WILDLAND FIRE MANAGEMENT PLAN

ANTIOCH DUNES NATIONAL WILDLIFE REFUGE

2002

JANUARY 2002

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

When approved, this document will become the Antioch Dune National Wildlife Refuge fire management plan. Major components include:

- ♦ updated policy for prescribed fires at Antioch Dunes National Wildlife Refuge.
- ♦ format changes under the direction of Fire Management Handbook (Release Date 6/1/00).

This plan is written to provide guidelines for appropriate suppression and prescribed fire programs at Antioch Dunes National Wildlife Refuge. Prescribed fires may be used to reduce hazard fuels, restore the natural processes and vitality of ecosystems, improve wildlife habitat, remove or reduce non-native species, and/or conduct research.

INTRODUCTION

The 55-acre Antioch Dunes National Wildlife Refuge (Refuge) and adjacent 12-acre Pacific Gas and Electric (PG&E) land support the last remaining populations of three endangered species including the Antioch Dunes evening primrose (*Oenothera deltoides* ssp. *howellii*), Contra Costa wallflower (*Erysimum capitatum* ssp. *angustatum*), and the Lange's metalmark butterfly (*Apodemia mormo* ssp. *langei*). The primary objective of the Refuge is to provide habitat for these three endemic endangered species. Historically, many factors have contributed to the decline of these species, including human development and sand mining of the dunes. Currently the primary threat to these species is the stabilization of the dunes and the subsequent encroachment of non-native vegetation such as rip-gut brome grass (*Bromus diandrus*) and yellow starthistle (*Centaurea solstitialis*).

The Fire Management Plan (FMP) for Antioch Dunes National Wildlife Refuge will help achieve resource management objectives by using prescribed fire to control non-native vegetation for the restoration of native riverine sand dune habitat. The Department of the Interior policy requires that all refuges with vegetation that can sustain fire must have a Fire Management Plan that details fire management policies, the use of prescribed fire for attaining resource management objectives, and fire program operational procedures. This plan meets NEPA/NHPA compliance (See Appendix C).

This plan is written as an operational guide for managing the refuge's wildland fire and prescribed fire programs. It defines levels of protection needed to ensure safety, protect facilities and resources, and restore and perpetuate natural processes, given current understanding of the complex relationships in natural ecosystems. It is written to comply with a service-wide requirement that refuges with burnable vegetation develop a fire management plan (620 DM 1).

There is no dedicated fire staff at Antioch Dunes NWR or San Francisco Bay NWRC. All wildland fires will be suppressed by local cooperating agencies (Contra Costa Fire Protection District) with the oversight of the Project Leader and Zone Fire Management Officer (FMO). All prescribed fires will be coordinated through the Zone FMO.

COMPLIANCE WITH USFWS POLICY

The Refuge was established in 1980 under the authority of the Endangered Species Act to preserve and protect two endangered plants, the Antioch Dunes evening-primrose and the Contra Costa wallflower, and an endangered butterfly, the Lange's metalmark butterfly. The primary management objective of the Refuge is to provide the necessary habitat for these and other native species through restoring native riverine sand dune habitat and controlling non-native vegetation.

This FMP specifically addresses the use of prescribed fire for resource management purposes.

The objectives of the Refuge are to protect and restore riverine sand dune habitat for the three endangered species and other native dune species. Several operational plans are used by the Refuge to meet these objectives, including a recovery plan for the three endangered species, multiple internal Section 7 endangered species consultations, and an environmental assessment for the Refuge. The plans that currently apply to Fire Management include the Internal Section 7 Consultation for Prescribed Burning (Appendix D), Environmental Assessment (EA) for Prescribed Burning (Appendix C), the Prescribed Fire Plan (Appendix E), and the 1984 Fire Management Plan with 1997 Prescribed Burning Addendum.

The FMP is a detailed program of action to implement fire management policies and objectives, and addresses policy on prescribed burning to control non-native vegetation and restore native riverine sand dune habitat. The FMP meets the objectives of the Refuge's operational plans by supporting strategies which rely upon fire as a management tool and by identifying where and when fire is not wanted.

The Department Manual, DM 910 (USDI 1997) states the following regarding wildland fires:

> "Wildfires may result in loss of life, have detrimental impacts upon natural resources, and damage to or destruction of man-made developments. However, the use of fire under carefully defined conditions is to be a valuable tool in wildland management. Therefore, all wildfires within the Department will be classified either as wildfire or as prescribed fires.
>
> Wildfires, whether on lands administered by the Department or adjacent thereto, which threaten life, man-made structures, or are determined to be a threat to the natural resources or the facilities under the Department's jurisdiction, will be considered emergencies and their suppression given priority over normal Departmental programs.
>
> Bureaus will give the highest priority to preventing the disaster fire - the situation in which a wildfire causes damage of such magnitude as to impact management objectives and/or socio-economic conditions of an area. However, no wildfire situation, with the possible exception of threat to human survival, requires the exposure of firefighters to life threatening situations. Within the framework of management objective and plans, overall wildfire damage will be held to the minimum possible giving full consideration to (1) an aggressive fire prevention program; (2) the least expenditure of public funds for effective suppression; (3) the methods of suppression least damaging to resources and the environment; and (4) the integration of cooperative suppression actions by agencies of the Department among themselves or with other qualified suppression organizations.

> "Prescribed fires...may be used to achieve agency land or resource management objectives as defined in the fire management plans....Prescribed fires will be conducted only when the following conditions are met:
>
> a. Conducted by qualified personnel under written prescriptions.
> b. Monitored to assure they remain within prescription.
>
> Prescribed fires that exceed the limits of an approved prescribed fire plan will be reclassified as a wildfire. Once classified a wildfire, the fire will be suppressed and will not be returned to prescribed fire status."

The authority for funding (normal fire year programming) and all emergency fire accounts is found in the following authorities:

> Section 102 of the General Provisions of the Department of Interior's annual Appropriations Bill provides the authority under which appropriated monies can be expended or transferred to fund expenditures arising from the emergency prevention and suppression of wildland fire.
>
> P.L. 101-121, Department of the Interior and Related Agencies Appropriation Act of 1990, established the funding mechanism for normal year expenditures of funds for fire management purposes.
>
> 31 US Code 665(E)(1)(B) provides the authority to exceed appropriations due to wildland fire management activities involving the safety of human life and protection of property.

Authorities for procurement and administrative activities necessary to support wildland fire suppression missions are contained in the Interagency Fire Business Management Handbook.

The Reciprocal Fire Protection Act of May 27, 1955 (42 USC 815a; 69Stat 66) provides Authorities to enter into agreements with other Federal bureaus and agencies; with state, county, and municipal governments; and with private companies, groups, corporations, and individuals regarding fire activities. Authority for interagency agreements is found in "Interagency Agreement between the Bureau of Land Management, Bureau of Indian Affairs, National Park Service, US Fish and Wildlife Service of the United States Department of the Interior and the Forest Service of the United States Department of Agriculture" (1996).

FIRE MANAGEMENT OBJECTIVES

Wildland fires probably did not occur very frequently on the historic dunes because they were much more sparsely vegetated than present day. Due to the ecology of the area, the sensitivity of the habitat, and the proximity of developed areas, all wildland fires will be suppressed. Prescribed fire will be used to reduce hazardous fuels, control non-native vegetation, prepare sites for seeding and planting, and enhance conditions for native dune species.

The Fire Management Objectives for this Refuge are:

1. Firefighter and public safety top priority. All Fire Management activities will reflect this commitment.

2. Integrate prescribed fire management actions with other management activities to provide for the protection, restoration and enhancement of native dune species. Wildland fire management actions will be consistent with personnel safety and resource protection objectives.

3. Actively suppress and prevent the occurrence of wildland fire that could seriously jeopardize populations of endangered species.

4. Protect important local resources and private lands from fire.

DESCRIPTION OF REFUGE

The Refuge is located along the southern shore of the lower San Joaquin river near the city of Antioch, Contra Costa County, California (Figure 1). The Refuge lies within an ecoregion described by Bailey (1995) as the Mediterranean Division, California Dry Steppe Province. Historically, the Antioch Dunes extended over two miles along the southern bank of the San Joaquin river and reached heights of 117 feet. The 55-acre Refuge was extensively mined for sand in the past and subsequently ranges in elevation from 0 to 50 feet. The Refuge currently exists as isolated habitat, surrounded by industrial development.

The Antioch area has a modified Mediterranean climate with warm to hot dry summers and moist, mild winters. Rainfall averages 12.53 inches annually, falling mainly during November-April. The average annual temperature is 61.8 degrees F with an average annual maximum temperature of 74 degrees F and an average annual minimum temperature of 47 degrees F. The hottest recorded temperature is 114 degrees F, and the lowest recorded temperature is 14 degrees F. Winds in the summer come off the river from the west or northwest at an average of 10-20 mph.

The Refuge is split into two units: Sardis and Stamm. Soils in the Refuge are representative of the Oakley sands interlaced with alluvial fan deposits. The Sardis Unit (14 acre eastern parcel) was mined down to a clay/peat substrate for the most part and subsequently some sand was replaced over many of these areas. The perimeter still consists of sandy loam substrate. The Stamm Unit (41 acre western parcel) was also mined down to a "hard pan" layer of varying thickness, but underneath this hard pan is sandy loam. Sand was replaced over a small portion of the mined area on the Stamm Unit as well.

The Sardis Unit is bordered by Wilbur Avenue on the South, the San Joaquin River on the North, and PG&E on the East and West. The Stamm Unit is bordered by Fulton Shipyard to the West, Fulton Shipyard Rd. to the Southwest, The City of Antioch Public Works Disposal Site and Burlington Northern Railroad to the South, and Georgia Pacific Gypsum to the East.

CULTURAL RESOURCES

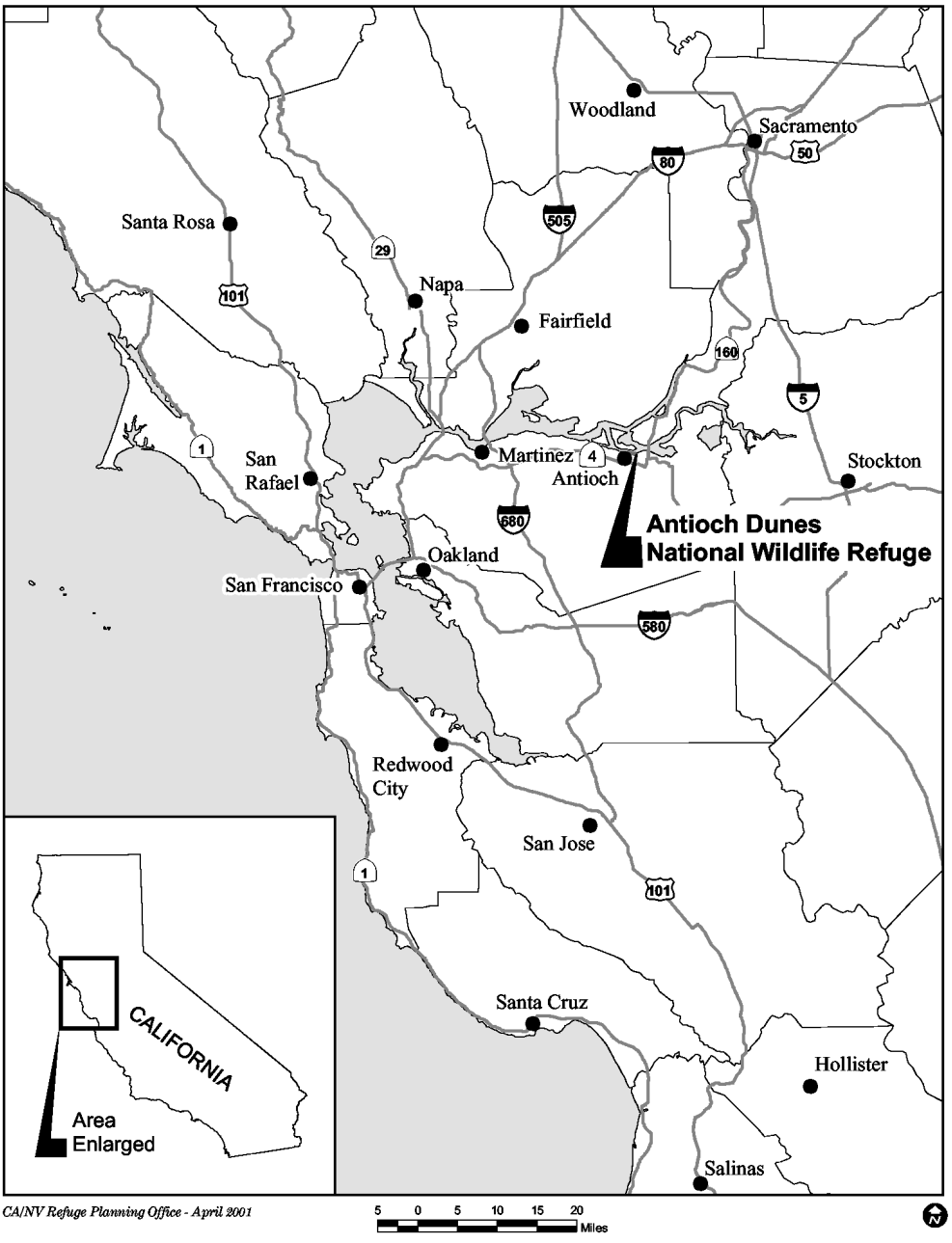
Under Federal ownership, archaeological and historical resources within the Refuge receive protection under Federal laws mandating the management of cultural resources, including, but not limited to, the Archaeological Resources Protection Act; the Archaeological and Historical Preservation Act; the Native American Graves and Repatriation Act, and the National Historic Preservation Act of 1966. The Refuge has obtained Section 106 Compliance Permit (May 28, 1997; Appendix C).

Evidence of native settlements and Spanish exploration of the area has been documented. A native village is thought to have been located within the present-day Antioch area. The area was traveled and used by settlers for residence, grazing, and recreation. Railroad spurs and sand removal from the dunes (now located within the refuge) began in the 1890s.

Little evidence of human activity remains on the refuge due to the extensive sand mining that occurred until the early 1900's. Cultural artifacts can still be found among what remains of the leveled dunes. The refuge was used as a de facto garbage dump during the mining era.

FIGURE 1: VICINITY MAP

Figure 1. Location Map



Fish and Wildlife

The Refuge lands support the last remaining populations of the Lange's metalmark butterfly (*Apodemia mormo* ssp. *langei*). The primary objective of the Refuge is to provide habitat for this endemic endangered species. Historically, many factors have contributed to the decline of the species, including human development and sand mining of the dunes.

The Refuge provides important habitat for many types of wildlife including nesting and migratory birds and the California legless lizard. In recent times, eight species of reptiles and no amphibians were identified on the refuge. Recent observations of mammals have been limited but include gopher, gray fox, red fox, coyote, Beechy ground squirrel, black-tailed jack rabbit, and muskrat. Bird species include Anna's hummingbird, western meadowlark, scrub jay, cedar waxwing, red-shafted flicker, belted kingfisher, northern rough-winged swallow, and other migratory and resident birds.

Federally listed or proposed fish species occurring in the waters adjacent to the Refuge include winter-run chinook salmon, delta smelt, steel-head trout, and Sacramento splittail. Surveys on the refuge have identified nearly 400 species of invertebrates. Changes in invertebrate species composition have been linked to changes in vegetation and the increase in weedy species.

VEGETATION

Six main habitat types are found within the 55-acre Refuge: littoral, riparian, open sand dunes, abandoned vineyard, disturbed/mined areas and grassland areas. The littoral zone contains a state listed rare plant: Mason's lilaeopsis (*Lilaeopsis masonii*). The riparian area is characterized by native species such as, but not limited to, coast live oak (*Quercus agrifolia*), red willow (*Salix laevigata*), narrow-leaved willow (*Salix exigua*), arroyo willow (*Salix lasiolepis*), California toyon (*Heteromeles arbutifolia*) and elderberry (*Sambucus mexicana*). The open dune areas consist of native species including: Antioch dunes evening primrose, Contra Costa wallflower (both federally listed as endangered), naked-stemmed buckwheat, host plant for the endangered Lange's metalmark butterfly, telegraph weed (*Heterotheca grandiflora*), *Senecio flaccidus* var. *douglasii*, deerweed (*Lotus scoparius*) and many others, as well as non-native grasses and other non-native species (Appendix C). In the disturbed, grassland, and vineyard areas there is an abundance of non-native species including vetch (*Vicia* spp.), rip-gut brome grass, yellow starthistle, and Russian thistle (*Salsola tragus*), as well as some native species.

The Refuge and adjacent 12-acre Pacific Gas and Electric (PG&E) land support the last remaining populations of two endangered plant species, the Antioch Dunes evening primrose *(Oenothera deltoides ssp. howellii*) and the Contra Costa wallflower (*Erysimum capitatum* ssp. *angustatum*). The primary objective of the Refuge is to provide habitat for these endemic endangered species. Historically, many factors have contributed to the decline of these species, including human development and sand mining of the dunes. Currently the primary threat to these species is the stabilization of the dunes and the encroachment of non-native vegetation such as rip-gut brome grass (*Bromus diandrus*), yellow starthistle (*Centaurea solstitialis*), and vetch (*Vicia villosa*).

STRUCTURES AND FACILITIES

There are no buildings of any kind within the Refuge boundaries. However, on the Stamm Unit, the City of Antioch maintains a sewage outfall structure to the San Joaquin River. The refuge is also surrounded by industrial plants.

WILDLAND FIRE MANAGEMENT SITUATION

HISTORIC ROLE OF FIRE

The majority of the habitat on both units of the Refuge are highly susceptible to wildland fire. The dominant vegetation is composed of annual grasses and scattered brush. These fuels are highly flammable and would result in a high rate of spread should a wildland fire occur. The predominant, strong, northwest winds combined with the usual low humidity and high temperature during the summer would aid the spread and intensity of a fire. Fire ignitions within the Refuge boundaries occur after curing of annual grasses and prior to normal beginning of fall precipitation (May - October; Loredo pers. comm. 2001)

Pre-settlement Fires

The history of fire in the area is not well known. It could be assumed that since the area is situated so close to the water's edge and the vegetation was much sparser than it currently is, that there were few wildland fires. There is little information regarding Native American use of fire in the area.

Post-settlement Fire History

There is an extensive history of unplanned fires at the Refuge. The Refuge was originally open to the public, but due to the large amount of fires that were started by users, the Refuge was closed and subsequent unplanned fire frequency decreased. Table 1 is a complete history of fire at Antioch Dunes NWR since it's establishment in 1980.

