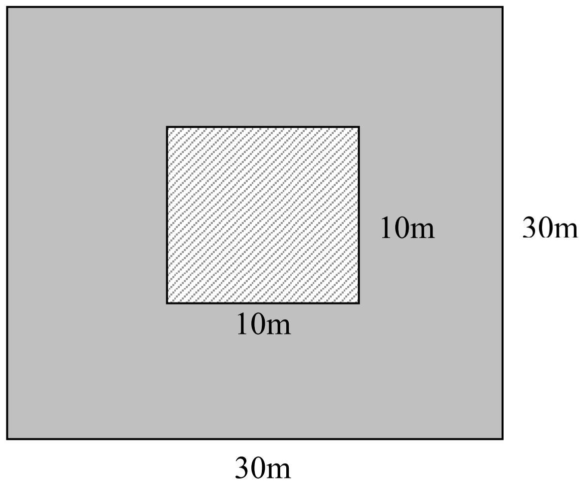


Figure 7: Nested plots used to monitor the abundance of covered species and occurrence of factors that degrade their habitat in the maritime chaparral sampling protocol (Details provided in text and Table 7).

Table 8: Temporal design for split panel sampling of maritime chaparral. (Details provided in text.)

	sample	**year**																																								
panel	**size**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	…
1	50	●	o	o	o	o	●	o	o	o	o	●	o	o	o	o	●	o	o	o	o	●	o	o	o	o	●	o	o	o	o	●	o	o	o	o	●	o	o	o	o	●	
2	50	●	o	o	o	o	●	o	o	o	o	●																															
3	50											●	o	o	o	o	●	o	o	o	o	●																					
4	50																					●	o	o	o	o	●	o	o	o	o	●											
5	50																															●	o	o	o	o	●	o	o	o	o	●	
⋮																																										●	o

● sites within panel sampled completely (Table 7)

o sites within panel sampled only for factors within 10m x 10m plot (Table 7)

Section 6: Monitoring Program Implementation

Like all adaptive management and monitoring plans, the program described here will require a commitment of resources for successful implementation, including both personnel time and equipment. This section briefly describes the requisite resources and recommendations for implementation.

Personnel

Skill

Successful implementation of this monitoring program will require leadership personnel skilled in the design, implementation, and analysis of biological monitoring studies. Leadership personnel should have a strong background in the field of plant ecology, particularly quantitative field ecology, and a thorough understanding of the ecology of the communities and covered plant species of the FOHCP. Due to the important role of sampling in the program, leadership personnel will need working knowledge of a wide variety of inferential statistical methods, including general linear models and power analysis.

During revision of the program following implementation of the pilot study, the leadership personnel may find it necessary to consult with a biometrician, or statistician that focuses on ecological/environmental sampling studies, especially long term monitoring programs, to ensure that the ultimate monitoring program design will render data that are analyzable as planned. Input of biometricians may similarly be needed to develop the mixed linear models that will be used to analyze the data collected as part of the split panel designs.

Individuals conducting the monitoring protocols in the field must also have sufficient background in biological monitoring and most importantly, be well trained. As stressed through the program, successfully monitoring plant populations requires that studies be implemented using techniques will ensure accuracy and repeatability. While the monitoring protocols include elements that were designed to achieve this objective, the manner in which they are implemented in the field will determine whether they are successful. As a result, it is essential that field personnel individuals be well-trained and carefully supervised by the leadership personnel. Trainings followed by performance tests are recommended throughout the program to facilitate this goal. Field personnel with a background in biology and ecological methodology may find it easier to complete the training, pass the test, and successfully implement the monitoring protocols; however, with thorough training, those without the academic background can similarly be successful.

Time

Successful implementation of this monitoring program will also require a commitment of substantial personnel time. Many of the monitoring protocols must be implemented during the spring (March-June); thus many seasonal field staff will be needed. Analysis and reporting will require time following seasonal field work, but only a fraction of the seasonal field staff and the leadership personnel.

Table 9 illustrates a hypothetical timeline for monitoring protocol implementation. In it, initiation of the areal mapping protocols for the covered species is staggered during the first 5 years following permitting, in order to reduce the level of effort required in a given year, while maintaining consistent monitoring intervals.

Equipment

Implementation of the monitoring program will require equipment. In addition to basic field survey materials (transect tapes, etc.), the areal mapping protocols described here were designed based on the availability of new technologies that can greatly enhance the accuracy and efficiency of data collection. Hand held or tablet personal computers equipped with GIS software (ArcPad) and potentially GPS receivers are recommended for mapping the areal extent of the covered plants in the field as this allows the data to be transferred directly into the GIS, reducing time and error associated with the intermediate step of digitizing. Data analysis and reporting will also require one or more personal computers equipped with requisite software, including: statistical packages that includes general linear models, power analysis packages, and GIS software (i.e. ArcGIS)

Coordination and Responsibilities

It is recommended that the monitoring program for the covered plants of the Fort Ord HCP be coordinated by a single entity. The monitoring protocols are designed to be implemented installation-wide, including in each of the management entity regions in which the covered species occur. It is essential that the monitoring be conducted consistently in order for the results to be interpretable. This is much more likely if a single entity is responsible for coordination; however, personnel from multiple entities could certainly comprise the team that implements the monitoring program.

The Coordinated Resources Management Program (CRMP) will determine the implementing entity(ies) for the monitoring program. The University of California has expressed interest in assuming responsibility for implementing the monitoring program for the covered plants installation-wide. The University could be an appropriate implementing entity for several reasons, including:

1. The University has access to personnel with the requisite skills and knowledge, including a seasonal pool of skilled personnel comprised of undergraduate students and recent graduates with backgrounds sufficient to conduct monitoring following training. Involving students and recent graduates in such a program is consistent with the Universities mission of educating and training students.
2. The University has infrastructure that can facilitate success of the monitoring program, including knowledgeable scientists, libraries, and computer facilities including a GIS lab.
3. The University can facilitate involvement of scientists and students in the monitoring program, thereby enhancing understanding of the ecological system and species through extra curricular analyses and side projects involving the monitoring data.
4. The University has been successfully conducting monitoring studies similar in design to those prescribed in this program since it acquired the UC Fort Ord Natural Reserve.

Other agencies and entities with qualified personnel could similarly implement the monitoring program. Ideally, the entity(ies) involved would be responsible for monitoring over a long term (i.e. several decades or perhaps in perpetuity), as continuity of personnel will greatly enhance effectiveness of this adaptive monitoring program.

Table 9: Hypothetical annual schedule for implementation of the monitoring protocols during the first 25 years. (Details described in text.)

		Year																									
Species	**Monitoring Protocol**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**24**	**25**
Sand gilia	areal mapping	pilot study	establish Adjusted Baseline										long term monitoring										long term monitoring				
	abundance sampling	pilot study	pilot study	establish Adjusted Baseline	establish Adjusted Baseline	establish Adjusted Baseline	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	
Monterey spineflower	areal mapping		pilot study	establish Adjusted Baseline										long term monitoring										long term monitoring			
	abundance sampling		pilot study	pilot study	establish Adjusted Baseline	establish Adjusted Baseline	establish Adjusted Baseline	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	
seaside bird's-beak	areal mapping			pilot study	establish Adjusted Baseline										long term monitoring										long term monitoring		
	abundance sampling			pilot study	pilot study	establish Adjusted Baseline	establish Adjusted Baseline	establish Adjusted Baseline	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring
Contra Costa goldfields	recon. surveys	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring																
	areal mapping				pilot study	establish Adjusted Baseline										long term monitoring										long term monitoring	
	abundance sampling				pilot study	pilot study	establish Adjusted Baseline	establish Adjusted Baseline	establish Adjusted Baseline	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring
coast wallflower	areal mapping					pilot study	establish Adjusted Baseline										long term monitoring										long term monitoring
	abundance sampling					pilot study	pilot study	establish Adjusted Baseline	establish Adjusted Baseline	establish Adjusted Baseline	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring
Yadon's piperia	recon. surveys	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring																
	Tier 2	TBD																									
robust spineflower	recon. surveys	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring																
	Tier 2	TBD																									
maritime chaparral incl. covered shrubs	areal mapping	2003[1]										long term monitoring										long term monitoring					
	abundance sampling		pilot study	pilot study	establish Adjusted Baseline	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	long term monitoring	

Legend:
- pilot study
- establish Adjusted Baseline
- long term monitoring

[1] Based on using Van Dyke and Holl 2003 as baseline

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Appendix H
Monitoring Protocols for Yadon's Piperia and HCP Wildlife Species

APPENDIX H

MONITORING PROTOCOLS FOR YADON'S PIPERIA AND HCP WILDLIFE SPECIES

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Appendix H
Monitoring Protocols for Yadon's Piperia and HCP Wildlife Species

H.1 Introduction

The following are recommended survey and monitoring protocols for the Yadon's piperia (*Piperia yadonii*) and the Habitat Conservation Plan (HCP) wildlife species. It is important to use consistent monitoring methods throughout the permit term to ensure consistency in the analysis. If pilot surveys determine that alternative monitoring methods are more appropriate for determining species distribution and abundance then those alternative methods should be adopted as minor amendments to the HCP.

H.2 Yadon's Piperia

At the time of the writing of the Plant Monitoring Program (Appendix G; McGraw 2005), the monitoring protocols to track the distribution and abundance of Yadon's piperia had not been developed because of the unknown distribution and abundance of the species in the Plan Area. Based on recent information regarding the species occurrence in the Plan Area, a monitoring protocol has been created from recommendations made for the Plant Monitoring Program as well as existing monitoring protocols for other herbaceous species of similar distribution. Based on its distribution and abundance within the Habitat Management Areas (HMAs), Yadon's piperia will be monitored using three complementary monitoring protocols.

- Reconnaissance surveys to identify new populations of Yadon's piperia.
- Areal extent mapping to determine and monitor the distribution of Yadon's piperia.
- Census monitoring to determine the abundance of Yadon's piperia.

In the event that Yadon's piperia distribution and abundance is much higher than currently known within the Plan Area, alternative methods may be proposed but must be approved by the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW) through the Coordinated Resource Management and Planning (CRMP) program prior to implementation. A minor amendment would be required to changes protocols.

H.2.1 Field Reconnaissance Surveys

Reconnaissance surveys are designed to identify potential populations of Yadon's piperia within the HMAs.

H.2.2 Monitoring Design

H.2.2.1 Field Methods

H.2.2.1.1 Location

Reconnaissance surveys will be used to search areas identified as potential habitat for Yadon's piperia, which can be characterized as adjacent to shrubs in maritime chaparral and underneath the canopy of Monterey pines (Doak and Graff 2001, U.S. Fish and Wildlife Service 2004).

H.2.2.1.2 Search

To cover as much of the potential appropriate habitat during the course of the up to 10 years of implementation, surveys will be sequential, with all areas of potential appropriate habitat being surveyed each year. They will begin in the most appropriate potential habitat areas and progress into less likely potential areas, based on an initial screening of vegetation types, soils, hydrology and other environmental factors that have been shown to support Yadon's piperia occurrence. To aid a thorough initial survey, systematic searching will be conducted by dividing the potential habitat into sectors or cells (e.g., as created by overlaying a 50 meter (m) x 50 m grid upon a recent aerial photograph). Once each cell has been thoroughly searched, the observer(s) can move onto the next cell. Areas surveyed with negative findings will be re-examined during subsequent years of reconnaissance surveys because Yadon's piperia exhibits dormancy which could potentially prevent populations from being detected in any given year.

H.2.2.2 Implementation

H.2.2.2.1 Seasonality

Reconnaissance surveys for Yadon's piperia must occur in two phases. First, a reconnaissance survey conducted between mid-January and early April will be used to search for vegetative rosettes of the genus *Piperia*. Identified rosettes will be placed under cages to prevent herbivory and ensure that positive identification can be made in the flowering season. Areas featuring rosettes will be revisited in the flowering season (July–August) to determine whether they are *P. yadonii*. Summer surveys can also facilitate detection of Yadon's piperia that may have been missed during the vegetative stage.

H.2.2.2.2 Frequency

Reconnaissance level monitoring will be implemented annually for 10 years. Once Yadon's piperia is positively identified within an HMA, areal mapping and census monitoring will be initiated in that area, with areal mapping updated annually as needed if field surveys indicate changes in the population distribution. Reconnaissance surveys will continue within those surveyed areas that had negative findings and within the un-surveyed areas for the duration of the 10-year period.

H.2.2.2.3 Personnel

Reconnaissance surveys will be conducted by individuals familiar with the morphological characters that distinguish *Piperia yadonii* from conspecifics with which it co-occurs in the region.

H.2.2.3 Pilot Studies

Exploratory studies can be used to evaluate techniques designed to increase effectiveness and cost effectiveness of the search for Yadon's piperia during reconnaissance surveys, including methods of delineating sectors to divide the search area into discrete patches, and the optimal number of searchers, among other factors. However, reconnaissance surveys are fairly straightforward and will not require full implementation as a pilot study prior to establishment of the adjusted baseline.

H.2.2.4 Establishing the Adjusted Baseline

New populations of Yadon's piperia identified during the course of 10 years of reconnaissance surveys will be included in the adjusted baseline, which will be based on areal mapping and census monitoring, as described in the following sections. This extended survey period is required because this species exhibits dormancy, in which individuals persist belowground through corms (storage organs) which may or may not produce aboveground structures in any given year. This may explain the substantial fluctuation in the species' occurrence at the Marina Northwest Corner since the baseline surveys.

H.2.3 Areal Mapping

The distribution of Yadon's piperia will be determined and monitored using areal extent mapping in which the area and location of Yadon's piperia patches are mapped using field surveys.

The objectives of areal mapping are the following.

- To identify and track the location and areal coverage of Yadon's piperia patches within the HMAs.
- To allow spatially explicit examination of the distribution that will facilitate the design of management and other monitoring studies (including census monitoring) and provides insight into the factors affecting the population distribution and persistence.

H.2.3.1 Monitoring Design

H.2.3.1.1 Field Survey

H.2.3.1.1.1 Location

Areal mapping of Yadon's piperia will occur in all HMAs in which the species is known to occur, including areas added as a result of reconnaissance surveys.

H.2.3.1.1.2 Patch Delimitation

Each Yadon's piperia patch will be delimited by "connecting the dots" between outermost individual plants, with plants more than 3 m apart included in separate patches. Isolated patches (i.e., two or more plants) that occupy 1 square meter (m^2) or less will be mapped as points and assigned an area of 1 m^2. Individual plants (i.e., those greater than 3 m from other aboveground individuals) will be mapped as points. Paved roads or other areas which clearly are *not* occupied by Yadon's piperia will be excluded from the mapped patches, even if they are flanked by patches of the rare plant which are less than 3 m apart.

H.2.3.1.1.3 Anthropogenic Factors

Within the delimited polygons, the occurrence of the following will also be recorded: 1) aggressive exotic plants (*Cortaderia jubata, Carpobrotus edulis* or other large exotics); 2) dense infestations of European annual plants; and 3) erosion caused by roads or recreational use (historical or current).

H.2.3.1.2 Implementation

H.2.3.1.2.1 Seasonality

Field surveys for Yadon's piperia must occur in two phases. First, areal mapping of vegetative rosettes of the genus *Piperia* will be conducted between mid-January and early April in areas identified during reconnaissance surveys to be occupied by Yadon's piperia. Mapped areas will be revisited during the flowering season (July–August) to confirm whether they are *P. yadonii*. Rosettes will be caged between the two survey periods to protect plants from herbivory and ensure accurate identification.

H.2.3.1.2.2 Frequency

Areal mapping of Yadon's piperia will occur annually with updates occurring in concert with census monitoring (Section H.2.4*, Census Monitoring*). The most recent aerial imagery available will be used.

H.2.3.1.2.3 Personnel

Areal extent mapping of Yadon's piperia will be completed by a team of individuals trained to identify the rare plant and delineate patch perimeters following the mapping rules described above. Individuals will be required to pass a field test to establish their qualification for the field component of areal mapping.

H.2.3.1.3 Analyses

H.2.3.1.3.1 Descriptive

Through geographic information systems (GIS), the patch (polygons) layer will be used to calculate total patch area, the number of patches, and mean patch size for Yadon's piperia, and areal coverage of anthropogenic factors. These statistics will be computed as applicable by HMA, by management entity region, and the installation as a whole.

H.2.3.1.3.2 Comparisons

Change in Yadon's piperia and anthropogenic factor areal coverage can be calculated as:

$$\Delta = \frac{\text{Area}(t) - \text{Area}(ab)}{\text{Area}(ab)}$$

where t is the current time period, and ab is the adjusted baseline.

H.2.3.1.4 Pilot Study

Exploratory studies should be used to evaluate the effectiveness of the mapping rules in delineating patch polygons. Specifically, the nearest neighbor rule for patch inclusion, which assigns fixed metrics between two or more classes in order to differentiate them (in this case 3 m or more), should be evaluated for their accuracy and repeatability.

H.2.3.1.5 Establishing the Adjusted Baseline

At the recommendation of USFWS, the adjusted baseline for Yadon's piperia distribution will be established through 10 years of annual areal mapping following permit issuance through the Fort Ord HCP. Provided that the areal mapping meets the monitoring objectives, the total patch area recorded over the 10-year monitoring period will be used as the adjusted baseline for Yadon's piperia distribution. In the event additional lands are transferred after the 10-year period, surveys will be extended as necessary to ensure base-wide coverage.

H.2.3.1.6 Thresholds and Evaluation

Thresholds used to trigger remedial efforts for Yadon's piperia are based on the total patch area accumulated over a 10-year monitoring period (i.e., 2005–2015 compared to 2015–2025). The monitoring results will be compared against the adjusted baseline. At this time, recommended thresholds are as follows.

- A 10% decline in total areal coverage compared to the adjusted baseline for each HMA, management entity region, or base-wide.
- A 10% increase in the total areal coverage of anthropogenic factors which negatively impact Yadon's piperia distribution, including exotic plants and unnatural disturbances and erosion caused by recreation.

These thresholds may need to be revised per results of the pilot study, power analysis, and adjusted baseline. The result of monitoring will be used to inform adaptive management.

H.2.4 Abundance Monitoring

The abundance of Yadon's piperia will be monitored by repeated censuses of Yadon's piperia within patches of occupied habitat identified in the areal mapping for each of the HMAs. The census should be conducted simultaneous to the areal mapping.

H.2.4.1.1 Field Methods

H.2.4.1.1.1 Plant Counts

Once a patch has been delimited using pin flags or a similar visual aid, a count of all basal rosettes within the patch will be conducted. Only Yadon's piperia individuals that are rooted within the delimited patch will be counted. Plants rooted on the border will be counted. If the species' distribution has changed significantly (as determined by statistical tests) since the previous year's surveys, areal mapping will be updated, in concert with census monitoring, to reflect these changes. These updates will occur during the flowering season; to ensure that newly included individuals are indeed *P. yadonii*. These newly updated patches will be used for census monitoring, to ensure that all *P. yadonii* individuals are counted.

In addition to the number of Yadon's piperia individuals, the following will be visually estimated using cover classes.

- The percent cover of exotic plants.
- The percent cover of woody plants (subshrubs, shrubs, and trees).
- The percent cover of unnatural soil disturbance and/or erosion.

Cover classes, in percentages, will be: <1, 1–5, 6–25, 26–50, 51–75, 76–95, and 96–100.

H.2.4.1.2 Implementation

H.2.4.1.2.1 Seasonality

Field surveys for Yadon's piperia must occur in two phases. First, a census of vegetative rosettes of the genus *Piperia* will be conducted between mid-January and early April within areas identified during reconnaissance surveys to be occupied by Yadon's piperia. Censused areas will be revisited in the flowering season (July–August) to confirm whether they are *P. yadonii*. Rosettes will be caged between the two survey periods to protect plants from herbivory and ensure accurate identification.

H.2.4.1.2.2 Personnel

A census of Yadon's piperia will be completed by a team of individuals trained to identify the rare plant, accurately count individuals, and provide repeatable visual estimates of habitat factors using cover classes. Individuals will be required to pass a field test to establish their qualification for the field census.

H.2.4.1.3 Pilot Study to Evaluate Monitoring

Exploratory studies can be used to evaluate techniques designed to increase effectiveness of the monitoring for Yadon's piperia during censuses, including methods of counting plants and the optimal number of census-takers, among other factors.

H.2.4.1.4 Establishment of the Adjusted Baseline

At the recommendation of USFWS, the adjusted baseline for Yadon's piperia density will be established simultaneous to the adjusted baseline for the species' distribution, through the implementation of an annual census over a 10-year period. The adjusted baseline for abundance will be calculated as applicable for each HMA, management entity region, and base-wide as the average of the 10-year densities for each mapped polygon.

H.2.4.1.5 Evaluating Thresholds based on Long-Term Monitoring

The following thresholds are proposed to trigger remedial efforts based on the results of the Yadon's piperia census averages. The monitoring results will be compared against the adjusted baseline.

- 20% decline in average density or abundance for each HMA, management entity region, or base-wide relative to the adjusted baseline.
- 10% increase in the percent cover of anthropogenic factors that negatively impact Yadon's piperia.

The result of monitoring will be used to inform adaptive management.

H.3 Smith's Blue Butterfly

H.3.1 Habitat Mapping of Smith's Blue Butterfly Host Plants

H.3.1.1 Monitoring Design

Smith's blue butterfly habitat patches will be delimited by "connecting the dots" between individual host plants that are less than 10 meters apart. Plants more than 10 m apart will be included in separate patches. Isolated patches (i.e., two or more plants) that occupy 1 m^2 or less will be mapped as points and assigned an area of 1 m^2. Individual plants (i.e., those greater than 10 m from other aboveground individuals) will be mapped as points. Because the host plants are perennial and can be observed year round, habitat mapping can occur at any time. However, habitat mapping would likely be facilitated by summer (June–August) surveys, when the buckwheat species are in flower and therefore more visible. Habitat mapping of Smith's blue butterfly habitat will occur over the entire area of potential habitat once every 10 years, but may be completed incrementally (in sub areas) over that 10-year period. Through GIS, the patch (polygons) layer will be used to calculate total patch area, the number of patches, and mean patch size for Smith's blue butterfly habitat.

H.3.1.2 Establishing the Adjusted Baseline

The adjusted baseline for Smith's blue butterfly habitat distribution will be established through implementation of habitat mapping following permit issuance through the Fort Ord HCP. Provided that the patch delimitation meets the monitoring objectives (see Section 6.5.8.2, *Monitoring Goals*), the total patch area will be used as the adjusted baseline for Smith's blue butterfly habitat distribution.

H.3.1.3 Thresholds and Evaluation

Because of the low frequency at which habitat mapping will be conducted, thresholds used to trigger remedial efforts for the area of Smith's blue butterfly habitat will be based on single intervals (i.e., 2015 compared to 2005). At this time, recommended thresholds are as follows.

- 15% decline in total areal coverage compared to the adjusted baseline.

H.3.2 Abundance Sampling for Smith's Blue Butterfly Host Plants

The abundance of Smith's blue butterfly host plants will be monitored within patches of Smith's blue butterfly habitat identified during habitat mapping.

H.3.2.1 Monitoring Design

H.3.2.1.1 Field Methods

H.3.2.1.1.1 Sampling Design

The density of Smith's blue butterfly host plants and occurrence of factors that degrade Smith's blue butterfly habitat will be determined through detailed mapping of habitat patches. Habitat mapping will also capture information on the presence of exotic plant species and any observed soil disturbances.

H.3.2.1.2 Implementation

To provide accurate abundance information that can be compared through time sampling must be implemented considering the timing of the surveys and personnel.

H.3.2.1.2.1 Timing of Surveys

Host plant density and the cover of factors that might degrade Smith's blue butterfly habitat will be evaluated every 3 to 5 years, during the peak season for host plant flowering (June–July). No specific weather conditions are required to conduct this sampling.

H.3.2.1.2.2 Personnel

Host plant sampling will be conducted by personnel trained to identify the two buckwheat species in all life stages and provide repeatable visual estimates of habitat factors using cover classes.

H.3.2.1.3 Establishment of the Adjusted Baseline

The adjusted baseline for Smith's blue butterfly host plant abundance will be established through implementation of the abundance sampling protocols during 3 consecutive years after habitat mapping is conducted for Smith's blue butterfly habitat. The adjusted baseline will be calculated as follows based on 3-year averages.

- Mean number of adult host plants per habitat patch
- Mean cover of exotic plants per habitat patch
- Mean percentage of soil disturbance per habitat patch

H.3.2.1.4 Evaluating Thresholds based on Long-Term Monitoring

The following thresholds are proposed to trigger remedial efforts based on the results of the Smith's blue butterfly host plant abundance density sampling.

- 15% decline in the abundance of adult individuals of either or both of the host plants.
- 15% increase in the percentage cover of exotic plants or soil disturbance.

H.3.3 Presence/Absence Surveys for Smith's Blue Butterflies

H.3.3.1 Monitoring Design

H.3.3.1.1 Field Methods

A single observer will walk transects through the entire area of all mapped habitat patches and record any Smith's blue butterflies observed within the habitat patch. To provide accurate information that can be compared through time, sampling must be implemented considering the timing of surveys.

H.3.3.1.2 Timing of Surveys

Presence/absence surveys will occur once in a 5-year period. Surveys must occur during the flight season, which typically occurs between late May and early September, but is timed to coincide with the flowering of the host plants, and thus varies according to the climate of the year. Biweekly surveys will be conducted from June 15 to September 15. Surveys for presence/absence can be suspended when presence is confirmed within a transect.

Smith's blue butterfly sampling will occur during peak time of adult activity, between 10 a.m. and 3 p.m. It should only occur during conditions conducive to adult activity, which are as follows.

- Temperature: > 60 °F.
- Wind: no wind to light breeze (ideally <5 miles per hour [mph]); sustained winds over 10 mph would require an additional survey.
- Sky: full sun to only partly cloudy. Surveys may be conducted on overcast days if temperatures do not drop below 65 °F.
- Surveys will not be conducted under conditions with heavy fog, drizzle, or rain.

Hand-held instruments will be used to measure air temperature and wind speed. Activity of other butterfly species will be used to confirm appropriate conditions for surveys. Smith's blue butterfly presence/absence monitoring will be completed by personnel trained to identify the endangered insect.

H.3.3.1.3 Establishment of the Adjusted Baseline

The adjusted baseline for Smith's blue butterfly presence/absence will be established through implementation of the survey protocol during 3 consecutive years after habitat mapping is conducted for Smith's blue butterfly. Currently, there is a total of roughly 120 acres of occupied and potential species habitat located across FODSP, FONR, City of Seaside, County of Monterey, and City of Marina lands. Species habitat spans 91 habitat patches ranging from 0.02 to 19.03 acre, with 0.35 acre as the median patch size. The adjusted baseline will be calculated as follows based on 3-year averages.

- Mean number and acreage of habitat patches with occurrences of Smith's blue butterfly.

H.3.3.1.4 Evaluating Thresholds Based on Long-Term Monitoring

The following thresholds are proposed to trigger remedial efforts based on the results of the Smith's blue butterfly presence/absence surveys.

- 20% decline in number of patches occupied by Smith's blue butterfly per survey (occurring every 5 years) compared to the adjusted baseline.
- 20% decline in the total area occupied by Smith's blue butterfly per survey (occurring every 5 years) compared to the adjusted baseline.
- 15% decline in areal coverage and/or abundance of flowering individuals of the host plants compared to the adjusted baseline..

H.4 Western Snowy Plover

H.4.1 Background

Although the shoreline is narrow south of Stilwell Hall and there is public access at Marina State Beach to the north, nesting and rearing of western snowy plovers (*Charadrius nivosus*) has occurred along the Fort Ord coast. While habitat availability for successful nesting and chick rearing is critical to recovery of the western snowy plover, winter roosting habitat is also important. Continued provision of habitat opportunities for all life stages of the western snowy plover in the beach and foredune areas at Fort Ord will determine the success of management efforts for this species. Maintaining nesting and rearing habitat at Fort Ord will require careful management of public access and predator control. Because the primary factors that would affect western snowy plover habitat quality at Fort Ord are human-related disturbance and predation, success criteria for management of western snowy plover habitat will be based primarily on compliance with restrictions on public use that may impact western snowy plovers and on predator control measures.

H.4.2 Monitoring Program

The monitoring program will consist of three components: suitable habitat surveys to quantify available habitat, window surveys to monitor breeding population numbers, and a demographic, recreational, and predator monitoring to obtain specific information on breeding success. Monitoring for western snowy plover will be in concordance with the window surveys detailed in *Appendix J Monitoring Guidelines for the Western Snowy Plover, Pacific Coast Population*[1] published as part of the *Recovery Plan for the Pacific Coast Population of the Western Plover (Charadrius alexandrines nivosus)*[2] (U.S. Fish and Wildlife Service 2007). The monitoring program for western snowy plovers involves regular, seasonally-timed walking surveys along the Fort Ord shoreline to observe and record western snowy plover presence and behavior. Monitoring of western snowy plovers during the breeding season along the Fort Ord shoreline will be conducted annually and will be evaluated against the adjusted baseline. Details of the surveys are provided below.

H.4.2.1 Suitable Habitat Methods

Suitable habitat will be quantified by measuring the amount of dry and wet sand present on the beach for the duration of the plan term. The width of the total dry sand area and wet sand area within FODSP (approximately 4 miles of beach habitat) will be measured once a year for 3 years, and then every 5 years for the duration of the 50-year plan term. All data will be provided to USFWS for the regional monitoring effort that is part of the species recovery program. The amount of dry sand will be measured from the western edge of the steep dune bluffs that back the beach and the wet sand will be measured from the high tide line. The width will be an average of three measurements: the northern end, center (2-mile point), and southern end of the habitat. Data

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1 <http://www.fws.gov/arcata/es/birds/WSP/documents/RecoveryPlanWebRelease_09242007/WSP%20Final %20Appendices%20Part%202.pdf>.

2 <http://www.fws.gov/arcata/es/birds/WSP/documents/RecoveryPlanWebRelease_09242007/WSP%20Final %20RP%2010-1-07.pdf>.

collection will occur between March 1 and March 3, in coordination with the construction of the symbolic fencing.

H.4.2.2 Window Survey Methods

Caution and patience are required for surveying western snowy plovers. Surveys should provide maximum coverage with the least possible disturbance to western snowy plovers and other fauna and flora.

Early mornings at high tide on calm, dry, overcast days with few or no disturbances constitute ideal survey conditions. Surveys should be suspended or postponed in intense heat, heavy rain, or high wind.

Required equipment for surveys includes permit/certification, binoculars, field notebook, pencil, and timepiece. Recommended equipment includes spotting scope, site map, 2-way radio or cellular phone, emergency contact information, hat with visor, sunscreen, drinking water, camera, and educational handouts.

The following survey procedures are recommended.

- **Walk, don't drive.** Walking increases the chance of seeing birds and decreases the chance of crushing nests and chicks.
- **Survey all potential habitat.** If the area is associated with an estuary, survey the nesting habitat during high tide to reduce the chance that western snowy plovers will be feeding far from shore. One observer should be sufficient on narrow beaches. For beaches wider than 50 m (164 feet), extra observers, spaced every 50 m (164 feet), are advisable.
    - Observers should walk down the beach together with the person(s) closest to the dunes about 25 m (82 feet) ahead of the person next to the water. Stop every 50 m (164 feet) to scan at least 100 m (328 feet) ahead with binoculars. Synchronize walking and scanning among team members. Carefully note the location of western snowy plovers in the distance; they may crouch and be difficult to find when you get closer. While walking, continue to watch for western snowy plovers and be careful not to step on nests. Avoid flushing western snowy plovers.
- **The observer by the water should be the survey recorder.** Other observers should inform the recorder as soon as they sight a western snowy plover to avoid double counting.
- **Salt pond levees and lagoon margins can be surveyed similarly to beaches.** Lagoon or salt pond playas should be surveyed from the edges. Move between vantage points, conceal yourself if possible, and use binoculars and a telescope to scan potential habitat for at least 15 minutes per vantage station.
- **Record age and sex.** Indicate M(ale), F(emale), or U(nknown) for sex and A(dult), J(uvenile), C(hick), or U(nknown) for age. Chicks are incapable of flight, while juveniles are able to fly. Juveniles have pale feather edges on the back and wing coverts. In the fall, worn feather edges can give the appearance of a juvenile bird.
- **Track birds carefully.** If western snowy plovers fly behind you (where you have already counted), they can be added to the total. If they fly ahead, to areas not yet covered, they should not be counted unless the number of flying birds is greater than the number of western snowy plovers subsequently encountered on the ground.

- **Check for color bands.** Carefully record band combinations. Color-banded birds provide important information on survival and dispersal. At locations with enough color-banded birds, a more accurate population index can be obtained.
- **Duplicate the survey route.** After working out a suitable route, try to duplicate it on future surveys to obtain consistent results among surveys.
- **Focus on western snowy plovers.** Western snowy plovers are difficult to observe and should be the sole focus of monitoring. Western snowy plover surveys should not be combined with monitoring for other species.

H.4.2.3 Breeding Success Monitoring Methods

The objectives of this monitoring program are to determine the occurrence, abundance, distribution, and success of breeding western snowy plovers along the Fort Ord shoreline.

H.4.2.4 Monitoring Methods

H.4.2.4.1 Survey Frequency, Range, and Timing

Surveys will commence as early as possible, when environmental conditions allow, during the western snowy plover nesting season (March 1 to September 30). All suitable habitat along the Fort Ord shoreline will be surveyed. Surveys will be conducted three times a week in the beginning of the nesting season until the first nest is located. After the first nest is discovered, surveys will be conducted 5 days a week to ensure that nest loss/success is recorded. Later in the season (August), once the last nest has hatched and monitoring indicates that nesting is complete, monitors will conduct surveys three times a week until all remaining broods have fledged (or have been documented as lost), which may be as late as mid-September. Surveys will not be conducted during extreme heat, cold, wind, or rain. Disturbance of incubating birds under these conditions, even for a few minutes, may expose eggs to over-heating, chilling, inundation, or coverage by sand. Inclement weather conditions could also make sightings more difficult. Surveys should be conducted with the least amount of disturbance, particularly human activity on the beaches. The recommended time for surveys is as early in the morning as possible, tide permitting.

H.4.2.4.2 Training

All survey personnel will be trained to ensure that each is familiar with western snowy plover identification and behavior, that data are collected consistently, and that surveys are conducted in a manner that will minimize the potential for harm or harassment of breeding western snowy plovers. Training will take place under direct supervision of a 10(a)(1)(A) permit holder, for activities that involve locating, identifying, and monitoring nests, or erecting exclosures around nests. Surveyors must be approved by USFWS under a 10(a)(1)(A) permit or must have equivalent skills and experience and be approved by USFWS under this HCP and its associated ITP. At least one surveyor must be permitted by USFWS to band western snowy plovers.

H.4.2.4.3 Reconnaissance Survey

Early season (March) reconnaissance of the shoreline will occur to evaluate potential breeding habitat areas, conditions that could preclude nesting along the beach or foredune area (e.g., extremely steep/narrow beach areas or high summer wave wash) and to determine the need for additional observers in subsequent surveys.

H.4.2.4.4 Survey Procedures

H.4.2.4.4.1 Extent of Coverage

Observers will survey all suitable shoreline and foredune habitat from the high tide line to the first line of foredunes. Where the habitat area is wide, two surveyors will cover the beach in suitably spaced walking transects or a single surveyor will walk a zigzag path through the area. Using 7x35 power (or greater magnification) binoculars, observer(s) will stop approximately every 100 m to scan the beach and dunes ahead for western snowy plovers.

H.4.2.4.4.2 Sighting of Plover

When a western snowy plover is located, observer(s) will approach only close enough to identify the sex of the individual and to determine if it is banded and if it is nesting. Once a western snowy plover is seen, its location will be noted (preferably using GPS-based mapping). General habitat conditions of the area, especially percent cover of vegetation, debris and beach characteristics (e.g., slope, width, distance from public access points) will be recorded.

H.4.2.4.4.3 Determination and Documentation of Nesting

The location of a nest will be determined by one of two methods.

- If an observed western snowy plover appears to have flushed from a nest, the observer can watch the behavior of the bird from a concealed position to determine if the bird returns to the nest in a relatively short period of time. The location of the nest can be determined if the western snowy plover returns to it.
- If western snowy plover tracks are seen, the observer may be able to follow the tracks back to the nest site. A large number of tracks will commonly converge on the nest site.

If a positive determination of nesting activity is made, nest locations will be mapped (preferably using GPS). Nest site and surrounding habitat conditions, particularly within a 10-m radius of the nest, will be characterized and recorded. Characterization should include distance from large objects; dune or vegetation; types of small material in, around, or near the nest; and signs of other species, human activity or other disturbance close to the nest. An identifying landmark and the nest's direction and distance from the landmark should be recorded. The presence/absence of eggs in a nest will be recorded each day. If eggs are missing from the nest near the predicted hatch date (based on clutch initiation or float data), pips will be located in the nest bowl, if possible, and/or the brood will be monitored. If the eggs or entire nest are lost or abandoned, the reason, such as predation, trampling, tide, or other factor, will be identified and recorded.

H.4.2.4.4.4 Fledging Success Rates

When a nest is first discovered, the adult plovers associated with the nest will be located. If the male and female are banded, the band colors will be recorded. If an early season nest (March 1 to May 30), which have been document to fledge more young (Saunders et al.), is depredated, lethal removal and/or live trapping and removal will be initiated. Once the nests hatches, the chicks will be banded and the adult male and chicks will be tracked to fledge.

H.4.2.4.4.5 Recreational/Observed Predators Surveys

While walking transects looking for nests, monitors will record any observed foot traffic within the symbolically fenced habitat. Monitors will GPS the location of foot traffic, recording the number of people, entrance and exit locations, and activity within the habitat (e.g., dragging wood, building a campfire). The number of horses/dogs will be recorded, whether or not the individual was approached, and if the interaction was positive. Kites, hang gliders, and the number of people using each beach access route will also be recorded. Observed predators within the symbolically fenced habitat or flying overhead will also be noted during surveys. Monitors will record the species, number of individuals, and locations of predators. Monitors will also remain within view of one access corridor for 1 hour three times a week (all three access corridors will be monitored once a week) to document recreation and observed predators.

H.4.2.5 Establishment of the Adjusted Baseline

The adjusted baseline for western snowy plovers will be established through implementation of the survey protocol during 3 consecutive years after permit issuance. The adjusted baseline will evaluate the following metrics.

- Average of 11 males
- Average of 15 chicks
- Average rate of 1.3 chicks fledged per adult male

The adjusted baseline for western snowy plover status and trends monitoring will be established to allow for consistent monitoring methods but will not be used to alter the threshold and demographic targets for the biological goals and objectives.

H.4.2.6 Evaluating Thresholds based on Long-Term Monitoring

The following thresholds are proposed to trigger remedial efforts based on the results of the western snowy plover surveys. The monitoring results will be compared against the adjusted baseline.

- 10% decline (as a 3-year rolling average) in the number of males, chicks, or chicks fledged per male.
- 10% increase in the number of informal access routes observed per month or if more than two nests are lost because of visitor use in one nesting season.
- 10% increase in mammalian or avian predators or if more than two nests are lost because of predators in one nesting season

The result of monitoring will be used to inform adaptive management.

H.4.2.7 Coordination

All monitoring will be coordinated through the Cooperative and data will be shared with USFWS and Point Blue Conservation Science. USFWS coordinates range-wide window surveys for the western snowy plover. Point Blue Conservation Science is conducting an ongoing demographic study of western snowy plovers throughout the Monterey Bay area.

H.5 California Tiger Salamander

H.5.1 Sampling, Characterization, and Mapping of Suitable Aquatic Sites for California Tiger Salamander Larvae

H.5.1.1 Sampling Locations

A total of 66 aquatic locations that may function as breeding habitat for California tiger salamander (*Ambystoma californiense*) have been identified (HCP Chapter 4, Section 4.1, Approach). Suitable aquatic habitat for this species is described in the species' account (HCP Chapter 2, Section 2.2*, HCP Species*) and includes vernal pools, ephemeral and relatively permanent ponds, ponded water in creeks, old quarry pits, and grassland swales. Baseline assessment and/or sampling will occur initially in any of those areas that occur in HMAs. However, only those determined or considered suitable to support breeding populations of California tiger salamander through the adjusted baseline assessment will require regular monitoring over time. The target sampling locations may be modified based on sampling results, adaptive management decisions, or other factors following USFWS and CDFW review through the CRMP program.

H.5.1.2 Monitoring Methods

H.5.1.2.1 Frequency and Timing

Springtime sampling (e.g., dip netting, seining) for larvae will be conducted at all suitable aquatic habitat areas identified through the adjusted baseline assessment on a 3-year rotation. Roughly one third of all ponds determined to be suitable breeding habitat will be sampled on a yearly basis. This frequency will allow for adjustments to be made to the sampling effort in extremely wet or dry years. Two separate sampling events per season (one survey in late March - early April, and the second in early May, with at least 10 days between surveys) will occur in all suitable ponds at 3-year intervals. Drift fences in upland areas following USFWS protocol are not required but may occur as part of an approved assessment program (e.g., to determine absence for allowable development and/or for exclusion/capture/relocation purposes) in consultation with USFWS and CDFW. In addition to annual springtime sampling, late season monitoring will occur approximately every three years. This monitoring will focus on documenting ponds with extended hydroperiods that have the potential to support non-native predators such as bullfrogs or hybrid paedomorph salamanders.

H.5.1.2.2 Training

All personnel involved in handling California tiger salamanders will work under a Designated Biologist approved by the Wildlife Agencies and be trained to ensure that each is familiar with California tiger salamander identification and that sampling is performed in a manner that will minimize the potential for harm or harassment of California tiger salamander larvae.

H.5.1.2.3 Sampling

H.5.1.2.3.1 Equipment and Procedures

Ponds will be initially sampled using D-shaped or similar, long-handled dipnets with 0.125-inch (3.2-millimeter [mm]) or finer mesh. If California tiger salamander larvae are not captured in the first 50 dipnet sweeps, covering representative portions of the pond, seines will be used. For all ponds where California tiger salamander larvae are captured surveyors will record the depth of the pond, the total length and the snout-vent length, development stage, and a photo (dorsal view) of up to 30 larvae. The development stage will be assigned based off the following seven stage scale which was developed in coordination with CDFW (von May & Vollmar 2011). During the second sampling effort the surveyors will determine if the remaining pond depth is sufficient to support metamorphosis.

The seven larval development stages are:

1. no leg buds, gills visible
2. gills and limbs visible
3. limbs present but digits not visible
4. fingers visible; feet not completely developed
5. arms and legs fully developed, fingers visible; gills still fully developed
6. arms and legs fully developed, gills half way reduced or smaller
7. no gills visible, or gills almost completely reabsorbed

If dipnetting has been unsuccessful, seines should be used to sample 100% of the surface area of ponds smaller than 1 acre and at least 30% of the surface area of larger pools, including a representative sample from different water depths and vegetated and nonvegetated areas. Fine mesh minnow seines with weights along the bottom and floats along the top edge should be used (0.125-inch [3.2 mm] or finer mesh), with doweling or polyvinyl chloride(PVC) pipe attached to the end of the seine so the bottom edge can be dragged along the bottom of the pool. Whenever possible, the seine should be pulled from one edge of the pond to the other.

Use of minnow traps will be considered on a case-by-case basis. Minnow trapping for California tiger salamander larvae should only be conducted in habitats that are too deep to adequately survey with dipnets and seines, or in which dense vegetation impedes normal dipnetting/seining activities. In these cases the surveyor should submit to USFWS a written minnow trap sampling design based on the requirements detailed below. No minnow trapping should be conducted in ponds known to support state or federally threatened or endangered animals (e.g., California red-legged frogs [*Rana draytonii*]). In areas where California red-legged frogs may occur, minnow trapping should be preceded by negative surveys following USFWS guidelines for this species. To conduct minnow trap sampling in pools known to contain California red-legged frogs, surveyors must possess a valid Recovery Permit for this species pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973, as amended.

Minnow trapping should be conducted in the following manner.

a. Minnow traps should be monitored for three 3-day intervals between March 1 and May 15 (for a total of 9 days of trapping per site). Trapping intervals should be separated by at least 10 days. Minnow trap surveys should immediately cease if California tiger salamander presence is determined.

b. Minnow trapping should be avoided during warm periods when air temperatures reach 80 °F or when water temperatures reach 70 °F or warmer, to prevent the possibility of mortality due to reduced oxygen availability.

c. Minnow traps should be deployed overnight and checked frequently enough to ensure that larvae are not killed or injured. Traps should be checked at least once per day.

d. A minimum of four traps should be placed in each pond. For larger ponds, traps should be distributed along the shoreline with no more than 23 m (75 feet) between traps. Each trap should be clearly marked with the name, telephone number, and state and federal permit number of the surveyor. Traps should be anchored to stakes set near the shoreline. Steel braided fishing line or heavy cord works well for this purpose; galvanized wire and stainless steel wire should not be used because these wires may kink and break. If livestock are present, the surveyor will devise a method to anchor the trap in a manner to prevent entanglement of livestock. Brightly colored flagging should be affixed to each anchor point. For extra security, a float attached to each trap can aid in detection. If a minnow trap is lost, every effort should be made to recover it to avoid the possibility of leaving behind a trap that can kill a variety of species over time.

e. Traps should be deployed to the deepest parts of ponds and in shoreline areas with aquatic vegetation growth.

H.5.1.2.3.2 Minimize Effects on California Tiger Salamander

Captured California tiger salamanders should remain in nets for the minimum amount of time necessary, but no longer than 5 minutes. During this time, larvae should not be kept out of water for more than 30 seconds. Photographs should document a representative sample of captured California tiger salamander. Tissue samples for genetic analysis may be collected with approval from USFWS and CDFW. Disruption to the pond's bottom should be minimized. Shallow areas where young larvae may occur should be traversed in the most direct and least disturbing manner possible.

H.5.1.2.3.2.1 Disinfecting

Surveyors should follow guidance below for disinfecting equipment and clothing after surveying a pond and before entering a new pond, unless the two ponds are hydrologically connected to one another. These recommendations are adapted from the Declining Amphibian Population Task Force's Code, which can be found in its entirety at: <http://www.fws.gov/ventura/species_information/protocols_guidelines/docs/DAFTA.pdf>.

a. All dirt and debris, including mud, snails, plant material (including fruits and seeds), and algae, should be removed from nets, traps, boots, vehicle tires and all other surfaces that have come into contact with water. Cleaned items should be rinsed with clean water before leaving each study site.

b. Boots, nets, traps, etc., should then be scrubbed with a 70% ethanol solution, a bleach solution (0.5–1.0 cup of bleach to 1.0 gallon of water), QUAT128 (quaternary ammonium, use 1:60 dilution), or a 6% sodium hypochlorite 3 solution and rinsed clean with water between study sites. Cleaning equipment in the immediate vicinity of a pond or wetland should be avoided. Care should be taken so that all traces of the disinfectant are removed before entering the next aquatic habitat.

c. When working at sites with known or suspected disease problems, disposable gloves should be worn and changed between handling each animal.

d. Used cleaning materials (liquids, etc.) should be disposed of safely, and if necessary, taken back to the lab for proper disposal. Used disposable gloves should be retained for safe disposal in sealed bags.

H.5.1.2.3.3 Documentation

Data regarding the type and quality of each pool sampled should be recorded. At a minimum, these data should include the date and time, location, type of water body (e.g., vernal pool, seasonal wetland, artificial impoundment), dimension and depth of pond, water temperature, turbidity, presence of aquatic vegetation (submergent and emergent), and dominant invertebrates and all vertebrates observed. Photographs of pools and adjacent upland areas are helpful and copies should be included in the final report.

H.5.2 Characterization and Mapping of Adjacent Upland Habitat

H.5.2.1 Monitoring Design

H.5.2.1.1 Field Survey

H.5.2.1.1.1 Location

All upland habitat within 1 mile of suitable aquatic habitat areas will be evaluated.

H.5.2.1.1.2 Habitat Characterization

Each adjacent upland area will be visually assessed and characterized though systematic field reconnaissance following standard habitat typing techniques consistent with other Fort Ord habitat characterization and mapping. Site characteristics will include acreage, elevation, topography, plant communities, presence and types of water bodies, fossorial mammal species and their burrows, current land use, a description of adjacent lands, and an assessment of potential barriers to California tiger salamander movement (USFWS protocol). Aquatic habitats should be mapped and characterized, and suitable upland habitat, including locations of underground refugia for California tiger salamander should be mapped as well (USFWS protocol).

H.5.2.1.1.3 Anthropogenic Factors

Within each area, large infestations of non-native, invasive plants, erosion caused by roads or recreational use (historical or current), potential barriers to California tiger salamander movement, disturbance (e.g., hardstand), restoration activities and other anthropogenic factors will be noted and evaluated.

H.5.2.1.1.4 Habitat Mapping

Large scale (1 inch = 200 feet or better) ortho-photographic base maps will be used to map habitat types and features observed on the ground.

H.5.2.1.1.5 Frequency

Adjacent upland habitat characterization and mapping will occur for all suitable aquatic sites once every 10 years, but may be completed incrementally (in sub areas) over that 10-year period.

H.5.3 Analyses

H.5.3.1.1.1 Descriptive

Through GIS, the habitat types, anthropogenic factors, and other features will be mapped as layers, quantified, and characterized.

H.5.3.1.1.2 Single Interval Comparisons

Change in the area of mapped habitat and anthropogenic factors will be calculated as:

$$\Delta = \frac{\text{Area}(t) - \text{Area}(ab)}{\text{Area}(ab)}$$

where t is the current time period, and ab is the adjusted baseline.

H.5.4 Establishing the Adjusted Baseline

Once areal mapping is conducted, the adjusted baseline for California tiger salamander will be established by species surveys for 3 consecutive years. This will include both breeding and upland habitat surveys. Breeding habitat surveys will be conducted in both known occupied and potential habitat. Upland habitat surveys will be conducted using habitat indicators (e.g., vegetative type, presence of small mammal burrows) as a proxy for species status. Baseline information will comprise the following.

- Number of ponds/wetlands occupied by California tiger salamander larvae and/or breeding adults.
- Unoccupied breeding habitat with the potential to support breeding populations. USFWS protocol guidelines will be followed.
- Assessment of upland habitat around occupied and potential breeding habitat. Areal extent of mammal burrows, vegetation type, and land use will be used to assess suitability of upland habitat.
- Presence of factors (threats) that appear to affect breeding success at a given location, such as non-native bullfrogs and predatory fish species.

The same protocol used in the baseline surveys will be followed for surveys in subsequent years on a 3-year rotation. As such, both known occupied and potential breeding habitat will be surveyed. Upland habitat will be surveyed every 10 years.

The monitoring results will be compared against the adjusted baseline. The result of monitoring will be used to inform adaptive management.

H.5.5 Thresholds and Evaluation

The following threshold is proposed to trigger remedial efforts based on the results of the California tiger salamander breeding habitat surveys. The monitoring results will be compared against the adjusted baseline.

- 15% decline in number of ponds that support California tiger salamander larvae compared with the adjusted baseline.

Due to the low frequency at which upland habitat characterization and mapping will be conducted, thresholds used to trigger remedial efforts for the area of California tiger salamander upland habitat will be based on single intervals (i.e., 2015 compared to 2005). At this time, the recommended threshold for changes in extent of upland habitat is as follows.

- 20% decrease in areal extent of small mammal burrows.
- 20% decrease in appropriate upland habitat due to anthropogenic factors and natural succession that could be detrimental to California tiger salamander.

The result of monitoring will be used to inform adaptive management.

H.6 California Red-legged Frog

H.6.1 Sampling Locations

A total of 64 wetland locations that may function as breeding habitat for California red-legged frog have been identified by the Army (U.S. Fish and Wildlife Service 2005). Suitable habitat comprises coldwater ponds with emergent and submergent vegetation and riparian vegetation along the edges. These wetlands include vernal pools, ephemeral and relatively permanent ponds, ponded water in creeks, old quarry pits, and grassland swales. Baseline assessment and/or sampling will occur initially in any of those areas that occur in HMAs, but only those determined or considered suitable to support breeding populations of California red-legged frog through the adjusted baseline assessment will require regular monitoring over time. The target sampling locations may be modified based on sampling results, adaptive management decisions, or other factors following USFWS and CDFW review through the CRMP program.

H.6.2 Monitoring Methods

H.6.2.1 Frequency and Timing

Springtime sampling (e.g., dip netting, seining) for presence/absence of larvae will be conducted at all suitable aquatic habitat areas identified through the adjusted baseline assessment on a 3-year rotation. The same protocol used in the baseline surveys will be followed for surveys once every 5 years in subsequent years for all potential breeding habitat during the breeding season. Surveys may begin anytime during January and should be completed by the end of September. Multiple survey visits throughout the survey time period will increase the likelihood of detecting various life stages of the California red-legged frog. The breeding season is October 1 through June 30.

Sampling for presence/absence of adults will be conducted at all suitable aquatic habitat areas identified through the adjusted baseline assessment on a 3-year rotation. Adults are most likely detected at night between January 1 and June 30, sub-adults during the day from July 1 through September 30. The recommended protocol is up to eight surveys to determine presence: two day surveys and four night surveys are recommended during the breeding season. Each survey must take place at least 7 days apart, and at least one survey must be conducted prior to August 15. The survey period must be over a minimum period of 6 weeks.

H.6.2.2 Training

All personnel involved in handling California red-legged frog larvae will work under a USFWS-approved (permitted) biologist and be trained to ensure that each is familiar with California red-legged frog identification and that sampling is performed in a manner that will minimize the potential for harm or harassment of California red-legged frog larvae. Prior to conducting surveys all personnel involved will be required to have submitted a resume that demonstrates their knowledge and experience with the species and be given agency approval to conduct the work.

H.6.2.3 Field Visual Surveys

Upon arrival at the survey site, surveyors should listen for a few minutes for frogs calling, prior to disturbing the survey site by walking or looking for eye shine using bright lights. If California red-legged frog calls are identified, the surveyor should note this information on the survey data sheet and note the approximate location of the call. Once the survey begins, the surveyor should pay special attention to the area where the call originated in an attempt to visually identify the frog.

The most common method of surveying for California red-legged frog is the visual-encounter survey. This survey is conducted either during daylight hours or at night by walking entirely around the pond or marsh or along the entire length of a creek or stream while repeatedly scanning for frogs. This procedure allows one to scan each section of shore from at least two different angles. Surveyors should begin by first working along the entire shoreline, then by entering the water (if necessary and no egg masses would be crushed or disturbed), and visually scanning all shoreline areas and all aquatic habitats identified in the site assessment. Generally, surveyors shall focus on all open water to at least 2 m (6.5 feet) up the bank. When wading, surveyors must take maximum care to avoid disturbing sediments, vegetation, or larvae. When walking on the bank, surveyors shall take care to not crush rootballs, overhanging banks, and stream-side vegetation that might provide shelter for frogs. Surveys must cover the entire area, otherwise the remaining survey area must be surveyed the next day/night that weather conditions allow (both visits would constitute one day/night survey).

The main purpose of day surveys during the breeding season is to look for larvae, metamorphs, and egg masses; the main purpose of day surveys during the non-breeding season is to look for metamorphosing sub-adults, and non-breeding adults. Daytime surveys will be conducted between 1 hour after sunrise and 1 hour before sunset.

The main purpose of night surveys is to identify and locate adult and metamorphosed frogs.

Night surveys must commence no earlier than 1 hour after sunset. Due to diminished visibility, surveys should not be conducted during heavy rains, fog, or other conditions that impair the surveyor's ability to accurately locate and identify frogs. Air temperatures must be at least 50°F, to ensure that frogs are active; and wind speed must not exceed 5 mph. USFWS-approved lights should be used (e.g., Wheat Lamp, Nite Light, or sealed-beam light that produces less than 100,000 candle watt). Lights that the USFWS does not accept for surveys are lights that are either too dim or too bright. For example, Mag-Light-type lights and other types of flashlights that rely on 2 or 4 AA/AAA, 2 C or 2 D batteries. Lights with 100,000 candle watt or greater are too bright and also would not meet USFWS requirements. The USFWS-approved light must be held at the surveyor's eye level so that the frog's eye shine is visible to the surveyor. The use of binoculars is a must in order to effectively see the eye shine of the frogs. Surveys conducted without the use of binoculars may call into question the validity of the survey.

If the larval life stage is the only life stage detected and the larvae are not identified to species (or similarly, if sub-adult or adult frogs are observed but not identified to species), the surveyor must either return to the habitat to identify the frog in another life stage or obtain the appropriate permit (i.e., Section 10(a)(1)(A) permit) authorization allowing the surveyor to handle California red-legged frogs and their larvae. In order for the USFWS to consider a survey complete, all frogs encountered must be accurately identified.

H.6.2.4 Aquatic Sampling

H.6.2.4.1 Equipment and Procedures

Ponds should be initially sampled using D-shaped or similar, long-handled dipnets with 0.125-inch (3.2-mm) or finer mesh. If California red-legged frog larvae are not captured in the first 50 dipnet sweeps, covering representative portions of the pond, seines should be used.

If dipnetting is unsuccessful, seines should be used to sample 100% of the surface area of ponds smaller than 1 acre and at least 30% of the surface area of larger pools, including a representative sample from different water depths and vegetated and non-vegetated areas. Fine mesh minnow seines with weights along the bottom and floats along the top edge should be used (0.125-inch [3.2 mm] or finer mesh), with doweling or PVC pipe attached to the end of the seine so the bottom edge can be dragged along the bottom of the pool. Whenever possible, the seine should be pulled from one edge of the pond to the other.

Use of minnow traps in conjunction with California tiger salamander sampling (Section H.5.1.2.3.1, *Equipment and Procedures*) will be considered on a case-by-case basis and only if surveyors possess a valid Recovery Permit for both species.

H.6.2.4.2 Minimize Effects on California Red-Legged Frog

Captured California red-legged frog should remain in nets for the minimum amount of time necessary, but no longer than 5 minutes. During this time, larvae should not be kept out of water for more than 30 seconds. Photographs should document a representative sample of captured California red-legged frogs. Disruption to the pond's bottom should be minimized. Shallow areas where young larvae may occur should be traversed in the most direct and least disturbing manner possible.

H.6.2.4.3 Disinfection

Surveyors should follow guidance below for disinfecting equipment and clothing after surveying a pond and before entering a new pond, unless the two ponds are hydrologically connected to one another. These recommendations are adapted from the Declining Amphibian Population Task Force's Code which can be found in its entirety at: <http://www.fws.gov/ventura/species_information/protocols_guidelines/docs/DAFTA.pdf>.

a. All dirt and debris, including mud, snails, plant material (including fruits and seeds), and algae, should be removed from nets, traps, boots, vehicle tires, and all other surfaces that have come into contact with water. Cleaned items should be rinsed with clean water before leaving each study site.

b. Boots, nets, traps, etc., should then be scrubbed with a 70% ethanol solution, a bleach solution (0.5–1.0 cup of bleach to 1.0 gallon of water), QUAT128 (quaternary ammonium, use 1:60 dilution), or a 6% sodium hypochlorite 3 solution and rinsed clean with water between study sites. Cleaning equipment in the immediate vicinity of a pond or wetland should be avoided. Care should be taken so that all traces of the disinfectant are removed before entering the next aquatic habitat.

c, When working at sites with known or suspected disease problems, disposable gloves should be worn and changed between handling each animal.

d. Used cleaning materials (liquids, etc.) should be disposed of safely, and if necessary, taken back to the lab for proper disposal. Used disposable gloves should be retained for safe disposal in sealed bags.

H.6.2.4.4 Documentation

Data regarding the type and quality of each pool sampled should be recorded. At a minimum, these data should include the date and time, location, type of water body (e.g., vernal pool, seasonal wetland, artificial impoundment), dimension and depth of pond, water temperature, turbidity, presence of aquatic vegetation (submergent and emergent), and dominant invertebrates and all vertebrates observed. Photographs of pools and adjacent upland areas are helpful and copies should be included in the final report. Reports should include copies of data sheets, photographs of the habitat and California red-legged frog observed, if possible, and maps.

H.7 Black Legless Lizard

H.7.1 Monitoring Methods

H.7.1.1 Survey Frequency and Timing

Coverboard sampling and manual searches for black legless lizards (*Anniella pulchra nigra*) will occur at 5-year intervals and each sampling year shall involve a minimum of three sampling visits. Searches will be conducted during appropriate temperature/moisture windows in which the lizards are active and at the surface, preferably between March and June, but may extend into the fall season if conditions allow.

H.7.1.2 Training

All survey personnel will be trained to ensure that each is familiar with black legless lizard identification; that data are collected consistently; and that surveys are conducted in a manner that will minimize the potential for harm or harassment of black legless lizards.

H.7.1.3 Survey Procedures

In order to obtain baseline data on black legless lizard presence/absence in the Plan Area, coverboards and timed manual searches will be used. The combination of both methods is necessary to optimize the potential for finding black legless lizards, especially in diverse habitats; coverboards alone may not show black legless lizards presence except in prime habitat, maritime chaparral. Once baseline data has been obtained, coverboards will be the predominant method used; timed manual searches will be used in areas where low densities of black legless lizards are expected. Experimental design will assure that all potential habitat types are well covered.

H.7.1.3.1 Coverboards

Permanent (or semi-permanent) coverboard (60 x 60 cm coverboards) lines, consisting of 20 boards per line, will be established at a minimum of one line per habitat type per reserve area with the following minimum areal coverage: ≤100 acres=2 lines; >100 acres ≤500 acres=4 lines; >500 acres ≤1,000 acres= 6 lines, and 1 line for every 1,000 acres over the first 1,000. Monitors will search underneath them and dig to 15 cm monthly.

H.7.1.3.2 Low-Impact Time-Constrained Searches

Manual searches will be performed in habitats designated as less than prime but still likely to contain black legless lizards at lower densities than the maritime chaparral. These areas will be selected based on land cover and soil maps. One to two randomly selected plots (400 m^2) will be surveyed in each location. A "location" is defined as a contiguous area of potential, but less than prime, habitat, as determined based on land cover and soil type. Contiguous areas are those that are connected within the GIS data; the existence and size of gaps in this data will likely be determined by the minimum mapping unit of the land cover and soil data used for mapping. The number of plots to be surveyed will be determined by the size of the locations but will generally follow the same rules used to establish the number of coverboard lines (2 plots for areas ≤100 acres, 4 plots for areas >100 acres ≤500 acres, 6 plots for areas >500 acres ≤1,000 acres, and one additional plot for every 1,000 acres over the first 1,000). Once the land cover and soil mapping has been completed for these less-than-prime habitat areas, the number and size of locations will be assessed and revised, if needed, to achieve the appropriate monitoring density. Trained personnel, working in appropriate temperature/moisture windows will perform timed (30-minute) hand searches within established plot boundaries, on the surface, under dried vegetation or objects, and to a depth of 5–7 cm below the surface, while minimizing disturbance of vegetation. All disturbed materials will be restored as close as possible to pre-sampling conditions. Data will include black legless lizards found, identity of the closest associated plant species, condition of the soil, temperature, moisture level, and presence of invertebrates.

