

Appendix A. References

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Appendix B. Species Lists

- Vegetation
- Invertebrate
- Fish
- Bird
- Mammal

Vegetation List

Scientific Name	Family	Common Name	Non-native	Invasive	Status
<i>Sesuvium verrucosum</i>	Aizoaceae	Western sea purslane			
<i>Tetragonia tetragonioides</i>	Aizoaceae	New Zealand spinach	Y		
<i>Conium maculatum</i>	Apiaceae	Poison hemlock	Y		
<i>Foeniculum vulgare</i>	Apiaceae	Common Fennel	Y		
<i>Achillea millefolium</i>	Asteraceae	Common yarrow			
<i>Baccharis pilularis</i>	Asteraceae	Coyote brush			
<i>Centaurea calcitrapa</i>	Asteraceae	Purple star thistle	Y	Y	
<i>Centaurea solstitialis</i>	Asteraceae	Yellow star thistle	Y	Y	
<i>Cirsium vulgare</i>	Asteraceae	Bull thistle	Y	Y	
<i>Cotula coronopifolia</i>	Asteraceae	Brass buttons	Y	Y	
<i>Gnaphalium stramineum</i>	Asteraceae	Cudweed			
<i>Grindelia stricta</i>	Asteraceae	Gum plant			
<i>Dittrichia graveolens</i>	Asteraceae	Stinkwort	Y	Y	
<i>Jaumea carnosa</i>	Asteraceae	Salt marsh daisy			
<i>Lactuca serriola</i>	Asteraceae	Prickly lettuce	Y	Y	
<i>Picris echioides</i>	Asteraceae	Bristly ox tongue	Y	Y	
<i>Silybum marianum</i>	Asteraceae	Milk thistle	Y	Y	
<i>Sonchus asper</i>	Asteraceae	Prickly sow thistle	Y		
<i>Sonchus oleraceus</i>	Asteraceae	Common sow thistle	Y		
<i>Amsinckia menziesii</i>	Boraginaceae	Coast fiddlehead			
<i>Lepidium latifolium</i>	Brassicaceae	Perennial pepperweed	Y	Y	
<i>Brassica rapa</i>	Brassicaceae	Field Mustard	Y	Y	
<i>Raphanus sativus</i>	Brassicaceae	Common wild radish	Y	Y	
<i>Spergula arvensis</i>	Caryophyllaceae	Stickwort	Y		
<i>Spergularia macrotheca</i>	Caryophyllaceae	Sand spurrey			
<i>Spergularia rubra</i>	Caryophyllaceae	Sand spurrey			
<i>Atriplex triangularis</i>	Chenopodiaceae	Fat hen			
<i>Salicornia europaea</i>	Chenopodiaceae	European pickleweed			
<i>Atriplex semibaccata</i>	Chenopodiaceae	Australian saltbush	Y	Y	
<i>Salicornia virginica</i>	Chenopodiaceae	Common pickleweed			
<i>Sarcocornia pacifica</i>	Chenopodiaceae	Pickleweed			
<i>Cuscuta salina</i>	Cuscutaceae	Dodder			
<i>Scirpus americanus</i>	Cyperaceae	American bulrush			
<i>Scirpus spp.</i>	Cyperaceae	Bulrush			
<i>Scirpus californicus</i>	Cyperaceae	California bulrush			
<i>Scirpus maritimus</i>	Cyperaceae	Salt marsh bulrush			
<i>Lathyrus jepsonii</i> var. <i>jepsonii</i>	Fabaceae	Delta tule pea			SR
<i>Lotus corniculatus</i>	Fabaceae	Bird's foot trefoil	Y		
<i>Vicia sativa</i>	Fabaceae	Common vetch	Y		
<i>Frankenia salina</i>	Frankeniaceae	Alkali heath			
<i>Juncus balticus</i>	Juncaceae	Baltic rush			
<i>Lythrum hyssopifolium</i>	Lythraceae	Loosestrife			
<i>Eucalyptus spp.</i>	Myrtaceae	Eucalyptus	Y	Y	
<i>Limonium californicum</i>	Plumbaginaceae	Sea lavender			
<i>Bromus hordeaceus</i>	Poaceae	Soft chess	Y	Y	
<i>Festuca myuros</i>	Poaceae	Fox tail	Y	Y	
<i>Lolium multiflorum</i>	Poaceae	Italian rye grass	Y	Y	
<i>Agrostis avenacea</i>	Poaceae	Bent grass	Y	Y	
<i>Avena fatua</i>	Poaceae	Wild oats	Y	Y	
<i>Bromus diandrus</i>	Poaceae	Rip gut brome	Y	Y	
<i>Distichlis spicata</i>	Poaceae	Salt grass			
<i>Hordeum marinum</i>	Poaceae	Mediterranean barley	Y		
<i>Lolium perenne</i>	Poaceae	Perennial rye grass	Y		
<i>Polypogon monspeliensis</i>	Poaceae	Rabbitfoot beard grass	Y	Y	
<i>Spartina foliosa</i>	Poaceae	Cord grass			

Vegetation List

Scientific Name	Family	Common Name	Non-native	Invasive	Status
<i>Polygonum marinense</i>	Polygonaceae	Marin knotweed			
<i>Polygonum arenastrum</i>	Polygonaceae	Prostrate knotweed	Y		
<i>Rumex crispus</i>	Polygonaceae	Curly dock	Y	Y	
<i>Ruppia maritima</i>	Potamogetonaceae	Ditch grass			
<i>Anagallis arvensis</i>	Primulaceae	Scarlet pimpernel	Y		
<i>Glaux maritima</i>	Primulaceae	Sea milkwort			
<i>Cordylanthus mollis ssp. mollis</i>	Scrophulariaceae	Soft bird's-beak			SR, FE
<i>Scrophularia californica</i>	Scrophulariaceae	Bee plant			
<i>Typhus latifolia</i>	Typhaceae	Broad-leaved cattail			

Invertebrate List

Scientific Name	Common Name	Non-native	Status
<i>Cancer antennarius</i>	Brown rock crab		
<i>Cancer gracilis</i>	Slender crab		
<i>Cancer productus</i>	Red rock crab		
<i>Carcinus maenas</i>	Green crab		
<i>Cnidarian</i>	Jellyfish		
<i>Crangon spp.</i>	Crangon shrimp		
<i>Crangon franciscorum</i>	California bay shrimp		
<i>Crangon nigricauda</i>	Blacktail bay shrimp		
<i>Crangon nigromaculata</i>	Blackspotted bay shrimp		
<i>Eriocheir sinensis</i>	Chinese mitten crab	Y	
<i>Exopalaemon modestus</i>	Siberian prawn		
<i>Hemigrapsus sp.</i>	Hemigrapsus crab		
<i>Heptacarpus stimpsoni</i>	Stimpson coastal shrimp		
<i>Metacarcinus magister</i>	Dungeness crab		
<i>Palaemon macrodactylus</i>	Oriental shrimp	Y	
<i>Palaemon sp.</i>	Palaemon shrimp		

Fish List

Scientific Name	Common Name	Non-native	Status
<i>Acanthogobius flavimanus</i>	Yellowfin goby	Y	
<i>Alosa sapidissima</i>	American shad	Y	
<i>Atherinops affinis</i>	Topsmelt		
<i>Catostomus occidentalis</i>	Sacramento sucker		
<i>Citharichthys stigmaeus</i>	Speckled sanddab		
<i>Clevelandia ios</i>	Arrow goby		
<i>Clupea pallasii</i>	Pacific herring		
<i>Cottus asper</i>	Prickly sculpin		
<i>Cottus gulosus</i>	Riffle sculpin		
<i>Cymatogaster aggregata</i>	Shinerperch		
<i>Dorosoma petenense</i>	Threadfin shad	Y	
<i>Engraulis mordax</i>	Northern anchovy		
<i>Gambusia affinis</i>	Western mosquitofish	Y	
<i>Gasterosteus aculeatus</i>	Three-spined stickleback		
<i>Genyonemus lineatus</i>	White croaker		
<i>Gillichthys mirabilis</i>	Longjaw mudsucker		
<i>Hypomesus nipponensis</i>	Wakasagi goby	Y	
<i>Hypomesus pretiosus</i>	Surf smelt		
<i>Hypomesus transpacificus</i>	Delta smelt		FT, ST
<i>Hysterocarpus traskii</i>	Tule perch		
<i>Ilypnus gilberti</i>	Cheekspot goby		
<i>Lavinia symmetricus</i>	California roach		
<i>Lepidogobius lepidus</i>	Bay goby		
<i>Lepomis cyanellus</i>	Green sunfish	Y	
<i>Leptocottus armatus</i>	Pacific staghorn sculpin		
<i>Lucania parva</i>	Rainwater killifish	Y	
<i>Menidia beryllina</i>	Inland silverside	Y	
<i>Micrometrus minimus</i>	Dwarf perch		
<i>Morone saxatilis</i>	Striped bass	Y	
<i>Mustelus henlei</i>	Brown smooth-hound		
<i>Oncorhynchus mykiss irideus</i>	Steelhead/Rainbow trout		
<i>Oncorhynchus tshawytscha</i>	Chinook salmon		
<i>Orthodon microlepidotus</i>	Sacramento blackfish		
<i>Paralichthys californicus</i>	California Halibut		
<i>Parophrys vetulus</i>	English sole		
<i>Pimephales promelas</i>	Fathead minnow	Y	
<i>Platichthys stellatus</i>	Starry flounder		
<i>Pogonichthys macrolepidotus</i>	Sacramento splittail		ST
<i>Porichthys notatus</i>	Plainfin midshipman		
<i>Ptychocheilus grandis</i>	Sacramento pikeminnow		
<i>Spirinchus thaleichthys</i>	Longfin smelt		
<i>Stizostedion vitreum</i>	Walleye surfperch		
<i>Symphurus atricauda</i>	California tonguefish		
<i>Syngnathus leptorhynchus</i>	Bay pipefish		
<i>Triakis semifasciata</i>	Leopard shark		
<i>Tridentiger barbatus</i>	Shokihaze goby	Y	

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Fish List

Scientific Name	Common Name	Non-native	Status
<i>Tridentiger bifasciatus</i>	Shimofuri goby	Y	

Bird List

Common Name	Scientific Name	Status
<u>Grebes</u>		
Horned grebe	<i>Podiceps auritus</i>	
Eared grebe	<i>Podiceps nigricollis</i>	
Pied-billed grebe	<i>Podilymbus podiceps</i>	
Western grebe	<i>Aechmophorus occidentalis</i>	
Clark's grebe	<i>Aechmophorus clarkii</i>	
<u>Pelecaniformes</u>		
American white pelican	<i>Pelecanus erythrorhynchos</i>	CSC (breeding)
Brown pelican	<i>Pelacanus occidentalis</i>	CSC (breeding)
Double-crested cormorant	<i>Phalacrocorax auritus</i>	CSC (breeding)
<u>Wading Birds</u>		
American bittern	<i>Botaurus lentiginosus</i>	CSC (breeding)
Great blue heron	<i>Ardea herodias</i>	CSC (breeding)
Great egret	<i>Ardea alba</i>	CSC (breeding)
Snowy egret	<i>Egretta thula</i>	CSC (breeding)
Black-crowned night-heron	<i>Nycticorax nycticorax</i>	CSC (breeding)
<u>Geese and ducks</u>		
Greater white fronted goose	<i>Anser albifrons</i>	
Canada goose	<i>Branta canadensis</i>	
Mallard	<i>Anas platyrhynchos</i>	
Gadwall	<i>Anas strepera</i>	
Northern pintail	<i>Anas acuta</i>	
American wigeon	<i>Anas americana</i>	
Northern shoveler	<i>Anas clypeata</i>	
Cinnamon teal	<i>Anas cyanoptera</i>	
Green-winged teal	<i>Anas crecca</i>	
Canvasback	<i>Aythya valisineria</i>	CSC (breeding)
Redhead	<i>Aythya americana</i>	CSC (breeding)
Greater scaup	<i>Aythya marila</i>	
Lesser scaup	<i>Aythya affinis</i>	
Long-tailed duck	<i>Clangula hyemalis</i>	
Surf scoter	<i>Melanitta perspicillata</i>	
Common goldeneye	<i>Bucephala clangula</i>	
Bufflehead	<i>Bucephala albeola</i>	
Ruddy duck	<i>Oxyura jamaicensis</i>	
<u>Raptors</u>		
Northern harrier	<i>Circus cyaneus</i>	CSC (breeding)
White-tailed kite	<i>Elanus leucurus</i>	CSC (breeding)
Cooper's hawk	<i>Accipiter cooperii</i>	CSC (breeding)
Sharp-shinned hawk	<i>Accipiter striatus</i>	CSC (breeding)
Red-shouldered hawk	<i>Buteo lineatus</i>	
Red-tailed hawk	<i>Buteo jamaicensis</i>	
Swainson's hawk	<i>Buteo swainsoni</i>	ST, CC, CSC (breeding)

