UNITED STATES DEPARTMENT OF THE INT[illegible]RIOR
FISH AND WILDLIFE SERVICE

DRAFT FISH AND WILDLIFE COORDINATION[illegible]ACT RE[illegible]
FOR THE

HAMILTON ARMY A[illegible]
WETLAND RESTORA[illegible]ON PR[illegible]

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PREPARED FOR:
U.[illegible]. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
SAN FRANCISCO, CALIFORNIA

DA[illegible]O REVISION

AUGUST 1998

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UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

DRAFT FISH AND WILDLIFE COORDINATION ACT REPORT FOR THE

HAMILTON ARMY AIRFIELD WETLAND RESTORATION PROJECT

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EXECUTIVE SUMMARY

The Hamilton Army Airfield (HAAF) Wetland Restoration project would restore about 829 acres of tidal and seasonal wetlands adjacent to San Pablo Bay in Marin County, California. Before being diked and drained in the late 1800s, the HAAF and surrounding areas were covered with huge areas of tidal wetlands. Since being diked and drained, the HAAF has subsided up to 8 feet below sea level. It is now vacant, and the contaminants left on the site are being cleaned up by the U.S. Army Corps of Engineers (Corps).

Two previous evaluations of the HAAF site were completed by the Fish and Wildlife Service (Service) for the J.F. Baldwin Deepwater Ship Channel and Oakland Harbor 50-foot Navigation projects. However, the restoration designs have changed considerably since the evaluations for these projects were done. The enclosed report evaluates five restoration alternatives: Alternative 1 considers no-action; Alternative 2 considers natural sedimentation (without dredge material) at the HAAF parcel; Alternative 3 considers natural gradient (with dredge material) at the HAAF parcel; Alternative 4 considers natural sedimentation at the HAAF and State Lands Commission Parcel (SLCP); and Alternative 5 considers natural gradient at the HAAF and SLCP.

Existing cover-types that would be impacted by the restoration project are tidal emergent marsh (outboard of the levee only), seasonal wetlands, uplands, mudflats (outboard of the levee only), and non-tidal emergent marsh. Cover-types that would be created with the project are tidal emergent marsh, seasonal wetlands, tidal channels, subtidal habitat, mudflats (temporarily), tidal ponds, tidal pannes, and non-tidal emergent marsh. Several wildlife species, such as the California clapper rail and salt marsh harvest mouse, whose existence have become threatened or endangered, mainly through loss of wetlands around the Bay, would potentially receive benefits from the project.

A Habitat Evaluation Procedures (HEP) was completed which compares each alternative, and is found in Appendix A of the enclosed report. Results of the HEP indicate an obvious similarity amongst the four alternatives, in that net gains in Average Annual Habitat Units (AAHUs) would occur for tidal emergent marsh, seasonal wetlands, tidal channels, subtidal habitat, mudflats, and tidal ponds, and net losses would occur for uplands. There are several differences amongst the alternatives as well. For Alternatives 3 and 5, there would be a gain, of course, in AAHUs for tidal pannes, and a loss in AAHUs for non-tidal emergent marsh habitat. Alternatives 2 and 4 would initially allow more tidal emergent marsh creation (more acres at target year (TY) 6 than Alternatives 3 and 5), but by TY 16, Alternatives 3 and 5 would allow more creation of tidal emergent marsh, due to the fact that dredged material helped “speed the process along” of tidal emergent marsh creation. Alternatives 3 and 5 would allow the creation of tidal pannes and seasonal wetlands would be created more quickly using Alternatives 1 and 2. Habitat Suitability Index (HSI) values for each cover-type and each alternative would be fairly similar, however, by the end of the period of analysis (TY 52 for Alternatives 2 and 4, and TY 56 for Alternatives 3 and 5). Total AAHU net gains for Alternatives 3 and 5 are higher than for Alternatives 2 and 4, however, AAHUs net losses are also higher for Alternatives 3 and 5. The higher net gains for

Alternatives 3 and 5 are due to higher AAHU values for tidal emergent marsh, seasonal wetlands, tidal ponds, and tidal pannes (of which there are none for Alternatives 2 and 4). Alternatives 2 and 4 had higher AAHU net gains for only subtidal habitat, mudflats, and non-tidal emergent marsh. Net changes in AAHUs for tidal channels were slightly higher for Alternative 2 than Alternative 3, but slightly lower for Alternative 4 than Alternative 5.

The Service places high priority on the HAAF tidal restoration project, owing to its location, minimal existing values, high ultimate habitat potential, and associated benefit of remediating contaminants on site with dredged material. The primary concerns with the HAAF site are the lack of a detailed project design and insufficient testing and monitoring from demonstration sites such as Sonoma Baylands to ensure success. Therefore, at this time, we are not recommending one alternative over the other, however, we do recognize that any of the four proposed alternatives would provide benefits to fish and wildlife in the project area due to the nature of the restoration.

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INTRODUCTION

The Hamilton Army Airfield Wetland Restoration project (project) would restore over 829 acres of tidal and seasonal wetlands adjacent to San Pablo Bay in Marin County, California (Figure 1). Before being diked and drained in the late 1800s, the HAAF and surrounding areas were covered with huge areas of tidal wetlands that contributed to a rich and integral part of the San Francisco Bay estuary. Since being diked and drained, the HAAF has subsided up to 8 feet below sea level, served as a military airfield, and now lies vacant while areas of contaminants left on the site are being cleaned up by the Corps for eventual transfer and reuse for other purposes. Several wildlife species, such as the California clapper rail and salt marsh harvest mouse, whose existence have become threatened or endangered mainly through loss of wetlands around the Bay, would potentially receive benefits from the project (Woodward-Clyde *et al*. 1998).

Our analysis is based on engineering and other project information provided by the Corps prior to July 28, 1998. Our appraisal of resources is based on literature reviews; personal communications with other recognized experts; field investigations and surveys; best professional judgement of Service biologists; and a projection of future conditions using current land-use information and analyses provided by the Corps. Our analyses will not remain valid if the project, the resource base, or anticipated future conditions change significantly.

This report identifies fish and wildlife resources within the project area, and impacts of the proposed wetlands restoration project on these resources. It provides recommendations to protect existing fish and wildlife resources and to minimize resource losses caused by project construction. We applied the HEP methodology to assess project impacts on terrestrial and aquatic resources within the project area (Appendix A).

Letters of concurrence with our analysis of project impacts on fish and wildlife (Appendix B) from the California Department of Fish and Game (Department) and the National Marine Fisheries Service (NMFS) will be incorporated into the final FWCA report.

AREA DESCRIPTION

The HAAF and SLCP sites are located about 25 miles north of San Francisco, in the City of Novato, and are adjacent to San Pablo Bay. The HAAF site occupies about 579 acres of the former 1,600-acre Hamilton Air Force Base. Most of the airfield lies in an area that was historically salt marsh. This habitat was drained, levees were constructed, and the airfield was converted to grassland and seasonal wetland habitats. Current elevations range from -4 to -7 feet National Geodetic Vertical Datum (NGVD). Existing flood control on the HAAF consists of levees and pump stations. The SLCP is adjacent to the HAAF site, separated by a levee, and occupies about 233 acres.

Figure 1. General location area of the Hamilton Army Airfield Wetlands Restoration Project (source: AAA 1979)

PROJECT DESCRIPTION

Two contiguous parcels, totaling about 829 acres have been analyzed for the project (Figure 2): the former HAAF and the Hamilton Army antenna field (termed the States Lands Commission Parcel, or SLCP, after the entity which currently owns it). The decommissioned Hamilton Army antenna field, a 579 acre site, contains essentially uplands habitat. The Defense Base Realignment and Closure Act of 1988 (BRAC I), Public Law 100-526, required the closing and disposing of HAAF property and facilities still owned by the military (JSA 1995). The HAAF site is currently controlled by the U.S. Army, Presidio of San Francisco, and has been identified as an alternative for potential dredged material disposal and tidal wetlands restoration (USACE *et al.* 1994a). About 11 million cubic yards (cys) of dredged material may be needed to raise elevations at the HAAF and the SLCP to levels appropriate for tidal marsh vegetation (Eric Polson, pers. comm., 1998).

Although a final detailed restoration plan is not yet available, we assumed it would be guided by site-specific concept plans provided by the Hamilton Restoration Group (Group), a collaborative comprised of resource agencies, local interests and private consultants. From these plans, a draft "Hamilton Wetlands Restoration Plan" was prepared by the consulting agencies of Woodward-Clyde, H.T. Harvey & Associates, and Eric Polson, Consulting Engineer (1998). This conceptual proposal would create: (a) tidal habitats on about 80 percent of the area available for restoration, to consist of mudflats (low intertidal), mid- and high- intertidal marsh, tidal channels, tidal ponds, supertidal pannes, and subtidal habitats; and (b) non-tidal habitats on about 20 percent of the area, to consist of seasonal ponds and emergent marsh, persistent deep ponds and emergent marsh, and grassland habitat. A riparian corridor may be established adjacent to a channel in which flows from Pacheco Pond could be routed onto the HAAF, however, at this time, it is uncertain whether this will occur. It is possible that the root depth and mass of riparian trees could threaten the integrity of perimeter levees, and make them unsuitable for riparian vegetation. Therefore, an analysis of the creation of riparian habitat will be delayed until this aspect of the design is determined. Also, in order to introduce tidal flow, one to two main breaches would be created, and tidal channels would form from these. Tidal channels would also be excavated outside of the existing levee, within existing tidal emergent marsh and mudflat habitat, to facilitate tidal action.