H.7.1.4 Data Collection

Presence/absence, numbers of animals found per coverboard and hand-searched area, closest associated plant species, qualitative assessment of temperatures and moisture levels (e.g., damp and warm, hot and dry) in soils under boards and in hand-searched areas, and qualitative assessment of invertebrate and other fauna observed will be recorded.

H.7.1.5 Mapping

A map of coverboard line and manual sampling locations, preferably using GPS, will be provided for every HMA. Map locations where black legless lizards are found will be provided for every monitoring year.

H.8 Monterey Ornate Shrew

H.8.1 Monitoring Design

Three monitoring designs for Monterey ornate shrew (*Sorex ornatus salaries*) are described here: 1) a pilot study; 2) a field habitat survey/assessment; and 3) a presence/absence survey. A pilot study is necessary to determine the types of habitat being utilized by this species. Habitat assessments will indicate changes in suitable Monterey ornate shrew habitat. Presence/absence surveys are necessary to determine suitable habitats for the species and may be advantageous in certain areas to determine whether Monterey ornate shrews can still be found in potential habitat. The pilot study will occur during the first 1–3 years of monitoring. Field habitat surveys/assessments and presence/absence surveys will occur every 5–10 years in all HMAs.

The pilot study will establish current Monterey ornate shrew presence. Habitat assessments will be used to estimate the amount of potential habitat available. Habitat management for the Monterey ornate shrew will be considered successful if there is no loss of actual (defined by positive survey results) or potential habitat. Long-term monitoring of sites using presence/absence surveys based on the pilot study can then track continued occupancy.

H.8.1.1.1 Pilot Study

The Monterey ornate shrew is a subspecies of the more common and widely distributed ornate shrew (*Sorex ornatus*). Little is known about the specific habitat requirements of this subspecies because of its fossorial behavior. Currently, the habitat use of the Monterey ornate shrew is assumed to be similar to that of the ornate shrew. Ornate shrews are known to be found in coastal marshes and riparian communities of California, from 39°N latitude southward discontinuously to the tip of Baja California (Mexico) (Maldonado et al. 2001). A pilot study will be conducted during the first 3 years prior to initiation of regular presence/absence surveys. The pilot study will involve sampling in all habitat types base-wide to ensure that future sampling efforts capture all habitat types occupied by the species. During the pilot study, morphological and genetic information will be collected to confirm subspecies identification.

For the purposes of sampling during the pilot study, the base will be divided into two habitat regions generally along Intergarrison Road. Region 1 includes the following HMAs: Marina Airport Habitat Reserve (AR), UC/FONR, the Landfill Parcel, Salinas River Habitat Area, and East Garrison North

Reserve. Region 2 includes Habitat Corridor/Youth Camp, Parker Flats Reserve, Oak Oval Reserve, Range 45 Reserve, the Bureau of Land Management (BLM) Fort Ord National Monument (FONM), Lookout Ridge, Wolf Hill, and East Garrison South Reserve. Each of the two habitat regions contains a mosaic of habitat types. Trapping in these areas will provide a representative sample across all habitat types contained within the Plan Area. Each of the two regions contains the five habitat types with potential to be used by Monterey ornate shrew: coastal scrub, coast live oak woodland and savanna, grassland, maritime chaparral, and riparian (HCP Chapter 2, *Environmental Setting / HCP Species*, Table 2-1). It is believed that this species prefers habitat containing a thick layer of duff. However, trapping at FONR found individuals in areas containing little to no duff, located near duffy areas (G. Dayton pers. comm.). Therefore, trapping locations will include a mix of sites containing substantial duff and those will little duff. If a pattern of duff preference is observed during trapping, future trapping locations will be altered to reflect this finding.

The pilot study will occur during the first 1–3 years of monitoring, with continuation determined adaptively based on the previous year's trapping success rate. Trapping will occur once in each of the seasons (spring, summer, fall, and winter) during the first year, in an attempt to detect any seasonal differences in habitat use by this species. Seasonality of trapping during subsequent years will be based on the results of the first year's trapping effort. It is likely that sampling in late summer or early fall after the breeding season when populations are generally at their yearly maximum will likely result in the greatest probability of capture.

Trapping efforts during the pilot study will employ three paired techniques consisting of: 1) pitfall traps; 2) Sherman live traps; and 3) hair tubes. During the course of the pilot study effort, the effectiveness of each method will be compared in order to determine which method will be used for ongoing presence/absence surveys. Fifteen trapping locations will be selected for each of the two regions, three per habitat type, for a total of 30 trapping locations. This sample size is roughly based on that used in recent trapping at FONR (G. Dayton pers. comm.).

H.8.1.1.2 Field Procedures

During the pilot study, the following methodology will be used to establish and conduct the paired trapping efforts. The 30 trapping locations will be selected according to the following criteria:

1. Select a site that is homogeneous in habitat. Habitat factors will be recorded including habitat type, vegetation species present, and amount of duff at the site.
2. Trapping locations will be marked (e.g,. rebar, t-posts) or the location recorded (at a minimum of 3-meter accuracy) in a manner that allows them to be easily repeated between years.
3. Trapping locations will be sited away from habitat edges and sites of disturbance.

Trapping efforts will be conducted according to the following guidelines:

1. Pitfall traps will be arranged in arrays of five, with drift fence crossing the open pits, as described in Wilson et. al (1996).
2. Small (2 x 2.5 x 6.5/9") Sherman traps (folding or non-folding) will be arranged in trap lines of ten placed approximately parallel to the pitfall drift fence.
3. Hair tubes will be constructed as described in Pocock and Jennings 2006, using 10-cm lengths of plastic tubing bound together in a sampling unit referred to as a "pan-pipe." The tubes will have internal diameters of approximately 2.1, 2.8, and 3.7 cm, to account for the variation in body

mass. Ten pan-pipes will be placed approximately 5 meters apart along a transect line approximately parallel to the pitfall drift fence.

4. All paired traps will be baited with the same food source. The bait used will be tailored toward the insectivorous diet of the Monterey ornate shrew, but may also contain items such as slices of carrots to help avoid dehydration.
5. Measures to reduce the chance of hypothermic or hyperthermic captures will be taken for pitfall and Sherman traps such as providing sufficient cotton bedding material or covering traps with debris, vegetation, or a lightweight board over the trap to provide additional insulation.
6. Trapping efforts will not be conducted on nights with a 30% or greater chance of rain. As a precautionary measure, squares of Styrofoam will be included in all pitfall traps.
7. Pitfall and Sherman traps will be set in the evening and checked every 1.5 to 2 hours to minimize mortalities and trap stress. Monterey ornate shrews, because of their high metabolic rates, do not survive long in live traps. If mortality is to be minimized, frequent trap checks are necessary.
8. Captured individuals will be identified as to species and age, sex class, and reproductive status. Weight will be measured for all captured individuals. Other standard morphometric measurements including total length, tail length, hind foot length, and ear length will be recorded. Records of each capture will include capture station number along with the biological data.
9. All captured individuals will be offered a small vial of 10% sugar in water using a clean eye drop bottle to administer the sugar solution. This measure is known to revitalize stressed, hypothermic, or heat-stressed captures.
10. Captured shrews will have hair and tissue samples collected. Tissue samples will obtained by clipping a small portion off one toe from the forefoot. The hair and tissue will then be preserved in a 95% ethanol solution and sent for genetic analysis and identification to subspecies. When possible, fecal samples for captured individuals will also be collected and analyzed.
11. Should any mortalities occur, the animals will be placed in individual plastic bags with a detailed data label. Mortalities will be frozen as soon as possible and prepared as voucher specimens. The Museum of Vertebrate Zoology at UC Berkeley will be contacted to add any individuals to their collection.
12. During each trapping effort (spring, summer, fall) the traps will be active for a period of 4–6 nights (Ritchie and Sullivan 1989).
13. When the trapping effort is complete, all Sherman traps and hair tubes will be removed and pitfall traps will be cleaned out and carefully sealed and closed.

H.8.1.2 Field Habitat Survey/Assessment

H.8.1.2.1 Location

Field habitat survey/assessments will begin after the pilot study has been completed. Surveys will occur in all HMAs with habitat types found to be occupied by Monterey ornate shrews during the pilot study or during recent studies conducted at FONR, as well as those habitat types in which historical occurrences were found. Of the land covers located in the Plan Area, those in which shrews were captured at FONR included maritime chaparral, coastal scrub, coast live oak woodland and savanna, and grasslands (G. Dayton pers. comm.). Historical occurrences have been recorded in riparian habitat and oak woodland and savanna habitat. Additional habitat types will be added to the mapping effort if they are found to be occupied by the species during the pilot study. The presence/absence of duff as a determining factor in species habitat preference will be included in the mapping effort as much as possible, based on results of the pilot study.

H.8.1.2.2 Habitat Characterization

Each suitable area will be visually assessed and characterized through systematic field reconnaissance following standard habitat typing techniques consistent with other Fort Ord habitat characterization and mapping (Section 6.5, *Species Monitoring*).

H.8.1.2.3 Anthropogenic Factors

Within each area, large infestations of non-native, invasive plants, erosion caused by roads or recreational use (historical or current), disturbance (e.g., hardstand), restoration activities, and other anthropogenic factors will be noted and evaluated.

H.8.1.2.4 Habitat Mapping

Large scale (1 inch = 200 feet or better) ortho-photographic base maps will be used to map habitat types and features observed on the ground.

H.8.1.2.5 Frequency

Habitat characterization and mapping will occur for all suitable sites once every 5–10 years, on the same schedule as presence/absence monitoring. Field mapping may be completed incrementally (in sub areas) over that 5 or 10 year period.

H.8.1.3 Presence/Absence Monitoring: Trapping

H.8.1.3.1 Sampling Effort

The general objective of presence/absence surveys is to determine whether a species is present, to document species geographic ranges, or to determine species richness in an area. Determining presence of a species is far easier than establishing absence. Some species may occur at very low densities, be difficult to detect (have low trappability) and/or show a great degree of spatial and temporal variability in distribution. The documentation of the absence of any individual species can only occur after survey efforts are replicated sufficiently both spatially and temporally. The sample size should be determined experimentally. Data from previous studies in similar habitat or pilot studies can be used as a starting point for this determination.

Presence/absence monitoring will commence after the completion of the pilot study. Sampling methods for this monitoring effort will be determined by the results of the pilot study. The most effective of the three trapping techniques used during the pilot study will be selected as the preferred method and will generally follow the technique outlined above for the pilot study under Section H.8.1.1.2, *Field Procedures*. Sampling during presence/absence monitoring will only occur in habitat types that have been determined to be occupied by Monterey ornate shrews during the pilot study or during trapping at FONR. Sampling size and trap locations will be determined based on the results of the pilot study. Presence/absence monitoring will occur every 5–10 years, with specific frequency determined adaptively based on results of the pilot study and any previous presence/absence sampling that has occurred.

H.8.2 Analyses

H.8.2.1 Descriptive

Through GIS, the habitat types, anthropogenic factors, and other features will be mapped as layers, quantified, and characterized.

H.8.2.1.1 Single Interval Comparisons

Change in the area of mapped habitat and anthropogenic factors will be calculated as:

$$\Delta = \frac{\text{Area}(t) - \text{Area}(ab)}{\text{Area}(ab)}$$

where t is the current time period, and ab is the adjusted baseline.

H.8.3 Establishing the Adjusted Baseline

H.8.4 The adjusted baseline for suitable habitat will be established through initial implementation of the characterization and mapping protocol no more than 2 years following the pilot study. Thresholds and Evaluation

Due to the low frequency at which suitable habitat characterization and mapping will be conducted, thresholds used to trigger remedial efforts will be based on single intervals (i.e., 2015 compared to 2005). The monitoring results will be compared against the adjusted baseline. At this time, the recommended thresholds are as follows.

- 20% increase in the total areal coverage of anthropogenic factors which could negatively impact Monterey ornate shrew habitat, including exotic plants and unnatural disturbances and erosion caused by recreation, development, or other factors.
- 20% decrease in the total acreage of occupied habitat, based on presence/absence surveys.

The result of monitoring will be used to inform adaptive management.

H.9 California Linderiella

H.9.1 Sampling Locations

Approximately 60 wetland locations that may function as habitat for California linderiella (*Linderiella occidentalis*) have been identified by the Army (U.S. Fish and Wildlife Service 2005).

These wetlands include vernal pools, ephemeral and relatively permanent ponds, ponded water in creeks, old quarry pits, and grassland swales. Baseline assessment and/or sampling will occur initially in any of those areas that occur in HMAs, but only those determined or considered suitable to support populations of California linderiella through the adjusted baseline assessment will require regular monitoring over time. The target sampling locations may be modified based on sampling results, adaptive management decisions, or other factors following USFWS and CDFW review and concurrence through the CRMP program.

H.9.2 Monitoring Methods

Since California linderiella is not a listed species, USFWS Guidelines for surveying listed vernal pool branchiopods are not necessary. However, it is recommended that personnel conducting monitoring for this species possess a Section 10(a)(1)(A) permit for working with listed vernal pool branchiopods, as they will have the necessary skills for working with this species and identifying any other species that may be encountered during monitoring.

H.9.2.1 Frequency and Timing

Sampling for presence/absence of California linderiella will be conducted at all suitable aquatic habitat areas identified through the adjusted baseline assessment on a 5-year rotation.

H.9.2.2 Training

All personnel involved in handling California linderiella will be trained to ensure that each is familiar with California linderiella identification and that sampling is performed in a manner that will minimize the potential for harm to California linderiella. A Section 10(a)(1)(A) permit for a listed vernal pool branchiopod species is recommended for surveying. Sampling will be conducted by USFWS-approved biologists familiar with vernal pool species and able to identify the California linderiella.

H.9.2.3 Sampling Procedures

H.9.2.3.1 Wet Season Sampling

Wet season survey sampling will not be conducted at any project site unless the permittee receives prior permission from USFWS.

H.9.2.3.2 Survey Initiation, Frequency, and Termination

Surveyors should visit sites after initial storm events to determine when pools/swales have been inundated. A pool/swale is considered to be inundated when it holds greater than 3 cm of standing water 24 hours after a rain event. Pools/swales will be adequately sampled once every 2 weeks, beginning no later than 2 weeks after their initial inundation and continuing until they are no longer inundated, or until they have experienced 120 days of continuous inundation. In cases where the pools/swales dry and then refill in the same wet season, sampling will be reinitiated within 8 days of refilling every time they meet the 3 cm of standing water criteria and will continue until they have experienced 120 days of continuous inundation, or until they are no longer inundated. If a vernal pool/swale has already experienced 120 days of continuous inundation, but then dries down and subsequently refills in the same wet season, surveys must be re-initiated each time the vernal pool/swale refills and meets the 3 cm of standing water criteria.

H.9.2.3.3 Survey Sampling

At each wet season visit, representative portions of the pool/swale bottom, edges, and vertical water column will be adequately sampled using a seine, dip net, or aquarium net appropriate for the size of the pool or swale. Net mesh size shall not be larger than 0.125 inch. Seines shall be examined and emptied of material at least once every 5 m.

Voucher specimens will be collected only once for each individual vernal pool/swale and will be accessioned to the California Academy of Sciences (CAS). Voucher specimens of California linderiella captured will be collected and all other specimens will be returned in good condition to the vernal pool/swale where they were found as quickly as possible. No more than 20 specimens of California linderiella from each pool/swale, or less than 10% of the subpopulation present in the pool/swale, whichever is the lesser amount, will be retained and preserved as voucher specimens. Only sexually mature, adult branchiopods will be used for purposes of voucher specimens for species identification. USFWS will not accept species identifications made using immature specimens. The sample of 20 voucher specimens will include no less than 3 specimens of either sex.

H.9.2.3.4 Dry Season Surveys

Dry season soil sampling will not be conducted at any project site unless the permittee receives prior written permission from USFWS.

Soil will be collected when it is dry to avoid damaging or destroying cysts which are more fragile when wet. A hand trowel or similar instrument will be used to collect approximately 1 liter sample per pool/swale of the top 1–3 cm of pool sediment. Whenever possible, soil samples will be collected in chunks. The trowel will be used to pry up intact chunks of sediment, rather than loosening the soil by raking and shoveling which can damage cysts.

Each soil sample from the 10 soil sample locations will be labeled, stored, and analyzed individually. A total of 10 soil samples of approximately 100 milliliter (ml) each shall be taken from each pool/swale, for a total soil sample volume of approximately 1 liter per pool/swale. In the case of a very large playa, dry lake, or vernal pool, USFWS may authorize the removal of more than 1 liter of soil. If a pool has a diameter of less than 3 m, the total soil sample taken will not exceed 0.5 liter in volume per pool, and the 10 soil samples will be approximately 50 ml each in volume.

A total of 10 soil samples will be collected from the following locations within each pool/swale sampled.

1. Starting with one soil sample taken from the edge of the pool/swale, at least four soil samples will be taken from equidistant points along the longest transect of the pool/swale.
2. Starting with one soil sample taken from the edge of the pool/swale, at least four soil samples will be taken from equidistant points along the widest transect of the pool/swale.
3. If neither the longest nor the widest transect encompasses the deepest part (or parts) of the pool/swale, then at least two soil samples will be taken from the deepest part (or parts) of the pool/swale.

The soil samples from each soil sample location will be stored in separate bags, labeled with the specific location within the pool/swale from where each soil sample was taken. A sketch of the pool/swale showing the specific location of each soil sample will be made. Soil samples containing any residual moisture initially will be adequately ventilated and allowed to air dry thoroughly before storage of the sample. The bags containing the soil samples will be kept out of direct sunlight to avoid excessively heating the sample. All soil samples will be retained and stored as directed above until USFWS is able to provide direction in species-level identification of the cysts.

The soil samples will not be ground, crushed, or otherwise manipulated to expedite the sieving process. A relatively short period of pre-soaking the soil sample may be helpful/necessary to facilitate the sieving process. Small aliquots (approximately 50 ml in volume) of soil will be gently washed with water through a graded series of U.S. standard 8-inch soil sieves ending in mesh sizes 300 micron (μm) and 150 μm. Sieves must be thoroughly rinsed and visually inspected for any cysts adhered to the sieves prior to the start of sieving. This process must be repeated for each individual soil sample location. Sieves will also be rinsed and thoroughly inspected upon completion of sieving soil samples.

Washed and sieved soil fractions from the 300 μm and 150 μm sieves will be examined under a dissecting microscope for California linderiella cysts. The process will be repeated until all individual soil samples have been examined. All sieved material will be processed and dried as quickly as possible, preferably within 1 hour from the initial wetting.

Do not return soil to the survey sampling site.

All California linderiella cysts will be removed from the soil, placed into labeled vials, allowed to air-dry, and then stored dry.

Cyst density information for each soil sample location will be calculated by dividing the total number of cysts recovered by the total amount of soil from the individual aliquots from that soil sample location. Total cyst density information for each soil sample location will be reported for each species in terms of: none; 1–25 cysts/100 ml soil; 26–50 cysts/100 ml soil; 51–100 cysts/100 ml soil; 101–199 cysts/100 ml soil; or more than 200 cysts/100 ml soil.

Each cyst will be identified to genus by a qualified biologist. USFWS may require an independent review by a crustacean biologist(s) of any vernal pool branchiopod or cyst identification.

H.9.2.3.4.1 Minimize Effects on California Linderiella

Persons conducting projects that require permits (e.g., branchiopod or amphibian surveys) should also minimize walking through the pools.

H.9.2.3.4.2 Documentation

Data regarding the type and quality of each pool sampled will be recorded. At a minimum, these data should include the date and time, location, type of water body (e.g., vernal pool, seasonal wetland, artificial impoundment), dimension and depth of pond, water temperature, turbidity, presence of aquatic vegetation (submergent and emergent), and dominant invertebrates and all vertebrates observed. Photographs of pools and adjacent upland areas are helpful and copies should be included in the final report.

If at any point during the permit term California linderiella becomes a listed species, the following reporting will be required by USFWS for all field surveys. Reports for the USFWS, no more than 90 calendar days after completing the last field visit of the season at each project site, will include the following elements.

1. The location of the project site clearly delineated on an original or high quality copy of a U.S. Geological Survey topographic map (exact scale, 7.5 minute, 1 inch = 2,000 feet). The location of the listed vernal pool branchiopods is to be included on the 7.5 minute maps in as precise a manner as possible (e.g., latitude/longitude or location within a section).
2. Five color photographic 35 mm slides and/or 3 x 5-inch photographs of each project site taken during sampling in the wet season. These are to include two slides and/or photographs taken from standing position that portray the general landscape of the site (i.e., two photos from an opposing axis of the site [e.g., north and south compass headings]); and three slides and/or photographs of representative vernal pools, swales, and other areas within the site sampled for California linderiella. The following information will be legibly written on each slide/photograph with permanent ink: precise location of the project site, direction from which photograph was taken, date of photograph, initials of photographer, and initials of the scientific name of species found at the depicted site. Note: Slides and/or photographs only need to be submitted once per project site.
3. The estimated number of individuals California linderiella observed in each pool/swale shall be reported in terms of an order of magnitude (e.g., 10s, 100s, 1,000s).
4. The number of California linderiella individuals or cysts preserved from each pool/swale and the name of the institution in which they are accessioned.
5. A qualitative description of the vernal pool/swale community. Data collected during each field visit, including: date, air temperature, water temperature, weather conditions (e.g., sunny, overcast), maximum depth of each pool/swale, and size (area in square meters) of each pool/swale.
6. (Optional) water chemistry data collected during each field visit, including: alkalinity (total: parts per million [ppm] or milligrams per liter [mg/l]), conductivity (µMHO), dissolved oxygen (ppm or mg/l), dissolved NH4 (ppm or mg/l), pH, salinity (parts per thousand [ppt]), total dissolved solids (TDS, ppm), and turbidity.
7. This 90-day reporting requirement will only come into effect if California linderiella is listed during the permit term of this HCP.

H.9.2.4 Establishment of the Adjusted Baseline

The adjusted baseline for presence of California linderiella in suitable aquatic sites will be established after permit issuance through implementation of the sampling program during 3 consecutive years.

H.9.2.5 Evaluating Thresholds based on Long Term Monitoring

The following threshold is proposed to trigger remedial efforts based on the results of the California linderiella surveys. The monitoring results will be compared against the adjusted baseline. At

- 20% decline in the number of ponds that support California linderiella compared to the adjusted baseline.

Habitat management for California linderiella will be considered successful if there is no loss in the numbers of ponds supporting the species as determined by the adjusted baseline. The result of monitoring will be used to inform adaptive management.

H.10 References

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Appendix I
CRMP Program

Appendix J
CRMP Program

A coordinated resource management and planning (CRMP) program is a multi-agency multi-jurisdictional land use planning effort developed under the sponsorship of the California CRMP memorandum of understanding (MOU). This MOU has been signed by 14 federal and state agencies including the Bureau of Land Management (BLM), California Department of Fish and Wildlife (CDFW), Soil Conservation Service, U.S. Fish and Wildlife Service (USFWS), and University of California (UC). Additional details on the development of this planning process are contained in the California CRMP Handbook (1990).

BLM is using the CRMP program to develop management plans and prescriptions for BLM managed lands at former Fort Ord. BLM has invited other public entities having natural resource management or habitat conservation responsibilities applicable to the former Fort Ord area to participate in this cooperative planning effort. Agencies that have no resource conservation requirements on received lands but wish assistance in managing lands prior to development may also participate in the CRMP program.

The goal of the CRMP program is to develop annual work plans, each being a single multi-jurisdictional management plan for all maritime chaparral habitats that are to be preserved and managed for natural values. BLM and UC/Natural Reserve System (UC/NRS) are willing to consider managing species and habitats on other public and private lands on a fee basis for those entities required to conserve habitat under this Habitat Management Plan (HMP). This service may be provided under the CRMP program.

The CRMP program plans would be annually reviewed and would implement the HMP and subsequent Habitat Conservation Plan (HCP). Anticipated products from the CRMP program are listed below.

- Uniform special-status species and habitat-monitoring strategies.
- Multi-jurisdictional fire management strategies (prescribed fire and wildfire management).
- Uniform prescriptions of compatible and noncompatible uses.
- Realignment of land ownership to consolidate natural habitat management with natural resource management agencies.
- Consolidated public information publications (such as maps, brochures), volunteer programs, and other public relations activities.
- Combined single reports to USFWS/CDFW on status of special-status species.

Most importantly, the CRMP program will provide a mechanism for public agencies to share resources to deliver the most efficient habitat protection and public services for the money expended. Examples of responsibilities and resources that could be shared include the following.

- Patrolling lands; providing visitor assistance; maintaining signs, barriers, and other improvements; and conducting threatened and endangered species monitoring.
- Coordinating threatened and endangered species research and graduate intern projects.

- Coordinating environmental education and student intern projects.
- Providing natural resource interpretation staff and materials.
- Providing fire crews for prescribed fires.
- Providing road maintenance and personnel for manual labor projects.
- Coordinating vernal pool and wetland management.

Appendix J
Draft Implementing Ordinance and Policy

Exhibit A: Model HCP Ordinance
Exhibit B: Model HCP Institutional Policy

Exhibit A

ORDINANCE NO. 2014-XX (uncodified)

(Adoption of the Fort Ord Multispecies Habitat Conservation Plan
Community Facilities District Special Tax Collection and Implementation Procedures)

The Monterey County Board of Supervisors ordains as follows:

SECTION I. SUMMARY.

This ordinance implements the Fort Ord Multispecies Habitat Conservation Plan ("HCP") within the County of Monterey ("County") by County collecting the Fort Ord Reuse Authority ("FORA") Basewide Community Facilities District Special Tax. The Special Tax may be used to finance all or a portion of certain costs including: certain improvements, administrative expenses of the community facilities district, and habitat management. Habitat management in accordance with the HCP will mitigate potential County development impact on certain species.

SECTION II. NOTICE AND HEARING.

This ordinance complies with Government Code Sections 54986 and 66017–66018. Required notices have been given and public hearing held.

SECTION III. DEFINITIONS.

As used in this ordinance:

A. "Affected Development Projects" means the development projects to which this ordinance applies.

B. "Community Facilities District Special Tax" or "FORA Base-wide Community Facilities District Special Tax" or "Special Tax" means the special tax imposed on development projects under the Fort Ord Reuse Authority Base-wide Community Facilities District Notice of Special Tax Lien, recorded May 22, 2002. This special tax will finance all or a portion of the costs of the following types of facilities or programs: Roadway Improvements, Transit Improvements and Vehicles, Water and Storm Drain Improvements, Habitat Management, and Other Public Facilities. It is described in Section 9.3 of the HCP.

C. "Cooperative" means the Fort Ord Regional Habitat Cooperative, a Joint Powers Authority (JPA) formed by the Fort Ord Reuse Authority ("FORA"), County of Monterey ("County"), City of Marina ("Marina"), City of Seaside ("Seaside"), City of Del Rey Oaks ("Del Rey Oaks"), City of Monterey ("Monterey"), California Department of Parks and Recreation ("State Parks"), Regents of the University of California ("UC"), Board of Trustees of California State University ("CSUMB") (on behalf of the Monterey Bay), Monterey Peninsula College ("MPC"), Monterey Peninsula Regional Park District ("MPRPD"), and Marina Coast Water District ("MCWD") to oversee the implementation of the HCP.

D. "Development Project" means flat or vertical construction, including a project involving the issuance of a permit for construction or reconstruction, but not a permit to operate.

E. "Endowment Holder" means a government entity, community foundation, special district, nonprofit organization, or a congressionally chartered foundation meeting the requirements of Chapter 4.6 Mitigation Lands: Nonprofit Organizations in California Government Code (Section 65965-65968).

F. "Federal Permit" means the federal incidental take permit issued by the USFWS to the Permittees under Section 10(a)(1)(B) of ESA, as it may be amended from time to time.

G. "HCP" means the Fort Ord Multispecies Habitat Conservation Plan, approved by the USFWS on _____________, as may be revised.

H. "HCP Species" means the following species, each of which the HCP addresses in a manner sufficient to meet all of the criteria for issuing incidental take permits under ESA §10(a)(1)(B) or CESA §2081. Federal and state-listed species include: sand gilia (G*ilia tenuiflora* ssp. *arenaria*), Contra Costa goldfields (*Lasthenia conjugens*), Yadon's piperia (*Piperia yadonii*), robust spineflower (*Chorizanthe robusta* var. *robusta*), Monterey spineflower (*Chorizanthe pungens* var. *pungens*), Smith's blue butterfly (*Euphilotes enoptes smithi*), western snowy plover (*Charadrius nivosus*), California tiger salamander (*Ambystoma californiense*), California red-legged frog (*Rana draytonii*), and seaside bird's beak (*Cordylanthus rigidus* var. *littoralis*).

I. "Permittees" means the Cooperative, FORA, County, Marina, Monterey, Seaside, Del Rey Oaks, State Parks, UC, CSUMB, MPC, MPRPD, and MCWD.

J. "Project Applicant" means a property owner, or designated agent of the property owner, who has submitted a Development Project approval request to the County.

K. "Public Facilities" includes public improvements or utility services.

L. "State Permit" means the state incidental take permit issued to the Permittees under FGC Section 2081, as it may be amended from time to time.

M. "Take" has the same meaning provided by the ESA, as amended (16 United States Code [USC] §1531 et seq.) and it's implementing regulations with regard to activities subject to that Act. It has the same meaning provided in the California Fish and Game Code with regard to activities subject to the CESA (Fish and Game Code §2050 et seq.) . Take is defined in ESA to mean "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 USC §1532(18)) and in the

Fish and Game Code section 86 as "to hunt, pursue, catch, capture, or kill or attempt to hunt, pursue, capture, or kill."

N. "Urban Development Area" means the areas designated for urban development that are depicted on the map attached hereto as Exhibit A, incorporated herein by reference.

SECTION IV. APPLICATION OF ORDINANCE.

A. This ordinance applies to all Development Projects in unincorporated Monterey County within the Urban Development Area.

SECTION V. SPECIAL TAX/USE OF REVENUE.

A portion of the Special Tax will be set aside to finance HCP defined habitat management obligations as follows:

A. mitigate impacts on habitat and HCP Species,

B. fund habitat management to protect HCP Species,

C. fund monitoring of HCP Species and their habitats, and

D. administrative actions necessary to implement the HCP.

SECTION VI. FINDINGS.

The County Board of Supervisors finds and determines:

A. There is a need to establish a comprehensive framework to protect and conserve species, wetlands, natural communities, and ecosystems in the County, while improving the environmental permitting process for impacts of future development on rare, threatened, and endangered species.

B. To meet the purposes identified in Section V, the County joined with FORA and other agencies to develop the HCP and the 2081 Incidental Take Permit (ITP), described herein collectively as the HCP. The Board finds that the HCP will: a) provide comprehensive species and ecosystem conservation; b) help preserve endangered species; c) balance open space, habitat, and urban development; d) reduce the cost and increase the clarity and consistency of federal and state permits; e) consolidate these processes, to the greatest extent possible, into a single plan; f) encourage multiple uses of protected areas; g) share the costs and benefits of the HCP as widely and equitably as possible; and h) protect private property rights.

C. This ordinance will enable the County to: a) promote public benefit by helping achieve the conservation goals in the HCP and b) preserve the ability of affected property owners to make reasonable use of their land consistent with the requirements of the National Environmental Policy Act, the California Environmental Quality Act, ESA, CESA, and other applicable laws.

D. There is a reasonable relationship between the use of the Special Tax and Development Projects.

E. There is a reasonable relationship between the need for the conservation activities to be funded by the Special Tax and the type of Development Projects on which the tax is imposed because the need for these activities, which includes the management of habitat, arises from mitigating impacts of the very Development Projects to which the Special Tax will apply (i.e., Development Projects that disturb open space, habitat, and HCP Species).

F. There is a reasonable relationship between the amount of the Special Tax and the cost of the conservation activities attributable to the Development Projects.

SECTION VII. SPECIAL TAX.

The Special Tax funds conservation activities identified in Section V, as follows:

A. Special Tax

1. FORA charges a Special Tax against Affected Development Projects described in the Fort Ord Reuse Authority Base-wide Community Facilities District Notice of Special Tax Lien, recorded May 22, 2002.

2. For an Affected Development Project proposed by a third-party, the County will collect the Special Tax and remit to FORA or its successor, according to the terms and conditions of the FORA–County Implementation Agreement.

3. For an Affected Development Project proposed by the County, the County will pay the Special Tax, according to the terms and conditions of the FORA–County Implementation Agreement.

4. After FORA’s June 30, 2020 expiration, the County will ensure collection of the Special Tax in the unincorporated area of former Fort Ord and will disburse the appropriate amount to the Cooperative.

B. Condition of Approval

Compliance with this ordinance, including payment of the Special Tax is a condition of approval of Affected Development Projects.

C. Special Tax Transmittal

Affected Development Project developers, including the County, will transmit the Special Tax to the FORA Controller until June 30, 2020 and FORA shall disburse no less than 30% of the collected Special Tax to the HCP Capital Account and to the Endowment Manager(s) until the complete HCP Endowments are funded consistent with the HCP. After June 30, 2020, Affected Development Project developers, including the County, will transmit the Special Tax to the County Auditor-Controller and the County shall disburse no less than 30% of the collected Special Tax to the Cooperative until the Cooperative and FONR Endowment Funds are funded consistent with the HCP.

SECTION VIII. ADJUSTMENTS TO SPECIAL TAX.

On July 1 of each year, FORA will adjust the Special Tax as described in the Fort Ord Reuse Authority Base-wide Community Facilities District Notice of Special Tax Lien, recorded May 22, 2002. On July 1 of each year, beginning July 1, 2020, the County of Monterey will adjust the Special Tax as described in the Fort Ord Reuse Authority Base-wide Community Facilities District Notice of Special Tax Lien, recorded May 22, 2002.

SECTION IX. CERTIFICATE OF INCLUSION APPLICATION AND REVIEW PROCEDURES.

A. Section 3.3 of the HCP defines covered activities, which are those projects for which take authorization is issued under the HCP and state and federal incidental take permits. These projects fall into two general categories: 1) projects funded and implemented by the County as a Permittee and 2) projects for which there are private (i.e., non-signatory, third-party) applicants, which require entitlements from the County, who is a Permittee. In both cases, the entity seeking take authorization must follow the HCP concurrence process described in Chapter 7 of the HCP, including any amendments. To summarize from Chapter 7, if the project is an ongoing maintenance, management or other activity not subject to discretionary review, the Permittee or Cooperative shall issue a notice of HCP concurrence once they determine that the proposal is a covered activity under the HCP. If the proposed activity is subject to discretionary review, in accordance with Chapter 7 of the HCP, the third-party applicant will submit a report or certificate of inclusion application to the County as a Permittee with jurisdiction over the area at the time of project application (A third-party applicant requesting take coverage submits the certificate of inclusion application to the Permittee. If the Permittee requests take coverage, it submits a similar template to the Cooperative as part of the HCP concurrence process described in Chapter 7 of the HCP.), that supplies the following information:

- Definition of project area, including project footprint, extent of construction, and extent of ongoing maintenance activities.
- Written description of project, including maps.
- Results of planning surveys.

- Compliance with avoidance and minimization measures, especially in Borderlands (see Chapter 5 of the HCP, *Measures to Avoid and Minimize Impacts*).
- Quantification of anticipated direct and indirect impacts on HCP species habitats.
- Other information as directed by the Planning Director under the HCP.

B. In accordance with Chapter 7 of the HCP, the County may extend a portion of its take authorization under permit numbers (________) if it finds, on substantial evidence, that:

1. The application for a certificate of inclusion is complete.
2. The approval requires the Affected Development Project/applicant to comply with the JPA Agreement, the HCP, and the state and federal permits. Such terms and conditions include, but are not necessarily limited to, the following:

   a. Special Tax payment.

   b. Compliance with surveys, monitoring, avoidance, minimization and mitigation measures applicable to the project, under the HCP.

   c. Take authorization extension to be consistent with the HCP, the JPA Agreement, the state and federal permits, and federal, state and local laws and regulations.

SECTION X. JUDICIAL REVIEW.

An action to void the Special Tax shall be commenced within one hundred twenty (120) days after this ordinance is adopted. Any action to attack an increase adopted under Section VIII shall be commenced within one hundred twenty (120) days after the effective date of the increase.

SECTION XI. SEVERABILITY.

If any part of the Special Tax or any provision of this ordinance is held invalid, that holding will not affect the validity of the remaining Special Tax components and/or ordinance provisions. The Board declares it would have adopted each part of this ordinance irrespective of the validity of any other part.

SECTION XII. EFFECTIVE DATE.

This ordinance becomes effective _____________, or sixty (60) days after passage, whichever is later, and within fifteen (15) days after passage shall be published once with the names of the Supervisors voting for and against it in the Monterey County Herald, a newspaper of general circulation published in this County.

PASSED AND ADOPTED on ____________, by the following vote:

 DRAFT DRAFT

NOES: -
ABSENT:
ABSTAIN: ----
ATTEST:

POLICY REGARDING COLLECTION OF COMMUNITY FACILITIES DISTRICT SPECIAL TAX AND IMPLEMENTATION PROCEDURES FOR THE FORT ORD MULTISPECIES HABITAT CONSERVATION PLAN

To implement the Fort Ord Multispecies Habitat Conservation Plan ("HCP") on lands owned by the University of California ("University") within the former Fort Ord, this Policy will govern the collection of the Fort Ord Reuse Authority ("FORA") Basewide Community Facilities District Special Tax for development approved by the University on land controlled by it within the former Fort Ord. The Special Tax may be used to finance all or a portion of certain costs including: certain improvements and habitat management. Habitat management in accordance with the HCP will mitigate potential development impacts on certain species. The collection of the Special Tax pursuant to this Policy is necessary and appropriate for the following reasons:

A. There is a need to establish a comprehensive framework to protect and conserve species, wetlands, natural communities and ecosystems in the former Fort Ord, while improving the environmental permitting process for impacts of future development on rare, threatened and endangered species.

B. To achieve the objectives of Section III, the University joined with FORA and other agencies to develop the HCP and 2081 Incidental Take Permits (ITPs), described herein collectively as the HCP. The University finds that the HCPwill a) provide comprehensive species and ecosystem conservation; b) help preserve endangered species; c) balance open space, habitat, and urban development; d) reduce the cost and increase the clarity and consistency of federal and state permits; e) consolidate these processes, to the greatest extent possible, into a single plan; f) encourage multiple uses of protected areas; g) share the costs and benefits of the HCP as widely and equitably as possible; and h) protect private property rights.

C. This Policy will enable the University to: a) promote public benefit by helping achieve the conservation goals in the HCP, and b) preserve the ability of affected property owners to make reasonable use of their land consistent with the requirements of the National Environmental Policy Act, the California Environmental Quality Act, Federal Endangered Species Act ("ESA"), California Endangered Species Act ("CESA")and other applicable laws.

D. There is a reasonable relationship between the use of the Special Tax and Development Projects.

E. There is a reasonable relationship between the need for the conservation activities to be funded by the Special Tax and the type of development projects on which the Special Tax is imposed because the need for these activities, which includes the management of habitat, arises from mitigating impacts of the very Development Projects to which the Special Tax will apply, i.e., Development Projects that disturb open space, habitat, and HCP Species.

F. There is a reasonable relationship between the amount of the Special Tax and the cost of the conservation activities attributable to the Development Projects.

SECTION I. DEFINITIONS.

As used in this policy:

A. "Affected Development Project" means a Development Project (defined in Section I. D) on lands owned by the University of California ("University") within the former Fort Ord to which this policy applies.

B. "Community Facilities District Special Tax" or "FORA Basewide Community Facilities District Special Tax" or "Special Tax" means the Special Tax imposed on development projects under the Fort Ord Reuse Authority Basewide Community Facilities District Notice of Special Tax Lien, recorded May 22, 2002. This Special Tax will finance all or a portion of the costs of the following types of facilities or programs: Roadway Improvements, Transit Improvements and Vehicles, Water and Storm Drain Improvements, Habitat Management, and Other Public Facilities. It is described in Section 9.3 of the HCP.

C. "Cooperative" means the Fort Ord Regional Habitat Cooperative, a joint powers authority (JPA) formed by the Fort Ord Reuse Authority ("FORA"), County of Monterey ("County"), City of Marina ("Marina"), City of Seaside ("Seaside"), City of Del Rey Oaks ("Del Rey Oaks"), City of Monterey ("Monterey"), California Department of Parks and Recreation ("State Parks"), The Regents of University, California State University ("CSUMB"), Monterey Peninsula College ("MPC"), Monterey Peninsula Regional Park District ("Park District"), and Marina Coast Water District ("MCWD") to oversee the implementation of the HCP.

D. "Development Project" means flat or vertical construction requiring University discretionary approval.

E. "Endowment Holder" means a government entity, community foundation, special district, nonprofit organization, or a congressionally chartered foundation meeting the requirements of Chapter 4.6 Mitigation Lands: Nonprofit Organizations in California Government Code (Section 65965-65968).

F. "Federal Permit" means the federal incidental take permit issued by the USFWS to the Permittees under Section 10(a)(1)(B) of ESA, as it may be amended from time to time.

G. "HCP" means the Fort Ord Multispecies Habitat Conservation Plan, approved by the US Fish and Wildlife Service on _____________, as may be revised.

H. "HCP Species" means the following species, each of which the HCP addresses in a manner sufficient to meet all of the criteria for issuing incidental take permits under ESA §10(a)(1)(B) or CESA §2081. Federal and state-listed species include: sand gilia (G*ilia tenuiflora* ssp. *arenaria*), Yadon's piperia (*Piperia yadonii* Monterey spineflower (*Chorizanthe pungens* var. *pungens*), Smith's blue butterfly (*Euphilotes enoptes smithi*), western snowy plover (*Charadrius nivosus*), California tiger salamander (*Ambystoma californiense*), California red-legged frog (*Rana draytonii*), and seaside bird's beak (*Cordylanthus rigidus* var. *littoralis*).

I. "Permittees" means the Cooperative, FORA, County, Marina, Monterey, Seaside, Del Rey Oaks, State Parks, UC, CSUMB, MPC, MPRPD, and MCWD.

J. "Project Applicant" means a property owner, or designated agent of the property owner, who has submitted a Development Project approval request to the University.

K. "Public Facilities" includes public improvements or utility services.

L. "State Permits" means the state incidental take permit issued to the Permittees under FGC Section 2081, as it may be amended from time to time.

M. "Take" has the same meaning provided by the ESA, as amended (16 U.S.C. § 1531 et seq.) and it's implementing regulations with regard to activities subject to that Act. It has the same meaning provided in the California Fish and Game Code with regard to activities subject to the CESA (Fish & G. Code, § 2050 et seq.). Take is defined in ESA to mean "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 U.S.C. § 1532(18)) and in the Fish and Game Code section 86 as "to hunt, pursue, catch, capture, or kill or attempt to hunt, pursue, capture, or kill."

N. "Urban Development Area" means the areas designated for urban development that are depicted on the map attached hereto as Exhibit A, incorporated herein by reference.

SECTION II. APPLICATION OF POLICY.

A. This Policy applies to all Development Projects on lands owned by the University of California property within the former Fort Ord.

SECTION III. SPECIAL TAX/USE OF SPECIAL TAX REVENUE.

A portion of the Special Tax will be set aside to finance HCP defined habitat management obligations as follows:

A. mitigate impacts to habitat and HCP Species,

B. fund habitat management to protect HCP Species,

C. fund monitoring of HCP Species and their habitats, and

D. undertake administrative actions necessary to implement the HCP.

SECTION IV. SPECIAL TAX.

The Special Tax funds conservation activities identified in Section VI, as follows:

A. Special Tax

1. There exists a Special Tax against Affected Development Projects described in the Fort Ord Reuse Authority Basewide Community Facilities District Notice of Special Tax Lien, recorded May 22, 2002.

2. The University will, according to the terms and conditions of this Policy, direct third party developers to pay all applicable Special Tax for Affected Development Projects to the jurisdiction issuing building permits. In the event that the University approves an Affected Development Project, the University will collect from a third party, or itself will pay for an Affected Development Project proposed by the University, the Special Tax and remit to FORA or its successor, according to the terms and conditions of this Policy.

3. After FORA's June 30, 2020 expiration, or if extended, until the revised date for FORA sunset, the University will ensure collection or payment of the Special Tax for Affected Development Projects and will disburse the appropriate amount to the Cooperative.

B. Condition of Approval

Compliance with this Policy, including payment of Special Tax is a condition of approval of Affected Development Projects.

C. Special Tax Transmittal

The University shall transmit any Special Tax that it collects or owes to the FORA Controller until June 30, 2020 or until the sunset date of FORA, whichever is later, and FORA shall disburse no less than 30% of the Special Tax to the HCP Capital Account and to the Endowment Manager(s) until the HCP Endowment and Fort Ord Natural Reserve Endowment are fully funded consistent with the HCP. After the later of June 30, 2020 or the sunset date of FORA, the University shall transmit to the Cooperative any Special Tax that it collects or owes and the Cooperative will transmit no less than 30% of the Special Tax for approved Affected Development Projects to the HCP Capital Account and Endowment Manager(s) until the HCP Endowment and Fort Ord Natural Reserve Endowment are funded consistent with the HCP.

SECTION V. ADJUSTMENTS TO SPECIAL TAX.

On July 1 of each year, FORA will adjust the Special Tax as described in the Fort Ord Reuse Authority Basewide Community Facilities District Notice of Special Tax Lien, recorded May 22, 2002. On July 1 of each year, beginning July 1, 2020, the University will adjust the Special Tax as described in the Fort Ord Reuse Authority Basewide Community Facilities District Notice of Special Tax Lien, recorded May 22, 2002.

SECTION VI. CERTIFICATE OF INCLUSION APPLICATION AND REVIEW PROCEDURES.

A. Section 3.3 of the HCP defines covered activities, which are Affected Development Projects for which take authorization is issued under the HCP and CESA incidental take permit. These Affected Development Projects fall into two general categories: 1) those funded and implemented by the University and, 2) those for which there are private (i.e., non-signatory, third party) applicants, which require entitlements from the University. In both cases, the proponent of the Affected Development Project seeking take authorization must follow the HCP concurrence process described in Chapter 7 of the HCP. To summarize from Chapter 7, if the Affected Development Project is an ongoing maintenance, management or other activity not subject to discretionary review by the University, the University or Cooperative shall issue a notice of HCP concurrence once they determine that the proposal is a covered activity under the HCP. If the Affected Development Project is subject to discretionary review, the proponent of the Affected Development Project will submit a report or certificate of inclusion application to the Permittee with jurisdiction over the area at the time of project application (A third-party applicant requesting take coverage submits the certificate of inclusion application to UC or the local City or County. If the University requests take coverage, it submits a similar template to the Cooperative as part of the HCP concurrence process described in Chapter 7 of the HCP.) that supplies the following information:

1. Definition of Affected Development Project area, including footprint, extent of construction, and extent of ongoing maintenance activities.
2. Written description of Affected Development Project, including maps.
3. Results of planning surveys.
4. Compliance with avoidance and minimization measures, especially in Borderlands (see Section 5.6 *Measures to Avoid and Minimize Impacts*).
5. Quantification of anticipated direct and indirect impacts on HCP species habitats.
6. Other information as directed by the University under the HCP.

B. In accordance with Chapter 7 of the HCP, the University may extend a portion of its Take authorization under permit number (______) if it finds, on substantial evidence, that:

1. The application for a certificate of inclusion is complete.
2. The approval requires the Development Project/applicant to comply with the JPA Agreement, the HCP, and the state and federal permits. Such terms and conditions include but are not necessarily limited to the following:

    a. Special Tax payment.

    b. Compliance with surveys, monitoring, avoidance, minimization and conservation measures applicable to the project, under the HCP.

    c. Take authorization extension to be consistent with the HCP, the JPA Agreement, the state and federal permits and federal, state and local laws and regulations.

SECTION VII. JUDICIAL REVIEW.

An action to void the Special Tax shall be commenced within one hundred twenty (120) days after this Policy is adopted. Any action to attack an increase adopted under Section V shall be commenced within one hundred twenty (120) days after the effective date of the increase.

SECTION VIII. SEVERABILITY.

If any part of the Special Tax or any provision of this Policy is held invalid, that holding will not affect the validity of the remaining Special Tax components and/or Policy provisions.

SECTION IX. EFFECTIVE DATE.

This Policy becomes effective _____________following execution by the Chancellor of the Santa Cruz Campus of the University following The Regents delegation of authority to the Chancellor to adopt this Policy in connection with The Regents approval of the University's participation in the Cooperative.

Approved: Date: ___________________

____

Chancellor, University of California, Santa Cruz

Appendix K

Certificate of Inclusion

Installation-Wide Multispecies Habitat Conservation Plan
CERTIFICATE OF INCLUSION

The United States Fish and Wildlife Service (“USFWS”) and the California Department of Fish and Wildlife (“CDFW”) have issued incidental take permits pursuant to the federal Endangered Species Act and the California Endangered Species Act (collectively “Permits”) authorizing “Take” of certain species in accordance with the terms and conditions of the Permits, the Installation-Wide Multispecies Habitat Conservation Plan (“HCP”) prepared for the Fort Ord Reuse Authority, and the associated Implementing Agreement.

Under the Permits and Implementing Agreement, third-party (“non-signatory,” private) applicants may become authorized to perform certain activities covered in the HCP resulting in “Take” of certain species, provided all applicable terms and conditions of the Permits, the HCP, the associated Implementing Agreement, and **[insert Permittee name]**’s HCP Ordinance are met.

The participating owner (“Cooperator”) of the property depicted on Exhibit “A,” attached hereto and incorporated herein by this reference, is entitled to the protection of the Permits with respect to any Take of species and associated habitat identified in the HCP in connection with development of the subject property in accordance with **[[[insert (1) name of permit, (2) name of land use approval, or (3) cooperative agreement]]]**

In the event the property depicted on Exhibit “A” is used for other purposes without the express consent of **[insert Permittee name]**, Take Authorization under the Permits and Implementing Agreement will automatically cease and USFWS and CDFW shall be notified of the revocation of the Certificate of Inclusion within five (5) business days of such action. Such authorization is provided as described in the Permit, the HCP, the Implementing Agreement, and **[insert Permittee name]**’s HCP Ordinance.

By signing this Certificate of Inclusion, Cooperator signifies election to receive Take Authorization under the Permits and Implementing Agreement in accordance with the terms and conditions thereof and in accordance with the terms and conditions of the HCP Ordinance and **[[[insert (1) name of permit, (2) name of land use approval, or (3) cooperating agreement]]]**. This Certificate of Inclusion does not impose additional regulatory control over the signatory nor require the signatory to provide additional information not called for in the Certificate of Inclusion, but instead ensures compliance with 50 Code of Federal Regulations, section 13.25(d).

Coverage under the Permit will become effective upon receipt of this Certificate of Inclusion executed by **[insert Permittee name]** and Cooperator (property owner). In the event the subject property is sold or leased before “Take” occurs, the buyer or lessee must be informed of these provisions and execute a new Certificate of Inclusion.

[[[Name of Cooperator]]]
[[[Cooperator Representative]]]

Date
Address
Phone

[[[Name of Permittee]]]
Representative/Title
Date
Address
Phone

Appendix L

Standard Conservation Easement Template

PLEASE NOTE: The following sample Conservation Easement Deed is provided for reference. The Department of Fish and Wildlife updates this document as needed, and it does not necessarily contain all provisions appropriate for a given project.

RECORDING REQUESTED BY AND
WHEN RECORDED MAIL TO:

[***Fill in Grantee Name/Address***]
Grantee Name
Grantee Address
City, State ZIP
Attn:______________________

[***If Grantee is CDFW, use:***]
State of California
Wildlife Conservation Board
1807 13th Street, Suite 103
Sacramento, CA 95811

Space Above Line for Recorder's Use Only

CONSERVATION EASEMENT DEED

THIS CONSERVATION EASEMENT DEED ("Conservation Easement") is made the ______ day of __________________, 20____, by ________________ ("Grantor"), in favor of [***insert Grantee's full legal name:*** ________________________________] [***if CDFW is Grantee insert:*** the State of California] ("Grantee"), with reference to the following facts:

RECITALS

A. Grantor is the sole owner in fee simple of certain real property containing approximately ______ acres, located in the in the City of [***insert City name***], County of [***insert County name***], State of California, and designated Assessor's Parcel Number [***insert Assessor's Parcel Number(s)***] (the "Property"). The Property is legally described and depicted in **Exhibit A** attached to this Conservation Easement and incorporated in it by reference.

B. The Property possesses wildlife and habitat values of great importance to Grantee and the people of the State of California. The Property provides high quality habitat for [***list plant and/or animal species***]. Individually and collectively, these wildlife and habitat values comprise the "Conservation Values" of the Property.

C. The California Department of Fish and Wildlife ("CDFW") has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of these species, pursuant to California Fish and Game Code Section 1802. CDFW is authorized to hold easements for these purposes pursuant to Civil Code Section 815.3, Fish and Game Code Section 1348, and other provisions of California law.

D. [***Use this version of Recital D when a qualified nonprofit organization is Grantee***]. Grantee is authorized to hold this conservation easement pursuant to California Civil Code Section 815.3 and Government Code Section 65965. Specifically, Grantee is (i) a tax-exempt nonprofit organization qualified under section 501(c)(3) of the Internal Revenue Code of 1986, as amended, and qualified to do business in California; (ii) a "qualified organization" as defined in section 170(h)(3) of the Internal Revenue Code; and (iii) an organization which has as its primary and principal purpose and activity the protection and preservation of natural lands or resources in its natural, scenic, agricultural, forested, or open space condition or use.

[***Use this version of Recital D when governmental entity is Grantee***]. Grantee is authorized to hold this conservation easement pursuant to California Civil Code Section 815.3. Specifically, Grantee is a governmental entity identified in Civil Code Section 815.3 (b) and otherwise authorized to acquire and hold title to real property.

E. This Conservation Easement is granted pursuant to the California Endangered Species Act Incidental Take Permit No. [***insert tracking number***] by and between [***Permittee***] and CDFW, dated [***insert date of execution***] (the "Permit"). The Permit provides mitigation for certain impacts of [***describe project***] located in the City of [***insert City name***], County of [***insert County name***], State of California and requires implementation of a final management plan (as applicable, the "Management Plan") created thereunder.

The Permit and the Management Plan are incorporated by this reference into this Conservation Easement as if fully set forth herein.

A final, approved copy of the Permit, the Management Plan, and any amendments thereto approved by CDFW, shall be kept on file at the offices of the Grantee. If Grantor, or any successor or assign, requires an official copy of the Permit, the Management Plan, or any amendments thereto, it should request a copy from the Grantee at its address for notices listed in Section 13 of this Conservation Easement.

F. All section numbers referred to in this Conservation Easement are references to sections within this Conservation Easement, unless otherwise indicated.

COVENANTS, TERMS, CONDITIONS, AND RESTRICTIONS

For good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, and pursuant to California law, including Civil Code Section 815, *et seq*., Grantor hereby voluntarily grants and conveys to Grantee a conservation easement in perpetuity over the Property.

1. Purposes. The purposes of this Conservation Easement are to ensure that the Property will be retained forever in its natural, restored, or enhanced condition as contemplated by the Permit and the Management Plan, and to prevent any use of the Property that will impair or interfere with the Conservation Values of the Property. Grantor intends that this Conservation Easement will confine the use of the Property to activities that are consistent with such purposes, including, without limitation, those involving the preservation, restoration, and enhancement of native species and their habitats implemented in accordance with the Permit and the Management Plan.

2. Grantee's Rights. To accomplish the purposes of this Conservation Easement, Grantor hereby grants and conveys the following rights to Grantee:

(a) To preserve and protect the Conservation Values of the Property.

(b) To enter upon the Property at reasonable times in order to monitor compliance with and otherwise enforce the terms of this Conservation Easement, the Permit, and the Management Plan and to implement at Grantee’s sole discretion Permit and Management Plan activities that have not been implemented, provided that Grantee shall not unreasonably interfere with Grantor's authorized use and quiet enjoyment of the Property.

(c) To prevent any activity on or use of the Property that is inconsistent with the purposes of this Conservation Easement and to require the restoration of such areas or features of the Property that may be damaged by any act, failure to act, or any use or activity that is inconsistent with the purposes of this Conservation Easement.

(d) To require that all mineral, air and water rights as Grantee deems necessary to preserve and protect the biological resources and Conservation Values of the Property shall remain a part of and be put to beneficial use upon the Property, consistent with the purposes of this Conservation Easement.

(e) All present and future development rights appurtenant to, allocated, implied, reserved or inherent in the Property; such rights are hereby terminated and extinguished, and may not be used on or transferred to any portion of the Property, nor any other property adjacent or otherwise.

3. Prohibited Uses. Any activity on or use of the Property inconsistent with the purposes of this Conservation Easement is prohibited. Without limiting the generality of the foregoing, the following uses and activities by Grantor, Grantor's agents, and third parties, are expressly prohibited:

(a) Unseasonal watering; use of fertilizers, pesticides, biocides, herbicides or other agricultural chemicals; weed abatement activities; incompatible fire protection activities; and any and all other activities and uses which may impair or interfere with the purposes of this Conservation Easement [***include the following language only if the Permit or Management Plan, including any adaptive management measures, specifies such an exception:***], except for [***insert specific exception(s)***] as specifically provided in the [Permit ***or*** Management Plan].

(b) Use of off-road vehicles and use of any other motorized vehicles except on existing roadways [***include the following language only if the Permit or Management Plan, including any adaptive management measures, specifies such an exception:***], except for [***insert specific exception(s)***] as specifically provided in the [Permit ***or*** Management Plan].

(c) Agricultural activity of any kind [***include the following language only if the Permit or Management Plan, including any adaptive management measures, specifies such an exception:***], except grazing for vegetation management as specifically provided in the [Permit ***or*** Management Plan].

(d) Recreational activities including, but not limited to, horseback riding, biking, hunting or fishing, except for personal, non-commercial, recreational activities of the Grantor, so long as such activities are consistent with the purposes of this Conservation Easement and specifically provided for in the Management Plan.

(e) Commercial, industrial, residential, or institutional uses.

(f) Any legal or de facto division, subdivision or partitioning of the Property.

(g) Construction, reconstruction, erecting or placement of any building, billboard or sign, or any other structure or improvement of any kind [***include the following language only if the Permit or Management Plan, including any adaptive***

management measures, specifies such an exception:], except for [***insert specific exception(s)***] as specifically provided in the [Permit ***or*** Management Plan].

(h) Depositing or accumulation of soil, trash, ashes, refuse, waste, bio-solids or any other materials.

(i) Planting, introduction or dispersal of non-native or exotic plant or animal species.

(j) Filling, dumping, excavating, draining, dredging, mining, drilling, removing or exploring for or extraction of minerals, loam, soil, sands, gravel, rock or other material on or below the surface of the Property or granting or authorizing surface entry for any of these purposes.

(k) Altering the surface or general topography of the Property, including but not limited to any alterations to habitat, building roads or trails, paving or otherwise covering the Property with concrete, asphalt or any other impervious material except for those habitat management activities specified in the Permit or Management Plan.

(l) Removing, destroying, or cutting of trees, shrubs or other vegetation, except as required by law for (i) fire breaks, (ii) maintenance of existing foot trails or roads, or (iii) prevention or treatment of disease [***include the following language only if the Permit or Management Plan, including any adaptive management measures, specifies such an exception:***], except for [***insert specific exception(s)***] as specifically provided in the [Permit ***or*** Management Plan].

(m) Manipulating, impounding or altering any natural water course, body of water or water circulation on the Property, and activities or uses detrimental to water quality, including but not limited to degradation or pollution of any surface or sub-surface waters [***include the following language only if the Permit or Management Plan, including any adaptive management measures, specifies such an exception:***], except for [***insert specific exception(s)***] as specifically provided in the [Permit ***or*** Management Plan].

(n) Without the prior written consent of Grantee, which Grantee may withhold, transferring, encumbering, selling, leasing, or otherwise separating the mineral, air or water rights for the Property; changing the place or purpose of use of the water rights; abandoning or allowing the abandonment of, by action or inaction, any water or water rights, ditch or ditch rights, spring rights, reservoir or storage rights, wells, ground water rights, or other rights in and to the use of water historically used on or otherwise appurtenant to the Property, including but not limited to: (i) riparian water rights; (ii) appropriative water rights; (iii) rights to waters which are secured under contract with any irrigation or water district, to the extent such waters are customarily applied to the Property; and (iv) any water from wells that are in existence or may be constructed in the future on the Property.

(o) Engaging in any use or activity that may violate, or may fail to comply with, relevant federal, State, or local laws, regulations, or policies applicable to Grantor, the Property, or the use or activity in question.

[***Include the following section if CDFW is not the Grantee***]

4. Grantee's Duties.

(a) To ensure that the purposes of this Conservation Easement as described in Section 1 are being accomplished, Grantee, and its successors and assigns shall:

(1) Observe and carry out the obligations of Grantee pursuant to the Permit and Management Plan.

(2) Perform, at a minimum on an annual basis, compliance monitoring inspections of the Property; and

(3) Prepare reports on the results of the compliance monitoring inspections, and provide these reports to CDFW on an annual basis.

(b) In the event that the Grantee's interest in this Conservation Easement is held by, reverts to, or is transferred to the State of California, Section 4(a) shall not apply.

5. <u>Grantor's Duties</u>. Grantor shall undertake all reasonable actions to prevent the unlawful entry and trespass by persons whose activities may degrade or harm the Conservation Values of the Property, or that are otherwise inconsistent with this Conservation Easement. In addition, Grantor shall undertake all necessary actions to perfect and defend Grantee's rights under Section 2 of this Conservation Easement, and observe and carry out the obligations of Grantor pursuant to the Permit and Management Plan.

6. <u>Reserved Rights</u>. Grantor reserves to itself, and to its personal representatives, heirs, successors, and assigns, all rights accruing from Grantor's ownership of the Property, including the right to engage in or to permit or invite others to engage in all uses of the Property that are not expressly prohibited or limited by, and are consistent with the purposes of, this Conservation Easement.