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Bird List

Common Name	Scientific Name	Status
Ferruginous hawk	<i>Buteo regalis</i>	CSC (wintering)
Rough-legged hawk	<i>Buteo lagopus</i>	
Osprey	<i>Pandion haliaetus</i>	CSC (breeding)
Golden eagle	<i>Aquila chrysaetos</i>	
American kestrel	<i>Falco sparverius</i>	
Prairie falcon	<i>Falco mexicanus</i>	CSC (breeding)
Merlin	<i>Falco columbarius</i>	CSC (wintering)
Peregrine falcon	<i>Falco peregrinus</i>	CC, CSC (breeding)
Turkey vulture	<i>Cathartes aura</i>	
<u>Upland Game Birds</u>		
Ring-necked pheasant	<i>Phasianus colchicus</i>	
<u>Gruiformes</u>		
American coot	<i>Fulica americana</i>	
California clapper rail	<i>Rallus longirostris obsoletus</i>	FE, SE
Virginia rail	<i>Rallus limicola</i>	
Sora	<i>Porzana carolina</i>	
California black rail	<i>Laterallus jamaicensis coturniculus</i>	ST, CC
<u>Shorebirds</u>		
Black-bellied plover	<i>Pluvialis squatarola</i>	
American golden-plover	<i>Pluvialis dominica</i>	
Semipalmated plover	<i>Charadrius semipalmatus</i>	CC
Western snowy plover	<i>Charadrius alexandrinus nivosus</i>	FT, CC
Killdeer	<i>Charadrius vociferus</i>	
Black oystercatcher	<i>Haematopus bachmani</i>	CC
American Avocet	<i>Recurvirostra americana</i>	
Black-necked stilt	<i>Himantopus mexicanus</i>	
Greater yellowlegs	<i>Tringa melanoleuca</i>	
Lesser yellowlegs	<i>Tringa flavipes</i>	CC
Willet	<i>Catoptrophorus semipalmatus</i>	
Whimbrel	<i>Numenius phaeopus</i>	CC
Long-billed curlew	<i>Numenius americanus</i>	CC, CSC (breeding)
Marbled godwit	<i>Limosa fedoa</i>	CC
Black turnstone	<i>Arenaria melanocephala</i>	
Red knot	<i>Calidris canutus</i>	
Sanderling	<i>Calidris alba</i>	
Dunlin	<i>Calidris alpina</i>	
Western sandpiper	<i>Calidris mauri</i>	
Least sandpiper	<i>Calidris minutilla</i>	
Long-billed dowitcher	<i>Limnodromus scolopaceus</i>	
Short-billed dowitcher	<i>Limnodromus griseus</i>	CC
Wilson's snipe	<i>Gallinago delicata</i>	
Wilson's phalarope	<i>Phalaropus tricolor</i>	
Red-necked phalarope	<i>Phalaropus lobatus</i>	
<u>Gulls/Terns</u>		

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Bird List

Common Name	Scientific Name	Status
Bonaparte's gull	<i>Larus philadelphia</i>	
Franklin's gull	<i>Larus pipixcan</i>	
Ring-billed gull	<i>Larus delawarensis</i>	
California gull	<i>Larus californicus</i>	CSC (breeding)
Herring gull	<i>Larus argentatus</i>	
Glaucous-winged gull	<i>Larus glaucescens</i>	
Western gull	<i>Larus occidentalis</i>	
Heermann's gull	<i>Larus heermanni</i>	
Caspian tern	<i>Sterna caspia</i>	CSC (breeding)
Forster's tern	<i>Sterna forsteri</i>	CSC (breeding)
Least tern	<i>Sterna antillarum</i>	SE, FE
Black tern	<i>Chlidonias niger</i>	CSC (breeding)
<u>Alcids</u>		
Common murre	<i>Uria aalge</i>	
<u>Pigeons/Doves</u>		
Mourning dove	<i>Zenaida macroura</i>	
Rock dove	<i>Columba livia</i>	
<u>Owls</u>		
Barn Owl	<i>Tyto alba</i>	
Long-eared owl	<i>Asio otus</i>	CSC (breeding)
Short-eared owl	<i>Asio flammeus</i>	
Great-horned owl	<i>Bubo virginianus</i>	CSC
Western burrowing owl	<i>Athene cunicularia hypugea</i>	CSC (breeding/some wintering), CC
<u>Swifts</u>		
Vauxs swift	<i>Chaetura vauxi</i>	CSC (breeding)
<u>Hummingbird</u>		
Anna's hummingbird	<i>Calypte anna</i>	
Allen's hummingbird	<i>Selasphorus sasin</i>	CC, CSC (breeding)
<u>Woodpeckers</u>		
Northern flicker	<i>Colaptes auratus</i>	
<u>Flycatchers</u>		
Black phoebe	<i>Sayornis nigricans</i>	
Say's phoebe	<i>Sayornis saya</i>	
<u>Shrikes</u>		
Loggerhead shrike	<i>Lanius ludovicianus</i>	CC, CSC (breeding)
<u>Jays, Crows, Ravens</u>		
Scrub jay	<i>Aphelocoma californica</i>	
Common raven	<i>Corvus corax</i>	

Bird List

Common Name	Scientific Name	Status
American crow	<i>Corvus brachyrhynchos</i>	
Horned lark	<i>Eremophila alpestris</i>	
<u>Swallows</u>		
Northern rough-winged swallow	<i>Stelgidopteryx serripennis</i>	
Tree swallow	<i>Tachycineta bicolor</i>	
Violet-green swallow	<i>Tachycineta thalassina</i>	
Cliff swallow	<i>Petrochelidon pyrrhonota</i>	
Barn swallow	<i>Hirundo rustica</i>	
<u>Chickadees</u>		
Bushtit	<i>Psaltriparus minimus</i>	
<u>Wrens</u>		
Marsh wren	<i>Cistothorus palustris</i>	
<u>Thrushes</u>		
American robin	<i>Turdus migratorius</i>	
<u>Pipits</u>		
American pipit	<i>Anthus rubescens</i>	
<u>Waxwings</u>		
European starling	<i>Sturnus vulgaris</i>	
<u>Wood-warblers</u>		
Salt marsh common yellowthroat	<i>Geothlypis trichas sinuosa</i>	CC
<u>Sparrows</u>		
Savannah sparrow	<i>Passerculus sandwichensis</i>	
Golden-crowned sparrow	<i>Zonotrichia atricapilla</i>	
White-crowned sparrow	<i>Zonotrichia leucophrys</i>	
Song sparrow	<i>Melospiza melodia</i>	
Alameda song sparrow	<i>Melospiza melodia pusillula</i>	
San Pablo song sparrow	<i>Melospiza melodia samuelis</i>	CC
<u>Icterids</u>		
Western meadowlark	<i>Sturnella neglecta</i>	
Brown-headed cowbird	<i>Molothrus ater</i>	
Red-winged blackbird	<i>Agelaius phoeniceus</i>	
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	
<u>Finches</u>		
House finch	<i>Carpodacus mexicanus</i>	
American goldfinch	<i>Carduelis tristis</i>	

Mammal List

Common Name	Scientific Name	Status
Opossum	<i>Didelphis marsupialis</i>	
Salt marsh wandering shrew	<i>Sorex vagrans haliocoetes</i>	CSC
Ornate shrew	<i>Sorex ornatus</i>	
Suisun shrew	<i>Sorex sinuosus</i>	CSC
Raccoon	<i>Procyon lotor</i>	
River otter	<i>Lontra canadensis</i>	
Skunk	<i>Mephitis mephitis</i>	
Coyote	<i>Canis latrans</i>	
Harbor seal	<i>Phoca vitulina</i>	
Beaver	<i>Castor canadensis</i>	
Western harvest mouse	<i>Reithrodontomys megalotis</i>	
Salt marsh harvest mouse	<i>Reithrodontomys raviventris</i>	FE, SE
Deer mouse	<i>Peromyscus maniculatus</i>	
California vole	<i>Microtus californicus</i>	CSC
Muskrat	<i>Ondatra zibethicus</i>	
Norway rat	<i>Rattus norvegicus</i>	
House mouse	<i>Mus musculus</i>	
California Ground Squirrel	<i>Citellus beecheyi</i>	
Blacktail jackrabbit	<i>Lepus californicus</i>	
Black-tailed deer	<i>Odocoileus hemionus</i>	

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Glossary of Terms and Acronyms

CCP	Comprehensive Conservation Plan
CDFG	California Department of Fish and Game
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
GIS	Geographic Information System
I&M	Inventory and Monitoring
NEPA	National Environmental Policy Act
NWR	National Wildlife Refuge
NWRS/Refuge System	National Wildlife Refuge System
Refuge	San Pablo Bay National Wildlife Refuge
RLGIS	Refuge Lands Geographic Information System
SLAMM	Sea-Level Affecting Marsh Model
Central California	
USDA	U.S. Department of Agriculture
USFWS/Service	U.S. Fish and Wildlife Service
1997 Improvement Act	The National Wildlife Refuge System Improvement Act of 1997

Chapter 1. Purpose and Need for Action

Introduction

This environmental assessment (EA), in accordance with the requirements of the National Environmental Policy Act (NEPA), evaluates the environmental effects of three alternatives for managing the San Pablo Bay National Wildlife Refuge (Refuge) as presented in the draft Comprehensive Conservation Plan (CCP). The purpose of the CCP (also referred to as the *plan*) is to provide a 15-year management plan for the Refuge and long-term guidance in relation to management decisions, as directed by the National Wildlife Refuge System Improvement Act of 1997 (1997 Improvement Act). Both direction and guidance are described in detail through a set of goals, objectives, and strategies in the CCP.

Plan Area

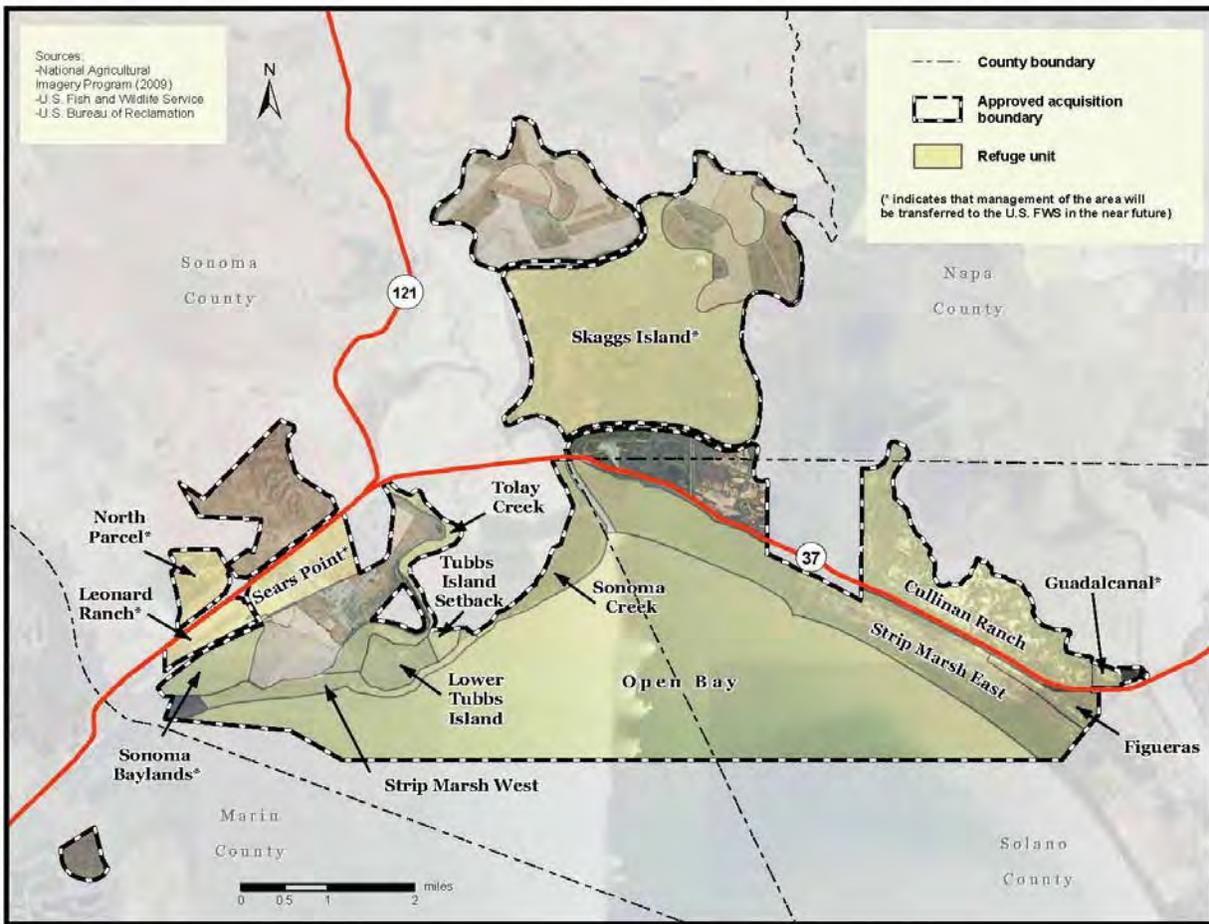
The Refuge abuts the northern edge of the San Francisco Bay Estuary. This sub region of the Estuary is also called San Pablo Bay. The Refuge extends into Sonoma, Napa and Solano Counties. According to Bay Area Air Quality Management District San Pablo Bay sits in the Cotati/Petaluma, Sonoma Valley, and Napa Valley regions. Eight non-contiguous units make up the Refuge: Figueras, Guadalcanal, Lower Tubbs Island, Tubbs Island Setback, Tolay Creek, Cullinan Ranch, Strip Marsh, and the open bay/mudflats. Some of these units are owned by the California State Lands Commission (see Figure 1), but managed by the Service. The Refuge is an important stopping point for migratory waterfowl, shorebirds, and songbirds. Endangered species including California clapper rail and salt marsh harvest mouse rely on the Refuge habitat for breeding and resting habitat.