According to the Group, the acreage of cover-types to be created should be considered a general goal rather than as a stringent requirement. At a minimum, however, the present wetland habitat functions provided at the site would need to be maintained and enhanced, although not necessarily in their present location or form. Four project alternatives, along with the no-action alternative, are described below:

1. ***No-action Alternative***. No restoration would be done. As discussed, the disposal of the HAAF is mandated by BRAC I and must be implemented unless directed otherwise by

Congress. Therefore, under the No-action Alternative, the HAAF would continue in caretaker status until disposal with no planned reuse. The site would be closed and any

Figure 2. Hamilton Army Airfield and State Lands Commission Parcel Restoration Project Sites (source: JSA 1998).

further on-site activity would be limited to those actions associated with caretaker status of surplus property (JSA 1995).

2. ***Alternative 2, Natural Sedimentation with Cross Levee, HAAF***. The project area would include the HAAF property only, which would be restored by relying entirely on natural sedimentation to establish tidal wetlands. This alternative would consist of tidal and non-tidal areas. The tidal area would contain high intertidal marsh, mid-intertidal marsh, low intertidal marsh, and tidal channels. The non-tidal area would contain seasonal wetlands, grassland transition zone to upland and possibly riparian, shallow ponds, and emergent marsh. A cross-levee would be constructed in order to preserve or create these diverse cover-types at the site, and preserve values of the existing 12.5 acres of the existing freshwater mitigation site. Perimeter levees would be constructed to prevent the flooding of adjacent properties. Initially, subtidal habitat and then mudflats would form on the site, however, the site would ultimately contain high and low tidal emergent marsh, tidal channels, and uplands in the form of peninsulas. Peninsulas would guide the tidal flows, however, specific information is not available at this time (location, number, etc.). Peninsulas would be temporary, and would degrade within about 10 years.

3. ***Alternative 3, Dredged Material with Natural Gradient, HAAF***. In order to implement this alternative, dredged material would be used to raise subsided elevations of diked, former baylands after which the levee would be breached, resulting in a system with tidal wetlands at lower elevations and seasonal wetlands at higher elevations. This alternative would consist of the HAAF property only. Freshwater non-tidal wetlands would be established at higher elevations along the site's northwestern end, next to Pacheco Pond, and would merge gradually through a transitional wetland area into lower elevation tidal wetlands at the eastern, bayward side of the site. The non-tidal areas would contain seasonal wetlands, a grassland transition zone to uplands and possibly riparian, shallow ponds, emergent marsh, and channels. The tidal areas would contain high intertidal marsh, mid-intertidal marsh, low intertidal marsh, tidal channels, and tidal pannes. Initially, subtidal habitat and then mudflats would form on the site after the dredged material is deposited, however, the site would ultimately contain high and low tidal emergent marsh, tidal channels, and uplands in the form of peninsulas. Peninsulas would guide the tidal flows, however, specific information is not available at this time (location, number, etc.). Peninsulas would be temporary, and would degrade within about 10 years.

4. ***Alternative 4, Natural Sedimentation with Cross Levee, HAAF and SLCP***. This alternative is the same as Alternative 2, but would include the SLCP as well.

5. ***Alternative 5, Dredged Material with Natural Gradient, HAAF and SLCP***. This alternative is the same as Alternative 3, but would include the SLCP as well.

Previous environmental documentation includes a draft Flood and Drainage Baseline Study for the HAAF Disposal and Reuse (USACE 1993); various Jones & Stokes Associates, Inc. reports (JSA 1993, 1995); two Service FWCA reports (USFWS 1997 and 1998); and a draft and final Environmental Impact Statement (USACE 1995 and 1996).

EXISTING BIOLOGICAL RESOURCES

The existing cover-types in the project area are divided into **developed areas** (*e.g.*, runways), **uplands** (grasslands), **seasonal wetlands**, **mudflats** (outboard of the levee), **coastal salt marsh** (outboard of the levee), and **non-tidal emergent marsh**. The developed areas on the HAAF consist of an 8,000 foot-long runway, hangar facilities and airfield support buildings, as well as asphalt and concrete. Uplands are found on the SLCP, with a small amount of seasonal wetlands and drainage ditches. The following is a brief description of the typical biotic elements of the site; complete descriptions and a full species list is available in USACE 1995.

Vegetation

Uplands consisting of annual and fescue grasslands are found on the unpaved portions of the airfield and on the levee slopes. Annual grassland is widespread, while fescue grassland is found mostly in low areas around the southeastern and northwestern margins of the airfield. Annual grassland vegetation includes species such as ripgut brome, wild oats, and yellow star-thistle. Fescue grassland vegetation includes species such as tall fescue (JSA 1995).

Seasonal wetland areas for the HAAF site were delineated by the Corps and consist of a western goldenrod wetland, sheep sorrel/6 weeks fescue wetland, creeping wildrye wetland, and sedge-rush wetland. The seasonal wetlands on the SLCP site are generally depressional areas or flat areas where surface drainage is impeded by spoil deposition. Common wetland species here are curly dock, spearscale, bristly oxtongue, and birdsfoot trefoil. Less common species are Italian ryegrass, Mediterranean barley, and bull thistle (USACE 1998a).

The **mudflat** cover-type is found outboard of the existing HAAF and SLCP levees. It is an intertidal aquatic habitat and is defined as a predominantly unvegetated (*i.e.*, not more than 30 percent cover) area that is flooded and unflooded daily due to diurnal tidal cycles. Intertidal mudflats occur in the project area as an exposed linear band of bay bottom at low tide between the bay and coastal salt marsh. Emergent species grow at the landward edges of the mudflats. These mudflats provide habitat for a variety of aquatic invertebrates, which are a primary food source for fish, shorebirds, and wading birds.

The **tidal emergent marsh** cover-type is also found outboard of the existing HAAF and SLCP levees. It consists of intertidal aquatic habitat that contains persistent, rooted herbaceous vegetation dominated by pickleweed and cordgrass. This habitat is divided into three distinct zones, which are low marsh, middle marsh, and high marsh, depending on the frequency and duration of tidal inundation. Low marsh is habitat between mean tide level and mean high water, and is inundated daily. Middle marsh is found between mean high water and mean higher high water, and is dominated by pickleweed. High marsh is found between mean higher high water and the highest tide level (JSA 1998).

Non-tidal emergent marsh in the project area consists of concrete-lined drainage ditches, saltgrass-saltplant wetland, and saltgrass-alkali heath wetland. Deeper drainage ditches are dominated by saltmarsh bulrush, and shallower drainage ditches are dominated by saltgrass and rabbitfoot grass (USACE 1998a).

Wildlife

The area was surveyed for wildlife species by Jones & Stokes Associates, Inc. in 1995. Upland species include the gopher snake, western fence lizard, turkey vulture, red-tailed hawk, American kestrel, ring-necked pheasant, western meadowlark, desert cottontail, and black-tailed deer. Burrowing owls have also been recently located on the HAAF (F. Botti, pers. com. 1998). The seasonal wetlands provide seasonal foraging habitat for some wetland wildlife species such as the great blue heron, great egret, killdeer, raccoon, striped skunk, and aquatic garter snake. Tidal emergent marsh provides food, cover, and breeding habitat for species such as rails, egrets, herons, waterfowl, and shorebirds. Those observed during surveys are the double-crested cormorant, great blue heron, great egret, American coot, killdeer, and San Pablo song sparrow. Mudflats provide excellent foraging habitat for finfish and diving birds at high tide, and wading birds and shorebirds at low tide.

Aquatic Resources

The fishery resources of San Pablo Bay vary with estuarine influence. The central bay is deep, dominated by tides, and least affected by seasonal and annual changes in freshwater inflow. The major species are marine: northern anchovy, young-of-the-year English sole, jacksmelt, shiner perch, croaker, white sturgeon, and various gobies. Pacific herring spawn in eelgrass beds in the central bay, and American shad and chinook salmon migrate through the bay in transit to spawning streams in the Central Valley. San Pablo Bay has extensive shallow areas, including vegetated marsh on the large northern border. Euryhaline fishes, like starry flounder, longfin smelt, and yellowfin goby increase in abundance in this area; anchovy, sole, and croaker are also found here at least seasonally, depending on outflow and salinity. San Pablo Bay is also considered a major nursery for dungeness crab.