7. Grantee's Remedies. If Grantee determines that a violation of the terms of this Conservation Easement has occurred or is threatened, Grantee shall give written notice to Grantor of such violation and demand in writing the cure of such violation ("Notice of Violation"). If Grantor fails to cure the violation within fifteen (15) days after receipt of a Notice of Violation, or if the cure reasonably requires more than fifteen (15) days to complete and Grantor fails to begin the cure within the fifteen (15)-day period or fails to continue diligently to complete the cure, Grantee may bring an action at law or in equity in a court of competent jurisdiction for any or all of the following: to recover any damages to which Grantee may be entitled for violation of the terms of this Conservation Easement or for any injury to the Conservation Values of the Property, to enjoin the violation, *ex parte* as necessary, by temporary or permanent injunction without the necessity of proving either actual damages or the inadequacy of otherwise available legal remedies; to pursue any other legal or equitable relief, including, but not limited to, the restoration of the Property to the condition in which it existed prior to any such violation or injury; or to otherwise enforce this Conservation Easement. Without limiting the liability of Grantor, Grantee may apply any damages recovered to the cost of undertaking any corrective action on the Property.

If Grantee, in its sole discretion, determines that circumstances require immediate action to prevent or mitigate damage to the Conservation Values of the Property, Grantee may pursue its remedies under this Conservation Easement without prior notice to Grantor or without waiting for the period provided for cure to expire. Grantee's rights under this section apply equally to actual or threatened violations of the terms of this Conservation Easement.

Grantor agrees that Grantee's remedies at law for any violation of this Conservation Easement are inadequate and that Grantee shall be entitled to the injunctive relief described in this section, both prohibitive and mandatory, in addition to such other relief to which Grantee may be entitled, including specific performance of this Conservation Easement, without the necessity of proving either actual damages or the inadequacy of otherwise available legal remedies. Grantee's remedies described in this section shall be cumulative and shall be in addition to all remedies now or hereafter existing at law or in equity, including but not limited to the remedies set forth in California Civil Code Section 815, *et seq.* The failure of Grantee to discover a violation or to take immediate legal action shall not bar Grantee from taking such action at a later time.

(a) Costs of Enforcement. All costs incurred by Grantee, where Grantee is the prevailing party, in enforcing the terms of this Conservation Easement against Grantor, including, but not limited to, costs of suit and attorneys' and experts' fees, and any costs of restoration necessitated by Grantor's negligence or breach of this Conservation Easement shall be borne by Grantor.

(b) Grantee's Discretion. Enforcement of the terms of this Conservation Easement by Grantee shall be at the discretion of Grantee, and any forbearance by Grantee to exercise its rights under this Conservation Easement in the event of any breach of any term of this Conservation Easement shall not be deemed or construed to be a waiver of such term or of any subsequent breach of the same or any other term of this Conservation Easement or of any rights of Grantee under this Conservation Easement. No delay or omission by Grantee in the exercise of any right or remedy shall impair such right or remedy or be construed as a waiver.

(c) Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury to or change in the Property resulting from (i) any natural cause beyond Grantor's control, including, without limitation, fire not caused by Grantor, flood, storm, and earth movement, or any prudent action taken by Grantor under emergency conditions to prevent, abate, or mitigate significant injury to the Property resulting from such causes; or (ii) acts by Grantee or its employees.

(d) Enforcement; Standing. All rights and remedies conveyed to Grantee under this Conservation Easement shall extend to and are enforceable by [***insert if State of California is Grantee:*** CDFW and] the Third-Party Beneficiaries (as defined in Section 15(m)). These enforcement rights are in addition to, and do not limit, the rights of enforcement under the [Permit ***or*** Management Plan]. If at any time in the future Grantor uses, allows the use, or threatens to use or allow use of, the Property for any purpose that is inconsistent with or in violation of this Conservation Easement then, despite the provisions of California Civil Code Section 815.7, the California Attorney General, the Third-Party Beneficiaries, or other individual with a justifiable interest in the preservation of this Conservation Easement each has standing as an interested party in any proceeding affecting this Conservation Easement.

(e) [***Add if nonprofit organization is Grantee***] Reversion. If CDFW determines that Grantee is not holding, monitoring or managing this Conservation Easement for the conservation purposes in the manner specified in this Conservation Easement or in the Permit or the Management Plan, then pursuant to California Government Code Section 65965(c), this Conservation Easement shall revert to the State of California, or to another public agency or nonprofit organization qualified pursuant to Civil Code Section 815.3 and Government Code Section 65965 (and any successor or other provision(s) then applicable) and approved by CDFW.

8. Fence Installation and Maintenance. Grantor shall install and maintain a fence reasonably satisfactory to Grantee around the Conservation Easement area to protect the Conservation Values of the Property, including but not limited to wildlife corridors.

9. Access. This Conservation Easement does not convey a general right of access to the public.

10. Costs and Liabilities. Grantor retains all responsibilities and shall bear all costs and liabilities of any kind related to the ownership, operation, upkeep, and maintenance of the Property. Grantor agrees that neither Grantee nor any Third-Party Beneficiaries shall have any duty or responsibility for the operation, upkeep, or maintenance of the Property, the monitoring of hazardous conditions on it, or the protection of Grantor, the public or any third parties from risks relating to conditions on the Property. Grantor remains solely responsible for obtaining any applicable governmental permits and approvals for any activity or use permitted by this Conservation Easement [***insert if CDFW or another government entity is Grantee:***, including permits and approvals required from Grantee acting in its regulatory capacity], and any activity or use shall be undertaken in accordance with all applicable federal, State, local and administrative agency laws, statutes, ordinances, rules, regulations, orders and requirements.

(a). Taxes; No Liens. Grantor shall pay before delinquency all taxes, assessments (general and special), fees, and charges of whatever description levied on or assessed against the Property by competent authority (collectively "Taxes"), including any Taxes imposed upon, or incurred as a result of, this Conservation Easement, and shall furnish Grantee with satisfactory evidence of payment upon request. Grantor shall keep the Property free from any liens, including those arising out of any obligations incurred by Grantor for any labor or materials furnished or alleged to have been furnished to or for Grantor at or for use on the Property.

(b) Hold Harmless.

(1) Grantor shall hold harmless, protect and indemnify Grantee and its directors, officers, employees, agents, contractors, and representatives and the heirs, personal representatives, successors and assigns of each of them (each a “Grantee Indemnified Party” and, collectively, "Grantee’s Indemnified Parties") from and against any and all liabilities, penalties, costs, losses, damages, expenses (including, without limitation, reasonable attorneys' fees and experts' fees), causes of action, claims, demands, orders, liens or judgments (each a “Claim” and, collectively, “Claims”), arising from or in any way connected with: (i) injury to or the death of any person, or physical damage to any property, resulting from any act, omission, condition, or other matter related to or occurring on or about the Property, regardless of cause, except that this indemnification shall be inapplicable to any Claim due solely to the negligence of Grantee or any of its employees; (ii) the obligations specified in Sections 5, 10 (a), and 10 (b); and (iii) the existence or administration of this Conservation Easement. If any action or proceeding is brought against any of the Grantee’s Indemnified Parties by reason of any such Claim, Grantor shall, at the election of and upon written notice from

Grantee, defend such action or proceeding by counsel reasonably acceptable to the Grantee Indemnified Party [***insert if CDFW is grantee:*** or reimburse Grantee for all charges incurred for services of the California Attorney General in defending the action or proceeding].

(2) [***insert if there are any Third-Party Beneficiaries, including CDFW;***] Grantor shall hold harmless, protect and indemnify Third-Party Beneficiaries and their respective directors, officers, employees, agents, contractors, and representatives and the heirs, personal representatives, successors and assigns of each of them (each a "Third-Party Beneficiary Indemnified Party" and collectively, "Third-Party Beneficiary Indemnified Parties") from and against any and all Claims arising from or in any way connected with: (i) injury to or the death of any person, or physical damage to any property, resulting from any act, omission, condition, or other matter related to or occurring on or about the Property, regardless of cause and (ii) the existence or administration of this Conservation Easement. Provided, however, that the indemnification in this Section 10 (b) (2) shall be inapplicable to a Third-Party Beneficiary Indemnified Party with respect to any Claim due solely to the negligence of that Third-Party Beneficiary Indemnified Party or any of its employees. If any action or proceeding is brought against any of the Third-Party Beneficiary Indemnified Parties by reason of any Claim to which the indemnification in this Section 10 (b) (2) applies, then at the election of and upon written notice from the Third-Party Beneficiary Indemnified Party, Grantor shall defend such action or proceeding by counsel reasonably acceptable to the applicable Third-Party Beneficiary Indemnified Party or reimburse the Third-Party Beneficiary Indemnified Party for all charges incurred for services of the California Attorney General in defending the action or proceeding.

(c) Extinguishment. If circumstances arise in the future that render the preservation of Conservation Values or other purposes of this Conservation Easement impossible to accomplish, this Conservation Easement can only be terminated or extinguished, in whole or in part, by judicial proceedings in a court of competent jurisdiction.

(d) Condemnation. [***Use the appropriate paragraph:***]

[***If CDFW or other state agency is Grantee:***] Condemnation. This Conservation Easement is a "wildlife conservation easement" acquired by a State agency, the condemnation of which is prohibited except as provided in California Fish and Game Code Section 1348.3.

[***All other Grantees:***] Condemnation. The purposes of this Conservation Easement are presumed to be the best and most necessary public use as defined at California Code of Civil Procedure Section 1240.680 notwithstanding Code of Civil Procedure Sections 1240.690 and 1240.700.

11. Transfer of Conservation Easement or Property.

(a) [***Edit this section as appropriate if CDFW is Grantee***] Conservation Easement. This Conservation Easement may be assigned or transferred by Grantee but Grantee shall give Grantor and CDFW at least sixty (60) days prior written notice of the proposed assignment or transfer. Grantee may assign or transfer its rights under this Conservation Easement only to an entity or organization: (i) authorized to acquire and hold conservation easements pursuant to Civil Code Section 815.3 (and any successor or other provision(s) then applicable); and (ii) otherwise reasonably acceptable to CDFW. Grantee shall require the assignee to record the assignment in the county where the Property is located. The failure of Grantee to perform any act provided in this section shall not impair the validity of this Conservation Easement or limit its enforcement in any way. Any transfer under this section is subject to the requirements of Section 12.

(b) [***Edit this section as appropriate if CDFW is Grantee***] Property. Grantor agrees to incorporate the terms of this Conservation Easement by reference in any deed or other legal instrument by which Grantor divests itself of any interest in all or any portion of the Property, including, without limitation, a leasehold interest. Grantor agrees that the deed or other legal instrument shall also incorporate by reference the Permit, the Management Plan, and any amendment(s) to those documents. Grantor further agrees to give written notice to Grantee and CDFW of the intent to transfer any interest at least sixty (60) days prior to the date of such transfer. Grantee or CDFW shall have the right to prevent any transfers in which prospective subsequent claimants or transferees are not given notice of the covenants, terms, conditions and restrictions of this Conservation Easement (including the exhibits and documents incorporated by reference in it). The failure of Grantor or Grantee to perform any act provided in this section shall not impair the validity of this Conservation Easement or limit its enforceability in any way. Any transfer under this section is subject to the requirements of Section 12.

12. [***Edit this section as appropriate if CDFW is Grantee***] Merger. The doctrine of merger shall not operate to extinguish this Conservation Easement if the Conservation Easement and the Property become vested in the same party. If, despite this intent, the doctrine of merger applies to extinguish the Conservation Easement then, unless Grantor, Grantee, and CDFW otherwise agree in writing, a replacement conservation easement or restrictive covenant containing the same protections embodied in this Conservation Easement shall be recorded against the Property.

13. [***Edit this section as appropriate if CDFW is Grantee***] Notices. Any notice, demand, request, consent, approval, or communication that either Grantor, Grantee, or Third-Party Beneficiary desires or is required to give to the others shall be in writing, with a copy to CDFW, and served personally or sent by recognized overnight courier that guarantees next-day delivery or by first class registered United States mail, postage fully prepaid, addressed as follows:

To Grantor: [Grantee name]
[Grantee address]
Attn: ____________________

To Grantee: [***insert the appropriate Grantee information:***]

[Department of Fish and Wildlife]
[Region name] Region
[Region address]
[Attn: Regional Manager]

OR

[Grantee Name]
[Grantee address]

[***Remove/modify the following blocks as appropriate when CDFW is not the Grantee or third-party beneficiaries to the conservation easement.***]

To CDFW: [Department of Fish and Wildlife]
[Region name] Region
[Region address]
[Attn: Regional Manager]

With a copy to: Department of Fish and Wildlife
Office of the General Counsel
1416 Ninth Street, 13th Floor
Sacramento, California 95814-2090
Attn: General Counsel

Or to such other address as Grantor, Grantee, or CDFW shall designate by written notice to the other parties. Notice shall be deemed effective upon delivery in the case of personal delivery or delivery by overnight courier or, in the case of delivery by registered first class mail, five (5) days after deposit into the United States mail.

14. [***Edit this section as appropriate if CDFW is Grantee***] Amendment. This Conservation Easement may be amended only by mutual written agreement of Grantor and Grantee with written approval by CDFW. Any such amendment shall be consistent with the purposes of this Conservation Easement and California law governing conservation easements, and shall not affect its perpetual duration. Any such amendment shall be recorded in the official records of [***insert county name***] County, State of California, and Grantee shall promptly provide a conformed copy of the recorded amendment to the Grantor and CDFW.

15. Additional Provisions.

(a) Controlling Law. The interpretation and performance of this Conservation Easement shall be governed by the laws of the State of California, disregarding the conflicts of law principles of such state.

(b) Liberal Construction. Despite any general rule of construction to the contrary, this Conservation Easement shall be liberally construed to effect the purposes of this Conservation Easement and the policy and purpose of Civil Code Section 815, *et seq* [***add if Grantee is nonprofit organization:*** and Government Code Section 65965]. If any provision in this instrument is found to be ambiguous, an interpretation consistent with the purposes of this Conservation Easement that would render the provision valid shall be favored over any interpretation that would render it invalid.

(c) Severability. If a court of competent jurisdiction voids or invalidates on its face any provision of this Conservation Easement, such action shall not affect the remainder of this Conservation Easement. If a court of competent jurisdiction voids or invalidates the application of any provision of this Conservation Easement to a person or circumstance, such action shall not affect the application of the provision to other persons or circumstances.

(d) Entire Agreement. This document (including its exhibits and the Permit and Management Plan incorporated by reference in this document) sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings, or agreements relating to the Conservation Easement. No alteration or variation of this Conservation Easement shall be valid or binding unless contained in an amendment in accordance with Section 14.

(e) No Forfeiture. Nothing contained in this Conservation Easement will result in a forfeiture or reversion of Grantor's title in any respect.

(f) Successors. The covenants, terms, conditions, and restrictions of this Conservation Easement shall be binding upon, and inure to the benefit of, the parties and their respective personal representatives, heirs, successors, and assigns and shall constitute a servitude running in perpetuity with the Property.

(g) Termination of Rights and Obligations. A party's rights and obligations under this Conservation Easement terminate upon transfer of the party's interest in the Conservation Easement or Property, except that liability for acts or omissions occurring prior to transfer shall survive transfer.

(h) Captions. The captions in this instrument have been inserted solely for convenience of reference and are not a part of this instrument and shall have no effect upon its construction or interpretation.

(i) No Hazardous Materials Liability.

(1) Grantor represents and warrants that it has no knowledge or notice of any Hazardous Materials (defined below) or underground storage tanks existing, generated, treated, stored, used, released, disposed of, deposited or abandoned in, on, under, or from the Property, or transported to or from or affecting the Property.

(2) Without limiting the obligations of Grantor under Section 10 (b), Grantor hereby releases and agrees to indemnify, protect and hold harmless the Indemnified Parties (defined in Section 10 (b)) from and against any and all Claims (defined in Section 10 (b)) arising from or connected with any Hazardous Materials or underground storage tanks present, alleged to be present, released in, from or about, or otherwise associated with the Property at any time, except any Hazardous Materials placed, disposed or released by Grantee or any of its employees or agents. This release and indemnification includes, without limitation, Claims for (i) injury to or death of any person or physical damage to any property; and (ii) the violation or alleged violation of, or other failure to comply with, any Environmental Laws (defined below). If any action or proceeding is brought against any of the Grantee's Indemnified Parties by reason of any such Claim, Grantor shall, at the election of and upon written notice from the applicable Grantee Indemnified Party, defend such action or proceeding by counsel reasonably acceptable to the Grantee Indemnified Party [***add if CDFW is Grantee***: or reimburse Grantee for all charges incurred for services of the California Attorney General in defending the action or proceeding].

(3) Without limiting the obligations of Grantor under Section 10 (b), Grantor hereby releases and agrees to indemnify, protect and hold harmless the Third-Party Beneficiary Indemnified Parties (defined in Section 10 (b)(2)) from and against any and all Claims arising from or connected with any Hazardous Materials or underground storage tanks present, alleged to be present, released in, from or about, or otherwise associated with the Property at any time, except that this release and

indemnification shall be inapplicable to a Third-Party Beneficiary Indemnified Party with respect to any Hazardous Materials placed, disposed or released by that Third-Party Beneficiary Indemnified Party or any of its employees. This release and indemnification includes, without limitation, Claims for (i) injury to or death of any person or physical damage to any property; and (ii) the violation of, alleged violation of, or other failure to comply with, any Environmental Laws. If any action or proceeding is brought against any of the Third-Party Beneficiary Indemnified Parties by reason of any such Claim, Grantor shall, at the election or and upon written notice from the applicable Third-Party Beneficiary Indemnified Party, defend such action or proceeding by counsel reasonably acceptable to the Third-Party Beneficiary Indemnified Party for all charges incurred for services of the California Attorney General in defending the action or proceeding.

(4) Despite any contrary provision of this Conservation Easement, the parties do not intend this Conservation Easement to be, and this Conservation Easement shall not be, construed such that it creates in or gives to Grantee or any Third Party Beneficiaries any of the following:

(A) The obligations or liability of an "owner" or "operator," as those terms are defined and used in Environmental Laws (defined below), including, without limitation, the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (42 U.S.C. Section 9601 *et seq.*; hereinafter, "CERCLA"); or

(B) The obligations or liabilities of a person described in 42 U.S.C. Section 9607(a)(3) or (4); or

(C) The obligations of a responsible person under any applicable Environmental Laws; or

(D) The right to investigate and remediate any Hazardous Materials associated with the Property; or

(E) Any control over Grantor's ability to investigate, remove, remediate, or otherwise clean up any Hazardous Materials associated with the Property.

(5) The term "Hazardous Materials" includes, without limitation, (i) material that is flammable, explosive or radioactive; (ii) petroleum products, including by-products and fractions thereof; and (iii) hazardous materials, hazardous wastes, hazardous or toxic substances, or related materials defined in CERCLA, the Resource Conservation and Recovery Act of 1976 (42 U.S.C. Section 6901 *et seq.*; hereinafter "RCRA"); the Hazardous Materials Transportation Act (49 U.S.C. Section 6901 *et seq.*; hereinafter "HTA"); the Hazardous Waste Control Law (California Health & Safety Code

Section 25100 *et seq.*; hereinafter "HCL"); the Carpenter-Presley-Tanner Hazardous Substance Account Act (California Health & Safety Code Section 25300 *et seq.*; hereinafter "HSA"), and in the regulations adopted and publications promulgated pursuant to them, or any other applicable Environmental Laws now in effect or enacted after the date of this Conservation Easement.

(6) The term "Environmental Laws" includes, without limitation, CERCLA, RCRA, HTA, HCL, HSA, and any other federal, state, local, or administrative agency statute, ordinance, rule, regulation, order or requirement relating to pollution, protection of human health or safety, the environment, or Hazardous Materials. Grantor represents, warrants and covenants to Grantee and Third-Party Beneficiaries that activities upon and use of the Property by Grantor, its agents, employees, invitees and contractors will comply with all Environmental Laws.

(j) <u>Warranty</u>. Grantor represents and warrants that Grantor is the sole owner of the Property. Grantor also represents and warrants that, [***insert if appropriate:*** except as specifically disclosed to and approved in writing by CDFW and attached as an exhibit] [***choose applicable statement:*** there are no outstanding mortgages, liens, encumbrances or other interests in the Property (including, without limitation, mineral interests) which may conflict or are inconsistent with this Conservation Easement have not been expressly subordinated to this Conservation Easement, and that the Property is not subject to any other conservation easement ***or*** the holder of any outstanding mortgage, lien, encumbrance or other interest in the Property (including, without limitation, mineral interest) which conflicts or is inconsistent with this Conservation Easement has expressly subordinated such interest to this Conservation Easement by a recorded Subordination Agreement approved by Grantee and CDFW].

(k) [***Edit this section as appropriate if CDFW is Grantee***] <u>Additional Interests</u>. Grantor shall not grant any additional easements, rights of way or other interests in the Property (other than a security interest that is subordinate to this Conservation Easement), nor shall Grantor grant, transfer, abandon or relinquish (each a “Transfer”) any mineral, air, or water right or any water associated with the Property, without first obtaining the written consent of Grantee and CDFW. Such consent may be withheld if Grantee or CDFW determine(s) that the proposed interest or Transfer is inconsistent with the purposes of this Conservation Easement or will impair or interfere with the Conservation Values of the Property. This Section 15(k) shall not limit the provisions of Section 2(d) or 3(n), nor prohibit transfer of a fee or leasehold interest in the Property that is subject to this Conservation Easement and complies with Section 11. Grantor shall provide a copy of any recorded or unrecorded grant or Transfer document to the Grantee and CDFW.

(l) Recording. Grantee shall record this Conservation Easement in the Official Records of [***county name***] County, California, and may re-record it at any time as Grantee deems necessary to preserve its rights in this Conservation Easement.

(m) [***Edit or delete this section as appropriate if CDFW is Grantee, or if there are any other third-party beneficiaries***] Third-Party Beneficiary. Grantor and Grantee acknowledge that CDFW, (the "Third-Party Beneficiary") is a third party beneficiary of this Conservation Easement with the right of access to the Property and the right to enforce all of the obligations of Grantor including, but not limited to, Grantor's obligations under Section 15, and all other rights and remedies of the Grantee under this Conservation Easement.

(n) Funding. Endowment funding for the perpetual management, maintenance and monitoring of the Property is specified in and governed by the Permit and the Management Plan.

IN WITNESS WHEREOF Grantor has executed this Conservation Easement the day and year first above written.

GRANTOR: [***Notarization Required***]

BY: ___________________________

NAME: ________________________

TITLE: ________________________

Representative]
DATE: _______________________

Approved as to form:

[***Remove or modify the approval block as appropriate, i.e., Grantee's legal counsel if CDFW is not Grantee.***]

General Counsel
State of California
Department of Fish and Wildlife

BY: ____________________________
[***Insert General Counsel***

General Counsel

[***Delete this page if CDFW will not be Grantee. If the Grantee will be a government agency, that agency must include its own Certificate of Acceptance.***]

CERTIFICATE OF ACCEPTANCE

This is to certify that the interest in real property conveyed by the Conservation Easement by ____________________, dated ________, to the State of California, Grantee, acting by and through its Department of Fish and Wildlife ("CDFW"), a governmental agency (under Government Code § 27281), is hereby accepted by the undersigned officer on behalf of the Grantee pursuant to the Fish and Game Code.

GRANTEE:

[***Remove or modify the approval block as appropriate if CDFW is not Grantee.***]

STATE OF CALIFORNIA, by and through its DEPARTMENT OF FISH AND WILDLIFE

By: ___________________________

Title: __________________________
Authorized Representative

Date: __________________________

Appendix M
Cost Model

Introduction

The following is a guide to the Cost Analysis Matrix. The Excel workbook contains cost and funding tables for the Habitat Conservation Plan (HCP) Chapter 9, *Cost and Funding,* and Appendix N, *Cost Model*. The tables were all prepared in one Excel workbook to ensure data consistency across tables (use of rounding and percentages among cost centers may account for minor differences between tables).

In 2007 and 2008, ICF Jones & Stokes completed a detailed cost model using five general cost categories—program administration, habitat restoration, habitat management and maintenance, monitoring, and unexpected costs—to estimate permit term, management entity, start-up, and post permit term costs. In addition to these five categories, several sub-tables feed into the general cost categories. In 2014, a comprehensive update to the cost model was conducted, updating baselines for the five general cost categories. Appendix N, Cost Model cost assumptions are shown in 2007 dollars.

Table N-1. Assumptions

Code	Assumption	N-3	N-4	N-5a	N-6a	N-6b	N-7a	N-7b
General	All costs are in 2007 dollars and do not account for inflation							
General	If a source for a cost item was prior to 2007, the U.S. Dept. of Labor, Bureau of Labor Statistics inflation calculator was used to determine 2007 cost (http://www.bls.gov/cpi/)							
General	All costs associated with “per hour” units are assumed to be contracted out. Any “per hour” maintenance, management, or monitoring duties that are not included in the table are costs that are inherent in the in-house staffing costs.							
1	Actually HCP costs are represented by the portion of an employee's time dedicated to HCP related tasks. For example, the UC reserve director is 1 full staff person, however only 40% of his time is dedicated to HCP related activites, therefore only 40% of his salary is reflected as an HCP cost.		X	X	X			
2	Benefits are calculated as a percentage of labor costs per position; BLM salaries already include benefits; 25% benefits multipler used for SP and JPA staff; 35% benefits multiplier used for UC full time staff; 10% benefits multiplier used for seasonal UC staff		X	X	X			
3	8 JPA board members + 1 BLM board member = 9 attendees, 4 meetings per year, and meeting stipend is $300 per member per meeting							
4	Calculated an average cost per square foot for office space rentals on http://www.agdavi.com/comlease.html for the Monterey/Seaside/Marina area.							
4a	1- 1000 ft2 for UC, 1-3000 ft2 space for JPA, BLM and SP employees housed in existing own facilities at no HCP cost; UC lease cost includes propane, electricity and water		X					
5	Cost based upon estimate of Suburban Propane FY2007.							
6	Cost estimate based on FY 2007 service fees paid through Denver.		X					
7	Cost estimate from Carmel Marina Corporation.							
8	Estimate based upon 2,500-3,000 square feet commerical space.		X					
9	Cost estimate based on FY 2007 Monterey County fee.							
10	Based upon the desired table of organization, this covers 5 sets of office furniture to accommodate staff JPA. Plus 2 sets of office furniture for UC. To be replaced every 20 years.		X					
11	All employees (see sub table *Number of Employees per Agency*)		X					
12	Computers will be replaced every 4 years, on average		X					
13	Software upgrades are assumed to be needed once every 4 years		X					
14	Cost estimate based on State Office phone service account records.		X					
15	Cost estimate from lease of Hollister Field Office copy machine.		X					
16	One for each office space					X		
17	1 for each office space		X			X		
18	Database server will be replaced once every 5 years, on average. Cost includes service contract or software updates.		X					
19	Cost of plotter assumes replacement once every 8 years. Some companies may offer a cash credit to upgrade to a new plotter, which could save on costs.		X					
20	Cost of ink cartridges estimated average of $200/month. Cost of paper estimated average of $200/month.							
21	Replaced every 5 years		X		X			
22	The estimate covers gas and utilization costs and assumes that each vehicle is driven 10,000 miles per year.		X					
23	This line item is related to additional vehicle expenses incurrred due to the presence of munitions and explosives of concern in the former range areas of Fort Ord		X					

Table N-1. Assumptions

Code	Assumption	N-3	N-4	N-5a	N-6a	N-6b	N-7a	N-7b
24	and the BLM is negotiating to have the Army cover these additional expenses. The estimate covers gas and utilization costs and assumes that each vehicle is driven 10,000 miles per year.							
	It is assumed that these vehicles would be needed for years 10-50.							
25	Training on topics directly related to HCP management and monitoring that with enhance HCP implementation		X					
26	Travel will be calculated at current federal billing rate.							
27	2 staff, one meeting per month							
29	Assumes outside legal counsel or cost of in-house counsel shared from a partner agency, particularly after start-up period		X					
30	Financial analyst review will occur once every 3 years for the first 10 years, once every 4 years for years 11-20, and once every 5 years until the end of the permit term, for an average frequency of .24 times per year. This is contracted out.		X					
31	Replaced every 10 years							
32	Environmental compliance is assumed to be needed on up to 50% of restoration projects							
33	If environmental compliance is necessary, it is assumed that permitting will be required for all compliance categories (NEPA/CEQA, CWA 440/401, NHPA, CDFG 1602, and Other)							
34	Environmental Compliance:							
	a “Small Project” = up to 10 acres or up to 0.1 stream miles.			X	X			
	b “Medium Project” = 11-20 acres or 0.1-0.5 stream miles				X			
	c “Large Project” = over 20 acres or over 0.5 stream miles				X			
35	Assumptions for restoration costs:							
	25% Plans, specifications, and engineering as percent of construction cost for non-aquatic restoration							
	20% Plans, specifications, and engineering as percent of construction cost for riparian, wetland, and open water restoration.							
	5% Construction oversight and monitoring as percent of construction cost							
	30% Post-construction monitoring and maintenance as percent of construction cost for non-aquatic restoration							
	15% Post-construction monitoring as percent of construction cost for riparian, wetland, and open water restoration							
	15% Percent of construction costs needed for remedial measures							
36	Construction costs for oak woodland was estimated using the median cost of 2 projects in Northern California between 1994 and 2007, cost adjusted for 2007.			X				
37	Construction costs for riparian restoration was estimated using the median cost of 13 projects in Northern California between the 1994 and 2007, cost adjusted for 2007.			X				
38	Construction costs for wetland and open water was estimated using the median cost of 9 projects in Northern California between 1994 and 2007, cost adjusted for 2007.			X				
39	Resource Management Plans will be contracted out for JPA managed HMAs: Monterey County, City of Marina, Monterey Penisula College and MPRPD. BLM, UC and SP RMPs will be prepared in-house and are a part of staff costs.				X			
40	All vehicle costs include fuel							
41	On average, handheld radios will be replaced every 3 years. It is assumed that there will be one radio per vehicle.				X			
42	Four digital cameras, replaced an average of every 4 years.				X			

Table N-1. Assumptions

Code	Assumption	N-3	N-4	N-5a	N-6a	N-6b	N-7a	N-7b
43	Examples of safety equipment and clothing include ear protection, goggles, chainsaw chaps, safety vests, and hardhats. Cost is estimated at $35 per management and maintenance staff per year.				X			
44	Miscellaneous equipment includes flagging, stakes, survey equip, field gear, etc.				X			
45	Cost estimates from evaluation of previous utilization rates.				X			
46	mower will be replaced once every 5 years				X			
47	Heavy equipment maintenance costs are assumed to be an average of 10% of total yearly equipment costs (includes fuel costs).				X			
48	One plan for each individual burn.				X			
49	The Non-native plant control average cost per unit was calculated using BLM's annual cost. The annual cost was divided by the acreage of BLM's HMA and then multiplied by the total number of acreages in the HCP.				X			
50	Air quality monitoring would be conducted by Monterey Bay Unified Air Pollution Control District at their professional services rate, which was quoted at $109 per hour				X			
51	Prescribed burn costs are based on BLM estimates for a 100-acre chaparral burn and include: 12 hours time for all burn personnel (burn boss, firing boss, holding boss, 20-person crew, meteorologist and resource advisor), equipment, and helicopters. Helicopter costs are pending negotiations and may be covered by Army.				X			
52	BLM burning of maritime chaparral would commence at year 20. This assumes that the Army will be burning and cleaning up future reserve lands for the next 10 years. Therefore, at year 20, BLM begins its first burn of 100 acres. This is an annual cost until year 50 (BLM). Burning for all other landcover types is also assumed to start at year 20.				X			
53	Estimate based upon FY 2006 expenditures.				X			
54	The Non-native plant control average cost per unit was calculated using BLM's annual cost. The annual cost was divided by the acreage of BLM's HMA and then multiplied by the total number of acreages in the HCP.				X			
55	Cost per acre for goat grazing depends on how many acres to be grazed total and density of growth. $500 per acre is based on a 20 acre site, but costs could be reduced if a larger area is grazed. We assumed the 5% of the total chaparral and grassland acreage will be grazed over 50 years at the $500 per acre rate.				X			
56	Assumes use of 52 volunteers				X			
57	Assumes 375 plants per acre for Oak Woodland/Savannah				X			
58	"Habitat Enhancement" includes hand removal and some planting							
59	Assumes no need for new road construction.				X			
60	Maintenance for paved roads assumed to be twice as much as for dirt roads							
61	Trail maintenance was calculated as 5% of construction costs.				X			
62	Assumes post every 10 ft.				X			
63	Sum of fence and post *5%, Assumes 5% replacement every year				X			
64	Assumed to be 1% of construction costs				X			
65	District Supt. and Sector Supt. Each 5%	X						
66	RAO and contracts each 5%	X						
67	Senior Environmental Scientist	X						
68	Employees stationed at the Hollister Field Office Duty Station. The salary assumption is based upon a step 3 GS or WG rating with an additional 25% to cover benefits.	X						
69	Personnel/Office support 2@5% each	X						

Table N-1. Assumptions

Code	Assumption	N-3	N-4	N-5a	N-6a	N-6b	N-7a	N-7b
70	Environmental Scientist	X						
71	District Planner/DSM	X						
72	Snowy Plover Monitoring 18hrs/wk for 7 mo - Mar-Sept	X						
73	Park Aid/Seasonal Labor- note difference in salary from JSA estimate	X						
74	Environmental Scientist	X						
75	Snowy Plover Management 18hrs/wk for 7 mo	X						
76	Park Aid/Seasonal Labor	X						
77	Natural Resource Protection	X						
78	Employees stationed at the Fort Ord Project Office Duty Station. The salary assumption is based upon a step 3 GS or WG rating with an additional 25% to cover benefits	X						
79	Environmental Scientist	X						
80	This line item is related to additional personnel and expenses incurrred due to the presence of munitions and explosives of concern in the former range areas of Fort Ord and the BLM is negotiating to have the Army cover these additional expenses. Employees stationed at the Fort Ord Project Office Duty Station. The salary assumption is based upon a step 3 GS or WG	X						
	rating with an additional 15% to cover benefits. It is assumed that these employees would be needed from years 10-50.							
81	Restoration costs are assumed to occur during the first 30 years of the permit term.							
82	The amount of all roads and trails were assumed to be proportional to those that exist on the BLM HMA				X			
83	It was assumed that no trails existed on the HMAs other than BLM							
84	Assumes erosion control for 2% of all oak savannah over the course of the permit term				X			
85	Equipment rental will be needed for 4 weeks each year				X			
86	Assumes that all fuelbreak acreage will receive hydromulch once every ten years				X			
87	Assumes 10% of Coast live oak woodland and savannah will be enhanced				X			
88	Assumes 10 for BLM plus 36 for all the other HMA combined (2 for each free standing parcel)				X			
89	BLM sourced labor costs include a 25% multiplier for benefits. These cost were subtracted from the benefits calculations.		X	X				
90	approximation based on cost of Massey Fergueson rear mounted mower				X			
91	based on the average cost per acre of UC/SP/BLM management and maintenance staff				X			
92	HMAs only maintaing the fence they install				X			
93	Assumes environmental compliance is done in-house for BLM, SP and UC, only restoration done for JPA managed HMAs will require out of house environmental compliance costs.			X				
95	Two seasonal staff hired for 3 months each							
96	**Aerial Mapping of Smith's blue butterfly Habitat.** Field truthing of habitat patch limits (determined primarily through aerial photo interpretation) and exploratory studies to test accuracy and repeatability of mapping procedures. Habitat mapping will be updated every 10 years to reestablish adjusted baseline. **Calculation of man-hours required: 1)** Field truthing of habitat patch limits (determined primarily through aerial photo interpretation) and exploratory studies to test accuracy and repeatability of mapping procedures. Three, 8-hour days for 2 personal = 48 hours							X

Table N-1. Assumptions

Code	Assumption	N-3	N-4	N-5a	N-6a	N-6b	N-7a	N-7b
97	**Calculation of man-hours required:** Host plant sampling will require 1 hour/ transect / per person (2 field people) times 20 transects = 40 man hours Travel time between sampling sites is assumed to add 2 hours (per person)/ sampling event= 4 man hours Total time required/ sampling event= 44 man hours. 1) **Pilot study=** 2 consecutive years of sampling with 44 man hours required/ year = 88 man hours 2) **Adjusted baseline**= 3 consecutive years of sampling required at 44 man hours/ year = 44 additional man hours on top of pilot study 3) **Abundance monitoring (once every 3-5 years)** = 44 man hours/per year							X
98	**Calculation of man-hours required:** Reconnaissance site visits to establish that Smith's blue butterfly have begun flight will require up to 16 man hours (Four 4- hour site checks). Presence absence surveys will require 1 hour/ transect survey times 20 transects times 2 survey events = 40 man hours. Travel time between sampling sites is assumed to add 2 hours /per person (2 people assumed to divide up surveys)/ survey event= 8 man hours. Total time required/ sampling year= 64 man hours. **Adjusted baseline**= 3 consecutive years of sampling required at 64 man hours/ year = 192 man hours. **Presence absence surveys (two survey events every 5 years)** = 64 man hours/per survey year.							
99	The JPA Executive Director would be a shared position with FOR A until its sunset and its successor there after.							
100	FORA office pays $77.40 per month. Assume this is a flat fee.		X					
101	Lease space of 750 SF needed. Approximately 100 SF x 4 employees + 350 SF ancillary space for use of copy, fax, breakroom, and restroom inside office building. Assumption: $1.25/ SF per month rent. Source: existing UC MBEST office lease space.		X					
102	FORA's existing office heating is approx. $750/ month. FORA office is not insulated. Assume $625/ month if space is insulated. Assume future office is 10% of existing FORA office space. Calculation: 625 x 12 x 10%		X					
103	Electricity bill is approx. half of PG&E gas bill for existing FORA office.		X					
104	Existing FORA office water bill is approx. $100/ mo. x 12 months. JPA + UC admin staff are 1/3 size of FORA staff.							
105	FORA pays $430 per month for these services. Assume $200 per month meets smaller JPA and UC office needs.							
106	3 JPA employees + 3 UC Admin. employees = funiture needs for 6.		X					
107	2 part-time and 2 full-time JPA employees and 3 full-time UC employees.		X					
108	HP Proliant - DL185 G5 special server $4,000-$6,000 + service contract = $7,500		X					
109	HPC7791C: DesignJet 130 Multi-Format Color Ink $1,360.		X					
110	$50/month for paper supplies + 150/month ink supplies.		X					
111	Fujitsu LifeBook T4220 Tablet PC - $2,000.		X					
112	$300/hr. based on FORA budgeting experience.		X					
113	FORA's publications budget is $30K per year, but includes Munitions Cleanup program and other FORA programs. Assumption: JPA Cooperative will be lower profile than current FORA publications - assume $12,500.		X					
114	Yadon's Piperia survey costs of $2,110 in 2006 and $2,600 in 2007						X	
115	21 ponds , 3 days, two people 8 hour days (48 h total) @ $67/hr = (3x(8x2))x$67							X

Table N-1. Assumptions

Code	Assumption	N-3	N-4	N-5a	N-6a	N-6b	N-7a	N-7b
116	Original calc has two changed needed. 1st - calc is for all 40 ponds instead of the reduced #. 2nd - it is off by a factor of 2. It only accounts for 1 sampling event per pond per year. New Calc - 48 hours (3, 8 hour days for 2 people) x $67/hour 40 of 60 wetlands provide suitable breeding habitat 1/3 of the wetlands will be sampled each year = 14 ponds 14 ponds x 3h/pond x 2 surveyors = 84 hours @ $67/h then multiply by 2 for 2 sampling events per year = ([(3x14)x2]x$67)x2							X
117	= 40 x $67							X
118	reduced to 3 days instead of 5. changed to the same level of effort as Breeding Habitat assessment = (3x(8x2))x$67							X
119	= 40 x $67							X
120	2 hours added per pool to survey effort 14 ponds x 2h/pond x 2 surveyors = 84 hours @ $67/h genetic sampling will take place during presence/absence surveys. p/a surveys are only done for 1/3 of the 40 pools, so adjusted baseline genetic sampling will take 3 years =([(2x14)x2] x $67)							X
121	20% of 40 ponds sampled = 8, 33% of captured larvae clipped 1 of every 3. maximum of 30. $50/sample. Frequency is only 1 year. Additional cost of funding 1/3-1/2 year of a lab tech position to process samples is approximately $15,000. = [(8x30) x 50] + 15,000							X
122	cost of 1st year sampling (field surveys + genetic sampling) and 1st year genetic testing.							X
123	i.e. eradication survey w/bullfrog eradication effort, 2 8 hour nights of two people $67/hr, every three years = (2x(8x2))x$67							X
124	2 per year, 4 hours per event, 67 per hour, yearly =(2x4)x$67							X
125	1 week per year for two people (80 hours) * 67/hr, every 3 years =80x$67							X

Table N-2. Cost Summary by Management Agency

	BLM	BLM	BLM	BLM	BLM	BLM	BLM	BLM
Cost Category	1-10	10-20	20-30	30-40	40-50	Average Annual Cost	Total Permit Term Cost	Annual Post-Permit Term Costs
Total Costs								
Program Administration	$ 1,806,757	$ 1,806,757	$ 1,908,757	$ 1,908,757	$ 1,908,757	$ 186,796	$ 9,339,785	$ 89,731
Habitat Restoration	$ 1,193,040	$ 1,193,040	$ -	$ -	$ -	$ 47,722	$ 2,386,079	$ -
HMA Management and Maintenance	$ 15,913,953	$ 15,913,953	$ 17,611,214	$ 17,611,214	$ 17,611,214	$ 1,693,231	$ 84,661,546	$ 1,748,616
Monitoring, Research, and Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Contingency and Remedial Measures	$ 1,073,836	$ 1,073,836	$ 894,880	$ 894,880	$ 894,880	$ 96,646	$ 4,832,313	$ -
Grand Total (in 2007 dollars)	$ 19,987,585	$ 19,987,585	$ 20,414,851	$ 20,414,851	$ 20,414,851	$ 2,024,394	$ 101,219,723	$ 1,838,347
								$ -
Capital Costs								
Program Administration	$ 59,944	$ 59,944	$ 59,944	$ 59,944	$ 59,944	$ 5,994	$ 299,722	$ 2,390
Habitat Restoration	$ 667,700	$ 667,700	$ -	$ -	$ -	$ 26,708	$ 1,335,400	$ -
HMA Management and Maintenance	$ 842,718	$ 842,718	$ 842,718	$ 842,718	$ 842,718	$ 84,272	$ 4,213,588	$ 82,117
Monitoring, Research, and Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Restoration Contigency (only first 20 years)	$ 178,956	$ 178,956				$ 7,158	$ 357,912	
Capital Cost Total (in 2007 dollars)	$ 1,749,318	$ 1,749,318	$ 902,662	$ 902,662	$ 902,662	$ 124,132	$ 6,206,622	$ 84,507
Operational Costs								
Program Administration	$ 1,746,813	$ 1,746,813	$ 1,848,813	$ 1,848,813	$ 1,848,813	$ 180,801	$ 9,040,063	$ 87,341
Habitat Restoration	$ 525,340	$ 525,340	$ -	$ -	$ -	$ 21,014	$ 1,050,679	$ -
HMA Management and Maintenance	$ 15,071,235	$ 15,071,235	$ 16,768,496	$ 16,768,496	$ 16,768,496	$ 1,608,959	$ 80,447,958	$ 1,666,500
Monitoring, Research, and Adaptive Management						$ -	$ -	$ -
Budget Contingency	$ 894,880	$ 894,880	$ 894,880	$ 894,880	$ 894,880	$ 89,488	$ 4,474,401	
Remedial Measures								
Operational Cost Total (in 2007 dollars)	$ 18,238,267	$ 18,238,267	$ 19,512,189	$ 19,512,189	$ 19,512,189	$ 1,900,262	$ 95,013,101	$ 1,753,840

Table N-2. Cost Summary by Management Agency

Cost Category	State Parks 1-10	State Parks 10-20	State Parks 20-30	State Parks 30-40	State Parks 40-50	State Parks Average Annual Cost	State Parks Total Permit Term Cost	State Parks Annual Post-Permit Term Costs	UC/NRS 1-10
Total Costs									
Program Administration	$ 215,053	$ 215,053	$ 215,053	$ 215,053	$ 215,053	$ 21,505	$ 1,075,266	$ 10,250	$ 267,568
Habitat Restoration	$ 3,008,872	$ -	$ -	$ -	$ -	$ 60,177	$ 3,008,872	$ -	$ 131,250
HMA Management and Maintenance	$ 2,630,376	$ 2,630,376	$ 2,630,376	$ 2,630,376	$ 2,630,376	$ 263,038	$ 13,151,878	$ 263,038	$ 1,505,668
Monitoring, Research, and Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Contingency and Remedial Measures	$ 588,363	$ 588,363	$ 137,032	$ 137,032	$ 137,032	$ 31,756	$ 1,587,821	$ -	$ 104,781
Grand Total (in 2007 dollars)	$ 6,442,663	$ 3,433,792	$ 2,982,461	$ 2,982,461	$ 2,982,461	$ 376,477	$ 18,823,837	$ 273,288	$ 2,009,267
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Capital Costs									
Program Administration	$ 15,139	$ 15,139	$ 15,139	$ 15,139	$ 15,139	$ 1,514	$ 75,695	$ 254	$ 59,068
Habitat Restoration	$ 1,708,200	$ -	$ -	$ -	$ -	$ 34,164	$ 1,708,200	$ -	$ 131,250
HMA Management and Maintenance	$ 89,654	$ 89,654	$ 89,654	$ 89,654	$ 89,654	$ 8,965	$ 448,269	$ 8,965	$ 110,961
Monitoring, Research, and Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Restoration Contigency (only first 20 years)	$ 451,331	$ 451,331				$ 18,053	$ 902,662		$ 19,688
Capital Cost Total (in 2007 dollars)	$ 2,264,324	$ 556,124	$ 104,793	$ 104,793	$ 104,793	$ 62,697	$ 3,134,826	$ 9,220	$ 320,967
Operational Costs									
Program Administration	$ 199,914	$ 199,914	$ 199,914	$ 199,914	$ 199,914	$ 19,991	$ 999,571	$ 9,996	$ 208,500
Habitat Restoration	$ 1,300,672					$ 26,013	$ 1,300,672	$ -	$ -
HMA Management and Maintenance	$ 2,540,722	$ 2,540,722	$ 2,540,722	$ 2,540,722	$ 2,540,722	$ 254,072	$ 12,703,609	$ 254,072	$ 1,394,707
Monitoring, Research, and Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Budget Contingency	$ 137,032	$ 137,032	$ 137,032	$ 137,032	$ 137,032	$ 13,703	$ 685,159		$ 85,094
Remedial Measures									
Operational Cost Total (in 2007 dollars)	$ 4,178,340	$ 2,877,668	$ 2,877,668	$ 2,877,668	$ 2,877,668	$ 313,780	$ 15,689,011	$ 264,068	$ 1,688,301

Table N-2. Cost Summary by Management Agency

	UC/NRS	UC/NRS	UC/NRS	UC/NRS	UC/NRS	UC/NRS	UC/NRS
Cost Category	10-20	20-30	30-40	40-50	Average Annual Cost	Total Permit Term Cost	Annual Post-Permit Term Costs
Total Costs							
Program Administration	$ 267,568	$ 267,568	$ 267,568	$ 267,568	$ 26,757	$ 1,337,840	$ 22,125
Habitat Restoration	$ 131,250	$ -	$ -	$ -	$ 5,250	$ 262,500	$ -
HMA Management and Maintenance	$ 1,505,668	$ 1,670,616	$ 1,834,056	$ 1,505,668	$ 160,434	$ 8,021,676	$ 146,911
Monitoring, Research, and Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Contingency and Remedial Measures	$ 104,781	$ 85,094	$ 85,094	$ 85,094	$ 9,297	$ 464,844	$ -
Grand Total (in 2007 dollars)	$ 2,009,267	$ 2,023,278	$ 2,186,718	$ 1,858,330	$ 201,737	$ 10,086,860	$ 169,036
	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Capital Costs							
Program Administration	$ 59,068	$ 59,068	$ 59,068	$ 59,068	$ 5,907	$ 295,340	$ 1,300
Habitat Restoration	$ 131,250	$ -	$ -	$ -	$ 5,250	$ 262,500	$ -
HMA Management and Maintenance	$ 110,961	$ 110,961	$ 110,961	$ 110,961	$ 11,096	$ 554,806	$ 8,440
Monitoring, Research, and Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Restoration Contigency (only first 20 years)	$ 19,688				$ 788	$ 39,375	
Capital Cost Total (in 2007 dollars)	$ 320,967	$ 170,029	$ 170,029	$ 170,029	$ 23,040	$ 1,152,021	$ 9,740
Operational Costs							
Program Administration	$ 208,500	$ 208,500	$ 208,500	$ 208,500	$ 20,850	$ 1,042,500	$ 20,825
Habitat Restoration	$ -	$ -	$ -	$ -	$ -	$ -	$ -
HMA Management and Maintenance	$ 1,394,707	$ 1,559,655	$ 1,723,095	$ 1,394,707	$ 149,337	$ 7,466,870	$ 138,471
Monitoring, Research, and Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Budget Contingency	$ 85,094	$ 85,094	$ 85,094	$ 85,094	$ 8,509	$ 425,469	
Remedial Measures							
Operational Cost Total (in 2007 dollars)	$ 1,688,301	$ 1,853,249	$ 2,016,689	$ 1,688,301	$ 178,697	$ 8,934,839	$ 159,296

Table N-2. Cost Summary by Management Agency

	Coop	Coop	Coop	Coop	Coop	Coop	Coop	Coop
Cost Category	1-10	10-20	20-30	30-40	40-50	Average Annual Cost	Total Permit Term Cost	Annual Post-Permit Term Costs
Total Costs								
Program Administration	$ 3,629,059	$ 3,629,059	$ 3,629,059	$ 3,629,059	$ 3,629,059	$ 362,906	$ 18,146,000	$ 174,711
Habitat Restoration	$ 96,750	$ 96,750	$ -	$ -	$ -	$ 3,870	$ 194,000	$ -
HMA Management and Maintenance	$ 2,797,549	$ 2,797,549	$ 2,882,412	$ 2,882,412	$ 2,882,412	$ 284,847	$ 14,243,000	$ 280,266
Monitoring, Research, and Adaptive Management	$ 3,496,629	$ 3,496,629	$ 3,126,047	$ 3,185,411	$ 3,151,124	$ 321,705	$ 16,086,000	$ 112,146
Contingency and Remedial Measures	$ 1,755,323	$ 1,755,323	$ 1,740,811	$ 1,740,811	$ 1,740,811	$ 174,662	$ 2,348,000	$ -
Grand Total (in 2007 dollars)	$ 11,775,310	$ 11,775,310	$ 11,378,328	$ 11,437,692	$ 11,403,405	$ 1,147,989	$ 51,017,000	$ 567,122
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Capital Costs								
Program Administration	$ 264,471	$ 264,471	$ 264,471	$ 264,471	$ 264,471	$ 26,447	$ 1,323,000	$ 8,282
Habitat Restoration	$ 96,750	$ 96,750	$ -	$ -	$ -	$ 3,870	$ 194,000	$ -
HMA Management and Maintenance	$ 161,271	$ 161,271	$ 161,271	$ 161,271	$ 161,271	$ 16,127	$ 807,000	$ 8,152
Monitoring, Research, and Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Restoration Contigency (only first 20 years)	$ 14,513	$ 14,513				$ 581	$ 30,000	
Capital Cost Total (in 2007 dollars)	$ 537,004	$ 537,004	$ 425,742	$ 425,742	$ 425,742	$ 47,025	$ 2,354,000	$ 16,434
Operational Costs								
Program Administration	$ 3,364,588	$ 3,364,588	$ 3,364,588	$ 3,364,588	$ 3,364,588	$ 336,459	$ 16,823,000	$ 166,429
Habitat Restoration	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
HMA Management and Maintenance	$ 2,636,278	$ 2,636,278	$ 2,721,141	$ 2,721,141	$ 2,721,141	$ 268,720	$ 13,436,000	$ 272,114
Monitoring, Research, and Adaptive Management	$ 3,496,629	$ 3,126,047	$ 3,126,047	$ 3,185,411	$ 3,151,124	$ 321,705	$ 16,086,000	$ 112,146
Budget Contingency	$ 463,442	$ 463,442	$ 463,442	$ 463,442	$ 463,442	$ 46,344	$ 2,318,000	
Remedial Measures	$ 1,277,369	$ 1,277,369	$ 1,277,369	$ 1,277,369	$ 1,277,369	$ 127,737	$ 6,387,000	
Operational Cost Total (in 2007 dollars)	$ 11,238,306	$ 10,867,724	$ 10,952,587	$ 11,011,951	$ 10,977,664	$ 1,100,965	$ 55,050,000	$ 550,688

Table N-3. Employees

				Annual time allocation to HCP				Time allocation		BLM		SP		UC		Coop		Total	Post-permit term
Position	**Assumption**	**# of staff**	**Cost/employee/year[a]**	**BLM**	**State Parks**	**UC/NRS**	**Coop**	**Total**	**TOTAL annual cost**	multiplier	cost	multiplier	cost	multiplier	cost	multiplier	cost	Avg Annual Cost	Y/N
Program Administration Personnel																			
Executive Director-level staffing																			
Coop Program Administrator	65	1	$ 140,000				0.50	0.50	$ 70,000	0%	$ -	0%	$ -	0%	$ -	50%	$ 70,000	$ 70,000	Y
State Parks District Superintendent	65	1	$ 136,219		0.02			0.02	$ 2,724			2%	$ 2,724					$ 2,724	Y
State Parks Sector Superintendent		1	$ 88,762		0.02			0.02	$ 1,775			2%	$ 1,775					$ 1,775	Y
BLM Field Manager	68	1	$ 139,298	0.25	0.05			0.30	$ 41,789	25%	$ 34,825	5%	$ 6,965	0%	$ -	0%	$ -	$ 41,789	Y
Budget Analyst staffing																			
Budget Analyst	66	2	$ 72,805	0.10	0.01		0.00	0.11	$ 8,009	10%	$ 7,281	1%	$ 728	0%	$ -	0%	$ -	$ 8,009	Y
Accounting Manager	66	1	$ 50,000				0.30	0.30	$ 15,000	0%	$ -	0%	$ -	0%	$ -	30%	$ 15,000	$ 15,000	Y
Grant Specialist and Conservation Planning staffing																			
State Parks Senior Environmental Scientist	67	1	$ 85,000					0.00	$ -	0%	$ -	0%	$ -	0%	$ -	0%	$ -	$ -	Y
Senior Grant Specialist/ Conservation Planner/ GIS/Database Manager	67	1	$ 70,000				1.00	1.00	$ 70,000	0%	$ -	0%	$ -	0%	$ -	100%	$ 70,000	$ 70,000	Y
Assistant Grant Specialist/ Conservation Planner/ GIS/Database Manager		1	$ 50,000				1.00	1.00	$ 50,000	0%	$ -	0%	$ -	0%	$ -	100%	$ 50,000	$ 50,000	Y
IT- GIS/Database Management Support staffing																			
IT- GIS/ Database Manager Support	68	2	$ 108,100	0.25	0.03		0.00	0.28	$ 29,728	25%	$ 27,025	3%	$ 2,703	0%	$ -	0%	$ -	$ 29,728	Y
Administrative Personnel Support staffing																			
Administrative Assistant	68, 69	2	$ 72,805	0.25	0.07			0.32	$ 23,298	25%	$ 18,201	7%	$ 5,096	0%	$ -	0%	$ -	$ 23,298	Y
TOTAL (Admin.)		**14**		**0.85**	**0.20**	**0.00**	**2.80**	**3.85**	**$ 312,323**		**$ 87,331**		**$ 19,991**		**$ -**		**$ 205,000**	**$ 312,323**	
Habitat Restoration Personnel																			
Project Manager	70	1	$ 80,149		0.75			0.75	$ 60,112	0%	$ -	75%	$ 60,112	0%	$ -	0%	$ -	$ 60,112	N
Ranger (enforcement)	71	1	$ 90,000		0.00			0.00	$ -	0%	$ -	0%	$ -	0%	$ -	0%	$ -	$ -	N
Biologist	72	1	$ 70,200		0.00			0.00	$ -	0%	$ -	0%	$ -	0%	$ -	0%	$ -	$ -	N
Field Staff	73	2	$ 21,971		2.00			2.00	$ 43,942	0%	$ -	200%	$ 43,942	0%	$ -	0%	$ -	$ 43,942	N
BLM Biologist		1	$ 118,794	0.12				0.12	$ 13,821	12%	$ 13,821	0%	$ -	0%	$ -	0%	$ -	$ 13,821	N
BLM Administration Staff Officer		1	$ 72,805	0.005				0.01	$ 385	1%	$ 385	0%	$ -	0%	$ -	0%	$ -	$ 385	N
BLM Archeologist		1	$ 104,430	0.02				0.02	$ 2,209	2%	$ 2,209	0%	$ -	0%	$ -	0%	$ -	$ 2,209	N
BLM Fort Ord Manager		1	$ 149,414	0.01				0.01	$ 1,580	1%	$ 1,580	0%	$ -	0%	$ -	0%	$ -	$ 1,580	N
BLM Fuels Crew Employee		1	$ 39,520	0.04				0.04	$ 1,672	4%	$ 1,672	0%	$ -	0%	$ -	0%	$ -	$ 1,672	N
BLM Heavy Equipment Operator		1	$ 84,405	0.03				0.03	$ 2,678	3%	$ 2,678	0%	$ -	0%	$ -	0%	$ -	$ 2,678	N
BLM Hollister Field Manager		1	$ 116,480	0.005				0.01	$ 616	1%	$ 616	0%	$ -	0%	$ -	0%	$ -	$ 616	N
BLM Implementation Team Lead		1	$ 113,288	0.05				0.05	$ 5,991	5%	$ 5,991	0%	$ -	0%	$ -	0%	$ -	$ 5,991	N
BLM Munitions Expert		1	$ 94,906	0.06				0.06	$ 6,023	6%	$ 6,023	0%	$ -	0%	$ -	0%	$ -	$ 6,023	N
BLM Park Ranger		1	$ 81,013	0.02				0.02	$ 1,714	2%	$ 1,714	0%	$ -	0%	$ -	0%	$ -	$ 1,714	N
BLM Planning and Environmental Coordinator		1	$ 121,123	0.02				0.02	$ 2,562	2%	$ 2,562	0%	$ -	0%	$ -	0%	$ -	$ 2,562	N
BLM Soil/Air/Water Specialist		1	$ 94,096	0.02				0.02	$ 1,990	2%	$ 1,990	0%	$ -	0%	$ -	0%	$ -	$ 1,990	N
BLM Watershed Insititue Staff		1	$ 94,096	0.12				0.12	$ 11,292	12%	$ 11,292	0%	$ -	0%	$ -	0%	$ -	$ 11,292	N
TOTAL (Restoration)		**17**		**0.47**	**2.75**	**0.00**	**0.00**	**3.28**	**$ 156,588**		**$ 52,534**		**$ 104,054**		**$ -**		**$ -**	**$ 156,588**	N
HMA Management and Maintenance Personnel																			
Preserve Manager	74	1	$ 80,149		0.15			0.15	$ 12,022	0%	$ -	15%	$ 12,022	0%	$ -	0%	$ -	$ 12,022	Y
UC Reserve Manager		1	$ 56,000			1.00		1.00	$ 56,000					100%	$ 56,000			$ 56,000	Y
Biologist	75	1	$ 61,694		0.10			0.10	$ 6,169	0%	$ -	10%	$ 6,169	0%	$ -	0%	$ -	$ 6,169	Y
Laborer	76	1	$ 21,971		1.00			1.00	$ 21,971	0%	$ -	100%	$ 21,971	0%	$ -	0%	$ -	$ 21,971	Y
Ranger (enforcement)	77	1	$ 79,095		1.00			1.00	$ 79,095	0%	$ -	100%	$ 79,095	0%	$ -	0%	$ -	$ 79,095	Y
Fort Ord Manager (Natural Area Manager)	78	1	$ 149,414	1.00				1.00	$ 149,414	100%	$ 149,414	0%	$ -	0%	$ -	0%	$ -	$ 149,414	Y
Biologist	78	1	$ 118,794	1.00				1.00	$ 118,794	100%	$ 118,794	0%	$ -	0%	$ -	0%	$ -	$ 118,794	Y
Natural Resource Specialist	78, 79	1	$ 94,096	1.00				1.00	$ 94,096	100%	$ 94,096	0%	$ -	0%	$ -	0%	$ -	$ 94,096	Y
Biotech Lead (Weed Crew Supervisor)	78	1	$ 87,420	1.00				1.00	$ 87,420	100%	$ 87,420	0%	$ -	0%	$ -	0%	$ -	$ 87,420	Y
Biotech Field Worker (Weed Crew Member)	78	1	$ 54,595	1.00				1.00	$ 54,595	100%	$ 54,595	0%	$ -	0%	$ -	0%	$ -	$ 54,595	Y
Biotech Field Worker (Weed Crew Member)	80	2	$ 54,595	2.00				2.00	$ 109,190	200%	$ 109,190	0%	$ -	0%	$ -	0%	$ -	$ 109,190	N
Law Enforcement Ranger 1	78	2	$ 146,606	1.25				1.25	$ 183,258	125%	$ 183,258	0%	$ -	0%	$ -	0%	$ -	$ 183,258	Y
Law Enforcement Ranger 2, 11/3	80	2	$ 146,606	1.25				1.25	$ 183,258	125%	$ 183,258	0%	$ -	0%	$ -	0%	$ -	$ 183,258	N
Maintenance Worker WG 9/3	78	1	$ 84,405	1.00				1.00	$ 84,405	100%	$ 84,405	0%	$ -	0%	$ -	0%	$ -	$ 84,405	Y
Park Ranger (Interpretive Specialist) 9/3	78	1	$ 81,013	1.00				1.00	$ 81,013	100%	$ 81,013	0%	$ -	0%	$ -	0%	$ -	$ 81,013	Y
Park Ranger Tech 5/3	78	1	$ 54,595	0.50				0.50	$ 27,298	50%	$ 27,298	0%	$ -	0%	$ -	0%	$ -	$ 27,298	Y
UXO-Qualified Safety Escort 11/3	80	2	$ 94,906	2.00				2.00	$ 189,812	200%	$ 189,812	0%	$ -	0%	$ -	0%	$ -	$ 189,812	N
Fuels Crew Supervisor 8/3	78	1	$ 90,472	1.00				1.00	$ 90,472	100%	$ 90,472	0%	$ -	0%	$ -	0%	$ -	$ 90,472	Y
Fuels Crew Member 4/3	78	2	$ 60,445	2.00				2.00	$ 120,890	200%	$ 120,890	0%	$ -	0%	$ -	0%	$ -	$ 120,890	Y
Equipment Operator WG10/3	78	1	$ 84,405	1.00				1.00	$ 84,405	100%	$ 84,405	0%	$ -	0%	$ -	0%	$ -	$ 84,405	Y
Security Patrol		1	$ 54,595	1.00				1.00	$ 54,595	100%	$ 54,595	0%	$ -	0%	$ -	0%	$ -	$ 54,595	Y
UC Steward		1	$ 43,000			1.00		1.00	$ 43,000	0%	$ -	0%	$ -	100%	$ 43,000	0%	$ -	$ 43,000	Y
TOTAL (Preserve Mgt and Maint Personnel)		**21**		**13.75**	**2.25**	**2**	**0**	**18.00**	**$ 1,448,912**		**$ 1,230,654**		**$ 119,258**		**$ 99,000**		**$ -**	**$ 1,448,912**	
Total																			
TOTAL PERSONNEL		**52**		**15.07**	**5.20**	**2.00**	**2.80**	**25.13**			**$ 1,370,519**		**$ 243,303**		**$ 99,000**		**$ 205,000**	**$ 1,917,822**	**$ 26**
TOTAL ARMY MEC-related costs									**$ 482,260**		$ 482,260							$ 482,259.50	

[a] the "cost/employee/year" column represents the total cost to fund one person in a specified position full time for the full year.The columns that follow indicate the average percentage of the employee's time dedicated to HCP-related activities in a given year.