Proposed Action

The Service proposes to develop and implement a CCP for the San Pablo Bay Refuge that best achieves the purposes for which the Refuge was established, helps fulfill the mission of the National Wildlife Refuge System, is consistent with sound fish and wildlife management, and ensures that the biological integrity, diversity, and environmental health of the Refuge System are maintained.

The Service examined a range of management alternatives. A description of these alternatives is contained in Chapter 2. Alternative C represents the Service's proposed action for the Refuge; however, the final decision can be any of the alternatives, and may reflect a modification of certain elements of any alternative based on consideration of public comment. Of the alternatives evaluated, this alternative appears to best achieve the purpose, vision, and goals for the Refuge, while also appropriately addressing the major issues and relevant mandates identified for the Refuge during the development of the CCP.

Figure 1. San Pablo Bay NWR



Purpose and Need for the Proposed Action

The development of the CCP provides guidance for conducting general Refuge operations, wildlife and habitat management, habitat enhancement and restoration, cultural resource management, and visitor services. The CCP is intended to ensure that management actions are consistent with the purposes for which the Refuge was established, the mandates of the Refuge System, and the Refuge’s goals and objectives. The purpose of the CCP is to describe the desired future conditions of San Pablo Bay Refuge over the next 15 years and provide guidance for achieving those conditions. The CCP accomplishes the following:

- Sets a long term vision for the Refuge;
- Establishes management goals, objectives, and strategies for the Refuge;
- Provides the Refuge with a 15-year management plan for the conservation of fish, wildlife, and plant resources and their related habitats;
- Defines compatible public uses;
- Develops a plan that, when fully implemented, will achieve Refuge purposes, help fulfill the mission of the System, and maintain and, where appropriate, restore ecological integrity;
- Communicates the Service’s management priorities for the Refuge to the public; and

- Provides a basis for budget needs to support staffing, operations, maintenance, and capital improvements.

The development of this CCP is also required to fulfill legislative obligations of the Service. The National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act), requires that every refuge or related complex of refuges have a CCP in place within 15 years of the Improvement Act's enactment. In order to comply with NEPA, an EA or Environmental Impact Statement (EIS) which evaluates the effects of different alternatives that meet the goals of the Refuge must be prepared to accompany the CCP. The Draft CCP and its appendices are herein incorporated by reference.

NEPA and this Document

NEPA requires federal agencies to consider the environmental effects of all actions¹ they undertake. This EA evaluates the effects of various alternative management scenarios for the Refuge. Federal agencies must also consider the environmental effects of a reasonable range of alternatives and make public the environmental effects of the preferred alternative and other reasonable alternatives. If adverse environmental effects are identified, NEPA requires an agency to identify means to mitigate those adverse effects. An EA documents that an agency has considered and addressed all these issues. This EA has been prepared to assess the environmental effects of the action alternatives. The U.S. Fish and Wildlife Service (Service) will also use this EA process to solicit public involvement in the refuge planning process and determine whether the CCP will have a significant effect on the quality of the human environment, as well.

This EA discusses the purpose and need for the San Pablo Bay National Wildlife Refuge CCP; it also provides an analysis of the impacts that could be expected from each of the management proposals outlined in the plan. This analysis will help the Service determine if it will need to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI) regarding the preferred alternative for the Refuge.

The policies of the Service, the 1997 Improvement Act, and NEPA require the Service to actively seek public involvement in the preparation of environmental documents. NEPA also requires the Service to give serious consideration to all reasonable alternatives for managing refuges, including the no-action alternative representing continuation of current conditions and management practices. Alternative management scenarios were developed as part of the planning process described in this EA.

This EA describes the existing resources on the Refuge and the projected environmental effects of the three management alternatives on those resources. Two of the three alternatives presented in this EA are *action alternatives* that would involve a change in the current management of the Refuge. The remaining alternative is the *no-action alternative*, under which current management of the Refuge would continue, and which provides a basis of comparison to the action alternatives. A final CCP would be prepared regardless of which alternative is selected.

¹ Under NEPA and implementing regulations, *action* refers to a policy, plan, program, or project that is implemented, funded, permitted, or controlled by a federal agency or agencies.

Decisions to be Made

Based on the analysis documented in this EA, the Regional Director must determine the type and extent of management and visitor service opportunities on the Refuge and if the selected management alternative would have a significant effect on the quality of the environment. If the selected alternative has no significant impacts, then the Service would prepare a Finding of No Significant Impact (FONSI). If the proposed management alternative is found to have significant impacts, then the Service would prepare an Environmental Impact Statement before making a decision.

The planning team has recommended Alternative C for implementation. The Service will make a final selection of an alternative to implement in the CCP, based on this document and the input received from the public during the comment process. The plan will be monitored annually and revised when necessary.

Comprehensive Conservation Planning Process

The Service developed the CCP using a systematic decision-making approach that encouraged public involvement in management decisions throughout the planning process. A planning team was assembled (see Chapter 5) of personnel from the Service's San Francisco Bay National Wildlife Refuge Complex. The Service contacted a wide array of people to participate, including representatives of federal agencies, Congress, state officials, state conservation agencies, conservation organizations, local interest groups, and other members of the public. These interested participants and local residents received announcements regarding the location, date, and time for the initial scoping meeting. At the scoping meeting the staff explained the Refuge's purpose, history, and laws and regulations governing management, as well as the purpose and need for the CCP and the relevant management activities and issues.

The planning team consists primarily of Refuge staff, Service technical experts, and other landowners of the Refuge (some Refuge lands are managed by the Service but owned by other public agencies). The team developed a list of issues and concerns that included comments generated from the scoping meeting, written comments, and verbal comments from discussions with various parties. The planning team reviewed the current Refuge management actions and ultimately presented three alternatives for future Refuge management during the planning process.

Key steps in the Service's comprehensive conservation planning are listed below:

1. Preplanning.
2. Identifying issues and developing a vision statement.
3. Gathering information.
4. Analyzing resource relationships.
5. Developing alternatives and assessing environmental effects.
6. Identifying a preferred alternative.
7. Publishing the draft plan and NEPA document.
8. Addressing public comments on the draft plan.
9. Preparing the final plan.
10. Securing approval of the Regional Director.
11. Implementing the plan.

Issues Identification

The Service followed NEPA guidelines and identified issues, concerns, and opportunities through early planning discussions and the public scoping process, which began with the first planning update in September 2006. The planning team identified a range of reasonable alternatives, evaluated the consequences of each alternative, and identified a preferred alternative for guiding the Refuge's future direction. This planning effort and the planning team's ongoing dialogue with various federal, state, and county agencies; interest groups; and individuals provided important direction in synthesizing the proposed goals, objectives, and strategies found in the draft CCP. It will be necessary to further coordinate and cooperate with these entities to implement the plan.

Public Involvement

Public involvement is an essential component of the comprehensive conservation planning and NEPA process. The Service announced the beginning of this planning effort for the San Pablo Bay National Wildlife Refuge through a Federal Register Notice of Intent on July 26, 2006. The Service sent individual letters announcing commencement of the planning process to several local organizations, the local city government, congressional members, state officials, state agencies, interested parties, and conservation organizations. Since July 2006, the Service has sent two planning updates to a mailing list of more than 100 individuals. The Refuge hosted a public scoping meeting on July 26, 2006 in Vallejo, California. Public comments were generated from the public scoping meeting and the Federal Register Notice published on July 26, 2006. Two people attended the meeting. The Service also held individual meetings with different stakeholders and stakeholder groups to orient them on the CCP process.

Written public input received during the process is incorporated into the CCP and EA when feasible, and a summary of the comments is presented in the CCP. The original comments are maintained in planning team files at the San Francisco Bay National Wildlife Refuge Complex headquarters in Fremont, California, and are available for review.

U.S. Fish and Wildlife Service and National Wildlife Refuge System

The mission of the Service is working with others to conserve, protect, and enhance the nation's fish and wildlife and their habitats for the continuing benefit of the American people. The Service is the primary federal agency responsible for migratory birds, endangered plants and animals, certain marine mammals, and interjurisdictional fish. This responsibility to conserve the nation's fish and wildlife resources is shared with other federal agencies as well as with state and tribal governments.

As part of this responsibility, the Service manages the National Wildlife Refuge System (NWRS). The Refuge System is the only nationwide system of federal lands managed and protected for wildlife and their habitats. The mission of the Refuge System is to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans. The Refuge is managed as part of the Refuge System in accordance with the National Wildlife Refuge System Administration Act of 1966 as amended and other relevant legislation, executive orders, regulations, and policies.

Purposes of the San Pablo Bay National Wildlife Refuge

Refuges are not only guided by the Service and NWRS missions, but also individual purposes that form the authority for the establishment of a Refuge. These purposes are often drawn from

federal acts or executive orders. Further, these purposes provide the foundation for which the Refuge vision statement and the CCP goals have been developed. San Pablo Bay NWR was established under the authority of three federal acts:

— for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.” 16 U.S.C.715d (Migratory Bird Conservation Act)

”... particular value in carrying out the national migratory bird management program.” 16 U.S.C. 667b (An Act Authorizing the Transfer of Certain Real Property for Wildlife, or other purposes)

”... to conserve (A) fish or wildlife which are listed as endangered species or threatened species... or (B) plants ...” 16 U.S.C. 1534 (Endangered Species Act of 1973)

Vision Statement

San Pablo Bay National Wildlife Refuge lies within the larger San Francisco Estuary, one of the largest estuaries along the Pacific Coast. The location of San Pablo Bay relative to freshwater influences of the Sacramento and San Joaquin Rivers and saline waters of the Pacific Ocean result in a unique and rich array of physical and biological conditions. Large contiguous expanses of pickleweed-dominated tidal marsh support high densities of the endangered salt marsh harvest mouse, as well as provide habitat for the endangered California clapper rail and other sensitive estuarine-dependent species. This Estuary is of hemispheric importance to shorebirds. Hundreds of thousands of shorebirds and waterfowl use this area to overwinter or rest and feed as they migrate along the Pacific Flyway.

Through history, humans have altered San Pablo Bay, resulting in high levels of contaminants and conversion of tidal environments to agricultural lands, salt ponds, and other non-tidal conditions. Despite these changes and the proximity to a highly urbanized environment, lands immediately surrounding the Refuge are dominated by open space. These open spaces provide opportunities to restore historic tidal and upland environments, directly linking them to adjacent uplands and freshwater seasonal wetlands, a rare historic feature of the larger San Francisco Estuary and a condition that will enhance and sustain populations of native flora and fauna.

The Refuge, working with partners, will play an important role in protecting, enhancing, and restoring tidal and upland environments of San Pablo Bay, especially where opportunities exist to expand or link tidal wetlands to uplands and freshwater seasonal wetlands. Our efforts will focus on the use of natural processes, where possible, to achieve desired environmental structure and function. An adaptive management framework will be used to respond to changing environmental conditions, especially with respect to invasive species, enhancement and restoration projects, and projected climate-related events.