A variety of native and introduced fishes, particularly juveniles, would be expected to occur in the tidal channels. The fish and infauna of tidal sloughs differ moderately from the open waters of the bay (SFEP 1991). Native Baltic clam and the introduced ribbed mussel are common within the cordgrass zones. The predominant mud snail and native hornsnail and saltmarsh snail species occur in the higher pickleweed zone.

The major species of zooplankton, shrimp and molluscs vary somewhat predictably with salinity and delta outflow (Herbold *et al*. 1992). The copepod *Acartia clausi* is found in the more saline waters in San Pablo Bay. Intertidal mudflats are most prevalent in the project area adjacent to the tidal emergent marsh on the southeastern portion of the HAAF. These areas have a biota comparable in benthic composition to subtidal muds, consisting of mud snails, softshell and littleneck clams, and ghost shrimp. These organisms provide forage for finfish and diving birds at high tide, and wading birds and shorebirds at low tide.

Endangered Species

The following is a discussion of federally listed threatened and endangered species that may occur at or near the study area. Appendix C provides a list of species and a summary of a Federal agency's responsibilities under section 7(a) and (c) of the Endangered Species Act (Act) of 1973, as amended. The information provided is preliminary and meant only to assist the Corps in preparation of a Biological Assessment, if needed. The Department should be contacted regarding any State listed or proposed species occurring, or that may occur, in the project area. State listed species of concern, according to the Department's Natural Diversity Data Base (1998) are the California black rail (threatened), California clapper rail (endangered), salt marsh harvest mouse (endangered), and Marin dwarf-flax (threatened).

We recommend that the Corps review its requirements, published in 50 CFR 402, for compliance with the Act. The Service has consultation responsibility for most of the federally listed species that may be affected by the project, and this office should be contacted regarding further consultation requirements. The NMFS has responsibility for most marine fish and wildlife, and should be consulted on activities which may affect any such listed or proposed species in the project area.

If any listed species are believed to possibly occur in the project area, the Corps should prepare a Biological Assessment to confirm their presence or absence and, if present, address potential project-related impacts upon the species. If the Corps determines endangered or threatened species are present and likely to be affected by the project, formal consultation must be initiated to determine if the contemplated actions would jeopardize the continued existence of these species, or adversely modify critical habitat of such species. However, if only proposed, or candidate species are present and likely to be affected by the project, then informal consultation is recommended. The Corps should request, in writing from the Service, a list of threatened and endangered species that may occur in the project area, or an updated list if an earlier list is more than 90 days old at the time preparation of any Biological Assessment for this project is undertaken.

According to the most recent list, dated August 13, 1998 (Appendix C, Novato and Petaluma Point quadrangles), there are 18 federally listed threatened and endangered species, or proposed threatened and endangered species, that may occur at the HAAF and SLCP sites. Endangered species are the salt marsh harvest mouse, American peregrine falcon, California brown pelican, California clapper rail, winter-run chinook salmon, tidewater goby, and California freshwater shrimp. Threatened species are the western snowy plover, bald eagle, northern spotted owl, delta smelt, Central California coast coho salmon, Central California steelhead, California red-legged frog, and Marin dwarf-flax. There is one proposed endangered species, the Central Valley spring-run chinook salmon, and two proposed threatened fish species, the Central Valley fall-run chinook salmon and Sacramento splittail. One candidate species and 49 species of concern may also be found in the project area.

Mammals

Salt marsh harvest mouse populations are limited in distribution to native salt and brackish habitats of the middle and upper tidal or diked marshes bordering bays, estuaries, and rivers of the San Francisco Bay region. Salt marsh harvest mice are critically dependent on dense cover, and their preferred habitat is pickleweed (Fisler 1965; Shellhammer 1977, 1981; Wondolleck *et al.* 1976). Studies have shown that the best type of pickleweed association for harvest mice has the following characteristics: 1) 100 percent cover, 2) a cover depth of 30 to 50 centimeters (cm) at summer maximum, 3) a high percentage cover of pickleweed, *i.e.*, 60 percent or more, and 4) complexity in the form of fat hen and alkali heath or other halophytes (USFWS 1994). In marshes with an upper zone of peripheral halophytes, mice use this vegetation to escape the higher tides, and may even spend a considerable portion of their lives there. Fisler (1965) noted that mice also move into the adjoining grasslands during the highest winter tides.

There are five principal reasons for the decline of the salt marsh harvest mouse: 1) habitat loss, 2) fragmentation of remaining marshes, 3) widespread loss of the high marsh zone as a result of backfilling, 4) land subsidence, and 5) vegetational change (USFWS 1994). The main factor reducing the numbers of these mice is habitat destruction. The tidal marshes of the San Francisco Bay system have been greatly reduced and fragmented (most estimates are by 79 percent or more) by filling, diking, and land subsidence followed by flooding. This reduction and fragmentation, along with decreases in cover and changes in salinity are major threats to the salt marsh harvest mouse. Key determinants of habitat suitability include moderate to dense vegetation cover, mostly in the form of halophytic vegetation, and escape from high waters. Salt marsh harvest mice do not venture into open areas even a few feet from vegetation fearing predation by predators such as feral cats and birds of prey (Fisler 1965, Zetterquist 1977). Therefore roads or open areas as little as thirty feet wide are effective barriers to their movement (Faber 1990). Plants providing a dense mat of cover, ideally 0.2 to 1.0 m high, with a network of spaces on the ground are required (Hooper 1944, Wondolleck *et al.* 1976).

The salt marsh harvest mouse probably eats seeds, stems, and leaves of salt marsh plants. In the winter, fresh green grasses are its preferred diet. For the remainder of the year, it mainly eats saltgrass and pickleweed. Nests are constructed of grasses and sedges. It breeds from May to November. Litter size averages about 4 young (Zeiner *et al*., 1990a).

Birds

The **American peregrine falcon** is an uncommon breeding resident and an uncommon migrant to California. Important yearlong habitats include riparian areas, and coastal and inland wetlands. Protected cliffs and ledges are needed for nesting and cover. It breeds in woodlands, forests, and coastal habitats and the breeding period is from early March to late August (Zeiner *et al.*, 1990b). It is not known to nest in the proposed project area, however, falcons may occasionally be found foraging in the area in the fall and winter months. Peregrine falcons eat primarily birds. The American peregrine falcon does not breed at the site, but could be an intermittent visitor.

The **California brown pelican**, a subspecies of brown pelican, is a fairly common post-breeding resident (May-November) throughout the open waters of Central San Francisco Bay and San Pablo Bays (Cogswell 1977, Palmer 1978). In the Bay, these pelicans forage over deep open water and roost on sites relatively free from human disturbance such as breakwaters, pilings, and, to a lesser extent, salt-pond dikes (USFWS 1992). Factors contributing to their decline include pesticide-induced eggshell thinning, oil spills, human disturbance of breeding colonies, over-harvest of its prey, loss of post-breeding roost sites, and fishing gear entanglement (CDFG 1989). No systematic survey has been attempted to monitor brown pelican abundance in the San Francisco Estuary. During surveys for nesting seabirds in 1988-1990, Service and Point Reyes Bird Observatory personnel observed as many as 130 birds at several Central San Francisco Bay and San Pablo Bay roost sites (USFWS 1992). Year-to-year variations in the numbers of post-breeding pelicans in California and San Francisco Bay may be related to the timing and success of nesting in Gulf of California colonies, the availability of their main prey, the northern anchovy, and sea surface temperatures along the coast (Briggs *et al.* 1983). The California brown pelican does not breed at the site, but could use the area for perching and roosting (JSA 1995).

The **California clapper rail's** prime habitat consists of large salt marshes (dominated by cord grass, pickleweed, salt grass, and gum plant with well-developed tidal slough networks and adjacent mudflats. Habitat suitability of many marshes for clapper rails is limited or precluded by small size, fragmentation, and lack of tidal channel systems and other micro habitat features. Since much habitat is within the range of high winter tides, high ground with plenty of cover from which to escape the rising water is a necessity. These limitations render much of the remaining tidal marsh acreage unsuitable or of low value for the species.

The life of a rail is closely tied to the flow of the tides, which produce a change in water levels of several feet, four times each day. During low tides, California clapper rails are often found foraging on the mud flats. A rail's diet is comprised of animal matter including insects, frogs, crustaceans, mollusks, small fish and crabs, and snails. They also forage on aquatic plants and seeds and have been known to take salt marsh harvest mice and other small mammals. In the north Bay the breeding season for the clapper rails, including pair bonding and nest construction, may begin as early as February according to Evens and Page (1983). Rails typically build their nests near tidal sloughs, at lower marsh elevations. The nests are built out of living and dead plant material and covered with a canopy of plants. The male assists in incubation. Clapper rails lay 6 to 12 eggs, usually 8 or 9. The end of the breeding season is typically defined as the end of August, which corresponds with the time when eggs laid during renesting attempts have hatched and young are mobile (Evens and Page 1983). The California clapper rail is found in the vicinity of the HAAF and SLCP.