Table N-4. Program Administration Costs

Cost Item	Assumption	Unit	# of units	Replacement rate (every X	$/Unit	Units/Yr	Avg Annual Cost	% of total	Total Permit term cost	C/O	Sources
		Permit Term Base-wide Costs									
Staff Costs											
Labor (x positions, w/ x time dedicated to HCP tasks)	1	see table 9-5					$ 312,323	52%	$ 15,616,134	O	
Benefits (25% JPA; 35% for UC)	2, 89	per employee					$ 51,250	8%	$ 2,562,500	O	
Staff Costs Total							**$ 363,573**	**60%**	**$ 18,178,634**		
Insurance											
Officers (coverage for JPA)		per year	1	1	$ 5,700	1	$ 5,700	1%	$ 285,000	O	SCV HCP
Liability (coverage for JPA)		per year	1	1	$ 5,700	1	$ 5,700	1%	$ 285,000	O	SCV HCP
Professional liability (coverage for JPA)		per year	1	1	$ 8,500	1	$ 8,500	1%	$ 425,000	O	SCV HCP
Fire and Renter's Insurance (2 offices)		per year	1	1	$ 10,000	1	$ 10,000	2%	$ 500,000	O	JSA
Vehicle Insurance (x vehicles)		yr/ vehicle	12	1	$ 1,750	12	$ 21,000	3%	$ 1,050,000	O	SCV HCP
Insurance Total							**$ 50,900**	**8%**	**$ 995,000**		
Office Space and Utilities											
JPA - Lease cost (1 offices starts in 2016)	101	sq. ft./ month	750	1	$ 1	750	$ 12,500	2%	$ 625,000	O	FORA
UC- Lease cost (1 office)	101	sq. ft./ month	750	1	$ 1	750	$ 11,250	2%	$ 562,500	O	FORA
Propane (1 office)	102	service per year	1	1	$ 1,500	1	$ 1,500	0%	$ 75,000	O	FORA
Electrictiy (1 office)	103	service per year	1	1	$ 750	1	$ 750	0%	$ 37,500	O	FORA
Water (1 office)	4a,6	service per year	1	1	$ 400	1	$ 400	0%	$ 20,000	O	FORA
Waste Management Services (30 yard dumpster) (1 office)	100	service per month	12	1	$ 77	12	$ 929	0%	$ 46,440	O	FORA
Janitorial (1 office)	4a,8	service per week	52	1	$ 200	52	$ 10,400	2%	$ 520,000	O	FORA
Office Space Total							**$ 37,729**	**6%**	**$ 1,886,440**		
General Office Equipment											
Office/Cubicle furniture - 6 cubicles, replaced every 20 years	10,106	office cubilce / year	5	20	$ 2,000	0.25	$ 500	0%	$ 25,000	C	BLM
Office supplies	11	per employee time allocation/ year	23.13	1	$ 100	23.1275	$ 2,313	0%	$ 115,638	C	BLM
Office supplies UC		per month	12	1	$ 100	12	$ 1,200	0%	$ 60,000	C	
Computers - 1 per cubicle, replaced every 5 years	12, 10	per office space cubicle	3	5	$ 2,500	0.6	$ 1,500	0%	$ 75,000	C	BLM
UC-Computers - 1 per cubicle, replaced every 5 years		per office space cubicle	2	5	$ 2,650	0.4	$ 1,060	0%	$ 53,000	C	UC
Software (Microsoft Office Suite) per computer, updated every 5 years	13	per software	3	5	$ 3,800	0.6	$ 2,280	0%	$ 114,000	C	JSA
UC-Software (Microsoft Office Suite) per computer, updated every 5 years		per software	2	5	$ 1,710	0.4	$ 684	0%	$ 34,200	C	UC
Office Phone Service (7 phones)	14,107	service per phone	3	1	$ 40	3	$ 120	0%	$ 6,000	C	BLM
UC office phones		service per phone	2	1	$ 180	2	$ 360	0%	$ 18,000	C	UC
Cell Phone Service (4 cell phones)	14	service per cell phone	4	1	$ 50	4	$ 200	0%	$ 10,000	C	BLM
UC cell phones		service per phone	2	1	$ 500	2	$ 1,000	0%	$ 50,000		
Copy machine (lease) (1)	15	per office space	1	1	$ 3,500	1	$ 3,500	1%	$ 175,000	C	BLM
UC/NRS copy machine		annual cost	1	1	$ 1,150	1	$ 1,150	0%	$ 57,500	C	UC
Fax Machine (1 machines replaced every 5 years)	16	per machine	1	5	$ 500	0.2	$ 100	0%	$ 5,000	C	BLM
Printers (2 printers replaced every 5 years)	17	per printer	2	5	$ 1,000	0.4	$ 400	0%	$ 20,000	C	BLM
General Office Equipment Total							**$ 16,367**	**3%**	**$ 818,338**		
GIS and Database Equipment											
GIS/ Database servers & service contract (1 replaced every 5yrs)	18, 108	per server	1	5	$ 7,500	0.2	$ 1,500	0%	$ 75,000	C	FORA
UC GIS Lab access		per year	1	1	$ 500	1	$ 500	0%	$ 25,000	C	
Plotters (1 replaced every 8 yrs)	19, 109	per plotter	1	8	$ 1,360	0.125	$ 170	0%	$ 8,500	C	FOR A
Plotter ink and paper	2, 110	per year	1	1	$ 2,400	1	$ 2,400	0%	$ 120,000	C	JSA
GIS and statistics software (1 updated every 5 yrs)	13	per year	1	5	$ 8,000	0.2	$ 1,600	0%	$ 80,000	C	CNLM (2005 PAR)
Tablet PCs (2 replaced every 5 yrs)	21, 111	per tablet PC	2	5	$ 2,000	0.4	$ 800	0%	$ 40,000	C	FORA
GIS and Database Equipment Total							**$ 6,970**	**1%**	**$ 348,500**		
Vehicles and Fuel											
4-wheel drive SUV (non LE)	22	per vehicle	4	1	$ 5,400	4	$ 21,600	4%	$ 1,080,000	O	BLM
4-wheel drive SUV (LE)	22	per vehicle	1	1	$ 6,200	1	$ 6,200	1%	$ 310,000	O	BLM
4-wheel drive SUV (LE) (begins in year 20)	23	per vehicle			$ 6,200	0.6	$ 3,720	1%	$ 186,000	O3	BLM
4-wheel drive SUV (non LE) (begins in year 20)	23	per vehicle			$ 5,400	1.2	$ 6,480	1%	$ 324,000	O3	BLM
4-wheel drive utility trucks	22	per vehicle	2	1	$ 10,300	2	$ 20,600	3%	$ 1,030,000	O	BLM
4-wheel drive trucks	22	per vehicle	4	1	$ 6,100	4	$ 24,400	4%	$ 1,220,000	O	BLM
4-wheel drive crew truck	22	per vehicle	1	1	$ 10,300	1	$ 10,300	2%	$ 515,000	O	BLM
Vehicle Total			**12**			**13.8**	**$ 93,300**	**15%**	**$ 4,665,000**		
Staff Training											
Training	25	per employee time allocation	25.13	1	$ 200	25.13	$ 5,026	1%	$ 251,275	C	BLM
Training Total							**$ 5,026**	**1%**	**$ 251,275**		
Legal and Financial Assistance											
Legal assistance	29, 112	per hour	50	1	$ 300	50	$ 15,000	2%	$ 750,000	O	FORA
Financial analysis assistance	30	per year	1	3	$ 7,000	0.24	$ 1,680	0%	$ 84,000	O	JSA
Legal and Financial Assistance Total							**$ 16,680**	**3%**	**$ 834,000**		
Education/ Outreach/ Public Relations											
Publications	113	per year	1	1	$ 12,500	1	$ 12,500	2%	$ 625,000	C	JSA
Education/ Outreach/ Public Relations Total							**$ 12,500**	**2%**	**$ 625,000**		
Totals											
Operational Costs											
Start-up (O) Year 0-1							$ 80,000		**$ 80,000**		
Years 1-20 (O)							$ 551,981		$ 11,039,629		
Years 21-50 (O+O3)							$ 562,181		$ 16,865,444		
Post-permit term (O+O3)							$ 284,590				
Capital costs											
Start-up © Year 0-1							$ 47,200		$ 47,200		
Years 1-50 (C)							$ 39,862		$ 1,993,113		
Post-permit term							$ 12,226				
Total											
Start-up							$ 127,200		$ 127,200		
Years 1-20							$ 591,844		$ 11,836,874		
Years 21-50							$ 602,044		$ 18,061,312		
Post-permit term							$ 296,817				
Total							**$ 603,044**	**100%**	**$ 30,025,386**		**$ -**
TOTAL ARMY MEC-related costs					**$ 11,600**		**$ 10,200**		**$ 510,000**		**$ -**

Table N-4. Program Administration Costs

Cost Item	Permit Term Costs by Management Enity										
	BLM	BLM	SP	SP	UC/ NRS	UC/NRS	COO P	COOP	Total Avg. Annual Cost	Total Check	percent age check
	%	cost ($)	%	cost ($)	%	cost ($)	%	cost ($)	($)		%
Staff Costs											
Labor (x positions, w/ x time dedicated to HCP tasks)		$ 87,331		$ 19,991		$ -		$ 205,000	$ 312,323	$ -	
Benefits (25% JPA; 35% for UC)		$ -				$ -		$ 51,250	$ 51,250		
Staff Costs Total		**$ 87,331**		**$ 19,991**		**$ -**		**$ 256,250**	**$ 363,573**		
Insurance											
Officers (coverage for JPA)	0%	$ -	0%	$ -	0%	$ -	100%	$ 5,700	$ 5,700		100%
Liability (coverage for JPA)	0%	$ -	0%	$ -	0%	$ -	100%	$ 5,700	$ 5,700		100%
Professional liability (coverage for JPA)	0%	$ -	0%	$ -	0%	$ -	100%	$ 8,500	$ 8,500		100%
Fire and Renter's Insurance (2 offices)	0%	$ -	0%	$ -	0%	$ -	100%	$ 10,000	$ 10,000		100%
Vehicle Insurance (x vehicles)	75%	$ 15,750	0%	$ -	17%	$ 3,500	8%	$ 1,750	$ 21,000		100%
Insurance Total		**$ 15,750**		**$ -**		**$ 3,500**		**$ 25,950**	**$ 50,900**		
Office Space and Utilities											
JPA - Lease cost (1 offices starts in 2016)	0%	$ -	0%	$ -	0%	$ -	100%	$ 12,500	$ 12,500		100%
UC- Lease cost (1 office)	0%	$ -	0%	$ -	100%	$ 11,250	0%	$ -	$ 11,250		100%
Propane (1 office)	0%	$ -	0%	$ -	0%	$ -	100%	$ 1,500	$ 1,500		100%
Electrictiy (1 office)	0%	$ -	0%	$ -	0%	$ -	100%	$ 750	$ 750		100%
Water (1 office)	0%	$ -	0%	$ -	0%	$ -	100%	$ 400	$ 400		100%
Waste Management Services (30 yard dumpster) (1 office)	0%	$ -	0%	$ -	0%	$ -	100%	$ 929	$ 929		100%
Janitorial (1 office)	0%	$ -	0%	$ -	0%	$ -	100%	$ 10,400	$ 10,400		100%
Office Space Total		**$ -**		**$ -**		**$ 11,250**		**$ 26,479**	**$ 37,729**		
General Office Equipment											
Office/Cubicle furniture - 6 cubicles, replaced every 20 years	0%	$ -	0%	$ -	40%	$ 200	60%	$ 300	$ 500		100%
Office supplies	64%	$ 1,480	22%	$ 509	0%	$ -	14%	$ 324	$ 2,313		100%
Office supplies UC	0%	$ -	0%	$ -	100%	$ 1,200	0%	$ -	$ 1,200		100%
Computers - 1 per cubicle, replaced every 5 years	0%	$ -	0%	$ -	0%	$ -	100%	$ 1,500	$ 1,500		100%
UC-Computers - 1 per cubicle, replaced every 5 years	0%	$ -	0%	$ -	100%	$ 1,060			$ 1,060		100%
Software (Microsoft Office Suite) per computer, updated every 5 years	0%	$ -	0%	$ -	0%	$ -	100%	$ 2,280	$ 2,280		100%
UC-Software (Microsoft Office Suite) per computer, updated every 5 years	0%		0%		100%	$ 684			$ 684		100%
Office Phone Service (7 phones)	0%	$ -	0%	$ -	0%	$ -	100%	$ 120	$ 120		100%
UC office phones					100%	$ 360			$ 360		100%
Cell Phone Service (4 cell phones)	50%	$ 100	0%	$ -	0%	$ -	50%	$ 100	$ 200		100%
UC cell phones					100%	$ 1,000			$ 1,000		100%
Copy machine (lease) (1)	0%	$ -	0%	$ -	0%	$ -	100%	$ 3,500	$ 3,500		100%
UC/NRS copy machine					100%	$ 1,150			$ 1,150		100%
Fax Machine (1 machines replaced every 5 years)	0%	$ -	0%	$ -	0%	$ -	100%	$ 100	$ 100		100%
Printers (2 printers replaced every 5 years)	0%	$ -	0%	$ -	50%	$ 200	50%	$ 200	$ 400		100%
General Office Equipment Total		**$ 1,580**		**$ 509**		**$ 5,854**		**$ 8,424**	**$ 16,367**		
GIS and Database Equipment											
GIS/ Database servers & service contract (1 replaced every 5yrs)	0%	$ -	0%	$ -	0%	$ -	100%	$ 1,500	$ 1,500		100%
UC GIS Lab access	0%	$ -	0%	$ -	100%	$ 500	0%	$ -	$ 500		100%
Plotters (1 replaced every 8 yrs)	0%	$ -	0%	$ -	0%	$ -	100%	$ 170	$ 170		100%
Plotter ink and paper	0%	$ -	0%	$ -	0%	$ -	100%	$ 2,400	$ 2,400		100%
GIS and statistics software (1 updated every 5 yrs)	100%	$ 1,600	0%	$ -	0%	$ -	0%	$ -	$ 1,600		100%
Tablet PCs (2 replaced every 5 yrs)	0%	$ -	0%	$ -	0%	$ -	100%	$ 800	$ 800		100%
GIS and Database Equipment Total		**$ 1,600**		**$ -**		**$ 500**		**$ 4,870**	**$ 6,970**		
Vehicles and Fuel											
4-wheel drive SUV (non LE)	75%	$ 16,200	0%	$ -	0%	$ -	25%	$ 5,400	$ 21,600		100%
4-wheel drive SUV (LE)	100%	$ 6,200	0%	$ -	0%	$ -	0%	$ -	$ 6,200		100%
4-wheel drive SUV (LE) (begins in year 20)	100%	$ 3,720	0%	$ -	0%	$ -	0%	$ -	$ 3,720		100%
4-wheel drive SUV (non LE) (begins in year 20)	100%	$ 6,480	0%	$ -	0%	$ -	0%	$ -	$ 6,480		100%
4-wheel drive utility trucks	100%	$ 20,600	0%	$ -	0%	$ -	0%	$ -	$ 20,600		100%
4-wheel drive trucks	75%	$ 18,300	0%	$ -	25%	$ 6,100	0%	$ -	$ 24,400		100%
4-wheel drive crew truck	100%	$ 10,300	0%	$ -	0%	$ -	0%	$ -	$ 10,300		100%
Vehicle Total		**$ 81,800**		**$ -**		**$ 6,100**		**$ 5,400**	**$ 93,300**		
Staff Training											
Training	56%	$ 2,814	20%	$ 1,005	11%	$ 553	13%	$ 653	$ 5,026		100%
Training Total		**$ 2,814**		**$ 1,005**		**$ 553**		**$ 653**	**$ 5,026**		
Legal and Financial Assistance											
Legal assistance	0%	$ -	0%	$ -	0%	$ -	100%	$ 15,000	$ 15,000		100%
Financial analysis assistance	0%	$ -	0%	$ -	0%	$ -	100%	$ 1,680	$ 1,680		100%
Legal and Financial Assistance Total		**$ -**		**$ -**		**$ -**		**$ 16,680**	**$ 16,680**		
Education/ Outreach/ Public Relations											
Publications	0%	$ -	0%	$ -	0%	$ -	100%	$ 12,500	$ 12,500		100%
Education/ Outreach/ Public Relations Total		**$ -**		**$ -**		**$ -**		**$ 12,500**	**$ 12,500**		
Totals											
Operational Costs											
Start-up (O) Year 0-1											
Years 1-20 (O)		$ 174,681		$ 19,991		$ 20,850		$ 336,459	$ 551,981		
Years 21-50 (O+O3)		$ 184,881		$ 19,991		$ 20,850		$ 336,459	$ 562,181		
Post-permit term (O+O3)											
Capital costs											
Start-up © Year 0-1											
Years 1-50 (C)		$ 5,994		$ 1,514		$ 5,907		$ 26,447	$ 39,862		
Post-permit term											
Total											
Start-up											
Years 1-20		$ 180,676		$ 21,505		$ 26,757		$ 362,906	$ 591,844		
Years 21-50		$ 190,876		$ 21,505		$ 26,757		$ 362,906	$ 602,044		
Post-permit term											
Total		**$ 190,876**		**$ 21,505**		**$ 27,757**		**$ 357,206**	**$ 603,044**		
TOTAL ARMY MEC-related costs		**$ 10,200**		**$ -**		**$ -**		**$ -**	**$ 10,200**		

Table N-4. Program Administration Costs

Cost Item	Start up cost	cost per item	BLM	BLM	SP	SP	UC/NRS	UC/NRS	COOP	COOP	Start-up cost total
	Start up costs by Management Entity										
	Y/N	$/unit	# of units	cost ($)	# of units	cost ($)	# of units	cost ($)	# of units	cost ($)	($)
Staff Costs											
Labor (x positions, w/ x time dedicated to HCP tasks)	N			$ -		$ -		$ -		$ -	$ -
Benefits (25% JPA; 35% for UC)	N			$ -		$ -		$ -		$ -	$ -
Staff Costs Total				**$ -**		**$ -**		**$ -**		**$ -**	**$ -**
Insurance											
Officers (coverage for JPA)	N			$ -		$ -		$ -		$ -	$ -
Liability (coverage for JPA)	N			$ -		$ -		$ -		$ -	$ -
Professional liability (coverage for JPA)	N			$ -		$ -		$ -		$ -	$ -
Fire and Renter's Insurance (2 offices)	N			$ -		$ -		$ -		$ -	$ -
Vehicle Insurance (x vehicles)	N			$ -		$ -		$ -		$ -	$ -
Insurance Total				**$ -**		**$ -**		**$ -**		**$ -**	**$ -**
Office Space and Utilities											
JPA - Lease cost (1 offices starts in 2016)	N			$ -		$ -		$ -		$ -	$ -
UC- Lease cost (1 office)	N										
Propane (1 office)	N			$ -		$ -		$ -		$ -	$ -
Electrictiy (1 office)	N			$ -		$ -		$ -		$ -	$ -
Water (1 office)	N			$ -		$ -		$ -		$ -	$ -
Waste Management Services (30 yard dumpster) (1 office)	N			$ -		$ -		$ -		$ -	$ -
Janitorial (1 office)	N			$ -		$ -		$ -		$ -	$ -
Office Space Total	**$ -**			**$ -**		**$ -**		**$ -**		**$ -**	**$ -**
General Office Equipment											
Office/Cubicle furniture - 6 cubicles, replaced every 20 years	Y	$ 2,000					2	$ 4,000	4	$ 8,000	$ 12,000
Office supplies	N							$ -		$ -	$ -
Office supplies UC	N							$ -		$ -	$ -
Computers - 1 per cubicle, replaced every 5 years	Y	$ 2,500					2	$ 5,000	4	$ 10,000	$ 15,000
UC-Computers - 1 per cubicle, replaced every 5 years											
Software (Microsoft Office Suite) per computer, updated every 5 years	Y	$ 3,800						$ -	4	$ 15,200	$ 15,200
UC-Software (Microsoft Office Suite) per computer, updated every 5 years											
Office Phone Service (7 phones)	N							$ -		$ -	$ -
UC office phones	N										
Cell Phone Service (4 cell phones)	N							$ -		$ -	$ -
UC cell phones											
Copy machine (lease) (1)	N							$ -		$ -	$ -
UC/NRS copy machine	N										
Fax Machine (1 machines replaced every 5 years)	Y	$ 500					1	$ 500	1	$ 500	$ 1,000
Printers (2 printers replaced every 5 years)	Y	$ 1,000					1	$ 1,000	1	$ 1,000	$ 2,000
General Office Equipment Total	**$ -**			**$ -**		**$ -**		**$ 10,500**		**$ 34,700**	**$ 45,200**
GIS and Database Equipment											
GIS/ Database servers & service contract (1 replaced every 5yrs)	N										$ -
UC GIS Lab access	N										$ -
Plotters (1 replaced every 8 yrs)	N										$ -
Plotter ink and paper	N										$ -
GIS and statistics software (1 updated every 5 yrs)	N										$ -
Tablet PCs (2 replaced every 5 yrs)	Y	$ 2,000					1	$ 2,000			$ 2,000
GIS and Database Equipment Total				**$ -**		**$ -**		**$ 2,000**		**$ -**	**$ 2,000**
Vehicles and Fuel											
4-wheel drive SUV (non LE)	Y	$40,000							1	$ 40,000	$ 40,000
4-wheel drive SUV (LE)	N										$ -
4-wheel drive SUV (LE) (begins in year 20)	N										$ -
4-wheel drive SUV (non LE) (begins in year 20)	N										$ -
4-wheel drive utility trucks	N										$ -
4-wheel drive trucks	Y	$40,000					1	$ 40,000			$ 40,000
4-wheel drive crew truck	N										$ -
Vehicle Total								**$ 40,000**		**$ 40,000**	$ 80,000
Staff Training											
Training	N										
Training Total											
Legal and Financial Assistance											
Legal assistance	N										
Financial analysis assistance	N										
Legal and Financial Assistance Total											
Education/ Outreach/ Public Relations											
Publications	N										$ -
Education/ Outreach/ Public Relations Total				**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Totals											
Operational Costs											
Start-up (O) Year 0-1				$ -		$ -		$ 40,000		$ 40,000	$ 80,000
Years 1-20 (O)											
Years 21-50 (O+O3)											
Post-permit term (O+O3)											
Capital costs											
Start-up © Year 0-1				$ -		$ -		$ 12,500		$ 34,700	$ 47,200
Years 1-50 (C)											
Post-permit term											
Total											
Start-up				$ -		$ -		$ 52,500		$ 74,700	$ 127,200
Years 1-20											
Years 21-50											
Post-permit term											
Total				**$ -**		**$ -**		**$ 52,500**		**$ 74,700**	**$ 127,200**
TOTAL ARMY MEC-related costs											

Table N-4. Program Administration Costs

Cost Item	Post-Permit Term Average Annual Costs by Management Entity											
	Post-Permit Term Cost (Y/N)	% of permit term avg annual cost	Avg Annual post-permit cost	BLM	BLM	SP	SP	UC/ NRS	UC/NRS	COOP	COOP	Total Check
		%	($)	%	cost ($)	%	cost ($)	%	cost ($)	%	cost ($)	Avg. Annual Cost
Staff Costs												
Labor (x positions, w/ x time dedicated to HCP tasks)	Y	50%	$ 156,161		$ 43,666		$ 9,996		$ -		$ 102,500	$ 156,161
Benefits (25% JPA; 35% for UC)	Y	50%	$ 25,625		$ -		$ -		$ -		$ 25,625	$ 25,625
Staff Costs Total			**$ 181,786**		**$ 43,666**		**$ 9,996**		**$ -**		**$ 128,125**	**$ 181,786**
Insurance												
Officers (coverage for JPA)	Y	100%	$ 5,700	0%	$ -	0%	$ -	0%	$ -	100%	$ 5,700	$ 5,700
Liability (coverage for JPA)	Y	100%	$ 5,700	0%	$ -	0%	$ -	0%	$ -	100%	$ 5,700	$ 5,700
Professional liability (coverage for JPA)	Y	100%	$ 8,500	0%	$ -	0%	$ -	0%	$ -	100%	$ 8,500	$ 8,500
Fire and Renter's Insurance (2 offices)	Y	50%	$ 5,000	0%	$ -	0%	$ -	0%	$ -	100%	$ 5,000	$ 5,000
Vehicle Insurance (x vehicles)	Y	50%	$ 10,500	75%	$ 7,875	0%	$ -	17%	$ 1,750	8%	$ 875	$ 10,500
Insurance Total			**$ 35,400**		**$ 7,875**		**$ -**		**$ 1,750**		**$ 20,075**	**$ 35,400**
Office Space and Utilities												
JPA - Lease cost (1 offices starts in 2016)	Y	50%	$ 6,250	0%	$ -	0%	$ -	0%	$ -	100%	$ 6,250	$ 6,250
UC- Lease cost (1 office)	Y	50%	$ 5,625	0%	$ -	0%	$ -	100%	$ 5,625	0%	$ -	$ 5,625
Propane (1 office)	Y	100%	$ 1,500	0%	$ -	0%	$ -	0%	$ -	100%	$ 1,500	$ 1,500
Electrictiy (1 office)	Y	100%	$ 750	0%	$ -	0%	$ -	0%	$ -	100%	$ 750	$ 750
Water (1 office)	Y	100%	$ 400	0%	$ -	0%	$ -	0%	$ -	100%	$ 400	$ 400
Waste Management Services (30 yard dumpster) (1 office)	Y	100%	$ 929	0%	$ -	0%	$ -	0%	$ -	100%	$ 929	$ 929
Janitorial (1 office)	Y	100%	$ 10,400	0%	$ -	0%	$ -	100%	$ 10,400	0%	$ -	$ 10,400
Office Space Total			**$ 25,854**		**$ -**		**$ -**		**$ 16,025**		**$ 9,829**	**$ 25,854**
General Office Equipment												
Office/Cubicle furniture - 6 cubicles, replaced every 20 years	Y	50%	$ 250	0%	$ -	0%	$ -	40%	$ 100	60%	$ 150	$ 250
Office supplies	Y	50%	$ 1,156	64%	$ 740	22%	$ 254	0%	$ -	14%	$ 162	$ 1,156
Office supplies UC	Y	50%	$ 600	0%	$ -	0%	$ -	100%	$ 600	0%	$ -	$ 600
Computers - 1 per cubicle, replaced every 5 years	Y	50%	$ 750	0%	$ -	0%	$ -	0%	$ -	100%	$ 750	$ 750
UC-Computers - 1 per cubicle, replaced every 5 years				0%		0%		100%				
Software (Microsoft Office Suite) per computer, updated every 5 years	Y	50%	$ 1,140	0%	$ -	0%	$ -	0%	$ -	100%	$ 1,140	$ 1,140
UC-Software (Microsoft Office Suite) per computer, updated every 5 years								100%				
Office Phone Service (7 phones)	Y	50%	$ 60	0%	$ -	0%	$ -	0%	$ -	100%	$ 60	$ 60
UC office phones								100%				
Cell Phone Service (4 cell phones)	Y	50%	$ 100	50%	$ 50	0%	$ -	0%	$ -	50%	$ 50	$ 100
UC cell phones												
Copy machine (lease) (1)	Y	50%	$ 1,750	0%	$ -	0%	$ -	0%	$ -	100%	$ 1,750	$ 1,750
UC/NRS copy machine								100%				
Fax Machine (1 machines replaced every 5 years)	Y	50%	$ 50	0%	$ -	0%	$ -	0%	$ -	100%	$ 50	$ 50
Printers (2 printers replaced every 5 years)	Y	50%	$ 200	0%	$ -	0%	$ -	50%	$ 100	50%	$ 100	$ 200
General Office Equipment Total			**$ 6,056**		**$ 790**		**$ 254**		**$ 800**		**$ 4,212**	**$ 6,056**
GIS and Database Equipment												
GIS/ Database servers & service contract (1 replaced every 5yrs)	Y	100%	$ 1,500	0%	$ -	0%	$ -	0%	$ -	100%	$ 1,500	$ 1,500
UC GIS Lab access	Y	100%	$ 500	0%	$ -	0%	$ -	100%	$ 500	0%	$ -	$ 500
Plotters (1 replaced every 8 yrs)	Y	100%	$ 170	0%	$ -	0%	$ -	0%	$ -	100%	$ 170	$ 170
Plotter ink and paper	Y	100%	$ 2,400	0%	$ -	0%	$ -	0%	$ -	100%	$ 2,400	$ 2,400
GIS and statistics software (1 updated every 5 yrs)	Y	100%	$ 1,600	100%	$ 1,600	0%	$ -	0%	$ -	0%	$ -	$ 1,600
Tablet PCs (2 replaced every 5 yrs)	Y	100%	$ 800	0%	$ -	0%	$ -	0%	$ -	0%	$ -	$ -
GIS and Database Equipment Total			**$ 6,970**		**$ 1,600**		**$ -**		**$ 500**		**$ 4,070**	**$ 6,170**
Vehicles and Fuel												
4-wheel drive SUV (non LE)	Y	50%	$ 10,800	75%	$ 8,100	0%	$ -	0%	$ -	25%	$ 2,700	$ 10,800
4-wheel drive SUV (LE)	Y	50%	$ 3,100	100%	$ 3,100	0%	$ -	0%	$ -	0%	$ -	$ 3,100
4-wheel drive SUV (LE) (begins in year 20)	N	0%	$ -	100%	$ -	0%	$ -	0%	$ -	0%	$ -	$ -
4-wheel drive SUV (non LE) (begins in year 20)	N	0%	$ -	100%	$ -	0%	$ -	0%	$ -	0%	$ -	$ -
4-wheel drive utility trucks	Y	50%	$ 10,300	100%	$ 10,300	0%	$ -	0%	$ -	0%	$ -	$ 10,300
4-wheel drive trucks	Y	50%	$ 12,200	75%	$ 9,150	0%	$ -	25%	$ 3,050	0%	$ -	$ 12,200
4-wheel drive crew truck	Y	50%	$ 5,150	100%	$ 5,150	0%	$ -	0%	$ -	0%	$ -	$ 5,150
Vehicle Total			**$ 41,550**		**$ 35,800**		**$ -**		**$ 3,050**		**$ 2,700**	**$ 41,550**
Staff Training												
Training	N	0%	$ -	56%	$ -	20%	$ -	11%	$ -	13%	$ -	$ -
Training Total			**$ -**		**$ -**		**$ -**		**$ -**		**$ -**	**$ -**
Legal and Financial Assistance												
Legal assistance	N	0%	$ -	0%	$ -	0%	$ -	0%	$ -	100%	$ -	$ -
Financial analysis assistance	N	0%	$ -	0%	$ -	0%	$ -	0%	$ -	100%	$ -	$ -
Legal and Financial Assistance Total			**$ -**		**$ -**		**$ -**		**$ -**		**$ -**	**$ -**
Education/ Outreach/ Public Relations												
Publications	Y	0%	$ -	0%	$ -	0%	$ -	0%	$ -	100%	$ -	$ -
Education/ Outreach/ Public Relations Total			**$ -**		**$ -**		**$ -**		**$ -**		**$ -**	**$ -**
Totals												
Operational Costs												
Start-up (O) Year 0-1												
Years 1-20 (O)												
Years 21-50 (O+O3)												
Post-permit term (O+O3)			$ 284,590		$ 87,341		$ 9,996		$ 20,825		$ 166,429	$ 284,590
Capital costs												
Start-up © Year 0-1												
Years 1-50 (C)												
Post-permit term			$ 13,026		$ 2,390		$ 254		$ 1,300		$ 8,282	$ 12,226
Total												
Start-up												
Years 1-20												
Years 21-50												
Post-permit term			$ 297,617		$ 89,731		$ 10,250		$ 22,125		$ 174,711	$ 296,817
Total	**$ -**		**$ 297,617**		**$ 89,731**		**$ 10,250**		**$ 22,125**		**$ 169,011**	**$ 296,817**
TOTAL ARMY MEC-related costs	**$ -**		**$ -**		**$ -**		**$ -**		**$ -**		**$ -**	**$ -**

Table N-5a. Habitat Restoration Costs

Cost Item	Permit term Base-wide Costs										
	Assumptions	Unit	Avg. Cost /Unit	Total Acres Restored over Permit Term	# of Units per Year	Avg Annual Cost	% of total	20 Year Cost	C/O	Post-Permit Term	Sources
Staff Costs (See Table N-1)											
Labor-BLM	1	see table N-3				$ 52,534	12%	$ 1,050,679	O12	N	
Labor SP		see table N-3				$ 104,054	23%	$ 1,040,538	O1		
Benefits-SP	2,89	per employee				$ 26,013	6%	$ 260,134	O1	N	
Staff Costs Total						***$ 182,601***	***41%***	***$ 2,351,351***			
Restoration Costs by Community Type	**see subtable, 35**										
Maritime chapparal/ Coastal Scrub		acres	$17,500	21	1.05	$ 18,375	4%	$367,500	C12	N	SCV HCP
Maritime chapparal/ Coastal Scrub- BLM	occurs annually for 1st 20 years	per year	$23,420	150	7.5	$ 23,420	5%	$468,400	C12	N	
Coastal strand and dune		acres	$6,833	250	25.0	$ 170,820	39%	$1,708,200	C1	N	SP
Coast live oak woodland and savannah	36	acres	$41,500	10	0.5	$ 20,750	5%	$415,000	C12	N	
Riparian	37	acres	$53,300	2.5	0.125	$ 6,663	2%	$133,250	C12	N	
Wetland and Open Water	38	acres	$127,500	2.5	0.125	$ 15,938	4%	$318,750	C12	N	
Restoration Total						***$ 255,965***	***58%***	***$3,411,100***			
Environmental Compliance	**See subtable, 32,33**										
Small/simple	34a, 93	1 small project	$10,500		0.05	$ 525	0%	$10,500	C12	N	
Medium/more complex	34b, 93	1 medium project	$29,000		0.05	$ 1,450	0%	$29,000	C12	N	
Large/most complex	34b, 93	1 large project	$49,000		0.05	$ 2,450	1%	$49,000	C12	N	
Environmental Compliance Total						***$ 4,425***	*1%*	***$ 88,500***			
TOTALS						**$ 442,991**	**100%**	**$ 5,850,951**			

*BLM and UC restoration assumed to take place within first 20 years of permit term

Table N-5a. Habitat Restoration Costs

Cost Item	Permit term Costs by Management Entity								
	BLM	BLM	SP	SP	UC/NRS	UC/NRS	JPA	JPA	Total
Staff Costs (See Table N-1)	%	cost	%	cost	%	cost	%	cost	Avg. Annual Cost
Labor-BLM		$ 52,534				$ -		$ -	$ 52,534
Labor SP				$ 104,054					$ 104,054
Benefits-SP			25%	$ 26,013					$ 26,013
Staff Costs Total		***$ 52,534***	***$ 0.25***	***$ 130,067***	***$ -***	***$ -***	***$ -***	***$ -***	***$ 182,601***
Restoration Costs by Community Type									
Maritime chapparal/ Coastal Scrub	0%	$ -	0%	$ -	71%	$ 13,125	29%	$5,250	$ 18,375
Maritime chapparal/ Coastal Scrub- BLM	100%	$ 23,420	0%	$ -		$ -		$ -	$ 23,420
Coastal strand and dune	0%	$ -	100%	$ 170,820		$ -		$ -	$ 170,820
Coast live oak woodland and savannah	100%	$ 20,750	0%	$ -		$ -		$ -	$ 20,750
Riparian	100%	$ 6,663	0%	$ -		$ -		$ -	$ 6,663
Wetland and Open Water	100%	$ 15,938	0%	$ -		$ -		$ -	$ 15,938
Restoration Total		***$ 66,770***		***$ 170,820***		***$ 13,125***		***$ 5,250***	***$ 255,965***
Environmental Compliance									
Small/simple	0%	$ -	0%	$ -	0%	$ -	100%	$ 525	$ 525
Medium/more complex	0%	$ -	0%	$ -	0%	$ -	100%	$ 1,450	$ 1,450
Large/most complex	0%	$ -	0%	$ -	0%	$ -	100%	$ 2,450	$ 2,450
Environmental Compliance Total		***$ -***		***$ -***		***$ -***		***$ 4,425***	***$ 4,425***
TOTALS		**$ 119,304**		**$ 300,887**		**$ 13,125**		**$ 9,675**	**$ 442,991**

*BLM and UC restoration assumed to take |

Table N-5b. Detailed Restoration costs

Restoration Cost Category	Maritime chaparral/ Coastal Scrub	Coastal strand and dune	Coast live oak woodland and savannah	Grassland	Riparian	Wetland and Open Water
Unit	*Acre*	*Acre*	*Acre*	*Acre*	*Acre*	*Acre*
Design	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
Plans, specifications, and engineering	$2,500	$833	$6,250	$0	$7,400	$18,000
Construction bid assistance	$300	$300	$300	$0	$300	$300
Pre-construction surveys	$200	$200	$200	$200	$200	$200
Construction (equipment + labor)	$10,000	$3,333	$25,000	$1,900	$37,000	$90,000
Construction oversight & monitoring	$500	$167	$1,250	$95	$1,850	$4,500
Post-construction monitoring and maintenance	$3,000	$1,000	$7,500	$570	$5,550	$13,500
Remedial measures	$1,500	$500	$3,750	$285	$5,550	$13,500
Total per acre cost	**$17,500**	**$6,833**	**$41,500**	**$3,765**	**$53,300**	**$127,500**
Assumptions/ Source	BLM	SP	SCV HCP/NCCP		37	38

25%	Plans, specifications, and engineering as percent of construction cost for non-aquatic restoration
20%	Plans, specifications, and engineering as percent of construction cost for riparian, wetland, and open water restoration.
5%	Construction oversight and monitoring as percent of construction cost
30%	Post-construction monitoring and maintenance as percent of construction cost for non-aquatic restoration
15%	Post-construction monitoring as percent of construction cost for riparian, wetland, and open water restoration
15%	Percent of construction costs needed for remedial measures

Table N-5c. Restoration Acreage Assumptions

Community Type	BLM NRMA (acres)	SP FODSP(acres)	UC/NRS FONR* (acres)	MOCOLF*** (acres)	City of Marina Airport Habitat Reserve (acres)	Monterey Peninsula College—Range 45 Reserve** (acres)	Total
Maritime chapparal/ Coastal Scrub	150		6	8		7	**171**
Coastal strand and dune		250					**250**
Coast live oak woodland and savannah	10						**10**
Grassland			0		0		**0**
Riparian	2.5						**2.5**
Wetland and Open Water	2.5						**2.5**
Total	**165**	**250**	**6**	**8**	**0**	**7**	**436**
	0.951834862						

*Estimate of the total size of the UC Corridor Reserve parcel, all of which is assumed to be restored to sand hill maritime chaparral.

**MPC Range 45 restoration acres estimated based on 10% of the total size of the Reserve (202 acres)

***Landfill will not be turned over until remediated by Army. This delays the cost to later in the permit term

Table N-5d. Average Cost Per Project By Size and Compliance Categories

Project size	Acreage Range	NEPA/CEQA	CWA 404/401	NHPA	CDFG 1602	Other	Total
Small/simple	1.0-10.0	$ 2,000	$ 2,500	$ 2,000	$ 2,000	$ 2,000	$ 10,500
Medium/more complex	10.1-20.0	$ 10,000	$ 7,500	$ 3,000	$ 3,500	$ 5,000	$ 29,000
Large/most complex	>20.1	$ 20,000	$ 10,000	$ 5,000	$ 4,000	$ 10,000	$ 49,000

Table N-6a. HMA Management and Maintenance Costs

Cost Item		Permit Term Base-wide Cost								
	Assumptions	Unit	# of units	replacement rate (every X yrs)	$/Unit	Units/ Yr	Avg Annual Cost	Total Permit term cost	C/O	Sources
Staff Costs										
Full Time Labor (x positions, w/ x time dedicated to HCP tas	1	Table 9-5					$ 1,448,912	$ 72,445,588	O	
Benefits full time (25% JPA; 35% for UC)	2	per employee					$ 64,464	$ 3,223,222	O	
Contracted Labor for JPA maintained HMAs (3 laborers)	91	per acre			$ 65,000.00	3	$ 195,000	$ 9,750,000	O	
Staff Costs Total							**$ 1,708,376**	**$ 75,668,809**		
Planning										
Resource Management Plans (1 plan updated every 10 yrs)	39	per plan	1	10	$ 50,000	0.1	$ 5,000	$ 50,000	C	JSA
Planning Total							**$ 5,000**	**$ 50,000**		
Environmental Compliance										
Small/simple	34a	1 small project			$ 10,500	0.25	$ 2,625	$ 131,250	C	
Medium/more complex	34b	1 medium project			$ 29,000	0.1	$ 2,900	$ 145,000	C	
Large/most complex	34c	1 large project			$ 49,000	0.1	$ 4,900	$ 245,000	C	
Environmental Compliance Total							**$ 10,425**	**$ 521,250**		
Field Tools and Equipment										
UC Mule (1 replaced every 7 years) (init. $7,700)		ATV	1	7	$ 7,700	0.14	$ 1,100	$ 55,000	C	
GPS units (4 replaced every five years)	21	GPS unit	4	5	$ 5,240	0.8	$ 4,192	$ 209,600	C	JSA
GPS units (1 replaced every 3 years) - UC		GPS unit	1	3	$ 300	0.333333	$ 100	$ 5,000	C	
Hand held radios (4 replaced every 3 years)	41	radio	4	3	$ 250	1.333333	$ 333	$ 16,667	C	JSA
Digital cameras (4 replaced every 5 years)	42	camera	4	5	$ 300	0.8	$ 240	$ 12,000	C	JSA
Protective clothing/ safety gear (adjust for UC)	43	set	16	1	$ 35	16	$ 560	$ 28,000	C	JSA
UC Protective clothing/ safery gear (annual replacement)		set	4	1	$ 35	4	$ 140	$ 7,000	C	UC/NRS
UC Protective clothing/ safery gear (replace every 5 yr)		set	2	5	$ 200	0.4	$ 80	$ 4,000	C	UC/NRS
Miscellaneous field materials	44	set	1	1	$ 300	1	$ 300	$ 15,000	C	JSA
Field Tools and Equipment Total							**$ 7,045**	**$ 352,267**		
Heavy Equipment										
Dump truck (45%)	45	machine	1	1	$ 6,500	1	$ 6,500	$ 325,000	C	BLM
Grader (45%)	45	machine	1	1	$ 7,700	1	$ 7,700	$ 385,000	C	BLM
Backhoe (45%)	45	machine	1	1	$ 3,300	1	$ 3,300	$ 165,000	C	BLM
Loader (45%)	45	machine	1	1	$ 4,300	1	$ 4,300	$ 215,000	C	BLM
ASV (45%) - MEC program related	45	machine	1	1	$ 4,900	1	$ 4,900	$ 245,000	C	BLM
Sweco (45%)	45	machine	1	1	$ 4,900	1	$ 4,900	$ 245,000	C	BLM
Talbert Trailer (45%)	45	machine	1	1	$ 2,200	1	$ 2,200	$ 110,000	C	BLM
Massey Fergusen Tractor (100%) ($55,000 initial C cost for	45	machine	2	1	$ 3,150	2	$ 6,300	$ 315,000	C	BLM
D6R (45%)	45	machine	1	1	$ 8,700	1	$ 8,700	$ 435,000	C	BLM
3 axle Transport (45%)	45	machine	1	1	$ 6,200	1	$ 6,200	$ 310,000	C	BLM
1600 gal Water truck (45%)	45	machine	1	1	$ 3,800	1	$ 3,800	$ 190,000	C	BLM
3,600 gal Water Truck (45%)	45	machine	1	1	$ 6,500	1	$ 6,500	$ 325,000	C	BLM
Excavator (25%)	45	machine	1	1	$ 3,675.00	1	$ 3,675	$ 183,750.00	O	BLM
Mower (rear-mounted for tractor)	46, 90	mower	2	5	$ 3,500	0.4	$ 1,400	$ 70,000	C	
UC front loader w/ bucket (1 replaced every 15 years)		machine	1	15	$ 9,000	0.07	$ 600	$ 30,000	C	
UC tractor blade (1 replaced every 15 years)		machine	1	15	$ 3,000	0.07	$ 200	$ 10,000	C	
UC tractor trailer		machine	1	1	$ 700	1	$ 700	$ 35,000	C	
Equipment maintenance	47	maintenance	1	1	$ 6,933	1	$ 6,933	$ 346,625	O	
UC Equipment maintenance		maintenance	1	1	$ 500	1	$ 500	$ 25,000	O	
UC other equipment (field tools, compressors etc.)		set	1	1	$ 500	1	$ 500	$ 25,000	C	
Heavy Equipment Total			**18**				**$ 79,808**	**$ 3,940,375**		
Prescribed Burning (see sub tables)										
BLM-Plan preparation	48,49	plan	32	30	$ 4,000	1.1	$ 4,267	$ 128,000	O3	JSA
BLM-Air quality monitoring	50,49	A.Q. monitoring	32	30	$ 1,308	1.1	$ 1,395	$ 41,856	O3	Monterey Bay Unified Air Pollution Control District
BLM-Public Noticing		Noticing	32	30	$ 200	1.1	$ 213	$ 6,400	O3	JSA
BLM-Maritime chapparal/ Coastal scrub	51,52,49	Acre	3150	30	$ 807	105	$ 84,756	$ 2,542,680	O3	BLM
BLM-Coast live oak woodland and savannah	51, 52	Acre	3255	30	$ 807	109	$ 87,581	$ 2,627,436	O3	BLM
UC-Plan preparation	48,49	plan	1	2	$ 4,000	0.5	$ 2,000	$ 4,000	O-30	JSA
UC-Air quality monitoring	50,49	A.Q. monitoring	1	1	$ 1,308	1.0	$ 1,308	$ 1,308	O-30	Monterey Bay Unified Air Pollution Control District
UC-Public Noticing		Noticing	1	1	$ 200	1.0	$ 200	$ 200	O-30	JSA
UC-Maritime chapparal/ Coastal scrub	51,52,49	Acre	200	1	$ 807	200	$ 161,440	$ 161,440	O-30	BLM
UC-Plan preparation	48,49	plan	1	1	$ 4,000	1.0	$ 4,000	$ 4,000	O-40	JSA
UC-Air quality monitoring	50,49	A.Q. monitoring	1	1	$ 1,308	1.0	$ 1,308	$ 1,308	O-40	Monterey Bay Unified Air Pollution Control District
UC-Public Noticing		Noticing	1	1	$ 200	1.0	$ 200	$ 200	O-40	JSA
UC-Maritime chapparal/ Coastal scrub	51,52,49	Acre	400	1	$ 807	400	$ 322,880	$ 322,880	O-40	BLM
Prescribed Burn Total							**$ 671,548**	**$ 5,841,708**		
Other Vegetation Management										
Herbicides / spray equipment	53, 54	equipment	1	1	$ 3,798	1.0	$ 3,798	$ 189,890	C	BLM
UC Herbicides		equipment	1	1	$ 300	1.0	$ 300	$ 15,000	C	
UC spray equipment (2 sets replaced every 4 years)		equipment	2	4	$ 100	0.5	$ 50	$ 2,500	C	
Hand Tools (i.e. shovels, pulaskis, etc)	54	equipment	1	4	$ 1,260	0.3	$ 315	$ 15,750	C	C
UC Hand Tools		equipment	1	5	$ 400	0.2	$ 80	$ 4,000	C	
Power Tools (i.e. chainsaws, weed eaters, etc)	54	equipment	1	4	$ 3,150	0.3	$ 788	$ 39,375	C	
UC Power Tools (already has, not initial capital cost		equipment	1	5	$ 2,000	0.2	$ 400	$ 20,000	C	
Grazing (goats)	55	acres	13.388	1	$ 500	13.4	$ 6,694	$ 334,700	O	Intensive Grazing Project (A. Johnson, pers comm)
Other Vegetation Management Total							**$ 12,424**	**$ 621,215**		**$ -**
Feral Animal Control										
Feral pig eradication	56	annual eradication	1	1	$ 6,502	1.0	$ 6,502	$ 325,100	C	BLM (Bruce Delgado)
pond draining (bullfrogs and non-native fish)		acre	5	1	$ 300	5.0	$ 1,500	$ 75,000	O	
Feral Animal Control Total							**$ 8,002**	**$ 400,100**		**$ -**
Erosion control										
Equipment rental	85	per rental	28	1	$ 1,081	28.0	$ 30,268	$ 1,513,400	O	CNLM (1999 PAR)
Hydromulch	86	per acre	373.6	10	$ 2,161	37.4	$ 80,735	$ 4,036,748	O	CNLM (1999 PAR)
Seeds and seedlings	57, 84	per acre	1.3	1	$ 6,000	1.3	$ 7,812	$ 390,600	C	
Erosion control Total							**$ 118,815**	**$ 5,940,748**		**$ -**
Other Habitat Enhancement	58									
Coastal strand and dune maintenance- protect and manage beaches, bluffs, blowouts		per acre	800	1	$ 100	800.0	$ 80,000	$ 4,000,000	O	State Parks
snowy plover predator control		per year	1	1	$ 20,000	1.0	$ 20,000	$ 1,000,000	O	State Parks
snowy plover symbolic fencing										
6-foot steel thimbleye anchor rods (from Graybar Electric) evey 15ft replaced every 5 years)		per anchor rod	1408	5	$ 15	282	$ 4,224	$ 211,200	C	A. Palkovic (SP)
¼" aircraft cable or wire rope coated with plastic (from Carpenter Rigging of San Jose) replaced every 3 years)		per foot	21,120	3	$ 0.32	7,040	$ 2,253	$ 112,640	C	A. Palkovic (SP)
post pounder		per item	2	7	$ 80.00	0.3	$ 23	$ 1,143	C	A. Palkovic (SP)
cable cutter		per item	2	7	$ 150.00	0.3	$ 43	$ 2,143	C	A. Palkovic (SP)
hand swager		per item	2	7	$ 200.00	0.3	$ 57	$ 2,857	C	A. Palkovic (SP)
Signs- small		per sign	704	3	$ 10	235	$ 2,347	$ 117,333	C	
Coast live oak woodland and savannah- plant seedlings	57, 87	per acre	1.3	1	$ 6,000	1.3	$ 7,812	$ 390,600	O	
Other Habitat Enhancement Total							**$ 116,758**	**$ 5,837,916**		**$ -**
Roads and Trails										
Dirt road maintenance (miles) (110 BLM + 20 all others)	59, 82	per mile	130	1	$ 1,000	130	$ 130,000	$ 6,500,000	O	State Parks
Trail construction (start-up cost) (10 miles of trails)		per foot	52,800	1	$ 3	52,800		$ -	C	SCC Parks
Trail maintenance (10 miles JPA + 75 miles BLM)	61, 82	per foot	448,800	1	$ 0.14	448,800	$ 63,730	$ 3,186,480	O	
Roads and Trails Total							**$ 193,730**	**$ 9,686,480**		**$ -**
Access Control (see subtable)										
New fence installation (start up cost)		per linear foot	30280	1	$ 11	30,280		$ -	C	BLM, FOR A
New fence posts (start up cost)	62	per post	3028	1	$ 7	3,028		$ -	C	
Fence repair/ replacement	63, 92	per linear foot	1,937.6	1	$ 4	1,938	$ 7,750	$ 387,520	O	BLM
Repair, replacement, and installation of gates	88	per gate	76	1	$ 211	76	$ 321	$ 16,069	O	CNLM (2004 PAR)
Locks (MasterLock)		per lock	76	1	$ 29	76	$ 88	$ 4,408	C	CNLM (1999 PAR)
Signs- small		per sign	105	10	$ 10	11	$ 105	$ 5,250	C	CNLM (1999 PAR)
UC signs			106	10	$ 10	11	$ 106	$ 5,300	C	CNLM (1999 PAR)
Access Control Total							**$ 8,265**	**$ 413,247**		**$ -**
Field Facilities										
Field storage facilities (Capital Start up)	see subtable	per facility	1	1	$ 100,000	1	$ -		C	
Facilities utilities, maintenance, and repair	64	per facility	3	1	$ 5,000	3	$ 15,000	$ 750,000	O	
Facilities utilities, maintenance, and repair - UC		per facility	1	1	$ 1,000	1	$ 1,000	$ 50,000	O	
Field Facilities Total							**$ 15,000**	**$ 750,000**		**$ -**
Totals										
Operational Costs										
Start-up (O)							$ -			
Years 1-20 (O)							$ 2,164,294	**$ 43,285,880**		
Years 21-50 (O+O3)							$ 2,342,506	**$ 70,275,193**		
Post-permit term (O+O3)							$ 2,331,157			
Capital costs										
Start-up (C)										
Years 1-10 (C1 + C)							$ 240,920	**$ 2,409,202**		
Years 11-50 (C)							$ 120,460	**$ 4,818,405**		
Post-permit term							$ 107,674			
Total										
Start-up										
Year 1-10							$ 2,405,214	**$ 24,052,143**		
Years 11-20							$ 2,284,754	**$ 22,847,541**		
Years 21-50							$ 2,462,967	**$ 14,416,419**		
Post-permit term							$ 2,438,831			
Total								**$ 61,316,103**		
TOTALS							**$ 2,955,197**	**$ 110,024,115**		**$ -**

Table N-6a. HMA Management and Maintenance Costs

Cost Item	Permit Term Costs by Management Entity										
	BLM %	BLM cost ($)	SP %	SP cost ($)	UC/ NRS %	UC/NRS cost ($)	JPA %	JPA cost ($)	Total Avg. Annual Cost ($)	Percentage check	Notes
Staff Costs											
Full Time Labor (x positions, w/ x time dedicated to HCP tas		$ 1,230,654		$ 119,258		$ 99,000		$ -	$ 1,448,912	0%	
Benefits full time (25% JPA; 35% for UC)		$ -	25%	$ 29,814	35%	$ 34,650	25%	$ -	$ 64,464	85%	25% of employee salary
Contracted Labor for JPA maintained HMAs (3 laborers)		$ -					100%	$ 195,000	$ 195,000	100%	
Staff Costs Total		**$ 1,230,654**		**$ 149,072**		**$ 133,650**		**$ 195,000**	**$ 1,708,376**	0%	
Planning											
Resource Management Plans (1 plan updated every 10 yrs)	0%	$ -	0%	$ -	0%	$ -	100%	$ 5,000	$ 5,000	100%	
Planning Total		**$ -**		**$ -**		**$ -**		**$ 5,000**	**$ 5,000**	0%	
Environmental Compliance											
Small/simple	0%	$ -	0%	$ -	0%	$ -	100%	$ 2,625	$ 2,625	100%	UC = 0
Medium/more complex	0%	$ -	0%	$ -	0%	$ -	100%	$ 2,900	$ 2,900	100%	
Large/most complex	0%	$ -	0%	$ -	50%	$ 2,450	50%	$ 2,450	$ 4,900	100%	UC= 2
Environmental Compliance Total		**$ -**		**$ -**		**$ 2,450**		**$ 7,975**	**$ 10,425**	100%	
Field Tools and Equipment											
UC Mule (1 replaced every 7 years) (init. $7,700)	0%	$ -	0%	$ -	100%	$ 1,100	0%	$ -	$ 1,100	100%	
GPS units (4 replaced every five years)	0.33	$ 1,397	0.17	$ 699	0%	$ -	0.33	$ 1,397	$ 3,493	83%	
GPS units (1 replaced every 3 years) - UC					100%	$ 100			$ 100	100%	
Hand held radios (4 replaced every 3 years)	100%	$ 333	0%	$ -		$ -		$ -	$ 333	100%	
Digital cameras (4 replaced every 5 years)	50%	$ 120	0%	$ -	25%	$ 60	25%	$ 60	$ 240	100%	
Protective clothing/ safety gear (adjust for UC)	86%	$ 481	85%	$ 476		$ -	0%	$ -	$ 957	171%	
UC Protective clothing/ safery gear (annual replacement)	0%	$ -	0%	$ -	100%	$ 140	0%	$ -	$ 140	100%	
UC Protective clothing/ safery gear (replace every 5 yr)	0%	$ -	0%	$ -	100%	$ 80	0%	$ -	$ 80	100%	
Miscellaneous field materials	0%	$ -	0%	$ -	100%	$ 300	0%	$ -	$ 300	100%	
Field Tools and Equipment Total		**$ 2,332**		**$ 1,175**		**$ 1,780**		**$ 1,457**	**$ 6,744**		
Heavy Equipment											
Dump truck (45%)	100%	$ 6,500	0%	$ -	0%	$ -	0%	$ -	$ 6,500	100%	
Grader (45%)	100%	$ 7,700	0%	$ -	0%	$ -	0%	$ -	$ 7,700	100%	
Backhoe (45%)	100%	$ 3,300	0%	$ -	0%	$ -	0%	$ -	$ 3,300	100%	
Loader (45%)	100%	$ 4,300	0%	$ -	0%	$ -	0%	$ -	$ 4,300	100%	
ASV (45%) - MEC program related	100%	$ 4,900	0%	$ -	0%	$ -	0%	$ -	$ 4,900	100%	
Sweco (45%)	100%	$ 4,900	0%	$ -	0%	$ -	0%	$ -	$ 4,900	100%	
Talbert Trailer (45%)	100%	$ 2,200	0%	$ -	0%	$ -	0%	$ -	$ 2,200	100%	
Massey Fergusen Tractor (100%) ($55,000 initial C cost for	50%	$ 3,150	0%	$ -	50%	$ 3,150	0%	$ -	$ 6,300	100%	
D6R (45%)	100%	$ 8,700	0%	$ -	0%	$ -	0%	$ -	$ 8,700	100%	
3 axle Transport (45%)	100%	$ 6,200	0%	$ -	0%	$ -	0%	$ -	$ 6,200	100%	
1600 gal Water truck (45%)	100%	$ 3,800	0%	$ -	0%	$ -	0%	$ -	$ 3,800	100%	
3,600 gal Water Truck (45%)	100%	$ 6,500	0%	$ -	0%	$ -	0%	$ -	$ 6,500	100%	
Excavator (25%)	100%	$ 3,675	0%	$ -	0%	$ -	0%	$ -	$ 3,675	100%	
Mower (rear-mounted for tractor)	50%	$ 700	0%	$ -	50%	$ 700	0%	$ -	$ 1,400	100%	
UC front loader w/ bucket (1 replaced every 15 years)	0%	$ -	0%	$ -	100%	$ 600	0%	$ -	$ 600	100%	
UC tractor blade (1 replaced every 15 years)	0%	$ -	0%	$ -	100%	$ 200	0%	$ -	$ 200	100%	
UC tractor trailer	0%	$ -	0%		100%	$ 700	0%	$ -	$ 700	100%	
Equipment maintenance	100%	$ 6,933	0%	$ -	0%	$ -	0%	$ -	$ 6,933	100%	
UC Equipment maintenance	0%	$ -	0%	$ -	100%	$ 500	0%	$ -	$ 500	100%	
UC other equipment (field tools, compressors etc.)	0%	$ -	0%	$ -	100%	$ 500	0%	$ -	$ 500	100%	
Heavy Equipment Total		**$ 73,458**		**$ -**		**$ 6,350**		**$ -**	**$ 79,808**		
Prescribed Burning (see sub tables)											
BLM-Plan preparation	95%	$ 4,063	0%	$ -	0%	$ -	5%	$ 203	$ 4,267	100%	
BLM-Air quality monitoring	95%	$ 1,329	0%	$ -	0%	$ -	5%	$ 66	$ 1,395	100%	
BLM-Public Noticing	95%	$ 203	0%	$ -	0%	$ -	5%	$ 10	$ 213	100%	
BLM-Maritime chapparal/ Coastal scrub	95%	$ 80,720	0%	$ -	0%	$ -	5%	$ 4,036	$ 84,756	100%	
BLM-Coast live oak woodland and savannah	95%	$ 83,411	0%	$ -	0%	$ -	5%	$ 4,171	$ 87,581	100%	
UC-Plan preparation	0%	$ -	0%	$ -	100%	$ 2,000	0%	$ -	$ 2,000	100%	
UC-Air quality monitoring	0%	$ -	0%	$ -	100%	$ 1,308	0%	$ -	$ 1,308	100%	
UC-Public Noticing	0%	$ -	0%	$ -	100%	$ 200	0%	$ -	$ 200	100%	
UC-Maritime chapparal/ Coastal scrub	0%	$ -	0%	$ -	100%	$ 161,440	0%	$ -	$ 161,440	100%	
UC-Plan preparation	0%	$ -	0%	$ -	100%	$ 4,000	0%	$ -	$ 4,000	100%	
UC-Air quality monitoring	0%	$ -	0%	$ -	100%	$ 1,308	0%	$ -	$ 1,308	100%	
UC-Public Noticing	0%	$ -	0%	$ -	100%	$ 200	0%	$ -	$ 200	100%	
UC-Maritime chapparal/ Coastal scrub	0%	$ -	0%	$ -	100%	$ 322,880	0%	$ -	$ 322,880	100%	
Prescribed Burn Total		**$ 169,726**		**$ -**		**$ 164,948**		**$ 8,486**	**$ 343,160**		
Other Vegetation Management											
Herbicides / spray equipment	82%	$ 3,100	65%	$ 2,469	0%	$ -	13%	$ 490	$ 6,059	160%	
UC Herbicides	0%	$ -	0%	$ -	100%	$ 300	0%	$ -	$ 300	100%	
UC spray equipment (2 sets replaced every 4 years)	0%	$ -	0%	$ -	100%	$ 50	0%	$ -	$ 50	100%	
Hand Tools (i.e. shovels, pulaskis, etc)	79%	$ 249	63%	$ 198	3%	$ 10	12%	$ 39	$ 497	158%	
UC Hand Tools					100%	$ 80	0%	$ -	$ 80	100%	
Power Tools (i.e. chainsaws, weed eaters, etc)	79%	$ 622	20%	$ 158	3%	$ 26	12%	$ 98	$ 903	115%	
UC Power Tools (already has, not initial capital cost	0%	$ -	0%	$ -	100%	$ 400	0%	$ -	$ 400	100%	
Grazing (goats)	100%	$ 6,694	0%	$ -	0%	$ -	0%	$ -	$ 6,694	100%	
Other Vegetation Management Total		**$ 10,665**		**$ 2,825**		**$ 866**		**$ 628**	**$ 14,983**		
Feral Animal Control											
Feral pig eradication	100%	$ 6,502	0%	$ -	0%	$ -	0%	$ -	$ 6,502	100%	
pond draining (bullfrogs and non-native fish)	90%	$ 1,350	0%	$ -	0%	$ -	10%	$ 150	$ 1,500	100%	
Feral Animal Control Total		**$ 7,852**		**$ -**		**$ -**		**$ 150**	**$ 8,002**		
Erosion control											
Equipment rental	0%	$ -	0%	$ -	0%	$ -	100%	$ 30,268	$ 30,268	100%	
Hydromulch	82%	$ 65,901	0%	$ -	0%	$ -	13%	$ 10,427	$ 76,327	95%	
Seeds and seedlings	82%	$ 6,377	12%	$ 937	0%	$ -	13%	$ 1,009	$ 8,323	107%	
Erosion control Total		**$ 72,277**		**$ 937**		**$ -**		**$ 41,704**	**$ 114,918**		
Other Habitat Enhancement											
Coastal strand and dune maintenance- protect and manage beaches, bluffs, blowouts	0%	$ -	100%	$ 80,000	0%	$ -	0%	$ -	$ 80,000	100%	
snowy plover predator control	0%	$ -	100%	$ 20,000	0%	$ -	0%	$ -	$ 20,000	100%	
snowy plover symbolic fencing											
6-foot steel thimbleye anchor rods (from Graybar Electric) evey 15ft replaced every 5 years)	0%	$ -	45%	$ 1,901		$ -	0%	$ -	$ 1,901	45%	
¼" aircraft cable or wire rope coated with plastic (from Carpenter Rigging of San Jose) replaced every 3 years)	0%	$ -	45%	$ 1,014	0%	$ -	0%	$ -	$ 1,014	45%	
post pounder	0%	$ -	100%	$ 23	0%	$ -	0%	$ -	$ 23	100%	
cable cutter	0%	$ -	100%	$ 43	0%	$ -	0%	$ -	$ 43	100%	
hand swager	0%	$ -	100%	$ 57	0%	$ -	0%	$ -	$ 57	100%	
Signs- small	0%	$ -	42%	$ 986	0%	$ -	0%	$ -	$ 986	42%	
Coast live oak woodland and savannah- plant seedlings	86%	$ 6,745	0%	$ -	0%	$ -	14%	$ 1,067	$ 7,812	100%	
Other Habitat Enhancement Total		**$ 6,745**		**$ 104,023**		**$ -**		**$ 1,067**	**$ 111,835**		
Roads and Trails											
Dirt road maintenance (miles) (110 BLM + 20 all others)	85%	$ 110,000	0%	$ -	0%	$ -	11%	$ 14,058	$ 124,058	95%	
Trail construction (start-up cost) (10 miles of trails)	0%	$ -	0%	$ -	0%	$ -	100%	$ -	$ -	100%	
Trail maintenance (10 miles JPA + 75 miles BLM)	88%	$ 56,232		$ -	0%	$ -	12%	$ 7,498	$ 63,730	100%	
Roads and Trails Total		**$ 166,232**		**$ -**		**$ -**		**$ 21,555**	**$ 187,787**	0%	
Access Control (see subtable)											
New fence installation (start up cost)	17%	$ -	0%	$ -	83%	$ -	0%	$ -	$ -	100%	
New fence posts (start up cost)	17%	$ -	0%	$ -	83%	$ -	0%	$ -	$ -	100%	
Fence repair/ replacement	46%	$ 3,590	0%	$ -	54%	$ 4,160	0%	$ -	$ 7,750	100%	
Repair, replacement, and installation of gates	0%	$ -	0%	$ -	50%	$ 161	50%	$ 161	$ 321	100%	
Locks (MasterLock)	0%	$ -	0%	$ -	50%	$ 44	50%	$ 44	$ 88	100%	
Signs- small	82%	$ 86	5%	$ 6	0%	$ -	13%	$ 14	$ 105	100%	
UC signs	0%	$ -	0%	$ -	100%	$ 106	0%	$ -	$ 106	100%	
Access Control Total		**$ 3,676**		**$ 6**		**$ 4,365**		**$ 218**	**$ 8,265**		
Field Facilities											
Field storage facilities (Capital Start up)	0%	$ -	0%	$ -	0%	$ -	0%	$ -	$ -	0%	
Facilities utilities, maintenance, and repair	0.33	$ 5,000	0.33	$ 5,000		$ -	0.33	$ 5,000	$ 15,000	100%	
Facilities utilities, maintenance, and repair - UC					100%	$ 1,000			$ 1,000	100%	
Field Facilities Total		**$ 5,000**		**$ 5,000**		**$ -**		**$ 5,000**	**$ 15,000**		
Totals											
Operational Costs											
Start-up (O)										#DIV/0!	
Years 1-20 (O)		$ 1,496,774		$ 254,072		$ 139,471		$ 263,628	**$ 2,153,944**	100%	
Years 21-50 (O+O3)		$ 1,666,500		$ 254,072		$ 139,471		$ 272,114	**$ 2,332,157**	100%	
Post-permit term (O+O3)										0%	
Capital costs											
Start-up (C)										#DIV/0!	
Years 1-10 (C1 + C)		$ 164,234		$ 17,931		$ 22,192		$ 32,254	**$ 236,611**	0%	
Years 11-50 (C)		$ 82,117		$ 8,965		$ 11,096		$ 16,127	**$ 118,305**	0%	
Post-permit term										0%	
Total											
Start-up										#DIV/0!	
Year 1-10		$ 1,661,007		$ 272,003		$ 161,663		$ 295,882	**$ 2,390,555**	99%	
Years 11-20		$ 1,578,890		$ 263,038		$ 150,567		$ 279,755	**$ 2,272,250**	99%	
Years 21-50		$ 1,748,616		$ 263,038		$ 150,567		$ 288,241	**$ 2,450,462**	99%	
Post-permit term										0%	
Total										#DIV/0!	
TOTALS		**$ 1,748,616**		**$ 263,038**		**$ 314,409**		**$ 288,241**	**$ 2,614,304**	88%	