Although humans have had negative impacts on San Pablo Bay, a century of agricultural uses has resulted in the preservation of open spaces where tidal wetlands and native grasslands can be restored. This environment links people to open space and their agrarian past. The Refuge will be an open space resource where wildlife and people connect—where people belong with nature and are immersed in it. The Refuge will be inclusive of all age groups, backgrounds, and skill levels by providing a variety of opportunities, including fishing, hunting, trails, interpretive signs and guided tours, and off- refuge environmental education to facilitate that connection, that belonging, that immersion.

Goals of the Refuge

Refuge goals were developed on the basis of four themes: wildlife management, habitat management, compatible wildlife-oriented recreation, and environmental education and outreach.

- GOAL 1: Support and contribute to the recovery and protection of threatened and endangered species and related ecosystems of the San Francisco Estuary.
- GOAL 2: Protect, enhance and restore high quality roosting and foraging environments for over-wintering and migratory shorebirds and waterfowl.
- GOAL 3: Acquire, protect, enhance, and restore functioning tidal marsh and associated upland systems to benefit all native wildlife and plants that use environments of the Refuge.
- GOAL 4: Protect and enhance subtidal systems for the benefit of marine and subtidal dependent species.
- GOAL 5: Identify, assess and adapt to current and future climate change impacts to refuge resources.
- GOAL 6: Develop a supportive relationship with the surrounding community to foster understanding and stewardship of the Refuge and the National Wildlife Refuge System mission.
- GOAL 7: Provide visitors and the local community with compatible wildlife-oriented outdoor recreation opportunities to enjoy, understand and appreciate the resources of the Refuge.
- GOAL 8: Provide a quality environmental education and interpretation program that enriches the local community with the history and purpose of the natural habitats of North San Pablo Bay and the mission of the National Wildlife Refuge System.

Chapter 2. Alternatives, Including the Preferred Alternative

This chapter describes three alternatives for managing the Refuge: Alternative A (No Action, current management); Alternative B, and Alternative C (*preferred alternative*). These alternatives are described below and summarized in Table 1 at the end of this chapter. The visitor service and environmental education alternatives are also depicted in Figure 2, Figure 3, and Figure 4 at the end of this chapter. All proposed alternatives considered in this EA were developed with the mission of the Refuge System and the purposes of the Refuge as guiding principles. Two of the three alternatives presented in this chapter are “action alternatives” that would result in a change to the current management of the Refuge. The Service’s preferred alternative is Alternative C.

Current Management

The Refuge currently has no integrated plan to guide the management of all its resources and uses. Current management efforts on the Refuge focus on the monitoring endangered species, monitoring nonnative and invasive plants, habitat restoration, environmental education and public uses.

For a complete description of the current management practices, please see Chapter 4, *Current Refuge Management and Programs*, of the CCP.

Alternatives Development Process

Three alternatives were developed to manage San Pablo Bay NWR.

- Alternative A: current management (no action)
- Alternative B: standardize survey and monitoring protocols; expand tidal restoration activities; provide additional visitor access and environmental education
- Alternative C: same as B; additionally, develop wildlife population goals; provide additional visitor access locations; provide additional environmental education and interpretation opportunities.

The alternatives development process was an iterative process that began after the planning team developed the Refuge vision statement and revised the Refuge’s goals. The first step in this process was to identify all the important issues related to Refuge management. The list of issues was generated collaboratively by the core planning team, Service staff, and Refuge stakeholders. The public also helped to identify important management issues through the scoping process.

Once the list of important management issues was generated, the planning team described Alternative A (no action). It was important to describe this alternative accurately because the no-action alternative serves as the baseline against which all other alternatives are compared.

Next, the planning team listed a wide range of management actions that would address the issues identified and would achieve one or more of the Refuge goals. These actions were refined during several meetings and planning team reviews. The planning team then clustered these actions into logical groupings to form the action alternatives. Many actions are common to more than one alternative, but the actions within each alternative reflect a common management approach, as described in detail below. The staff then analyzed the physical, biological, economic, and social impacts of each of the alternatives on the Refuge environment to select the preferred alternative.

Description of Management Alternatives

Alternative A: No Action

Under Alternative A, the Service would continue to manage the Refuge as it has done in the recent past. The focus of the Refuge would remain the same: to protect, conserve, and restore breeding and resting habitat for migratory waterfowl, shorebirds, songbirds, and endangered species. The Refuge would continue to be staffed with four full-time staff (who also manage Marin Islands and Antioch Dunes NWRs) to monitor wildlife, restore habitats, support public use activities, and promote environmental education. Additional support is often requested from the San Francisco Bay National Wildlife Refuge Complex staff. Special Use Permits (SUPs) would be issued on a case-by-case basis to outside researchers meeting certain criteria.

Habitat Management. Under Alternative A, the Service would continue to conduct habitat restoration activities including tidal restoration, native plant restoration, and nonnative/invasive plant removal. Removal of perennial pepperweed (*lepidium latifolium*) through chemical and manual methods is the highest priority, with a goal of reducing its cover by 90 percent. Invasive *Spartina* is removed manually when detected. Staff has a current goal of increasing native plant cover along the marsh-upland transition zone to greater than 50 percent along two-kilometers of levee bordering tidal marshes.

Hydrology would be improved for 80 acres of tidal marsh in the Tolay Creek and Lower Tubbs Island units through methods such as breaches to restore tidal flow. The 1,500-acre Cullinan Ranch upland will be restored to tidal marsh. The Refuge will continue to seek properties that benefit existing Refuge resources. Contaminants will be removed where known and where removal is feasible.

There is a long history of mosquito management throughout the San Francisco Bay region given the large human population in the area. Per public health protection, mosquito control on the Refuge is an existing activity conducted by the local Marin/Sonoma and Napa-Solano Mosquito Abatement Districts. Refuge staff is currently developing an integrative pest management plan for mosquitoes and NEPA documentation to comprehensively address these and other techniques for controlling mosquito populations.

Volunteers would continue to support habitat restoration through plant propagation at the refuge nursery, planting native vegetation on the Refuge, and conducting nonnative vegetation surveys. Priority nonnatives include pepperweed and *spartina*. The native marsh-upland transition zone would be targeted for increasing native plant cover.

Migratory Birds. Under Alternative A, biological monitoring would continue including waterfowl and shorebird surveys with partners on an annual basis by surveys on foot and by aircraft.

Threatened and Endangered Species. Species listed under the Federal Endangered Species Act (ESA)—salt marsh harvest mouse and California clapper rail—breed or forage on the Refuge. Tidal marsh restoration activities will support recovery plan objectives for these species. Surveys for these species are conducted annually on a subset of the Refuge units. Data collection is standardized to allow for analysis of long-term datasets and distribution to other partners.

Public Access. Access to all the Refuge units is limited because the only access currently is via

Highway 37, a two-lane highway with both directions of traffic separated by a concrete barrier. The Tolay Creek/Tubbs Island unit is currently the only public access site for wildlife observation, photography, and interpretation. Under Alternative A, this would continue to be the only public access point at the Refuge.

Restoration activities are currently being conducted at the Cullinan Ranch unit that will include public access once completed. Acceleration/deceleration access lanes, kayak launch, benches, interpretive signs, and a pier will be constructed as part of the restoration project. This infrastructure will facilitate non-motorized boating (e.g., kayaking), wildlife observation, interpretation, photography, and fishing.

Fishing is allowed in the open bay (San Pablo Bay) and navigable slough sections of the Refuge. Waterfowl hunting is only permitted in the navigable sloughs and open waters of the Refuge, requiring waterfowl hunters to use boats (see CCP for hunting map). No waterfowl hunting from levees is permitted. There is limited upland game hunting by foot for the month of December at the Tolay Creek unit (domesticated pheasant escapees). All hunting on the Refuge must comply with State and Federal Regulations. Under Alternative A, these activities would be unchanged.

Environmental Education. Partners help to bring schoolchildren to the Refuge to learn about and participate in tidal marsh restoration. This restoration program has yielded approximately 980 and 650 participants (on and off the Refuge) in 2008 and 2009, respectively. Staff participates in environmental education festivals and fairs at least twice annually to disseminate information about the Refuge and on-site activities available to schools.

Outreach. Staff participates in off-site established outreach events at least twice a year.

Cultural Resources. A comprehensive cultural resource assessment has never been conducted on the Refuge. The area where the Refuge is located was once open water and marsh, making it difficult to locate physical evidence of human activity. The possibility of prehistoric sites within the Refuge is minimal because of the drastically altered landscape due to gold washing activities (N. Valentine, pers. comm.).

The Refuge does not maintain any historic structures or archaeological sites. Under Alternative A, management of cultural resources would remain unchanged. If any unknown cultural resources are found during construction activities on the Refuge, these activities would be assessed by Service cultural resources staff to determine potential impacts and compliance with applicable federal laws and executive orders.

Alternative B: Expand Wildlife Management and Habitat Management; Moderate Visitor Access

Under Alternative B, substantial wildlife monitoring and habitat restoration actions would be emphasized. Six additional visitor access points would be created at the different Refuge units and there would be further environmental education programs targeted at adults and families. Additional staff would be required for this alternative including: an outdoor recreation planner, a biological technician, an administrative officer, a maintenance worker, and a law enforcement officer. These positions would be shared with Marin Islands and Antioch Dunes NWRs.

Habitat Management. Under Alternative B, the Service would continue habitat management activities as described for Alternative A. In addition, the Service would begin to identify, analyze, prioritize, and propose new tidal marsh enhancement projects at a number of Refuge areas (e.g., Sonoma Creek, Tolay Creek, and Lower Tubbs Island) to reduce stagnant water and improve tidal hydrology. Annual projects will be prioritized based on this information and funding availability. As new land (e.g., Sears Point) is acquired, land protection, restoration, and more thorough habitat management plans will be developed.

Under this alternative, the current pepperweed control plan will be refined and adapted for implementation. There will be an active search and eradication of invasive *Spartina* species within all units of the Refuge, and coordination with the Invasive *Spartina* Project to monitor pre- and post-treatment. Also, a marsh-upland ecotone restoration plan will be prepared and implemented. A summary of present and historical sub-tidal wildlife and plant resources on the Refuge will be conducted. There have been limited resources available for assessing contaminants. Under this alternative, the Service will assess the current state and source of contaminants on Refuge units.

Migratory Birds. Shorebird and waterfowl surveys would continue as in Alternative A. A summary will be prepared of existing survey data. Migratory bird data would be analyzed and summarized to identify high use areas and to develop management protections. Data surveying and monitoring would also be standardized based on time intervals and spatial reference. Invasive plant and predator population controls would be conducted to enhance migratory bird habitat.

Threatened and Endangered Species. Beyond the activities described in Alternative A, a comprehensive inventory and monitoring plan would be implemented for listed species as well as a survey of habitats, species, and processes that affect them. The monitoring plan would include a comprehensive survey of all Refuge resources rather than the current surveying of select species. Habitat management plans will be developed for the California clapper rail and the salt marsh harvest mouse. Native plant cover will be increased (through native plant propagation, planting of native plants, and control of invasive weeds) within the marsh-upland transition zone in order to provide high-tide refugia for tidal marsh species like salt marsh harvest mouse. Predator populations and impacts will also be assessed in this alternative to determine management needs for protecting listed species.

According to the California Natural Diversity Database, the endangered soft bird's-beak plant is located on the Refuge. However, recent vegetation surveys have not detected any individuals on the Refuge. Staff will continue to monitor for presence, distribution, and abundance of this species at the Refuge units.

Other Species. An inventory and monitoring plan will also be developed for other wildlife, fish, invertebrate, and plant populations. Staff will also work with partners to assess fish, invertebrate, and plant species that are present in sub-tidal areas of the Refuge.

Climate Change. Under Alternative B, staff will work to refine and build upon the recent Sea Level Affecting Marshes Model (SLAMM) that was completed in 2009. SLAMM provided an estimate of the habitat changes expected on the Refuge as a result of sea-level rise. Staff will partner with others to analyze climate change projections for the Refuge to develop and prioritize future management actions. Additional local, regional, and national climate change modeling will

be used to provide habitat change projections. An assessment of potential climate change impacts (flood risk, erosion analyses, and sediment dynamics) to refuge resources (e.g., wildlife habitat) will be conducted to address near-term and long-term impacts. High quality habitats, infrastructure (e.g., levees), and public access amenities (e.g., trails) will be evaluated to determine protection, mitigation, or removal needs. Also, an evaluation of the carbon footprint for refuge activities will be conducted to develop more efficient alternatives where feasible (e.g., transportation, energy use, recycling). Outreach activities will also include educating visitors about green activities to offset climate change.