Table 1: Fire History

Unit	Date	Location	Acres	Type	Cause
Stamm	6/01	Hardpan #1	3	Prescribed	
Stamm	6/01	Vineyard area along RR	8	Prescribed	
Stamm	6/00	Hardpan #1	3	Prescribed	
Stamm	6/00	Vineyard area along RR	8	Prescribed	
Stamm	6/99	Triangle Unit near gate	3	Prescribed	
Stamm	6/99	Vineyard area along RR	8	Prescribed	
Stamm	6/99	Hardpan #1	3	Prescribed	
Stamm	5/99	Hardpan #1 near water	<1	Wildland fire	industrial
Stamm	5/99	Hardpan/ NE	18	Wildland fire	Escaped illegal campfire
Stamm	6/98	Triangle Unit near gate	3	Prescribed	
Stamm	6/98	Vineyard area along RR	5	Prescribed	
Stamm	10/97	NE Corner along river	1.0	Wildland fire	Escaped illegal campfire
Stamm	6/17/97	Triangle unit near gate	3	Prescribed	

Stamm	6/16/97	Vineyard area along RR	5.0	Prescribed	
Stamm	7/6/96	SE Corner near RR	.1	Wildland fire	Unknown
Stamm	10/31/90	Along railroad track	7.0	Wildland fire	Potential Arson
Stamm	12/31/90	Near river next to blowout	2.0	Wildland fire	Unknown
Stamm	3/28/88	Along river - west side	.5	Wildland fire	Campfire
Stamm	6/24/87	Triangle Unit near gate	3.0	Wildland fire	Fireworks
Stamm	6/7/85	Between river and access road, west end	10.0	Wildland fire	Unknown-suspicious
Sardis	6/99	South Plateau near gate	4.25	Prescribed	
Sardis	6/98	South Plateau near gate	4.25	Prescribed	
Sardis	6/16/97	South Plateau near gate	4.25	Prescribed	
Sardis	6/25/90	Along Wilbur, Little Corral Parking area.	3.0	Wildland fire	Unknown
Sardis	7/21/89	East of entrance gate along fence	.1	Wildland fire	Unknown
Sardis	7/21/88	West of entrance gate along fence	.2	Wildland fire	Cigarette from highway?
Sardis	6/5/85	West of entrance gate along fence	3.0	Wildland fire	Unknown -suspicious
Sardis	9/30/84	N. of old parking lot	1.0	Wildland fire	Unknown
Sardis	8/12/84	Near river against PG&E east boundary	1.5	Wildland fire	Unknown
Sardis	7/12/84	Beach fire	.1	Wildland fire	Unattended campfire
Sardis	5/10/84	East of gate onto PG&E east	2.5	Wildland fire	Arson
Sardis	7/5/83	Unknown	.1	Wildland fire	Staff caused-welding
Sardis	7/23/82	SE corner of pit area	2.25	Wildland fire	Unknown-suspicious
PG&E	3/3/85	Center of East Unit	.5	Wildland fire	Unattended campfire
PG&E	10/9/84	East Unit trees near river	.25	Wildland fire	Unknown
PG&E	6/18/84	East Unit around tower	1.0	Wildland fire	Downed electric line

Prescribed Fire History

The prescribed burn program began in 1997 to manage non-native species. Table 1 above shows dates of past prescribed burns.

RESPONSIBILITIES

Antioch Dunes NWR does not have an onsite fire management staff or suppression equipment. There is a Service fire crew stationed part-time (late spring to early fall) at San Luis NWRC and "collateral duty" Refuge personnel stationed at San Francisco Bay NWRC. Both of these sites are approximately 90 miles from the Refuge. Wildland fires in this area are generally reported by the public and suppressed by firefighters from the Contra Costa County Fire Protection District (FPD) before Service staff can respond.

Responsibilities for fire management at Antioch Dunes are shared by: the Antioch Dunes Refuge Manager, Refuge Biologist, San Francisco Bay NWR Complex Project Leader, and the Zone Fire Management Officer stationed at San Luis NWRC (Appendix F-Fire Dispatch Plan for further detail). Primary wildland fire management responsibilities are:

- develop and cultivate working relationships with local fire departments in the area that can provide mutual aid
- maintain firebreaks on Refuge to prevent wildland fire
- conduct prescribed fire activities in support of refuge habitat management programs
- establish and maintain appropriate fire related agreements/contracts
- monitor results of wildland and prescribed fires
- update fire management and associated plans (dispatch, training, etc.), call-out lists, and mobilization guidelines, air quality certifications.
- continue to develop a cadre of "red-carded" firefighters for wildland fire, trained and equipped to accomplish the fire management program
- maintain the refuge fire cache and fire equipment in a ready state

Agency Administrator/ Project Leader (PL)

- Is responsible for implementation of all Fire Management activities within the Complex and will ensure compliance with Department, Service and refuge policies.
- Selects the appropriate management responses to wildland fire.

Deputy Project Leader (DPL)

- Coordinates Complex programs to ensure personnel and equipment are made available and utilized for fire management activities including fire suppression, prescribed burning and fire effects monitoring.
- Ensures that the fire management program has access to Refuge and complex resources when needed.
- Ensures that Refuge Managers and complex Staff consider the fire management program during Refuge related planning and implementation.

Refuge Manager (RM)

- Identifies prescribed burn units and biological objectives to Fire Management Officer (FMO) and Prescribed Fire Specialist (PFS), notifies FMO of prescribed fire project

constraints, and ensures that Refuge resources are available to accomplish prescribed fire and fire suppression objectives.

- Acts as the primary Refuge Resource Management Specialist during fire management planning and operations.
- Prepares an annual report detailing fire occurrences and prescribed fire activities undertaken in each calendar year. This report will serve as a post-year's fire management activities review, as well as provide documentation for development of a comprehensive fire history record for the Refuge.
- Is responsible for planning, coordinating, and directing preparedness activities including fire training, physical fitness testing and Interagency Fire Qualification System (IFQS) data entry, fire cache and equipment inventory accountability, maintenance, and operation, cooperation with cooperative agencies.

Biologist

- Coordinates through Refuge Managers and Deputy Project Leader to provide biological input for the fire program with the FMO and PFS.
- Ensures fire effects monitoring is being implemented and drafts wildland fire Rehabilitation Plans for Deputy Project Leader.
- Assists in design and implementation of fire effects monitoring, with FMO and PFS.
- Participates, as requested, in prescribed burning and wildland fire suppression.

Zone Fire Management Officer (FMO)

- Responsible for all fire related planning and implementation for the Refuge.
- Integrates biological Refuge objectives into all fire management planning and implementation.
- Solicits program input from the RM and Biologist.
- Supervises prescribed fire planning.
- Coordinates fire related training.
- Coordinates with cooperators to ensure adequate resources are available for fire operational needs.
- Is responsible for implementation of this Plan. This responsibility includes coordination and supervision of all prevention, pre-suppression, detection, wildland fire, prescribed fire, suppression, monitoring, and post-fire activities involving Refuge lands.
- Is responsible for preparation of fire reports following the suppression of wildland fires and for operations undertaken while conducting prescribed fires.
- Submits budget requests and monitors FIREBASE funds.
- Maintains records for all personnel involved in suppression and prescribed fire activities, detailing the individual's qualifications and certifications for such activities.
- Updates all fire qualifications for entry into the Fire Management Information System.
- Nominates personnel to receive fire-related training, as appropriate.
- Designates the person to serve as Incident Commander (IC) for initial attack purposes. The FMO may assume the position of IC at his/her discretion or designate other personnel to take over that position at his/her discretion.

Prescribed Fire Specialist (PFS)

- Responsible for the planning and implementation of a program, which collects information for the documentation, analysis, and prediction of fire behavior and effects.
- Develops and recommends, plans, and schedules management ignited fire activities for the Refuge.
- Implements and directs burns.
- Plans and develops a program to collect information on the effects and behavior of prescribed fire.
- Plans and directs studies to monitor and analyze fire behavior parameters, then uses these data to support the development of fire plans.
- Plans and directs surveys for the collection, analysis and documentation of data relating to fire effects on biotic and abiotic resources.
- Organizes and performs studies to develop fire management prescriptions for prescribed burns.
- Is responsible for ensuring a cadre of qualified prescribed fire overhead by recommending personnel for training, through both formal in-house and field training assignments.
- Is responsible for record keeping associated with burn planning, fire occurrence reporting and fire weather.
- Identifies areas of fire management requiring research and works with research scientists in the development of project statements to accomplish this research.

Fire Management/Suppression Personnel

- Consist of all Refuge personnel, whether permanent or seasonal, who meet the minimum standard set by the National Wildfire Coordinating Group (NWCG) for firefighters.
- Are fully equipped with proper personal protective equipment, have taken and passed the minimum classroom training, and meet physical fitness standards required.
- Undertake fire management duties as assigned by the Prescribed Fire Burn Boss on each prescribed fire project.
- Are responsible for their personal protective equipment and physical conditioning, qualifying annually with the work capacity test before May 31.

Incident Commander

Incident Commanders (of any level) use strategies and tactics as directed by the Refuge Manager and Wildland Fire Situation Assessment (WFSA) where applicable to implement selected objectives on a particular incident. A specific Limited Delegation of Authority (Appendix G) will be provided to each Incident Commander prior to assuming responsibility for an incident. Major duties of the Incident Commander are given in NWCG Fireline Handbook, including:

- Brief subordinates, direct their actions and provide work tools
- Ensure that safety standards identified in the Fire Orders, the Watch Out Situations, and agency policies are followed at all times.
- Personally scout and communicate with others to be knowledgeable of fire conditions, fire weather, tactical progress, safety concerns and hazards, condition of personnel, and needs for additional resources.
- Decides when to request overhead or additional firefighting personnel and equipment.
- Order resources to implement the management objectives for the fire.

- Inform appropriate dispatch of current situation and expected needs.
- Coordinate mobilization and demobilization with dispatch and the FMO.
- Perform administrative duties; i.e., approving work hours, completing fire reports for command period, maintaining property accountability, providing or obtaining medical treatment, and evaluating performance of subordinates.
- Assure aviation safety is maintained to the highest standards.

Initial Attack Teams

Initial attack teams will consist of experienced, fully- qualified firefighters, those on their first fire, and well-qualified leadership. Teams will be prepared and equipped with hand and power tools as needed and will be dispatched with a day's supply of food and water, so they can continue work for 24 hours without additional support.

Employees participating in any wildland fire activities on Fish and Wildlife Service or cooperator's lands will meet fitness and training requirements established in PMS 310-1, except where Service-specific fitness requirements apply.

INTERAGENCY OPERATIONS

There are no formal cooperative fire agreements in place at this time, however a Memorandum of Understanding is currently being established between the Refuge and the Contra Costa County FPD. The Contra Costa County FPD has traditionally responded to wildland fires at the Refuge because of their legal fire protection responsibility to the property surrounding the Refuge. Thus, any wildland fire originating on Refuge lands is considered a threat to their property.

Antioch Dunes NWR will use the Incident Command System (ICS) as a guide for fireline organization. Qualifications for individuals is per DOI Wildland Fire Qualifications and Certification System, part of NIIMS and the National Wildland Fire Coordination Group (NWCG) Prescribed Fire Qualification Guide. Depending on fire complexity, some positions may be filled by the same person.

A listing of key interagency contacts can be found in the Fire Dispatch Plan. The plan is an annual assembly of information required to facilitate a rapid response to a fire report and to coordinate the initial attack (Appendix F).

PROTECTION OF SENSITIVE RESOURCES

Aggressive attack of all unplanned ignitions with minimum acreage burned is the goal. Heavy equipment shall not be used due to the sensitivity of the habitat, except in cases where life or fire-fighter safety is threatened or when the Refuge Manager determines necessary. Suppression guidelines will be discussed with Contra Costa County FPD during annual operating plan meetings.

The Regional Archaeologist and/or his/her staff will work with fire staff, project leaders, and incident commanders to ensure that cultural resources are protected from fire and fire management activities. The "Request For Cultural Resource Compliance" form (RCRC, Appendix I) will be used to inform the Regional Archaeologist of impending activities, thereby meeting the regulations and directions governing the protection of cultural resources as outlined in Departmental Manual Part 519, National Historic Preservation Act (NHPA) of 1966, Code of Federal Regulations (36CFR800), the Archaeological Resources Protection Act of 1979, as amended, and the Archaeological and Historic Preservation Act of

1974. The NHPA Section 106 clearance will be followed for any fire management activity that may affect historic properties (cultural resources eligible to the National Register of Historic Places).

Impacts to archaeological resources by fire resources vary. The four basic sources of damage are (1) fire intensity, (2) duration of heat, (3) heat penetration into soil, and (4) suppression actions. Of the four, the most significant threat is from equipment during line construction for prescribed fires or wildfire holding actions (Anderson 1983).

The following actions will be taken to protect archaeological and cultural resources:

Wildland Fires

- Minimum impact fire suppression tactics will be used to the fullest extent possible.
- Resource Advisors will inform Fire Suppression personnel of any areas with cultural resources. The Resource advisor should contact the Regional Archaeologist and/or his/her staff for more detailed information.
- Foam use will be limited in areas known to harbor surface artifacts.
- Mechanized equipment should not be used in areas of known cultural significance.
- The location of any sites discovered as the result of fire management activities will be reported to the Regional Archaeologist.
- Rehabilitation plans will address cultural resources impacts and will be submitted to the Regional Archaeologist using the RCRC.

Prescribed Fires

- The Refuge Fire staff will submit a completed RCRC to the Regional Archaeologist and/or his/her staff as soon as the burn area is identified (i.e., as soon as feasible).
- Upon receipt of the RCRC, the Regional Archaeologist and/or his/her staff will be responsible for consulting with the FMO and evaluating the potential for adverse impacts to cultural resources.
- When necessary, the Regional Archaeologist and/or his/her staff will coordinate with the State Historic Preservation Officer (SHPO). The SHPO has 30 days to respond. The Refuge will consider all SHPO recommendations.
- Mechanized equipment should not be used in areas of know cultural significance.
- The location of any sites discovered as the result of fire management activities will be reported to the Regional Archaeologist.

WILDLAND FIRE ACTIVITIES

Fire program management describes the operational procedures necessary to implement fire management at Antioch Dunes NWR. Program management includes: fire prevention, preparedness, emergency preparedness, fire behavior predictions, step-up staffing plan, fire detection, fire suppression, minimum impact suppression, minimum impact rehabilitation, and documentation.

All fires not classified as prescribed fires are wildland fires and will be appropriately suppressed. Suppression operations will generally be conducted by Contra Costa County Fire Protection District (CCFD).

Records show that fire season is typically from May-October. Depending on the specific weather of any particular year the seasons may be shorter or longer and, therefore, may start earlier or last longer.

FIRE MANAGEMENT STRATEGIES

All unplanned wildland fires will be suppressed in a prompt, safe, aggressive, and cost-effective manner to produce fast, efficient action with minimum damage to resources using appropriate management strategies.

Fire suppression strategies at Antioch Dunes NWR will include a range of suppression techniques in order to provide for protection of values at risk, natural resources, firefighter safety and cost efficiency. Suppression strategies and tactics will be unique to each wildland fire, predicated by weather parameters, fuel conditions, safety considerations, resources, and threats to the endangered, threatened and sensitive species. Determination of strategies and tactics will be made by the Incident Commander on scene utilizing knowledge of Refuge fire management objectives and input from Refuge Manager or designate.

All wildland fires will be suppressed. However, there may be occasions when direct attack in high intensity, rapidly spreading wildland fire would jeopardize firefighter safety and may not be appropriate. In these cases indirect strategy will be employed utilizing natural and man-made firebreaks as wildland fire control points.

The following will be employed to meet fire management objectives:

1) Suppress all unplanned ignitions in a safe and cost effective manner consistent with resources and values at risk. Minimum impact strategies and tactics will be used, particularly in areas with high densities of endangered species.

2) Conduct all fire management programs in a manner consistent with applicable laws, policies and regulations.

3) Initiate cost effective fire monitoring which will inform managers if objectives are being met. Monitoring information will also be used to refine burn prescriptions to better achieve objectives.

4) Utilize prescribed fire as a management tool for achieving hazard fuel reductions and resource management objectives. To the extent possible, hazard fuel prescribed fire will be used to accomplish specific restoration objectives established for individual land units. Prescribed fires

are fires which are deliberately set to burn under prescribed conditions in order to achieve pre-determined resource management objectives.

Although resource impacts of suppression alternatives must always be considered in selecting a fire management strategy, resource benefits will not be the primary consideration. Appropriate suppression action will be taken to ensure firefighter safety, public safety, and protection of resources.

Critical protection areas, such as adjacent properties and sensitive habitat will receive priority consideration in fire control planning efforts. In all cases, the primary concerns of fire suppression personnel shall be safety, and if needed, all individuals not involved in the suppression effort may be evacuated.

Suppression strategies should be applied so that the equipment and tools used to meet the desired objectives are those that inflict the least impacts upon the natural and cultural resources. Minimum impact suppression tactics will be employed to protect all resources. Natural and artificial barriers will be used as much as possible for containment. When necessary, fire line construction will be conducted in such a way as to minimize long-term impacts to resources.

Heavy equipment such as crawlers, tractors, dozers, or graders will not be used within the refuge boundaries unless their use is necessary to prevent a fire from destroying privately-owned and/or government buildings and historic resources. The use of any heavy equipment requires approval from the Refuge Manager or designate.

Sites impacted by fire suppression activities or by the fire will be rehabilitated as necessary, based on an approved course of action for each incident.

PREPAREDNESS

Preparedness is the work accomplished prior to fire occurrence to ensure that the appropriate response, as directed by the Fire Management Plan, can be carried out. Preparedness activities include: budget planning, equipment acquisition, equipment maintenance, dispatch (Initial attack, extended, and expanded), equipment inventory, personnel qualifications, and training. The preparedness objective is to have a well trained and equipped fire management organization to manage all fire situations within the Refuge. Preparedness efforts are to be accomplished in the time frames outside the normal fire season dates.

The Fish and Wildlife Service has minimum training requirements for all fire positions. The Service is a member to the National Wildfire Coordinating Group (NWCG) and accepts its standards for interagency operations. There is required annual refresher training for all personnel that are involved with wildland fire activities. These requirements are found in the Service Fire Management Preparedness and Planning Handbook, Section 1.5; Training, Qualification, and Certification.

Annual fire readiness requires an inventory of existing cache items. The cache should be capable of outfitting six personnel for wildland fire activities and will be inventoried as ready by May 31 of each year. The cache is located at the San Francisco Bay National Wildlife Refuge Complex (San Francisco Bay NWRC) Headquarters in Newark over 90 miles from the Antioch Dunes NWR. There is no fire

equipment stationed on site, therefore reliance on local fire departments for quick initial attack is of greater value.

Local conditions and the status of local fire department resource availability is a major indicator which would affect the level of fire management activities at the Refuge. Regional and National Preparedness Levels do play a role in determining the level of fire management operations at the Refuge, but less than the local conditions. Local fire restrictions imposed within the Antioch city limits are of greater significance due to the strong influence of Contra Costa County FPD.

Historical Weather Analysis
The fire season generally begins with the curing of annual grasses in late May and extends until the first rains in mid-October. East wind conditions in September and October increase the potential for large fires in the local area.

Contra Costa County Fire Department does not have any weather station data that reflects the conditions at the Refuge. The closest RAWS unit is located at Black Diamond Mine (1,600 foot elevation) but has little in common with the weather conditions at the refuge.

Fire Prevention
An active fire prevention program may be conducted in conjunction with other agencies to protect human life and property, and prevent damage to cultural resources or physical facilities.

A program of internal and external education regarding potential fire danger may be implemented. Visitor contacts, bulletin board materials, handouts and interpretive programs may be utilized to increase visitor and neighbor awareness of fire hazards. Employees need to relate to the public the beneficial effects of prescribed fires as opposed to unwanted human-caused fires, with emphasis on information, essential to understanding the potential severity of human-caused wildland fires and how to prevent them.

No formal prevention plan has been developed. However, fire lines are mowed along Wilbur Avenue and non-native vegetation control measures are implemented on an annual basis. Additionally, since most wildland fire on the Refuge has been caused by trespassers, Refuge personnel will take appropriate actions to prevent the entry of unauthorized persons.

Staffing Priority Levels
There is no fire-funded staffing stationed at the Refuge. Fire suppression response is provided by Contra Costa County FPD, therefore Contra Costa County FPD will adjust staffing levels based on current fire danger. The refuge is closed to the public and no Refuge facilities are located within the boundaries. Therefore, high fire danger will not require any additional closures.

Training
Departmental policy requires that all personnel engaged in suppression and prescribed fire duties meet the standards set by the National Wildfire Coordinating Group (NWCG). Antioch Dunes NWR will conform strictly to the requirements of the Wildland and Prescribed Fire Management Qualification and Certification System (PM 310-1) and USFWS guidelines.

Basic wildland fire training refreshers are offered annually for red-carded firefighters and records kept in a centralized database. Additional training is available from surrounding agencies in pump and engine operation, power saws, firefighter safety, fire weather and fire behavior, helicopter safety and prescribed fire objectives and activities. On-the job training is encouraged and will be conducted at the field level. Whenever appropriate, the use of fire qualification task books will be used to document fire experience of trainees. The FMO will coordinate fire training needs with those of other nearby refuges, cooperating agencies, and the RO.

The refuge supports the development of individual Incident Command System (ICS) overhead personnel from among qualified and experienced refuge staff for assignment to overhead teams at the local, regional, and national level.

Fire suppression is an arduous duty. On prescribed fires, personnel may be required to shift from implementation/monitoring activities to suppression. Poor physical condition of crew members can endanger safety and lives during critical situations.