Table N-6a. HMA Management and Maintenance Costs

Cost Item	Start up costs by Management Entity						
	Start up cost	BLM	SP	UC/NRS	JPA	Total start up costs	% check
	Y/N						
Staff Costs							
Full Time Labor (x positions, w/ x time dedicated to HCP tas	N					$ -	0%
Benefits full time (25% JPA; 35% for UC)	N					$ -	85%
Contracted Labor for JPA maintained HMAs (3 laborers)	N					$ -	100%
Staff Costs Total		**$ -**	**$ -**	**$ -**	**$ -**	$ -	
Planning							
Resource Management Plans (1 plan updated every 10 yrs)	Y				$ 50,000	$ 50,000	100%
Planning Total		**$ -**	**$ -**	**$ -**	**$ 50,000**	$ 50,000	
Environmental Compliance							
Small/simple	N					$ -	100%
Medium/more complex	N					$ -	100%
Large/most complex	N					$ -	100%
Environmental Compliance Total		**$ -**	**$ -**	**$ -**	**$ -**	$ -	
Field Tools and Equipment							
UC Mule (1 replaced every 7 years) (init. $7,700)	Y			$ 7,700		$ 7,700	100%
GPS units (4 replaced every five years)	Y					$ -	83%
GPS units (1 replaced every 3 years) - UC	Y			$ 300		$ 300	100%
Hand held radios (4 replaced every 3 years)	Y			$ 250		$ 250	100%
Digital cameras (4 replaced every 5 years)	Y			$ 300		$ 300	100%
Protective clothing/ safety gear (adjust for UC)	Y			$ 35		$ 35	171%
UC Protective clothing/ safery gear (annual replacement)	Y			$ 35		$ 35	100%
UC Protective clothing/ safery gear (replace every 5 yr)	Y			$ 200		$ 200	100%
Miscellaneous field materials	Y			$ 300		$ 300	100%
Field Tools and Equipment Total		**$ -**	**$ -**	**$ 9,120**	**$ -**	$ 9,120	
Heavy Equipment							
Dump truck (45%)	N					$ -	100%
Grader (45%)	N					$ -	100%
Backhoe (45%)	N					$ -	100%
Loader (45%)	N					$ -	100%
ASV (45%) - MEC program related	N					$ -	100%
Sweco (45%)	N					$ -	100%
Talbert Trailer (45%)	N					$ -	100%
Massey Fergusen Tractor (100%) ($55,000 initial C cost for	Y			$ 55,000		$ 55,000	100%
D6R (45%)	N					$ -	100%
3 axle Transport (45%)	N					$ -	100%
1600 gal Water truck (45%)	N					$ -	100%
3,600 gal Water Truck (45%)	N					$ -	100%
Excavator (25%)	N					$ -	100%
Mower (rear-mounted for tractor)	N					$ -	100%
UC front loader w/ bucket (1 replaced every 15 years)	Y			$ 9,000		$ 9,000	100%
UC tractor blade (1 replaced every 15 years)	Y			$ 3,000		$ 3,000	100%
UC tractor trailer	Y			$ 8,000		$ 8,000	100%
Equipment maintenance	N					$ -	100%
UC Equipment maintenance	N					$ -	100%
UC other equipment (field tools, compressors etc.)	Y			$ 10,000		$ 10,000	100%
Heavy Equipment Total		**$ -**	**$ -**	**$ 85,000**	**$ -**	$ 85,000	
Prescribed Burning (see sub tables)							
BLM-Plan preparation	N					$ -	100%
BLM-Air quality monitoring	N					$ -	100%
BLM-Public Noticing	N					$ -	100%
BLM-Maritime chapparal/ Coastal scrub	N					$ -	100%
BLM-Coast live oak woodland and savannah	N					$ -	100%
UC-Plan preparation	N					$ -	100%
UC-Air quality monitoring	N					$ -	100%
UC-Public Noticing	N					$ -	100%
UC-Maritime chapparal/ Coastal scrub	N					$ -	100%
UC-Plan preparation	N					$ -	100%
UC-Air quality monitoring	N					$ -	100%
UC-Public Noticing	N					$ -	100%
UC-Maritime chapparal/ Coastal scrub	N					$ -	100%
Prescribed Burn Total		**$ -**	**$ -**	**$ -**	**$ -**	$ -	
Other Vegetation Management							
Herbicides / spray equipment	Y				$ 3,798	$ 3,798	160%
UC Herbicides	Y			$ 300		$ 300	100%
UC spray equipment (2 sets replaced every 4 years)	Y			$ 200		$ 200	100%
Hand Tools (i.e. shovels, pulaskis, etc)	Y				$ 1,260	$ 1,260	158%
UC Hand Tools	Y			$ 400		$ 400	100%
Power Tools (i.e. chainsaws, weed eaters, etc)	Y				$ 3,150	$ 3,150	115%
UC Power Tools (already has, not initial capital cost	N					$ -	100%
Grazing (goats)	N					$ -	100%
Other Vegetation Management Total		**$ -**	**$ -**	**$ 900**	**$ 8,208**	$ 9,108	
Feral Animal Control							
Feral pig eradication	N					$ -	100%
pond draining (bullfrogs and non-native fish)	N					$ -	100%
Feral Animal Control Total		**$ -**	**$ -**	**$ -**	**$ -**	$ -	
Erosion control							
Equipment rental	N					$ -	100%
Hydromulch	N					$ -	95%
Seeds and seedlings	N					$ -	107%
Erosion control Total		**$ -**	**$ -**	**$ -**	**$ -**	$ -	
Other Habitat Enhancement							
Coastal strand and dune maintenance- protect and manage beaches, bluffs, blowouts	N					$ -	100%
snowy plover predator control	N					$ -	100%
snowy plover symbolic fencing	N					$ -	0%
6-foot steel thimbleye anchor rods (from Graybar Electric) evey 15ft replaced every 5 years)	Y		$ 21,120.0			$ 21,120	45%
¼" aircraft cable or wire rope coated with plastic (from Carpenter Rigging of San Jose) replaced every 3 years)	Y		$ 6,758.4			$ 6,758	45%
post pounder	Y		$ 160.0			$ 160	100%
cable cutter	Y		$ 300.0			$ 300	100%
hand swager	Y		$ 400.0			$ 400	100%
Signs- small	Y		$ 7,040.0			$ 7,040	42%
Coast live oak woodland and savannah- plant seedlings	N					$ -	100%
Other Habitat Enhancement Total		**$ -**	**$ 35,778**	**$ -**	**$ -**	$ 35,778	
Roads and Trails							
Dirt road maintenance (miles) (110 BLM + 20 all others)	N					$ -	95%
Trail construction (start-up cost) (10 miles of trails)	Y				$ 149,952	$ 149,952	100%
Trail maintenance (10 miles JPA + 75 miles BLM)	N					$ -	100%
Roads and Trails Total		**$ -**	**$ -**	**$ -**	**$ 149,952**	$ 149,952	
Access Control (see subtable)							
New fence installation (start up cost)	Y	$ 56,624		$ 276,456		$ 333,080	100%
New fence posts (start up cost)	Y	$ 36,033		$ 175,927		$ 211,960	100%
Fence repair/ replacement	N					$ -	100%
Repair, replacement, and installation of gates	N					$ -	100%
Locks (MasterLock)	N					$ -	100%
Signs- small	N					$ -	100%
UC signs							
Access Control Total		**$ 92,657**	**$ -**	**$ 452,383**	**$ -**	$ 545,040	
Field Facilities							
Field storage facilities (Capital Start up)	Y			$ 100,000		$ 100,000	0%
Facilities utilities, maintenance, and repair	N					$ -	100%
Facilities utilities, maintenance, and repair - UC	N						
Field Facilities Total		**$ -**	**$ -**	**$ 100,000**	**$ -**	$ 100,000	
Totals							
Operational Costs							
Start-up (O)		$ -	$ -	$ -	$ -		
Years 1-20 (O)							
Years 21-50 (O+O3)							
Post-permit term (O+O3)							
Capital costs							
Start-up (C)		$ 92,657	$ 35,778	$ 647,403	$ 208,160	$ 983,998	
Years 1-10 (C1 + C)							
Years 11-50 (C)							
Post-permit term							
Total							
Start-up		$ 92,657	$ 35,778	$ 647,403	$ 208,160	$ 983,998	
Year 1-10							
Years 11-20							
Years 21-50							
Post-permit term							
Total							
TOTALS		$ 92,657	$ 35,778	$ 647,403	$ 208,160	$ 983,998	

Table N-6a. HMA Management and Maintenence Costs

Cost Item				Post-Permit Term Costs by Management Entity								
	Post-Permit Term (Y/N)	% of permit term avg annual cost %	Avg Annual post-permit cost ($)	BLM %	BLM cost ($)	SP %	SP cost ($)	UC/ NRS %	UC/NRS cost ($)	JPA %	JPA cost ($)	Total Check Avg. Annual Cost
Staff Costs												
Full Time Labor (x positions, w/ x time dedicated to HCP tas	Y	100%	$ 1,448,912		$ 1,230,654		$ 119,258		$ 99,000		$ -	$ 1,448,912
Benefits full time (25% JPA; 35% for UC)	Y	100%	$ 64,464		$ -	25%	$ 29,814	30%	$ 34,650	25%	$ -	$ 64,464
Contracted Labor for JPA maintained HMAs (3 laborers)	Y	100%	$ 195,000		$ -		$ -		$ -	100%	$ 195,000	$ 195,000
Staff Costs Total			**$ 1,708,376**		**$ 1,230,654**		**$ 149,072**		**$ 133,650**		**$ 195,000**	**$ 1,708,376**
Planning												
Resource Management Plans (1 plan updated every 10 yrs)	N	100%	$ 5,000	0%	$ -	0%	$ -	0%	$ -	100%	$ 5,000	$ 5,000
Planning Total			**$ 5,000**		**$ -**		**$ -**		**$ -**		**$ 5,000**	**$ 5,000**
Environmental Compliance												
Small/simple	N	0%	$ -	0%	$ -	0%	$ -	0%	$ -	100%	$ -	$ -
Medium/more complex	N	0%	$ -	0%	$ -	0%	$ -	0%	$ -	100%	$ -	$ -
Large/most complex	N	0%	$ -	0%	$ -	0%	$ -	50%	$ -	50%	$ -	$ -
Environmental Compliance Total			**$ -**		**$ -**		**$ -**		**$ -**		**$ -**	**$ -**
Field Tools and Equipment												
UC Mule (1 replaced every 7 years) (init. $7,700)	Y	100%	$ 1,100	0%	$ -	0%	$ -	100%	$ 1,100	0%	$ -	$ 1,100
GPS units (4 replaced every five years)	Y	100%	$ 4,192	33%	$ 1,397	17%	$ 699	0%	$ -	33%	$ 1,397	$ 3,493
GPS units (1 replaced every 3 years) - UC	Y	100%	$ 100									
Hand held radios (4 replaced every 3 years)	Y	100%	$ 333	100%	$ 333	0%	$ -	0%	$ -	0%	$ -	$ 333
Digital cameras (4 replaced every 5 years)	Y	100%	$ 240	50%	$ 120	0%	$ -	25%	$ 60	25%	$ 60	$ 240
Protective clothing/ safety gear (adjust for UC)	Y	100%	$ 560	86%	$ 481	85%	$ 476	0%	$ -	0%	$ -	$ 957
UC Protective clothing/ safery gear (annual replacement)	Y	100%	$ 140	0%	$ -	0%	$ -	100%	$ 140	0%	$ -	$ 140
UC Protective clothing/ safery gear (replace every 5 yr)	Y	100%	$ 80	0%	$ -	0%	$ -	100%	$ 80	0%	$ -	$ 80
Miscellaneous field materials	Y	100%	$ 300	0%	$ -	0%	$ -	100%	$ 300	0%	$ -	$ 300
Field Tools and Equipment Total			**$ 7,045**		**$ 2,332**		**$ 1,175**		**$ 1,680**		**$ 1,457**	**$ 6,644**
Heavy Equipment												
Dump truck (45%)	Y	100%	$ 6,500	100%	$ 6,500	0%	$ -	0%	$ -	0%	$ -	$ 6,500
Grader (45%)	Y	100%	$ 7,700	100%	$ 7,700	0%	$ -	0%	$ -	0%	$ -	$ 7,700
Backhoe (45%)	Y	100%	$ 3,300	100%	$ 3,300	0%	$ -	0%	$ -	0%	$ -	$ 3,300
Loader (45%)	Y	100%	$ 4,300	100%	$ 4,300	0%	$ -	0%	$ -	0%	$ -	$ 4,300
ASV (45%) - MEC program related	Y	100%	$ 4,900	100%	$ 4,900	0%	$ -	0%	$ -	0%	$ -	$ 4,900
Sweco (45%)	Y	100%	$ 4,900	100%	$ 4,900	0%	$ -	0%	$ -	0%	$ -	$ 4,900
Talbert Trailer (45%)	Y	100%	$ 2,200	100%	$ 2,200	0%	$ -	0%	$ -	0%	$ -	$ 2,200
Massey Fergusen Tractor (100%) ($55,000 initial C cost for	Y	100%	$ 6,300	50%	$ 3,150	0%	$ -	50%	$ 3,150	0%	$ -	$ 6,300
D6R (45%)	Y	100%	$ 8,700	100%	$ 8,700	0%	$ -	0%	$ -	0%	$ -	$ 8,700
3 axle Transport (45%)	Y	100%	$ 6,200	100%	$ 6,200	0%	$ -	0%	$ -	0%	$ -	$ 6,200
1600 gal Water truck (45%)	Y	100%	$ 3,800	100%	$ 3,800	0%	$ -	0%	$ -	0%	$ -	$ 3,800
3,600 gal Water Truck (45%)	Y	100%	$ 6,500	100%	$ 6,500	0%	$ -	0%	$ -	0%	$ -	$ 6,500
Excavator (25%)	Y	100%	$ 3,675	100%	$ 3,675	0%	$ -	0%	$ -	0%	$ -	$ 3,675
Mower (rear-mounted for tractor)	Y	100%	$ 1,400	50%	$ 700	0%	$ -	50%	$ 700	0%	$ -	$ 1,400
UC front loader w/ bucket (1 replaced every 15 years)	Y	100%	$ 600	0%	$ -	0%	$ -	100%	$ 600	0%	$ -	$ 600
UC tractor blade (1 replaced every 15 years)	Y	100%	$ 200	0%	$ -	0%	$ -	100%	$ 200	0%	$ -	$ 200
UC tractor trailer	Y	100%	$ 700	0%	$ -	0%	$ -	100%	$ 700	0%	$ -	$ 700
Equipment maintenance	Y	100%	$ 6,933	100%	$ 6,933	0%	$ -	0%	$ -	0%	$ -	$ 6,933
UC Equipment maintenance	Y	100%	$ 500	0%	$ -	0%	$ -	100%	$ 500	0%	$ -	$ 500
UC other equipment (field tools, compressors etc.)	Y	100%	$ 500	0%	$ -	0%	$ -	100%	$ 500	0%	$ -	$ 500
Heavy Equipment Total			**$ 79,808**		**$ 73,458**		**$ -**		**$ 6,350**		**$ -**	**$ 79,808**
Prescribed Burning (see sub tables)												
BLM-Plan preparation	Y	100%	$ 4,267	95%	$ 4,063	0%	$ -	0%	$ -	5%	$ 203	$ 4,267
BLM-Air quality monitoring	Y	100%	$ 1,395	95%	$ 1,329	0%	$ -	0%	$ -	5%	$ 66	$ 1,395
BLM-Public Noticing	Y	100%	$ 213	95%	$ 203	0%	$ -	0%	$ -	5%	$ 10	$ 213
BLM-Maritime chapparal/ Coastal scrub	Y	100%	$ 84,756	95%	$ 80,720	0%	$ -	0%	$ -	5%	$ 4,036	$ 84,756
BLM-Coast live oak woodland and savannah	Y	100%	$ 87,581	95%	$ 83,411	0%	$ -	0%	$ -	5%	$ 4,171	$ 87,581
UC-Plan preparation	Y	100%	$ 2,000	0%	$ -	0%	$ -	100%	$ 2,000	0%	$ -	$ 2,000
UC-Air quality monitoring	Y	100%	$ 1,308	0%	$ -	0%	$ -	100%	$ 1,308	0%	$ -	$ 1,308
UC-Public Noticing	Y	100%	$ 200	0%	$ -	0%	$ -	100%	$ 200	0%	$ -	$ 200
UC-Maritime chapparal/ Coastal scrub	Y	100%	$ 161,440	0%	$ -	0%	$ -	100%	$ 161,440	0%	$ -	$ 161,440
UC-Plan preparation	Y	100%	$ 4,000	0%	$ -	0%	$ -	100%	$ 4,000	0%	$ -	$ 4,000
UC-Air quality monitoring	Y	100%	$ 1,308	0%	$ -	0%	$ -	100%	$ 1,308	0%	$ -	$ 1,308
UC-Public Noticing	Y	100%	$ 200	0%	$ -	0%	$ -	100%	$ 200	0%	$ -	$ 200
UC-Maritime chapparal/ Coastal scrub	Y	100%	$ 322,880	0%	$ -	0%	$ -	100%	$ 322,880	0%	$ -	$ 322,880
Prescribed Burn Total			**$ 178,212**		**$ 169,726**		**$ -**		**$ -**		**$ 8,486**	**$ 178,212**
Other Vegetation Management												
Herbicides / spray equipment	Y	100%	$ 3,798	82%	$ 3,100	65%	$ 2,469	0%	$ -	13%	$ 490	$ 6,059
UC Herbicides	Y	100%	$ 300	0%	$ -	0%	$ -	100%	$ 300	0%	$ -	$ 300
UC spray equipment (2 sets replaced every 4 years)	Y	100%	$ 50	0%	$ -	0%	$ -	100%	$ 50	0%	$ -	$ 50
Hand Tools (i.e. shovels, pulaskis, etc)	Y	100%	$ 315	79%	$ 249	63%	$ 198	3%	$ 10	12%	$ 39	$ 497
UC Hand Tools	Y	100%	$ 80	0%	$ -	0%	$ -	100%	$ 80	0%	$ -	$ 80
Power Tools (i.e. chainsaws, weed eaters, etc)	Y	100%	$ 788	79%	$ 622	20%	$ 158	3%	$ 26	12%	$ 98	$ 903
UC Power Tools (already has, not initial capital cost	Y	100%	$ 400	0%	$ -	0%	$ -	100%	$ 400	0%	$ -	$ 400
Grazing (goats)	Y	100%	$ 6,694	100%	$ 6,694	0%	$ -	0%	$ -	0%	$ -	$ 6,694
Other Vegetation Management Total			**$ 12,424**		**$ 10,665**		**$ 2,825**		**$ 866**		**$ 628**	**$ 14,983**
Feral Animal Control												
Feral pig eradication	Y	100%	$ 6,502	100%	$ 6,502	0%	$ -	0%	$ -	0%	$ -	$ 6,502
pond draining (bullfrogs and non-native fish)	Y	100%	$ 1,500	90%	$ 1,350	0%	$ -	0%	$ -	10%	$ 150	$ 1,500
Feral Animal Control Total			**$ 8,002**		**$ 7,852**		**$ -**		**$ -**		**$ 150**	**$ 8,002**
Erosion control												
Equipment rental	Y	100%	$ 30,268	0%	$ -	0%	$ -	0%	$ -	100%	$ 30,268	$ 30,268
Hydromulch	Y	100%	$ 80,735	82%	$ 65,901	0%	$ -	0%	$ -	13%	$ 10,427	$ 76,327
Seeds and seedlings	Y	100%	$ 7,812	82%	$ 6,377	12%	$ 937	0%	$ -	13%	$ 1,009	$ 8,323
Erosion control Total	**$ -**		**$ 118,815**		**$ 72,277**		**$ 937**		**$ -**		**$ 41,704**	**$ 114,918**
Other Habitat Enhancement												
Coastal strand and dune maintenance- protect and manage beaches, bluffs, blowouts	Y	100%	$ 80,000	0%	$ -	100%	$ 80,000	0%	$ -	0%	$ -	$ 80,000
snowy plover predator control	Y	100%	$ 20,000	0%	$ -	100%	$ 20,000	0%	$ -	0%	$ -	$ 20,000
snowy plover symbolic fencing			$ -	0%	$ -	0%	$ -	0%	$ -	0%	$ -	
6-foot steel thimbleye anchor rods (from Graybar Electric) evey 15ft replaced every 5 years)	Y	100%	$ 4,224	0%	$ -	45%	$ 1,901	0%	$ -	0%	$ -	$ 1,901
¼" aircraft cable or wire rope coated with plastic (from Carpenter Rigging of San Jose) replaced every 3 years)	Y	100%	$ 2,253	0%	$ -	45%	$ 1,014	0%	$ -	0%	$ -	$ 1,014
post pounder	Y	100%	$ 23	0%	$ -	100%	$ 23	0%	$ -	0%	$ -	$ 23
cable cutter	Y	100%	$ 43	0%	$ -	100%	$ 43	0%	$ -	0%	$ -	$ 43
hand swager	Y	100%	$ 57	0%	$ -	100%	$ 57	0%	$ -	0%	$ -	$ 57
Signs- small	Y	100%	$ 2,347	0%	$ -	42%	$ 986	0%	$ -	0%	$ -	$ 986
Coast live oak woodland and savannah- plant seedlings	Y	100%	$ 7,812	86%	$ 6,745	0%	$ -	0%	$ -	14%	$ 1,067	$ 7,812
Other Habitat Enhancement Total	**$ -**		**$ 116,758**		**$ 6,745**		**$ 104,023**		**$ -**		**$ 1,067**	**$ 111,835**
Roads and Trails												
Dirt road maintenance (miles) (110 BLM + 20 all others)	Y	100%	$ 130,000	85%	$ 110,000	0%	$ -	0%	$ -	11%	$ 14,058	$ 124,058
Trail construction (start-up cost) (10 miles of trails)	N	0%	$ -	0%	$ -	0%	$ -	0%	$ -	100%	$ -	$ -
Trail maintenance (10 miles JPA + 75 miles BLM)	Y	100%	$ 63,730	88%	$ 56,232	0%	$ -	0%	$ -	12%	$ 7,498	$ 63,730
Roads and Trails Total	**$ -**		**$ 193,730**		**$ 166,232**		**$ -**		**$ -**		**$ 21,555**	**$ 187,787**
Access Control (see subtable)												
New fence installation (start up cost)	N	0%	$ -	17%	$ -	0%	$ -	83%	$ -	0%	$ -	$ -
New fence posts (start up cost)	N	0%	$ -	17%	$ -	0%	$ -	83%	$ -	0%	$ -	$ -
Fence repair/ replacement	Y	100%	$ 7,750	46%	$ 3,590	0%	$ -	54%	$ 4,160	0%	$ -	$ 7,750
Repair, replacement, and installation of gates	Y	100%	$ 321	0%	$ -	0%	$ -	50%	$ 161	50%	$ 161	$ 321
Locks (MasterLock)	Y	100%	$ 88	0%	$ -	0%	$ -	50%	$ 44	50%	$ 44	$ 88
Signs- small	Y	100%	$ 105	82%	$ 86	5%	$ 6	0%	$ -	13%	$ 14	$ 105
UC signs												
Access Control Total	**$ -**		**$ 8,265**		**$ 3,676**		**$ 6**		**$ 4,365**		**$ 218**	**$ 8,265**
Field Facilities												
Field storage facilities (Capital Start up)	N	0%	$ -	0%	$ -	0%	$ -	0%	$ -	0%	$ -	$ -
Facilities utilities, maintenance, and repair	Y	100%	$ 15,000	33%	$ 5,000	33%	$ 5,000	0%	$ -	33%	$ 5,000	$ 15,000
Facilities utilities, maintenance, and repair - UC												
Field Facilities Total	**$ -**		**$ 15,000**		**$ 5,000**		**$ 5,000**		**$ -**		**$ 5,000**	**$ 15,000**
Totals												
Operational Costs												
Start-up (O)												
Years 1-20 (O)												
Years 21-50 (O+O3)												
Post-permit term (O+O3)			$ 2,341,506		$ 1,666,500		$ 254,072		$ 138,471		$ 272,114	$ 2,331,157
Capital costs												
Start-up (C)												
Years 1-10 (C1 + C)												
Years 11-50 (C)												
Post-permit term			$ 109,929		$ 82,117		$ 8,965		$ 8,440		$ 8,152	$ 107,674
Total												
Start-up												
Year 1-10												
Years 11-20												
Years 21-50												
Post-permit term			**$ 2,451,436**		**$ 1,748,616**		**$ 263,038**		**$ 146,911**		**$ 280,266**	**$ 2,438,831**
Total												
TOTALS	**$ -**		**$ 2,451,436**		**$ 1,748,616**		**$ 263,038**		**$ 146,911**		**$ 280,266**	**$ 2,438,831**

Table N-6b. Prescribed Burning

Prescribed Burning	Acres	Acres	Acres	
HMA	**Oak**	**Chaparral**	**Grassland**	**Assumption**
BLM	X	3000		16,17
UC				
MOCO East Garrison Burn	X			
MOCO Parker Flats		150		
TOTAL	**3255**	**3150**	**0**	

Table N-6c. HMA Acreages

HMA acreages	
HMA	**ACRES**
BLM	14,638
State Parks	979
UC	606
MOCO EGR-N	147
MOCO EGR-S	275
MOCO YC	398
MOCO OOR	73
MOCO PFR	379
MOCO Landfill	308
MOCO LSRE WH	79
MOCO LSRE LR	196
Marina SRHA	43
Marina AHR	130
Marina NWC	63
MPC Reserve	206
MPRPD NAE	19
1.264653641	**18,539**
	370.78

Table N-6d. Feral Pig Eradication Costs

Feral Pig Eradication Costs	
traps	$ 4,950
misc	$ 679
bait	$ 873
	$ 6,502

JPA managed acres 2,316

	% of land
BLM	79%
State Parks	5%
UC	3%
Coop	12%

Table N-6e. Erosion control

Erosion Control	
Community Type	**Acres**
Maritime chapparal/ Coastal Scrub	10,401
Coastal strand and dune	837
Coast live oak woodland and savannah	3,255
Grassland	2,987
Riparian	190
Wetland and Open Water	92
Total	**17,762**

Table N-6f. Field facilities

Field Facilities		
HMA	**Acres**	#
BLM	300	0
State Parks	142	0
UC	6	1
Total	**448**	**1**

$ 500,000	Cost to build a workshop/parking area
$ 75,000	Cost to build native plant nursery
$ 750	Cost of pre-construction surveys per project
5%	Construction oversight and monitoring as percent of construction cost

Note: Field facilities contain an area for equipment storage, a manager's office, a shared office, a locker room, restrooms, and a parking area.

Table N-6g. Access Control

Access Control	HMA					Borderland			
	Fence			Gates		Fence			Gates
HMA	**current (ft)**	**new (ft)**	**Total (ft)**	**current**	**new**	**current**	**new (ft)**	**Total**	
BLM	39,600	5,280	44,880				95,040		
State Parks			-				46,937		
UC	27,000	25,000	52,000	6	4		45,105		
MOCO EGR-N			-				13,325		
MOCO EGR-S			-	1			26,675		
MOCO YC			-				11,875		
MOCO OOR			-				9,180		
MOCO PFR			-				27,225		
MOCO Landfill			-	8			15,044		
MOCO LSRE WH & LR			-	4			24,600		
Marina SRHA			-				9,563		
Marina AHR			-				12,692		
Marina NWC			-				9,880		
MPC Reserve			-	6			16,368		
MPRPD NAE			-	1			3,550		
Total	**66,600**	**30,280**	**96,880**	**26**			**367,059**		

Table N-6h. Prescribed Burning

BLM RX COST
Hollister Field Office

L A B O R			For Hire		Federal		
Name	Rate	Amount	Qty	Amount	Qty	Amount	Total $
Burn Boss / IC	**12 hrs**	$30			1	$360.00	$ 360
Firing Boss	**12 hrs**	$25			1	$300.00	$ 300
Holding Boss	12 hrs	$25			1	$300.00	$ 300
20 person crew	Day	$2,000			1	-	$ 2,000
Wendell Nuss - Meteorologist	Day	100	15	1,500			$ 1,500
Resource Advisor	12 hrs	$30			1	$360.00	$ 360
*These are based on 12 hrs. day		**Labor Subtotal:**		**$ 1,500**			$ 4,820
E Q U I P M E N T							
Engine - Type 6 - Federal	Daily			-	1	$1,000.00	$ 1,000
Engine - Type 6 - Federal	Daily			-	1	$1,000.00	$ 1,000
Engine - Type 3 - Federal	Daily				1	$1,200.00	$ 1,200
Engine - Type 3 - Federal	Daily				1	$1,200.00	$ 1,200
Water Tender-Federal	Daily				1	$500.00	$ 500
Water Tender-Federal	Daily			-	1	$500.00	$ 500
Dozer - Federal	Daily			-	1	$1,000.00	$ 1,000
Terra Torch Mixing Unit	Daily					1,500	$ 1,500
Ignition Helicopter*	2 days	17,000	2	34,000		-	$ 34,000
Suppression Helicopter*	2 days	17,000	2	34,000		-	$ 34,000
Materials and Equipment Subtotal:				**$ 68,000**		**$ 7,900**	
Total Labor, Equipment & Materials:							**$ 80,720**
BLM costs (excludes Army funded items):							**$ 12,720**

*Negotiated line item related to munitions and explosives of concern with the Army - see Army RI/FS

Table N-7a Plant Monitoring										
Cost item	Notes	Unit	Unit/yr	$/Unit	Avg Annual Cost ($/yr) (Unit/yr * $/Unit)	Interval (every x years)	Frequency (permit term/interval)	Total 50 Year Cost ($/yr * frequency)	Frequency Codes	Capital/ Operational ?
Monitoring CSUMB/ Covered Plants										
Reconnaissance Studies (annually for 1st 10 years)										
Yadon's Piperia (2 people)	114	hours	70	$ 60	$ 4,200	1	10	$ 42,000	r	O
staff mileage (20 miles/day/team)		miles	80	$ 0.58	$ 46	1	10	$ 464	r	O
Areal Mapping										
Group 1: Sand Gilia, Monterey spineflower, seaside bird's-beak										
Pilot (year 1 only) (2 people)		hours	130	$ 60	$ 7,800	1	1	$ 7,800	p1	O
statistical analysis hours		hours	20	$ 60	$ 1,200	1	1	$ 1,200	p1	O
staff mileage (20 miles*team day)		miles	140	$ 0.58	$ 81	1	1	$ 81	p1	O
Adjusted baseline surveys (years 2,3,4 only) (2 people)		hours	1417	$ 60	$ 85,000	1	3	$ 255,000	ab234	O
statistical analysis hours		hours	7	$ 60	$ 400	1	3	$ 1,200	ab234	O
staff mileage (20 miles*team day)		miles	4,260	$ 0.58	$ 2,471	1	3	$ 7,412	ab234	O
Every 10 years (2 people)		hours	500	$ 60	$ 30,000	9	5	$ 150,000	am9	O
statistical analysis hours		hours	20	$ 60	$ 1,200	9	5	$ 6,000	am9	O
staff mileage (20 miles*team day)		miles	500	$ 0.58	$ 290	1	5	$ 1,450	am9	O
Group 2: Maritime Chaparral					--					
GIS mapping (every 10 years)		hours	20	$ 60	$ 1,200	10	6	$ 7,200	10	O
statistical analysis hours		hours	30	$ 60	$ 1,800	10	6	$ 10,800	10	O
Status and trends monitoring GIS mapping (every 10 years)		hours	20	$ 60	$ 1,200	10	6	$ 7,200	10	O
Status and trends statistical analysis hours		hours	30	$ 60	$ 1,800	10	6	$ 10,800	10	O
Abundance Sampling										
Sand Gilia (45 plots)					--					
Pilot (year 1 only) (2 people)		hours	180	$ 60	$ 10,800	1	1	$ 10,800	p1	O
statistical analysis hours		hours	20	$ 60	$ 1,200	1	1	$ 1,200	p1	O
staff mileage (20 miles*team day)		miles	180	$ 0.58	$ 104	1	1	$ 104	p1	O
Pilot (year 2 only) (2 people)		hours	160	$ 60	$ 9,600	1	1	$ 9,600	p2	O
statistical analysis hours		hours	20	$ 60	$ 1,200	1	1	$ 1,200	p2	O
staff mileage (20 miles*team day)		miles	160	$ 0.58	$ 93	1	1	$ 93	p2	O
Annual (years 3-50) (2 people)		hours	160	$ 60	$ 9,600	1	48	$ 460,800	as48	O
statistical analysis hours		hours	20	$ 60	$ 1,200	1	48	$ 57,600	as48	O
staff mileage (20 miles*team day)		miles	160	$ 0.58	$ 93	1	48	$ 4,454	as48	O
Monterey Spineflower (45 plots)										
Pilot (year 1 only) (2 people)		hours	180	$ 60	$ 10,800	1	1	$ 10,800	p1	O
statistical analysis hours		hours	20	$ 60	$ 1,200	1	1	$ 1,200	p1	O
staff mileage (20 miles*team day)		miles	180	$ 0.58	$ 104	1	1	$ 104	p1	O
Pilot (year 2 only) (2 people)		hours	160	$ 60	$ 9,600	1	1	$ 9,600	p2	O
statistical analysis hours		hours	20	$ 60	$ 1,200	1	1	$ 1,200	p2	O
staff mileage (20 miles*team day)		miles	160	$ 0.58	$ 93	1	1	$ 93	p2	O
Annual (years 3-50) (2 people)		hours	180	$ 60	$ 10,800	1	48	$ 518,400	as48	O
statistical analysis hours		hours	20	$ 60	$ 1,200	1	48	$ 57,600	as48	O
staff mileage (20 miles*team day)		miles	160	$ 0.58	$ 93	1	48	$ 4,454	as48	O
Seaside bird's-beak (45 plots)										
Pilot (year 1 only) (2 people)		hours	180	$ 60	$ 10,800	1	1	$ 10,800	p1	O
statistical analysis hours		hours	20	$ 60	$ 1,200	1	1	$ 1,200	p1	O
staff mileage (20 miles*team day)		miles	180	$ 0.58	$ 104	1	1	$ 104	p1	O
Pilot (year 2 only) (2 people)		hours	160	$ 60	$ 9,600	1	1	$ 9,600	p2	O
statistical analysis hours		hours	20	$ 60	$ 1,200	1	1	$ 1,200	p2	O
staff mileage (20 miles*team day)		miles	160	$ 0.58	$ 93	1	1	$ 93	p2	O
Annual (years 3-50) (2 people)		hours	160	$ 60	$ 9,600	1	48	$ 460,800	as48	O
statistical analysis hours		hours	20	$ 60	$ 1,200	1	48	$ 57,600	as48	O
staff mileage (20 miles*team day)		miles	160	$ 0.58	$ 93	1	48	$ 4,454	as48	O
Maritime Chaparral (100 plots)										
Fire History map		map	1	$ 25,000	$ 25,000	1	1	$ 25,000	p1	O
Pilot (year 1) (2 people)		hours	840	$ 60	$ 50,400	1	1	$ 50,400	p1	O
statistical analysis hours		hours	25	$ 60	$ 1,500	1	1	$ 1,500	p1	O
staff mileage (20 miles*team day)		miles	840	$ 0.58	$ 487	1	1	$ 487	p1	O
5-year interval (2 people)		hours	500	$ 60	$ 30,000	5	11	$ 330,000	as10	O
statistical analysis hours		hours	20	$ 60	$ 1,200	5	11	$ 13,200	as10	O
staff mileage (20 miles*team day)		miles	500	$ 0.58	$ 290	1	11	$ 3,190	as10	O
Adaptive Management										
Annual stipend for members of CRMP		Members	10	$ -	$ -	1	50	$ -	50	O
Other costs (both plants and wildlife)										
Additional project level monitoring and research (plants) (assumed 5% of abundance sampling)		annual cost			$ 7,647	1	50	$ 382,368	50	O
Additional project level monitoring and research (wildlife) (assumed 5% of annual abundance sampling)		annual cost			$ 6,600	1	50	$ 330,019	50	O
Project management (including team meetings, organizing team client meetings, progress reports, etc.)		hours	320	$ 100	$ 32,000	1	50	$ 1,600,000	50	O
Data organization		hours	80	$ 100	$ 8,000	1	50	$ 400,000	50	O
Creating/refining field forms		hours	80	$ 100	$ 1,340	1	50	$ 67,000	50	O
Training field staff		hours	80	$ 100	$ 8,000	1	50	$ 400,000	50	O
Tools and supplies		set	1	variable	$ 3,220	1	50	$ 161,000	50	O
GPS Equip purchase (year 1 only)		unit	10	$ 5,000	$ 50,000	1	1	$ 50,000	p1	O
GPS Equip maintenance (year 2)		year	1	$ 10,000	$ 10,000	1	1	$ 10,000	p2	O
GPS Equip maintenance (starting in yr 3)		year	1	$ 10,000	$ 10,000	1	48	$ 480,000	as48	O
Annual monitoring reports		hours	180	$ 100	$ 18,000	1	50	$ 900,000	50	O
Total								$ 7,407,926		
CSUMB Total (including 20% of TMDC)								**$ 8,178,028**		

Table N-7a Plant Monitoring										
Cost item	Year 1	2	3	4	5	6	7	8	9	10
	r,p1,10	**r, p2, ab234, as10**	**r, ab234, as48**	**r, ab234, as48**	**r, as48**	**r, as48, as10**	**r, as48**	**r, as48**	**r, as48**	**r, am9, 10, as48**
Monitoring CSUMB/ Covered Plants										
Reconnaissance Studies (annually for 1st 10 years)										
Yadon's Piperia (2 people)	$ 4,200	$ 4,200	$ 4,200	$ 4,200	$ 4,200	$ 4,200	$ 4,200	$ 4,200	$ 4,200	$ 4,200
staff mileage (20 miles/day/team)	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46
Areal Mapping	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Group 1: Sand Gilia, Monterey spineflower, seaside bird's-beak	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ 7,800	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ 1,200	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ 81	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adjusted baseline surveys (years 2,3,4 only) (2 people)	$ -	$ 85,000	$ 85,000	$ 85,000	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ 400	$ 400	$ 400	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ 2,471	$ 2,471	$ 2,471	$ -	$ -	$ -	$ -	$ -	$ -
Every 10 years (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,000
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 290
Group 2: Maritime Chaparral	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
GIS mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Status and trends monitoring GIS mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Status and trends statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Abundance Sampling	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sand Gilia (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ 10,800	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ 1,200	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ 104	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ 9,600	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ 1,200	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ 93	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ -	$ -	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600
statistical analysis hours	$ -	$ -	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Monterey Spineflower (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ 10,800	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ 1,200	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ 104	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ 9,600	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ 1,200	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ 93	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ -	$ -	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800
statistical analysis hours	$ -	$ -	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Seaside bird's-beak (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ 10,800	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ 1,200	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ 104	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ 9,600	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ 1,200	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ 93	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ -	$ -	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600
statistical analysis hours	$ -	$ -	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Maritime Chaparral (100 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fire History map	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5-year interval (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual stipend for members of CRMP	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other costs (both plants and wildlife)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Additional project level monitoring and research (plants) (assumed 5% of abundance sampling)	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647
Additional project level monitoring and research (wildlife) (assumed 5% of annual abundance sampling)	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600
Project management (including team meetings, organizing team client meetings, progress reports, etc.)	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000
Data organization	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000
Creating/refining field forms	$ 8,000	$ 5,000	$ 4,000	$ 3,000	$ 2,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Training field staff	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000
Tools and supplies	$ 8,000	$ 6,000	$ 5,000	$ 4,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000
GPS Equip purchase (year 1 only)	$ 50,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
GPS Equip maintenance (year 2)	$ -	$ 10,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
GPS Equip maintenance (starting in yr 3)	$ -	$ -	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000
Annual monitoring reports	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000
Total	$ 195,889	$ 226,043	$ 92,117	$ 223,243	$ 133,373	$ 132,373	$ 132,373	$ 132,373	$ 132,373	$ 163,863
CSUMB Total (including 20% of TMDC)	**$ 235,066**	**$ 271,252**	**$ 110,541**	**$ 267,892**	**$ 160,047**	**$ 158,847**	**$ 158,847**	**$ 158,847**	**$ 158,847**	**$ 196,635**

Table N-7a Plant Monitoring										
Cost item	11	12	13	14	15	16	17	18	19	20
	as48, as10	**as48**	**as48**	**as48**	**as48**	**as48, as10**	**as48**	**as48**	**as48**	am9, 10, as48
Monitoring CSUMB/ Covered Plants										
Reconnaissance Studies (annually for 1st 10 years)										
Yadon's Piperia (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles/day/team)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Areal Mapping	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Group 1: Sand Gilia, Monterey spineflower, seaside bird's-beak	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adjusted baseline surveys (years 2,3,4 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Every 10 years (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,000
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 290
Group 2: Maritime Chaparral	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
GIS mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Status and trends monitoring GIS mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Status and trends statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Abundance Sampling	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sand Gilia (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Monterey Spineflower (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Seaside bird's-beak (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Maritime Chaparral (100 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fire History map	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5-year interval (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual stipend for members of CRMP	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other costs (both plants and wildlife)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Additional project level monitoring and research (plants) (assumed 5% of abundance sampling)	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647
Additional project level monitoring and research (wildlife) (assumed 5% of annual abundance sampling)	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600
Project management (including team meetings, organizing team client meetings, progress reports, etc.)	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000
Data organization	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000
Creating/refining field forms	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Training field staff	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000
Tools and supplies	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000
GPS Equip purchase (year 1 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
GPS Equip maintenance (year 2)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
GPS Equip maintenance (starting in yr 3)	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000
Annual monitoring reports	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000
Total	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 159,616
CSUMB Total (including 20% of TMDC)	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 191,539**

Table N-7a Plant Monitoring										
Cost item	21	22	23	24	25	26	27	28	29	30
	as48, as10	**as48**	**as48**	**as48**	**as48**	**as48, as10**	**as48**	**as48**	**as48**	am9,10, as48
Monitoring CSUMB/ Covered Plants										
Reconnaissance Studies (annually for 1st 10 years)										
Yadon's Piperia (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles/day/team)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Areal Mapping	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Group 1: Sand Gilia, Monterey spineflower, seaside bird's-beak	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adjusted baseline surveys (years 2,3,4 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Every 10 years (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,000
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 290
Group 2: Maritime Chaparral	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
GIS mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Status and trends monitoring GIS mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Status and trends statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Abundance Sampling	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sand Gilia (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Monterey Spineflower (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Seaside bird's-beak (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Maritime Chaparral (100 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fire History map	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5-year interval (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual stipend for members of CRMP	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other costs (both plants and wildlife)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Additional project level monitoring and research (plants) (assumed 5% of abundance sampling)	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647
Additional project level monitoring and research (wildlife) (assumed 5% of annual abundance sampling)	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600
Project management (including team meetings, organizing team client meetings, progress reports, etc.)	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000
Data organization	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000
Creating/refining field forms	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Training field staff	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000
Tools and supplies	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000
GPS Equip purchase (year 1 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
GPS Equip maintenance (year 2)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
GPS Equip maintenance (starting in yr 3)	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000
Annual monitoring reports	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000
Total	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 159,616
CSUMB Total (including 20% of TMDC)	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 191,539**

Table N-7a Plant Monitoring						
Cost item	31	32	33	34	35	36
	as48, as10	**as48**	**as48**	**as48**	**as48**	**as48, as10**
Monitoring CSUMB/ Covered Plants						
Reconnaissance Studies (annually for 1st 10 years)						
Yadon's Piperia (2 people)	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles/day/team)	$ -	$ -	$ -	$ -	$ -	$ -
Areal Mapping	$ -	$ -	$ -	$ -	$ -	$ -
Group 1: Sand Gilia, Monterey spineflower, seaside bird's-beak	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -
Adjusted baseline surveys (years 2,3,4 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -
Every 10 years (2 people)	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -
Group 2: Maritime Chaparral	$ -	$ -	$ -	$ -	$ -	$ -
GIS mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -
Status and trends monitoring GIS mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -
Status and trends statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -
Abundance Sampling	$ -	$ -	$ -	$ -	$ -	$ -
Sand Gilia (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Monterey Spineflower (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Seaside bird's-beak (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Maritime Chaparral (100 plots)	$ -	$ -	$ -	$ -	$ -	$ -
Fire History map	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -
5-year interval (2 people)	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -
Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -
Annual stipend for members of CRMP	$ -	$ -	$ -	$ -	$ -	$ -
Other costs (both plants and wildlife)	$ -	$ -	$ -	$ -	$ -	$ -
Additional project level monitoring and research (plants) (assumed 5% of abundance sampling)	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647
Additional project level monitoring and research (wildlife) (assumed 5% of annual abundance sampling)	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600
Project management (including team meetings, organizing team client meetings, progress reports, etc.)	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000
Data organization	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000
Creating/refining field forms	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Training field staff	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000
Tools and supplies	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000
GPS Equip purchase (year 1 only)	$ -	$ -	$ -	$ -	$ -	$ -
GPS Equip maintenance (year 2)	$ -	$ -	$ -	$ -	$ -	$ -
GPS Equip maintenance (starting in yr 3)	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000
Annual monitoring reports	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000
Total	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126
CSUMB Total (including 20% of TMDC)	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**

Table N-7a Plant Monitoring										
Cost item	37	38	39	40	41	42	43	44	45	46
	as48	**as48**	**as48**	am9, 10, as48	**as48, as10**	**as48**	**as48**	**as48**	**as48**	**as48, as10**
Monitoring CSUMB/ Covered Plants										
Reconnaissance Studies (annually for 1st 10 years)										
Yadon's Piperia (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles/day/team)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Areal Mapping	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Group 1: Sand Gilia, Monterey spineflower, seaside bird's-beak	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adjusted baseline surveys (years 2,3,4 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Every 10 years (2 people)	$ -	$ -	$ -	$ 30,000	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ 1,200	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ 290	$ -	$ -	$ -	$ -	$ -	$ -
Group 2: Maritime Chaparral	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
GIS mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Status and trends monitoring GIS mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Status and trends statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Abundance Sampling	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sand Gilia (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Monterey Spineflower (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 10,800
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Seaside bird's-beak (45 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual (years 3-50) (2 people)	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 9,600
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 1,200
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93	$ 93
Maritime Chaparral (100 plots)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fire History map	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Pilot (year 1) (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5-year interval (2 people)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adaptive Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual stipend for members of CRMP	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other costs (both plants and wildlife)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Additional project level monitoring and research (plants) (assumed 5% of abundance sampling)	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 7,647
Additional project level monitoring and research (wildlife) (assumed 5% of annual abundance sampling)	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 6,600
Project management (including team meetings, organizing team client meetings, progress reports, etc.)	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 32,000
Data organization	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000
Creating/refining field forms	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Training field staff	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 8,000
Tools and supplies	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000
GPS Equip purchase (year 1 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
GPS Equip maintenance (year 2)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
GPS Equip maintenance (starting in yr 3)	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000
Annual monitoring reports	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000
Total	$ 128,126	$ 128,126	$ 128,126	$ 159,616	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126	$ 128,126
CSUMB Total (including 20% of TMDC)	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 191,539**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 153,751**

Table N-7a Plant Monitoring					
Cost item	47	48	49	50	Total
	as48	**as48**	**as48**	am9,10, as48, as10	
Monitoring CSUMB/ Covered Plants					
Reconnaissance Studies (annually for 1st 10 years)					
Yadon's Piperia (2 people)	$ -	$ -	$ -	$ -	$ 42,000
staff mileage (20 miles/day/team)	$ -	$ -	$ -	$ -	$ 464
Areal Mapping	$ -	$ -	$ -	$ -	$ -
Group 1: Sand Gilia, Monterey spineflower, seaside bird's-beak	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ 7,800
statistical analysis hours	$ -	$ -	$ -	$ -	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ 81
Adjusted baseline surveys (years 2,3,4 only) (2 people)	$ -	$ -	$ -	$ -	$ 255,000
statistical analysis hours	$ -	$ -	$ -	$ -	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ 7,412
Every 10 years (2 people)	$ -	$ -	$ -	$ 30,000	$ 150,000
statistical analysis hours	$ -	$ -	$ -	$ 1,200	$ 6,000
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ 290	$ 1,450
Group 2: Maritime Chaparral	$ -	$ -	$ -	$ -	$ -
GIS mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -
Status and trends monitoring GIS mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -
Status and trends statistical analysis hours	$ -	$ -	$ -	$ -	$ -
Abundance Sampling	$ -	$ -	$ -	$ -	$ -
Sand Gilia (45 plots)	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ 10,800
statistical analysis hours	$ -	$ -	$ -	$ -	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ 104
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ 9,600
statistical analysis hours	$ -	$ -	$ -	$ -	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ 93
Annual (years 3-50) (2 people)	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 460,800
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 57,600
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 4,454
Monterey Spineflower (45 plots)	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ 10,800
statistical analysis hours	$ -	$ -	$ -	$ -	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ 104
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ 9,600
statistical analysis hours	$ -	$ -	$ -	$ -	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ 93
Annual (years 3-50) (2 people)	$ 10,800	$ 10,800	$ 10,800	$ 10,800	$ 518,400
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 57,600
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 4,454
Seaside bird's-beak (45 plots)	$ -	$ -	$ -	$ -	$ -
Pilot (year 1 only) (2 people)	$ -	$ -	$ -	$ -	$ 10,800
statistical analysis hours	$ -	$ -	$ -	$ -	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ 104
Pilot (year 2 only) (2 people)	$ -	$ -	$ -	$ -	$ 9,600
statistical analysis hours	$ -	$ -	$ -	$ -	$ 1,200
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ 93
Annual (years 3-50) (2 people)	$ 9,600	$ 9,600	$ 9,600	$ 9,600	$ 460,800
statistical analysis hours	$ 1,200	$ 1,200	$ 1,200	$ 1,200	$ 57,600
staff mileage (20 miles*team day)	$ 93	$ 93	$ 93	$ 93	$ 4,454
Maritime Chaparral (100 plots)	$ -	$ -	$ -	$ -	$ -
Fire History map	$ -	$ -	$ -	$ -	$ -
Pilot (year 1) (2 people)	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -
5-year interval (2 people)	$ -	$ -	$ -	$ -	$ -
statistical analysis hours	$ -	$ -	$ -	$ -	$ -
staff mileage (20 miles*team day)	$ -	$ -	$ -	$ -	$ -
Adaptive Management	$ -	$ -	$ -	$ -	$ -
Annual stipend for members of CRMP	$ -	$ -	$ -	$ -	$ -
Other costs (both plants and wildlife)	$ -	$ -	$ -	$ -	$ -
Additional project level monitoring and research (plants) (assumed 5% of abundance sampling)	$ 7,647	$ 7,647	$ 7,647	$ 7,647	$ 382,368
Additional project level monitoring and research (wildlife) (assumed 5% of annual abundance sampling)	$ 6,600	$ 6,600	$ 6,600	$ 6,600	$ 330,019
Project management (including team meetings, organizing team client meetings, progress reports, etc.)	$ 32,000	$ 32,000	$ 32,000	$ 32,000	$ 1,600,000
Data organization	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 400,000
Creating/refining field forms	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 67,000
Training field staff	$ 8,000	$ 8,000	$ 8,000	$ 8,000	$ 400,000
Tools and supplies	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 161,000
GPS Equip purchase (year 1 only)	$ -	$ -	$ -	$ -	$ 50,000
GPS Equip maintenance (year 2)	$ -	$ -	$ -	$ -	$ 10,000
GPS Equip maintenance (starting in yr 3)	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 480,000
Annual monitoring reports	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 900,000
Total	$ 128,126	$ 128,126	$ 128,126	$ 159,616	$ 6,948,149
CSUMB Total (including 20% of TMDC)	**$ 153,751**	**$ 153,751**	**$ 153,751**	**$ 191,539**	**$ 8,337,779**

Cost item	Notes
Table N-7a Frequency codes	
Reconnaissance Studies (annually for 1st 10 years)	r
pilot surveys year 1 only	p1
pilot surveys year 2 only	p2
Adjusted baseline surveys, year 2-4 only (3 years total)	ab234
Areal mapping- every 10 years, starting year 10	am9
Every 10 years, beginning in year 1	10
Annual abundance sampling (starts year 3, after pilot studies)	as48
Abundance sampling, evey 5 years, starts in year 2	as10
Annual cost	50

Table N-7a Plant Monitoring													
Cost item	Post-Permit term cost (Y/N)	Frequency	1	2	3	4	5	6	7	8	9	10	permit Avg annual cost
Monitoring CSUMB/ Covered Plants													
Reconnaissance Studies (annually for 1st 10 years)													
Yadon's Piperia (2 people)	N							0			0		0
staff mileage (20 miles/day/team)	N							0			0		0
Areal Mapping								0			0		0
Group 1: Sand Gilia, Monterey spineflower, seaside bird's-beak								0			0		0
Pilot (year 1 only) (2 people)	N							0			0		0
statistical analysis hours	N							0			0		0
staff mileage (20 miles*team day)	N							0			0		0
Adjusted baseline surveys (years 2,3,4 only) (2 people)	N							0			0		0
statistical analysis hours	N							0			0		0
staff mileage (20 miles*team day)	N							0			0		0
Every 10 years (2 people)	Y	10-15 years						0			0		0
statistical analysis hours	Y	10-15 years						0			0		0
staff mileage (20 miles*team day)	Y	10-15 years						0			0		0
Group 2: Maritime Chaparral								0			0		0
GIS mapping (every 10 years)	Y	once in 10 years						0			0	1,200	400
statistical analysis hours	Y	once in 10 years						0			0	1,800	600
Status and trends monitoring GIS mapping (every 10 years)	Y	once in 10 years						0			0	1,200	400
Status and trends statistical analysis hours	Y	once in 10 years						0			0	1,800	600
Abundance Sampling								0			0		0
Sand Gilia (45 plots)								0			0		0
Pilot (year 1 only) (2 people)	N							0			0		0
statistical analysis hours	N							0			0		0
staff mileage (20 miles*team day)	N							0			0		0
Pilot (year 2 only) (2 people)	N							0			0		0
statistical analysis hours	N							0			0		0
staff mileage (20 miles*team day)	N							0			0		0
Annual (years 3-50) (2 people)	Y	3-5 years			9,600			9,600			9,600		9,600
statistical analysis hours	Y	3-5 years			1,200			1,200			1,200		1,200
staff mileage (20 miles*team day)	Y	3-5 years			93			93			93		93
Monterey Spineflower (45 plots)								0			0		0
Pilot (year 1 only) (2 people)	N							0			0		0
statistical analysis hours	N							0			0		0
staff mileage (20 miles*team day)	N							0			0		0
Pilot (year 2 only) (2 people)	N							0			0		0
statistical analysis hours	N							0			0		0
staff mileage (20 miles*team day)	N							0			0		0
Annual (years 3-50) (2 people)	Y	3-5 years			10,800			10,800			10,800		10,800
statistical analysis hours	Y	3-5 years			1,200			1,200			1,200		1,200
staff mileage (20 miles*team day)	Y	3-5 years			93			93			93		93
Seaside bird's-beak (45 plots)								0			0		0
Pilot (year 1 only) (2 people)	N							0			0		0
statistical analysis hours	N							0			0		0
staff mileage (20 miles*team day)	N							0			0		0
Pilot (year 2 only) (2 people)	N							0			0		0
statistical analysis hours	N							0			0		0
staff mileage (20 miles*team day)	N							0			0		0
Annual (years 3-50) (2 people)	Y	3-5 years			9,600			9,600			9,600		9,600
statistical analysis hours	Y	3-5 years			1,200			1,200			1,200		1,200
staff mileage (20 miles*team day)	Y	3-5 years			93			93			93		93
Maritime Chaparral (100 plots)								0			0		0
Fire History map	N												
Pilot (year 1) (2 people)	N							0			0		0
statistical analysis hours	N							0			0		0
staff mileage (20 miles*team day)	N							0			0		0
5-year interval (2 people)	Y	every 7-10 years						0	30,000		0		10,000
statistical analysis hours	Y	every 7-10 years						0	1,200		0		400
staff mileage (20 miles*team day)	Y	every 7-10 years						0	290		0		97
Adaptive Management								0			0		0
Annual stipend for members of CRMP	N							0			0		0
Other costs (both plants and wildlife)								0			0		0
Additional project level monitoring and research (plants) (assumed 5% of abundance sampling)	N							0			0		0
Additional project level monitoring and research (wildlife) (assumed 5% of annual abundance sampling)	N							0			0		0
Project management (including team meetings, organizing team client meetings, progress reports, etc.)	N							0			0		0
Data organization	N							0			0		0
Creating/refining field forms	N							0			0		0
Training field staff	N							0			0		0
Tools and supplies	Y	every survey			3,220			3,220	3,220		3,220	3,220	3,220
GPS Equip purchase (year 1 only)													
GPS Equip maintenance (year 2)													
GPS Equip maintenance (starting in yr 3)													
Annual monitoring reports	Y	every survey			18,000			18,000	18,000		18,000	18,000	18,000
Total			0	0	55,098	0	0	55,098	52,710	0	55,098	27,220	24,523
CSUMB Total (including 20% of TMDC)													

Table N-7a Assumptions:	
Hourly wages	For CSUMB, faculty salaries (including benefits) would be up to $100/hr, but project staff ($50/hr with benefits) and students would be doing a majority of the work, as mentored by faculty. Student salaries including benefits would range from $25/hr for undergrads to $35/hr for MS students (mean $30/hr). It is assumed that 30% of the hours would go to faculty, 30% to staff, and 40% to students. The weighted salaries and benefits results in an average hourly wage of ~$60/hr including benefits. However, benefits and wages would increase over time for cost of living increases.
Per diem	A local contractor (like CSUMB) would not have to charge per diem since they live in the area. There would still be mileage charges because even local employees would need to use their private vehicles to get around Ft. Ord. The mileage assumption is 20 miles/day/team.
GPS equipment	As far as GPS equipment, The project would buy its own GPS units,for a purchase costs in the first year ($5000/unit * 10 units = $50,000) and then just annual maintenance after that ($10,000/yr). There would also be some upfront computer hardware costs (2-4 laptops at $1000 each). CSUMB could provide the necessary software and could provide supplemental GPS units for students working on course-related projects.
Ongoing Costs-Field Forms, Tools & Supplies	For the Field Forms and Tools & Supplies, there would be up-front costs over the first 5 yrs, but after that it seems to me that costs would decrease substantially since the forms would not need to be altered much after that, and the measurement tools (quadrats, tapes, etc) would have been previously purchased.
CSUMB overhead charge	Grants and Contracts of CSUMB would charge an overhead = 20% of modified direct total cost (sum of all expenditures).
Burned areas	Most of these HCP annuals really responded well to fire at Parker Flats, so any burn areas would need to be surveyed and the acreage of these survey areas would change on a year-to-year basis as the acreage burned/yr would also change.
Plots/day assumptions – HCP annuals abundance sampling	These plots are only 1m x 5m, so I would think one could do 5-6/day, given driving/hiking time, etc. If the pilot study finds that bigger or smaller plots are necessary – this would also then decrease or increase the no. of plots/day that could be measured.With sand gilia and Mry spineflower at Parker Flats, the 5m2 plot size would be fine.
Maritime chaparral mapping	Ft Ord needs a better fire history map at the start of the HCP monitoring since – we found at Parker Flats that the time since last fire, as well as burn frequency, had a significant influence on the distribution of the HCP shrubs, particularly Toro manzanita (probably because it takes some time for this shrub to develop large seedbanks). Sites that burned too frequently (e.g. less than every 25-30 yrs) had fewer Toro manzanita and more Mry Ceanothus. So there would be some up-front cost in year 1 to map the fire history by examining historical aerial photos of Ft Ord – the UCSC map library has photos back to the 1930's and these worked well for developing a fire history of Parker Flats. estimate $25,000 to do this right for all of Ft. Ord.
Areal mapping	There is quite a bit of Monterey spineflower in these areas and some gilia exists there. Sampling for gilia has to be in April and early May during the middle of the day (when flowers are open). That is somewhat limiting for recon studies (in terms of amount of available hours to even charge and also to get the job done).