The **western snowy plover** is a beach dweller that is typically found on sandy marine and estuarine shores in the fall and winter months. It feeds on insects and amphipods found on dry sands along the upper beach (Zeiner *et al.* 1990). The snowy plover will lay its eggs in shallow depressions in the sand, sometimes lined with small pebbles, glass fragments, or gravel. Snowy plovers have been eliminated from a substantial portion of their former breeding range on the Pacific Coast, and numbers of coastal breeders appear to be on the decline (Page and Stenzel

1981, Page *et al.* 1990). Human encroachment of breeding habitat and nest loss to introduced predators (red foxes) are two of the most serious problems currently faced by the plover. Western snowy plovers do not breed at the site, but could be an intermittent visitor.

The **bald eagle** is a resident of, and is also known to migrate through, and winter in, California. It feeds mainly on fish, but will also eat water birds and mammals. It perches high in large, stoutly limbed trees, on snags or broken-topped trees, or on rocks near water. It requires large bodies of water, or free-flowing rivers with abundant fish, and adjacent snags or other perches. The bald eagle breeds in February through July, with peak activity from March to June. Eighty-seven percent of nest sites are located within 1 mile of water. It is monogamous and breeds first at year 4 or 5, with an average clutch size of two eggs (Zeiner *et al.* 1990b). Populations of bald eagles have seriously diminished in number due to shooting, pesticides, and human encroachment. The bald eagle does not breed at the site, but could be an intermittent visitor.

The geographical range of the **northern spotted owl** encompasses a number of physiographic provinces. Climate and vegetation vary within these provinces but, in general, owl habitat requirements include extensive forested areas characterized by large trees with a canopy closure of 60 to 80 percent, high incidence of tree deformities, large accumulations of heavy woody debris on the forest floor, and a relatively open understory that permits the owls to move freely under the tree canopy. In most parts of the owl's range, trees of 150-to-200 years of age are required to develop suitable habitat characteristics. However, in some areas (*e.g.,* California coastal forests), owl pairs have been reported in younger stands. Most young forest stands, especially young plantations, do not contain suitable structural characteristics to support owl pairs (USFWS 1992). The northern spotted owl is not likely to be found in the project area.

Fish

The **winter-run chinook salmon** is a unique population of chinook salmon that spawns in the Sacramento River and is distinguishable from other chinook salmon runs found in the river based on the timing of its upstream migration and spawning season. Flow modification, water diversions, and loss of spawning and rearing habitat are thought to be major factors contributing to the decline of the winter-run chinook salmon. Currently, about 95 percent of winter-run chinook salmon spawning occurs between Keswick Dam and Red Bluff Diversion Dam; the remainder occurs downstream of Red Bluff Diversion Dam (NMFS 1992). Winter-run chinook salmon may be found in San Pablo Bay, since they outmigrate from there during the rainy season.

Central Valley spring-run chinook salmon spend the summer months before spawning, in deep riverine pools. Spring-run chinook salmon runs are differentiated by 1) the maturity of fish entering fresh water; 2) time of spawning migrations; 3) spawning areas; 4) incubation times; 5) incubation temperature requirements; and 6) migrations of juveniles. Differences in life histories isolate spring-run chinook salmon from other runs. In general, spring-run chinook salmon migrate great distances up streams to spawn. They enter rivers from March through May, which is the period of snow-melt flows (Marcotte 1984), and are between 2-5 years old. When they enter freshwater, spring-run chinooks are immature, however, they become mature during the summer holding period. Spawning then occurs from mid-September through October. Movement of juveniles takes place from March-May (Cramer and Hammock 1952; F. Meyer, pers. comm. *in* CDFG 1989). Spring-run chinook salmon may be found in San Pablo Bay, since they outmigrate from there during the rainy season.

Adult **Central Valley fall-run chinook salmon** migrate through the Sacramento-San Joaquin Delta and into the Central Valley rivers from July through December, and spawn from October through December. Peak spawning activity usually occurs in October and November. Incubation of eggs begins with spawning in October and can extend into March. Fall-run chinook salmon fry (*i.e.*, juveniles less than 2 inches long), generally emerge from December through March, with peak emergence occurring by the end of January. Most fall-run fry can be found rearing in freshwater from December through June, with emigration as smolts occurring from April through June. A very small number (generally considered <5%) of fall-run juveniles spend over a year in fresh water, and emigrate as yearling smolts the following November through April (USFWS 1995). Central Valley fall-run chinook salmon may be found in San Pablo Bay, since they outmigrate from there during the rainy season.

The **tidewater goby** is a relatively small goby that rarely exceeds 50 mm standard length. It is found along most of California's coast, in scattered lagoons and marshes. Specifically, it is found in brackish water (salinities usually less than 10 parts per trillion [ppt]) to fresh water (Miller and Lea 1972, Moyle 1976, Swift 1980, Wang 1982, Irwin and Soltz 1984) and slow-moving or fairly still but not stagnant water (Irwin and Soltz 1984). Males dig vertical nesting burrows 10-20 centimeters (cm) deep in clean, coarse sand, beginning in late April to early May at water temperatures of 18-22 C and salinities of 5 to 10 percent. Restricted habitat and a short life span have caused many populations to disappear, particularly in southern California and in the San Francisco Bay area (Swift *et al.* 1989). Tidewater gobies may occur in the tidal channels of the tidal emergent marsh vegetation.

The **delta smelt** is a slender-bodied translucent planktivorous fish known to occur in the San Francisco Bay Estuary. It is the only true native estuarine fish in the Estuary (Moyle *et al.* 1994). Delta smelt typically have a 1 year life span. Adults enter dead-end sloughs and channel edge-waters of the Delta to spawn between about February and June. Spawning occurs in open waters, and the adhesive, demersal eggs attach to hard substrates such as rocks, tree roots, gravel, and submerged branches and vegetation. Fecundity is low, usually ranging between 1,400 and 2,800 eggs per female. Adults typically die after spawning. Eggs hatch in 10 to 14 days, and the planktonic larvae and juveniles are transported downstream to the estuarine mixing zone that, depending on outflow, may be located from Suisun Bay to the confluence of the Sacramento and San Joaquin Rivers. Juveniles also feed on zooplankton.

Although the delta smelt was one of the most common fish in the Delta as recently as the 1970s, it has undergone roughly a ten-fold decline in the past 10 years (from several million to several hundred thousand). Consequently, in 1993 the smelt was listed as threatened under the Federal Endangered Species Act. Factors which are believed to have contributed to the decline in population are: 1) low Delta outflow that results in (a) placement of the mixing zone upstream within the "zone of influence" of the Central Valley Project/State Water Project pumps, and (b) reductions in the geographic distribution of the smelt; 2) acute toxicity caused by influences of irrigation drain water; and 3) competition for food sources with recently introduced species such as the inland silverside and the Asiatic clam.

The **Coho salmon** is anadromous, entering fresh water to spawn (Godfrey 1965). Beginning in July, but later than August in some areas, they return from the open ocean to coastal areas near the outlets of their natal streams. They enter rivers on all but peak floods, moving upstream primarily in daylight. Runs take place from August to February. They spend 30 to 60 days in freshwater and, in North America, peak spawning occurs from late September to January, and continues as late as March. Optimum rearing habitat consists of a mixture of pools and riffles, abundant instream and bank cover, water temperatures that average between 10 and 15 C in the summer, dissolved oxygen near saturation, and low amounts of fine sediments (Reiser and Bjornn 1979). Juvenile coho salmon eat prey such as decapod crustacean larvae, fish, amphipods, and polychaetes. Adults eat fish such as anchovy, surf smelt, whitebait smelt, and juvenile chinook salmon. Central California coast coho salmon may be found in the bay, as it outmigrates from there during the rainy season.

The **Central California steelhead trout** migrates from the ocean to freshwater in the fall and winter (Raleigh *et al.*, 1984, Moyle 1976). They spawn in late winter and early spring (January through April). Incubation of eggs and emergence from gravel are from May and early June respectively. Fry remain in freshwater for 1 to 3 years to rear to juveniles before smolting and emigrating to the ocean. Emigration is usually from March to June. They mature after 1 to 2 years in the ocean, and then return to their natal stream to spawn. Central California steelhead may be found in the bay, as it outmigrates from there during the rainy season.

The **Sacramento splittail** is a large (up to 40 cm) minnow endemic to California's Central Valley. The species has been restricted to a small portion of its former range (Moyle *et al.* 1989) and is now found primarily in the Sacramento-San Joaquin Delta, Suisun Bay, Suisun Marsh, and Napa Marsh. The splittail is easily distinguished from other minnow species by the enlarged upper lobe of its caudal fin. It is tolerant of brackish water conditions, and can often be found in Suisun Bay, San Pablo Bay, and the Carquinez Strait following winter high-flow periods, when waters in these areas are relatively diluted. Splittail feed primarily upon benthic invertebrates. Spawning requirements appear to be similar to those of delta smelt, in that both species congregate for spawning in the dead-end sloughs of the Delta. Splittail apparently spawn on flooded streambank vegetation or on beds of aquatic plants (Moyle 1976). Sacramento splittail may occur in the tidal channels of the tidal emergent marsh vegetation.