Personnel performing fire management duties will maintain a high level of physical fitness. This requires successful completion of a fitness pack test. Personnel must complete a three mile hike with a 45 pound pack in less than 45 minutes.

Supplies and Equipment

A small, 10-person cache for the Refuge is located at the Complex headquarters in Newark. The cache is maintained by the Complex staff.

Additional equipment and supplies are available through cooperators and the interagency cache system. Requests for additional personnel and equipment are made through the Mendocino NF Dispatch. The contact list can be found in the Dispatch plan (Appendix F).

DETECTION

Most wildland fires are reported by the public to 9-1-1. The 9-1-1 dispatchers contact Contra Costa County FPD for suppression response. The refuge is contacted by Contra Costa County FPD to report all wildland fire activities.

The Fire Management Plan does not discriminate between human-caused and lightning caused fire. All wildland fires will be suppressed. However, detection shall include a determination of fire cause. Moreover, human-caused fires will require an investigation and report by law enforcement personnel. For serious human-caused fires, including those involving loss of life, a qualified arson investigator will be requested.

COMMUNICATIONS

There is no open radio communication frequency for Refuge personnel. Instead, staff utilize a direct connect cellular phone system.

Prescribed fire activities performed by Service personnel utilize the various NIFC Tactical channels as needed. Normally NIFC Tactical channels 2 (168.200 mhz) and 3 (168.600 mhz) are used depending upon the number of frequencies needed during prescribed burns.

CCPFD utilizes a ultra high frequency in the 800 mhz band. There is not a common link between Service personnel and CCPFD at this time.

PRE-ATTACK PLAN

The pre-attack plan is reflected by maps which include: locations of water sources, roads, private property, etc (Figure 2 and 3). Access to the Refuge is extremely limited. The San Joaquin River acts as the north boundary of the Refuge. Any wildland fire that cannot be contained from roads or natural boundaries would probably be allowed to burn to the river since road access to the northern portions of the Refuge is extremely limited. However most wildland fires have been successfully contained by local fire department personnel from Wilbur Road and other roads that are open to the public. Contra Costa County FPD has maps and keys for the Refuge.

FIRE MANAGEMENT UNITS

The Refuge will be managed as two units, Sardis and Stamm. The overall objective for both units is to restore the native dune habitat. Suppression of all unplanned ignitions with minimum acreage loss will be employed over the entire Refuge.

During the fire season (May - October), prevailing winds come off the river from the west or northwest at an average of 10-20 mph (Loredo pers. comm. 2001). Mean daily humidities range from around 48 % in the winter to the mid-teens in the spring and summer. Wind conditions during the fall could bring humidities even lower. Typically, humidity is highest during the early morning hours and lowest during the mid-afternoon hours.

The Antioch area has a modified Mediterranean climate with warm to hot dry summers and moist, mild winters. Rainfall averages 12.53 inches annually, falling mainly during November-April. The average annual temperature is 61.8 degrees F with an average annual maximum temperature of 74 degrees F and an average annual minimum temperature of 47 degrees F. The hottest recorded temperature is 114 degrees F, and the lowest recorded temperature is 14 degrees F.

Sardis Unit

The Sardis Unit consists of 14 acres of varying topography. Fuel types in the South Plateau, a primarily flat area along Wilbur Avenue, consists of annual grassland and oak woodland. The rest of the Unit includes a deep pit located approximately 70 feet below the Plateau. Slopes leading down to the pit on the west, south, and east sides are greater than 50%. The slopes are heavily vegetated with annual grasses. The pit consists primarily of undulating shallow dunes covered with annual grasses and shrubby vegetation. To the north of the pit, a mixture of oak woodland, riparian vegetation, and shrub habitat stretch along the San Joaquin River.

In this unit, fire behavior under drought conditions is expected to range from a creeping/ spreading fire along the river to a fast running fire with 6 to 10 foot flame lengths in open grassland. In the drier riparian areas which are dominated by shrubs such as coyote brush and toyon, fire intensity would be significantly greater. Due to the character of the slope and heavy vegetation on the sides of the pit, erratic behavior should be anticipated in this area. In areas adjacent to the river, fire behavior could be expected to be slow and creeping.

Stamm Unit
The Stamm Unit consists of 41 acres of limited topography. Fuel types on the western half of the property consist of dense shrubby vegetation and grasslands over flat terrain. The eastern half consists primarily of tall shrubby vegetation and grassland covering undulating and rolling dunes. Riparian vegetation along the river includes tules, willows, and low trees.

In this unit, fire behavior is expected to range from smoldering in moist vegetation along the river to running and spotting in the tall brush. Maximum expected flame lengths in the tall brush is 10-12'.

Due to staff limitations, relatively small land management parcels, long response times, valuable resources, and values at risk on neighboring lands, this plan does not recommend wildland fire managed for resource benefit as an option for any of the units. Wildland fires will be suppressed using the appropriate suppression response. Prescribed fires will be used to reduce hazardous fuels and to meet resource management objectives.

Fire Effects to Vegetation
The loss and modification of primrose habitat initially caused a decline in the species, eventually leading to its Federal Listing. Currently, the major threat to the primrose is the invasion of non-native plants such as yellow starthistle, vetch, and Ripgut brome. The burning of yellow-starthistle prior to seed production has been documented to reduce the seed bank. This burning needs to be conducted a minimum of three successive years to prove effective and must be followed up with spot herbicide application. Research into the effectiveness of prescribed burning on yellow starthistle continues at Antioch Dunes NWR.

The use of fire to treat yellow starthistle has caused some declines in ripgut brome. Unfortunately, other non-native weeds such as filaree and vetch may colonize the burn areas quickly. Primrose has responded favorably to fire treatments at Antioch Dunes NWR.

SUPPRESSION TACTICS
Wildland fires will be suppressed in a prompt, safe, aggressive, and cost-effective manner to produce fast, efficient action with minimum damage to resources. Suppression involves a range of possible actions from initial attack to final suppression. All wildland fires will be suppressed.

Personnel and equipment must be efficiently organized to suppress fire effectively and safely. To this end, the FMO assumes the command function on major or multiple fire situations, setting priorities for the use of available resources and establishing a suppression organization.

There will be only one Incident Commander responsible through the FMO to the Project Leader. The Incident Commander will designate all overhead positions on fires requiring extended attack. Reference should be made to a Delegation of Authority (Appendix G).

Figure 2. Sardis Unit

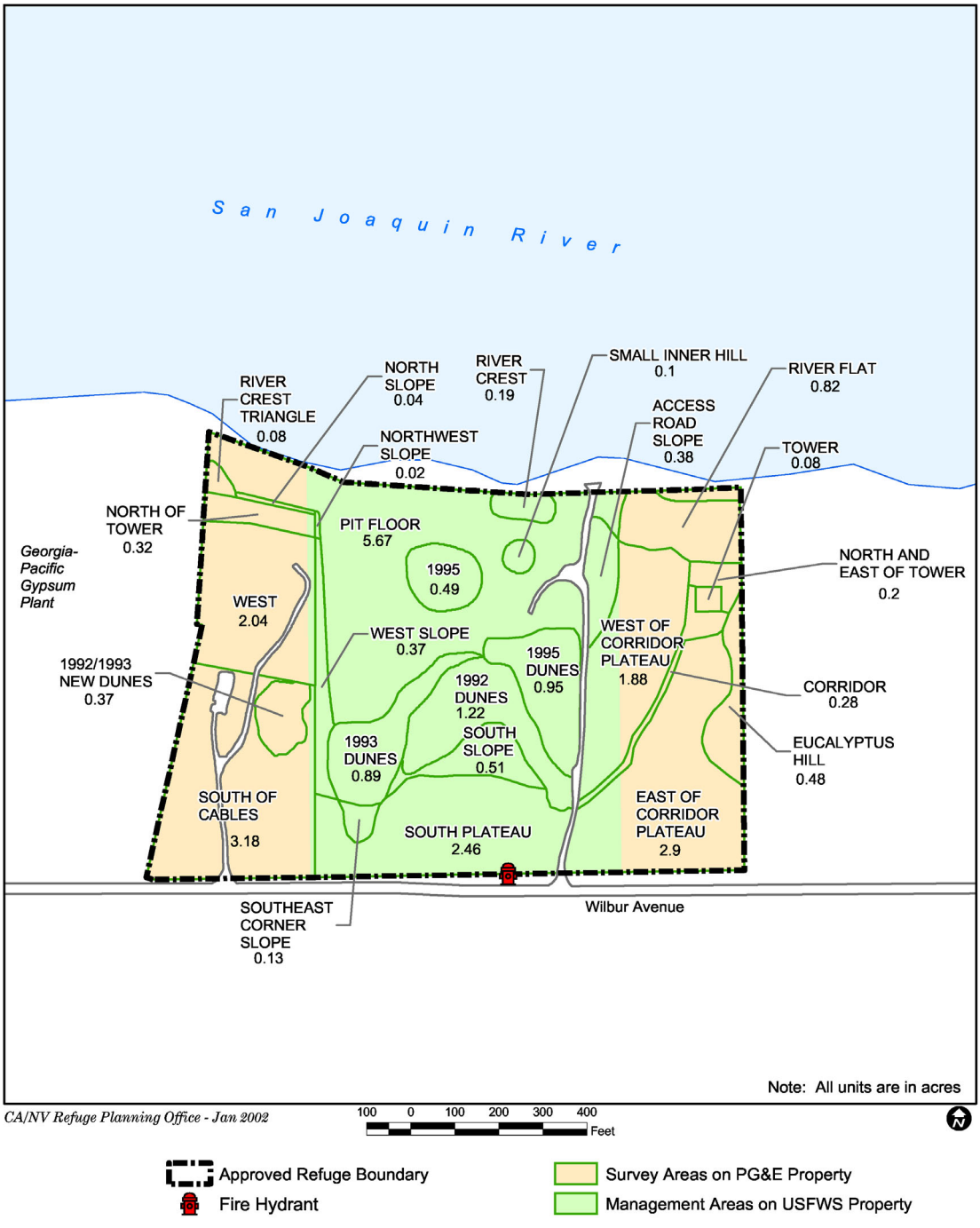
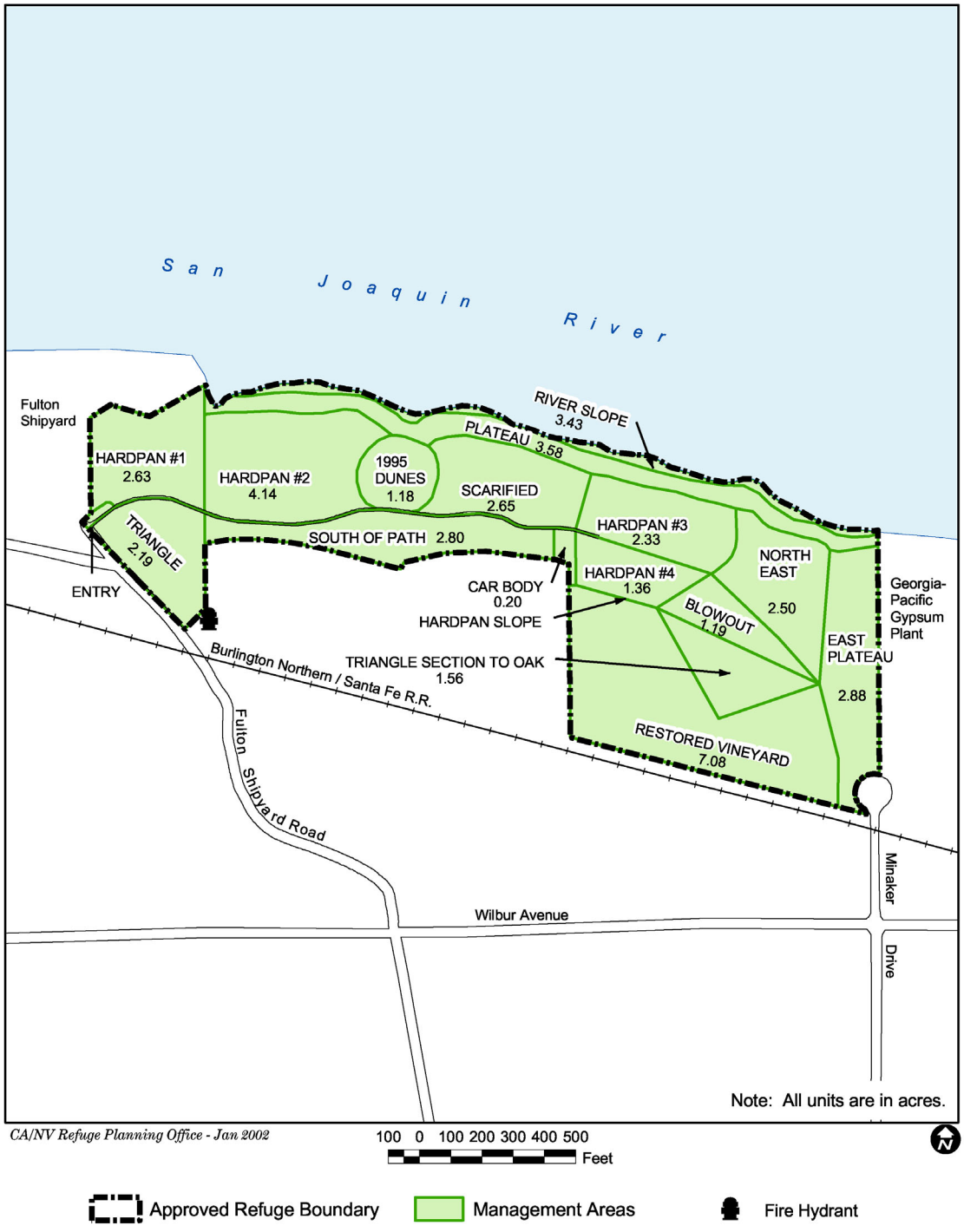


Figure 3. Stamm unit.



Suppression Conditions
The typical fire suppression response to a fire at Antioch Dunes NWR would consist of an IC provided by the Contra Costa County FPD and two engines. Water is the primary method for extinguishing fires. Handline is not usually needed for suppression efforts.

The goal for all unplanned ignitions is to control the fire with minimum acreage burned. Heavy equipment shall not be used due to the sensitivity of the habitat, except in cases where life or fire-fighter safety is threatened or when the Refuge Manager determines necessary. Suppression guidelines will be outlined in a future MOU with Contra Costa County FPD.

Wildland Fire Situation Analysis
For fires that cannot be contained in one burning period, a WFSA must be prepared. In the case of a wildland fire, the Incident Commander, in conjunction with the FMO, will prepare the WFSA. Approval of the WFSA resides with the Refuge Project Leader.

The purpose of the WFSA is to allow for a consideration of alternatives by which a fire may be controlled. Damages from the fire, suppression costs, safety, and the probable character of suppression actions are all important considerations.

Public safety will require coordination between all refuge staff and the IC. Traffic control will be necessary where smoke crosses roads, etc. Where wildland fires cross roads, the burned area adjacent to the road should be mopped up and dangerous snags felled. Every attempt will be made to utilize natural and constructed barriers, including changing fuel complexes, in the control of wildland fire. The first priority for rehabilitation efforts will concentrate on the damages done by suppression activities. A Burned Area Rehabilitation Plan will be prepared for damages caused by the fire itself.

Aircraft Operations
Aircraft may be used in all phases of fire management operations. All aircraft must be Office of Aircraft Services (OAS) or Forest Service approved. An OAS Aviation Policy Department Manual will be provided by OAS.

Helicopters may be used for reconnaissance, bucket drops and transportation of personnel and equipment. Natural helispots and parking lots are readily available in most cases. Clearing for new helispots should be avoided where possible. Improved helispots will be rehabilitated following the fire.

As in all fire management activities, safety is a primary consideration. Qualified aviation personnel will be assigned to all flight operations.

EMERGENCY STABILIZATION AND REHABILITATION
When suppression action is taken, rehabilitation is appropriate. The most effective rehabilitation measure is prevention of impacts through careful planning and the use of minimum impact suppression techniques.

Rehabilitation will be initiated by the Incident Commander, FMO, or Refuge Manager. Rehabilitation will be directed toward minimizing or eliminating the effects of the suppression effort and reducing the potential hazards caused by the fire. These actions may include:

1. Backfill control lines, scarify, and seed.
2. Install water bars and construct drain dips on control lines to prevent erosion.
3. Install check dams to reduce erosion potential in drainages.
4. Restore natural ground contours.
5. Remove all flagging, equipment and litter.
6. Consider and plan more extensive rehabilitation or revegetation to restore sensitive impacted areas.

If revegetation or seeding is necessary, only native plant species will be used.

If Emergency Stabilization and Rehabilitation (ESR) measures are needed or if rehabilitation is needed to reduce the effects of a wildland fire then the Refuge can request appropriate funding through the burned area ESR fund. The ESR fund is administered through the Service's ESR coordinator at the National Interagency Fire Center.

Fire rehabilitation will be as prompt as possible to prevent erosion and spread of non-native plants. This will be developed by the Refuge staff and submitted to the Regional Fire Management Coordinator for review within 90 days of the unplanned ignition being declared out.

REQUIRED REPORTING

A DI-1202, fire report, will be filled out and submitted to the Regional Fire Management Officer for input into the Fire Management Information System (FMIS) within 20 days of the fire being declared out. Copies of reports from the Contra Costa County FPD will be obtained and report will be written to summarize the specifics of the fire, actions taken and outcomes from those actions. A formal review will be conducted on all serious injuries and losses of significant resources.

FIRE INVESTIGATION

Fire management personnel will attempt to locate and protect the probable point of origin and record pertinent information required to determine fire cause. They will be alert for possible evidence, protect the scene and report findings to the fireline supervisor.

The Refuge Manager, FMO, or IC may request a fire investigator through the Contra Costa County FPD. Prompt and efficient investigation of all suspicious fires will be carried out. However, fire management personnel should not question suspects or pursue the fire investigation unless they are currently law enforcement commission qualified.

Personnel and services of other agencies may be utilized to investigate wildland fire arson or fire incidents involving structures. All fire investigations should follow the guidelines outlined in 4.1-2 of the Fire Management Handbook (2000).

PRESCRIBED FIRE ACTIVITIES

PRESCRIBED BURN PROGRAM OBJECTIVES

Prescribed fire can be a useful tool for restoring and maintaining natural conditions and processes at Antioch Dunes NWR.

Specific management needs for the refuge as a whole and for specific areas will be determined annually. Specific burn objectives, fire frequency rotation, firing methodology, and prescriptions will vary from year to year. Burn plans will be updated to reflect any variations. The Project Leader will approve prescribed fire plans.

There are two main objectives for the Antioch Dunes NWR: 1) To protect, enhance, and recover populations of endangered, threatened, and rare species of the Antioch Dunes Ecosystem, and 2) To protect, restore, and enhance the Antioch Dunes ecosystem for a diversity of native plant and insect species.

Historically, many factors have contributed to the decline of the three endemic endangered species: Antioch Dunes evening primrose, Contra Costa wallflower, and Lange's metalmark butterfly. Currently, however, the primary threat to these species is competition with non-native vegetation. The primrose appears to be particularly vulnerable to non-native vegetation encroachment. Despite Refuge management efforts to control non-native species by hand pulling and herbicide treatment, primrose numbers have decreased substantially in recent years. If non-native vegetation is not controlled, extinction of the primrose is highly likely.

While a wildland fire could negatively impact endangered plant populations, a properly timed prescribed fire would reduce competition from non-natives and create more suitable habitat for endangered and native species, which are dependant on relatively open, sand dune habitat. Objectives of prescribed fire in the Antioch Dunes NWR would be to: 1) Eliminate existing non-native plants and their seed heads, 2) Reduce hazardous fuels and organic matter, 3) Reduce the non-native seed bank, 4) stimulate native plant growth and 5) Prepare the area for transplanting endangered plants by exposing sandy soil substrate.

A multi-year prescribed burning program has been implemented encompassing both the Stamm and Sardis Units of the Antioch Dunes NWR. In the initial year, several sites (each approximately 3-5 acres) were burned according to a detailed prescribed burn plan. Sites selected had high densities of non-natives (primarily annual grasses, yellow starthistle, and Russian thistle), and few endangered species. A monitoring program was initiated to measure vegetation response in the burn areas and in non-burned control plots. If the results are favorable, additional areas on the Stamm and Sardis Units will be burned on a rotational basis in subsequent years. Endangered species and other native species would be planted in the burned areas after the non-native seed bank has been reduced.