Table N-7b. Wildlife Monitoring																								
Cost Item	Assump-tion	Unit	Unit/yr	$/Unit	Avg Annual Cost ($/yr) (Unit/yr * $/Unit)	Interval (every x years)	Frequency (permit term/interval)	Total 50 Year Cost ($/yr * frequency)	Frequency Codes		Capital/Operational?	1	2	3	4	5	6	7	8	9	10	11	12	13
Monitoring Contractors/ Covered Wildlife																								
Smith's Blue Butterfly																								
Aerial mapping of habitat (every 10 years)	96	hours	44	$ 67	$ 2,943	10	6	$ 17,655	10		O	$ 2,943	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,943	$ -	$ -	$ -
Abundance sampling for host plants	96																							
Pilot study (years 1 and 2 only)		hours	44	$ 67	$ 2,943		2	$ 5,885	p12		O	$ 2,943	$ 2,943	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adjusted baseline (years 3, 4, and 5 only)	97	hours	44	$ 67	$ 2,943		3	$ 8,828	ab345		O	$ -	$ -	$ 2,943	$ 2,943	$ 2,943	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Abundance monitoring (every 3-5 years)	97	hours	44	$ 67	$ 2,943	4	10	$ 29,425	4		O	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,943	$ -	$ -	$ -	$ -	$ 2,943	$ -
Species presence/absence surveys				$ 67							O	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adjusted baseline (years 1,2, and 3 only)		hours	64	$ 67	$ 4,280		3	$ 12,840	ab123		O	$ 4,280	$ 4,280	$ 4,280	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Presence/absence surveys (2 surveys every 5 years)		hours	64	$ 67	$ 4,280	2.50	19	$ 81,320	pa2.5		O	$ -	$ -	$ -	$ -	$ -	$ 4,280	$ -	$ 4,280	$ -	$ 4,280	$ -	$ -	$ 4,280
General Equipment-Pilot study (years 1 and 2 only)		set	1	$ 300	$ 300		2	$ 600	p12		O	$ 300	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
General Equipment-Adjusted baseline (years 3, 4, and 5 only)		set	1	$ 300	$ 300		3	$ 900	ab345		O	$ -	$ -	$ 300	$ 300	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
General Equipment-Abundance monitoring (every 3-5 years)		set	1	$ 300	$ 300	4.00	10	$ 3,000	4		O	$ -	$ -	$ -	$ -	$ -	$ -	$ 300	$ -	$ -	$ -	$ -	$ 300	$ -
Western Snowy Plover																								
Aerial mapping of habitat (every 10 years)		hours	8	$ 67	$ 535	10	6	$ 3,210	10		O	$ 535	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 535	$ -	$ -	$ -
"Window Surveys" (2 times annually)		hours	32	$ 67	$ 2,140	1	50	$ 107,000	50		O	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140
Predator Monitoring (bi-monthly, 4 hours during breeding season)		hours	56	$ 67	$ 3,745	1	50	$ 187,250	50		O	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745
Annual Surveys (2 individuals, 8-hours weekly for 32 weeks)(plus 54 hours revised (1)) (plus 348 hours revised (2))		hours	914	$ 67	$ 61,124	1	50	$ 3,056,188	50		O	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124
Annual Reconaissance Surveys (2 individuals, 2-8 hr days)(plus 54 hours revised (1))		hours	86	$ 67	$ 5,751	1	50	$ 287,563	50		O	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751
Recreation Surveys (2 indiv, 2 days/week for 16 weeks, every 5 years)(plus 8 hours on July 4th)		hours	264	$ 67	$ 17,655	5	10	$ 176,550	5		O	$ -	$ -	$ -	$ -	$ -	$ 17,655	$ -	$ -	$ -	$ -	$ 17,655	$ -	$ -
General Equipment		set	1	$ 300	$ 300	1	50	$ 15,000	50		O	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300
California Tiger Salamander																								
Breeding habitat adjusted baseline (year 1 only)	115	hours	48	$ 67	$ 3,210		1	$ 3,210	ab1		O	$ 3,210	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Presence/absence surveys (annually)											O	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Surveys	116	hours	168	$ 67	$ 11,235	1	50	$ 561,750	50		O	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235
Minnow trap surveys	117	hours	40	$ 67	$ 2,675	1	50	$ 133,750	50		O	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675
Upland habitat surveys and mapping (every 10 years)											O	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Field characterization	118	hours	48	$ 67	$ 3,210	10	6	$ 19,260	10		O	$ 3,210	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,210	$ -	$ -	$ -
GIS mapping	119	hours	40	$ 67	$ 2,675	10	6	$ 16,050	10		O	$ 2,675	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,675	$ -	$ -	$ -
General Equipment		set	1	$ 300	$ 300	1	50	$ 15,000	50		C	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300
Hybrid studies																								
Adjusted baseline genetic sampling (year 1)	120	hours	56	$ 67	$ 3,745		1	$ 3,745	ab1		O	$ 3,745	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adjusted baseline genetic testing (year 1)	121				$ 27,000		1	$ 27,000	ab1		O	$ 27,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Follow up monitoring (every 3 years)	122	hours	224	$ 67	$ 41,980	3	16	$ 671,680	3		O	$ -	$ -	$ -	$ 41,980	$ -	$ -	$ 41,980	$ -	$ -	$ 41,980	$ -	$ -	$ 41,980
Adaptive Management	123	hours	32	$ 67	$ 2,140	3	16	$ 34,240	3		O	$ -	$ -	$ -	$ 2,140	$ -	$ -	$ 2,140	$ -	$ -	$ 2,140	$ -	$ -	$ 2,140
Relocations	124	hours	8	$ 67	$ 535	1	50	$ 26,750	50		O	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535
Control Methods	125	hours	80	$ 67	$ 5,350	3	16	$ 85,600	3		O	$ -	$ -	$ -	$ 5,350	$ -	$ -	$ 5,350	$ -	$ -	$ 5,350	$ -	$ -	$ 5,350
California Red-legged Frog																								
Breeding habitat adjusted baseline (year 1 only)		hours	48	$ 67	$ 3,210		1	$ 3,210	ab1		O	$ 3,210	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Presence/absence surveys (annually)											O	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Surveys		hours	240	$ 67	$ 16,050	1	50	$ 802,500	50		O	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050
Minnow trap surveys		hours	40	$ 67	$ 2,675	1	50	$ 133,750	50		O	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675
Upland habitat surveys and mapping (every 10 years)											O	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Field characterization		hours	80	$ 60	$ 4,800	10	6	$ 28,800	10		O	$ 4,800	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,800	$ -	$ -	$ -
GIS mapping		hours	40	$ 60	$ 2,400	10	6	$ 14,400	10		O	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,400	$ -	$ -	$ -
General Equipment		set	1	$ 300	$ 300	1	50	$ 15,000	50		C	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300
Total								$ 6,588,908				**$ 168,080**	**$ 114,353**	**$ 114,353**	**$ 159,543**	**$ 110,073**	**$ 128,765**	**$ 159,543**	**$ 111,110**	**$ 106,880**	**$ 177,143**	**$ 124,485**	**$ 110,073**	**$ 160,580**
CSUMB Total (including 20% of TMDC)												**$ 201,696**	**$ 137,223**	**$ 137,223**	**$ 191,451**	**$ 132,087**	**$ 154,518**	**$ 191,451**	**$ 133,332**	**$ 128,256**	**$ 212,571**	**$ 149,382**	**$ 132,087**	**$ 192,696**

Table N-7b. Wildlife Monitoring																					
Cost Item	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Monitoring Contractors/ Covered Wildlife																					
Smith's Blue Butterfly																					
Aerial mapping of habitat (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,943	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,943	$ -	$ -	$ -	$ -
Abundance sampling for host plants																					
Pilot study (years 1 and 2 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adjusted baseline (years 3, 4, and 5 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Abundance monitoring (every 3-5 years)	$ -	$ -	$ -	$ 2,943	$ -	$ -	$ -	$ -	$ 2,943	$ -	$ -	$ -	$ -	$ 2,943	$ -	$ -	$ -	$ -	$ 2,943	$ -	$ -
Species presence/absence surveys	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adjusted baseline (years 1,2, and 3 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Presence/absence surveys (2 surveys every 5 years)	$ -	$ 4,280	$ -	$ -	$ 4,280	$ -	$ 4,280	$ -	$ -	$ 4,280	$ -	$ 4,280	$ -	$ -	$ 4,280	$ -	$ 4,280	$ -	$ -	$ 4,280	$ -
General Equipment-Pilot study (years 1 and 2 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
General Equipment-Adjusted baseline (years 3, 4, and 5 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
General Equipment-Abundance monitoring (every 3-5 years)	$ -	$ -	$ -	$ 300	$ -	$ -	$ -	$ -	$ 300	$ -	$ -	$ -	$ -	$ 300	$ -	$ -	$ -	$ -	$ 300	$ -	$ -
Western Snowy Plover																					
Aerial mapping of habitat (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ 535	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 535	$ -	$ -	$ -	$ -
"Window Surveys" (2 times annually)	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140
Predator Monitoring (bi-monthly, 4 hours during breeding season)	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745
Annual Surveys (2 individuals, 8-hours weekly for 32 weeks)(plus 54 hours revised (1)) (plus 348 hours revised (2))	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124
Annual Reconaissance Surveys (2 individuals, 2-8 hr days)(plus 54 hours revised (1))	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751
Recreation Surveys (2 indiv, 2 days/week for 16 weeks, every 5 years)(plus 8 hours on July 4th)	$ -	$ -	$ 17,655	$ -	$ -	$ -	$ -	$ 17,655	$ -	$ -	$ -	$ -	$ 17,655	$ -	$ -	$ -	$ -	$ 17,655	$ -	$ -	$ -
General Equipment	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300
California Tiger Salamander																					
Breeding habitat adjusted baseline (year 1 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Presence/absence surveys (annually)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Surveys	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235
Minnow trap surveys	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675
Upland habitat surveys and mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Field characterization	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,210	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,210	$ -	$ -	$ -	$ -
GIS mapping	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,675	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,675	$ -	$ -	$ -	$ -
General Equipment	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300
Hybrid studies																					
Adjusted baseline genetic sampling (year 1)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Adjusted baseline genetic testing (year 1)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Follow up monitoring (every 3 years)	$ -	$ -	$ 41,980	$ -	$ -	$ 41,980	$ -	$ -	$ 41,980	$ -	$ -	$ 41,980	$ -	$ -	$ 41,980	$ -	$ -	$ 41,980	$ -	$ -	$ 41,980
Adaptive Management	$ -	$ -	$ 2,140	$ -	$ -	$ 2,140	$ -	$ -	$ 2,140	$ -	$ -	$ 2,140	$ -	$ -	$ 2,140	$ -	$ -	$ 2,140	$ -	$ -	$ 2,140
Relocations	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535
Control Methods	$ -	$ -	$ 5,350	$ -	$ -	$ 5,350	$ -	$ -	$ 5,350	$ -	$ -	$ 5,350	$ -	$ -	$ 5,350	$ -	$ -	$ 5,350	$ -	$ -	$ 5,350
California Red-legged Frog																					
Breeding habitat adjusted baseline (year 1 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Presence/absence surveys (annually)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Surveys	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050
Minnow trap surveys	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675
Upland habitat surveys and mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Field characterization	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,800	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,800	$ -	$ -	$ -	$ -
GIS mapping	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,400	$ -	$ -	$ -	$ -
General Equipment	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300
Total	**$ 106,880**	**$ 111,110**	**$ 173,955**	**$ 110,073**	**$ 111,110**	**$ 156,350**	**$ 127,673**	**$ 124,485**	**$ 159,543**	**$ 111,110**	**$ 106,880**	**$ 160,580**	**$ 124,485**	**$ 110,073**	**$ 160,580**	**$ 106,880**	**$ 127,673**	**$ 173,955**	**$ 110,073**	**$ 111,110**	**$ 156,350**
CSUMB Total (including 20% of TMDC)	**$ 128,256**	**$ 133,332**	**$ 208,746**	**$ 132,087**	**$ 133,332**	**$ 187,620**	**$ 153,207**	**$ 149,382**	**$ 191,451**	**$ 133,332**	**$ 128,256**	**$ 192,696**	**$ 149,382**	**$ 132,087**	**$ 192,696**	**$ 128,256**	**$ 153,207**	**$ 208,746**	**$ 132,087**	**$ 133,332**	**$ 187,620**

Table N-7b. Wildlife Monitoring																					
Cost Item	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Total	Post-Permit te	Frequency (ev	1	2
Monitoring Contractors/ Covered Wildlife																		Y/N			
Smith's Blue Butterfly																					
Aerial mapping of habitat (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ 2,943	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,943	$ 17,655	Y	12-15 yrs	0	0
Abundance sampling for host plants																					
Pilot study (years 1 and 2 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,885	N			
Adjusted baseline (years 3, 4, and 5 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,828	N			
Abundance monitoring (every 3-5 years)	$ -	$ -	$ 2,943	$ -	$ -	$ -	$ -	$ 2,943	$ -	$ -	$ -	$ -	$ 2,943	$ -	$ -	$ 2,943	$ 29,425	Y	5-7 yrs		
Species presence/absence surveys	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Adjusted baseline (years 1,2, and 3 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 12,840	N			
Presence/absence surveys (2 surveys every 5 years)	$ 4,280	$ -	$ -	$ 4,280	$ -	$ 4,280	$ -	$ -	$ 4,280	$ -	$ 4,280	$ -	$ -	$ 4,280	$ -	$ 4,280	$ 81,320	Y	5-7 yrs		
General Equipment-Pilot study (years 1 and 2 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 600	N			
General Equipment-Adjusted baseline (years 3, 4, and 5 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 900	N			
General Equipment-Abundance monitoring (every 3-5 years)	$ -	$ -	$ 300	$ -	$ -	$ -	$ -	$ 300	$ -	$ -	$ -	$ -	$ 300	$ -	$ -	$ 300	$ 3,000	Y	5-7 yrs		
Western Snowy Plover																					
Aerial mapping of habitat (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ 535	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 535	$ 3,210	Y	12-15 yrs		
"Window Surveys" (2 times annually)	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 107,000	Y	1	$ 2,140	$ 2,140
Predator Monitoring (bi-monthly, 4 hours during breeding season)	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 3,745	$ 187,250	Y	3-5 years		
Annual Surveys (2 individuals, 8-hours weekly for 32 weeks)(plus 54 hours revised (1)) (plus 348 hours revised (2))	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 61,124	$ 3,056,188	Y	3-5 years		
Annual Reconaissance Surveys (2 individuals, 2-8 hr days)(plus 54 hours revised (1))	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 5,751	$ 287,563	Y	3-5 years		
Recreation Surveys (2 indiv, 2 days/week for 16 weeks, every 5 years)(plus 8 hours on July 4th)	$ -	$ 17,655	$ -	$ -	$ -	$ -	$ 17,655	$ -	$ -	$ -	$ -	$ 17,655	$ -	$ -	$ -	$ 17,655	$ 176,550	N			
General Equipment	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 15,000	Y	3-5 years		
California Tiger Salamander																					
Breeding habitat adjusted baseline (year 1 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,210	N			
Presence/absence surveys (annually)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Surveys	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 11,235	$ 561,750	Y	3-5 years	$ 11,235	
Minnow trap surveys	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 133,750	Y	3-5 years	$ 2,675	
Upland habitat surveys and mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Field characterization	$ -	$ -	$ -	$ -	$ -	$ 3,210	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,210	$ 19,260	Y	3-5 years	$ 3,210	
GIS mapping	$ -	$ -	$ -	$ -	$ -	$ 2,675	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,675	$ 16,050	Y	3-5 years	$ 2,675	
General Equipment	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 15,000	Y	3-5 years	$ 300	
Hybrid studies																					
Adjusted baseline genetic sampling (year 1)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,745	N			
Adjusted baseline genetic testing (year 1)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 27,000	N			
Follow up monitoring (every 3 years)	$ -	$ -	$ 41,980	$ -	$ -	$ 41,980	$ -	$ -	$ 41,980	$ -	$ -	$ 41,980	$ -	$ -	$ 41,980	$ -	$ 671,680	Y	3-5 years	$ 11,235	
Adaptive Management	$ -	$ -	$ 2,140	$ -	$ -	$ 2,140	$ -	$ -	$ 2,140	$ -	$ -	$ 2,140	$ -	$ -	$ 2,140	$ -	$ 34,240	Y	3-5 years	$ 11,235	
Relocations	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 535	$ 26,750	Y	3-5 years	$ 11,235	
Control Methods	$ -	$ -	$ 5,350	$ -	$ -	$ 5,350	$ -	$ -	$ 5,350	$ -	$ -	$ 5,350	$ -	$ -	$ 5,350	$ -	$ 85,600	Y	3-5 years	$ 11,235	
California Red-legged Frog																					
Breeding habitat adjusted baseline (year 1 only)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,210	N			
Presence/absence surveys (annually)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Surveys	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 16,050	$ 802,500	Y	3-5 years		$ 16,050
Minnow trap surveys	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 2,675	$ 133,750	Y	3-5 years		$ 2,675
Upland habitat surveys and mapping (every 10 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Field characterization	$ -	$ -	$ -	$ -	$ -	$ 4,800	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,800	$ 28,800	Y	3-5 years		$ 4,800
GIS mapping	$ -	$ -	$ -	$ -	$ -	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,400	$ 14,400	Y	3-5 years		$ 2,400
General Equipment	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300	$ 15,000	Y	3-5 years		$ 300
Total	**$ 111,110**	**$ 124,485**	**$ 159,543**	**$ 111,110**	**$ 106,880**	**$ 177,143**	**$ 124,485**	**$ 110,073**	**$ 160,580**	**$ 106,880**	**$ 111,110**	**$ 173,955**	**$ 110,073**	**$ 111,110**	**$ 156,350**	**$ 148,570**	**$ 6,588,908**	**$ -**	**$ 1**	**$ 67,175**	**$ 28,365**
CSUMB Total (including 20% of TMDC)	**$ 133,332**	**$ 149,382**	**$ 191,451**	**$ 133,332**	**$ 128,256**	**$ 212,571**	**$ 149,382**	**$ 132,087**	**$ 192,696**	**$ 128,256**	**$ 133,332**	**$ 208,746**	**$ 132,087**	**$ 133,332**	**$ 187,620**	**$ 178,284**	**$ 7,906,689**	**$ -**	**$ 1**	**$ 80,610**	**$ 34,038**

Table N-7b. Wildlife Monitoring														
Cost Item	3	4	5	6	7	8	9	10	11	12	13	14	15	Post-Permit Avg. Annual Cost
Monitoring Contractors/ Covered Wildlife														
Smith's Blue Butterfly														
Aerial mapping of habitat (every 10 years)	0	0	0	0	0	0	0	0	0	$ 2,943	0	0	0	
Abundance sampling for host plants														
Pilot study (years 1 and 2 only)														
Adjusted baseline (years 3, 4, and 5 only)														
Abundance monitoring (every 3-5 years)			$ 2,943											
Species presence/absence surveys														
Adjusted baseline (years 1,2, and 3 only)														
Presence/absence surveys (2 surveys every 5 years)			$ 4,280											
General Equipment-Pilot study (years 1 and 2 only)														
General Equipment-Adjusted baseline (years 3, 4, and 5 only)														
General Equipment-Abundance monitoring (every 3-5 years)			$ 300											
Western Snowy Plover														
Aerial mapping of habitat (every 10 years)											$ 535			
"Window Surveys" (2 times annually)	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	$ 2,140	
Predator Monitoring (bi-monthly, 4 hours during breeding season)	$ 3,745			$ 3,745			$ 3,745			$ 3,745			$ 3,745	
Annual Surveys (2 individuals, 8-hours weekly for 32 weeks)(plus 54 hours revised (1)) (plus 348 hours revised (2))	$ 61,124			$ 61,124			$ 61,124			$ 61,124			$ 61,124	
Annual Reconaissance Surveys (2 individuals, 2-8 hr days)(plus 54 hours revised (1))	$ 5,751			$ 5,751			$ 5,751			$ 5,751			$ 5,751	
Recreation Surveys (2 indiv, 2 days/week for 16 weeks, every 5 years)(plus 8 hours on July 4th)							$ -			$ -			$ -	
General Equipment	$ 300			$ 15,000			$ 300			$ 300			$ 300	
California Tiger Salamander														
Breeding habitat adjusted baseline (year 1 only)														
Presence/absence surveys (annually)														
Surveys		$ 11,235			$ 11,235			$ 11,235			$ 11,235			
Minnow trap surveys		$ 2,675			$ 2,675			$ 2,675			$ 2,675			
Upland habitat surveys and mapping (every 10 years)														
Field characterization		$ 3,210			$ 3,210			$ 3,210			$ 3,210			
GIS mapping		$ 2,675			$ 2,675			$ 2,675			$ 2,675			
General Equipment		$ 300			$ 300			$ 300			$ 300			
Hybrid studies														
Adjusted baseline genetic sampling (year 1)														
Adjusted baseline genetic testing (year 1)														
Follow up monitoring (every 3 years)		$ 11,235			$ 11,235			$ 11,235			$ 11,235			
Adaptive Management		$ 11,235			$ 11,235			$ 11,235			$ 11,235			
Relocations		$ 11,235			$ 11,235			$ 11,235			$ 11,235			
Control Methods		$ 11,235			$ 11,235			$ 11,235			$ 11,235			
California Red-legged Frog														
Breeding habitat adjusted baseline (year 1 only)														
Presence/absence surveys (annually)														
Surveys			$ 16,050			$ 16,050			$ 16,050			$ 16,050		
Minnow trap surveys			$ 2,675			$ 2,675			$ 2,675			$ 2,675		
Upland habitat surveys and mapping (every 10 years)														
Field characterization			$ 4,800			$ 4,800			$ 4,800			$ 4,800		
GIS mapping			$ 2,400			$ 2,400			$ 2,400			$ 2,400		
General Equipment			$ 300			$ 300			$ 300			$ 300		
Total	**$ 73,060**	**$ 67,175**	**$ 35,888**	**$ 87,760**	**$ 67,175**	**$ 28,365**	**$ 73,060**	**$ 67,175**	**$ 28,365**	**$ 76,003**	**$ 67,710**	**$ 28,365**	**$ 73,060**	**$ 57,913**
CSUMB Total (including 20% of TMDC)	**$ 87,672**	**$ 80,610**	**$ 43,065**	**$ 105,312**	**$ 80,610**	**$ 34,038**	**$ 87,672**	**$ 80,610**	**$ 34,038**	**$ 91,203**	**$ 81,252**	**$ 34,038**	**$ 87,672**	**$ 69,496**

Cost Item	Assump-tion
Frequency codes	
Aerial mapping of habitat - every 10 years, starting yr 1	10
Pilot studies - years 1 and 2 only	p12
Adjusted baseline- years 3,4,5 only	ab345
Abundance monitoring- every 3-5 yrs, starting yr 7	4
Adjusted baseline- years 1,2,3	ab123
Presence/absence surveys (2 surveys every 5 yrs)	pa2.5
Annual costs	50
Surveys every 5 years, starting year 6	5
Adjusted baseline- year 1 only	ab1
Adjuested baseline - years 2 and 3 only	ab23
Biological monitoring contractors - hourly cost	
Base cost per hour, Bay Area ES-II billing rate	$ 95
Per diem including lodging ($ per day)	$ 175
Travel ($ per day)	$ 55
Miles assumed for travel	100
Dollars per mile for travel	$ 0.550
Hours per day	8
Contractor cost per hour including amortized per diem and travel	**$124**
Biological monitoring-CSUMB	
Base rate	$ 60
Per diem including lodging ($ per day)	$ -
Travel ($ per day)	$ 55
Miles assumed for travel	100
Dollars per mile for travel	$ 0.550
Hours per day	8
CSUMB personell per hour rate + travel	**$67**

Table N-8a. Unexpected Costs

	Notes	Unit	Avg. Cost/Unit	# of Units per Year	Avg Annual Cost	50 Year Cost	C/O	Post-Permit Term	Sources
Remedial measures (Changed Circumstances)									
Catastrophic fire (12 times during permit term)	see below	event	$ 74,644	0.24	$ 17,915	$ 895,731	O	n/a	
Coastal erosion	see below	event	$ 43,942	1.00	$ 43,942	$ 2,197,079	O	n/a	
Storm-related hillside erosion/landsliding	see below	event	$ 41,727	1.00	$ 41,727	$ 2,086,368	O	n/a	
Invasion by new exotic species or disease	see below	event	$ 20,804	1.00	$ 20,804	$ 1,040,197	O	n/a	
Earthquake-related damage to HMA property	see below	event	$ 3,349	1.00	$ 3,349	$ 167,471	O	n/a	
Contingency Measures									
Overall Contingency (minus restoration) (5%)	5%	flat rate	$ 158,045	1.00	$ 158,045	$ 7,902,237	O	n/a	
Restoration Contingency (15%)	15%	flat rate	$ 438,566	0.15	$ 65,785	$ 8,771,323	C	n/a	
TOTALS					**$ 351,567**	**$ 23,060,405**		**n/a**	

Permit Term Cost by Management entity	**BLM**	**BLM**	**SP**	**SP**	**UC**	**UC**	**JPA**	**JPA**	**Total**
Remedial measures (Changed Circumstances)	**Multiplier**	**Cost**	**Multiplier**	**Cost**	**Multiplier**	**Cost**	**Multiplier**	**Cost**	
Catastrophic fire (12 times during permit term)	0%	$ -	0%	$ -	0%	$ -	100%	$ 17,915	$ 17,915
Coastal erosion	0%	$ -	0%	$ -	0%	$ -	100%	$ 43,941.57	$ 43,942
Storm-related hillside erosion/landsliding	0%	$ -	0%	$ -	0%	$ -	100%	$ 41,727.36	$ 41,727
Invasion by new exotic species or disease	0%	$ -	0%	$ -	0%	$ -	100%	$ 20,804	$ 20,804
Earthquake-related damage to HMA property	0%	$ -	0%	$ -	0%	$ -	100%	$ 3,349	$ 3,349
Total remedial								$ 127,737	$ 127,737
Contingency Measures									
Budget Contingency (minus restoration) (5%)	100%	$ 89,488	100%	$ 13,703	100%	$ 8,509	100%	$ 46,344	$ 158,045
Restoration Contingency (15% * average Annual rest. cost) (only for first 20 years)	15%	$ 17,896	15%	$ 45,133	15%	$ 1,969	15%	$ 1,451	$ 66,449
TOTALS	0%	**$ 107,384**	**$ -**	**$ 58,836**	**$ -**	**$ 10,478**		**$ 303,269**	**$ 479,967**
	15%	Contingency factor for restoration; assumed to be higher than standard contingency							

Table N-8b. Catastrophic Fire

	Notes	Unit	Avg. Cost/Unit	# of Units per Year	Avg Annual Cost
Employees					
Biotech Lead (1 month)		annual salary	$ 87,420.00	0.08	$ 7,285.00
Biotech field worker (1 month)		annual salary	$ 54,595.00	0.08	$ 4,549.58
Equipment operator (1 month)		annual salary	$ 84,405.00	0.08	$ 7,033.75
Ft. Ord Manager (1% of time)		annual salary	$ 149,414.00	0.01	$ 1,494.14
Total					*$ 20,362.47*
Erosion control					
Equipment rental (1 week)		per rental	$ 1,081.00	5.00	$ 5,405.00
Hydromulch (5% of average burn area)		per acre	$ 2,161.00	14.15	$ 30,578.15
seeds and seedlings (1% of average burn area)		per acre	$ 6,000.00	2.83	$ 16,980.00
Invasive weed control					
Herbicides / spray equipment		per acre	$ 0.20	286.00	$ 58.59
Hand Tools (i.e. shovels, pulaskis, etc)		per set	$ 1,260.00	1.00	$ 1,260.00
TOTAL					**$ 74,644.21**

Catastrophic fire assumptions:
12 fire events over 50 years
1 fire up to 1,274 acres
average fire size 283 acres
total acres burned =3,396 acres
remedial actions would take place over 1 month
erosion control and invasive weed control

Table N-8c. Coastal Erosion

	Notes	Unit	Avg. Cost/Unit	# of Units per Year	Avg Annual Cost
Employees					
Biotech Lead (2 weeks)		annual salary	$ 55,000.00	0.04	$ 2,115.38
Biotech field worker (2 weeks)		annual salary	$ 45,000.00	0.04	$ 1,730.77
Equipment operator (2 weeks)		annual salary	$ 71,000.00	0.04	$ 2,730.77
Ft. Ord Manager (1% of time)		annual salary	$ 97,760.00	0.01	$ 977.60
Total					$ 7,554.52
Erosion control					
Equipment rental (2 weeks)		per rental	$ 1,081.00	10.00	$ 10,810.00
Hydromulch (9 acres)		per acre	$ 2,161.00	9.00	$ 19,449.00
seeds and seedlings (1 acres)		per acre	$ 6,000.00	1.00	$ 6,000.00
Invasive weed control					
Herbicides / spray equipment		per acre	$ 0.20	10.00	$ 2.05
Hand Tools (i.e. shovels, pulaskis, etc) 1 set every ten years		per set	$ 1,260.00	0.10	$ 126.00
TOTAL					**$ 43,941.57**

Coastal erosion assumptions: addition restoration/enhancement areas may be needed due to habitat loss due to coastal erosion
remedial action would take place over 2 week
erosion control and invasive weed control
420 acres total; 10 acres per year

Table N-8d. Storm-Related Hillside Erosion/Landsliding

	Notes	Unit	Avg. Cost/Unit	# of Units per Year	Avg Annual Cost
Employees					
Biotech Lead (1 week)		annual salary	$ 55,000.00	0.02	$ 1,057.69
Biotech field worker (1 week)		annual salary	$ 45,000.00	0.02	$ 865.38
Equipment operator (1 week)		annual salary	$ 71,000.00	0.02	$ 1,365.38
Ft. Ord Manager (.05% of time)		annual salary	$ 97,760.00	0.01	$ 488.80
TOTAL					$ 3,777.26
Erosion control					
Equipment rental (1 week)		per rental	$ 1,081.00	5.00	$ 5,405.00
Hydromulch (15 acres)		per acre	$ 2,161.00	15.00	$ 32,415.00
Invasive weed control					
Herbicides / spray equipment		per acre	$ 0.20	20.00	$ 4.10
Hand Tools (i.e. shovels, pulaskis, etc) 1 set every ten years		per set	$ 1,260.00	0.10	$ 126.00
TOTAL					**$ 41,727.36**
Erosion/landsliding assumptions: erosion control and invasive weed control would be needed 15 acres annually					

Table N-8e. Invasion By New Exotic Species or Disease

	Notes	Unit	Avg. Cost/Unit	# of Units per Year	Avg Annual Cost
Employees					
Biotech Lead (4 weeks)		annual salary	$ 55,000.00	0.08	$ 4,230.77
Biotech field worker (4 weeks)		annual salary	$ 45,000.00	0.08	$ 3,461.54
Equipment operator (4 weeks)		annual salary	$ 71,000.00	0.08	$ 5,461.54
Ft. Ord Manager (.05% of time)		annual salary	$ 97,760.00	0.08	$ 7,520.00
Total					$ 20,673.85
Supplies					
Herbicides / spray equipment		per acre	$ 0.20	20.00	$ 4.10
Hand Tools (i.e. shovels, pulaskis, etc) 1 set every ten years		per set	$ 1,260.00	0.10	$ 126.00
TOTAL					**$ 20,803.94**

Table N-8f. Earthquake-Related Damage to HMA Property

		Unit	Avg. Cost/Unit	# of Units per Year	Avg Annual Cost
Employees					
Maintenance Worker WG 9/3	CC-1	annual salary	$ 62,000.00	0.02	$ 1,192.31
Maintenance Worker WG 9/3	CC-1	annual salary	$ 62,000.00	0.02	$ 1,192.31
Ft. Ord Manager (.05% of time)	CC-1	annual salary	$ 97,760.00	0.01	$ 488.80
TOTAL	CC-1				$ 2,873.42
Fence repair/replacement					
Fence repair/replacement	CC-1	per linear ft.	$ 11.00	10.00	$ 110.00
gate repair/replacement	CC-1	per gate	$ 211.00	1.00	$ 211.00
lock repair/replacement	CC-1	per lock	$ 29.00	1.00	$ 29.00
Hand Tools (i.e. shovels, pulaskis, etc) 1 set every ten years	CC-1	per set	$ 1,260.00	0.10	$ 126.00
TOTAL	CC-1				**$ 3,349.42**
Earthquake-related damage repair: 2 maintenance workers and 10 feet of fence repair and 1 gate annually					

Appendix N

Permit Applicant and BLM Reimbursement Agreements

MEMORANDUM OF AGREEMENT BETWEEN THE FORT ORD REGIONAL HABITAT COOPERATIVE AND THE BUREAU OF LAND MANAGEMENT CONCERNING REIMBURSEMENT OF HABITAT MANAGEMENT SERVICES

THIS MEMORANDUM OF AGREEMENT ("MOA") is made and entered into on __________, 2018 by and between the **Fort Ord Regional Habitat Cooperative** ("Cooperative"), a Joint Powers Authority created, operated and existing under the laws of the State of California and the U.S. Department of the Interior's **Bureau of Land Management** ("BLM"), a federal agency.

I. RECITALS

1.1 In 2018, the Cooperative and other Permit Applicants completed the Installation-Wide Multispecies Habitat Conservation Plan ("HCP") and were issued Incidental Take Permits ("ITP") from U.S. Fish and Wildlife Service ("USFWS") and California Department of Fish and Game ("CDFG") in accordance with the federal Endangered Species Act and the California Endangered Species Act.

1.2 In 1996, BLM received 7,212 acres of former Fort Ord lands from the U.S. Army and will receive another approximately 7,000 acres when the U.S. Army completes remediation activities on additional lands. BLM's former Fort Ord land holdings are referred to as the Natural Resource Management Area ("NRMA").

1.3 BLM has managed the NRMA consistent with the 1997 Installation-Wide Multispecies Habitat Management Plan ("HMP") for over 19 years.

1.4 BLM is a cooperating entity with the 2018 HCP.

1.5 The Cooperative must perform numerous HCP required actions related to the 2018 HCP and, given BLM's experience in performing similar actions, seeks to establish a contractual relationship with BLM to complete certain HCP required actions.

II. TERMS AND CONDITIONS

In consideration for the mutual promises contained herein the parties agree as follows:

2.1 **Deliverables.** BLM agrees to complete HCP required actions on behalf of the Cooperative, as described in **Attachment A – Scope of Services**, for not to exceed $_____________.

2.2 **Reimbursable Amount.** BLM will submit monthly invoices to the Cooperative as it completes the services described in **Attachment A**, not to exceed a total of $_________. Cooperative agrees to pay these invoices within thirty days of receipt.

2.3 **Hold Harmless.** BLM agrees to indemnify, defend and hold Cooperative harmless from any claim arising out of this work except claims based on nonpayment by Cooperative as provided in this agreement.

III. TERM AND TERMINATION

3.1 Term of Agreement. This Agreement shall terminate in one year or when all of the terms and conditions have been met or upon mutual agreement between the parties or their assignees.

3.2 Termination for Breach. If a party commits a material breach, the non-breaching party may terminate this Agreement by giving the party in breach written notice thereof and thirty (30) days in which to cure the breach. If the breach is not cured within thirty (30) days, this Agreement will be terminated upon the breaching party being given notice thereof by the non-breaching party. If the breach is curable, but not within 30 days, the non breaching party may not terminate the sale so long as the breaching party diligently works to cure the breach. If the breach is incurable within thirty (30) days, the breaching party shall not be considered to be in default so long as it diligently and in good faith continues to cure the breach in a reasonably diligent manner thereafter up to 90 days after the breach.

IV. GENERAL TERMS

4.1 Further Actions. Each of the parties agree to execute and deliver to the other such documents and instruments, and to take such actions, as may reasonably be required to give effect to the terms and conditions of this Agreement.

4.2 Modification. This Agreement is not subject to amendment or modification except by a writing signed by the parties hereto.

4.3. Assignment. Neither party may assign all or portions of its rights and obligations under this Agreement without prior written approval from the other party. Any Agents for the parties shall not unreasonably withhold approval of an assignment.

5. Interpretation. This Agreement has been negotiated by and between representatives of the parties hereto and their staffs, all persons knowledgeable in the subject matter of this Agreement, which was then reviewed by the respective legal counsel of each party. Accordingly, any rule of law (including Civil Code §1654) or legal decision that would require interpretation of any ambiguities in this Agreement against the party that has drafted it is not applicable and is waived. The provisions of this Agreement shall be interpreted in a reasonable manner to affect the purpose of the parties and this Agreement.

6. Attorney's Fees. In the event of any controversy, claim or dispute relating to this Agreement, or the breach thereof, the prevailing party shall be entitled to recover from the losing party reasonable expenses, attorney's fees and costs. Monterey County will be the venue for hearing any disputes.

7. Notice and Correspondence. Any notice required to be given to any party shall be in writing and deemed given if personally delivered upon the other party or deposited in the United States mail, and sent certified mail, return receipt requested, postage prepaid and addressed to the other party at the address set forth below or sent via facsimile transmission during normal business hours to the party to which notice is given at the telephone number listed for fax transmission.

<u>BUREAU OF LAND MANAGEMENT:</u>

Fort Ord Manager
Bureau of Land Management
Fort Ord Project Office, Hollister Resource Area
20 Hamilton Court
Hollister, California 95023
Telephone: (831) 394-8314
Facsimile: (831) 394-8346

<u>COOPERATIVE:</u>

Executive Director
Fort Ord Regional Habitat Cooperative
920 2nd Ave., Ste. A
Marina, California 93933
Telephone: (831) 883-3672
Facsimile: (831) 883-3675

8. <u>Areas of Non-Responsibility</u>. Neither party shall be liable for commitments made to a third party by the other party which are:

a. contrary to this Agreement or
b. not specifically included within the obligations of the parties hereto.

Each party shall defend, indemnify and hold the other harmless for any claims, costs, damages or other liability arising from such statements, representations or commitments.

9. <u>No Third Party Rights</u>. This Agreement shall not create any benefits or rights in third parties.

IN WITNESS WHEREOF, COOPERATIVE, and BLM, by their duly authorized representatives, have executed this Agreement as of the date first written above.

COOPERATIVE

By: ______________________________ As to form:______________________________
Executive Director Counsel

BUREAU OF LAND MANAGEMENT

By: ___________________________ As to form:______________________________
Fort Ord Manager Solicitor

Appendix O
Habitat Conservation Plan Endowment Cash Flow Strategy

MEMORANDUM

To: Michael Houlemard, Jr., Executive Officer, Fort Ord Reuse Authority

From: David Zehnder, Ellen Martin, and Kate O'Beirne

Subject: Habitat Conservation Plan Endowment Cash Flow Strategy; EPS #192003

Date: August 29, 2019

The Economics of Land Use

The Fort Ord Reuse Authority (FORA) retained Economic & Planning Systems, Inc. (EPS) to evaluate financing options for the Habitat Conservation Plan (HCP) endowment. The HCP endowment will be capitalized with revenues from the FORA Mello-Roos Community Facilities District (CFD) special tax (CFD Special Tax) or replacement funding mechanism. This draft memorandum is provided to document the HCP funding strategy in support of the submittal of the HCP report to the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW).

Endowment Funding Strategy Overview

The endowment funding strategy is illustrated in **Figure 1**. This strategy is to create and fund two separate endowments, one of which is composed of three funds:

- University of California (UC) Fort Ord Natural Reserve (FONR) Endowment Fund.
- Cooperative Endowment Fund:
  - HCP Fund.
  - Implementation Assurances Fund (IAF).
  - Borderlands Fund (BL).

The funding strategy recognizes three time periods to be considered:

1. Start-Up Costs.
2. Permit Term (period of the 50-year permit term).
3. Post-Permit Term (annually in perpetuity following expiration of the 50-year permit term).

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As described herein, the funding requirements for HCP-required actions and related costs vary during each distinct time period. As a result, the funding strategy reflects differing annual cash flow requirements for each endowment fund during the respective time periods. In general, the funding strategy relies on existing cash on hand and annual pay-as-you-go funding for initial costs and simultaneously builds each required endowment fund to pay for ongoing costs during the permit term and post-permit term (in perpetuity).

Endowment Funding Strategy—Guiding Principles

The endowment funding strategy has been shaped by the unique circumstances related to the HCP, including those listed below:

- Multiple agencies with mitigation requirements.
- State of California (State) Department of Parks and Recreation will perform a portion of the mitigation.
- Existing mitigation areas that are being maintained and managed.
- Nature of the primary funding source that will fund HCP endowments.

Given the unique circumstances of the HCP, the overall endowment capitalization and ongoing HCP funding strategy was created, based on the following set of guiding principles:

- Provide adequate funding for annual HCP costs when required.
- Synchronize the collection of revenue from new development with capitalization of the endowment funds, which are being used to mitigate habitat for new development.
- Maximize the use of pay-as-you-go financing.
- Flexibility in the overall funding strategy to adapt, as necessary, to changed circumstances (e.g., faster or slower pace of development, cost efficiencies, or inclusion of additional future revenue sources).
- Ensure permittees (other than State Parks and Monterey Peninsula Regional Park District) are not liable for annual HCP costs from General Funds.
- Deploy existing resources initially to the highest priority needs.
- Use existing staff and resources to minimize initial annual HCP costs.
- Cooperative to act as habitat management and Cooperative Endowment steward.

Endowment Funding Objectives

Through its flexibility and funding structure, the endowment funding strategy best meets the multiple objectives of CDFW, USFWS, Permittees, and future developers. The endowment funding strategy provides funding assurances to CDFW for required habitat management during the HCP permit and post-permit terms. The endowments will be held in conservative fixed-income securities, providing a low-risk investment vehicle to fund annual habitat management costs in perpetuity, thereby protecting member jurisdictions from incurring fiscal liabilities to their General Funds.

Moreover, the endowment funding strategy is designed to generate the required level of funding needed to cover permit-term and post-permit-term costs. The use of interest earnings and a principal drawdown reduces the CFD Special Tax or future replacement funding mechanism revenue needed to fund annual endowment costs, as compared to a strategy that does not incorporate a principal drawdown feature.

In addition, the endowment funding strategy includes several mechanisms to enable funds to be flexibly allocated to costs when they are needed:

- The allocated share of CFD Special Tax revenue (or future replacement funding mechanism) for habitat management can be adjusted annually to reflect funding needs.
- The proportionate allocation of CFD Special Tax revenue to each endowment fund also can be adjusted.
- Both annual habitat management costs and CFD Special Tax revenues are triggered by FORA’s land use development. If the pace of development is slow, annual CFD Special Tax revenues would be generated at a slower rate. However, the timing of required habitat mitigation measures also would be delayed, consequently reducing annual habitat management costs. This relation between annual endowment costs and revenues reduces the possibility of inordinate funding shortfalls being experienced during the permit and post-permit periods.

Proposed Endowment Management Option

Several endowment management options could be used to manage the HCP endowment funds. Passage of State Senate Bill No. 1094 (Kehoe) in 2012 affected the range of options available to Permittees for holding and managing endowment funds. In summary, for any endowment holder, they must be pre-approved by the State or complete a State approval/review process. The Proposed Endowment Management Option would use the UC’s pre-approved General Endowment Pool to hold the FONR Endowment and follow the State’s review process for cooperative/third-party management of the Cooperative Endowment.

Cooperative Endowment/Third-Party Management

This option is designed to provide the highest target payout rate/capitalization rate of 4.5 percent for the Cooperative Endowment. It has support of the Permittees because it provides the Cooperative with oversight for selection and management of a third-party endowment manager. As the preferred option, the cash flow tables attached to this draft memorandum are based on the assumption that the endowment will be managed by a third-party endowment holder.

To implement this option, the Cooperative would issue a Request for Proposals (RFP) to investment advisors of qualified firms to solicit proposals for endowment management. The RFP would identify the criteria required for the endowment holder and the investment policy for the endowments. The Cooperative would evaluate the proposals based on the criteria in the RFP, interview finalists, and make a selection based on the quality of service proposed, anticipated annual return, and flexibility.

The target payout rate for the HCP Endowment Fund is 4.5 percent. To obtain this payout rate, the Cooperative will follow CDFW/State law procedures to review/certify a third-party endowment manager/investment institution that can obtain this targeted higher rate of return.

Endowment Cash Flow Strategy

During the start-up phase of the endowment, cash on hand and CFD Special Tax revenues are used to cover start-up and initial annual costs and to fund each of the four separate funds (two endowments). Over the long term, the endowment cash flow strategy is structured to fund annual costs during the permit term and develop an adequate funding reserve to cover annual post-permit costs in perpetuity. This approach is carried out through two key mechanisms in the cash flow model:

- Endowment capitalization over time as CFD Special Tax revenue is collected from new development. In each fund, the inflows and outflows of cash are managed to ensure that each fund reaches a level to generate sufficient interest earnings to cover annual costs during the post-permit term.
- Principal balance drawdown during the permit term. Because the ongoing costs for the UC, HCP, and IAF decline during the post-permit phase, a principal drawdown feature is included, whereby a portion of the fund principal is used to pay ongoing costs during later years of the permit term. This drawdown occurs until the ending balances reach the amount required to maintain each fund in perpetuity during the post-permit term.

Figure 2 shows the effect of the endowment capitalization and principal drawdown feature over time. The HCP, UC, and IAF will experience an annual increase in the fund balance, followed by a gradual decrease in the later permit term years as a result of the principal drawdown. Because the BL fund will experience the same annual costs in the permit and post-permit terms, a principal drawdown feature is not included. Thus, the BL fund balance will remain constant from the permit term through the post-permit term. Some flexibility in the program could allow other sources to fund annual costs.

Cash Flow Assumptions

Assumptions used to develop the endowment funding strategy are summarized in **Table 1**. The text below summarizes critical assumptions used to prepare the endowment funding strategy:

- The permit term is assumed to begin in Fiscal Year (FY) 2020–21 and end in FY 2069-70. The post-permit term is assumed to begin in FY 2070-71.
- Annual start-up costs and ongoing costs were provided by FORA and are shown in **Table 2**. Average annual ongoing costs were estimated for the permit and post-permit term.
- Annual endowment funding growth is based on cash on hand, CFD Special Tax revenues from annual development, and interest earnings on annual endowment account balances.
- An annual interest rate of 4.5 percent is assumed for the HCP, IAF, and BL funds. The UC endowment is based on an annual assumed interest rate of 4.2 percent.
- The targeted endowment return rates are net of inflation.
- According to FORA, $15,979,149 in cash on hand is available to fund endowment costs. The funding strategy allocates 2.8 percent of these existing funds to fund start-up costs for the HCP and 6.4 percent for UC start-up costs. The remainder of the beginning endowment balance

allocates 86.6 percent to the HCP and 13.4 percent to UC. This allocation provides coverage for the start-up costs assumed to be incurred during the first year of the permit term.

- CFD Special Tax rates are as of FY 2019-20, as noted on the Notice of Special Tax Lien as of July 1, 2019, posted on the FORA Web site.
- The annual share of total CFD Special Tax revenues allocated to the endowments is assumed to be 30.0 percent for FY 2020-21, with the share reducing over time to 29.4 percent in FY 2021-22 to FY 2029-30, as shown in **Tables 3** and **4**. This breakdown represents the estimated annual allocation to meet endowment funding needs and accelerate endowment capitalization. Historically, the FORA Board has set aside 30.2 percent of annual CFD Special Tax revenues for HCP costs. This amount was based on a FORA Board policy decision and is in no way required by the regulatory agencies or otherwise mandated by an outside agency.
- Starting in FY 2020-21 and through the post-permit term, the annual allocation of CFD Special Tax revenues to each endowment is based on the following breakdown, as shown in **Table 4**:

Fund	Allocation Share
HCP	51.51%
UC FONR	13.67%
IAF	19.36%
BL	15.46%

  These amounts are flexible and can be adjusted in different proportions as necessary based on existing commitments and other obligations.

- The annual residential and nonresidential development schedule is based on the latest FORA Capital Improvement Program (CIP) cash flow and was informed by information from each of FORA's member jurisdictions.

Cash Flow Analysis

This section describes each of the tables that illustrate the endowment funding strategy. The initial tables identify major assumptions and endowment requirements. The subsequent tables identify annual cost and revenue calculations.

Table 1 describes endowment cash flow strategy modelling assumptions, including the permit-term and post-permit-term periods, total endowment requirements and annual costs, and initial CFD Special Tax rates by land use type. **Table 5** identifies the permit and post-permit term maximum endowment requirements and annual costs by fund, including the assumed payout rate and annual revenue that will be generated. This information was provided by FORA and ICF International.

Annual Cost Estimates

FORA provided EPS with annual initial and ongoing costs for each endowment fund, as shown in **Table 2**. Ongoing costs are anticipated to ramp up over time; however, **Table 2** identifies full costs needed to cover endowment needs in perpetuity because the rate at which costs and CFD contributions will ramp up is uncertain. The endowment model includes all costs to ensure that costs are acknowledged and funded. Some assumptions pertaining to annual costs are therefore less visible.

Annual Revenue Estimates

Table 6 shows FORA's annual forecast for residential and commercial development. The time horizon of the development forecast commences in FY 2020-21 and concludes in FY 2029-30. Annual CFD Special Tax revenues or a replacement funding mechanism for habitat management are based on the land use forecast, CFD Special Tax rates, and the assumed share of total revenue that will be allocated to habitat management costs. CFD Special Tax revenues are calculated in **Table 3**. As shown, the share of CFD Special Tax revenues for habitat management varies over time: starting at 30.0 percent for FY 2020-21 and declining to 29.4 percent from FY 2021-22 through FY 2029-30. The allocated shares are based on the amount of CFD Special Tax revenue needed to capitalize the endowment funds. If necessary, these percentages could be increased or decreased, based on identified need and Board policy decisions.

The CFD Special Tax revenues will be allocated to each endowment fund to cover annual initial and ongoing costs for habitat management. The allocation shares for each fund are shown in **Table 4**. The assumed breakdown is based on the amount needed to meet endowment funding requirements. The percentage allocation to each fund is assumed to remain constant each year but, again, could be revised during any given time period, if necessary, based on identified need and Board policy decisions.

Table 7 identifies the total annual CFD Special Tax revenues allocated to each fund based on the allocation shares in **Table 4**. In addition, **Table 7** compares the total CFD Special Tax revenues during the permit term to the maximum endowment amount estimated in **Table 3**. The total CFD Special Tax revenues generated by development do not necessarily reach the required maximum endowment amount for a given fund. This is because annual interest earnings and the principal drawdown generate a significant share of revenue for annual costs.

Cash Flow Performance

Table 8 summarizes the annual cash flow performance of all four funds. The cash flow summary includes the following components:

- Beginning balance.
- Interest earnings.
- Deposits (CFD Special Tax or replacement funding mechanism revenue for habitat management).
- Transfers in (from other endowment funds or other sources).
- Annual costs.
- Transfers out (to other endowment funds, if necessary).
- Ending balance.

The annual costs in FY 2070-71 are for habitat management activities that will be required after the permit term in perpetuity. **Tables 9** through **12** contain individual cash flow summaries of the HCP, UC, IAF, and BL funds and reflect the same structure as in **Table 8**. Each individual endowment cash flow table demonstrates that annual cash flow requirements will be met, thereby assuring HCP management activities will be adequately funded.

Table 13 demonstrates the principal drawdown feature by comparing interest earnings and annual costs for each endowment fund from FY 2020-21 through FY 2069-70. The differences between annual costs and interest earnings during the permit term illustrate that annual habitat management costs will be covered by interest earnings and by a portion of the endowment principal. This drawdown feature is to continue until FY 2069-70 and cease once the ending balance reaches the amount required to maintain each endowment fund in perpetuity during the post-permit term.

EPS looks forward to discussing this further with you, the FORA Board, and ultimately the affected regulatory agencies.

Figure 1
FORA Endowment Funding Strategy

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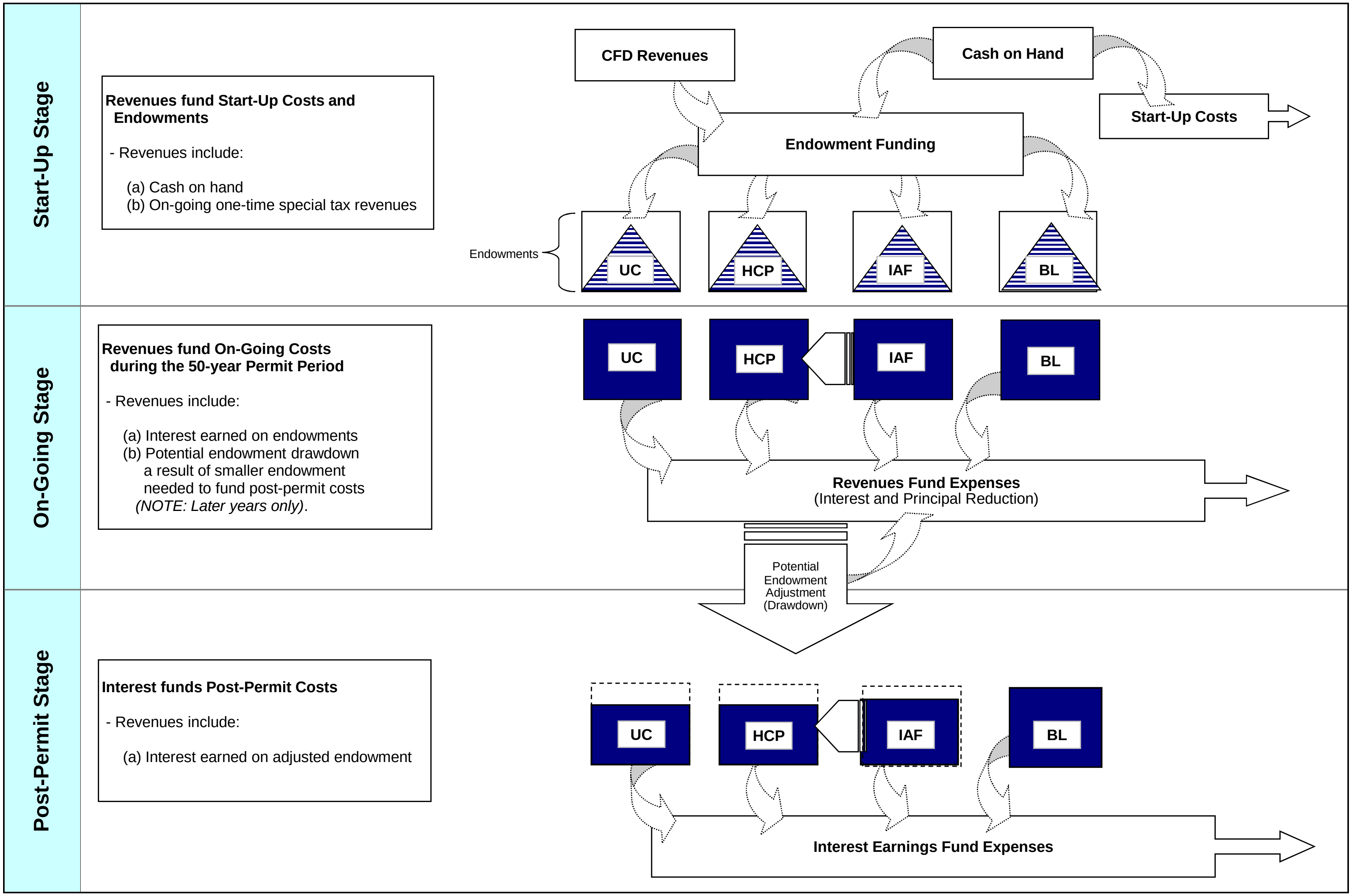

UC = UC/NRSs Endowment Fund	= Period of increased endowment funding	= IAF funds HCP as necessary	
HCP = Cooperative HCP Endowment Fund	= Required endowment		
IAF = Implementation Assurances Fund	= Maximum endowment		
BL = Borderland Management Cost/Fund	= Actual current endowment		

Prepared by EPS 8/12/2019

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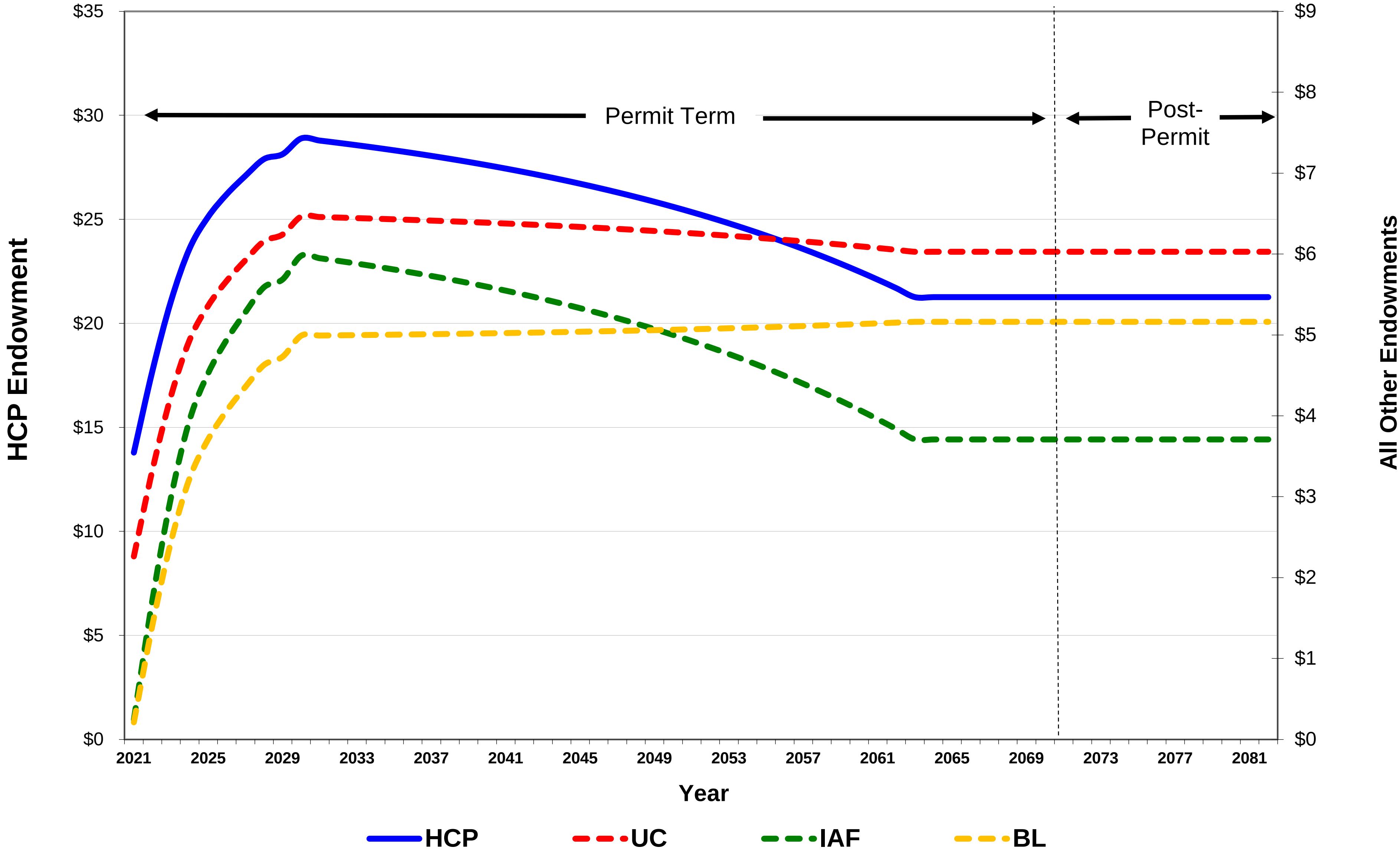
Figure 2
FORA Preliminary Endowment Cash Flow (in $000)



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Prepared by EPS 8/22/2019

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Table 1
FORA Biennial CIP Review
Summary of General Assumptions - HCP Endowment Funding

Item			
Land Mitigation Coverage Reserve			5.0%
FY 2019-20 Interest Rate			1.5%
Permit Term Begins FY Ending			2021
Post-Permit Term Begins FY Ending			2071
Endowment (2019$)	*Maximum Needed*	*Annual Return*	*Annual Revenue*
Habitat Conservation Plan (HCP)	$31,221,937	4.5000%	$1,404,987
University of California (UC)	$6,614,567	4.2000%	$277,812
Implementation Assurances Fund (IAF)	$6,672,621	4.5000%	$300,268
Borderlands Management (BL)	$4,938,027	4.5000%	$222,211
Total	**$49,447,152**		**$2,205,278**
Beginning Endowment Balance (2019$)			
Initial Balance			**$15,979,149**
Startup Costs			
Habitat Conservation Plan (HCP)			$444,609
University of California (UC)			$1,018,919
Implementation Assurances Fund (IAF)			$0
Borderlands Management (BL)			$0
Total			**$1,463,528**
Remainder of Beginning Endowment Balance			
Habitat Conservation Plan (HCP)			$12,570,528
University of California (UC)			$1,945,093
Implementation Assurances Fund (IAF)			$0
Borderlands Management (BL)			$0
Total			**$14,515,621**
Starting Special Tax Rate			
New Residential		$25,362	per Unit
Existing/Replacement Residential [1]		$25,362	per Unit
Office		$3,327	per Acre
Industrial		$3,327	per Acre
Retail		$68,555	per Acre
Hotel		$5,655	per Room
Annual Special Tax Escalation			0.0%

assump2

Source: FORA

[1] The 228 Sea Haven (formerly Marina Heights) units do not count towards the 6,160 unit threshold. These units are charged the new residential rate of $25,362 per dwelling unit, not the existing residential rate of $7,622 per dwelling unit.