Public Access. Under this alternative, access to the Refuge would continue at the Tolay Creek/Tubbs Island units described in Alternative A. In addition, more outreach will be developed for hunting and fishing. Hunt brochures would be developed and disseminated to the hunting community. Similar information would be developed for fishing access on the Refuge. A shoreline fishing location would be developed, such as a boardwalk or pier at Guadalcanal. Self-guided access (for hiking, biking, and boating) will be expanded at Guadalcanal, Sears Point, Figueras, Sonoma Baylands, and Skaggs Island as these properties become acquired. Interpretive materials, panels, and kiosks will also be developed as appropriate for these areas. Interpretation about the North Bay habitat, wildlife and cultural history will be expanded and shared.

A volunteer program will be established to initiate Refuge to Backyard connections with the local communities. This program will outreach to the local community about how the Refuge benefits the local community.

Environmental Education. In addition to the activities described in Alternative A, the outdoor recreation planner, with the support from Complex staff, will develop an environmental education program geared towards the local community, adults, and families. A garden education program will also be developed for families to emphasize use of native plants, volunteer opportunities, and other learning workshops. Refuge staff will also expand use of partnerships and volunteerism to conduct environmental education at local elementary schools.

Outreach. New local outreach opportunities will be pursued. A volunteer program will be built to support Refuge to backyard connections by demonstrating the benefits of native plant use in the local community.

Cultural Resources. The office is located in an old ranch that is representative of the cultural aesthetic of the area. A cultural assessment of Sears Point will be conducted to identify cultural characteristics to be maintained. Based on this information, the farm and ranch aesthetic of the headquarter site will be maintained and enhanced when renovating the office and maintenance buildings.

Alternative C: Same as B; Wildlife Management Emphasis, Expand Environmental Education and Interpretation

Under Alternative C, population goals would be developed for the California clapper rail, salt marsh harvest mouse, and other priority species. High use migratory bird habitat would be mapped and protected. More extensive hydrological assessments would be conducted to reduce stagnant water in the tidal marsh habitats of the Refuge. Management plans for upland areas of

the Refuge (e.g., Sears Point, when acquired) will be developed and implemented. Hunting and fishing would be supported by orientation workshops and fishing days to encourage these uses. The environmental education program would be expanded to the Sonoma Baylands and potentially the Guadaleanal site to accommodate more schools to the Refuge. Docent-led interpretation at the different publicly accessible sites would also be conducted. Additional staff would be required for this alternative including: a biologist/range conservationist, two biological technicians, an outdoor recreation planner, an administrative officer, a maintenance worker, and a law enforcement officer. These positions would be shared with Marin Islands and Antioch Dunes NWRs.

Habitat Management. Habitat management activities would be conducted as described in Alternative B. In addition, the Service would design and implement methods for increasing hydrological connectivity on the Refuge. Such actions could include levee breaches, lowering of levees/berms, and removing culverts. Modeling will be conducted to analyze the effects of alternative restoration/enhancement methods. Staff will also consider creating and maintaining refuge islands or other high-tide refugia for tidal marsh species. Grazing, haying, and soil stabilization management plans will be developed for Sears Point (when acquired) to enhance or restore native plant species.

With regard to invasive species, a *Spartina* control plan will be developed to incorporate treatment methods, monitoring, and data collection and storage based on existing practices conducted by the Invasive Spartina Project. A prioritization scheme will be developed for invasive plant monitoring. An invasive plant early detection and rapid response program will be developed and implemented.

Under this alternative, efforts will be made to identify sub-tidal conservation priorities and to foster opportunities with existing agencies and groups to conduct sub-tidal restoration or enhancement on the Refuge.

Contaminants assessment results will be used to prioritize and identify methods to manage, remove, reduce, and prevent introduction of contaminants.

An inventory and monitoring plan will also be implemented to measure climate-related changes to resources over time. Acquisitions will also be assessed in light of climate change.

Migratory Birds. Under this alternative, the Refuge staff would conduct migratory bird activities as described in Alternative B. In addition, Refuge staff would conduct studies of high use marsh interior tidal ponds (e.g., formation, persistence, shorebird use) to determine their protection needs (e.g., closing areas to access, creating buffer zones). Additional studies would be conducted on the effects of enhancement and restoration projects to marsh interior tidal ponds.

Threatened and Endangered Species. Protection of listed species would be the same as described for Alternative B. Based on survey information collected, staff will evaluate population health, assess population viability, develop population goals and identify and implement management actions for the California clapper rail, salt marsh harvest mouse, and other listed species in order to support recovery plan goals.

Staff will work with other Service experts and the USDA Wildlife Services to develop a predator

management plan, including predator population thresholds.

Other Species. Actions under this alternative would be the same as Alternative B.

Public Access. Under Alternative C, public access and education activities would be the same as those described for Alternative B. In addition, a hunt program would be developed and the existing hunt plan revised in cooperation with California Department of Fish and Game (CDFG), as well as a hunter orientation and cleanup program would be implemented. A fishing plan will be developed to officially permit fishing (an activity that had been conducted prior to the Refuge's establishment). A pier fishing day at Cullinan (or Guadalcanal, when acquired) for children and a fishing regulation workshop would be held annually. A docent-led tour program will be provided at Guadalcanal, Sears Point, Sonoma Baylands, Skaggs Island, or Lower Tubbs units to promote interpretation, wildlife observation, and photography. Wildlife photography and wildlife art workshops will be provided on the Refuge. A docent-led kayak tour at the Cullinan Ranch unit would be conducted twice a year. Computer-based interpretive materials will be developed for online access.

Environmental Education. In addition to the activities described in Alternative B, staff would continue to direct in-class environmental education programs conducted by partners. Staff would conduct school programs on site at the Sonoma Baylands and potentially the Guadalcanal units (when acquired) three times per week that focuses on migratory birds, wetlands, and habitat restoration. A trail will be created to connect the Sonoma Baylands unit to the Sears Point headquarter site to emphasize both the plant propagation and planting aspects involved with tidal marsh restoration.

Outreach. Outreach events would be conducted with the media to highlight refuge programs and activities. Additional outreach materials would be developed and the website updated. The Refuge Friends' group would be encouraged to conduct more outreach projects.

Cultural Resources. Cultural resource activities would be conducted as described for Alternative B. In addition, research and interpretive materials would be developed about the Native American history of the area.

Features Common to All Alternatives

Endangered Species Survey and Monitoring. All proposed alternatives involve some level of monitoring for endangered species, particularly the California clapper rail and the salt marsh harvest mouse. Research studies relevant to management needs will be encouraged and supported.

Shorebird and Waterfowl Monitoring. Annual monitoring of shorebirds and waterfowl are conducted with partners throughout the San Francisco Bay Estuary.

Mosquito Control. Mosquito control activities are coordinated and conducted with the Marin-Sonoma and Solano County Mosquito Abatement Districts. An integrative pest management plan and NEPA documentation is being developed to address significant mosquito populations in order to protect refuge resources and human health.

Vegetation Management. All the alternatives prescribe some level of monitoring, response, and

prevention of the spread of nonnative and invasive vegetation. The Refuge actively monitors and controls (through manual and chemical methods) invasive pepperweed. Invasive *Spartina* will be controlled when detected. The Refuge conducts native plant propagation and restoration of habitat through partners, volunteers, and school groups. Native plantings in marsh-upland transition zones are prescribed for all proposed alternatives. Monitoring of these plantings would be conducted to determine efficacy.

Tidal Marsh Restoration. Some tidal marsh restoration activities were planned prior to the CCP process (Cullinan Ranch and Tolay Creek/Lower Tubbs Island restoration plans) and the restoration of diked wetland or upland areas to tidal influence will continue.

Climate Change Considerations. Increased guidance at the regional level climate change will influence much of the decision, planning and restoration processes on the Refuge.

Public Access and Wildlife-oriented Recreation. The Refuge provides opportunities for wildlife observation, photography, hunting and fishing. These activities are prescribed for all the alternatives. At least one trail is provided for public access.

Environmental Education and Outreach. Through partners, the Refuge conducts a small field-based environmental education program. School groups and volunteers come to the Refuge to assist in the propagation and planting of native plants. Outreach activities for all proposed alternatives will involve attending off-site events such as fairs, festivals, and presentations with local organizations.

Facilities Maintenance. General maintenance of existing facilities including mechanical control of vegetation; inspection, repair, rehabilitation, or replacement of infrastructure and equipment (e.g., fencing and signage); and oversight of safety of operations, is required on the Refuge to provide safe access for staff, researchers, law enforcement activities, educational field trips, and the public. Upland areas require mowing to reduce fire hazards, provide non-native weed control, and provide access for maintenance, monitoring, and restoration/enhancement projects. The Refuge's headquarter site, levees, and trails require frequent maintenance and repair.

Alternatives Considered but Eliminated from Detailed Analysis

The alternatives development process under NEPA and the Improvement Act are designed to allow the planning team to consider the widest possible range of issues and develop feasible management solutions that respond to these issues. These management solutions are then incorporated into one or more alternatives evaluated in the EA process and considered for inclusion in the CCP.

Actions and alternatives that are not feasible or may cause substantial harm to the environment are usually not considered in an EA. Similarly, an action (and therefore, an alternative containing that action) should generally not receive further consideration if:

- It is illegal (unless it is the No Action Alternative, which must be considered to provide a baseline for evaluation of other alternatives, even though it may not be capable of legal implementation).
- It does not fulfill the mission of the National Wildlife Refuge System.
- It does not relate to or help achieve one of the goals of the Refuge.

- Its environmental impacts have already been evaluated in a previously approved NEPA document.

However, if such actions or alternatives address a controversial issue or an issue on which many public comments were received, they may be considered in detail in a NEPA document to demonstrate clearly why they are not feasible or would cause substantial harm to the environment.

During the alternatives development process, the planning team considered a wide variety of potential actions on the Refuge. The following actions were ultimately rejected and excluded from the alternatives proposed here because they did not achieve Refuge purposes or were incompatible with one or more goals.

Visitor Center. The idea of a visitor center on the Refuge to provide interpretive and environmental education programs was eliminated from detailed analysis. Staff felt that it was better to provide a contact station where visitors can receive information but emphasize resources and funding on outdoor opportunities instead.

Close Tolay Creek/Tubbs Island public access trail. This alternative would close public access to the Tolay Creek and Tubbs Island unit in order to provide greater protection to sensitive wildlife habitats located near the trail areas and to reduce maintenance costs to the site. The trail to this site is not owned by the Service, but its use is permitted to allow visitor access to the Refuge. The site requires significant maintenance (i.e. mowing, potholes, weed control and levee erosion) to continue providing access. This alternative was not analyzed in detail because we do not have authority to close the trail and there was stakeholder interest in maintaining one of the few direct public access points to the San Francisco Bay.

Preferred Alternative

The planning policy that implements the Improvement Act requires the Service to select a preferred alternative, which is also the preferred alternative under NEPA. The complete written description of this preferred alternative is Chapter 5: Refuge Management Direction of the CCP. Alternative C is the preferred alternative for the Refuge because it meets the following criteria:

- achieves the mission of the National Wildlife Refuge System
- achieves the purposes of the Refuge
- provides guidance for achieving the Refuge's 15-year vision and goals
- maintains and restores the habitats and populations on the Refuge
- addresses the important issues identified in the scoping process
- addresses the legal mandates of the Service and the Refuge
- is consistent with the scientific principles of sound fish and wildlife management and endangered species recovery

The preferred alternative described in the EA is preliminary. The action ultimately selected and described in the Final CCP will be determined, in part, by the comments received on the Draft EA. The preferred alternative presented in the Final CCP may suggest a modification of one of the alternatives presented here. The three alternatives considered for managing the Refuge are summarized in Table 1 and are described below.