Small experimental plots (each approximately 7 sq. yards) containing primrose and buckwheat were also burned in order to test the response of these native species to fire. This step is important because it is assumed that fire was not a component of these species' natural ecosystem, so the results on native species is difficult to predict.

All planned ignitions will be accomplished using qualified personnel. This will include annual refresher training as stated in the Service Fire Management Preparedness and Planning Handbook (See section 1.5.1).

Prescribed fires involve the use of fire as a tool to achieve management objectives. Research burning may also be conducted when determined to be necessary for accomplishment of research project objectives. Actions included in the prescribed burn program include: the selection and prioritization of prescribed burns to be carried out during the year, prescribed burn plans, burn prescriptions, burn operations, documentation and reporting, and burn critiques.

Several units of 3-5 acres each will be burned in any one season. Only one burn will be executed at a time. Fuel types are primarily annual grasses, annual forbs, and some perennial brush species (Fire Behavior Fuel Models 1 and 3). There are several smoke sensitive areas in the vicinity: The City of Antioch lies west, south and east of the Antioch Dunes NWR, and smoke could drift over the area. The railroad lies directly south of the Refuge. Due to the small size of the areas proposed for burn, and the fine nature of the fuels, consumption of target fuels would take a short time (about an hour), minimizing the amount of smoke. Public concern about prescribed burning is anticipated to be low because it will be over with quickly and without any lingering smoke. Past prescribed burns conducted at Antioch Dunes NWR have shown that smoke rapidly dissipates if burning occurs during unstable atmospheric conditions.

FIRE MANAGEMENT STRATEGIES

All prescribed fire activity will comply with applicable Federal, state, and local air quality laws and regulations. All prescribed fire projects will have a burn plan approved by the Project Leader. Each burn plan will be prepared using a systematic decision-making process, and contain measurable objectives, predetermined prescriptions, and using an approved environmental compliance document. Appropriate NEPA documentation and Section 7 consultation (Appendix C and D) exist for this Fire Management Plan. Therefore, additional NEPA documentation will be necessary only for prescribed fire projects not meeting the criteria outlined in this Plan.

Prescribed Fire Burn Plans must include components such as a Go/ No-Go Checklist, contingency actions to be taken in the event the prescription is exceeded, and the need for alerting neighbors and appropriate public officials to the timing and the planning of the burn. A burn plan format meeting all required needs is located in Appendix E.

Fire monitoring will be used to evaluate the degree to which burn objectives are accomplished. Monitoring can assist managers in documenting success in achieving overall programmatic objectives and limiting occurrence of undesired effects.

PRESCRIBED FIRE PLANNING

The two existing Refuge units, Stamm (41 acres) and Sardis (14 acres) also serve as discrete Fire Management Units. Within these units, there are currently two Prescribed Burn Areas identified for the Stamm Unit (Hardpan 1 and Vineyard), and one Prescribed Burn Area identified for the Sardis Unit (South Plateau; Figures 1-3). These will likely be expanded or additional units identified in the future.

The prescribed burning season is May-June. During these months, the grasses are dry enough to carry a hot fire that is required to reduce the non-native seed bank and the seed heads. Yellow star-thistle would be approximately 5% flower during this time, which is the optimum time to burn it because the fire would destroy the thistle before it produces seed, yet it will have expended enough energy to prevent regrowth.

This correlates with overall Fire Management Objectives to: 1) Use prescribed fire to accomplish resource management objectives, and 2) Protect endangered species and other native species from a large scale wildland fire, which could potentially wipe out all, or major portions of, available habitat.

Annual Activities

The FMO will be responsible for completing an annual fire summary report. The report will contain the number of fires by type, acres burned by fuel type, cost summary, personnel utilized, and fire effects.

The Refuge Manager, Biologist, and FMO will determine burn unit priorities, timing, and burn plan development schedule by February of each year. Burn Plans will be prepared and submitted for Project Leader review and approval by April. The Burn Plan will be submitted to the Air Quality District by April 30 for smoke management review and authorizing letter.

Prescribed Fire activities will be reviewed annually. Necessary updates or changes to the Fire Management Plan will be accomplished prior to the next fire season. Any additions, deletions, or changes will be reviewed by the Refuge Manager to determine if such alterations warrant a re-approval of the plan.

Prescribed Burn Plan

The Prescribed Burn Boss will conduct a field reconnaissance of the proposed burn location with the FMO, AFMO, PFS, biologist, and/or Refuge Manager to discuss objectives and special concerns, and to gather all necessary information to write the Burn Plan. After completing the reconnaissance, the a qualified Burn Boss will write the Prescribed Burn Plan.

All prescribed fires will have Prescribed Burn Plans. The Prescribed Burn Plan is a site specific action plan describing the purpose, objectives, prescription, and operational procedures needed to prepare and safely conduct the burn. The treatment area, objectives, constraints, and alternatives will be clearly outlined. No burn will be ignited unless all prescriptions of the plan are met. Fires not within those parameters will be suppressed. Prescribed Burn Plans will follow the format contained in Appendix E. Each burn plan will be reviewed by the Refuge Manager, Biologist, FMO/AFMO, PFS, and Burn Boss. The Project Leader has the authority to approve the burn plan. The term “burn unit” refers to a specific tract of land to which a Prescribed Burn Plan applies.

Strategies and Personnel

Execution of prescribed burns will only be executed by qualified personnel. The Prescribed Burn Boss will fill all required positions to conduct the burn with qualified personnel. All personnel listed in the Burn Plan must be available for the duration of the burn or the burn will not be initiated. Personnel will meet minimum USFWS fitness and qualifications standards for prescribed burning.

Weather and fuel moisture conditions must be monitored closely in planned burn units to determine when the prescription criteria are met. A belt weather kit may also be utilized to augment monitoring. Fuel moisture samples of 10-, 100-, and 1000-hour down and dead logs (where applicable) and of live plants may be monitored each week and percent moisture contents figured to help determine when the prescription criteria are met.

When all prescription criteria are within the acceptable range, the Prescribed Burn Boss will select an ignition date based on current and predicted weather forecasts. A thorough briefing will be given by the Prescribed Burn Boss and specific assignments and placement of personnel will be discussed. An updated spot weather forecast will be obtained on the day of ignition and all prescription elements will be rechecked to determine if all elements are still within the approved ranges. If all prescription elements are met, a test fire will be ignited to determine on-site fire behavior conditions as affected by current weather. If conditions are not satisfactory, the test fire will be suppressed and the burn will be rescheduled. If conditions are satisfactory the burn will continue as planned.

Depending upon the complexity of the burn, two or more fire crews (3 crew members per crew) from the Central Valley Refuges Zone and 3-4 collateral fire duty personnel from San Francisco Bay NWRC may be needed to ignite, hold, and mop-up the burn. In addition, personnel and equipment from Contra Costa County FPD shall be available in the event that fire spreads outside Refuge property and into their local area of responsibility. A qualified Prescribed Burn Boss Type II or higher will be required to write the Burn Plan and serve as Burn Boss during any planned ignitions

One person with botanical/sampling design expertise will also be needed to conduct pre and post burn monitoring. One person with biological/botanical expertise will be needed to assist in developing site specific prescribed burn plans.

Only qualified personnel will be used to conduct burns on the Refuge. Pre- and post-fire briefings will be conducted on all planned ignitions.

Coordination needed with the following entities:

- Bay Area Air Quality Management District: Written approval required; Burn Plan needs to be submitted 30 days in advance of planned ignition; day of fire approval required.
- City of Antioch Public Works: Needs to be contacted 1 week prior to proposed burn date.
- City of Antioch Police Department: Needs to be contacted the day of the burn to notify them of potential smoke across roads.
- Contra Costa County FPD: Needs to receive copy of prescribed burn plan 1 month in advance.
- Burlington Northern Railroad: Needs to be contacted 1 week prior to burn to advise them of potential smoke across tracks.
- Pacific Gas and Electric Company; Georgia Pacific Company and other adjacent landowners: Adjacent or nearby landowners need to be contacted 1 week prior to the burn so that vehicles are moved and employees are aware of the burn.

The Refuge will procure burn permits and follow procedures in them. In addition, the Zone Fire Management Officer or an individual qualified at the Prescribed Burn Boss Type II level will write a Burn Plan to be approved by the Project Leader. The guidance and format for writing Burn Plans is

found in the Service's Prescribed Fire Management Handbook, Section 2.2. All ignitions require a DI-1202 form to be completed and returned to the responsible fire management officer for input into the Fire Management Information System (FMIS) within 20 days after the fire is declared out.

If the prescribed burn escapes the predetermined burn area, all further ignition will be halted except as needed for suppression efforts. Suppression efforts will be initiated, as discussed in the preburn briefing. The FMO will be notified immediately of any control actions on a prescribed burn. If the burn exceeds the initial suppression efforts, the burn will be declared a wildland fire and suppressed using guidelines established in this plan. If a prescribed burn is declared a wildland fire, all personnel must meet NWCG qualifications and fitness levels for wildland fire activities. A WFSA will be completed and additional personnel and resources ordered as determined by the Incident Commander. If the fire continues to burn out of control, additional resources will be called from the local cooperating agencies via the servicing dispatch. A management overhead team may be requested to assume command of the fire.

Recommendations of the Bay Area Air Quality Management District will be followed which will satisfy the District's criteria for use of the "72-Hour Outlook/48-Hour Decision" forecasting procedure. These may include restrictions on igniting under certain wind speeds/directions, humidity, or other conditions that would cause local air quality to be degraded. Other conditions under which fires will not be ignited include: east wind conditions, Red Flag Warnings /Watches as determined by Contra Costa County FPD, situations where local fire department resources are over committed to wildland fires in the Bay Area (i.e., Oakland Hills Fire 1991 or Vision -Pt. Reyes Fire 1995). The prescribed fire plan will also identify other "no-go" or suppression criteria. Prior to any planned ignitions, Burn Boss will contact Contra Costa County FPD Emergency Communications Center to determine resource availability in case of an escaped burn.

Monitoring and Evaluation

Monitoring of prescribed fires is intended to provide information for quantifying and predicting fire behavior and its ecological effects on refuge resources while building a historical record. Monitoring measures the parameters common to all fires: fuels, topography, weather and fire behavior. In addition, ecological changes such as species composition and structural changes will be monitored after a fire. This information will be very useful in fine-tuning the prescribed burn program.

All wildland fires will be appropriately suppressed. However, monitoring wildland fires may be appropriate and potentially valuable in mapping and documenting the growth of the fire, measuring on-site weather and fuel loading to provide the fire staff with present and expected fire behavior and effects. During prescribed burns, monitoring can serve as a precursor to invoking suppression action by determining if the fire is in prescription, assessing its overall potential, and determining the effects of the prescribed burn.

During prescribed burning, monitoring should include mapping, weather, site and fuel measurements and direct observation of fire characteristics such as flame length, rate of spread and fire intensity. Operational monitoring provides a check to insure that the fire remains in prescription and serves as a basis for evaluation and comparison of management actions in response to measured, changing fire conditions, and changes such as fuel conditions and species composition.

Fires may be monitored regardless of size. The FMO will establish specific fire information guidelines for each fire to update intelligence about the fire. Highest priority for monitoring will be assigned to large fires or fires which threaten to leave the refuge.

Short term: BEHAVE predictions will be used to model fire behavior, and a belt weather kit will be used to monitor actual burn day conditions.

Long term: The response of native and non-native vegetation to fire will be monitored. Plant species composition and percent cover will be measured pre- and post-burn for certain native and weed species of concern.

Monitoring must be done to document and verify that the stated objectives have been met. Plots, photo points, or other methods will be developed to document the results of the burn. These data will be stored for future refinement of prescriptions and to determine the success of the program.

Required Reports

All prescribed burn forms will be completed as outlined by the Prescribed Burn Boss. A monitor will be assigned to collect all predetermined information and complete all necessary forms prior to, during, and after the burn. All records will be archived in the refuge's fire records for future use and reference.

The Prescribed Burn Boss will prepare a final report on the prescribed burn. Reports will include a calculations of particulate matter emissions and a monitoring report. Information will include a narrative of the burn operation, a determination of whether objectives were met, weather and fire behavior data, map of the burn area, photographs of the burn, number of work hours, and final cost of the burn.

Prescribed Burn Critique

A report detailing the actual burn will accompany any recommendations or changes deemed necessary in the program. This report will be submitted to the Refuge Project Leader. A post-season critique of the fire management program, including the prescribed burn program, will be held each year at the conclusion of the fall fire season.

AIR QUALITY / SMOKE MANAGEMENT GUIDELINES

Air quality is monitored and managed by the Bay Area Air Quality Management District. Although they do not issue Burn Permits, they do grant permission to burn if a burn proposal falls under one of their open burning categories. In order to qualify for one of their open burning categories (Regulation 5), the Refuge needs to determine which category best meets the intent and objective of the project. Previous burns at Antioch Dunes NWR fell under Regulation 5-Open Burning, Section 8 Allowable Fires, Subsection P-Wildland Vegetation Management, 401.16. In addition, Section 5-408 sets forth those requirements needed to conduct prescribed burning. These requirements need to be adhered to in order to receive permission to conduct a prescribed burn.

In order to obtain permission to burn under this category, a Burn Plan must be submitted to the Enforcement Branch at least 30 days prior to burning. BAAQMD grants permission to burn on a case-by-case basis. There is no recurring or annual burn permit/ permission. The Refuge will need to obtain permission for each burn project planned. The Refuge will follow all conditions contained in the letter of permission.

Specific aspects of a Smoke Management Plan (wind, weather, visibility hazard, and residual smoke problems) will be addressed in Prescribed Burn Plans prepared for each burn.

FIRE RESEARCH

The Refuge will continue collecting data and monitoring the success or failure of burning conditions required to accomplish objectives of controlling non-native vegetation and restoring riverine sand dune habitat. Weather conditions will be recorded to establish future successful/ideal burning results. Normal fire program monies are not intended to fund fire research activities.

The Refuge has identified a research need to determine the short-term and long-term effects of prescribed burning on invertebrate abundance and diversity. Data collected will be presented to the refuge as results become available.

PUBLIC SAFETY

Antioch Dunes NWR is dedicated to ensuring the safety of all residents and property adjacent to the refuge's boundary.

Firefighter and pubic safety will always take precedence over property and resource protection during any fire management activity. For public safety, the fire scene will remain clear of unauthorized people. The responsibility for managing public safety lies with the Incident Commander (IC) or Burn Boss for wildland or prescribed fire. Public safety considerations will be included as part of the burn prescription.

Due to the proximity of Wilbur Road to the Refuge, Burn Boss and Refuge Manager will coordinate traffic control along Wilbur Road with Refuge Law Enforcement Officers and local law enforcement when burns are conducted.

Due to the proximity of the Burlington Northern Santa Fe Railroad to the Refuge, Burn Boss and Refuge Manager will notify Railroad Security Officers of planned burns.

See Appendix H for list of adjacent landowners with phone numbers and addresses for notification purposes.

During prescribed burns at least one burn team member will have first aid training. A first aid kit will be on-site for prescribed burns as well as wildland fires. The local police, fire, and emergency medical services will be notified prior to the ignition of any prescribed burn. They will also be notified of the location of any wildland fires.

PUBLIC INFORMATION AND EDUCATION

Educating the public on the value of fire as a natural process is important to increasing public understanding and support for the fire management program. The refuge will use the most appropriate and effective means to explain the overall fire and smoke management program. This may include supplemental handouts, signing, personal contacts, interpretive signs, or media releases. When deemed necessary, interpretive presentations will address the fire management program and explain the role of fire in the environment.

Informing the public is an important part of the fire management program. During a wildland fire, the IC is responsible for providing information to the public. Prescribed fire public information has been further addressed in the Prescribed Fire Plan and the Environmental Assessment (See Appendices C and D).

The public information program will be developed as follows:

1. Concepts of the prescribed burn program will be incorporated, as appropriate, in publications, brochures, and handouts.
2. The fire management program may be incorporated into visitor contacts. Particular attention will be given when fires are conspicuous from roads or visitor use areas.
3. News releases will be distributed to the media as appropriate.
4. The public information outlets of neighboring and cooperating agencies and the regional office will be provided with all fire management information.
5. The fire management program will be discussed in informal talks with all employees, volunteers, residents, and neighbors.

Prior to the lighting of any planned ignition, information will be made available to visitors, local residents, and/or the press about what is scheduled to happen and why. This information will include prescribed burn objectives and control techniques, fire location and expected behavior, effects caused by the fire, and potential impacts on private and public facilities and services.

FIRE CRITIQUES AND ANNUAL PLAN REVIEW

FIRE CRITIQUES

Fire reviews will be documented and filed with the final fire report. The FMO will provide a copy for the refuge files.

ANNUAL FIRE SUMMARY REPORT

The FMO will be responsible for completing an annual fire summary report. The report will contain the number of fires by type, acres burned by fuel type, cost summary (prescribed burns and wildland fires), personnel utilized, and fire effects.

ANNUAL FIRE MANAGEMENT PLAN REVIEW

The Fire Management Plan will be reviewed annually. Necessary updates or changes will be accomplished prior to the next fire season. Any additions, deletions, or changes will be reviewed by the Refuge Manager to determine if such alterations warrant a re-approval of the plan.

The fire management plan will be updated as major policy decisions are made. At a minimum, this plan will be reviewed once a year by the individual on the Refuge with fire responsibility to maintain the integrity of the plan. Amendments to the fire management plan itself will be made as needed by sending them to the Regional Fire Management Coordinator for concurrence and to be approved by the Regional Director in Portland. Minor changes to the appendices, such as phone number corrections and personnel changes, can be made at the Refuge level and attached to the plan during this yearly review process without involvement of the Regional Office.

CONSULTATION AND COORDINATION

The following agencies, organizations and/or individuals were consulted in preparing this plan.

Chris Bandy, Refuge Manager, Antioch Dunes NWR, Newark, CA

Roddy Baumann, Prescribed Fire Specialist, Pacific Region, USFWS, Portland, OR.

Rachel Hurt, Biologist, San Francisco Bay NWRC, USFWS, Fremont, CA.

Richard Hadley, Assistant Refuge Supervisor, California/ Nevada Operations, USFWS, Sacramento, CA.

Ivette Loredo, Refuge Biologist, Antioch Dunes NWR, USFWS, Fremont, CA

Amanda McAdams, Fire Planner, Pacific Region, USFWS, Portland, OR.

Tom Romanello, Assistant Fire Management Officer, Sheldon-Hart NWR, Lakeview, CA.

APPENDICES

APPENDIX A: REFERENCES CITED

Bailey, R.G. 1995. Description of the ecoregions of the United States. USDA Forest Service. 108 pp.

Green, J.A. 1995. Three reproductive ecology studies in the narrow endemic *Oenothera deltoides* ssp. *howellii* (Onagraceae). M.A. Thesis, Claremont Graduate School.

Loredo, Ivette. USFWS, Personal Communication, 7/2001.

APPENDIX B: DEFINITIONS

Agency Administrator. The appropriate level manager having organizational responsibility for management of an administrative unit. May include Director, State Director, District Manager or Field Manager (BLM); Director, Regional Director, Complex Manager or Project Leader (FWS); Director, Regional Director, Park Superintendent, or Unit Manager (NPS), or Director, Office of Trust Responsibility, Area Director, or Superintendent (BIA).

Appropriate Management Action. Specific actions taken to implement a management strategy.

Appropriate Management Response. Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

Appropriate Management Strategy. A plan or direction selected by an agency administrator which guide wildland fire management actions intended to meet protection and fire use objectives.

Appropriate Suppression. Selecting and implementing a prudent suppression option to avoid unacceptable impacts and provide for cost-effective action.

Bureau. Bureaus, offices or services of the Department.

Class of Fire (as to size of wildland fires):
Class A - 3 acre or less.
Class B - more than 3 but less than 10 acres.
Class C - 10 acres to 100 acres.
Class D - 100 to 300 acres.
Class E - 300 to 1,000 acres.
Class F - 1,000 to 5,000 acres.
Class G - 5,000 acres or more.