Amphibians

The **California red-legged frog** typically occurs in the vicinity of quiet, permanent pools of streams, marshes, and ponds (Zeiner *et al.* 1990c). It prefers well-shaded permanent water. Emergent vegetation, such as *Typha* and *Scirpus*, is an important component of breeding habitat. A dense understory adjacent to wetlands is also an important component, and shrubby riparian willow woodland is a key overstory habitat. Adults eat aquatic and terrestrial insects, crustaceans, snails, worms, fish, tadpoles, and smaller frogs. Aquatic larvae are mostly herbivorous. They are likely subject to predation by aquatic invertebrates, and vertebrates such as fish, other amphibians, snakes, birds, and mammals. Loss of habitat and the introduction of exotic predators are primary causes of the species' decline (Zeiner *et al.* 1990c). Field surveys for the California red-legged frog revealed no frogs existing on-site (USACE 1995).

Invertebrates

The **California freshwater shrimp** is a decapod crustacean of the family Atyidae. The shrimp, the only extant species in the genus *Syncaris* on the Pacific Coast, is one of two surviving genera of the Atyidae in the United States. Adults may reach 5 cm (2.5 inches) in length. Nearly transparent in water, the adults appear out of water to be greenish-gray to almost black with pale blue tail fins. Adult females lay relatively few eggs (50-to-70, Hedgpeth 1975; 100-to-120, Eng 1981). Over winter, eggs are carried on the female and released in May. During the first summer, larval growth is rapid, but sexual maturity is not reached until the second summer. The California freshwater shrimp is endemic to gentle gradients (less than 1 percent), low elevation (below 115 meters [380 feet]), freshwater streams in Marin, Napa, and Sonoma Counties, California. The species, a true freshwater shrimp, inhabits quiet portions of tree-lined streams with underwater vegetation and exposed tree roots

Plants

Marin dwarf-flax is a rare plant endemic to California. It is limited to one population or several restricted populations. The preferred habitat includes chaparral and valley and foothill grasslands. It is found on serpentinite substrates. Marin dwarf-flax is an annual herb which blooms from May to July. It is known from fewer than twenty occurrences. The species is threatened by development and foot traffic.

Contaminants

HAAF. Past activities at the HAAF have generated hazardous and toxic wastes, including solvents, aircraft fuel, and other domestic and industrial wastes. The hazardous and toxic substances include PCBs, asbestos, pesticides, elevated and moderate levels of petroleum hydrocarbons, high and low levels of volatile organic compounds and semi-volatile organic compounds, and elevated and high concentrations of metals (*e.g.*, lead, beryllium, cobalt, barium, cadmium, copper, and mercury) (USACE 1995). The contamination is characterized as numerous hot points with levels of contamination encircling them. These hazardous and toxic substances were found at several areas: the revetment area, the burn pit, the pump station, the former sewage treatment plant, the aircraft maintenance area, along fuel lines and electrical transformers (BCDC 1995), the perimeter drainage ditch and spoils area, the east levee landfill area, and the landfill 26 area. There also exists soil, which had been removed from the government services administration area, and is now stockpiled on the runway. It has yet to be determined where this stockpiled soil will be disposed.

At the HAAF parcel, a programmatic approach for fast-track cleanup based on EPA's Guidance on Conducting Time-Critical Removal Actions under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is being pursued (USACE 1988a). Outparcel sites that have been contaminated primarily by petroleum products will be cleaned up using recommendations by the State Water Quality Control Board. The Corps identified the nature and extent of contamination during a series of assessments and investigations, which resulted in the Comprehensive Remedial Investigation Report (USACE 1988b). Based on those assessments and investigations, site-specific removal actions during 1998 and 1999 will be used to clean up contamination to preliminary screening levels, recommended by oversight regulatory agencies. Confirmatory sampling, toxicity testing, and ecological and human health risk assessments will provide information to be used to determine final cleanup goals (remedial action objectives) in a feasibility study during 1999. It is expected that all remedial actions required to meet the cleanup goals will be completed during the removal and confirmatory stages of fieldwork, leading to an environmental Record of Decision (ROD) that does not require more work (JSA 1998). However, monitoring of the sites after remediation may be warranted.

SLCP. The SLCP site is in the preliminary assessment/site investigation portion of the CERCLA process. Subsequent investigation of the SLCP site will be conducted during a remedial investigation, if deemed necessary. There are current plans to adopt remedial cleanup values developed for the HAAF parcel because of the similarity in contaminants, geology, and anticipated future land use. An interim removal action is planned at the conclusion of the SLCP site investigation, and will include the rifle range if Potentially Responsible Party negotiations have resulted in a settlement. Any remaining cleanup will be conducted after a ROD is agreed to by the Department of Defense and federal and state regulators (JSA 1998).

FUTURE CONDITIONS WITHOUT THE PROJECT

Disposal of HAAF is mandated by BRAC I and must be implemented unless directed otherwise by Congress. Therefore, under the No-Action Alternative, the HAAF would continue in caretaker status until disposal with no planned reuse. The site would be closed and any further on-site activity would be limited to those actions associated with caretaker status of surplus property (JSA 1995).

Cleanup of contaminants at HAAF would be completed by about 1999, and would involve removal of hazardous material and capping residual hot spots, thereby reducing potential exposure of wildlife and modestly improving conditions. No other significant changes in habitat type, wildlife, or aquatic resources are anticipated at either HAAF or SLCP if this alternative is not used for dredged material disposal.

FUTURE CONDITIONS WITH THE PROJECT

A cleanup of contaminants at the HAAF portion of this alternative would also be done prior to restoration to tidal action, however, the cleanup methods would be different in order to contain materials due to exposure to water and tidal action.

Vegetation

All of the restoration project alternatives would impact the same baseline footprint, consisting of the following cover-type areas: 1) 3.0 acres of tidal emergent marsh (coastal salt marsh) (outboard of the levee); 2) 32.5 acres of seasonal wetlands; 3) 258.7 acres of uplands; 4) 14.3 acres of mudflats (outboard of the levee); 5) 4.1 acres of non-tidal emergent marsh; and 6) 283.6 acres of developed areas. Although the project would impact some cover-types, there would be a large gain in acres and habitat values within the SLCP and/or the HAAF sites. Newly created habitat would include tidal emergent marsh, seasonal wetlands, tidal channels, subtidal habitat, tidal ponds, and tidal pannes. The tidal emergent marsh cover-type that would be created would restore tidal marsh vegetation to the area. Impacted seasonal wetlands would be replaced in-kind. Uplands habitat and developed areas would be replaced out-of-kind by tidal emergent marsh, tidal channels, subtidal habitat, mudflats (temporarily), tidal ponds, tidal pannes (for Alternatives 3 and 5), and non-tidal emergent marsh (for Alternatives 2 and 4). Mudflats would be temporarily created to benefit shorebirds and waterfowl. Acreage for the non-tidal emergent marsh cover-type would increases greatly for Alternatives 2 and 4.

The HEP analyzed the four restoration alternatives separately; HSI calculations and a comparison of AAHU gains and losses are found in Appendix A.

Wildlife

Wildlife values in the impact area would be diminished during the time that dredged materials are applied to the site (years 1-6 for Alternatives 3 and 5), for the period while the area is flooded before the levees are breached (at year 6), and for a short time period after the levees are breached. Uplands in the form of peninsulas that would be created to attenuate waves and may provide some initial habitat values, however, these would erode by year 16 (10 years after construction). Created mudflats would provide temporary habitat values for wading birds and shorebirds. Species which utilize tidal emergent marsh, tidal channels, seasonal wetlands, and brackish marsh cover-types would benefit from project implementation, including waterfowl, some wading birds, and passerine species. Small and large mammals would be expected to benefit by the creation of higher value habitat for foraging and cover than is currently present.

Aquatic Resources

Fishes and invertebrates of the San Pablo Bay area would benefit from creation of additional tidal wetlands and channels. These areas would provide additional feeding, breeding, and nursery grounds for numerous marine and estuarine species. Larger tidal channels would provide some nursery or foraging areas for juvenile fishes.

Endangered Species

Restoration of tidal wetlands would likely benefit the endangered salt marsh harvest mouse, California clapper rail, and California black rail by creating additional breeding and foraging habitat, as well as cover. Winter-run chinook salmon, spring-run chinook salmon, fall-run chinook salmon, Central California coast coho salmon, and Central California would also likely benefit, as discussed above, from the creation of larger tidal channels.