Table 1. Summary of Alternatives

	Alternative A: No Action (Status Quo)	Alternative B: Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C: Same as B; additionally, develop wildlife population goals; expand environmental education and interpretation opportunities (<i>preferred alternative</i>)
WILDLIFE/PLANT POPULATION AND HABITAT MANAGEMENT			
Endangered Species			
California clapper rail and salt marsh harvest mouse	<ul style="list-style-type: none"> • Implement tidal marsh recovery plan objectives in core recovery areas of the Refuge. • Conduct annual surveys within a subset of Refuge units. • Standardize data collection, maintenance, and distribution. 	<ul style="list-style-type: none"> • Same as Alternative A. • Develop and begin to implement an inventory and monitoring (I&M) program that prioritizes species, habitats, ecosystems, and processes. • Develop monitoring database (non-spatial and spatial) and use the Refuge Lands Geographic Information System (RLGIS) where appropriate. • Expand enhancement and restoration of the marsh-upland ecotone. • Prepare habitat management plans for these species. • Support management-oriented research for this species. • Assess native and non-native predators of San Pablo Bay, including thresholds for management action. 	<ul style="list-style-type: none"> • Same as Alternative A. • Same as Alternative B. • Evaluate population health, assess population viability, develop population goals and identify and implement management actions that will preserve or enhance existing populations.
Other listed species	<ul style="list-style-type: none"> • I&M for restoration projects. 	<ul style="list-style-type: none"> • Develop and begin to implement an I&M program to determine presence, distribution, and abundance. 	<ul style="list-style-type: none"> • Same as Alternative B. • Evaluate population health, assess

	Alternative A: No Action (Status Quo)	Alternative B: Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C: Same as B; additionally, develop wildlife population goals; expand environmental education and interpretation opportunities (<i>preferred alternative</i>)
			population viability, develop population goals and identify and implement management actions that will preserve or enhance existing populations.
Non-T&E Species Management			
Other Wildlife, Fisheries, and Plant Populations	<ul style="list-style-type: none"> No activities currently conducted. 	<ul style="list-style-type: none"> Develop and begin to implement an inventory and monitoring (I&M) program. 	<ul style="list-style-type: none"> Same as Alternative B.
Migratory Birds	<ul style="list-style-type: none"> Participate in regional waterfowl and shorebird surveys. Conduct annual migration and winter surveys for shorebirds and waterfowl. 	<ul style="list-style-type: none"> Same as Alternative A. Same as Alternative A. Prepare a summary of migratory bird survey data pertinent to the Refuge (local, regional, Pacific Flyway). Identify distribution and high use areas of the Refuge. Implement recommendations from the Pacific Shorebird Plan and other appropriate conservation plans. Control or eliminate invasive species and predator populations. Support shorebird and waterfowl research that informs refuge management. 	<ul style="list-style-type: none"> Same as Alternative A. Same as Alternative A. Same as Alternative B. Identify and protect existing high tide roost environments as priority conservation areas (e.g., develop map). Limit disturbance to priority conservation areas. Conduct studies on interior tidal ponds

	Alternative A: No Action (Status Quo)	Alternative B: Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C: Same as B; additionally, develop wildlife population goals; expand environmental education and interpretation opportunities (<i>preferred alternative</i>)
			(formation, persistence, shorebird use). <ul style="list-style-type: none"> Evaluate effects of wetland restoration or enhancement projects on shorebird and waterfowl habitat. Reduce or mitigate negative effects of management actions and improve habitat.
Native Plant Restoration	<ul style="list-style-type: none"> Increase native plant cover within marsh-upland transition zone to greater than 50% along 2-km of levee bordering tidal marshes. Propagate native plants using the Refuge nursery. 	<ul style="list-style-type: none"> Same as Alternative A. Same as Alternative A. Use partnerships and volunteers to support the propagation program. Prepare and implement a marsh-upland ecotone restoration plan. 	<ul style="list-style-type: none"> Same as Alternative A. Same as Alternative A. Same as Alternative B. Same as Alternative B. Develop grazing, haying, and soil stabilization management plans for Sears Point (when acquired) to enhance or restore native plant species to the site. Conduct a herpetological inventory of grazed and hayed sites. Establish an expert panel of grassland and range scientists to develop a restoration plan(s). Establish a seasonal wetland expert panel of scientists for the hayed wetland portion of the land.
Non-native and Invasive Plants	<ul style="list-style-type: none"> Develop and implement a control program for 	<ul style="list-style-type: none"> Same as Alternative A. 	<ul style="list-style-type: none"> Same as Alternative A.

	Alternative A: No Action (Status Quo)	Alternative B: Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C: Same as B; additionally, develop wildlife population goals; expand environmental education and interpretation opportunities (<i>preferred alternative</i>)
	<p>pepperweed (<i>Lepidium latifolium</i>) with a goal of reducing cover by 90 percent.</p> <ul style="list-style-type: none"> Control invasive <i>Spartina</i> plants as they are detected. 	<ul style="list-style-type: none"> Refine and adapt the Refuge pepperweed control plan. Use RLGIS or other database to inventory and monitor pepperweed and treatments. Fund and conduct treatments. Search for and eradicate invasive <i>Spartina</i> species within all areas of the Refuge that have the potential to harbor this species. Coordinate with the Invasive <i>Spartina</i> Project to monitor pre- and post-<i>Spartina</i> cover and treatments, incorporate RLGIS if possible. Evaluate impacts of control efforts on target invasive species and non-target native species. Control native and non-native vegetation in publicly accessible areas. 	<ul style="list-style-type: none"> Same as Alternative B. Develop a <i>Spartina</i> control plan for the Refuge that incorporates treatment methods, monitoring, and data collection and storage. Implement an invasive plant early detection and rapid response program. Develop prioritization scheme for invasive plant monitoring: area, environment, and species foci. Conduct or support research on high priority invasive species. Same as Alternative B.

	Alternative A: No Action (Status Quo)	Alternative B: Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C: Same as B; additionally, develop wildlife population goals; expand environmental education and interpretation opportunities (<i>preferred alternative</i>)
Sub-tidal Resource Management	<ul style="list-style-type: none"> No activities currently conducted. 	<ul style="list-style-type: none"> Develop a summary of present and historical subtidal wildlife and plant resources of the Refuge. 	<ul style="list-style-type: none"> Same as Alternative B. Identify subtidal conservation priorities (e.g., Sub-Tidal Goals Project) and work with existing agencies and groups to conduct subtidal restoration or enhancement on the Refuge.
Predator Management	<ul style="list-style-type: none"> No activities currently conducted. 	<ul style="list-style-type: none"> Assess native and non-native predators of priority species of San Pablo Bay, conduct baseline assessments of predators of concern. 	<ul style="list-style-type: none"> Same as Alternative B. Develop predator population thresholds that will trigger control actions. Consult with USFWS and USDA Wildlife Services to develop a predator management plan. Assess implications of restoration projects and public access to predator movement.
Mosquito Population Management	<ul style="list-style-type: none"> Continue to allow mosquito control activities by local mosquito abatement districts. Develop and implement an integrative pest management approach to control significant mosquito populations while protecting refuge resources and human health. 	<ul style="list-style-type: none"> Same as Alternative A. Same as Alternative A. Identify, prioritize and begin to implement tidal marsh enhancement projects that would reduce human-induced water impoundments and 	<ul style="list-style-type: none"> Same as Alternative A. Same as Alternative A. Same as Alternative B.

	Alternative A: No Action (Status Quo)	Alternative B: Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C: Same as B; additionally, develop wildlife population goals; expand environmental education and interpretation opportunities (<i>preferred alternative</i>)
		improve tidal hydrology.	
WETLANDS MANAGEMENT			
Tidal Marsh Enhancement and Restoration	<ul style="list-style-type: none"> • Improve hydrology within 80 acres of tidal marsh in the Tolay Creek and Lower Tubbs Island units. • Restore the 1,500 acre Cullinan Ranch unit to tidal marsh. • Identify, acquire, protect and enhance lands within the vicinity of the Refuge, particularly Guadalcanal, Sears Point, and Sonoma Baylands. 	<ul style="list-style-type: none"> • Identify, prioritize and begin to implement tidal marsh enhancement projects (e.g., at Sonoma Creek, Tolay Creek, and Lower Tubbs Island) that would reduce human-induced water impoundments and improve tidal hydrology. • Same as Alternative A. • Same as Alternative A. • Develop restoration plan for Skaggs Island. • Develop and begin to implement a planning tool (e.g., database, work lists) the Refuge will use to annually prioritize and guide restoration and enhancement projects on the Refuge. • Identify parameters that may assist with project prioritization such as habitat quality, presence of sensitive species, climate change, adjacent landowner actions, mosquito reduction, invasive species, wildlife disease, and levee and erosion risks. • Evaluate and incorporate when feasible, USFWS national and regional restoration and conservation goals. 	<ul style="list-style-type: none"> • Same as Alternative B. • Same as Alternative A. • Same as Alternative A. • Same as Alternative B.

	Alternative A: No Action (Status Quo)	Alternative B: Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C: Same as B; additionally, develop wildlife population goals; expand environmental education and interpretation opportunities (<i>preferred alternative</i>)
		<ul style="list-style-type: none"> • Delineate and describe tidal impoundments or hydrological issues. 	<ul style="list-style-type: none"> • Same as Alternative B. • Design and implement methods for increasing hydrological connectivity including levee breaches, lowering levees/berms and removing culverts. • Analyze effects of alternative restoration/enhancement methods on tidal environments through modeling. • Promote conservation or creation of refuge islands or other high-tide refugia.
Contaminants	<ul style="list-style-type: none"> • Remove contaminants or inputs when located and where possible. 	<ul style="list-style-type: none"> • Same as Alternative A. • Conduct an assessment of contaminant sources that may affect the environmental health of refuge resources. 	<ul style="list-style-type: none"> • Same as Alternative A. • Same as Alternative B. • Use assessment results to prioritize actions for reducing contaminant inputs or prevention where possible. • Prioritize actions for removal and prevention.
DATA MANAGEMENT			
GIS/RLGIS	<ul style="list-style-type: none"> • Use GIS/RLGIS to store invasive plant data. 	<ul style="list-style-type: none"> • Same as Alternative A. • Identify and adopt standards for the collection and maintenance of spatially referenced biological and physical data collected on the Refuge. • Spatially document existing Refuge resources within the Refuge Lands 	<ul style="list-style-type: none"> • Same as Alternative A. • Same as Alternative B. • Same as Alternative B.

	Alternative A: No Action (Status Quo)	Alternative B: Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C: Same as B; additionally, develop wildlife population goals; expand environmental education and interpretation opportunities (<i>preferred alternative</i>)
		Geodatabases.	
Data Sharing	<ul style="list-style-type: none"> Share Refuge environmental data and findings whenever possible and appropriate including conferences, web data portals, scientific publications, etc. 	<ul style="list-style-type: none"> Same as Alternative A. 	<ul style="list-style-type: none"> Same as Alternative A. Integrate Data sharing (metadata) standards.
CLIMATE CHANGE			
Modeling and monitoring	<ul style="list-style-type: none"> Support and encourage climate-change related research on the Refuge. 	<ul style="list-style-type: none"> Same as Alternative A. Assess potential impacts to refuge resources, develop adaptive strategies and prioritize management to address near-term and long-term climate change impacts (e.g., erosion, flooding). Work with Service experts and others to conduct climate change analyses (or other appropriate modeling tools). Conduct flood risk and erosion analysis of lands on and adjacent to the Refuge. Incorporate research on current and expected sediment dynamics in San Pablo Bay. Identify areas that contain high quality habitats or features that will require a high level of protection relative to other refuge resources. Evaluate existing and future public access amenities relative to expected climate change impacts. 	<ul style="list-style-type: none"> Same as Alternative A Same as Alternative B.

	Alternative A: No Action (Status Quo)	Alternative B: Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C: Same as B; additionally, develop wildlife population goals; expand environmental education and interpretation opportunities (<i>preferred alternative</i>)
		<ul style="list-style-type: none"> • Prioritize wetland restoration, enhancement projects, and acquisition based on climate change data. 	<ul style="list-style-type: none"> • Same as Alternative B. • Develop and implement a climate change inventory and monitoring plan. • Develop and implement a plan that identifies lands that will be important to acquire in light of climate change. • Work with adjacent land owners in the San Pablo Bay region to plan and prioritize wetland and upland enhancement and conservation projects with respect to predicted environmental changes. • Promote and support research that evaluates climate change related effects to endangered species populations.
Reduce carbon footprint		<ul style="list-style-type: none"> • Evaluate carbon footprint of refuge activities and improve efficiency where feasible (e.g., transportation, energy efficiency, recycling). • Increase carbon sequestration through tidal restoration projects and use solar and wind energy to power refuge operations. • Seek additional partnerships and funding sources to promote the use of solar and wind energy outside the Refuge and to fund projects within Refuge. • Educate and empower visitors to the Refuge about green activities that offset climate change. 	<ul style="list-style-type: none"> • Same as Alternative B.