Emergency Fire Rehabilitation/Burned Area Emergency Rehabilitation (EFR/BAER). Emergency actions taken during or after wildland fire to stabilize and prevent unacceptable resource degradation or to minimize threats to life or property resulting from the fire. The scope of EFR/BAER projects are unplanned and unpredictable requiring funding on short notice.

Energy Release Component (ERC) A number related to the available energy (BTU) per unit area (square foot) within the flaming front at the head of a fire. It is generated by the National Fire Danger Rating System, a computer model of fire weather and its effect on fuels. The ERC incorporates thousand hour dead fuel moistures and live fuel moistures; day to day variations are caused by changes in the moisture content of the various fuel classes. The ERC is derived from predictions of (1) the rate of heat release per unit area during flaming combustion and (2) the duration of flaming.

Extended attack. A fire on which initial attack forces are reinforced by additional forces.

Fire Suppression Activity Damage. The damage to lands, resources and facilities directly attributable to the fire suppression effort or activities, including: dozer lines, camps and staging areas, facilities (fences, buildings, bridges, etc.), handlines, and roads.

Fire effects. Any consequences to the vegetation or the environment resulting from fire, whether neutral, detrimental, or beneficial.

Fire intensity. The amount of heat produced by a fire. Usually compared by reference to the length of the flames.

Fire management. All activities related to the prudent management of people and equipment to prevent or suppress wildland fire and to use fire under prescribed conditions to achieve land and resource management objectives.

Fire Management Plan. A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational procedures such as preparedness plans, preplanned dispatch plans, prescribed fire plans and prevention plans.

Fire prescription. A written direction for the use of fire to treat a specific piece of land, including limits and conditions of temperature, humidity, wind direction and speed, fuel moisture, soil moisture, etc., under which a fire will be allowed to burn, generally expressed as acceptable range of the various fire-related indices, and the limit of the area to be burned.

Fuels. Materials that are burned in a fire; primarily grass, surface litter, duff, logs, stumps, brush, foliage, and live trees.

Fuel loadings. Amount of burnable fuel on a site, usually given as tons/acre.

Hazard fuels. Those vegetative fuels which, when ignited, threaten public safety, structures and facilities, cultural resources, natural resources, natural processes, or to permit the spread of wildland fires across administrative boundaries except as authorized by agreement.

Initial Attack. An aggressive suppression action consistent with firefighter and public safety and values to be protected.

Maintenance burn. A fire set by agency personnel to remove debris; i.e., leaves from drainage ditches or cuttings from tree pruning. Such a fire does not have a resource management objective.

Natural fire. A fire of natural origin, caused by lightning or volcanic activity.

NFDRS Fuel Model. One of 20 mathematical models used by the National Fire Danger Rating System to predict fire danger. The models were developed by the US Forest Service and are general in nature rather than site specific.

NFFL Fuel Model. One of 13 mathematical models used to predict fire behavior within the conditions of their validity. The models were developed by US Forest Service personnel at the Northern Forest Fire Laboratory, Missoula, Montana.

Prescription. Measurable criteria which guide selection of appropriate management response and actions. Prescription criteria may include safety, public health, environmental, geographic, administrative, social, or legal considerations.

Prescribed Fire. A fire ignited by agency personnel in accord with an approved plan and under prescribed conditions, designed to achieve measurable resource management objectives. Such a fire is designed to produce the intensities and rates of spread needed to achieve one or more planned benefits to natural resources as defined in objectives. Its purpose is to employ fire scientifically to maximize net benefits at minimum impact and acceptable cost. A written, approved prescribed fire plan must exist and NEPA requirements must be met prior to ignition. NEPA requirements can be met at the land use or fire management planning level.

Preparedness. Actions taken seasonally in preparation to suppress wildland fires, consisting of hiring and training personnel, making ready vehicles, equipment, and facilities, acquiring supplies, and updating agreements and contracts.

Prevention Activities directed at reducing the number or the intensity of fires that occur, primarily by reducing the risk of human-caused fires.

Rehabilitation (1) Actions to limit the adverse effects of suppression on soils, watershed, or other values, or (2) actions to mitigate adverse effects of a wildland fire on the vegetation-soil complex, watershed, and other damages.

Suppression. A management action intended to protect identified values from a fire, extinguish a fire, or alter a fire's direction of spread.

Unplanned ignition. A natural fire that is permitted to burn under specific conditions, in certain locations, to achieve defined resource objectives.

Wildfire. An unwanted wildland fire.

Wildland Fire. Any non-structure fire, other than prescribed fire, that occurs in the wildland.

Wildland Fire Situation Analysis (WFSA). A decision-making process that evaluates alternative management strategies against selected safety, environmental, social, economical, political, and resource management objectives as selection criteria.

Wildland/urban interface fire A wildland fire that threatens or involves structures.

Appendix C: NEPA and NHPA Compliance

FINAL ENVIRONMENTAL ASSESSMENT

Prescribed Burn Program

Antioch Dunes National Wildlife Refuge

San Francisco Bay National Wildlife Refuge Complex

Under the authority of the National Wildlife Refuge System Administration Act of 1966 and Endangered Species Act of 1973

Contra Costa County, California

Prepared by: Erin C. Fernández
Title: Wildlife Biologist
Duty Station: San Francisco Bay National Wildlife Refuge Complex
June 1997

TABLE OF CONTENTS

LIST OF FIGURES

ABSTRACT

This environmental assessment evaluates alternatives for managing non-native vegetation on the 55-acre Antioch Dunes National Wildlife Refuge (Refuge). The preferred alternative would utilize prescribed burning as a management tool to eliminate non-native vegetation from the Refuge. This unique Refuge was established in 1980 in order to protect three endemic endangered species: the Antioch Dunes evening primrose, Contra Costa wallflower, and the Lange's metalmark butterfly. Historically, many factors have contributed to the decline of these species, including human development and sand mining of the dunes. Currently, however, the primary threat to these species is competition with non-native vegetation. The preferred alternative will drastically reduce the amount of non-native vegetation present at the dunes. Prescribed burning will assist in restoration of the Refuge and enhance habitat for endangered and other native species. No significant adverse socioeconomic impacts to the area are anticipated.

Section I: PURPOSE AND NEED FOR ACTION

The 55-acre Antioch Dunes National Wildlife Refuge (Refuge) and adjacent 12-acre Pacific Gas and Electric (PG&E) land support the last remaining populations of three endangered species including the Antioch Dunes evening primrose (Oenothera deltoides ssp. howellii), Contra Costa wallflower (Erysimum capitatum ssp. angustatum), and the Lange's metalmark butterfly (Apodemia mormo ssp. langei). The primary objective of the Refuge is to provide habitat for these three endemic endangered species. Historically, many factors have contributed to the decline of these species, including human development and sand mining of the dunes. Currently the primary threat to these species is the encroachment of non-native vegetation such as rip-gut brome grass (Bromus diandrus) and yellow starthistle (Centaurea solstitialis).

United States Fish and Wildlife Service (Service) staff actively manages these endangered species by conducting annual population surveys and through habitat restoration. Management tools include the Non-native Vegetation Management Program, which currently includes hand pulling and herbicide treatment of non-natives. Despite our management efforts however, numbers of primrose continue to decline primarily due to competition with weed species.

Primrose numbers have decreased substantially in recent years. There were 5,800 mature primrose in 1984, and only 963 mature primrose in 1996, a decrease of 83%. Primrose appears particularly vulnerable to non-native vegetation encroachment. Green (1995) in her thesis, *Three Reproductive Ecology Studies in the Narrow Endemic Oenothera deltoides ssp. howellii*, found no primrose seedlings around mature primrose that were surrounded by weed species, yet seedlings were found around 40% of mature primrose that were not surrounded by weed species. If non-native vegetation is not controlled, extinction of natural populations of primrose is highly likely.

In order to restore the primrose, the Service must improve and expand our current non-native vegetation management techniques. Ecologists, including Joseph DiTomaso (University of California, Davis), John Rusmore (UC Davis), John Randall (UC Davis), Bruce Pavlik (Mills College) and Martha Hastings (California Department of Parks and Recreation), have advised the Service that prescribed burning will create more suitable habitat for endangered species dependant on the historic sand-dune environment. Prescribed burning of selected areas will control non-native vegetation which will serve to stabilize and increase populations of the primrose and other endangered native species.

Section II: ALTERNATIVES INCLUDING THE PROPOSED ACTION

A. No Action Alternative

This alternative would maintain the status quo of continued hand pulling of weeds and selective herbicide use only. Currently, volunteers and Refuge staff annually pull non-native vegetation approximately once every two weeks in the spring and summer. Refuge staff spray weeds with herbicide once a year in the spring to create a small buffer zone between high desities of endangered species and non-native species.

B. Prescribed Burning Alternative (Proposed action)

This alternative would allow prescribed burning to be used as a tool for endangered species management. Selected dune sites of manageable size would be burned under predetermined conditions, every year or every other year, in order to remove non-native vegetation until the non-native seed bank is exhausted. Burning would then be conducted on an as-needed basis. This will enhance existing habitat and create more suitable habitat for endangered and native species, which are dependant on relatively open, sand-dune habitat.

The first year the Service proposes to burn three, approximately three acre sites on the Refuge that are dominated by non-native vegetation, have very few natives, and a few endangered species. We will establish non-burned control plots similar in vegetative composition to the burn areas. We will monitor both control and non-control areas for species richness and percent cover before and after the burn. We will analyze before and after burn data, as well as compare control areas to burned areas in order to determine the response of non-native vegetation to fire. We will plant native and endangered species in these areas after the non-native seed bank has been substantially diminished, which may take up to three years of burning. If this method proves successful, additional areas will be burned on a rotational basis and subsequently replanted with native and endangered species.

We also propose to burn 15 experimental plots (7 sq. y.) with primrose and buckwheat in order to test the response of primrose and buckwheat to fire. This will be done through the use of a burn box in which we can contain a small fire hot enough to scorch the existing vegetation. Ten of the plots will have one to two primrose, a few natives and many non-natives. Five of the plots will contain buckwheat in order to test the response of buckwheat to fire. We will establish 15 non-burned control plots similar in vegetative composition to the burn areas and monitor these areas for species richness and percent cover before and after the burn. We will analyze before and after burn data, as well as compare control areas to burned areas in order to determine the response of non-native and native vegetation to fire.

The Refuge will monitor prescribed burn plots by recording environmental factors and locating sites with a Global Positioning System. We will monitor areas for native and non-native species richness and percent cover before and after the burn in order to compare control areas to burned areas, as well as to track annual progress of the sites. We will use a combination of line transects and fixed plots to monitor vegetation. We will monitor vegetation both in the middle of these burn plots as well as toward the edge of the burn plot so that we may be able to detect differences in the amount of non-native vegetation resprouting from the residual seed source versus the amount of non-native vegetation encroaching on the burn area from peripheral areas.

Burning would primarily be conducted in May or June in order to achieve two objectives: 1) kill the existing non-native plants and their seed heads; and 2) exhaust the non-native seed bank. In May/June, the grasses will be dry enough to carry a hot fire that is required to destroy the non-native seed bed and the seed heads. The yellow-star thistle should be under 5% flower at this time. This is the optimum time to burn it because the fire would destroy the thistle before it produces seed, yet it will have expended enough energy that it should not regrow in that season. Burning may take place at a less optimum time depending on allowable burn days, however, any burn from spring through fall will help to reduce the non-native seed bank.

C. Increased Weeding Effort Alternative

This alternative would allow only for increased manual removal of exotic vegetation and would preclude prescribed burning as a tool in any management. Work crews would manually pull non-native vegetation every year in order to create suitable habitat for endangered species. The Refuge would require additional full time staff in order to reduce non-native vegetation through manual methods. Vegetation would be monitored using methods similar to that described in Alternative B.

D. Grazing Alternative

This alternative would allow grazing, in addition to ongoing weed control measures, and would preclude prescribed burning as a tool in any management. Livestock would graze selected areas on a rotational schedule to remove non-native vegetation. Vegetation would be monitored using methods similar to that described in Alternative B.

E. Heavy Equipment Alternative

This alternative would allow for the use of mowing, disking, and plowing at the Refuge to control non-native vegetation and would preclude prescribed burning as a tool in any management. Selected areas of the Refuge would be mowed, disked, and/or plowed to remove non-native vegetation. Vegetation would be monitored using methods similar to that described in Alternative B.

Section III: AFFECTED ENVIRONMENT

A. Background information

The Refuge is located along the southern shore of the lower San Joaquin river near the city of Antioch, Contra Costa County, California (Fig. 1). The Refuge lies within an ecoregion described by Bailey (1995) as the Mediterranean Division, California Dry Steppe Province. Historically, the Antioch Dunes extended over two miles along the southern bank of the San Joaquin river and reached heights of 117 feet. The 55-acre Refuge was extensively mined for sand in the past and subsequently ranges in elevation from 0 to 50 feet. The Refuge currently exists as an isolated habitat, surrounded by industrial development.

B. Climate

The Antioch area has a modified Mediterranean climate with warm to hot dry summers and moist, mild winters. Rainfall averages 12.53 inches annually, falling mainly during November-April. The average annual temperature is 61.8 degrees F with an average annual maximum temperature of 74 degrees F and an average annual minimum temperature of 47 degrees F. The hottest recorded temperature is 114 degrees F, and the lowest recorded temperature is 14 degrees F. Winds in the summer come off the river from the west or northwest at an average of 10-20 mph.

C. Soils

Soils in the Refuge are representative of the Oakley sands interlaced with alluvial fan deposits. The Sardis unit (14 acre eastern parcel) was mined down to a clay/peat substrate for the most part and subsequently sand was replaced over many of these areas. The perimeter still consists of sandy loam substrate. The Stamm unit (41 acre western parcel) has a "hard pan" layer of varying thickness but underneath this hard pan is sandy loam. Sand was replaced over a small portion of the mined area of the Stamm unit as well.

D. Vegetation/Wildlife

Six main habitat types are found within the 55-acre Refuge: littoral, riparian, open sand dunes, abandoned vineyard, disturbed/mined areas and grassland areas. The littoral zone contains a state listed rare plant: Mason's lilaeopsis (Lilaeopsis masonii). The riparian area is characterized by native species such as, but not limited to, coast live oak (Quercus agrifolia), red willow (Salix laevigata), narrow-leaved willow (Salix exigua), arroyo willow (Salix lasiolepis), California toyon (Heteromeles arbutifolia) and elderberry (Sambucus mexicana). The open dune areas consist of primarily native species including: Antioch dunes evening primrose, Contra Costa wallflower, both federally listed as endangered, naked-stemmed buckwheat, host plant for the endangered Lange's metalmark butterfly, telegraph weed (Heterotheca grandiflora), Senecio flaccidus var. douglasii, deerweed (Lotus scoparius) and many others (Refer to Appendix D of the Draft CCP). In the disturbed, grassland, and vineyard areas there is an abundance of non-native species including rip-gut brome grass, yellow starthistle, Russian thistle (Salsola tragus), as well as some native species.

The Refuge provides important habitat for many types of wildlife including: nesting and migratory bird species and the California legless lizard (Aniella pulchra pulchra).

Section IV: ENVIRONMENTAL CONSEQUENCES

The principal environmental and socioeconomic effects are outlined in Table 1 and discussed in the following text.

A. No Action Alternative

The no action alternative would result in non-native vegetation continuing to inhibit the survival of endangered species at the Refuge. The Antioch dunes evening primrose would continue to decrease and the currently stable populations of Contra Costa wallflower and naked-stemmed buckwheat (host plant for the Lange's metalmark butterfly) could begin to decline. As non-native species encroach, the potential for a devastating wildfire increases.

If additional non-native vegetation control measures are not taken now, the problem will only be exacerbated, non-native species will increase, and more frequent and costly control measures could have to be taken in order to halt the spread of non-native species. Under the No Action alternative, there is high potential that the Antioch dunes evening primrose would be eliminated from its historic range. This inability of the Refuge to provide suitable habitat for endangered species is inconsistent with the Refuge's goals and conflicts with Service goals of recovering endangered species.

B. Prescribed Burning Alternative

Cut firelines, existing roads, and other control techniques that will be utilized to prevent escaped burns will prevent the escape of fire into areas where concentrations of endangered species occur. The selection of, and adherence to, a proper prescription and careful coordination with the Bay Area Air Quality Management District, the Contra Costa Fire Department, Service Ecological Services Office, and Service Regional Fire Management Officer will greatly limit the chance of an escaped burn.

For the first three years, the large burn plot areas within the Refuge will be carefully selected to avoid endangered species. However, a few primrose, wallflower, and buckwheat plants could be within a burn area and would be temporarily adversely affected. The Lange's metalmark butterfly may be detrimentally affected by burning its host plant, naked stemmed buckwheat. The small burn plots will be selected to contain a few endangered species so that we can closely monitor their response to fire. These species would be temporarily adversely affected. During the first three years, only buckwheat that was hand planted by the Service approximately five years ago and poor butterfly production stands will be burned. A Section 7 consultation has been requested.

Proposed burn areas will be thoroughly surveyed for any native bird nests prior to burning. If any nests are found, these areas will not be burned.

On a long-term scale, endangered and other native species will benefit from the removal of exotic species. Also, habitats, including designated critical habitat for the primrose and wallflower, will be enhanced. If burning non-native vegetation proves successful at restoring native and endangered species habitat, further large plots and small experimental plots will be selected for burning. If endangered species respond favorably to burning methods, areas will be burned on a continual, rotational basis. High butterfly producing stands and areas with high density of endangered and native species will not be selected for burning methods of vegetation control. These sensitive areas will continue to be maintained through hand-weeding efforts.

Prescribed burning will entail some economic costs to the Service; however, this is considered the most cost effective method to remove large areas of exotic vegetation. The aesthetic quality (scenery and odor) of the Antioch area will be temporarily altered because of smoke from the fire. However, prescribed burning will greatly mitigate potential future negative impacts resulting from wildfires by reducing a thick fuel layer.

Under Federal ownership, archaeological and historical resources within the Refuge receive protection under Federal laws mandating the management of cultural resources, including, but not limited to, the Archaeological Resources Protection Act; the Archaeological and Historic Preservation Act; the Native American Graves Protection and Repatriation Act; and the National Historic Preservation Act. The Service shall take all necessary steps to comply with section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended for the prescribed burning alternative.

C. Increased Weeding Effort Alternative

In some locations, this alternative would remove non-native vegetation and produce desired results. Endangered species, species of special concern, critical wildlife habitat, species diversity/abundance, and non-game species would all be positively affected by increased manual removal of non-native vegetation.

However, this would not fully solve the problems because manual removal of non-native vegetation would require a long period of time due to the large size of areas that need to be weeded and does not remove the non-native seed bank. During this period, the Antioch Dunes evening primrose could continue to decline and other currently stable species could begin to decline.

The Refuge would require two to three additional full time staff members to assist with non-native vegetation removal. This would require substantial additional funding.

D. Grazing Alternative

Endangered species, species of special concern, critical wildlife habitat, species diversity/abundance, and non-game species may be positively affected by cattle grazing due to the decrease in non-native species. However, this method would not effectively remove the non-native seed bank which may detrimentally affect endangered species. Additionally, if cattle escaped fenced areas they could cause vehicular highway accidents.

It would be difficult to contain cattle in areas devoid of endangered species. If cattle escaped from fenced areas they could severely detrimentally impact endangered and other native species at the Refuge by trampling them or directly consuming them. Since the only source of water for the cattle is the river, this alternative could result in detrimental impacts to the Mason's lilaeopsis, which grows in the littoral zone.

Because of the need to closely manage cattle rotations and the poor quality of forage, it would be difficult to find a rancher willing to meet these stringent requirements for such a small area. Grazing would require funds for the purchase and maintenance of fencing, and potentially for a contract with a cattle operator. The Refuge would require additional full time staff members to manage the grazing program.

E. Heavy Equipment Alternative

Endangered species, species of special concern, critical wildlife habitat, species diversity/abundance, and non-game species would all be positively affected by increased removal of non-native vegetation. Endangered species and species of special concern will be detrimentally affected if they are within a work site. Sites would be selected to minimize impacts to these species. Heavy equipment could not effectively remove the non-native seed bank which may detrimentally affect endangered species.