Table 2
FORA Biennial CIP Review
Summary of Initial and Ongoing Costs - Individual Endowments

		HCP Endowment			UC Endowment			IAF Endowment			Borderlands Endowment		
Permit Year	FY Ending	Startup Costs	Ongoing Costs	Total	Startup Costs	Ongoing Costs	Total	Startup Costs	Ongoing Costs	Total	Startup Costs	Ongoing Costs	Total
	2020	($444,609)	$0	**($444,609)**	($1,018,919)	$0	**($1,018,919)**	$0	$0	**$0**	$0	$0	**$0**
1	2021	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2022	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2023	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2024	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2025	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2026	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2027	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2028	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2029	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
10	2030	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2031	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2032	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2033	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2034	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2035	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2036	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2037	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2038	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2039	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
20	2040	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2041	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2042	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2043	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2044	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2045	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2046	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2047	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2048	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2049	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
30	2050	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2051	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2052	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2053	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2054	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2055	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2056	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2057	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2058	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2059	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**

Table 2
FORA Biennial CIP Review
Summary of Initial and Ongoing Costs - Individual Endowments

		HCP Endowment			UC Endowment			IAF Endowment			Borderlands Endowment		
Permit Year	FY Ending	Startup Costs	Ongoing Costs	Total	Startup Costs	Ongoing Costs	Total	Startup Costs	Ongoing Costs	Total	Startup Costs	Ongoing Costs	Total
40	2060	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2061	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2062	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2063	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2064	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2065	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2066	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2067	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2068	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2069	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
50	2070	$0	($1,404,987)	**($1,404,987)**	$0	($277,812)	**($277,812)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	Post-Permit												
	2071+	$0	($780,983)	**($780,983)**	$0	($232,779)	**($232,779)**	$0	($105,019)	**($105,019)**	$0	($222,211)	**($222,211)**

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Source: FORA.

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Table 3
FORA Biennial CIP Review
Special Tax Revenue Generated for Habitat Management by Year

FY Ending	New Residential [1]	Exist./Replac. Residential [2]	Office [3]	Industrial	Retail	Hotel	Total CFD Revenue	Habitat Mgmt. Revenue: % of CFD Rev. [4]	Habitat Mgmt. Revenue: Net Revenue
Special Tax Rate	$25,362 *Per Unit*	$25,362 *Per Unit*	$3,327 *Per Acre*	$3,327 *Per Acre*	$68,555 *Per Acre*	$5,655 *Per Room*		*See Table 4*	
2019	$0	$0	$0	$0	$0	$0	$0	0.0%	$0
2020	$4,742,694	$1,192,014	$43,644	$0	$125,904	$0	$6,104,257	30.0%	$1,831,277
2021	$7,064,585	$0	$55,428	$3,819	$339,942	$2,081,040	$9,544,814	29.4%	$2,806,175
2022	$28,329,354	$0	$31,544	$18,140	$1,652,497	$1,131,000	$31,162,534	29.4%	$9,161,785
2023	$23,510,574	$0	$41,582	$29,596	$739,689	$1,866,150	$26,187,592	29.4%	$7,699,152
2024	$16,612,110	$0	$59,040	$131,196	$928,546	$1,945,320	$19,676,212	29.4%	$5,784,806
2025	$11,235,366	$0	$50,176	$35,724	$991,498	$0	$12,312,764	29.4%	$3,619,953
2026	$8,876,700	$0	$71,999	$31,905	$0	$0	$8,980,604	29.4%	$2,640,297
2027	$7,278,894	$0	$10,911	$18,140	$0	$0	$7,307,945	29.4%	$2,148,536
2028	$5,934,708	$0	$32,733	$1,909	$0	$565,500	$6,534,851	29.4%	$1,921,246
2029	$2,536,200	$0	$10,911	$0	$0	$0	$2,547,111	29.4%	$748,851
2030	$5,883,984	$0	$32,733	$0	$0	$0	$5,916,717	29.4%	$1,739,515
TOTAL	**$122,005,169**	**$1,192,014**	**$440,703**	**$270,429**	**$4,778,076**	**$7,589,010**	**$136,275,400**		**$40,101,593**

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Source: FORA; EPS.

[1] Per FORA the VTC intends to meet the tier 1 CFD rate discount, which is 5% of the new residential rate, for their entitled 71-unit project. Therefore FORA applied a 5% factor on the CFD calculation for these units.
[2] The 228 Sea Haven (formerly Marina Heights) units do not count towards the 6,160 unit threshold. These units are charged the new residential rate of $25,362 per dwelling unit, not the existing residential rate of $7,622 per dwelling unit.
[3] Per FORA the UC office space is exempt from the CFD calculation.
[4] Represents the estimated annual percentage to meet endowment funding needs and accelerate capitalization.

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Table 4
FORA Biennial CIP Review
Summary of Assumptions Varying by Year

FY Ending	**Share of CFD Special Tax Allocated to FORA Habitat Mgmt** [1]	**Special Tax Revenues Available for Habitat Management Allocation**			
		HCP	UC	IAF	BL Mgmt
2020	30.0%	51.5%	13.7%	19.4%	15.5%
2021	29.4%	51.5%	13.7%	19.4%	15.5%
2022	29.4%	51.5%	13.7%	19.4%	15.5%
2023	29.4%	51.5%	13.7%	19.4%	15.5%
2024	29.4%	51.5%	13.7%	19.4%	15.5%
2025	29.4%	51.5%	13.7%	19.4%	15.5%
2026	29.4%	51.5%	13.7%	19.4%	15.5%
2027	29.4%	51.5%	13.7%	19.4%	15.5%
2028	29.4%	51.5%	13.7%	19.4%	15.5%
2029	29.4%	51.5%	13.7%	19.4%	15.5%
2030	29.4%	51.5%	13.7%	19.4%	15.5%

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Source: FORA; EPS.

[1] Represents the estimated annual percentage to meet endowment funding needs and accelerate capitalization.

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Table 5
FORA Biennial CIP Review
Endowment Requirements

	Permit Term			Post-Permit Term		
Item	2019$	Assumed Payout	Annual Revenue Required	2019$	Assumed Payout	Annual Revenue Required
	[1]		[1]			[1]
HCP Endowment Fund	$31,221,937	4.50%	$1,404,987	$17,355,177	4.50%	$780,983
UC/NRS Endowment Fund	$6,614,567	4.20%	$277,812	$5,542,353	4.20%	$232,779
Implementation Assurances Fund						
Remedial Measures	$3,909,026	4.50%	$175,906	$0		$0
Additional FONM Mitigations	$2,095,050	4.50%	$94,277	$2,095,050	4.50%	$94,277
State Parks	$238,699	4.50%	$10,741	$238,699	4.50%	$10,741
Contingency	$429,846	4.50%	$19,343	$0		$0
Subtotal	**$6,672,621**	**4.50%**	**$300,267**	**$2,333,749**	**4.50%**	**$105,019**
Borderlands Management Cost	$4,938,027	4.50%	$222,211	$4,938,027	4.50%	$222,211
TOTAL ENDOWMENTS	**$49,447,152**		**$2,205,278**	**$30,169,306**		**$1,340,992**

cost

Source: FORA; EPS.

[1] Based on HCP estimates current as of August 2019 provided by FORA.

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Table 6
FORA Biennial CIP Review
Planned Land Use Summary by Year

FY Ending	New Residential [1]	Existing/Replac. Residential	Nonresidential [2] Office [3]	Industrial	Retail	Hotel
	Units	*Units*	*Acres*	*Acres*	*Acres*	*Rooms*
2019	0	0	0.0	0.0	0.0	0
2020	187	47	13.1	0.0	1.8	0
2021	346	0	20.6	1.1	5.0	368
2022	1,117	0	14.7	5.5	24.1	200
2023	927	0	24.3	8.9	10.8	330
2024	655	0	29.6	39.4	13.5	344
2025	443	0	26.9	10.7	14.5	0
2026	350	0	21.6	9.6	0.0	0
2027	287	0	3.3	5.5	0.0	0
2028	234	0	9.8	0.6	0.0	100
2029	100	0	3.3	0.0	0.0	0
2030	232	0	9.8	0.0	0.0	0
TOTAL	**4,878**	**47**	**177.1**	**81.3**	**69.7**	**1,342**

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Source: FORA.

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Table 7
FORA Biennial CIP Review
Tax Revenues Allocated by Endowment

FY Ending	**Special Tax Revenue** Annual [1]	Cumulative	**HCP** Annual	Cumulative	**UC** Annual	Cumulative	**IAF** Annual	Cumulative	**BL Mgmt** Annual	Cumulative
Maximum Endowment			$31,221,937		$6,614,567		$6,672,621		$4,938,027	
2020	$1,831,277	$1,831,277	$943,291	$943,291	$250,336	$250,336	$354,535	$354,535	$283,115	$283,115
2021	$2,806,175	$4,637,452	$1,445,461	$2,388,752	$383,604	$633,940	$543,276	$897,811	$433,835	$716,950
2022	$9,161,785	$13,799,238	$4,719,236	$7,107,987	$1,252,416	$1,886,356	$1,773,722	$2,671,532	$1,416,412	$2,133,362
2023	$7,699,152	$21,498,390	$3,965,833	$11,073,820	$1,052,474	$2,938,830	$1,490,556	$4,162,088	$1,190,289	$3,323,651
2024	$5,784,806	$27,283,196	$2,979,754	$14,053,574	$790,783	$3,729,613	$1,119,938	$5,282,027	$894,331	$4,217,982
2025	$3,619,953	$30,903,148	$1,864,638	$15,918,212	$494,848	$4,224,460	$700,823	$5,982,850	$559,645	$4,777,627
2026	$2,640,297	$33,543,446	$1,360,017	$17,278,229	$360,929	$4,585,389	$511,162	$6,494,011	$408,190	$5,185,817
2027	$2,148,536	$35,691,982	$1,106,711	$18,384,940	$293,705	$4,879,094	$415,957	$6,909,968	$332,164	$5,517,980
2028	$1,921,246	$37,613,228	$989,634	$19,374,574	$262,634	$5,141,728	$371,953	$7,281,921	$297,025	$5,815,005
2029	$748,851	$38,362,078	$385,733	$19,760,307	$102,368	$5,244,096	$144,977	$7,426,898	$115,772	$5,930,777
2030	$1,739,515	$40,101,593	$896,024	$20,656,331	$237,792	$5,481,888	$336,770	$7,763,668	$268,929	$6,199,706
2031	$0	$40,101,593	$0	$20,656,331	$0	$5,481,888	$0	$7,763,668	$0	$6,199,706
2032	$0	$40,101,593	$0	$20,656,331	$0	$5,481,888	$0	$7,763,668	$0	$6,199,706
TOTAL	**$40,101,593**		**$20,656,331**		**$5,481,888**		**$7,763,668**		**$6,199,706**	

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Source: FORA; EPS.

[1] See net revenue projected in Table 3.

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Table 8
FORA Biennial CIP Review
Preliminary Endowment Cash Flow - All Endowments

All Endowments

Permit Year	FY Ending	Beginning Balance	Interest Earnings (+)	Deposits (+)	Transfer In (+)	Subtotal	Annual Costs (-)	Transfer Out (-)	Ending Balance
	2020	$15,979,149	$710,170	$0	$0	$16,689,319	($1,463,528)	$0	$15,225,791
1	2021	$15,225,791	$678,952	$2,806,175	$0	$18,710,918	($2,205,278)	$0	$16,505,641
	2022	$16,505,641	$735,967	$9,161,785	$0	$26,403,393	($2,205,278)	$0	$24,198,115
	2023	$24,198,115	$1,078,920	$7,699,152	$0	$32,976,187	($2,205,278)	$0	$30,770,909
	2024	$30,770,909	$1,371,951	$5,784,806	$0	$37,927,667	($2,205,278)	$0	$35,722,389
	2025	$35,722,389	$1,592,694	$3,619,953	$0	$40,935,036	($2,205,278)	$0	$38,729,758
	2026	$38,729,758	$1,726,752	$2,640,297	$0	$43,096,808	($2,205,278)	$0	$40,891,530
	2027	$40,891,530	$1,823,107	$2,148,536	$0	$44,863,173	($2,205,278)	$0	$42,657,895
	2028	$42,657,895	$1,901,831	$1,921,246	$0	$46,480,973	($2,205,278)	$0	$44,275,695
	2029	$44,275,695	$1,973,931	$748,851	$0	$46,998,477	($2,205,278)	$0	$44,793,199
10	2030	$44,793,199	$1,996,970	$1,739,515	$0	$48,529,684	($2,205,278)	$0	$46,324,406
	2031	$46,324,406	$2,065,207	$0	$0	$48,389,614	($2,205,278)	$0	$46,184,336
	2032	$46,184,336	$2,058,923	$0	$0	$48,243,259	($2,205,278)	$0	$46,037,981
	2033	$46,037,981	$2,052,357	$0	$0	$48,090,339	($2,205,278)	$0	$45,885,061
	2034	$45,885,061	$2,045,496	$0	$0	$47,930,557	($2,205,278)	$0	$45,725,280
	2035	$45,725,280	$2,038,328	$0	$0	$47,763,607	($2,205,278)	$0	$45,558,330
	2036	$45,558,330	$2,030,837	$0	$0	$47,589,167	($2,205,278)	$0	$45,383,889
	2037	$45,383,889	$2,023,011	$0	$0	$47,406,900	($2,205,278)	$0	$45,201,623
	2038	$45,201,623	$2,014,833	$0	$0	$47,216,456	($2,205,278)	$0	$45,011,178
	2039	$45,011,178	$2,006,289	$0	$0	$47,017,467	($2,205,278)	$0	$44,812,189
20	2040	$44,812,189	$1,997,361	$0	$0	$46,809,550	($2,205,278)	$0	$44,604,272
	2041	$44,604,272	$1,988,032	$0	$0	$46,592,304	($2,205,278)	$0	$44,387,026
	2042	$44,387,026	$1,978,285	$0	$0	$46,365,311	($2,205,278)	$0	$44,160,033
	2043	$44,160,033	$1,968,100	$0	$0	$46,128,133	($2,205,278)	$0	$43,922,855
	2044	$43,922,855	$1,957,458	$0	$0	$45,880,313	($2,205,278)	$0	$43,675,035
	2045	$43,675,035	$1,946,338	$0	$0	$45,621,373	($2,205,278)	$0	$43,416,096
	2046	$43,416,096	$1,934,720	$0	$0	$45,350,816	($2,205,278)	$0	$43,145,538
	2047	$43,145,538	$1,922,580	$0	$0	$45,068,118	($2,205,278)	$0	$42,862,840
	2048	$42,862,840	$1,909,895	$0	$0	$44,772,736	($2,205,278)	$0	$42,567,458
	2049	$42,567,458	$1,896,642	$0	$0	$44,464,100	($2,205,278)	$0	$42,258,822
30	2050	$42,258,822	$1,882,793	$0	$0	$44,141,615	($2,205,278)	$0	$41,936,337
	2051	$41,936,337	$1,868,323	$0	$0	$43,804,659	($2,205,278)	$0	$41,599,382
	2052	$41,599,382	$1,853,203	$0	$0	$43,452,585	($2,205,278)	$0	$41,247,307
	2053	$41,247,307	$1,837,405	$0	$0	$43,084,711	($2,205,278)	$0	$40,879,434
	2054	$40,879,434	$1,820,897	$0	$0	$42,700,331	($2,205,278)	$0	$40,495,053
	2055	$40,495,053	$1,803,649	$0	$0	$42,298,702	($2,205,278)	$0	$40,093,425
	2056	$40,093,425	$1,785,627	$0	$0	$41,879,052	($2,205,278)	$0	$39,673,774
	2057	$39,673,774	$1,766,796	$0	$0	$41,440,570	($2,205,278)	$0	$39,235,292
	2058	$39,235,292	$1,747,120	$0	$0	$40,982,412	($2,205,278)	$0	$38,777,134
	2059	$38,777,134	$1,726,560	$0	$0	$40,503,694	($2,205,278)	$0	$38,298,416
40	2060	$38,298,416	$1,705,078	$0	$0	$40,003,494	($2,205,278)	$0	$37,798,217
	2061	$37,798,217	$1,682,632	$0	$0	$39,480,848	($2,205,278)	$0	$37,275,571
	2062	$37,275,571	$1,659,178	$0	$0	$38,934,749	($2,205,278)	$0	$36,729,471
	2063	$36,729,471	$1,634,672	$0	$0	$38,364,143	($2,205,278)	$0	$36,158,865
	2064	$36,158,865	$1,609,065	$0	$0	$37,767,930	($2,205,278)	$0	$35,562,653
	2065	$35,562,653	$1,582,310	$0	$0	$37,144,962	($2,205,278)	$0	$34,939,685
	2066	$34,939,685	$1,554,353	$0	$0	$36,494,038	($2,205,278)	$0	$34,288,760
	2067	$34,288,760	$1,525,142	$0	$0	$35,813,902	($2,205,278)	$0	$33,608,624
	2068	$33,608,624	$1,494,619	$0	$0	$35,103,243	($2,205,278)	$0	$32,897,966
	2069	$32,897,966	$1,462,727	$0	$0	$34,360,693	($2,205,278)	$0	$32,155,415
50	2070	$32,155,415	$1,429,403	$0	$0	$33,584,818	($2,205,278)	$0	$31,379,540
	Post Permit								
	2071+	$31,379,540	$1,394,583	$0	$0	$32,774,123	($1,340,992)	$0	$31,433,131

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Table 9
FORA Biennial CIP Review
Preliminary Endowment Cash Flow - Habitat Conservation Plan

HCP Endowment

Permit Year	FY Ending	Beginning Balance	Interest Earnings (+)	Deposits (+)	Transfer In (+)	Subtotal	Annual Costs (-)	Transfer Out (-)	Ending Balance
Source			*Table 1*	*Table 7*			*Table 2*		
Annual Return in FY 2020			*1.50%*						
Annual Return Starting in FY 2021			*4.50%*						
	2020	$13,015,137	$585,681	$0	$0	$13,600,818	($444,609)	$0	$13,156,209
1	2021	$13,156,209	$592,029	$1,445,461	$0	$15,193,699	($1,404,987)	$0	$13,788,712
	2022	$13,788,712	$620,492	$4,719,236	$0	$19,128,440	($1,404,987)	$0	$17,723,453
	2023	$17,723,453	$797,555	$3,965,833	$0	$22,486,841	($1,404,987)	$0	$21,081,854
	2024	$21,081,854	$948,683	$2,979,754	$0	$25,010,291	($1,404,987)	$0	$23,605,304
	2025	$23,605,304	$1,062,239	$1,864,638	$0	$26,532,180	($1,404,987)	$0	$25,127,193
	2026	$25,127,193	$1,130,724	$1,360,017	$0	$27,617,934	($1,404,987)	$0	$26,212,947
	2027	$26,212,947	$1,179,583	$1,106,711	$0	$28,499,240	($1,404,987)	$0	$27,094,253
	2028	$27,094,253	$1,219,241	$989,634	$0	$29,303,129	($1,404,987)	$0	$27,898,142
	2029	$27,898,142	$1,255,416	$385,733	$0	$29,539,291	($1,404,987)	$0	$28,134,304
10	2030	$28,134,304	$1,266,044	$896,024	$0	$30,296,371	($1,404,987)	$0	$28,891,384
	2031	$28,891,384	$1,300,112	$0	$0	$30,191,497	($1,404,987)	$0	$28,786,510
	2032	$28,786,510	$1,295,393	$0	$0	$30,081,902	($1,404,987)	$0	$28,676,915
	2033	$28,676,915	$1,290,461	$0	$0	$29,967,377	($1,404,987)	$0	$28,562,390
	2034	$28,562,390	$1,285,307	$0	$0	$29,847,697	($1,404,987)	$0	$28,442,710
	2035	$28,442,710	$1,279,922	$0	$0	$29,722,632	($1,404,987)	$0	$28,317,645
	2036	$28,317,645	$1,274,294	$0	$0	$29,591,939	($1,404,987)	$0	$28,186,952
	2037	$28,186,952	$1,268,413	$0	$0	$29,455,364	($1,404,987)	$0	$28,050,377
	2038	$28,050,377	$1,262,267	$0	$0	$29,312,644	($1,404,987)	$0	$27,907,657
	2039	$27,907,657	$1,255,844	$0	$0	$29,163,502	($1,404,987)	$0	$27,758,515
20	2040	$27,758,515	$1,249,133	$0	$0	$29,007,648	($1,404,987)	$0	$27,602,661
	2041	$27,602,661	$1,242,120	$0	$0	$28,844,780	($1,404,987)	$0	$27,439,793
	2042	$27,439,793	$1,234,791	$0	$0	$28,674,584	($1,404,987)	$0	$27,269,597
	2043	$27,269,597	$1,227,132	$0	$0	$28,496,729	($1,404,987)	$0	$27,091,742
	2044	$27,091,742	$1,219,128	$0	$0	$28,310,870	($1,404,987)	$0	$26,905,883
	2045	$26,905,883	$1,210,765	$0	$0	$28,116,647	($1,404,987)	$0	$26,711,660
	2046	$26,711,660	$1,202,025	$0	$0	$27,913,685	($1,404,987)	$0	$26,508,698
	2047	$26,508,698	$1,192,891	$0	$0	$27,701,589	($1,404,987)	$0	$26,296,602
	2048	$26,296,602	$1,183,347	$0	$0	$27,479,949	($1,404,987)	$0	$26,074,962
	2049	$26,074,962	$1,173,373	$0	$0	$27,248,335	($1,404,987)	$0	$25,843,348
30	2050	$25,843,348	$1,162,951	$0	$0	$27,006,299	($1,404,987)	$0	$25,601,312
	2051	$25,601,312	$1,152,059	$0	$0	$26,753,371	($1,404,987)	$0	$25,348,384
	2052	$25,348,384	$1,140,677	$0	$0	$26,489,061	($1,404,987)	$0	$25,084,074
	2053	$25,084,074	$1,128,783	$0	$0	$26,212,857	($1,404,987)	$0	$24,807,870
	2054	$24,807,870	$1,116,354	$0	$0	$25,924,224	($1,404,987)	$0	$24,519,237
	2055	$24,519,237	$1,103,366	$0	$0	$25,622,603	($1,404,987)	$0	$24,217,616
	2056	$24,217,616	$1,089,793	$0	$0	$25,307,409	($1,404,987)	$0	$23,902,422
	2057	$23,902,422	$1,075,609	$0	$0	$24,978,030	($1,404,987)	$0	$23,573,043
	2058	$23,573,043	$1,060,787	$0	$0	$24,633,830	($1,404,987)	$0	$23,228,843
	2059	$23,228,843	$1,045,298	$0	$0	$24,274,141	($1,404,987)	$0	$22,869,154
40	2060	$22,869,154	$1,029,112	$0	$0	$23,898,266	($1,404,987)	$0	$22,493,279
	2061	$22,493,279	$1,012,197	$0	$0	$23,505,476	($1,404,987)	$0	$22,100,489
	2062	$22,100,489	$994,522	$0	$0	$23,095,011	($1,404,987)	$0	$21,690,024
	2063	$21,690,024	$976,051	$0	$0	$22,666,075	($1,404,987)	$0	$21,261,088
	2064	$21,261,088	$956,749	$0	$0	$22,217,837	($1,404,987)	$0	$20,812,850
	2065	$20,812,850	$936,578	$0	$0	$21,749,428	($1,404,987)	$0	$20,344,441
	2066	$20,344,441	$915,500	$0	$0	$21,259,941	($1,404,987)	$0	$19,854,954
	2067	$19,854,954	$893,473	$0	$0	$20,748,427	($1,404,987)	$0	$19,343,440
	2068	$19,343,440	$870,455	$0	$0	$20,213,895	($1,404,987)	$0	$18,808,908
	2069	$18,808,908	$846,401	$0	$0	$19,655,308	($1,404,987)	$0	$18,250,321
50	2070	$18,250,321	$821,264	$0	$0	$19,071,586	($1,404,987)	$0	$17,666,599
	Post Permit								
	2071+	$17,666,599	$794,997	$0	$0	$18,461,596	($780,983)	$0	$17,680,613

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Table 10
FORA Biennial CIP Review
Preliminary Endowment Cash Flow - University of California

UC Endowment

Permit Year	FY Ending	Beginning Balance	Interest Earnings (+)	Deposits (+)	Transfer In (+)	Subtotal	Annual Costs (-)	Transfer Out (-)	Ending Balance
Source			*Table 1*	*Table 7*			*Table 2*		
Annual Return in FY 2020			*1.50%*						
Annual Return Starting in FY 2021			*4.20%*						
	2020	$2,964,012	$124,489	$0	$0	$3,088,501	($1,018,919)	$0	$2,069,582
1	2021	$2,069,582	$86,923	$383,604	$0	$2,540,109	($277,812)	$0	$2,262,296
	2022	$2,262,296	$95,017	$1,252,416	$0	$3,609,729	($277,812)	$0	$3,331,917
	2023	$3,331,917	$139,941	$1,052,474	$0	$4,524,332	($277,812)	$0	$4,246,519
	2024	$4,246,519	$178,354	$790,783	$0	$5,215,657	($277,812)	$0	$4,937,844
	2025	$4,937,844	$207,390	$494,848	$0	$5,640,082	($277,812)	$0	$5,362,269
	2026	$5,362,269	$225,216	$360,929	$0	$5,948,414	($277,812)	$0	$5,670,601
	2027	$5,670,601	$238,166	$293,705	$0	$6,202,472	($277,812)	$0	$5,924,660
	2028	$5,924,660	$248,836	$262,634	$0	$6,436,130	($277,812)	$0	$6,158,318
	2029	$6,158,318	$258,650	$102,368	$0	$6,519,336	($277,812)	$0	$6,241,523
10	2030	$6,241,523	$262,145	$237,792	$0	$6,741,460	($277,812)	$0	$6,463,647
	2031	$6,463,647	$271,474	$0	$0	$6,735,121	($277,812)	$0	$6,457,309
	2032	$6,457,309	$271,208	$0	$0	$6,728,516	($277,812)	$0	$6,450,704
	2033	$6,450,704	$270,930	$0	$0	$6,721,634	($277,812)	$0	$6,443,822
	2034	$6,443,822	$270,641	$0	$0	$6,714,463	($277,812)	$0	$6,436,651
	2035	$6,436,651	$270,340	$0	$0	$6,706,991	($277,812)	$0	$6,429,178
	2036	$6,429,178	$270,026	$0	$0	$6,699,204	($277,812)	$0	$6,421,392
	2037	$6,421,392	$269,699	$0	$0	$6,691,091	($277,812)	$0	$6,413,279
	2038	$6,413,279	$269,358	$0	$0	$6,682,637	($277,812)	$0	$6,404,825
	2039	$6,404,825	$269,003	$0	$0	$6,673,828	($277,812)	$0	$6,396,016
20	2040	$6,396,016	$268,633	$0	$0	$6,664,649	($277,812)	$0	$6,386,837
	2041	$6,386,837	$268,248	$0	$0	$6,655,084	($277,812)	$0	$6,377,272
	2042	$6,377,272	$267,846	$0	$0	$6,645,118	($277,812)	$0	$6,367,306
	2043	$6,367,306	$267,427	$0	$0	$6,634,733	($277,812)	$0	$6,356,921
	2044	$6,356,921	$266,991	$0	$0	$6,623,912	($277,812)	$0	$6,346,100
	2045	$6,346,100	$266,537	$0	$0	$6,612,636	($277,812)	$0	$6,334,824
	2046	$6,334,824	$266,063	$0	$0	$6,600,887	($277,812)	$0	$6,323,075
	2047	$6,323,075	$265,570	$0	$0	$6,588,645	($277,812)	$0	$6,310,832
	2048	$6,310,832	$265,056	$0	$0	$6,575,888	($277,812)	$0	$6,298,076
	2049	$6,298,076	$264,520	$0	$0	$6,562,595	($277,812)	$0	$6,284,783
30	2050	$6,284,783	$263,962	$0	$0	$6,548,744	($277,812)	$0	$6,270,932
	2051	$6,270,932	$263,380	$0	$0	$6,534,312	($277,812)	$0	$6,256,499
	2052	$6,256,499	$262,774	$0	$0	$6,519,273	($277,812)	$0	$6,241,461
	2053	$6,241,461	$262,142	$0	$0	$6,503,603	($277,812)	$0	$6,225,790
	2054	$6,225,790	$261,484	$0	$0	$6,487,274	($277,812)	$0	$6,209,462
	2055	$6,209,462	$260,798	$0	$0	$6,470,260	($277,812)	$0	$6,192,447
	2056	$6,192,447	$260,083	$0	$0	$6,452,531	($277,812)	$0	$6,174,718
	2057	$6,174,718	$259,339	$0	$0	$6,434,057	($277,812)	$0	$6,156,245
	2058	$6,156,245	$258,563	$0	$0	$6,414,808	($277,812)	$0	$6,136,995
	2059	$6,136,995	$257,754	$0	$0	$6,394,750	($277,812)	$0	$6,116,937
40	2060	$6,116,937	$256,912	$0	$0	$6,373,849	($277,812)	$0	$6,096,037
	2061	$6,096,037	$256,034	$0	$0	$6,352,071	($277,812)	$0	$6,074,259
	2062	$6,074,259	$255,119	$0	$0	$6,329,378	($277,812)	$0	$6,051,566
	2063	$6,051,566	$254,166	$0	$0	$6,305,732	($277,812)	$0	$6,027,920
	2064	$6,027,920	$253,173	$0	$0	$6,281,093	($277,812)	$0	$6,003,281
	2065	$6,003,281	$252,138	$0	$0	$6,255,419	($277,812)	$0	$5,977,607
	2066	$5,977,607	$251,060	$0	$0	$6,228,667	($277,812)	$0	$5,950,854
	2067	$5,950,854	$249,937	$0	$0	$6,200,791	($277,812)	$0	$5,922,979
	2068	$5,922,979	$248,766	$0	$0	$6,171,744	($277,812)	$0	$5,893,932
	2069	$5,893,932	$247,546	$0	$0	$6,141,478	($277,812)	$0	$5,863,665
50	2070	$5,863,665	$246,275	$0	$0	$6,109,940	($277,812)	$0	$5,832,127
	Post Permit								
	2071+	$5,832,127	$244,950	$0	$0	$6,077,077	($232,779)	$0	$5,844,298

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Table 11
FORA Biennial CIP Review
Preliminary Endowment Cash Flow - Implementation Assurances Fund

IAF Endowment

Permit Year	FY Ending	Beginning Balance	Interest Earnings (+)	Deposits (+)	Transfer In (+)	Subtotal	Annual Costs (-)	Transfer Out (-)	Ending Balance
Source			*Table 1*	*Table 7*			*Table 2*		
Annual Return in FY 2020			*1.50%*						
Annual Return Starting in FY 2021			*4.50%*						
	2020	$0	$0	$0	$0	$0	$0	$0	$0
1	2021	$0	$0	$543,276	$0	$543,276	($300,267)	$0	$243,008
	2022	$243,008	$10,935	$1,773,722	$0	$2,027,665	($300,267)	$0	$1,727,398
	2023	$1,727,398	$77,733	$1,490,556	$0	$3,295,686	($300,267)	$0	$2,995,419
	2024	$2,995,419	$134,794	$1,119,938	$0	$4,250,151	($300,267)	$0	$3,949,884
	2025	$3,949,884	$177,745	$700,823	$0	$4,828,452	($300,267)	$0	$4,528,184
	2026	$4,528,184	$203,768	$511,162	$0	$5,243,114	($300,267)	$0	$4,942,847
	2027	$4,942,847	$222,428	$415,957	$0	$5,581,231	($300,267)	$0	$5,280,964
	2028	$5,280,964	$237,643	$371,953	$0	$5,890,560	($300,267)	$0	$5,590,293
	2029	$5,590,293	$251,563	$144,977	$0	$5,986,833	($300,267)	$0	$5,686,566
10	2030	$5,686,566	$255,895	$336,770	$0	$6,279,231	($300,267)	$0	$5,978,964
	2031	$5,978,964	$269,053	$0	$0	$6,248,017	($300,267)	$0	$5,947,750
	2032	$5,947,750	$267,649	$0	$0	$6,215,399	($300,267)	$0	$5,915,131
	2033	$5,915,131	$266,181	$0	$0	$6,181,312	($300,267)	$0	$5,881,045
	2034	$5,881,045	$264,647	$0	$0	$6,145,691	($300,267)	$0	$5,845,424
	2035	$5,845,424	$263,044	$0	$0	$6,108,468	($300,267)	$0	$5,808,201
	2036	$5,808,201	$261,369	$0	$0	$6,069,569	($300,267)	$0	$5,769,302
	2037	$5,769,302	$259,618	$0	$0	$6,028,921	($300,267)	$0	$5,728,653
	2038	$5,728,653	$257,789	$0	$0	$5,986,442	($300,267)	$0	$5,686,175
	2039	$5,686,175	$255,878	$0	$0	$5,942,053	($300,267)	$0	$5,641,785
20	2040	$5,641,785	$253,880	$0	$0	$5,895,666	($300,267)	$0	$5,595,398
	2041	$5,595,398	$251,793	$0	$0	$5,847,191	($300,267)	$0	$5,546,924
	2042	$5,546,924	$249,611	$0	$0	$5,796,535	($300,267)	$0	$5,496,268
	2043	$5,496,268	$247,332	$0	$0	$5,743,600	($300,267)	$0	$5,443,332
	2044	$5,443,332	$244,950	$0	$0	$5,688,282	($300,267)	$0	$5,388,015
	2045	$5,388,015	$242,461	$0	$0	$5,630,475	($300,267)	$0	$5,330,208
	2046	$5,330,208	$239,859	$0	$0	$5,570,067	($300,267)	$0	$5,269,800
	2047	$5,269,800	$237,141	$0	$0	$5,506,941	($300,267)	$0	$5,206,673
	2048	$5,206,673	$234,300	$0	$0	$5,440,973	($300,267)	$0	$5,140,706
	2049	$5,140,706	$231,332	$0	$0	$5,372,038	($300,267)	$0	$5,071,770
30	2050	$5,071,770	$228,230	$0	$0	$5,300,000	($300,267)	$0	$4,999,733
	2051	$4,999,733	$224,988	$0	$0	$5,224,720	($300,267)	$0	$4,924,453
	2052	$4,924,453	$221,600	$0	$0	$5,146,053	($300,267)	$0	$4,845,786
	2053	$4,845,786	$218,060	$0	$0	$5,063,846	($300,267)	$0	$4,763,579
	2054	$4,763,579	$214,361	$0	$0	$4,977,940	($300,267)	$0	$4,677,672
	2055	$4,677,672	$210,495	$0	$0	$4,888,168	($300,267)	$0	$4,587,900
	2056	$4,587,900	$206,455	$0	$0	$4,794,356	($300,267)	$0	$4,494,088
	2057	$4,494,088	$202,234	$0	$0	$4,696,322	($300,267)	$0	$4,396,055
	2058	$4,396,055	$197,822	$0	$0	$4,593,877	($300,267)	$0	$4,293,610
	2059	$4,293,610	$193,212	$0	$0	$4,486,822	($300,267)	$0	$4,186,555
40	2060	$4,186,555	$188,395	$0	$0	$4,374,950	($300,267)	$0	$4,074,682
	2061	$4,074,682	$183,361	$0	$0	$4,258,043	($300,267)	$0	$3,957,775
	2062	$3,957,775	$178,100	$0	$0	$4,135,875	($300,267)	$0	$3,835,608
	2063	$3,835,608	$172,602	$0	$0	$4,008,210	($300,267)	$0	$3,707,943
	2064	$3,707,943	$166,857	$0	$0	$3,874,800	($300,267)	$0	$3,574,533
	2065	$3,574,533	$160,854	$0	$0	$3,735,387	($300,267)	$0	$3,435,119
	2066	$3,435,119	$154,580	$0	$0	$3,589,700	($300,267)	$0	$3,289,432
	2067	$3,289,432	$148,024	$0	$0	$3,437,457	($300,267)	$0	$3,137,189
	2068	$3,137,189	$141,173	$0	$0	$3,278,363	($300,267)	$0	$2,978,095
	2069	$2,978,095	$134,014	$0	$0	$3,112,109	($300,267)	$0	$2,811,842
50	2070	$2,811,842	$126,533	$0	$0	$2,938,375	($300,267)	$0	$2,638,108
Post Permit									
	2071+	$2,638,108	$118,715	$0	$0	$2,756,822	($105,019)	$0	$2,651,804

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Table 12
FORA Biennial CIP Review
Preliminary Endowment Cash Flow - Borderlands Management

Borderlands Endowment

Permit Year	FY Ending	Beginning Balance	Interest Earnings (+)	Deposits (+)	Transfer In (+)	Subtotal	Annual Costs (-)	Transfer Out (-)	Ending Balance
Source			*Table 1*	*Table 7*			*Table 2*		
Annual Return in FY 2020			*1.50%*						
Annual Return Starting in FY 2021			*4.50%*						
	2020	$0	$0	$0	$0	$0	$0	$0	$0
1	2021	$0	$0	$433,835	$0	$433,835	($222,211)	$0	$211,624
	2022	$211,624	$9,523	$1,416,412	$0	$1,637,559	($222,211)	$0	$1,415,348
	2023	$1,415,348	$63,691	$1,190,289	$0	$2,669,327	($222,211)	$0	$2,447,116
	2024	$2,447,116	$110,120	$894,331	$0	$3,451,567	($222,211)	$0	$3,229,356
	2025	$3,229,356	$145,321	$559,645	$0	$3,934,322	($222,211)	$0	$3,712,111
	2026	$3,712,111	$167,045	$408,190	$0	$4,287,346	($222,211)	$0	$4,065,135
	2027	$4,065,135	$182,931	$332,164	$0	$4,580,229	($222,211)	$0	$4,358,018
	2028	$4,358,018	$196,111	$297,025	$0	$4,851,154	($222,211)	$0	$4,628,943
	2029	$4,628,943	$208,302	$115,772	$0	$4,953,017	($222,211)	$0	$4,730,806
10	2030	$4,730,806	$212,886	$268,929	$0	$5,212,621	($222,211)	$0	$4,990,410
	2031	$4,990,410	$224,568	$0	$0	$5,214,978	($222,211)	$0	$4,992,767
	2032	$4,992,767	$224,674	$0	$0	$5,217,442	($222,211)	$0	$4,995,231
	2033	$4,995,231	$224,785	$0	$0	$5,220,016	($222,211)	$0	$4,997,805
	2034	$4,997,805	$224,901	$0	$0	$5,222,706	($222,211)	$0	$5,000,495
	2035	$5,000,495	$225,022	$0	$0	$5,225,517	($222,211)	$0	$5,003,306
	2036	$5,003,306	$225,149	$0	$0	$5,228,455	($222,211)	$0	$5,006,244
	2037	$5,006,244	$225,281	$0	$0	$5,231,524	($222,211)	$0	$5,009,313
	2038	$5,009,313	$225,419	$0	$0	$5,234,732	($222,211)	$0	$5,012,521
	2039	$5,012,521	$225,563	$0	$0	$5,238,084	($222,211)	$0	$5,015,873
20	2040	$5,015,873	$225,714	$0	$0	$5,241,587	($222,211)	$0	$5,019,376
	2041	$5,019,376	$225,872	$0	$0	$5,245,248	($222,211)	$0	$5,023,037
	2042	$5,023,037	$226,036	$0	$0	$5,249,074	($222,211)	$0	$5,026,863
	2043	$5,026,863	$226,209	$0	$0	$5,253,071	($222,211)	$0	$5,030,860
	2044	$5,030,860	$226,388	$0	$0	$5,257,249	($222,211)	$0	$5,035,038
	2045	$5,035,038	$226,576	$0	$0	$5,261,614	($222,211)	$0	$5,039,403
	2046	$5,039,403	$226,773	$0	$0	$5,266,176	($222,211)	$0	$5,043,965
	2047	$5,043,965	$226,978	$0	$0	$5,270,943	($222,211)	$0	$5,048,732
	2048	$5,048,732	$227,193	$0	$0	$5,275,925	($222,211)	$0	$5,053,714
	2049	$5,053,714	$227,417	$0	$0	$5,281,131	($222,211)	$0	$5,058,920
30	2050	$5,058,920	$227,651	$0	$0	$5,286,571	($222,211)	$0	$5,064,360
	2051	$5,064,360	$227,896	$0	$0	$5,292,256	($222,211)	$0	$5,070,045
	2052	$5,070,045	$228,152	$0	$0	$5,298,197	($222,211)	$0	$5,075,986
	2053	$5,075,986	$228,419	$0	$0	$5,304,405	($222,211)	$0	$5,082,194
	2054	$5,082,194	$228,699	$0	$0	$5,310,893	($222,211)	$0	$5,088,682
	2055	$5,088,682	$228,990	$0	$0	$5,317,672	($222,211)	$0	$5,095,461
	2056	$5,095,461	$229,296	$0	$0	$5,324,757	($222,211)	$0	$5,102,546
	2057	$5,102,546	$229,614	$0	$0	$5,332,160	($222,211)	$0	$5,109,949
	2058	$5,109,949	$229,947	$0	$0	$5,339,896	($222,211)	$0	$5,117,685
	2059	$5,117,685	$230,296	$0	$0	$5,347,981	($222,211)	$0	$5,125,770
40	2060	$5,125,770	$230,659	$0	$0	$5,356,430	($222,211)	$0	$5,134,219
	2061	$5,134,219	$231,040	$0	$0	$5,365,258	($222,211)	$0	$5,143,047
	2062	$5,143,047	$231,437	$0	$0	$5,374,484	($222,211)	$0	$5,152,273
	2063	$5,152,273	$231,852	$0	$0	$5,384,125	($222,211)	$0	$5,161,914
	2064	$5,161,914	$232,286	$0	$0	$5,394,200	($222,211)	$0	$5,171,989
	2065	$5,171,989	$232,739	$0	$0	$5,404,728	($222,211)	$0	$5,182,517
	2066	$5,182,517	$233,213	$0	$0	$5,415,730	($222,211)	$0	$5,193,519
	2067	$5,193,519	$233,708	$0	$0	$5,427,227	($222,211)	$0	$5,205,016
	2068	$5,205,016	$234,226	$0	$0	$5,439,242	($222,211)	$0	$5,217,031
	2069	$5,217,031	$234,766	$0	$0	$5,451,797	($222,211)	$0	$5,229,586
50	2070	$5,229,586	$235,331	$0	$0	$5,464,917	($222,211)	$0	$5,242,706
	Post Permit								
	2071+	$5,242,706	$235,922	$0	$0	$5,478,628	($222,211)	$0	$5,256,417

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Table 13
FORA Biennial CIP Review
Comparison of Annual Interest Earnings and Costs

		HCP Endowment			**UC Endowment**			**IAF Endowment**			**Borderlands Endowment**		
Permit Year	**Year**	Interest Earnings	Annual Costs	Difference	Interest Earnings	Annual Costs	Difference	Interest Earnings	Annual Costs	Surplus/ (Deficit)	Interest Earnings	Annual Costs	Surplus/ (Deficit)
Source		*Table 9*	*Table 9*		*Table 10*	*Table 10*		*Table 11*	*Table 11*		*Table 12*	*Table 12*	
	2020	$585,681	($444,609)	**$141,072**	$124,489	($1,018,919)	**($894,430)**	$0	$0	**$0**	$0	$0	**$0**
1	2021	$592,029	($1,404,987)	**($812,958)**	$86,923	($277,812)	**($190,890)**	$0	($300,267)	**($300,267)**	$0	($222,211)	**($222,211)**
	2022	$620,492	($1,404,987)	**($784,495)**	$95,017	($277,812)	**($182,796)**	$10,935	($300,267)	**($289,332)**	$9,523	($222,211)	**($212,688)**
	2023	$797,555	($1,404,987)	**($607,432)**	$139,941	($277,812)	**($137,872)**	$77,733	($300,267)	**($222,534)**	$63,691	($222,211)	**($158,520)**
	2024	$948,683	($1,404,987)	**($456,304)**	$178,354	($277,812)	**($99,458)**	$134,794	($300,267)	**($165,474)**	$110,120	($222,211)	**($112,091)**
	2025	$1,062,239	($1,404,987)	**($342,748)**	$207,390	($277,812)	**($70,422)**	$177,745	($300,267)	**($122,523)**	$145,321	($222,211)	**($76,890)**
	2026	$1,130,724	($1,404,987)	**($274,263)**	$225,216	($277,812)	**($52,597)**	$203,768	($300,267)	**($96,499)**	$167,045	($222,211)	**($55,166)**
	2027	$1,179,583	($1,404,987)	**($225,404)**	$238,166	($277,812)	**($39,647)**	$222,428	($300,267)	**($77,839)**	$182,931	($222,211)	**($39,280)**
	2028	$1,219,241	($1,404,987)	**($185,746)**	$248,836	($277,812)	**($28,976)**	$237,643	($300,267)	**($62,624)**	$196,111	($222,211)	**($26,100)**
	2029	$1,255,416	($1,404,987)	**($149,571)**	$258,650	($277,812)	**($19,162)**	$251,563	($300,267)	**($48,704)**	$208,302	($222,211)	**($13,909)**
10	2030	$1,266,044	($1,404,987)	**($138,943)**	$262,145	($277,812)	**($15,668)**	$255,895	($300,267)	**($44,372)**	$212,886	($222,211)	**($9,325)**
	2031	$1,300,112	($1,404,987)	**($104,875)**	$271,474	($277,812)	**($6,339)**	$269,053	($300,267)	**($31,214)**	$224,568	($222,211)	**$2,357**
	2032	$1,295,393	($1,404,987)	**($109,594)**	$271,208	($277,812)	**($6,605)**	$267,649	($300,267)	**($32,619)**	$224,674	($222,211)	**$2,463**
	2033	$1,290,461	($1,404,987)	**($114,526)**	$270,930	($277,812)	**($6,882)**	$266,181	($300,267)	**($34,087)**	$224,785	($222,211)	**$2,574**
	2034	$1,285,307	($1,404,987)	**($119,680)**	$270,641	($277,812)	**($7,171)**	$264,647	($300,267)	**($35,621)**	$224,901	($222,211)	**$2,690**
	2035	$1,279,922	($1,404,987)	**($125,065)**	$270,340	($277,812)	**($7,472)**	$263,044	($300,267)	**($37,223)**	$225,022	($222,211)	**$2,811**
	2036	$1,274,294	($1,404,987)	**($130,693)**	$270,026	($277,812)	**($7,786)**	$261,369	($300,267)	**($38,898)**	$225,149	($222,211)	**$2,938**
	2037	$1,268,413	($1,404,987)	**($136,574)**	$269,699	($277,812)	**($8,113)**	$259,618	($300,267)	**($40,649)**	$225,281	($222,211)	**$3,070**
	2038	$1,262,267	($1,404,987)	**($142,720)**	$269,358	($277,812)	**($8,454)**	$257,789	($300,267)	**($42,478)**	$225,419	($222,211)	**$3,208**
	2039	$1,255,844	($1,404,987)	**($149,143)**	$269,003	($277,812)	**($8,809)**	$255,878	($300,267)	**($44,390)**	$225,563	($222,211)	**$3,352**
20	2040	$1,249,133	($1,404,987)	**($155,854)**	$268,633	($277,812)	**($9,179)**	$253,880	($300,267)	**($46,387)**	$225,714	($222,211)	**$3,503**
	2041	$1,242,120	($1,404,987)	**($162,867)**	$268,248	($277,812)	**($9,565)**	$251,793	($300,267)	**($48,475)**	$225,872	($222,211)	**$3,661**
	2042	$1,234,791	($1,404,987)	**($170,196)**	$267,846	($277,812)	**($9,966)**	$249,611	($300,267)	**($50,656)**	$226,036	($222,211)	**$3,825**
	2043	$1,227,132	($1,404,987)	**($177,855)**	$267,427	($277,812)	**($10,385)**	$247,332	($300,267)	**($52,935)**	$226,209	($222,211)	**$3,998**
	2044	$1,219,128	($1,404,987)	**($185,859)**	$266,991	($277,812)	**($10,821)**	$244,950	($300,267)	**($55,318)**	$226,388	($222,211)	**$4,177**
	2045	$1,210,765	($1,404,987)	**($194,222)**	$266,537	($277,812)	**($11,276)**	$242,461	($300,267)	**($57,807)**	$226,576	($222,211)	**$4,365**
	2046	$1,202,025	($1,404,987)	**($202,962)**	$266,063	($277,812)	**($11,749)**	$239,859	($300,267)	**($60,408)**	$226,773	($222,211)	**$4,562**
	2047	$1,192,891	($1,404,987)	**($212,096)**	$265,570	($277,812)	**($12,243)**	$237,141	($300,267)	**($63,127)**	$226,978	($222,211)	**$4,767**
	2048	$1,183,347	($1,404,987)	**($221,640)**	$265,056	($277,812)	**($12,757)**	$234,300	($300,267)	**($65,967)**	$227,193	($222,211)	**$4,982**
	2049	$1,173,373	($1,404,987)	**($231,614)**	$264,520	($277,812)	**($13,293)**	$231,332	($300,267)	**($68,936)**	$227,417	($222,211)	**$5,206**
30	2050	$1,162,951	($1,404,987)	**($242,036)**	$263,962	($277,812)	**($13,851)**	$228,230	($300,267)	**($72,038)**	$227,651	($222,211)	**$5,440**
	2051	$1,152,059	($1,404,987)	**($252,928)**	$263,380	($277,812)	**($14,433)**	$224,988	($300,267)	**($75,280)**	$227,896	($222,211)	**$5,685**
	2052	$1,140,677	($1,404,987)	**($264,310)**	$262,774	($277,812)	**($15,039)**	$221,600	($300,267)	**($78,667)**	$228,152	($222,211)	**$5,941**
	2053	$1,128,783	($1,404,987)	**($276,204)**	$262,142	($277,812)	**($15,670)**	$218,060	($300,267)	**($82,207)**	$228,419	($222,211)	**$6,208**
	2054	$1,116,354	($1,404,987)	**($288,633)**	$261,484	($277,812)	**($16,329)**	$214,361	($300,267)	**($85,906)**	$228,699	($222,211)	**$6,488**
	2055	$1,103,366	($1,404,987)	**($301,621)**	$260,798	($277,812)	**($17,014)**	$210,495	($300,267)	**($89,772)**	$228,990	($222,211)	**$6,779**
	2056	$1,089,793	($1,404,987)	**($315,194)**	$260,083	($277,812)	**($17,729)**	$206,455	($300,267)	**($93,812)**	$229,296	($222,211)	**$7,085**

Prepared by EPS 8/22/2019

Table 13
FORA Biennial CIP Review
Comparison of Annual Interest Earnings and Costs

Permit Year	Year	HCP Endowment			UC Endowment			IAF Endowment			Borderlands Endowment		
		Interest Earnings	Annual Costs	Difference	Interest Earnings	Annual Costs	Difference	Interest Earnings	Annual Costs	Surplus/ (Deficit)	Interest Earnings	Annual Costs	Surplus/ (Deficit)
Source		*Table 9*	*Table 9*		*Table 10*	*Table 10*		*Table 11*	*Table 11*		*Table 12*	*Table 12*	
	2057	$1,075,609	($1,404,987)	**($329,378)**	$259,339	($277,812)	**($18,474)**	$202,234	($300,267)	**($98,034)**	$229,614	($222,211)	**$7,403**
	2058	$1,060,787	($1,404,987)	**($344,200)**	$258,563	($277,812)	**($19,249)**	$197,822	($300,267)	**($102,445)**	$229,947	($222,211)	**$7,736**
	2059	$1,045,298	($1,404,987)	**($359,689)**	$257,754	($277,812)	**($20,058)**	$193,212	($300,267)	**($107,055)**	$230,296	($222,211)	**$8,085**
40	2060	$1,029,112	($1,404,987)	**($375,875)**	$256,912	($277,812)	**($20,900)**	$188,395	($300,267)	**($111,873)**	$230,659	($222,211)	**$8,448**
	2061	$1,012,197	($1,404,987)	**($392,790)**	$256,034	($277,812)	**($21,778)**	$183,361	($300,267)	**($116,907)**	$231,040	($222,211)	**$8,829**
	2062	$994,522	($1,404,987)	**($410,465)**	$255,119	($277,812)	**($22,693)**	$178,100	($300,267)	**($122,168)**	$231,437	($222,211)	**$9,226**
	2063	$976,051	($1,404,987)	**($428,936)**	$254,166	($277,812)	**($23,646)**	$172,602	($300,267)	**($127,665)**	$231,852	($222,211)	**$9,641**
	2064	$956,749	($1,404,987)	**($448,238)**	$253,173	($277,812)	**($24,639)**	$166,857	($300,267)	**($133,410)**	$232,286	($222,211)	**$10,075**
	2065	$936,578	($1,404,987)	**($468,409)**	$252,138	($277,812)	**($25,674)**	$160,854	($300,267)	**($139,413)**	$232,739	($222,211)	**$10,528**
	2066	$915,500	($1,404,987)	**($489,487)**	$251,060	($277,812)	**($26,752)**	$154,580	($300,267)	**($145,687)**	$233,213	($222,211)	**$11,002**
	2067	$893,473	($1,404,987)	**($511,514)**	$249,937	($277,812)	**($27,876)**	$148,024	($300,267)	**($152,243)**	$233,708	($222,211)	**$11,497**
	2068	$870,455	($1,404,987)	**($534,532)**	$248,766	($277,812)	**($29,047)**	$141,173	($300,267)	**($159,094)**	$234,226	($222,211)	**$12,015**
	2069	$846,401	($1,404,987)	**($558,586)**	$247,546	($277,812)	**($30,267)**	$134,014	($300,267)	**($166,253)**	$234,766	($222,211)	**$12,555**
50	2070	$821,264	($1,404,987)	**($583,723)**	$246,275	($277,812)	**($31,538)**	$126,533	($300,267)	**($173,735)**	$235,331	($222,211)	**$13,120**
	Post Permit												
	2071+	$794,997	($780,983)	**$14,014**	$244,950	($232,779)	**$12,171**	$118,715	($105,019)	**$13,696**	$235,922	($222,211)	**$13,711**

performance

Source: FORA; EPS.

Appendix Q
Memorandum of Understanding Between The California Department of Parks and Recreation and the California Department of Toxic Substances Control Pursuant to Health and Safety Code Section 25355.5(a)(1)(c)

MEMORANDUM OF UNDERSTANDING
BETWEEN THE CALIFORNIA DEPARTMENT OF PARKS AND RECREATION (DPR) AND THE CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL (DTSC) PURSUANT TO HEALTH AND SAFETY CODE SECTION 25355.5 (a)(1)(c)

This Memorandum of Understanding (MOU) is made and entered into, by and between the State of California, Department of Toxic Substances Control (DTSC) and the State of California, Department of Parks and Recreation (DPR), through their duly appointed, qualified or acting representatives.

1.0 <u>Background and Recitals</u>.

1.1 The Restricted Property is Parcel Number one of the future Fort Ord Dunes State Park (FODSP), excluding approximately 122 acres of unrestricted area to be used for a campground and other park visitor activities. The Restricted Property consists of approximately 858 acres of the total 980 acres formerly owned by the United States Department of the Army (U.S. Army). The Restricted Property was part of the former U.S. Army Fort Ord and is located west of the cities of Marina and Seaside. The eastern boundary of the proposed FODSP is the railroad right of way owned by the Transportation Agency for Monterey County (TAMC), as depicted on Attachment 1. The western boundary of the proposed FODSP is the mean high tide line of the Pacific Ocean. The Restricted Property is limited to the north by the Marina State Beach (which is within the limits of the city of Marina), and to the south by a privately-owned former sand mine (which is within the limits of the city of Sand City), and to the south by a former sand mine. A site location map is attached as Attachment 1.

1.2 This MOU only applies to the Restricted Property described above within the proposed FODSP, herein referred to as the Property.

1.3 DTSC and DPR intend to enter into a Land Use Covenant to restrict soil use at Fort Ord Dunes State Park (FODSP Soil Covenant), which will be recorded at the Monterey County (County) Recorder's Office, restricting residential use, public or private school for persons under the age of 21, hospitals, day care center for children, or campgrounds. The FODSP Soil Covenant also requires a soil management plan and health and safety plan if soil is removed from the restricted property. The FODSP Soil Covenant will apply to the Restricted Property.

1.4 DTSC and the U.S. Army entered into another covenant which was signed on September 29, 2006, by the Covenantor (U.S. Army), and recorded at the County Recorder's Office on October 18, 2006, restricting the use of the groundwater and interference with groundwater remedy infrastructures (FODSP Groundwater Covenant). The FODSP Groundwater Covenant references County Ordinance No. 5011 that restricts installation of water wells in the impacted areas of the former Fort Ord. This FODSP Groundwater Covenant runs with the land and binds owners of the Property. An amendment to the FODSP Groundwater Covenant will be signed and recorded after DPR takes ownership of the property. The amendment will expand the restricted area and provide improved illustrations showing:

1) the County Ordinance groundwater protection zones,
2) revised restricted area; and,
3) the groundwater remediation system subsurface infrastructure locations.

1.5 Fort Ord was listed on the National Priorities List (Superfund) in 1990. The Fort Ord Federal Facility Agreement (FFA) was signed by the U.S. Army, the United States Environmental Protection Agency (U.S. EPA), DTSC and the California Regional Water Quality Control Board (RWQCB), Central Coast Region, in 1990. All of Fort Ord, including the Property, has been addressed under the federal Comprehensive Environmental Compensation and Liability Act (CERCLA).

1.6 The Property was used extensively as small arms (rifle) ranges. This activity deposited large volumes of lead bullets consisting of the slugs and miscellaneous metal casings and/or debris on and in several areas on the Property. The article of concern restricted in the FODSP Soil Covenant is the "lead bullet slugs". Because the predominant use of the small arms ranges was for less than 50-calibre target practice and resulted in lead bullet slugs, Munitions and Explosives of Concern (MEC), are not anticipated to be present on the Restricted Property, although incidental MEC may be present, as described in Sections 1.10 to 1.13, herein. The lead contamination from spent bullets at small arms ranges at the Property has been addressed by the *"Interim Record of Decision, Site 3, Beach Trainfire Ranges"* (Site 3 Interim ROD) dated January 13, 1997.

1.7 The U.S. Army conducted remedial actions pursuant to the Site 3 Interim ROD that included excavation and screening of soils contaminated with lead at the beach firing ranges. The U.S. Army removed high concentrations of bullet slugs and contaminated soil pursuant to the ROD as it deemed necessary and practical to protect "human health and natural resources". However, lead in the form of spent bullet slugs remain on some portions of the Property at levels inconsistent with residential and other sensitive uses. Due to wind and erosion, it is likely that additional areas with accumulations of bullet slugs will become visible in the future.