	Alternative A: No Action (Status Quo)	Alternative B: Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C: Same as B; additionally, develop wildlife population goals; expand environmental education and interpretation opportunities (<i>preferred alternative</i>)
			<ul style="list-style-type: none"> Develop and implement climate mitigation measures to offset refuge impacts on the environment.
VISITOR SERVICES AND ENVIRONMENTAL EDUCATION			
Hunting	<ul style="list-style-type: none"> Waterfowl hunting in the open bay and navigable sloughs. 	<ul style="list-style-type: none"> Same as Alternative A. Develop and disseminate a hunting brochure. 	<ul style="list-style-type: none"> Same as Alternative A. Same as Alternative B. Develop hunt program specifically for Refuge in cooperation with CDFG. Organize a hunter cleanup day; provide an orientation day with refuge law enforcement to provide hunting regulations and service opportunities.
Fishing	<ul style="list-style-type: none"> Fishing in the open bay and navigable sloughs. Fishing pier at Cullinan Ranch unit 	<ul style="list-style-type: none"> Same as Alternative A. Create and distribute to the public a fact sheet on fishing on the Refuge, include education on preventing introduction of nuisance species. Expand fishing areas to others units of the Refuge such as a boardwalk or pier at Guadalcanal. 	<ul style="list-style-type: none"> Same as Alternative A. Same as Alternative B. Same as Alternative B. Assess opportunities to conduct a fishing day at Cullinan and at Guadalcanal once this unit is acquired. Formally permit fishing through a fishing plan.
Wildlife observation and photography	<ul style="list-style-type: none"> Public Access, including bike, at Lower Tubbs Island, self-guided. Self-guided public access (boating, hiking) at Cullinan 	<ul style="list-style-type: none"> Develop a visitor services plan to expand public uses including wildlife observation and photography. Develop other self-guided public access (for hiking, biking, boating) in addition 	<ul style="list-style-type: none"> Same as Alternative B. Same as Alternative B.

	Alternative A: No Action (Status Quo)	Alternative B: Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C: Same as B; additionally, develop wildlife population goals; expand environmental education and interpretation opportunities (<i>preferred alternative</i>)
	Ranch unit	<p>to Tubbs Island, such as Figueras, Guadalcanal, Sears Point, Skaggs Island and Sonoma Baylands.</p> <ul style="list-style-type: none"> Expand opportunities, using partners when feasible, for wildlife observation and photography. 	<ul style="list-style-type: none"> Same as Alternative B. Conduct docent/staff-led kayak tours at Cullinan Ranch unit twice a year. Develop computer-based interpretive materials that can be downloaded to electronic devices.
Interpretation	<ul style="list-style-type: none"> Self-guided tours at Lower Tubbs Island and Cullinan Ranch. 	<ul style="list-style-type: none"> Develop self-guided access with interpretive signage, kiosks, and other related materials at sites such as Figueras, Guadalcanal, Sears Point, Skaggs Island, and Sonoma Baylands. Expand opportunities for interpretation of the North Bay habitat, wildlife and cultural history. 	<ul style="list-style-type: none"> Same as Alternative B. Same as Alternative B. Develop docent-led tour program at Guadalcanal, Sears Point, Sonoma Baylands, Skaggs Island and Lower Tubbs units.
Outreach	<ul style="list-style-type: none"> Participate in off-site established outreach events (e.g., fairs, festivals); develop and disseminate brochures. Conduct outreach to the public through participation in at least two off-site events per year. 	<ul style="list-style-type: none"> Same as Alternative A. Seek out new local outreach opportunities. Build a volunteer program to initiate Refuge to Backyard connections that outreaches local communities. 	<ul style="list-style-type: none"> Same as Alternative A. Same as Alternative B. Same as Alternative B.

	Alternative A: No Action (Status Quo)	Alternative B: Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C: Same as B; additionally, develop wildlife population goals; expand environmental education and interpretation opportunities (<i>preferred alternative</i>)
			<ul style="list-style-type: none"> • Conduct outreach events with the media at Sears Point (when acquired). • Develop additional outreach materials and update website information. • Work with the news media to highlight activities and programs at the Refuge. • Promote and support Refuge Friends group to conduct outreach projects.
Environmental Education	<ul style="list-style-type: none"> • Use partnerships to conduct on-site restoration projects with schoolchildren. • Provide support of environmental and/or environmental education festivals and fairs in the North Bay (BAEER Fair and Flyway Festival) by staffing informational booth and providing handouts and on-site activities. 	<ul style="list-style-type: none"> • Same as Alternative A. • Same as Alternative A. • Offer the Garden Education Program for families with emphasis on native plants and service opportunities, events, or workshops at least twice a year. • Expand partnering opportunities and volunteerism to further the environmental education program with local elementary schools. 	<ul style="list-style-type: none"> • Same as Alternative A. • Same as Alternative A. • Same as Alternative B. • Offer an environmental education field trip program for elementary schools to the Baylands or Guadalcanal units (when acquired), focusing on migratory birds, wetlands, and habitat restoration three times per week. • Construct entry road, outdoor education facilities, tables, restrooms and parking at the Baylands and Sears Point sites

	Alternative A: No Action (Status Quo)	Alternative B: Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C: Same as B; additionally, develop wildlife population goals; expand environmental education and interpretation opportunities (<i>preferred alternative</i>)
			<p>(when acquired).</p> <ul style="list-style-type: none"> • Develop a Refuge HQ/greenhouse program and infrastructure to physically link to Sonoma Baylands unit (when acquired). • Work with non-profit partners to implement in-class programs to support experiences on the Refuge.
Cultural Resource Management	<ul style="list-style-type: none"> • Assess any cultural resources found during construction or other activities. 	<ul style="list-style-type: none"> • Conduct cultural assessment of Sears Point to identify cultural characteristics to be maintained. • Upon acquisition of Sears Point, continue the aesthetic environment of the haying/ranching region by maintaining and repairing existing structures in the same style. • When building new infrastructure, construct facilities that mimic the haying/ranching culture of the site and the region. 	<ul style="list-style-type: none"> • Same as Alternative B. • Same as Alternative B. • Same as Alternative B. • Research and develop interpretive materials, presentations about the Native American presence on the Refuge.

Figure 2. Visitor Service and Environmental Education Activities for Alternative A

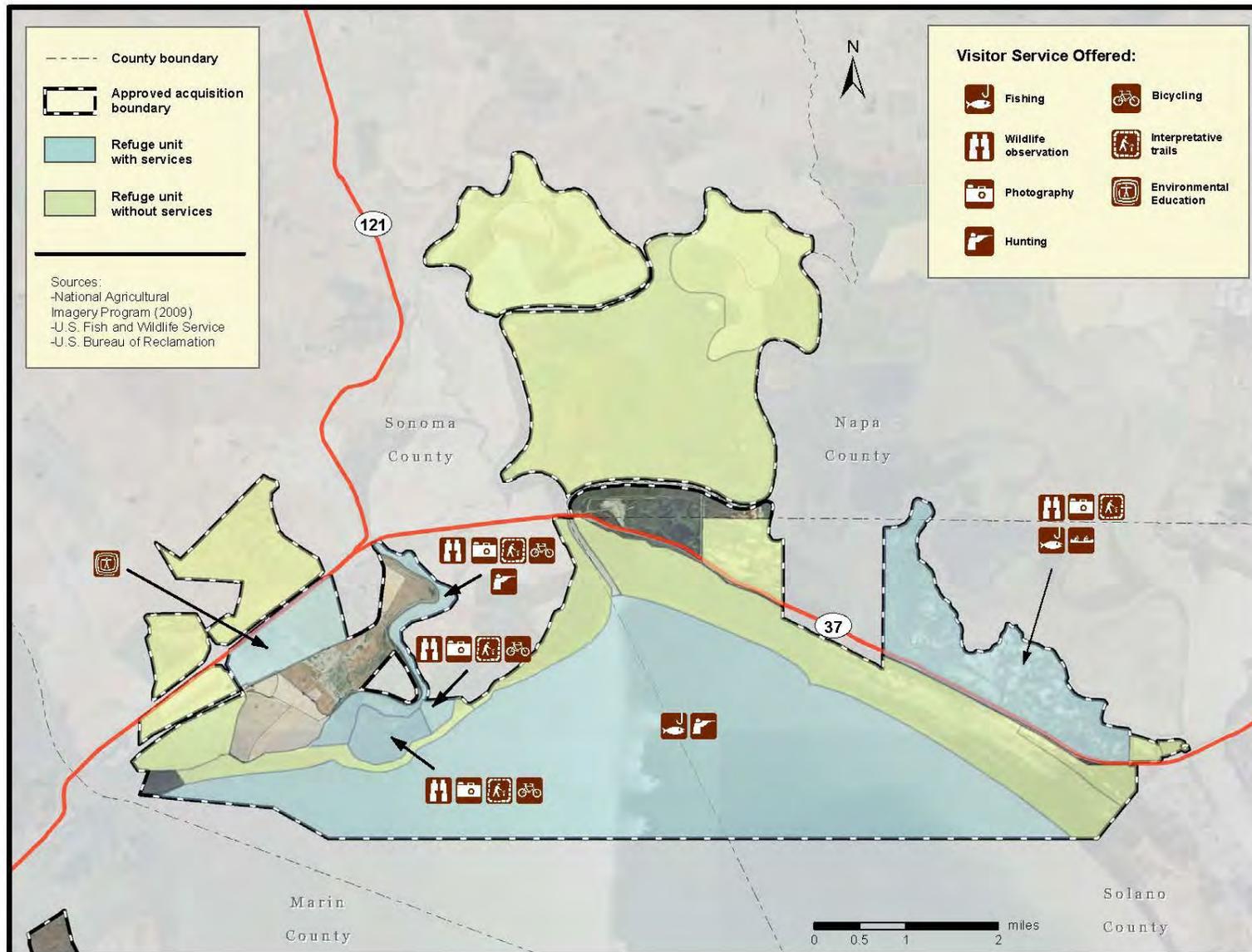


Figure 3. Visitor Service and Environmental Education Activities for Alternative B