The Service shall comply with NHPA in the same manner as stated in Alternative B.

Section V: CONSULTATION AND COORDINATION WITH OTHERS

All Refuge prescribed burns would be conducted under the restrictions imposed by the Bay Area Air Quality Management District, the Contra Costa Fire Department, Fish and Wildlife Service Ecological Services Office, and the mandates of a Service Regional Fire Management Officer from preapproved plans by regional and on site biologists, to minimize any potential for negative impacts. The following ecologists were consulted in order to determine the optimum type and timing of the burn in order to eliminate exotic vegetation while enhancing endangered species habitat: Joseph DiTomaso (University of California, Davis), John Rusmore (UC Davis), John Randall (UC Davis), Bruce Pavlik (Mills College) and Martha Hastings (California Department of Parks and Recreation.

A public notice was advertised in two newspapers, the Antioch Ledger and the Contra Costa Times, for three days to notify the public of the availability of the Draft Environmental Assessment and the 30 day comment period.

During a 30 day comment period, the draft Environmental Assessment was sent to the California Clearing House, Pacific Gas & Electric, Santa Fe Railroad, City of Antioch Public Works, Contra Costa Fire Department, Georgia Pacific Gypsum, Current Resident of 1805 Wilbur Ave, and Kemwater.

We received one comment from Georgia Pacific Gypsum regarding concerns of employee smoke exposure. We subsequently worked with them to resolve their concerns.

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San Francisco Bay National Wildlife Refuge

Section VI: CONCLUSION AND RECOMMENDATIONS

Based on the analysis contained in this document, I find that implementation of the proposed action is compatible with the major purposes for which the Refuge was established. Alternative B (prescribed burning) will improve habitat for endangered species and other wildlife in a cost effective manner. Therefore, Alternative B is the preferred alternative. Should the window of opportunity to burn at Antioch be missed in a given year, Alternative E (heavy equipment) is the preferred backup alternative. It would not constitute an action significantly affecting the quality of the human environment and therefore, I recommend that a Finding of No Significant Impact (FONSI) be prepared.

Douglas L Rader
Acting Project Leader

6/4/97
Date

Associate Manager

6/13/97
Date

LITERATURE CITED

Green, J.A. 1995. Three reproductive ecology studies in the narrow endemic Oenothera deltoides ssp. howellii (Onagraceae). M.A. Thesis, Claremont Graduate School.

Bailey, R.G. 1995. Description of the ecoregions of the United States. USDA Forest Service. 108 pp.

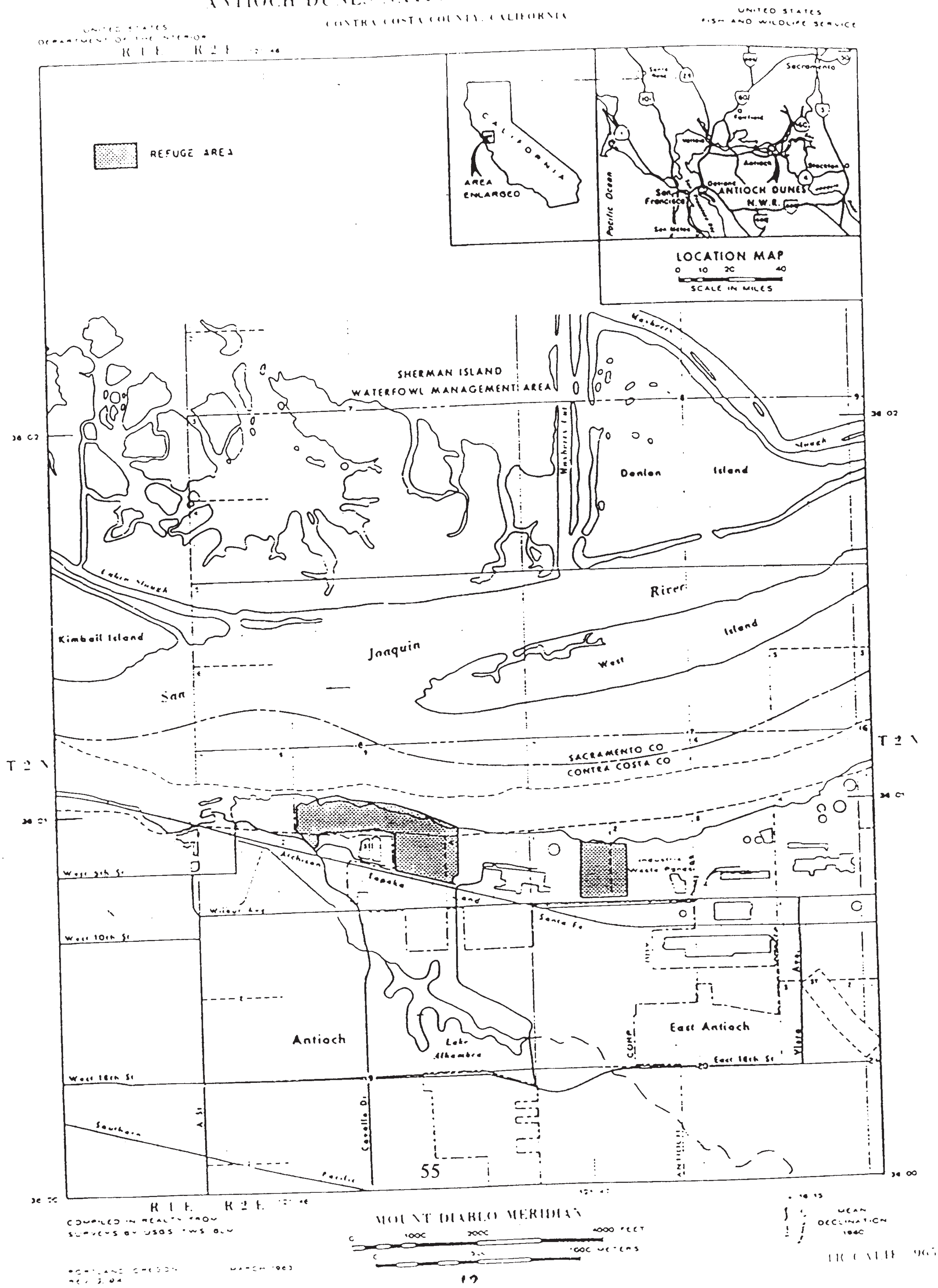
Table 1. Alternative Matrix

Principal Environmental Effects	No Action	Prescribed Burn	Increased Weeding Effort	Grazing	Heavy Equipment Alternative
Threatened and Endangered Species	High	Low	Low	Moderate	Low
Species of Special Concern	High	Low	Low	Moderate	Low
Principal Socioeconomic Effects					
Refuge Operating Costs	None	Low	High	Moderate	Low
Aesthetics (scenery and odor)	None	Low	None	Low	None

Figure 1

ANTIOCH DUNES NATIONAL WILDLIFE REFUGE

CONTRA COSTA COUNTY, CALIFORNIA



Attachment A

ANTIOCH DUNES
April 26, 1992

(NOTE: Nomenclature is according to A California Flora and Supplement by P. Munz and D. Keck, University of California Press, Berkeley, 1973)

Achillea millefolium
Alnus rhombifolia
Amaranthus albus
Ambrosia sp.
Amsinckia intermedia
Artemisia douglasiana
Arundo donax
Asparagus officinalis
Aster chilensis var. lentus
Atriplex patula ssp.hastata
Avena fatua
Baccharis pilularis ssp. consanguinea
Baccharis viminea
Bambusa sp.
Bidens laevis
Brassica geniculata
Bromus diandrus
Bromus mollis
Bromus rubens
Calystegia sepium ssp. limnophila
Carex sitchensis
Centurea solstitialis
Cephalanthus occidentalis var. californicus
Chenopodium sp.
Chrysopsis villosa var. echioides
Clarkia unguiculata
Cortaderia selloana
Croton californicus
Cynodon dactylon
Deschampsia cespitosa ssp. holiciformis
Distichlis spciata var. stolonifera
Elymus triticoides
Epilobium paniculatum
Epilobium sp.
Eriogonum nudum ssp. auriculatum
Erodium botrys
Erodium cicutarium
Eryngium articulatum
Erysimum capitatum var. angustatum
Eschscholzia californica var. crocea
Festuca megalura
Festuca sp.
Filago gallica
Foeniculum vulgare
Galium aparine
Galium sp.
Geranium dissectum
Gilia capitata ssp. staminea
Gnaphalium sp.
Grindelia camporum
Grindelia humilis
Gutierrezia californica
Helenium bigelovii
Heliotropium curassavicum var. oculatum
Heterotheca grandiflora
Hordeum brachyantherum
Hydrocotyle verticillata
Hypochoeris glabra
Hypochoeris radicata
Iris pseudacorus
Juglans hindsii
Juncus balticus
Juncus bufonius
Lactuca serriola
Lasthenia californica
Lathyrus jepsonii ssp. jepsonii
Lavatera cretica
Lepidium latifolium
Lilaeopsis masonii
Lolium multiflorum
Lotus purshianus
Lotus scoparius
Lotus subpinnatus
Ludwigia peploides
Lupinus albifrons
Lupinus bicolor ssp. pipersmithii
Lupinus bicolor ssp. umbellatus
Lupinus micranthus (?)
Lupinus succulentus
Lythrum californicum
Marah fabaceus
Medicago polymorpha
Melilotus albus
Melilotus indicus
Micropus californicus
Nicoiana glauca
Oenanthe sarmentosa
Oenothera deltoides var. howellii

Oenothera hookeri
Oenothera micrantha (? var.)
Panicum capillare var. occidentale
Phalaris canariensis
Phragmites communis var.
berlandieri
Plantago coronopus
Plantago lanceolata
Polygonum sp.
Populus fremontii
Portulaca oleracea
Potentilla edgedii
Prunus amygdalus
Prunus spp.
Psoralea macrostachya
Quercus agrifolia
Raphanus sativus
Robinia pseudo-acacia
Rosa californica
Rubus procerus
Rubus ursinus
Rumex crispus
Salix hindsiana
Salix lasiandra
Salix lasiolepis
Salsola kali var. tenuifolia
Sambucus caerulea
Scirpus californicus
Scirpus cernuus var. californicus
Senecio douglasii
Senecio vulgaris
Silene gallica
Sisybrium altissimum
Sonchus asper
Sonchus oleraceus
Stachys albens
Tillaea erecta
Toxicodendron diversilobum
Tragopogon porrifolius
Typha angustifolia
Typha domingensis
Ulmus parvifolia
Vicia angustifolia
Vicia dasycarpa
Vitis sp.
Xanthium strumarium var. canadense

RARE PLANTS reported to be at ANTIOCH DUNES

The following rare and endangered plants occurred historically at Antioch Dunes. Those with asterisks were seen on the CNPS Surveys done April 26 and May 16, 1992. It is unknown if the others still occur at the Dunes, but should be looked for on future surveys.

Species

*Aster lentus

Cryptantha hooveri

Elocharis parvula

*Erysimum capitatum angustatum

Eschscholzia rhombipetala

*Grindelia humilis

Lasthenia conjugens

*Lathyrus jepsonii ssp. jepsonii

*Lilaopsis masonii

Madia radiata

*Oenethera deltoides ssp. howellii

Particularly common or troublesome weeds.

Avena fatua (Wild Oats)
Brassica sp. (Mustard)
Bromus diandrus (=B. rigidus) (Ripgut Grass)
Centaurea solstitialis (Yellow Star Thistle)
Conyza canadensis (Horseweed)
Cortaderia selloana (Pampas Grass)
Cynodon dactylon (Bermuda Grass)
Erodium cicutarium (Filaree)
Foeniculum vulgare (Fennel)
Lactuca serriola (Prickly Lettuce)
Lepidium latifolium
Marrubium vulgare (Horehound)
Melilotus albus (Sweet Clover)
Melilotus indicus (Sour Clover)
Medicago hispida (Bur Clover)
Poa pratensis (Kentucky Bluegrass)
Rubus discolor (=R. procerus) (Himalaya-Berry)
Raphanus sativus (Wild Radish)
Salsola iberica (Russian Thistle) (=S. kali var. tenuifolia)

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
Region 1, Portland, Oregon

FINDING OF NO SIGNIFICANT IMPACT

Final Environmental Assessment
for
Prescribed Burning of Dune Areas on
Antioch Dunes National Wildlife Refuge
Contra Costa County, California
P.O. Box 524
Newark, California 94560

The U.S. Fish and Wildlife Service has prepared an Environmental Assessment to evaluate the effects associated with prescribed burning on the Antioch Dunes NWR.

The U.S. Fish and Wildlife Service proposes to conduct an on going program of prescribed burning with a back up of heavy equipment use to restore dune habitat for endangered and other native species. Prescribed burns may be utilized throughout parts of the Refuge and will result in a significant decrease in the amount of non-native vegetation as well as an increase in native and endangered species with minimum costs economically and environmentally. The effects of burning on endangered and native species will be closely monitored. If burning proves beneficial, it will be continued on an on going rotational basis. If the window of opportunity to burn is missed in any given year, heavy equipment will be used as a back-up means to remove non-native vegetation as described in Alternative E.

The U.S. Fish and Wildlife Service has analyzed a number of alternatives to the proposal, including the following:

A) No Action
B) Prescribed Burning (Preferred Alternative)
C) Increased Weeding Effort
D) Cattle Grazing
E) Heavy Equipment Use

The preferred alternative was selected over the other alternatives because:

Prescribed burning is the most effective method to remove large amounts of non-native vegetation and the non-native seed bank. Other alternatives evaluated would not be effective in removing the seedbank. It is the most cost effective alternative and has minimal environmental and socioeconomic impacts.

Implementation of the preferred alternative would be expected to result in the following environmental and socioeconomic effects:

Study of the environmental effects of the proposal has shown that the preferred alternative could impact some individual plants of the Antioch dunes evening primrose, Contra Costa wallflower, and the naked stemmed buckwheat (host plant to the Lange's metalmark butterfly). However, the long-term effects will be beneficial to these species because a significant amount of non-native vegetation will be removed which will decrease competition between these species.

The aesthetic quality (scenery and odor) of the Antioch area will be temporarily altered because of smoke from the fire. Escaped fire could threaten endangered species and their habitat, private property, and public safety.

Measures to mitigate and/or minimize adverse effects have been incorporated into the proposal. These measure include:

Measures to mitigate and/or minimize adverse effects have been incorporated into the proposal. These measures include: 1) close coordination with the Service Regional Fire Management Officer, Contra Costa Fire Department, Bay Area Air Quality Management District, and the Service Ecological Services Office; 2) selection of a proper burn prescription and cessation of burn activities when conditions exceed predetermined prescription levels; 3) the utilization of firebreaks (cut line, existing roads) around burn units to minimize any potential for wildfire.

Prescribed burning will greatly mitigate potential future negative impacts resulting from wildfires by reducing a thick fuel layer

The proposal is not expected to have any significant effects on the quality of the human environment because:

The action would have a beneficial effect on endangered and native species and their habitat on a long-term scale. The action would not degrade habitats, water, or air quality, and would not disrupt or conflict with any land use, social, cultural or economic factors.

Public Availability

A public notice was advertised in two newspapers, the Antioch Ledger and the Contra Costa Times, for three days to notify the public of the availability of the Draft Environmental Assessment and the 30 day comment period.

During a 30 day comment period, the draft Environmental Assessment was sent to the California State Clearing House, Pacific Gas & Electric, Santa Fe Rail Road, City of Antioch Public Works, Contra Costa Fire Department, and G.P. Gypsum. Their comments were considered in the formation of the final Environmental Assessment.

Determination

Based on review and evaluation of the information contained in the Environmental Assessment, the U.S. Fish and Wildlife Service has determined that the proposed activity is not a major Federal action which would significantly affect the quality of the human environment within the meaning of Section 102 (2)(c) of the National Environmental Policy Act of 1969. Accordingly, the preparation of an Environmental Impact Statement on the proposed action is not required.

Issued in Portland, Oregon, June 13, 1997

Acting Regional Director JOHN H DOEBEL

6/13/97
Date

United States Department of the Interior

FISH AND WILDLIFE SERVICE, REGION 1
Cultural Resource Team
c/o Tualatin River National Wildlife Refuge
20555 SW Gerda Lane
Sherwood, Oregon 97140
503-625-4377 (fax 503-625-4887)

May 28, 1997

To: Erica Fernandez
Antioch Dunes NWR

From: Anan Raymond
Regional Archaeologist

Subject: Section 106 compliance, Prescribed Burn

We have attached a copy of the cover page(s) of the cultural resource compliance request form(s) that you recently submitted to us. We have reviewed the form(s), applied the Programmatic Agreement, and marked the cover page(s) accordingly.

"Appendix A" applies to a project, you may proceed without further cultural resource consultation.

Thank you for considering cultural resources.

REQUEST FOR CULTURAL RESOURCE COMPLIANCE

Project Name: **Antioch Dunes NWR Prescribed Burn Project**

USFWS Unit: (Office Name and/or Org Code) **Antioch Dunes NWR**

Ecoregion: (By ARD: CSE, IPE, NCE, NCE)

Program: **Refuges**

(Partners, WSECP, Refuges, Hatcheries, Jobs, Chehalis RD, Federal Aid, Private Lands, Realty, Other)

NHPA COMPLIANCE

☑ Cleared under Appendix A Item 2
of the Programmatic Agreement.

☐ 36CFR800.4 to 800.6 applies.

Anan Raymond 5.28.97
Cultural Resources Team Date

Location: (nearest town) Antioch County: Contra Costa State: CA

2N	2E	17, 18	~~Mount Diablo~~ Antioch North
Township(s)	Range(s)	Section(s)	7.5' USGS Quad(s): Name, date

Project acres or linear meters/feet: approximately 12

Date you want to start the project: June 1, 1997

Date of this request: May 1, 1997

USFWS Contact: Erin Fernandez

Phone: (510)792-0222

Address: PO Box 524
Newark, CA 94560

Fax: (510)792-5828

Attach to this form:
- A project (sketch) map showing the Area of Potential Effect with locations of specific ground altering activities *(required)*.
- A photocopy of the USGS quad clearly marking the project area *(required)*.
- A photocopy of an air photo showing the project may be attached *(if available)*.

Directions to project: *(if not obvious)*

The Undertaking: *Describe the proposed project and means to facilitate it (e.g., provide funds to revegetate 1 mile of riparian habitat, restore 250 acres of seasonal wetlands, and construct a 5-acre permanent pond). How is the project designed (e.g., install 2 miles of fence and create approximately 25 feet of 3 foot high check dam)?*

The Service proposes to conduct a prescribed burn and/or use heavy equipment to restore dune habitat for endangered species at Antioch Dunes NWR. Burning and/or mowing/disking/plowing will help to control non-native vegetation that is outcompeting endangered species. The first year, we propose to burn three, approximately three acre sites in addition to 15 small experimental plots. If the acceptable window of opportunity to burn is missed, we will use heavy equipment to control non-native vegetation. Please see the attached draft environmental assessment for further detail.

February 20, 1997

MEMORANDUM

To: Field Supervisor, Ecological Services, Sacramento, CA

From: Refuge Manager, San Francisco Bay NWR Complex S.F., CA

Subject: Review of the Intra-Service Section 7 Evaluation Form for prescribed burning at Antioch Dunes NWR

We are proposing to conduct prescribed burning and mowing/disking/plowing at Antioch Dunes NWR to control non-native vegetation and enhance endangered species habitat. All pertinent information related to endangered species is contained in this document. The Final Prescribed Fire Plan, which addresses the technical aspects and human safety issues of prescribed burning will follow later.

If you have any questions regarding this activity or its impacts, please contact Erin Fernández of my staff at (510) 792-0222.