1.8 DPR will implement the final version of the FODSP Preliminary General Plan (PGP) and Draft Environmental Impact Report (DEIR) dated January 2004, which was approved in September 2004 by the State Park Commission. The PGP and DEIR restrict access to the dune areas, where it is most likely that lead contamination may be present. In accordance with Guideline BIO-2, DPR will limit use of the dune habitat areas to designated trails and public use area to preserve and maintain habitat and special status species. While limiting access to protect biological resources, DPR also concurrently limits access to the bullet-impacted dunes. Additional restrictions stated in the General Plan on the Restricted Property include:

1) no motorized vehicles,
2) low impact construction materials, such as raised walking trails (Guideline CIR-14), and
3) possibly paved trails and boardwalks.

Vista points and outdoor exhibits will be used to notify park users of the danger of removing spent bullets. Guideline HAZ-1 indicates that DPR will adopt measures to assure public and employee safety will be undertaken. Guideline HAZ-2 indicates that DPR will review lead data before development to assure protection of people from potential impacts associated with handling the disposal of lead impacted soil. The FODSP Soil Covenant also restricts DPR from removing the soil from the property without a DTSC-approved Soil Management Plan and Health and Safety Plan.

1.9 There is a possibility that some U.S. Army activities with MEC occurred on the Property and that live MEC items remain on the Property. The MEC was addressed by the *"Record of Decision, No Further Action Related to Munitions and Explosives of Concern-Track 1 Sites, No Further Action with Monitoring for Ecological Risks from Chemical Contamination"* (Track 1 ROD) dated April 6, 2005. The conclusion of the Track 1 Remedial Investigation/Feasibility Study (RI/FS) and ROD is: "*The site was used for training with military munitions, but items that potentially remain do not pose an unacceptable risk based upon site-specific evaluations conducted.*" However, DPR and DTSC agree that the potential, although very small, exists that additional live MEC items remain.

1.10 MEC are specific categories of military munitions that may pose unique explosive risks, including unexploded ordnance, discarded military munitions, and munitions constituents present in high enough concentrations to pose an explosive hazard. Lead bullet slugs from small arms ranges that are less than 50-calibre in size are not considered MEC at the former Fort Ord and are not considered to have explosive properties.

1.11 Pursuant to the Track 1 ROD, the "U.S. Army recommends construction personnel involved in intrusive operations at Site 3 attend the Army's ordnance recognition and safety training" as a safety precaution. The Track 1 also states that the "U.S. Army will provide ordnance recognition and safety training, as appropriate in accordance with the Site Security Program.

1.13 This MOU constitutes the Enforcement and Implementation Plan required by Title 22, California Code of Regulations Section 67391.

2.0 U.S. Army Activities.

2.1 U.S. Army to Perform Recurring Review. DTSC and DPR understands that the U.S. Army, pursuant to the National Oil and Hazardous Substances Pollution Contingency Plan, is required to continue to provide recurring MEC program reviews on the Property no less frequently than every 5 years (5-Year Review). This agreement shall be evaluated in the Army's 5-Year Review to determine future requirements.

2.2 U.S. Army to Provide MEC Recognition Training. In accordance with U.S. Army Regulation 75-15, and FORSCOM Supplement 1, the U.S. Army will conduct, at its expense, the MEC recognition training which is part of the former Fort Ord MRS Security Program. This training will increase the awareness and ability to identify MEC items to all workers performing soil disturbance. Because there is a potential for live MEC items being present, appropriate care must be taken. The U.S. Army, pursuant to the MRS Security Program, will also provide all training to property owners and others that may be involved with intrusive activities, including DPR employees and their contractors. This training is not required for delivery persons or other transient workers, who will have minimal potential for soil contact. If, at any time, the U.S. Army ceases to provide this training, which is a one hour class, DPR will provide equivalent training annually to its employees and contractors, as approved by DTSC.

2.3 U.S. Army to Transport and Dispose of Bullets Collected by DPR. The U.S. Army will transport and recycle or dispose of the bullets collected by DPR. U.S. Army submitted a letter to DTSC on November 16, 2006 (Attachment 3), which clarifies this agreement to transport and recycle or dispose of the lead bullet slugs that have been collected by DPR. The Army's letter restates Section 4.4 of the Track 1 ROD:

> "*In the future, should any military munitions-related site be found within any of the Track 1 sites that the Army will take an appropriate immediate action (i.e., removing the found item, recording the incident) and within 90 days of the discovery, submit a plan for appropriate follow up-action to EPA and DTSC for consultation, pursuant to Section 7.7(b) of the Fort Ord Federal Facilities Agreement (FFA).*"

3.0 DPR Activities.

3.1. Inspections. DPR personnel shall inspect each of the small arms ranges 1-17 and the windward side of the dunes on at least a quarterly basis and after significant rain events. In each annual report, the inspection frequency will be reviewed and may be reduced, if deemed appropriate and approved by DTSC. The inspections shall be in areas within the moderate lead covered areas (one to ten percent bullet cover shown as a hatched zone on drawings in Attachment 4). In addition, an employee shall inspect the ocean-facing bluffs across from the ranges along the ocean beach for the same materials. The inspections after significant rain events will be at DPR's discretion and should be conducted only where erosion is evident which may have removed surface materials and uncovered bullets (i.e., surface water runoff areas or beach facing cliffs). Personnel performing visual inspections shall complete Inspection Forms 1 through 4, as appropriate (Attachment 5), and shall have received the training described in Section 2.2 prior to carrying out the duties of this Section.

3.2. FODSP Soil Covenant. DPR will enter into a FODSP Soil Covenant pursuant to California Health and Safety Code sections 25220 et seq., 25355.5(a)(1)(C), and Civil Code section 1471 and et seq. to restrict residential use within the Restricted Property and provide for a soil management plan.

4.0 Soil Disturbance.

4.1. Soil disturbance is defined here as any excavation, site preparation, grading, drilling, rototilling, soil preparation, etc.

4.2 No soil disturbance or construction activity on the Property shall begin until personnel receive MEC Recognition training described in Section 2.2 above to all workers involved in soil disturbance and all other construction workers who will be working on the Property.

4.3 No soil shall be moved from the Restricted Property without a Soil Management Plan approved by DTSC and a Health and Safety Plan. Any soil removed from the site shall be appropriately sampled and managed in accordance with all applicable provisions of H&SC Chapters 6.5 and 6.8. DPR will implement mitigation measures Haz-1 and Haz-4 as described on Pages 4-37 and 4-40 of the FODSP PGP and DEIR. DPR will implement the final versions of these reports, as approved.

4.4 Spent lead bullet slugs uncovered over time shall be collected by DPR staff and placed in appropriate containers on site. DPR shall notify the U.S. Army Base Realignment and Closure (BRAC) office at (831) 242-7919, to arrange for transportation and recycling or disposal of the collected bullets as referenced in Section 2.3 above.

4.5 DPR shall follow all appropriate health and safety precautions in accordance with applicable Federal and California Occupational Health and Safety (OSHA) Regulations in complying with this section. DPR will implement mitigation measures Haz-1 and Haz-4 as described on Page 4-37 of the FODSP PGP and DEIR. DPR will implement the final versions of these reports, as approved.

4.6 In the event any person finds an item suspected to be a potential MEC item, other than a small arms casings or lead bullet slug, DPR shall stop work, evacuate all non-essential personnel and secure the area. In accordance with the MRS Security Program, Section 4.3.2.2, DPR shall:

1) Immediately notify the nearest jurisdictional law enforcement agency (911).

2) The jurisdictional law enforcement agency will arrange for a response and notify the Fort Ord BRAC office at (831) 242-7919.

3) Upon notification, the Fort Ord BRAC office will fill out Section A of a MEC incident report (Attachment 6), and document that a response has been completed.

4) The 60th Civil Engineer Squadron (EOD) at Travis Air Force Base, California (707) 424-5517, may respond to MEC discoveries on other than Fort Ord Property.

5) The Fort Ord BRAC office will obtain MEC incident reports from the 787th EOD or the initiating law enforcement agency, as appropriate.

6) Site security shall only be released after the experts described in 4) above have either removed the item or have assessed the item and determined that the item is not dangerous.

4.7 Reporting: On February 1st of each year, the Covenantor shall submit an annual letter report to DTSC covering activities undertaken during the previous period January 1st through December 31st. The annual letter report will include descriptions of grading and construction activities, any MEC or MEC related items discovered, bullet inspection reports, bullet accumulations posted on a map (or GPS coordinates will be recorded), bullet removal activities, specific safety training efforts conducted that year, and the specific compliance with each of the provisions of this agreement. The annual letter report shall also include a summary of the Covenantor's compliance with the Covenant. A map of the Restricted Property showing percent bullet cover and the surface features, is attached (Attachment 4). The Covenantor will plot the approximate locations of the bullet accumulations on Attachment 4 for the annual report or alternately, the Covenantor will provide GPS coordinates of the bullet accumulation areas in a table with appropriate coordinate system references, GPS make and model.

5.0 General Provisions.

5.1 Notice: Whenever any person gives or serves any Notice (Notice as used herein includes any demand or other communication with respect to this Agreement), each such Notice shall be in writing and shall be deemed effective: 1) when delivered, if personally delivered to the person being served, or 2) three (3) business days after deposit in the mail, if mailed by United States mail, postage paid, certified, return receipt requested:

To DPR:

District Superintendent, Monterey District
California Department of Parks and Recreation
2211 Garden Road
Monterey, California 93940

To DTSC:

Department of Toxic Substances Control
Northern California Region
Office of Military Facilities Branch Chief
8800 Cal Center Drive
Sacramento, California 95826

5.2 Assignment: Nothing herein shall prevent DPR, and it is specifically understood that DPR may, through a written agreement, assign some of the responsibilities (except reporting responsibilities, defined in Section 4.10 to another party. However, DPR remains responsible for ensuring compliance with this MOU.

5.3 Five-Year Review: Pursuant to the National Contingency Plan and the Federal Facilities Agreement (FFA), the U.S. Army shall be performing all appropriate 5-year reviews at U.S. Army's sole cost and expense.

5.4 Obligations of DTSC: DTSC agrees to review and oversee the measures to be performed by DPR pursuant to this MOU.

5.5 Project Coordinator: The DPR Project Coordinator shall be the Monterey District Superintendent who shall be responsible for receiving and submitting all notices, comments, approvals, and other communications from and to DTSC.

5.6 Submittals: All submittals, reports and notifications from DPR that are required by this MOU shall be sent to:

Department of Toxic Substances Control
Northern California Region
Office of Military Facilities, Branch Chief
8800 Cal Center Drive
Sacramento, California 95826

5.7 Communications: No informal advice, guidance, suggestions or comments by DTSC regarding reports, plans, specifications, schedules or any other writings by DPR shall be construed to relieve DPR of the obligations to obtain such formal approvals as may be required.

5.8 DTSC Review and Approval: If DTSC determines that any report, plan, schedule or other document submitted to DTSC for approval pursuant to this MOU, fails to comply with this MOU or fails to protect public health or safety or the environment, DTSC may: 1) modify the document as deemed necessary and approve the document as modified; or 2) return comments to DPR with recommended changes and a date by which DPR must submit to the DTSC a revised document incorporating the recommended changes. Any noncompliance with these directives shall be deemed a failure or refusal to comply with this MOU.

5.9 Stop Work Order: In the event that DTSC determines that any activity during (whether or not pursued in compliance with this MOU) may pose an imminent or substantial endangerment to the health or safety of people on the Site or in the surrounding area or to the environment, DTSC may order DPR to stop further disturbance on the Property for such period of time needed to abate the endangerment.

5.10 Compliance with Applicable Laws: DPR and DTSC shall carry out this MOU in compliance with all applicable local, state, and federal requirements, including, but not limited to, requirements to obtain permits and to assure worker safety.

5.11 Liabilities: Nothing in this MOU shall constitute or be construed as a satisfaction or release from liability for any conditions or claims arising as a result of current or future operations of DPR. Nothing in this MOU is intended or shall be construed to limit or preclude DTSC from taking any action authorized by law to protect public health or safety or the environment and recovering the cost thereof. Notwithstanding compliance with the terms of this MOU, DPR may be required to take further actions as are necessary to protect public health and the environment.

5.12 Site Access: DTSC shall have reasonable right-of-entry and access to the Property for inspection, monitoring, and other activities consistent with the purposes of this MOU, the U.S. Army CERCLA cleanup activities as deemed necessary by DTSC in order to protect the public health and safety or the environment and oversee any required activities, provided such access does not unreasonably interfere with either construction activities or DPR's use of the Property.

5.13 Record Retention: All data, reports and other documents required by this MOU shall be preserved by DPR for a minimum of ten (10) years after the conclusion of all activities under this MOU. If DTSC requests that some or all of these documents be preserved for a longer period of time, DPR shall either comply with that request or deliver the documents to DTSC, or permit DTSC to copy the documents prior to destruction. DPR shall notify DTSC in writing at least six (6) months prior to destroying any documents prepared pursuant to this MOU.

5.14 State Liabilities: DTSC shall not be liable for any injuries or damages to persons or property resulting from acts or omissions by DPR, in carrying out activities pursuant to this MOU, nor shall DTSC be held as a party to any contract entered into by DPR in carrying out activities pursuant to this MOU.

5.15 Severability: The requirements of this MOU are severable, and the parties shall comply with each and every provision hereof notwithstanding the effectiveness of any other provision.

5.16 Modification, Amendment, and Termination: DPR may upon written request, seek minor modifications, amendments or termination of the MOU at any time. DTSC shall under the appropriate circumstances, review and consider, and approve such request, such request not to be unreasonably withheld. Minor modifications may include but are not limited to corrections of typographic, grammatical and similar editing errors that do not change the intended meaning, or minor changes to reporting protocols. Any party may propose amendments or termination to the MOU by providing written notice to the other party. Such notice shall include a statement of the reason for the proposed modification and an analysis of its effect upon removal of MEC. The parties will use best efforts to respond to proposed amendments within 60 days of receipt of such notice. Proposed amendments shall become effective upon all parties' written approval.

5.17 Parties Bound: This Agreement applies to and is binding upon DPR and upon any successor agency of the State of California that may have responsibility for and jurisdiction over the subject matter of this MOU. DPR shall provide a copy of this MOU to any successor or assignee.

5.18 Cost Recovery: DPR shall be liable for all of DTSC costs incurred in activities and oversight associated with DPR's compliance with this MOU. These costs will include costs incurred in compliance with CCR Title 22, Division 4.5, Chapter 36, Section 67391.1 (h) for the covenants recorded on the property.

If DPR causes additional contamination, cost recovery may also be pursued by the DTSC under CERCLA, Health and Safety Code Section 25360, or any other applicable state or federal statute or common law. The Department will invoice DPR for DTSC costs on a quarterly basis.

Invoices shall be transmitted to:

District Superintendent, Monterey District
California Department of Parks and Recreation
2211 Garden Road
Monterey, California 93940

5.19 Effective Date: The effective date of this MOU is the date of signature by DTSC's authorized representative.

5.20 Representative Authority: Each undersigned representative of the parties to this MOU certifies that she or he is fully authorized to enter into the terms and conditions of this MOU and to execute and legally bind the parties to this MOU.

5.21 Entire MOU: This MOU constitutes the entire MOU between the parties. It supercedes any and all other agreements, either oral or in writing, among the parties with respect to the subject matter hereof and contains all of the covenants and agreements between them with respect to said matters, and each party acknowledges that no representation, inducement, promise or agreement, oral or otherwise, has been made on other party or anyone acting on behalf of any other party that is not embodied herein.

5.21.1 Duplicate Originals: The MOU may be executed in any number of duplicate originals. A complete original of this MOU shall be maintained in the official records of each of the parties to this MOU.

IN WITNESS WHEREOF, DTSC and DPR by their duly authorized representatives, have executed this Agreement on the dates set forth below at Sacramento, California.

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

By: ______________________________
Anthony J. Landis, P.E.

Title: Chief
Northern California Operations
Office of Military Facilities
Department of Toxic Substances Control

Date: 11-7-07

DEPARTMENT OF PARKS AND RECREATION

By: ______________________________
~~Stephen R. Lehman~~

Title: ~~Deputy Director~~
~~Acquisition and Development~~
~~Department of Parks and Recreation~~

Date: ______________________________

By: ______________________________
Mathew L. Fuzie

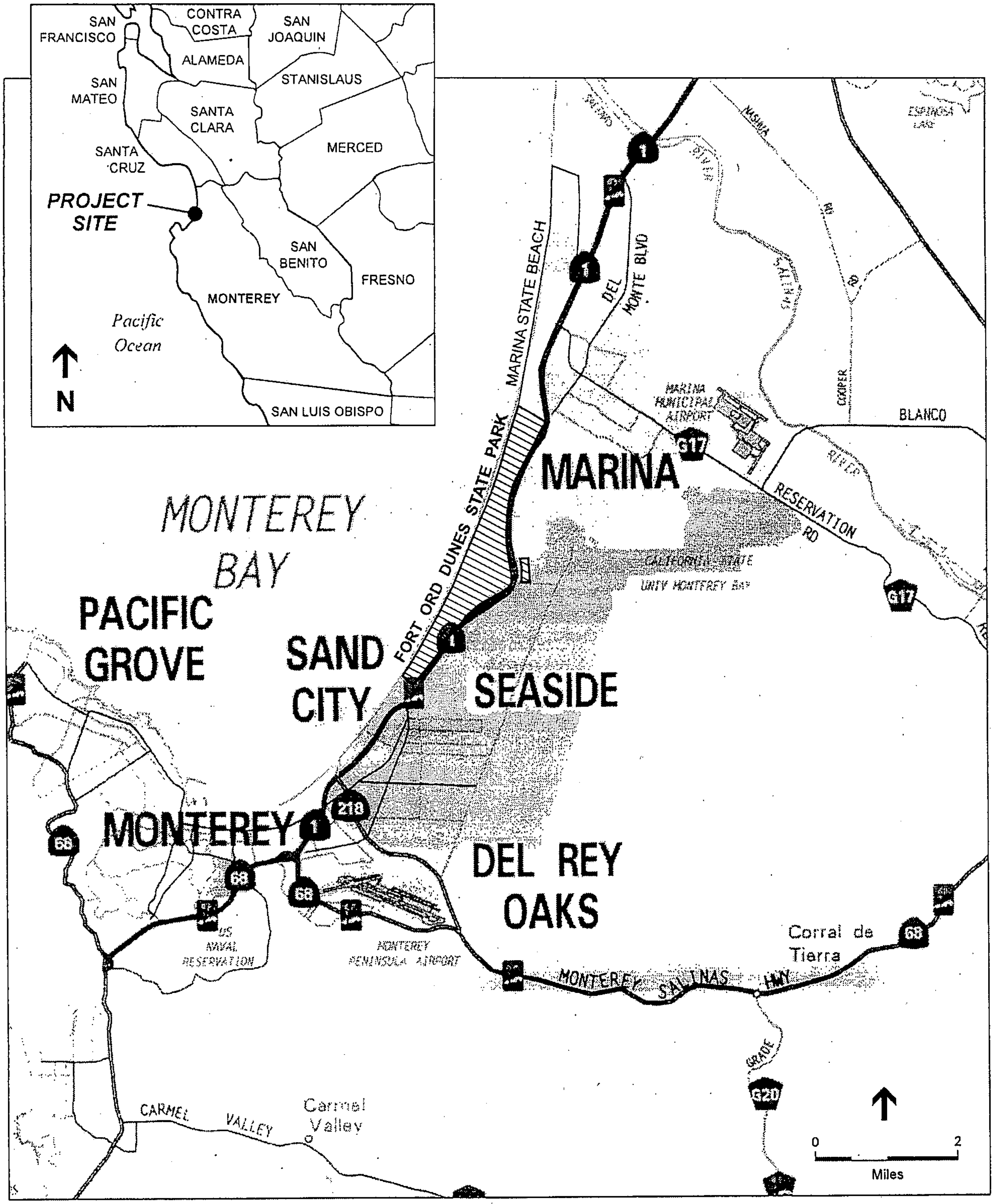
Title: District Superintendent
Monterey District
Department of Parks and Recreation

Date: 11/27/07

ATTACHMENT 1

Site Location Map

ATTACHMENT 1

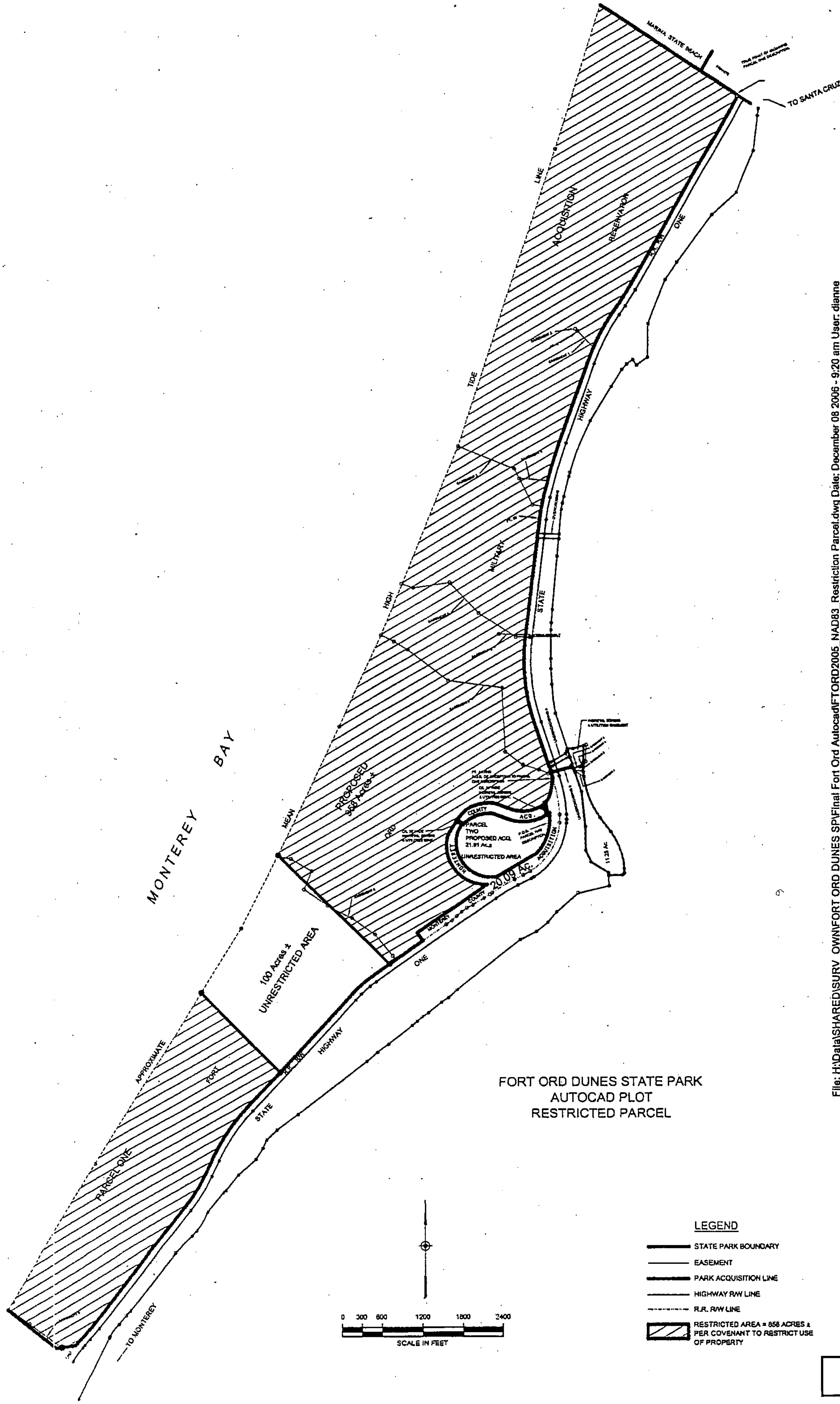


Fort Ord / 202318

SOURCE: Rand McNally, Environmental Science Associates

Attachment 1

Attachment 2



FORT ORD DUNES STATE PARK
AUTOCAD PLOT
RESTRICTED PARCEL

File: H:\Data\SHARED\SURV_OWN\FORT ORD DUNES SP\Final Fort Ord Autocad\FTORD2005_NAD83_Restriction Parcel.dwg Date: December 08 2006 - 9:20 am User: dianne

DEPARTMENT OF THE ARMY
FORT ORD OFFICE, ARMY BASE REALIGNMENT AND CLOSURE
P.O. BOX 5008, BUILDING #4463 GIGLING ROAD
MONTEREY, CA 93944-5008

NOV 16 2006

REPLY TO
ATTENTION OF:

Fort Ord BRAC Office

Dan Ward
Chief, Base Closure Unit
Office of Military Facilities -- Northern California
Department of Toxic Substances Control
8800 Cal Center Drive
Sacramento, CA 95826

Dear Mr. Ward:

This letter serves to clarify the Army's understanding regarding the agreement to collect spent bullets from the Beach Ranges (MRS Site 22, also called Site 3). As you undoubtedly recall, the Army representatives have stated at several meetings that, provided the California Department of Parks and Recreation staff collect spent bullets and notify the Army, the Army will collect the spent bullets and either recycle the material or properly dispose of it through the Army's hazardous waste disposal process. We view the following language, included in the *Record of Decision No Further Action Related to Munitions and Explosives of Concern - Track 1 Sites, No Further Remedial Action with Monitoring for Ecological Risks from Chemical Contamination at Site 3 (MRS-22)* on page 4 and again on page 38, to include the collection and proper handling of the spent bullets:

> "In the future, should any military munitions-related item be found within any of the Track 1 sites addressed in this ROD, the Army will take an appropriate immediate action (i.e., removing the found item, recording the incident), and within 90 days of the discovery, submit a plan for appropriate follow-on action to EPA and DTSC for consultation, pursuant to Section 7.7(b) of the Fort Ord Federal Facility Agreement (FFA)."

I hope this clarifies the situation. Please feel free to telephone me should further questions arise. I may be reached at (831) 242-7918. A copy of this correspondence is being provided to Roman Racca and Sue Goss from your office, and to Claire Trombadore and Martin Hausladen of the U.S. Environmental Protection Agency. Thank you, again, for your continued support and participation in the Fort Ord environmental cleanup program.

Sincerely,

G Youngblood

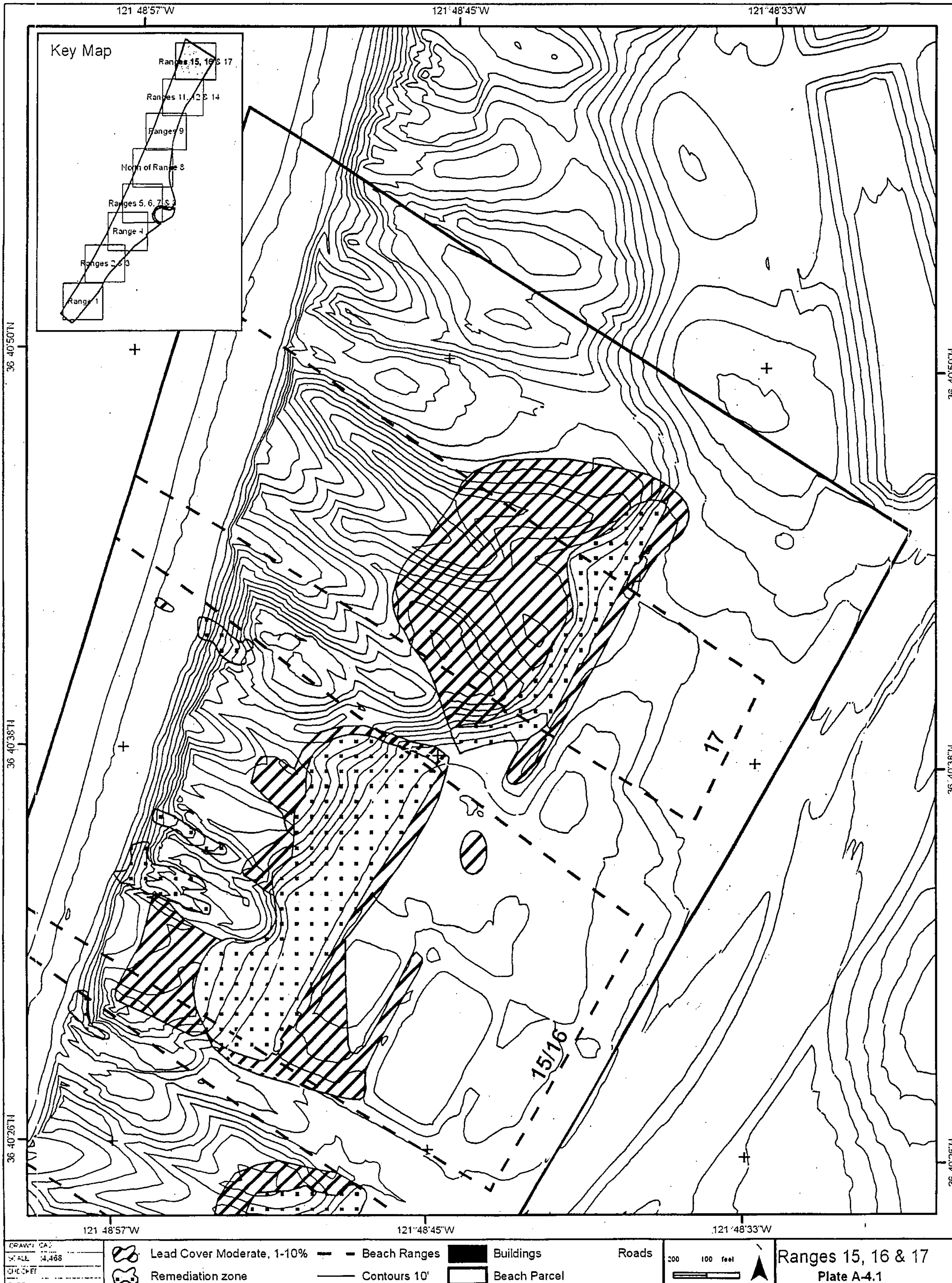
Gail Youngblood
BRAC Environmental Coordinator
Fort Ord

Attachment 3

ATTACHMENT 4
Plates A-4.1, A-4.2, A-4.3, A-4.4, A-4.5, A-4.6, A-4.7 and A-4.8

Maps of Ranges

ATTACHMENT 4



Ranges 15, 16 & 17

Plate A-4.1

Attachment 4.1

DRAWN:	
SCALE: 1:4,468	
CHECKED:	
DATE: Jan 24, 2007 at 12:45 PM	

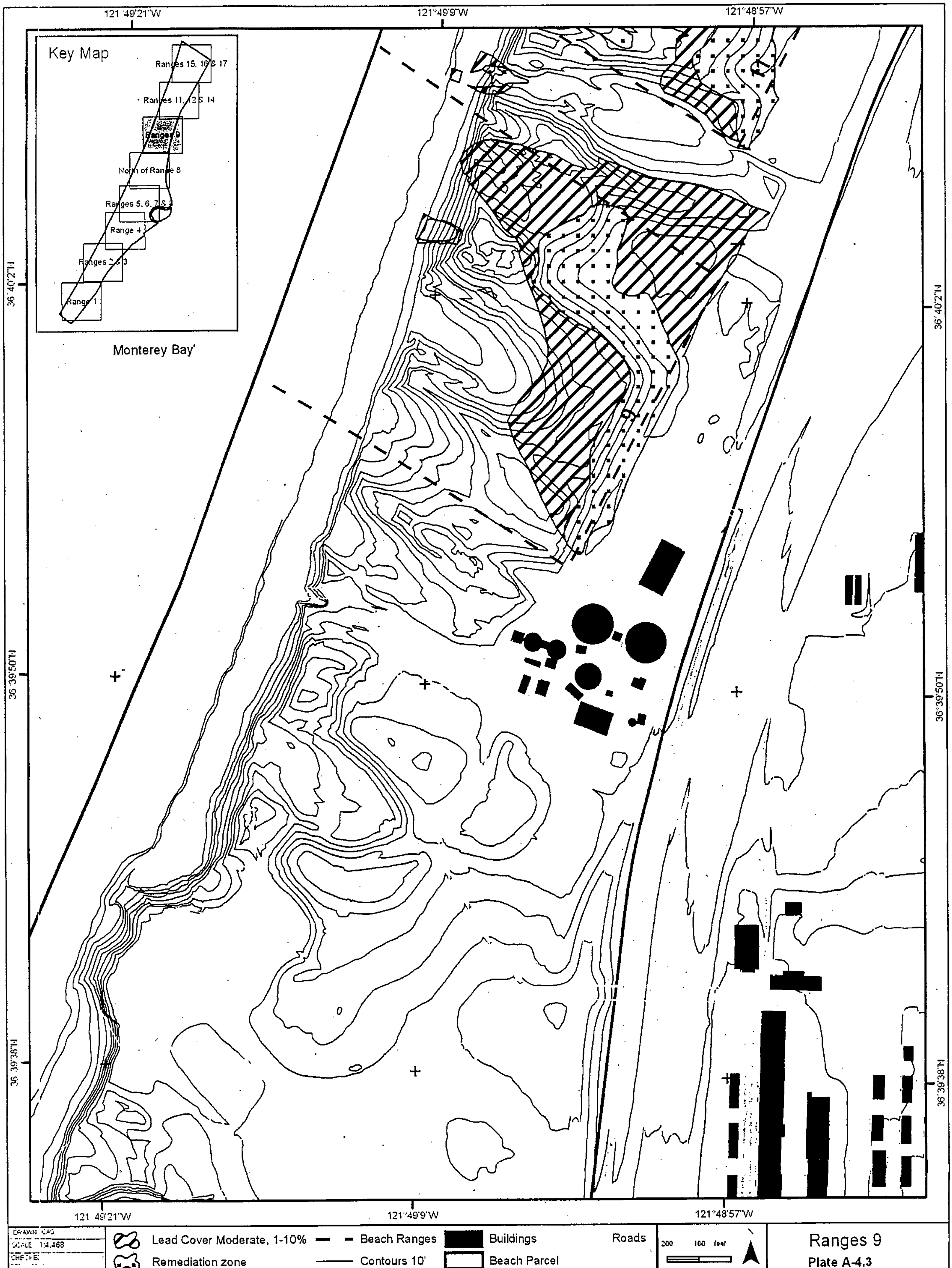
Lead Cover Moderate, 1-10%
Remediation zone
Beach Ranges
Contours 10'
Buildings
Beach Parcel
Roads

200 100 feet

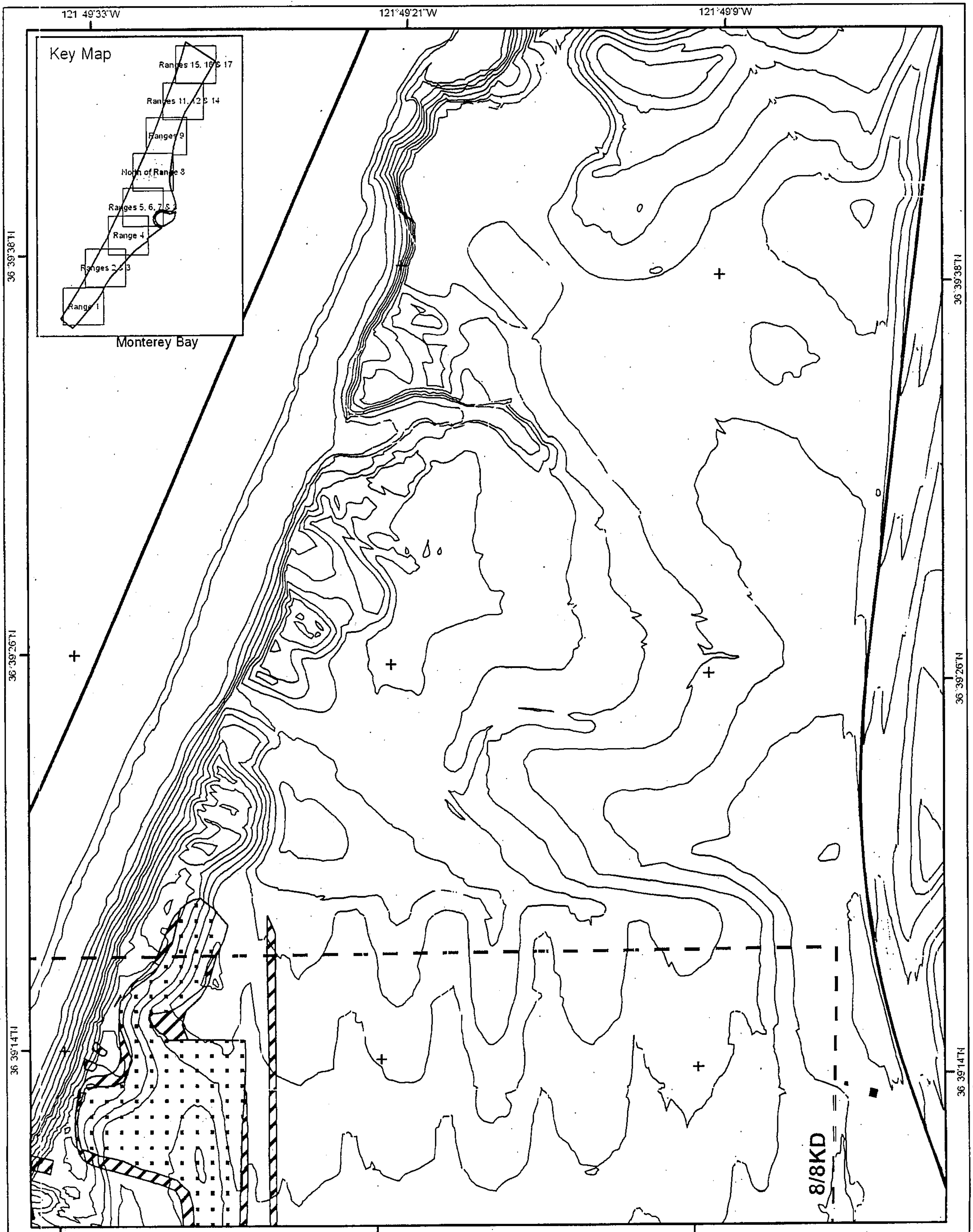
Ranges 11, 12 & 14

Plate A-4.2

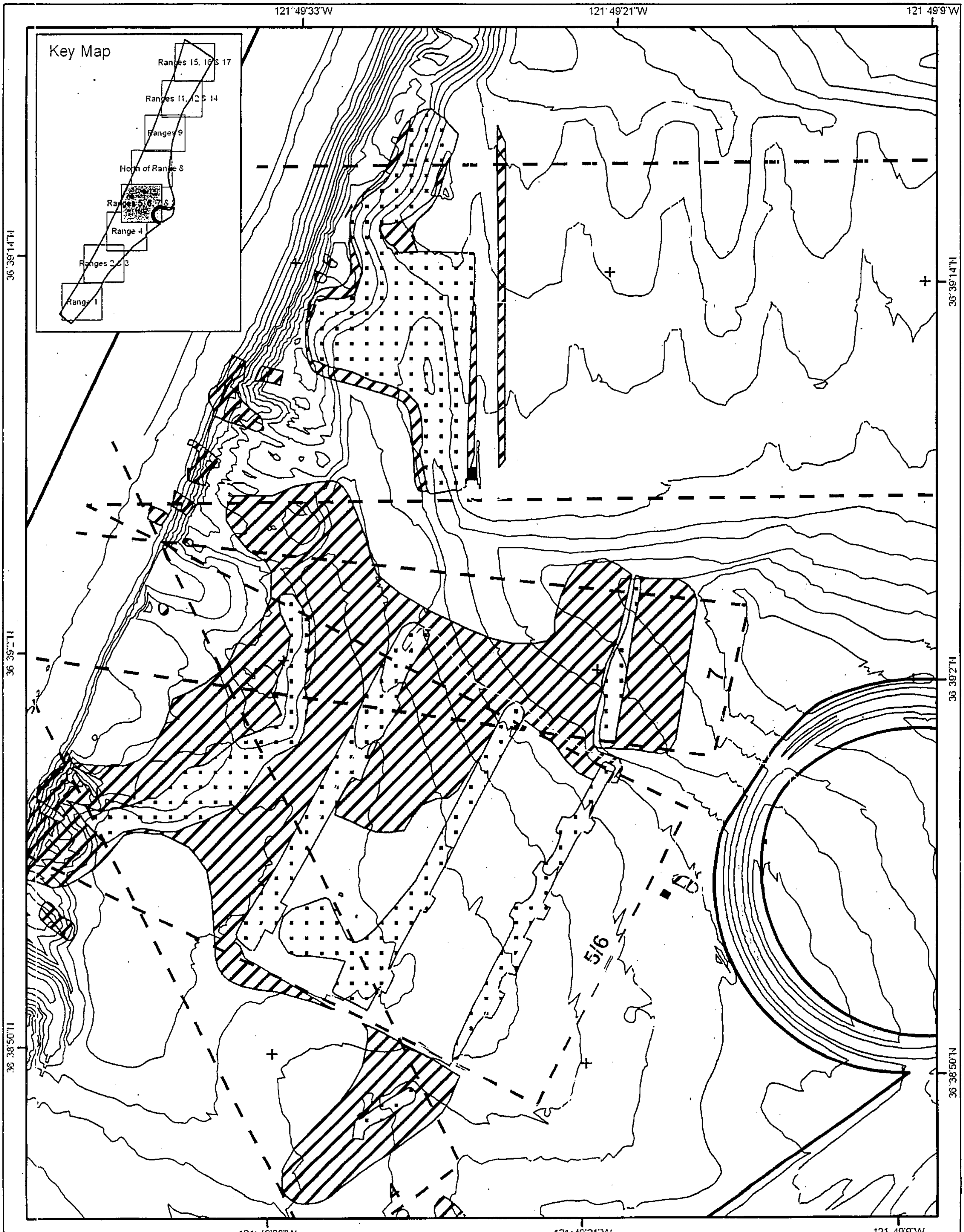
Attachment 4.2



Attachment 4.3



Attachment 4.4



Lead Cover Moderate, 1-10%

Remediation zone

Beach Ranges

Contours 10'

Buildings

Beach Parcel

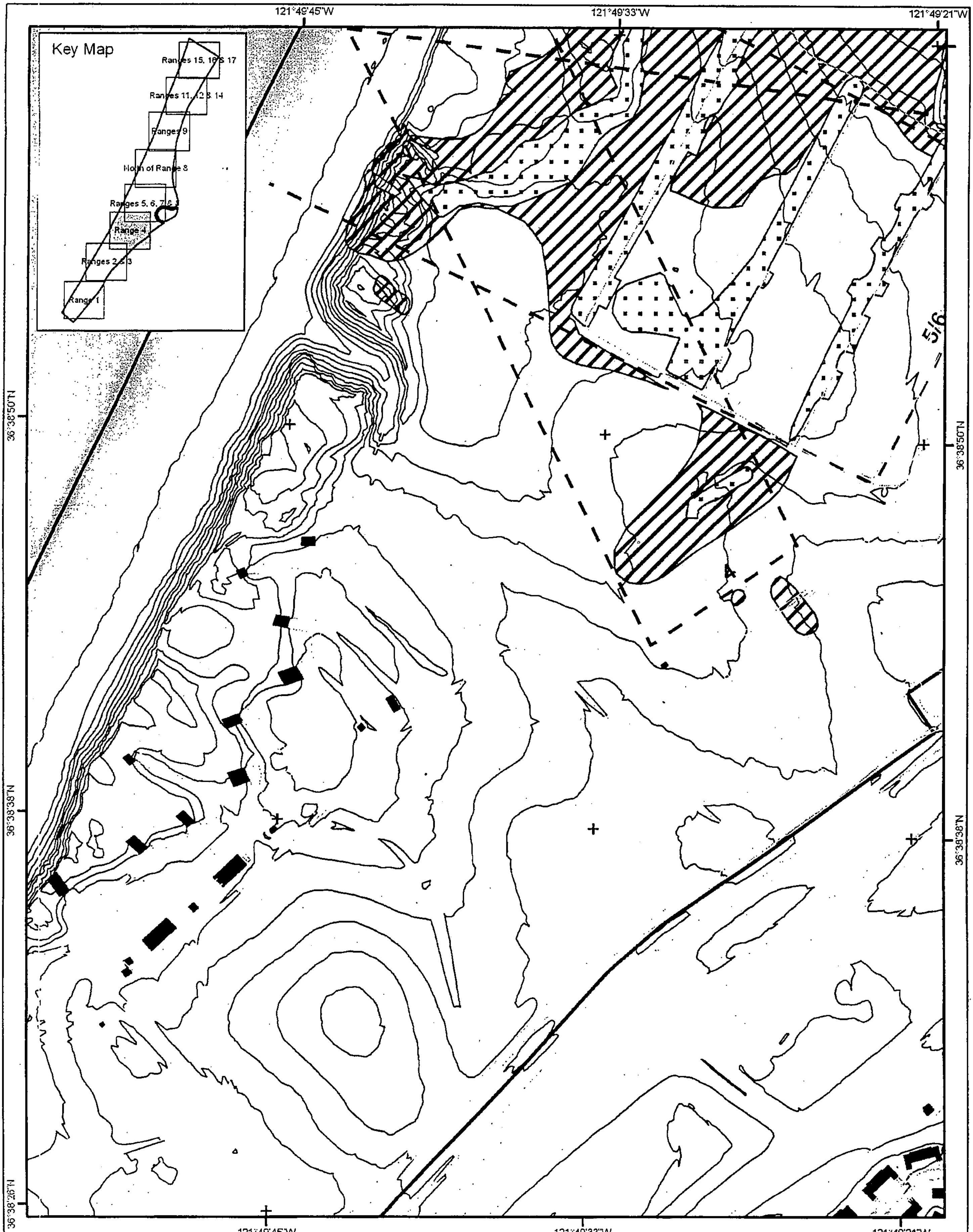
Roads

200 100 feet

Ranges 5, 6, 7 & 8

Plate A-4.5

Attachment 4.5



DRAWN: CAS		
SCALE 1:4,468		
CHECKED		
DATE Jan 24, 2007 at 12:45 PM		

Lead Cover Moderate, 1-10% — Beach Ranges — Buildings — Roads

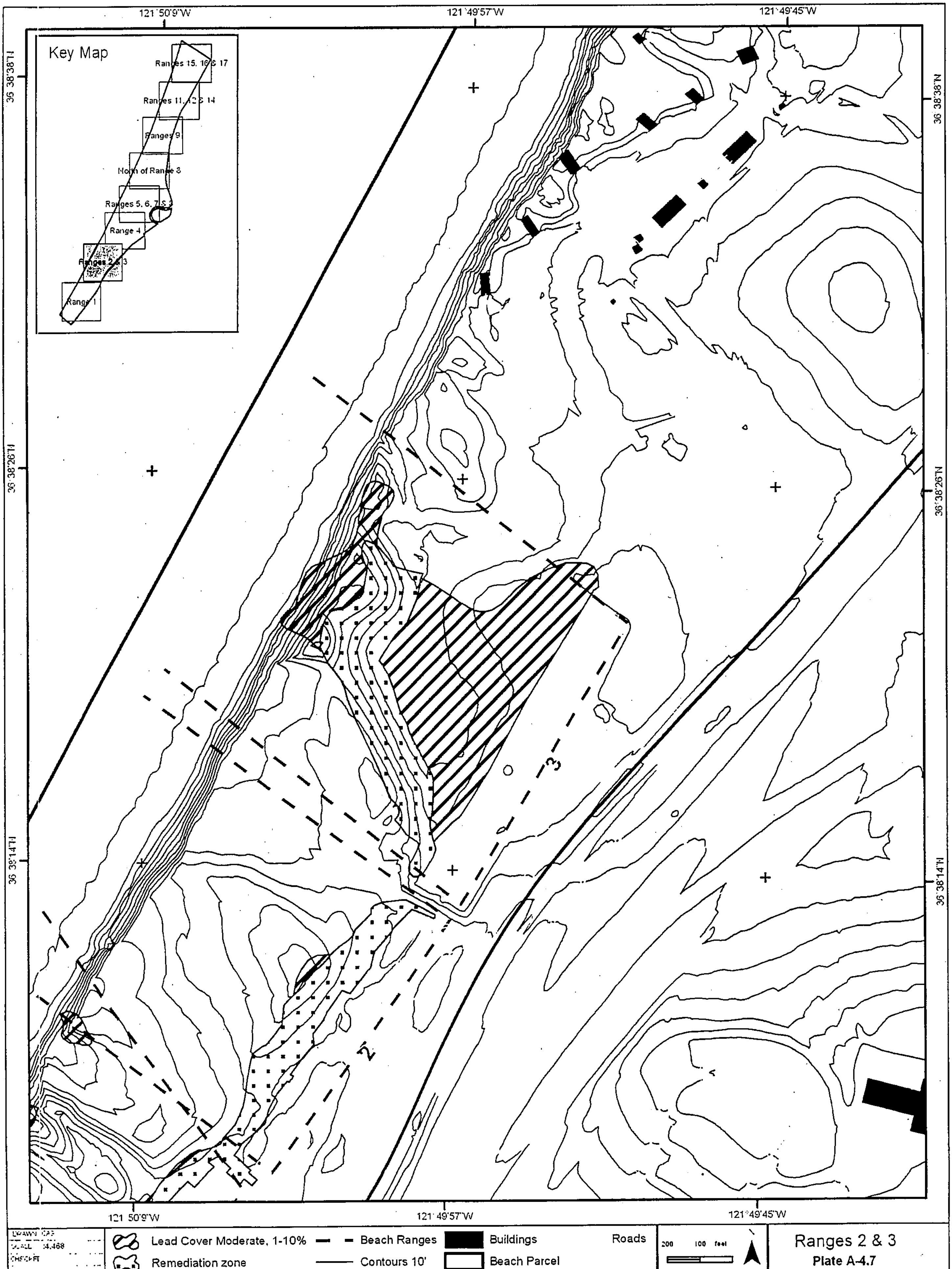
Remediation zone — Contours 10' — Beach Parcel

200 100 feet

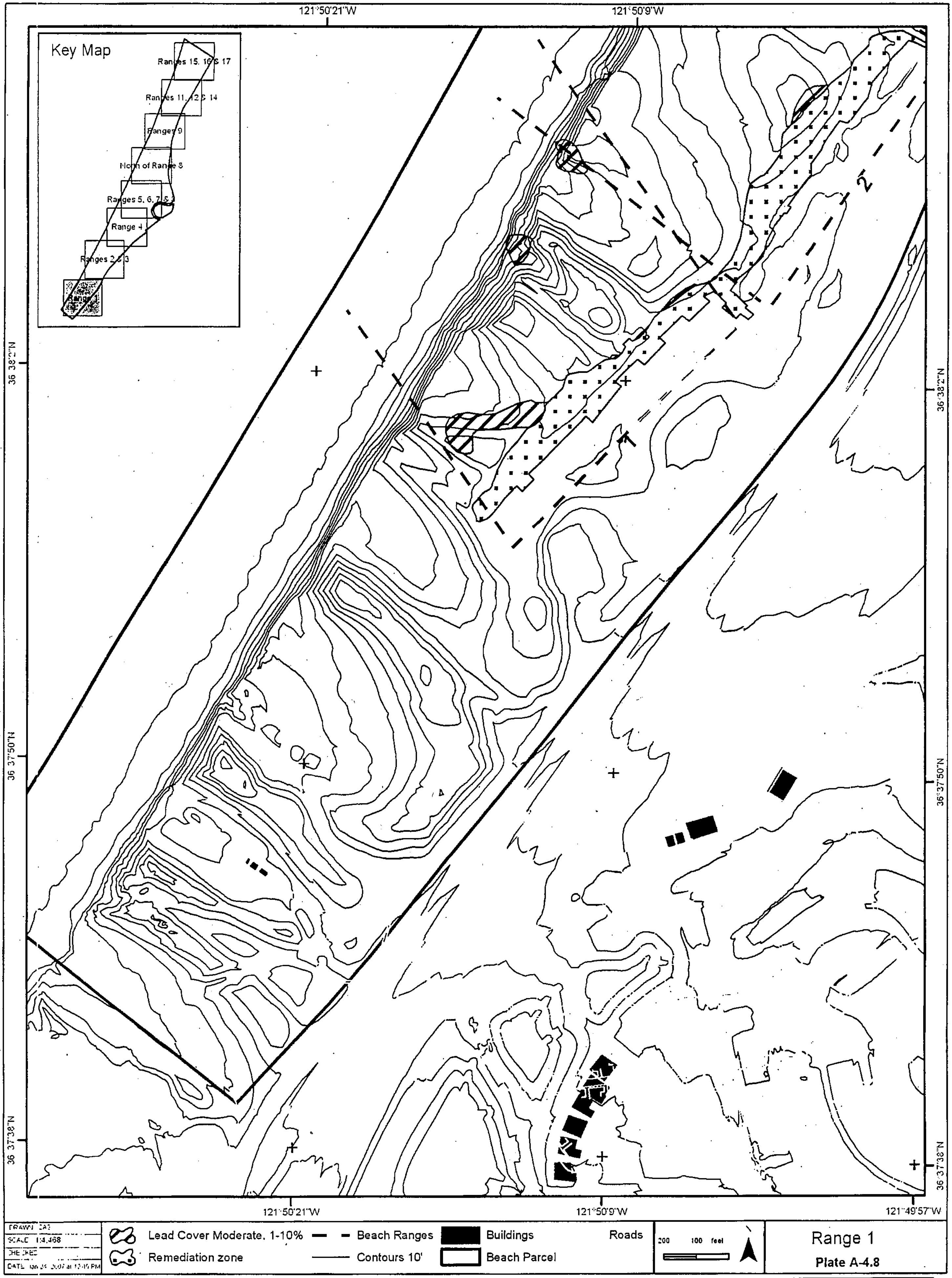
Range 4

Plate A-4.6

Attachment 4.6



Attachment 4.7



Attachment 4.8

Attachment 5-1:
Memorandum of Understanding for Fort Ord Dunes State Park
Marina, California

Form 5-1: Site Condition Summary

****Utilize Site Maps to Illustrate Locations Discussed in the Responses Below****

****After Logging Information Requested Below, Record Details of Any Observed Potential Deficiencies, LUC/MOU Violations, and Park User Complaints in Forms 2 through 4**

Name/Company of Inspector:

MEC recognition trained?: yes no

Date and Time of Inspection:

Weather Conditions:

Inspection of Dunes (Area ___): Excellent Good Fair Poor

Explain location and type of deficiencies observed such as soil disturbance, or any visible lead bullets, lead shot or MEC (details recorded below should also be transferred to Form 4):

Any Violations of Land Use Covent or MOU? Yes No

If yes, explain in detail the location and type of LUC/MOU violation (details recorded below should also be transferred to Forms 2a and 2b):

Attachment 5-1:
Memorandum of Understanding for Fort Ord Dunes State Park
Marina, California

Form 5-1: Site Condition Summary

****Utilize Site Maps to Illustrate Locations Discussed in the Responses Below****

****After Logging Information Requested Below, Record Details of Any Observed Potential Deficiencies, LUC/MOU Violations, and Park User Complaints in Forms 2 through 4**

Log Any Complaints or Concerns Expressed by Park Users-Employees During Quarterly Inspection (or reported to State Park Office) below (details recorded below should also be transferred to Form 3):

1) Park User-Employee Name/Address:

   Description of Complaint/Concern:

2) Park User-Employee Name/Address:

   Description of Complaint/Concern:

Additional notes:

Signature of Inspector **Date**

Attachment 5-2
Memorandum of Understanding for Fort Ord Dunes State Park, Marina, California

Form 5-2: Log of Violations of MOU/LUC

After Logging Information Requested Below, Record Details of LUC Violation in Form 3

Name and Address of Employee or Visitor Violating LUC	Name of Individual(s) Who Observed and Reported Violation if Not the Inspector (Include contact information)	Date/Time Violation Observed	Date/Time Violation Being Recorded in Log	Initials of Inspector Recording Information

Attachment 5-3
Memorandum of Understanding for Fort Ord Dunes State Park
Marina, California

Form 5-3: Detailed Report of
Park User/Employee Violation of LUC/MOU

Name/Company of Inspector:______________________________________**Date:**______

==

BACKGROUND INFORMATION

==

(1) Name and Address of Park User/Employee Violating LUC:

(2) Name of Individual(s) Who Observed and Reported Violation (If observed by individual(s) other than inspector):

(3) Date and Time Violation Observed:

==

LUC/MOU VIOLATION DETAILS

==

(1) Description of Activity Violating LUC/MOU:

Attachment 5-3
Memorandum of Understanding for Fort Ord Dunes State Park
Marina, California

Form 5-3: Detailed Report of
Park User/Employee Violation of LUC/MOU

IC VIOLATION FOLLOW UP **(This section may be completed at a later date)**

---

(1) Date and Time Informed State Parks of Violation

(2) Date and Time City Informed Park User/Employee of Violation

(3) Description of How State Employee Corrected/Remedied Violation:

Additional notes:

Attachment 5-4

Memorandum of Understanding for Fort Ord Dunes State Park, Marina, California

Form 5-4: Log of Maintenance/Disposal Activities at the Site

Date/Time Maintenance/Disposal Activity Performed	Location of Maintenance/ Disposal Activity	Description of Maintenance/Disposal Activity/Disposal Facility	Individual at Army Performing Maintenance/Disposal Activity (Include contact information)	Assessment of Effectiveness of Maintenance/Disposal Activity/ Problems Encountered	Initials of Individual Recording Information

FORT ORD MUNITIONS AND EXPLOSIVES OF CONCERN (MEC)
INCIDENT REPORTING FORM

If you recognize any object that resembles munitions or explosives on current or former Fort Ord property, retreat to a safe location, and report the finding to the **appropriate agencies immediately** (see below)

A. PROVIDE THE FOLLOWING INFORMATION:

Name of Person Reporting:	Telephone:
Agency:	Fax:
Date & Time of Incident/Discovery:	
Description of Item Found (refer to the "Safety Alert" pamphlet if possible):	
Location (direction from nearest road/building, attach map if possible):	
GPS Coordinate Location: (Type of Instrument, NAD83 California State Plan Coordinates Zone IV, feet)	
Describe how the item was found:	

CONTACT THE APPROPRIATE AGENCIES IMMEDIATELY:

Initial when completed	**Mon– Thu (6 a.m. – 5 p.m.) Contact and FAX Form to:**	**Contact Number**	**Date & Time Called**
	USACE Ordnance Safety Specialist or MMRP Site Safety Manager	Ph: (831) 884-9925 ext.226 Cell: (831) 760-2571 Fax:(831) 884-9030 Ph: (831) 242-7919 Fax:(831) 242-7019 Cell: (831) 760-2575	
	Fri – Sun (24 Hours) 787th EOD Company	Phone: (650) 603-8301/02 Fax: (650) 603-8305	
	Note: If 787th EOD Company is contacted, notify the MMRP Site Safety Manager: (831) 242-7919, Cell (831) 760-2575.		

B. To be completed by USACE Ordnance Safety Specialist when applicable (Mon – Thu)

Form Received By:		Date & Time:
Identification of Item Found:		
Extent of Area Surveyed:		Name of digital file for picture (date):
Disposition of Item:		
Fax completed form to MMRP Site Safety Mgr Bldg 4463 Gigling Rd, POM (Fort Ord) when response complete	Fax: (831) 242-7019 Phone: (831) 242-7919	Date & Time:

C. To be completed by MMRP Site Safety Manager:

Acknowledge Completed Form Received:	Date & Time:
Regulatory Agencies Notified (Date):	

Appendix S
List of Preparers

Following is a partial list of those individuals who contributed to this Habitat Conservation Plan (HCP). Preparation of the HCP has been in progress over a period of many years; numerous contributors who have been involved through the process are not listed below. Rather, this list represents the most current and active participants in the production of the HCP. Our apologies (and thanks) to those contributors who remain anonymous.

Bureau of Land Management

Eric Morgan

Bruce Delgado

Rick Cooper

California Department of Fish and Wildlife

Annee Ferranti

Deborah Hillyard

Abimael Leon

Carl Wilcox

Jeff Single

Julie Vance

Kevin Hunting

Tina Bartlett

California Department of Parks and Recreation

Brent Marshall

Ken Gray

Ian Harlen

Amy Palkovic

Steve Bachman

California State University Monterey Bay

Anya Spear

California Department of Transportation

David Murray

Center for Natural Lands Management

Sherry Teresa

Cameron Barrows

Edith Read

City of Del Rey Oaks

Daniel Dawson

Dick Goblirsch

City of Marina

Layne Long

Doug Yount

Theresa Szymanis

Christine di Iorio

Justin Meek

City of Monterey

Elizabeth Caraker

Gordon Siebert

Chip Rerig

Les Turnbeaugh

City of Seaside

John Dunn

Clark Larson

Rick Medina

County of Monterey

Carl Holm

Mike Novo

John Ford

Craig Spencer

Nick Chiulos

Jim Cook

Darby Marshall

Lynn Burgess

Nick Nichols

David Lutes

Denise Duffy & Associates

Erin Harwayne

Matthew Johnson

Bryce Ternet

Fort Ord Reuse Authority

Michael A. Houlemard, Jr.

Steve Endsley

Jonathan Brinkmann

Jerry Bowden

Mary C. Israel

Jodi McGraw (Consultant)

Josh Metz

Darren McBain

Ikuyo Yoneda-Lopez

ICF International

Terah Donovan

David Zippin

Aaron Gabbe

Jeff Thomas

Don Clark

Paola Bernazzani

Troy Rahmig

Danielle LeFer

Jasmin Mejia

Corrine Ortega

Anthony Ha

Debby Jew

Teresa Giffin

Tami Mihm

Torrey Edell

Kailash Mozumder

Simone Berkovitz

Marina Coast Water District

Marc Lucca

Belinda Allen

Brian True

Monterey Bay Unified APCD

Amy Taketomo

Monterey Peninsula College

Mike Gilmartin

Vicki Nakamura

Monterey Peninsula Regional Park District

Rafael Payan

Tim Jensen

The Pacific Gas and Electric Company

Erica Brand

Transportation Agency for Monterey County

Karen Clysdale

University of California

Michael Kisgen

Margaret Fusari

Graham Bice

Lora Martin

Gage Dayton

Sean McStay

U.S. Army, Base Realignment and Closure Act

Bill Collins

Karen Fisbeck

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