DISCUSSION

Description of the Service's Mitigation Policy

The Mitigation Policy as published in the Federal Register (46:15 January 23, 1981 provides Service personnel with guidance in making recommendations to protect or conserve fish and wildlife resources. The policy helps ensure consistent and effective Service recommendations and allows agencies to anticipate and plan early for mitigation needs. The intent of the policy is to ensure protection and conservation of the most important and valuable fish and wildlife resources, while allowing reasonable and balanced use of the Nation's natural resources.

In applying the Mitigation Policy, each specific habitat or cover-type that may be impacted by the project is identified. Cover-types are then assigned to one of four distinct Resource Categories, each having a mitigation planning goal which is consistent with the fish and wildlife habitat values involved. The Resource Categories cover a range of value, from those considered to be unique and irreplaceable, to those believed to be much more common and of relatively lesser value to fish and wildlife. Evaluation species which utilize each habitat or cover-type are selected for Resource Category determination. Selection of evaluation species can be based on several rationales, including: 1) species known to be sensitive to specific land and water use actions; 2) species that play a key role in nutrient cycling or energy flow; 3) species that utilize a common environmental resource; or 4) species that are associated with important resource problems, such as anadromous fish and migratory birds. Evaluation species used for Resource Category determinations may or may not be the same evaluation species used in an application of the Service's HEP, if one is conducted. Finally, based on the relative importance of each specific habitat to its selected evaluation species, and the habitat's relative abundance, the appropriate Resource Category and associated mitigation planning goal are determined.

Mitigation goals range from "no loss of existing habitat value" (Resource Category 1) to "minimize loss of habitat value" (Resource Category 4). The goal for Resource Category 2 is "no net loss of in-kind habitat value"; to achieve this goal, any unavoidable losses of habitat value would need to be replaced in-kind. As defined in the Mitigation Policy, "in-kind replacement" means providing or managing substitute resources to replace the habitat value of the resources lost, where such substitute resources are physically and biologically the same or closely approximate those lost.

In addition to mitigation goals based on habitat values as defined according to Resource Categories in the Mitigation Policy, Region 1 of the Service has a goal "...to ensure that no net loss (acreage or value, whichever is greater) of wetlands habitats occurs." The Service seeks this goal for all proposed Federal and non-Federal water development or flood control activities in California.

Exclusions to the Mitigation Policy are that it does not apply to: (1) threatened and endangered species, (2) projects permitted or licensed prior to Service authorities, or (3) Service recommendations related to enhancement of fish and wildlife resources. The Policy also allows some latitude in Service guidelines for meeting the goal of in-kind replacement of habitat value as prescribed by the Resource Category 2 determination. Specifically, exceptions to this goal *may* be recommended when either (1) different habitats and species available for replacement are determined to be of greater value than those lost, or (2) in-kind replacement is not physically or biologically attainable in the ecoregion.

Nine distinct, mappable cover-types occur (or will be created) within the project area and alternative disposal areas. These cover-types and their associated Resource Categories and mitigation planning goals are discussed below, and summarized below (Table 1).

Resource Category Determination

Developed Areas occur in the forms of concrete runways, roads, and/or building structures within the HAAF site. This cover-type is characterized by a very high (greater than 90 percent) conversion to impervious surfaces such as pavement or building surface. Although visited by wildlife, habitat value is considered very minimal, and changes in such value were not evaluated quantitatively.

Table 1. Summary of the cover-types, Resource Categories, and mitigation goals for the Hamilton Army Airfield Wetlands Restoration Project. (Note: * denotes wetland cover-types for which the Service's Regional goal regarding wetlands mitigation (i.e., no net loss of acreage or habitat value, whichever is greater) would also apply.)

COVER-TYPE	RESOURCE CATEGORY	MITIGATION PLANNING GOAL
Developed Areas	none	none
Uplands	3-4	No net loss of habitat value while minimizing loss of in-kind habitat value, or minimize loss of habitat value. No net loss of in-kind habitat value.
Seasonal Wetland*	2	No net loss of in-kind habitat value.
Intertidal Mudflat*	2	No net loss of in-kind habitat value.
Tidal Emergent Marsh*	2	No net loss of in-kind habitat value.
Non-tidal Emergent Marsh*	2	No net loss of in-kind habitat value.
Tidal Channels*	2	No net loss of in-kind habitat value.
Tidal Ponds	2	No net loss of in-kind habitat value.
Tidal Pannes	2	No net loss of in-kind habitat value.
Subtidal	3	No net loss of habitat value while minimizing loss of in-kind habitat value.

The **upland** cover-type includes the higher elevation grassland areas and levee. The evaluation species selected for this cover-type are raptors such as the rough-legged and red-tailed hawks, which utilize upland/agricultural areas and related herbaceous areas for foraging. These raptors were selected because of the Service's responsibilities for their protection and management under the Migratory Bird Treaty Act, and their overall high non-consumptive values to humans. Upland areas potentially impacted by the project vary in their relative values to raptors, depending on the degree of human disturbance and plant species composition. The upland/ agricultural areas have minimal habitat value for the evaluation species due to a variety of degrading factors such as contamination from past use; the Service's mitigation planning goal for these areas is to "minimize loss of habitat value" (i.e., Resource Category 4).

The **seasonal wetland** cover-type is present in minor portions of the HAAF and SLCP sites. This cover-type, while dry for much of the year, is subject to flooding or soil saturation during the winter season. In addition, the seasonal wetlands provide upland values during the dry season. Evaluation species selected for this cover-type are the wintering shorebirds and waterfowl, because of the Service's responsibilities for their protection and management and their high consumptive (waterfowl hunting) and non-consumptive (bird-watching) use values. Such wetland cover-types provide temporary foraging and roosting habitat for these evaluation species which is becoming scarce due to severe losses of such habitat in the Bay area over the last century. In subsided areas, seasonal wetlands occur where precipitation exceeds site drainage capacity. During these times, they provide significant forage values for migratory waterfowl and shorebirds. Based on recent Service observations of such areas in Phase I of Montezuma Wetlands in the spring of 1995, the regularity of flooding and bird use indicates such areas are of "high value", one of two designation criteria indicated by the Service's Mitigation Policy for Resource Category 2. Further, the seasonal wetland cover-type meets the Policy condition for Resource Category 2 as being "...relatively scarce or becoming scarce on a nation basis or in the ecoregion section". In accordance with the Mitigation Policy, we designate this cover-type as Resource Category 2, with its attendant mitigation planning goal of "no net loss of in-kind habitat value, or acreage."

The **intertidal mudflat** cover-type currently exists outboard of the HAAF and SLCP sites, and would be temporarily created by any of the proposed alternatives. This cover-type is defined as predominantly unvegetated (i.e., not more than 30 percent cover) area that is flooded and unflooded daily due to diurnal tidal cycles. The evaluation species selected for this cover-type include mud snails, softshell and littleneck clams, and ghost shrimp. These intertidal macroinvertebrates were selected because they provide high value forage for finfish and diving birds at high tide, and wading birds and shorebirds at low tide. The intertidal mudflat cover-type is of high value to these evaluation species and losses of such cover in the Bay area over the last century have been severe. Therefore, the Service has placed the intertidal cover-type in Resource Category 2 with its mitigation planning goal of "no net loss of in-kind habitat value, or acreage."

Tidal emergent marsh is the primary target cover-type which would be created by any of the alternatives; it currently exists outboard of the project levee. This cover-type is characterized by emergent vascular plants and tidal inundation either once or twice daily, and drainage by a complex of tidal channels. A wide variety of forage organisms and wildlife species utilize this cover-type, depending on the elevation, tidal regime, salinity and corresponding vegetative composition. Potential evaluation bird species would include marsh wren, red-winged blackbird, and various species of egrets, herons, rails, and marsh-associated songbirds like the salt marsh yellowthroat and salt marsh song sparrow. Finally, tidal marshes contribute to the productivity of adjacent open waters and tidal habitats through the production and transport of detritus and detritus-associated forage organisms. Tidal emergent marsh was formerly much more abundant in fringe marshes of central San Francisco and San Pablo Bays, and formed extensive stands in and around Suisun Bay. Most such areas have been lost through diking and conversion to agricultural use. Therefore, the Service has placed this cover-type in Resource Category 2 with its mitigation planning goal of “no net loss of in-kind habitat value, or acreage.”

The **non-tidal emergent marsh** cover-type includes permanent wetlands, in the form of scattered, partially vegetated irrigation drainages which would remain without dredge material disposal. Existing freshwater areas, though subject to disturbance through maintenance, are nonetheless foraging areas for evaluation species such as wading birds and waterfowl. In addition to the evaluation species, these area could provide some value to listed species like the salt marsh harvest mouse and clapper rail. We designate non-tidal emergent marsh as Resource Category 2 (i.e., a mitigation planning goal of “no net loss of in-kind habitat value, or acreage”).
Tidal Channels comprise a cover-type which is the subtidal part of the drainage system of the tidal emergent marsh component that would be created with the project. It provides foraging, spawning, and nursery habitat for a variety of native and introduced fishes. Though extremely important to these evaluation species, this cover-type has been impacted by the same reclamation activities that have affected the tidal emergent marsh. We have evaluated the aquatic benefits of this cover-type separately, and place it in Resource Category 2, with its mitigation planning goal of "no net loss of in-kind habitat value, or acreage."