Margaret T. Kolar

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services

Sacramento Field Office

3310 El Camino Avenue, Suite 130

Sacramento, California 95821-6340

REPLY REFER T0: 1-1-97-F-0075

June 11, 1997

Memorandum

To: Refuge Complex Manager, San Francisco Bay National Wildlife Refuge Complex, U.S. Fish and Wildlife Service, Newark, California

From: Field Supervisor, U.' S. Fish and Wildlife Service, Ecological Services, Sacramento Field office, Sacramento, California

Subject: Section 7 Consultation on Prescribed Burning and Mowing, Disking, or Plowing at the Antioch Dunes National Wildlife Refuge, Antioch, Contra Costa County, California

This memorandum is in response to your request for formal consultation on a plan to conduct prescribed burns and mechanical control of non-native vegetation at the Antioch Dunes National Wildlife Refuge (Refuge) of the San Francisco Bay National Wildlife Refuge Complex. Your memorandum, dated March 5, 1997, was received in this office on March 7, 1997. This document represents the U. S. Fish and Wildlife Service's (Service) biological opinion on the effects of the proposed action on the Lange's metalmark butterfly *(Apodemia mormo langei),* the Contra Costa wallflower *(Erysimum capitatum* var. *angrustatum) , and* the Antioch Dunes evening primrose *(Oenothera deltoides ssp. howellii) , in* accordance with section 7 of the Endangered Species Act of 1973, as amended ("Act"; 16 U.S.C. 1531 et seq.) . For brevity below, the word "butterfly" is sometimes omitted from the common name of the butterfly, as is common practice.

This consultation is based on information from the Intra-Service Section 7 Evaluation Form, dated February 20, 1997, the Prescribed Fire Plan, (undated, received April 4, 1997), discussions between Erin Fernandez of the Refuge and David Wright, Peter Baye, Nancy Kang, and Kirsten Tarp of my staff, site visits, Service files, and other sources of information. A complete administrative record of this consultation is on file in this office.

BIOLOGICAL OPINION

Description of the Proposed Action

The Service proposes to burn, and mow, disk, or plow, at the Antioch Dunes National Wildlife Refuge (part of the San Francisco Bay National Wildlife Refuge Complex) , to control non-native plant species and enhance habitat for

three endangered species: Antioch Dunes evening-primrose, Contra Costa wallflower, and Lange's metalmark butterfly. The proposed actions would take place on both the Stamm and Sardis units of the Refuge.

The 55-acre Refuge was established to protect a unique riverine dune ecosystem, which in addition to adjacent Pacific Gas and Electric Company (PG&E) land, supports the last natural populations of the Contra Costa wallflower and Lange's metalmark. only a few small populations of Antioch Dunes evening-primrose occur outside of the Refuge. Historically, many factors have contributed to the decline of these species, including human development and sand mining of the dunes. Currently, however, the primary threat to these species is the encroachment of non-native vegetation such as ripgut brome grass *(Bromus diandrus)* and yellow star-thistle *(Centaurea solstitialis)* Refuge staff actively manage the resident endangered species by conducting annual population surveys and restoring habitat. Management tools include the Exotic Vegetation Management Program, which currently includes hand pulling and herbicide treatment of non-natives. Despite management efforts, non-native plant species continue to out-compete native species, such as the endangered primrose.

In order to restore endangered and native species habitat, the Refuge proposes to improve and extend its exotic vegetation management activities. After consulting with ecologists, including Joseph DiTomaso (University of California, Davis) , John Rusmore (UC Davis) , John Randall (UC Davis) , Bruce Pavlik (Mills College) and Martha Hastings (California Department of Parks and Recreation), prescribed burning and mowing/disking/plowing were identified as techniques for restoring habitat at the Refuge and creating more suitable habitat for endangered and native species, which are dependent on the historic open, sand dune environment. Burning and mowing /disking/p lowing would remove non-native vegetation, and may subsequently decrease competition between endangered and exotic species. Burning was selected as the preferred method of non-native vegetation removal because it reduces the non-native seed bank at a faster rate than mechanical methods. However, if burning were not conducted during the acceptable burn window in any given year, the Refuge would use mowing, disking, or plowing methods to control non-native . vegetation. This would remove the non-native vegetation and prevent it from adding further to the non-native seed bank-in that year. Mowing/disking/ plowing would be conducted in the same locations and monitored in the same way. as burning. The proposed work would assess whether these weed-control techniques are an effective way to stabilize and increase populations of endangered species.

Selected dune sites of manageable size would be burned under predetermined conditions, every year or every other year, in order to remove non-native vegetation until the non-native seed bank is exhausted. Burning would then be conducted on an as-needed basis. During the first year, the Refuge proposes to burn three sites on the Refuge that are dominated by non-native vegetation, have very few natives, and few individuals of endangered species or their host plants. Refuge staff would establish non-burned control plots similar in vegetative composition to the burn areas. The Refuge would monitor both control and non-control areas for species richness and percent cover before

and after the burn. Data from before and after the burn would be analyzed, and control areas would be compared to burned areas in order to determine the response of non-native vegetation to fire. The Refuge would plant native and endangered species in these areas after the non-native seed bank has been substantially diminished, which may take up to three years of burning. If this method proves successful, further areas would be burned on a rotational basis and subsequently replanted with native and endangered species.

The three areas proposed for burning are the "triangle hard pan" (3 acres) and "old vineyard" (5 acres) areas of the Stamm Unit (Figure 1), and the "south plateau" (4.25 acres) of the Sardis Unit (Figure 2). Dominant plants of these areas include non-native annual grasses, yellow star-thistle, Russian thistle (*Salsola tragus*) , and yellow bush lupine (*Lupinus arboreus*) , a native species that can become excessively abundant and reduce diversity of rare or other native plants. Burn objectives would be to blacken 80-100% of the target areas, consuming 80-100% of standing vegetation and litter.

Great care would be -taken to ensure that fire does not escape the treatment areas. Cut fire lines and existing roads would be used to prevent escaped burns. The Refuge would select and adhere to a proper fire prescription, and would coordinate fully with the Bay Area Air Quality Management District, the Contra Costa Fire Department, and the Service's Regional Fire Management officer, which would limit the threat of fire escape.

The Refuge also proposes to burn 15 small experimental plots (7 square m eters each) containing primrose and buckwheat, in order to test the response of primrose and buckwheat to fire. This would be done through the use of a burn box in which a small fire hot enough to scorch the existing vegetation can be contained. Ten of the plots would have one to two primrose, a few natives and many non-natives. Five of the plots would contain buckwheat in order to test the response of buckwheat to fire. Refuge staff would establish-15 non-burned control plots similar in vegetative composition to the burn areas and monitor these areas for species richness and percent cover before and after the burn. Data from before and after the burn would be analyzed, and control areas would be compared to burned areas in order to determine the response of native and non-native vegetation to fire.

The Refuge would monitor prescribed burn plots by recording environmental. factors and locating sites with a Global Positioning System. Variables monitored would include native and non-native species richness and percent cover before and after the burn, to compare control areas to burned areas, as well as to track annual progress of the sites. Refuge staff would use a combination of line transects and fixed plots to monitor vegetation. Vegetation would be monitored both in the middle of burn plots and toward the edges, to detect differences in the amount of non-native vegetation resprouting from the residual seed source versus the amount encroaching on the burn area from the periphery.

Burning would be ideally conducted in May or June in order to achieve two primary objectives: kill the existing non-native plants and their seed heads, and exhaust the non-native. seed bank. In May and June, the grasses are dry

enough to carry a hot fire, which is required to destroy the non-native seed bed and the seed heads. Yellow star-thistle should be under 5% flower at this time. This is the optimum time to burn it because the fire would destroy the thistle before it produces seed, yet it will have expended enough energy that it should not regrow in that season. Burning might be done at a less optimal time ranging from spring through fall, depending on allowable burn days.

All Refuge prescribed burns would be conducted under the restrictions imposed by the Bay Area Air Quality Management District, the Contra Costa Fire Department, and the mandates of a Service Regional Fire Management officer, from pre-approved plans by regional and on-site biologists, to minimize any potential for negative impacts.

Status of the Species

The ranges and total populations of the species considered in this biological opinion have been lowered drastically by human activities. Sand mining, urban development, and invasion of non-native plant species have reduced the size and functionality of the dune ecosystem at Antioch Dunes. The Antioch Dunes probably once totaled roughly 200 acres (USFWS 1984), and adjacent sandy, nondune areas may have provided additional habitat. Now largely restricted to the Refuge and adjacent PG&E parcels, the dunes have been reduced to about 70 acres in extent. Even within the Refuge, the dunes have in the past been altered by sand mining and other human uses, and stabilized by plant growth. Stabilization can be detrimental to species which are adapted to the shifting sands typical of dunes. sand mining and urban development have resulted in habitat loss and fragmentation, and sand mining has caused gross loss of the soil substrate necessary for the development of the habitat. The former dune area has little topographic relief compared with historic conditions.

Introduction of invasive non-native plants, accelerated by grazing practices and sometimes by planting, has greatly altered California ecosystems and resulted in the widespread replacement of native plants,, especially in grasslands. Many of these invasive plants, some of which are present in the action area (for example, yellow star-thistle, ripgut brome, and Russian thistle), are capable of choking out or shading out the listed plant species and butterfly host plants.

Lange's metalmark butterfly

On June 1, 1976, Lange's metalmark was listed as an endangered species (41 FR 22044-22141). Critical habitat was proposed in 1977 (42 FR 7973) but never designated.

Lange's metalmark butterfly *(Apodemia mormo langei*)was discovered and named in 1938 as a result of entomological studies on the Antioch Dunes. It is a distinctive subspecies of the more widely distributed species *Apodemia mormo*, found in Mexico and the western United States (Opler & Powell *1962)* . Lange’s metalmark is restricted to the Antioch Dunes, which are now themselves largely restricted to the Refuge. The resent range of Lange's metalmark has been

reduced to about 70 acres, approximately corresponding to the Refuge and nearby areas.

Lange's metalmark is a fragile, medium-sized butterfly; brightly colored in orange, black, and brown with white spots. Unlike some butterfly species, Lange's metalmark has only one generation each year. All of the life stages of the butterfly are found in close proximity to the sole larval food plant, a subspecies of naked buckwheat (*Eriogonum nudum ssp. auriculatum*) . The eggs are laid on the withered buckwheat during the adult flight season, which occurs from the latter half of July through September. The eggs hatch after the winter rains begin; and the larvae crawl to the base of the plant where they overwinter and feed, if new foliage is available (Arnold 1980) . Pupation takes place in early to mid-summer in the litter at the base of the buckwheat, with the adults emerging in late summer (USFWS 1984) . The adult butterflies prefer naked buckwheat flowers as nectar sources and as perches, but use other flowering plants as well. Lange's metalmarks also use silver bush lupine, *Lupinus albifrons*, for cover during mating. Both sexes are capable of flying from a few to more than a hundred meters between perches (USFWS 1984). Individual adults live approximately one week; and the fecundity of wild females is low.

Arnold's annual report of January 15, 1986, to the Refuge indicated a slight increase in the population of the butterfly since 1977. From 1986 to 1991, the population increased exponentially, from approximately 160 butterflies counted in 1986 to nearly 2000 butterflies counted in 1991. In 1992, the population fell to about 1/3 of the previous year's peak level, but by 1996 had recovered to in excess of 2000 butterflies counted on the Refuge and the adjacent PG&E parcels. In the past, about 2/3 of adult individuals were counted on the western or Stamm Unit of the Refuge, and about- 1/3 on the eastern or Sardis Unit. In 1996, however, counts in the Stamm and Sardis units were more equal (USFWS 1996).

Lange's metalmark counts are not 'available for the large areas proposed for burning in 1997, the Stamm "old vineyard" and "triangle hard pan" (Figure 1) and the Sardis "south plateau" (Figure 2). These areas do not support any significant number of host buckwheat plants, and experience suggests that adult metalmark densities there are very low. A few scattered buckwheat plants (less than 10) occur in the old vineyard, among the grasses and star thistle, and no buckwheat are found in the other two burn areas (Erin Fernandez, personal communication, June 9, 1997). A few metalmark adults may sometimes be present in the large proposed burn areas; these individuals are probably resting or moving through. No larvae or pupae are expected to be in these areas because of the lack of host plants.

Five of the small "burn box" plots would contain buckwheat plants, in order to test the response of the buckwheat to prescribed burning. These experimental plots may be expected to burn a total of 0.0086 acres containing a total of perhaps 75 to 100 buckwheat plants. A few Lange's metalmark larvae or pupae may be exposed to fire by these experiments. Their likelihood of surviving is unknown, and would depend on the depth of soil covering them, if any, and the heat and duration of the fire.

Invasive non-native plants such as ripgut brome and yellow star-thistle threaten the butterfly by competing with larval and adult food plants, inhibiting establishment of buckwheat and other native plant seedlings, and perhaps by adversely changing the microclimate experienced by the larvae at the base of their buckwheat hosts (USFWS 1984) . Fire, on the other hand, may have mixed effects on the butterfly. A "wildfire" in 1976 near the PG&E east tower destroyed most of a buckwheat stand and the butterfly larvae present. Since that time the buckwheat has recovered and metalmarks have been observed in the area (USFWS 1984). Prescribed burning can be a useful tool for controlling invasive weeds, especially if carefully timed to cause maximum impact to the invader and lesser impact to native plants. Follow-up after the burn is essential to eliminate germinating invasive plants and to exhaust the seed bank of invasive species.

Antioch Dunes evening-primrose

The Antioch Dunes evening-primrose was listed as endangered with critical habitat on April 26, 1978 (43 FR 17916) . Township and range description for critical habitat of the species is T2N, R2E, SW 1/4 of Section 17, and E 2/3 of S 1/3 of Section 18 (MDM), Contra Costa County, which includes the Refuge.

The Antioch Dunes evening-primrose is a short-lived perennial herb to subshrub with a fleshy taproot, forming large tufts with coarse drooping stems 4-8 dm long, much branched; leaves incised to sharply pinnatifid, lance-like in outline, 3-12 cm long, 1-3 cm wide, grayish with numerous short and fewer longer hairs; sepals 2-3 cm long, densely more or less glandular-pubescent and few to many fine wavy hairs 1-3 mm long, prominent free sepal tips in bud 1-3 mm long; petals 2-3 cm long; capsule 3-4 mm thick at base.

The historic range of the species is presumably limited to the sandy soil type (Oakley or Delhi sand) found at the Antioch Dunes and over. a substantial portion of eastern Contra Costa County. The evening -primrose now occurs in three general localities, all near the confluence of -the Sacramento and San Joaquin rivers. The only verified natural. stand of the species is within the sand dunes near Antioch in Contra Costa county. One recently discovered erratic population occurs at an abandoned sand quarry south of Cowell Road intersection at Ygnacio Road in Contra Costa. County. This anomalous population consists of a mixture of *Oenothera deltoides* sspp. *howellii* and *cognata* and apparent intermediates, possibly hybrids. This population is of recent and uncertain (possibly anthropogenic) origin.

The Service placed most of the natural Antioch dune habitat within its National Wildlife Refuge System with the purchase of two parcels in 1980. PG&E, Domtar Gypsum, and a local citizen own the remaining habitat harboring the Antioch Dunes evening-primrose.

The subspecies also has been introduced into at least three different localities by East Bay Regional Parks Botanic Garden personnel since 1970. James Roof, late Director Emeritus of the Garden, suggested a solution to the mining activities that were quarrying the remaining dunes prior to their acquisition by the Service (Roof 1969) . He believed the "dispersal to remote

dunes areas" might ensure the survival of the evening - primrose. As a result, Walter Knight, former staff member of the garden, sowed seed on "low dunes" at Brannan Island State Recreation Area in Sacramento County (Anonymous 1971). In addition, Roof introduced the subspecies onto the coastal dunes at Point Reyes National Seashore in Marin County (Anonymous 1971) Roof (1969) had discussed these two introduction sites as suitable sites for introduction of Oenothera seed. Although the experiment failed at Point Reyes, the subspecies became naturalized at Brannan Island and thrives there today. Knight also started two small colonies on Brown's Island in Contra Costa County in 1978. He believed the plant was doing well on the island; however, Alice Howard reported in 1982 that the evening-primrose appeared to be declining (USFWS 1984) . The species is also cultivated in natural dune soil at Strybing Arboretum in Golden Gate Park, San Francisco, where it has a weedy, invasive habit.

Primrose numbers on the Refuge have decreased substantially in recent years. There were 5,800 mature primrose in 1984, 1468 in 1995, 963 in 1996, and only 455 mature primrose in 1997, a decrease of 92% in just over a decade (Erin Fernandez, pers. comm., June 9, 1997) . The primrose appears particularly vulnerable to exotic vegetation encroachment. Green (1995) found no primrose seedlings around mature primrose that were surrounded by weed species, yet seedlings were found around 40% of mature primrose that were not surrounded by weed species.

Anecdotal evidence suggests that the Antioch Dunes evening-primrose may benefit from certain forms of disturbance. Primrose were seeded successfully in an area accidentally burned in 1985, resulting in record populations in the 198G and 1987 censuses (USFWS 1987). The species is also reported to colonize disked areas (USFWS 1984).

Contra Costa wallflower

The Contra Costa wallflower was listed as endangered with critical habitat on April 26, 1978 (43 FR 17916). The designated critical habitat area is the same as that of the Antioch Dunes evening-primrose.

The wallflower is an erect, robust, coarse- stemmed, monocarpic perennial ("biennial") herb with simple or few branched stems 2-3 m tall; woody base (caudex) much- elongated and nearly 5 mm in diameter; basal leaves elongated lance-like to linear, tapering to a petiole at base and acute at apex; lowermost leaves 4-16 cm long 0.5-1 cm wide with minutely-toothed margins; flowers in unbranched stalks bearing flowers laterally from a lengthening tip; petals 4, yellow, 1.5-2 cm long; stamens 6 (4 long and 2 short)'; seed pods (siliques) 4-angled, stiffly ascending, slender, 5-10 cm long and usually under 2 mm broad.

Rossbach (1958) believed that the Contra Costa wallflower was "restricted to more or less consolidated dunes of fine sand and some clay" near Antioch, Contra Costa County. He said the habitat was covered "with sparse herbs and shrubs, or less often with pasture grasses, herbs, and scattered" live oaks (*Quercus agrifolia*). Johnson (1978) suggested that reproducing individuals

occurred principally on uneven sites (e.g., river bluff faces and edges). Pavlik and Manning (1993) concluded that optimal wallflower habitat consisted of steep, north-facing dune slopes with sparse vegetation cover and no exotic weeds. This is consistent with the original findings of the species, recovery plan and critical habitat designation,. which identified the essential role of relatively bare, mobile dune habitat for its regeneration. In this respect, it is ecologically similar to Antioch Dunes evening-primrose, which requires natural disturbances, sparse vegetation, and some dune mobility.

According to records in the California Natural Diversity Data Base (CDFG 1997), 234 wallflower plants were observed within the Refuge in 1978, 818 in 1984, 786 in 1985, and 2275 in 1991. This dramatic population increase has perhaps peaked in recent years: 10,870 in 1994, 7794 in 1995, and 11,337 in 199G (these last three censuses include the PG&E parcels) . In the 1997 census, 10,350 plants were counted, including 2239 on PG&E lands, primarily the east parcel (Erin Fernandez, pers. comm., June 9, 1997) . In all areas, the species is concentrated on north- and east-facing bluffs and around tower structures (CDFG 1997, PG&E 1996).

In the 1997 count, 79 Contra Costa wallflower plants were found in the Sardis south plateau burn area, representing somewhat less than it of the total population. No wallflowers occur in the other two proposed large burn areas, and none or very few would be expected in the burn boxes. Like the evening primrose, the wallflower was also reported to respond favorably following the accidental fire in 1985 (USFWS 1987).