Tidal ponds would be created with the project. They are hydrologically similar to tidal pannes (see below), but because of their location in the middle of the marsh plain, they usually receive tidal inundation from direct rainfall and spring tides, not from upland surface runoff. They support high densities of benthic invertebrates, therefore, shorebirds and waterfowl, which feed upon these invertebrates, were selected as the evaluation species for this cover-type because of the Service's responsibilities for their protection and management and their high consumptive (waterfowl hunting) and non-consumptive (bird-watching) use values. We designate non-tidal emergent marsh as Resource Category 2 (i.e., a mitigation planning goal of “no net loss of in-kind habitat value, or acreage”).

Tidal pannes would be created with the project. This cover-type is shallow and tidally-ponded, usually less than 6 inches deep, and would be located at the landward edge of the marsh plain in areas sometimes inundated by high tides. Tidal pannes impound saline water from high spring tides and fresh water flows from upland areas. This cover-type supports high densities of benthic invertebrates, thus, as with tidal ponds, shorebirds and waterfowl, which feed upon these invertebrates, were selected as the evaluation species for this cover-type because of the Service's responsibilities for their protection and management and their high consumptive (waterfowl hunting) and non-consumptive (bird-watching) use values. We designate non-tidal emergent marsh as Resource Category 2 (i.e., a mitigation planning goal of "no net loss of in-kind habitat value, or acreage").

This (unvegetated) **subtidal cover-type** that would be created with the project is defined as subtidal bottom substrates which lack vegetation. This cover-type provides habitat that varies in productivity with depth and dredging disturbance, and supports species such as shrimp and other macroinvertebrates, as well as fish like sturgeon, striped bass, steelhead trout and American shad. Bottom-dwelling fishes (sturgeon, flatfishes, rays) were selected as evaluation species for this cover-type because of their high commercial and sport-fishing importance within the Bay and nearby coastal waters, and their ability to represent other bottom dwellers, feeders, and lower trophic levels. Previously undredged, shallower benthic areas, such as those to be created at the HAAF and SLCP sites, would have significantly greater values to the evaluation species than areas that have been dredged, and are assigned a mitigation planning goal of "no net loss of habitat value while minimizing loss of in-kind habitat value" (Resource Category 3).

RESULTS

There are several issues of concern to the Service that we recommend be considered by the Corps for the proposed project. These are the: 1) amount of dredge material to be disposed; 2) various risks associated with the dredge material alternatives; 3) risks associated with vegetation creation; 4) internal peninsula design; 5) coordination with the revised Master Plan and mitigation proposals for Bel Marin Keys Unit 5, as well as other nearby parcels of land; 6) fill elevation and channel construction; 7) design and monitoring plan; 8) confirmation of the success of the Sonoma Baylands design; and 9) presence of various contaminants. Much of the following language is repeated from the Service's draft FWCA report for the Oakland Harbor 50-foot Navigation Project (USFWS 1998).

Although the Service supports the approach of maximum beneficial re-use in concept, past experiences raise the concern that the volume of material more often exceeds available re-use capacity, and outpaces planning efforts and traditional regulatory reviews for wetlands creation proposals. This was also the case for the 42-foot project at Oakland Harbor now under construction, in which only half of the 5 million cys is being used beneficially (at Sonoma Baylands), and the remainder is being disposed in the ocean. Similarly, for the 38-foot project at Richmond Harbor, a mere 183,000 cys is to be used beneficially (as a parking lot sub-base and remedial cover), and the bulk (1.7 million cys) is now being disposed in the ocean. Even though our agency supports tidal restoration as a goal, the HAAF and SLCP restoration planning is in early stages, and some constraints and potential problems still need more investigation.

One concern is the risk associated with large disposal efforts at either of the wetland creation sites. The use of dredged material for wetland creation is subject to diminished success owing to many factors, such as soil texture, soil chemistry (*e.g*., nutrients, sulfide toxicity), hydrology, and marsh elevation. The desired approach is not to complete these sites in one disposal action, but to implement the restoration "adaptively", in which a site is built gradually over an extended period of time, with each subsequent phase adjusted and refined in design based on the monitoring and success of earlier phases. Examples might include evaluating the degree of settlement of the grade following fill, the rates of sediment accretion, vegetative establishment, and other measures of ecological equivalence. Certain aspects of the design are subject to modification (*e.g*., channel dimension), however, other aspects such as sediment texture and settling rate would depend completely on the accuracy of pre-construction plan and design estimates.

Some examples of risks that apply to vegetation creation at the HAAF and SLCP sites include: 1) the tidal channels, if they do form, could eventually "slump" and fill in with salt marsh vegetation due to overfilling with dredged material; 2) if the dredged material forms a marsh plain that is too high, it will not support the desired marsh vegetation; 3) any subsidence could affect drainage patterns, species composition, and plant productivity (for instance, if the dredged material subsides, it will cause a "drowning" of new marsh until sedimentation increases the subsurface level to a height at which marsh plants will colonize; 4) exotic pepperweed, a non-desirable plant species, could cover a small or major portion of the high marsh, which would diminish wildlife values; and 5) the desired plant species may not successfully establish as a result of a lack of control of proper sediment texture or sediment accretion. Failure, for any of these reasons, may result in uncompensated losses of existing seasonal wetlands and grasslands values.

The HAAF and SLCP sites are within San Pablo Bay, a predominantly saline environment. Studies by Lee *et al*. (1995) using Pinole Shoal sediments, indicate that dredged material should support salt marsh plant and animal species with contaminant chemistry similar to reference wetlands in the Bay area. Growth studies were inconclusive; cordgrass (*Spartina*) grew poorly, which the authors attribute to transplant shock, while pickleweed (*Salicornia*) performed well. Elsewhere, in an attempt to re-create cordgrass at Sweetwater Marsh near San Diego using sandy dredged material, the soils accumulated less nitrogen and organic matter than reference areas, resulting in cordgrass too short and sparse for clapper rails, or colonization by a non-targeted plant, pickleweed (summarized in Malakoff 1998). In the San Francisco Bay region, pickleweed is a desired habitat feature for the listed salt marsh harvest mouse. As discussed earlier (see "Existing Biological Resources"), the HAAF site exhibits modest contamination. Dredged material could provide another benefit at HAAF if used as remedial cover over portions of the site, although this possibility would require much further study and coordination with the Service.

Also of lesser significance at HAAF and the SLCP sites are tradeoffs from existing values; the seasonal wetlands at the HAAF and SLCP are limited in area, and can be easily mitigated on site. The upland habitat at HAAF is considered of modest quality to wildlife; service roads, various buildings and the runway cause the area to be fragmented, and a portion of the grasslands are mowed regularly (JSA 1995). As the project design is currently envisioned by the Corps, some uplands would be created in the form of interior peninsulas within the tidal marsh, similar to those present in Sonoma Baylands, presumably for the purposes of reducing wind fetch and containing sediment prior to marsh revegetation. However, we recommend that more studies that would refine the proposed internal peninsula design.

The HAAF and SLCP sites are in close proximity to other human developments. Accordingly, we recommend a design plan include creation and/or designation of transitional upland area or buffer, especially between developed areas (such as where the New Hamilton Partners property lies to the west) and the proposed tidal restoration site. A minimum 100-foot-wide buffer is based on average buffers required to minimize human disturbance to waterbirds and other wildlife, and is consistent with a number of regulatory initiatives by various states and the California Coastal Commission. A wider buffer, at least 200-300 feet, may be required to protect specific habitat needs of resident endangered species such as the California clapper rail. This buffer would also provide upland habitat for displaced wildlife such as rabbits, squirrels, and deer.

The final EIS for the Bel Marin Keys, Unit 5 project, issued in August 1993, discussed the opportunity for restoration of historic baylands to natural tidal action, which would restore ecological linkage to adjacent habitats (Novato Creek mouth, Sonoma Baylands, San Pablo Bay Wildlife Management Area, and HAAF marshes) and create habitat for listed species such as the salt marsh harvest mouse, California clapper rail, and California black rail (TPG Management, Inc. *et al.* 1995). Incorporating the HAAF and SLCP sites with these adjacent parcels into a single project would increase the size of the restorable wetlands and add flexibility to the restoration design (NMFS 1995). The Service recommends that the habitat restoration and enhancement design for the HAAF and SLCP sites be coordinated with the revised Master Plan and any mitigation proposal for Bel Marin Keys Unit 5, as well as other nearby parcels of land.

The fill elevation and channel construction at HAAF should be carefully designed to optimize conditions for revegetation and natural channel formation. The greatest benefit of tidal restoration is likely to occur where the design fill elevations allow for natural deposition of material. For HAAF, BCDC (1995) indicated an elevation of about 0.5 foot below mean high water is the most appropriate for the growth of wetland vegetation. Channels should be created with steeper sides and larger dimensions than required so that natural sedimentation fills in the sides of the channels and provides a substrate for colonization of marsh plants such as cordgrass (Josselyn 1983). The design should consider any potential for settlement of underlying material or consolidation of the fill. The created tidal channels should be “linked” into the existing tidal channels, and the design should ensure that channel depths in the restored marsh would not be limited by runway position or remediated toxic sites (BCDC 1995).

To increase the likelihood of successful tidal marsh restoration, restoration goals should be set, and a design and monitoring plan prepared and approved by resource management and regulatory agencies with full public input. Monitoring should be done throughout all phases of the project to evaluate the progress of tidal marsh restoration and to establish criteria against which resource management and regulatory agencies can base decisions regarding any future designs (USACE 1994b). Monitoring should also include fill elevations, sedimentation rates, channel formation, sediment quality, and water quality (BCDC 1995). Levees should be maintained at least until full vegetation establishment. For the HAAF and SLCP sites, there are significant risks of failure which must be evaluated. Contingency plans should be devised for either site in the event of partial or complete restoration failure.

The recently constructed Sonoma Baylands project could serve as a model for assessing some, though not all, of these risks. However, at least 5 years of post-construction monitoring is needed before success criteria can begin to be evaluated and the results incorporated into the design of other projects. Because large-scale restoration opportunities are limited, and not easily altered after construction, it would be prudent to defer any further large restoration effort in order to confirm the success of the Sonoma Baylands design before applying it to other large sites. This should not exclude the possibility of using the HAAF and SLCP sites for dredged material disposal, since contaminant cleanup at HAAF is anticipated to take until the end of 1999. The Corps should also examine the development of other large tidal restorations in the North Bay, namely, Muzzi Marsh, Bel Marin Keys Unit 4, and Ignacio Industrial Park (see SFEP 1991 for references).

A final but significant issue specific to HAAF is the presence of various contaminants from prior base activities. It was initially anticipated that the Army would conduct a risk assessment and complete contaminant cleanup by 1997 (USACE 1995), however, it is now anticipated it will be completed, as mentioned, by the end of 1999. The Service concurs with the recommendations from BCDC (1995) to prevent exposure of wildlife to contaminants following restoration to tidal action. These include, in addition to fulfilling regulatory guidelines, (a) designing any necessary containment "caps" over residual contaminated soils to withstand tidal action, particularly in the vicinity of major channels, (b) conducting random testing of biota, sediment quality, surface water, groundwater, and decant water for compliance with levels determined to not cause injury to trust resources, and (c) monitoring for the potential movement of contaminants from dredged material to surrounding soils or water.

RECOMMENDATIONS

If the project is constructed, the Service recommends that the Corps implement the following:

For disposal of "cover" material at the HAAF and SLCP site:

1. Defer the dredge material disposal alternatives (Alternatives 3 and/or 5) at the HAAF and SLCP sites until such time that 5 years of post-construction monitoring data from the Sonoma Baylands site are available. Until this is completed, the Service defers a recommendation concerning the alternative designs of the site.

2. Evaluate the Sonoma Baylands monitoring data and other similar restoration projects, and refine the HAAF and SLCP sites concept design to maximize success.

However, if the project is pursued prior to obtaining such data, implement recommendations 3-16 below:

1. Avoid impacts to existing wetland habitats (specifically the Corps-delineated saltgrass-saltmarsh wetland and saltgrass-alkali heath wetland), by not grading over them during site preparation activities. These wetlands currently contain good foraging and cover habitat for a number of species, such as waterfowl.

2. Minimize impacts to the grassland/herbaceous cover-type by reseeding all impact areas of the upland herbaceous habitat not within the newly created tidal inundation zone, including all staging and access areas, with native grasses and forbs. Also, reseed all levees and dikes in the area. Conduct reseeding just prior to the rainy season to enhance germination and plant establishment. The estimated cost to reseed the affected areas is $800/acre.

3. Minimize contaminant exposure following restoration to tidal action by: a) designing any containment "caps" over residual contaminated soils to withstand tidal action, especially in areas where channels would be constructed or may form; b) conducting random testing of biota, sediment quality, surface water, groundwater, and decant water for compliance with levels determined to not cause injury to trust resources; and c) monitoring for the potential movement of contaminants from dredged material to surrounding soils or water.

4. Minimize impacts to wildlife by creating a transitional upland area, especially between developed areas (such as where the New Hamilton Partners property lies to the west) and the proposed tidal restoration site, which would include a slope of at least 100 feet. A wider buffer may be required to protect specific habitat needs of resident endangered species, such as the California clapper rail.

5. Implement the following, pursuant to section 7 of the Endangered Species Act:
   a) determine the potential effects of the proposed project on listed, proposed, and candidate species or critical habitat, by conducting surveys for the species or potential habitat, as appropriate (refer to Appendix C for a list of these potentially affected species; b) should any listed or proposed species or critical habitat be present, complete a Biological Assessment to determine whether the project may affect the species or critical habitat; c) should the proposed action be likely to adversely affect the species or its critical habitat, initiate formal consultation with the Service or NMFS, as appropriate; and d) implement the following to minimize potential adverse effects to the California clapper rail and salt marsh harvest mouse: i) avoid potential impacts to breeding California clapper rails by: ceasing construction work on levees (or laying of pipelines to convey dredged materials) within 250 feet of suitable clapper rail habitat during the clapper rail breeding season (February 1 through August 31), and locating such pipelines outside of suitable clapper rail habitat; and ii) minimize potential death or injury to the salt marsh harvest mouse by constructing exclusion fences where potential impacts may occur to suitable harvest mouse habitat, and trapping within the fences according to Service-approved methodology. A final determination will be made during the section 7 consultation regarding recommendations for avoidance measures for the species.

6. Develop, and provide to the Service, a more complete and detailed design, including a map of target elevations and cover-types, locations of major channels and levee breaches, etc. The design should take into account the need to underfill marshes to allow for natural sedimentation over the dredged material. Hydrologic modeling should be conducted to size and locate the channels and breaches.

7. Determine the capability of vegetation successfully growing in the dredged material, which would be composed mainly of sandy material, after it is deposited.

8. Develop a final monitoring plan, subject to the review and approval by the Service and other appropriate agencies, before the placement of any dredged materials on-site. Include in this monitoring plan the following components: a) a field and/or lab assessment of the bioaccumulation of trace metals and organochlorines in intertidal organisms; b) quantification of wildlife activity; and c) quantification of changes to adjacent outboard wetland habitats.

9. Provide the following for Service evaluation: a) rates of sedimentation following restoration to tidal action; b) identify constraints imposed by toxic remediation such as location of channels and minimum cover levels; and c) identify any relevant flood control considerations including, but not limited to, pumping of surface waters from adjacent areas.

10. Design the project to ensure continued functioning of 33-acre seasonal wetland/adjacent upland parcel which was created as mitigation for closure of Landfill 26.

11. Coordinate the habitat restoration and enhancement design for the HAAF with the revised Master Plan and any mitigation proposal for Bel Marin Keys Unit 5 and other adjacent parcels that have potential for tidal marsh restoration.

12. Investigate further the following: a) frequency, duration, velocity, and elevation of tidal flooding at the site; b) water quality, circulation and flushing conditions from both the Bay and freshwater sources; c) existing and target ground elevations, given that site elevations are presently below mean sea level; d) measures to achieve conditions favorable to sedimentation and wetlands plant establishment; e) mosquito abatement control needs; f) location of cuts in the bayward levee and the need to cut through existing tidal wetlands and mudflats; and g) long-term management and monitoring requirements.

13. Develop a public access component for the project. The provision of public access that would increase public appreciation and use of the shoreline and that is compatible with protection of resource values will need careful design and review.

14. Consider the "additional information needs related to base closure, Novato Sanitary District Facilities, and Adjacent Properties" and implement the proposed "wetland design development studies" found on pages 7-1 through 7-2 in the draft "Executive Summary" for the "Hamilton Wetlands Conceptual Restoration Plan" (Woodward-Clyde, *et al.* 1998). Although all information needs and studies are important, we are especially interested in

studies that would: a) refine estimates of the time frame for tidal wetlands creation; b) refine the proposed internal peninsula design; c) allow observation of vegetation and hydrologic characteristics of similar seasonal wetlands created on sand and dredged bay mud substrates; and d) refine the tidal panne design.

15. Modify the existing design for all alternatives in order to use dredge material to allow high marsh to form around the interior edges of the HAAF and SLCP sites (about 200 feet out), and then allow natural sedimentation create cover-types on the remainder of the interior.

16. Complete all investigations of the SLCP site so that the area can be accessed by the Service in order for us to complete the HEP analysis.

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