Species of Concern

Several species of concern to the Service may occur or once occurred on the site, including Middlekauf shieldback katydid (*Idiostatus. middlekaufi*) Antioch cophuran robberfly (*Cophura hurdi*), Antioch efferian robberfly (*Efferia antiochi*), Hurd's metapogon robberfly (*Metapogon huidi*), Antioch mutillid wasp (*Myrmosula pacifica* [=Myrmosa p.1), Antioch sphecid wasp: (*Philanthus nasalis*), red-headed sphecid wasp (*Eucerceris ruficeps*), Antioch andrenid bee (*Perdita scitula antiochensis*), yellow-banded andrenid bee (*Perdita hirticeps luteocincta*), Antioch anthicid beetle (*Anthicus antiochensis*), Sacramento anthicid beetle (*Anthicus sacramento*), and the Ciervo aegialian scarab beetle (*Aegialia concinna*). Many of these species. are known only from the Antioch Dunes; many have not been seen for years. Virtually nothing is known about the population sites, life histories or habitat requirements of these species, other than that they may prefer sandy soils. It is reasonable to assume that most depend on the native dune ecosystem for their survival and reproduction, and that limited use of fire or other vegetation management activities may pose some small risk to portions of their populations if still present, especial ly if individuals are found within areas dominated by the non-native weeds that are targeted for management. Adverse impacts to species of concern are likely to be temporary, and the net effect of these experiments on restoring the native ecosystem is likely to be beneficial.

Environmental Baseline

Under the provisions of section 7(a)(2) of the Act, when considering the effects of the proposed action on listed species, the Service is required to consider the environmental baseline. The environmental baseline takes into account the past and present effects of human activities on the species in the action area. The action area is defined as including all areas to be affected directly or indirectly by the action, and not merely the immediate area involved in the action (50 CFR §402.02).

The action area of the proposed project is nearly the same as the range of the listed species considered in this opinion; so the environmental baseline (status of the species in the action area) is essentially the same as the overall status of the species, presented above.

Effects of the Proposed Action

If they are present in the treatment area, prescribed burning is likely to kill Lange's metalmark larvae and pupae and Contra Costa wallflower plants. Individuals of the Antioch Dunes evening-primrose and naked stemmed buckwheat (the metalmark host) may be killed, or in some cases their underground roots might survive and re-sprout. Some seeds of all three plant species would be likely to survive and benefit from the long-term effects of the fire. Prescribed burning could seriously threaten any of the endangered species or species of concern if the fire escaped a treatment area and burned a significant portion of the area it inhabited.

For the first three years, the large burn areas within the Refuge would be carefully selected to avoid endangered species. However, a few evening primrose, wallflower, and buckwheat plants could be within a burn area, and likely adversely affected. The Lange's metalmark butterfly could be detrimentally affected by burning its host plant, naked stemmed buckwheat. The small burn plots would be selected to contain a few endangered plant species so that Refuge staff can closely monitor their response to fire. These individuals would be adversely affected. The populations of these species would not be adversely affected in the long term by the burn box experiment, since it would be conducted in weed-dominated areas that would inhibit long-term regeneration of endangered species if left alone. For the first three years, only buckwheat planted by Refuge staff approximately five years ago, and which are poor butterfly production stands, would be burned.

Heavy smoke deposition on buckwheat stands downwind of the prescribed burns could inhibit the respiration and feeding of any Lange's metalmark larvae that have not yet pupated. The risk of serious impacts of smoke deposition appears to be small. If burning occurred during the flight season of the metalmark (July-September), adult butterflies might suffer respiratory effects, or might attempt to flee the area and be lost to the inhospitable environment surrounding the Refuge.

The net effect of repeated controlled burns on evening-primrose, wallflower, and metalmark populations would probably be beneficial, since it would probably suppress exotic weeds that inhibit growth of the endangered plants

and the host plant of the butterfly. However, it is also possible that the burn may stimulate weedy plant regrowth. Some species, such as yellow bush lupine (*Lupinus arboreus*) develop luxuriant vegetative growth from re-sprouts after burns, and also exhibit flushes of seed germination. After recent fires in the dunes at Limantour Spit in Point Reyes National Seashore, abundance of yellow bush lupine appeared to increase substantially. Although fire may reduce the density of weed seeds, residual weed seed shallowly buried below the soil surface may still be sufficient for robust recolonization of burned areas. Nutrients released by burns could also stimulate regrowth of weeds. This is particularly a risk for the first post-burn growing season.

On a long-term scale, endangered and other native species would benefit from the removal of exotic species. Also, habitats, including designated critical habitat for the primrose and wallflower, would be enhanced. If burning and mowing/disking/plowing methods of non-native vegetation control prove successful at restoring native and endangered species habitat, further large plots and smaller experimental plots would be selected for burning. if endangered species respond favorably to burning and mowing/disking/plowing methods, selected areas would be burned periodically. High butterfly producing stands and areas with *high density* of endangered and native species would not be selected for burning or mowing methods of vegetation control. These sensitive areas would continue to be maintained through hand-weeding efforts.

Species of special concern that may be affected include: California legless lizard *(Aniella pulchra pulchra), M*iddlekauf katydid *(Idiostatus middlekauffi),* Antioch Robber *Fly (Cophura hurdi),* Antioch vespid wasp *(Microdynarud arenicolus),* Antioch tiphiid wasp *(Myrmusula pacifica)*, Antioch sphecid *wasp (Philanthus nasalis),* yellow-banded andrenid wasp *(Perdita hirticeps luteocincta*), Antioch, andrenid bee *(Perdita- scitula antiochensis*) and all native bird species. The Refuge is currently monitoring the area to determine if these species are present. If any legless lizards were found in a proposed burn site, fire breaks would be cut around the area in order to protect the lizards. The Refuge has not recently found any of the above insect species, and some may be extinct. Proposed burn areas would be thoroughly surveyed for any native bird nests prior to burning. It any nests are found, these areas would not be burned.

Mowing/disking/plowing methods of non-native vegetation control pose less risk than prescribed burning because there is little danger of mowing outside of plot boundaries. Except for the absence of smoke-induced impacts, other effects of mechanical methods to listed and other native species would be similar to the impacts induced by burning.

Cumulative Effects

Cumulative effects are those impacts of future non-Federal (State, local government, and private) actions on endangered and threatened species or critical habitat that are reasonably certain to occur within the action area. Future Federal actions will be subject to the consultation requirements of

section 7 of the Act and, therefore, are not considered cumulative to the proposed action.

The project area is limited to the Refuge. Since the Refuge is federally owned, all future proposed actions there will be subject to section 7 consultation and are not cumulative to the current action. Some individuals or populations of Lange's metalmark, Antioch Dunes evening-primrose, and Contra Costa wallflower occur outside the Refuge, on the adjacent PG&E lands and elsewhere. The Service is aware of a proposed cooperative agreement between the Refuge and PG&E that would address management of the PG&E lands. Because of the Refuge's involvement, this agreement would also be subject to Section 7 consultation.

Cumulative impacts to Antioch Dunes evening primrose are likely to occur as a result of the Summit Project development in Contra Costa County, where the outlier population of mixed probable hybrid and typical evening-primrose occurs in a former sand quarry. The probable hybrid status of the population, however, limits its long-term conservation significance for the species. Other non-Federal actions that the Service is currently unaware of could adversely affect the three listed species considered here. However, the proposed vegetation management is anticipated to have a net benefit for the endangered species, which would help offset external cumulative effects.

Conclusion

After reviewing the current status of the Lange's metalmark butterfly, the Antioch Dunes evening primrose, and the Contra Costa wallflower, the environmental baseline, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed vegetation management plan, using prescribed burns and other methods, is not likely to jeopardize the continued existence of the Lange's metalmark butterfly, the Antioch Dunes evening primrose, or the Contra Costa wallflower. No statutory critical habitat has been designated for the Lange's metalmark, therefore, none will be affected. The Service anticipates that the critical habitat of the evening primrose and the wallflower will be enhanced by the proposed action.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act prohibits take (i.e. to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. Harass is defined as an intentional or negligent act or omission 'which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns such as breeding, feeding, or sheltering. Incidental take is any take of listed animal species which results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or the applicant. Under the

terms of section 7(b)(4) and section 7(o)(2) taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be implemented by the Refuge in order for the exemption in section 7(o)(2) to apply. The Refuge has a continuing duty to regulate the activity covered by this incidental take statement. If the Refuge: (1) fails to adhere to the terms and conditions of the incidental take statement, or require any applicant to adhere to these terms and conditions through enforceable terms that are added to the permit or and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

The Service anticipates that Lange's metalmark butterflies may be taken as a result of the proposed action, and that this take will be difficult to quantify due to the difficulty of finding dead or impaired specimens, whether as eggs, larvae, pupae, or adults. However, take of these butterflies can be defined by the loss of larval and nectar plant habitat, disturbance, and delay in the recovery of burned habitat. Implementation of the burn box experiment will result in take of 0.0086 acres of Lange's metalmark habitat and all associated life history stages of the butterfly (5 boxes containing buckwheat, times 7 square meters each). In addition, occasional, scattered buckwheat host plants may be killed in the large burn areas. These isolated plants are not anticipated to support the listed metalmark.

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the listed species considered in this opinion, nor in destruction or adverse modification of critical habitat.

Reasonable and Prudent Measures

The Service believes that the following reasonable and prudent measure is necessary and appropriate to minimize the impacts of the project on Lange's metalmark butterfly, the Antioch Dunes evening primrose, the Contra Costa wallflower, and species of concern that potentially occur within the action area:

> Minimize and mitigate the negative short- and long-term impacts of prescribed burning on Lange's metalmark butterfly, the Antioch Dunes evening primrose, the Contra Costa wallflower, and the Antioch Dunes ecosystem.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act,. the Refuge must comply with the following terms and conditions, which implement the reasonable and prudent measure above. These terms and conditions are nondiscretionary.

1. The Refuge shall not burn during the flight season of the Lange's metalmark butterfly, mid-July to the end of September.

2. As a contingency measure in the event of excessive stimulation of weedy vegetation in burn treatment areas (either non-native weeds or native invasive species such as yellow bush lupine) , the Refuge shall apply, in combination with burning, 'if appropriate, other appropriate vegetation suppression methods (e.g., herbicide(s), deep regrading, disking, manual weed removal).

The reasonable and prudent measure, with its implementing terms and conditions, is designed to minimize incidental take that might otherwise result from the proposed action. With implementation of these measures, the Service believes that, annually, no more than 0.0086 acres of Lange's metalmark habitat and associated life history stages of the butterfly, and scattered unoccupied host plants will be incidentally taken. If, during the course of the action, this minimized level of incidental take is exceeded, such incidental take would represent new information requiring review of the reasonable and prudent measures provided. . The Refuge must then immediately investigate the causes of the taking and review the need for possible modification of the reasonable and prudent measures.

Reporting Requirements

Project personnel shall be required to report immediately any information about take or suspected take of Lange's metalmark. The Refuge shall record the date, time, and precise location of the incident/ specimen, and any other pertinent information. The reporting contact shall be the Office of Ecological Services, Endangered Species Division at 916-979-2752. Any Lange's metalmark butterflies found injured shall-be. turned in to the California Department of Fish and Game. The agency contact is the Supervisor of Environmental, Services of the California Department of Fish and Game (916-322-5574) . Any Lange's metalmark butterflies found dead shall be deposited in the insect collection of the California Academy of Sciences in San Francisco (415-750-7239).

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The recommendations provided here relate only to the proposed action and do not necessarily represent complete fulfillment of the agency's 7(a)(1) responsibilities. The Service recommends the following actions to protect federally listed species and their habitats during the control program:

1. To increase the utility of data obtained from burn boxes containing evening-primrose and wallflower individuals, use demographic methods to monitor rare plant species (censuses of marked individuals, measurement of reproductive output) rather than estimates of plant cover. Supplement measurements of non-native species richness with measures of relative abundance or cover of dominant non-native species.

2. Add sub-treatments to the experimental burn treatments to assess the effects of mechanical disturbance (disking, plowing) before and during spring regeneration of dominant weeds.

3. Investigate the feasibility of grading portions of the Refuge to increase topographic relief, dune height, and the, frequency of steep north/northwest facing erosional slopes with sparse vegetation cover (blowouts, erosional scarps). This structural modification could be combined with experimental re-introduction of evening-primrose and wallflower at the updrift (windward) ends of blowout axes. Steepened dunes should be encouraged to remain erosional and mobile.

4. Provide copies of annual reports to the Endangered Species Division of the Service's Sacramento Field office.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the proposed plan to conduct prescribed burns and other vegetation management actions at the Refuge. As provided in 50 CFR § 402.16, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals that the action may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the project is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Refuge Complex Manager

If you have any questions regarding this opinion, please contact David Wright at (916) 979-2739, ext. 442, regarding butterflies, or Peter Baye at (707) 643-9116 regarding plants.

Sincerely,

for Wayne S. White
Field Supervisor

cc: AES, Portland, OR

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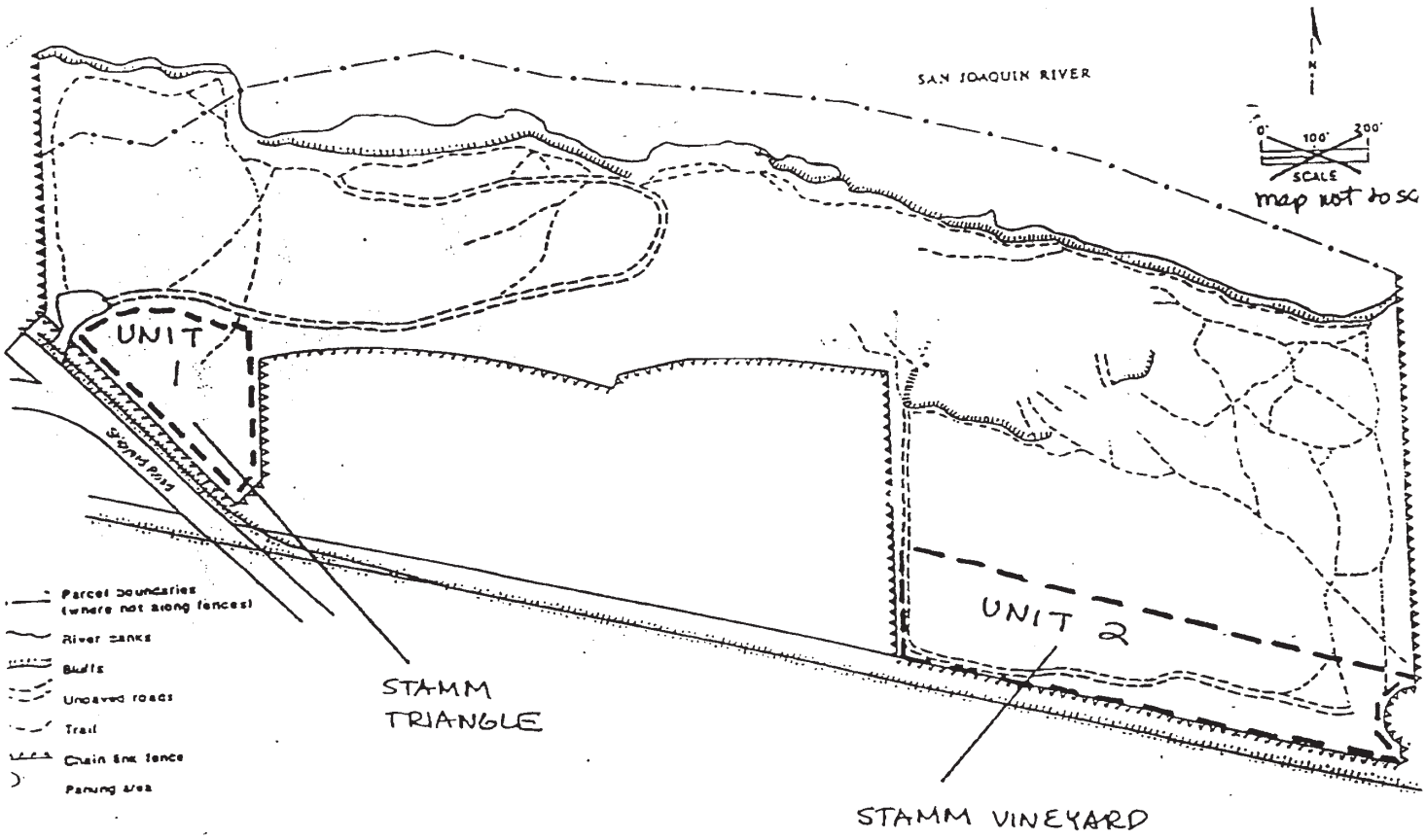
FIGURE 1



Antioch Dunes USFWS Stamm Parcel

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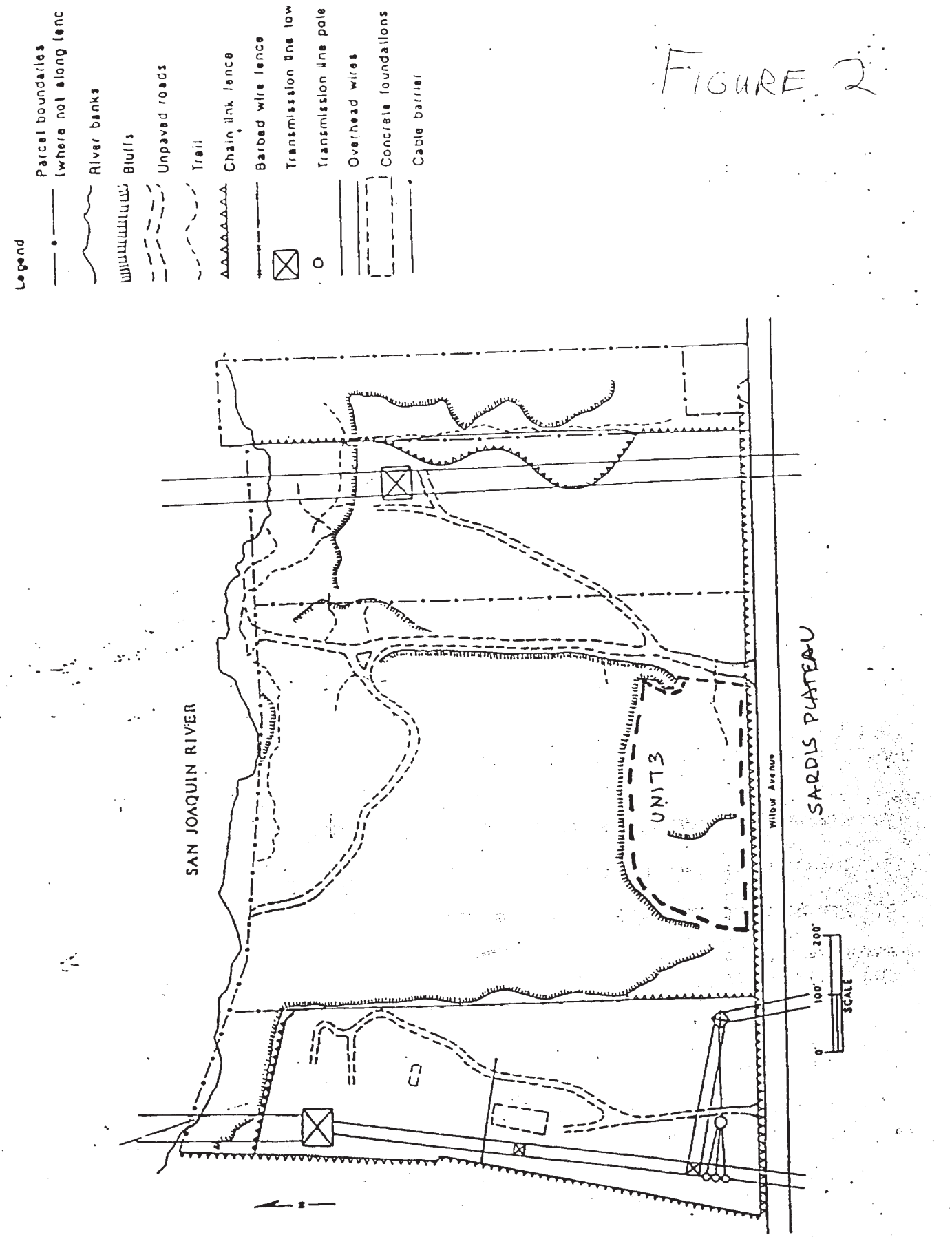
FIGURE 2


Legend
Parcel boundaries
(where not along fenc
River banks
Bluffs
Unpaved roads
Trail
Chain link fence
Barbed wire fence
Transmission line low
Transmission line pole
Overhead wires
Concrete foundations
Cable barrier
SAN JOAQUIN RIVER
UNIT 3
Willow Avenue
SARDIS PLATEAU
200'
100'
0'
SCALE