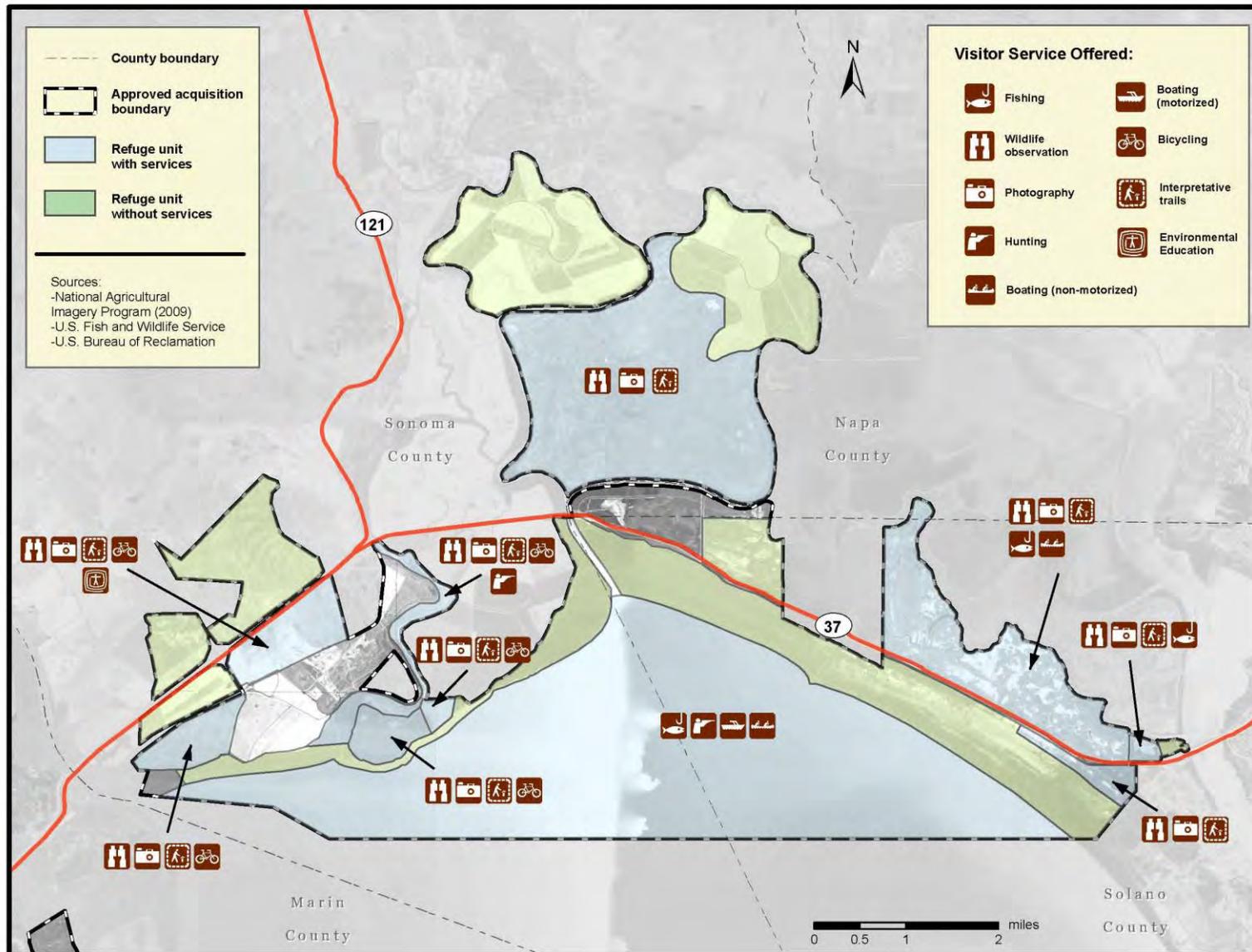
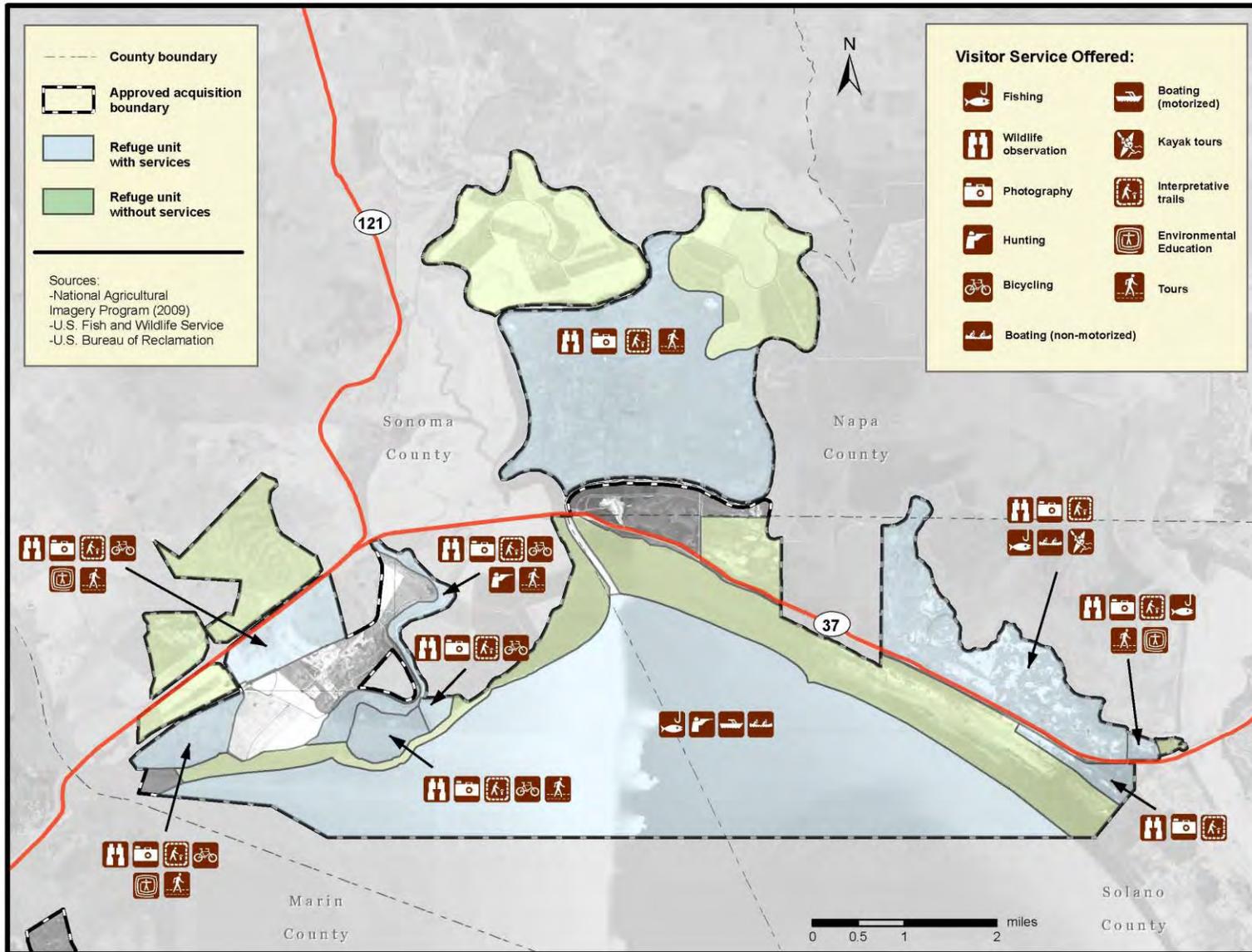


Figure 4. Visitor Service and Environmental Education Activities for Alternative C



Chapter 3. Affected Environment

This chapter is intended to describe the physical, biological, and cultural resources as well as the social and economic environment that would most likely be affected by the alternatives. Chapter 3, *Affected Environment*, of the CCP provides a detailed description of each of these components.

Chapter 4. Environmental Consequences

Chapter 4 analyzes the environmental impacts expected to result from implementation of the alternatives. Potential impacts to these resources are characterized by evaluating direct, indirect, and cumulative impacts where applicable for each alternative. Direct impacts are generally caused by the proposed actions and occur at the same time and place as the action, such as flushing of wildlife from wildlife observation activities. Indirect impacts are defined as reasonably foreseeable effects caused by the proposed action, but occurring later in time or farther away from the source of impact than direct effects. An example of an indirect impact is habitat modification that results in a change in abundance, breeding success, or prey availability. Cumulative effects would occur when incremental direct or indirect impacts are added to the impacts of other past, present and reasonably foreseeable future actions, regardless of the agency or person who undertakes them. The analysis is organized by each aspect of the environments described in Chapter 3 of the CCP, including physical, biological, cultural, social, and economic resources. The purpose of the analysis is to provide the context and intensity of the impacts of the action such that a determination of significance can be made by the decision-makers.

The analysis of environmental consequences focuses generally on all units of the Refuge. Separate, detailed analysis has been completed for individual restoration projects, such as the Cullinan Ranch Project. The Service completed an EIS/EIR for the Cullinan Ranch Wetland Restoration Project in 2009. The discussion and analysis in that document is incorporated by reference and is generally discussed below.

NEPA requires the development of mitigation measures when federal activities are likely to result in adverse impacts on the human environment. The EA and CCP identify measures that would avoid and minimize any environmental impacts that could occur during implementation of the CCP. Alternative A (no action) is a continuation of management practices that are currently in place and serves as a baseline against which Alternatives B, and C are compared.

Physical Resources

Hydrology

All Alternatives

Because much of the Refuge is located at or below sea level, several units of the Refuge are affected by tide changes in the Estuary. Levees and water control features have altered the hydrological patterns (i.e., natural slough channels) in the area resulting in poor water circulation such as trapping of stagnant water in some areas. Poor circulation has in turn resulted in poor quality tidal vegetation. From a public health perspective, stagnant waters breed mosquito populations that may carry diseases that are a threat to human health. Activities prescribed in the alternatives are expected to have long-term benefits to the hydrology of the Refuge and surrounding area. Tidal restoration activity will reduce stagnant waters and improve vegetation over the long-term, but may result in short-term erosion due restoration activities.

The Service recognizes the need to protect levees and other structures for the purpose of public safety and private property. Refuge staff plans to consider hydrological impacts to neighboring public and private property when pursuing restoration activity. The proposed alternatives would

not likely result in any adverse impact to private properties.

Alternative A

Activities associated with all of the alternatives are expected to improve or restore hydrological patterns and wetland function at Tolay Creek and Lower Tubbs Island (80 acres). However, such restorations and enhancements will cause high velocity water flows thereby inundating sites. Sediment (e.g., silt, clay, sand, and gravel) carried into low elevation areas will settle and discourage stagnating water. Over time, sedimentation will reduce these flows and encourage plant communities to form and stabilize the area.

Alternative B

Under Alternative B, additional hydrological improvements would be identified, prioritized and implemented at Refuge locations including Sonoma Creek, Tolay Creek, and Lower Tubbs Island. Tidal function would be improved to create high quality tidal marsh plant communities. As in Alternative A, restorations and enhancements have the potential to cause high velocity water flows thereby inundating sites. These water flows will reduce over time with the buildup of sedimentation and vegetation. Additional assessments for tidal impoundments and other hydrological issues would be assessed. Increased effort to remove pepperweed and invasive *Spartina* by chemical and manual means may result in temporary soil erosion to those treated sites. However, those sites will be replaced by native plants in the long-term to prevent long-term soil loss.

Alternative C

In addition to those elements in Alternative B, assessing hydrological patterns would clarify the possibilities for additional improvements to connectivity among the different tidal marsh units on the Refuge including breaches, lowering levees/berms, and removing culverts.

Water Quality and Contaminants

All Alternatives

Common water quality measures include salinity, pH, temperature, dissolved oxygen, and turbidity. Actions prescribed in the alternatives may cause short term impacts to water quality, but will result in the long term benefits to water quality. Tidal restoration and removal of invasive and non-native vegetation may result in short-term soil erosion and increase in turbidity in waterways. In the long-term restoration activities are expected improve water quality by allowing tidal exchange of water. Restoration actions will also draw sediment from waterways and the Bay into the refuge units to create land and eventually tidal marsh communities.

Tidal restoration activities in all the alternatives may introduce contaminants into or out of the Refuge.

Herbicide applications and manual removal of non-native vegetation may cause soil disturbance and the introduction of chemicals into the environment. Only approved herbicides appropriate for tidal marsh environments will be used according to label directions. Herbicide application will be permitted in or near waterbodies, but not during inclement weather to reduce impacts to water quality.

Alternative A

Restoration activities could result in temporary, short-term water quality impacts such as

increased turbidity from soil erosion, sedimentation, and the introduction of contaminants carried by tidal waters entering refuge units. As a mitigation measure, best management practices would be implemented including use of barriers to prevent sediment from flowing off the Refuge. Salinity and dissolved oxygen levels of waterbodies on the Refuge would be regulated through regular tidal exchange as a result of restoration.

The use of herbicides to remove non-native vegetation is anticipated under this alternative. Herbicides could be potentially applied near or in waterbodies which could impair water quality. As a mitigation measure, best management practices would be conducted such as using herbicides approved for aquatic use and avoiding use during inclement weather (e.g., rain, wind). All herbicides approved by the Service through the PUP process would be applied at label rates and all label recommendations would be followed (e.g., measures to preclude herbicide application on windy days).

Alternatives B and C

Alternatives B and C would result in similar effects described in Alternative A. Major restoration projects that will be assessed for Sonoma Creek, Tolay Creek, and Lower Tubbs Island may result in increased water turbidity from soil erosion in the short-term. In the long term, water quality such as salinity and dissolved oxygen will be improved through regular tidal exchange and reduction of water impoundments. Increased manual and chemical control of non-native and invasive vegetation may result in greater temporary water quality impacts such as introduction of herbicides and soil erosion into waterways and the Bay. Best management practices will be implemented to reduce water quality impacts such as avoiding restoration activities during inclement weathers and constructing barriers to prevent impact to waterbodies.

Under Alternatives B and C contaminants will likely be reduced through contaminants assessments to determine sinks and sources for removal on the Refuge.

Geology and Soils

All Alternatives

Tidal restoration activities proposed in all the alternatives will result in changes or disturbance to soil. Some areas may encounter increased sedimentation while sediment loss may occur in other areas depending on tidal flows. Grazing, mowing, nonnative plant removal, and native planting could disturb soils. These activities are expected to result in temporary impacts to soil while providing long-term stability to soil regimes on the Refuge.

Alternative A

Under Alternative A, current tidal restoration activities will increase sedimentation in some areas of the Refuge and reduce sedimentation in other areas, changing the topography of sites. Current invasive plant removal may also result in temporary soil erosion, but these areas are replaced by native plants which should reduce long-term erosion potential. Immediate best management practices to mitigate for soil erosion include constructing fencing to prevent soil from escaping the area.

Alternative B

Alternative B would also be similar to Alternative A in that tidal restoration would continue to take place but at a more accelerated pace. This could result in greater short-term loss of sediment, but overall long-term creation of stable native plant communities that will stabilize soils

and reduce long-term sediment loss. Expanded invasive removal by means such as mowing, disking, and grazing may result in additional temporary disturbance and erosion, but would be offset by replacement with native plants. Increased soil disturbance and erosion may also occur from development of fishing infrastructure (i.e., boardwalk, pier), walking trails, and interpretive infrastructure. Signage will be placed in public areas to encourage the public to stay within trails to reduce erosion. As a mitigation measure, infrastructure will be placed in less sensitive areas.

Alternative C

Activities conducted in Alternative C would result in the same effects as Alternative B. Developing an expanded on-site environmental education location at Sonoma Baylands has the potential to also increase soil erosion and disturbance potential. Sensitive habitat and erosion potential will be aspects considered when placing associated environmental education infrastructure (e.g., seating, signage, interpretive panels).

Air Quality and Climate

All Alternatives

The use of motorized construction equipment for restoration, construction, and maintenance activities in all alternatives would result in increased vehicle emissions (e.g., nitrous oxides, sulfur oxides, carbon dioxide) to the local area. Also, most visitors to the Refuge arrive by motorized vehicles which would result in particulates emissions as well. However, these activities are not expected to significantly affect air quality. It is reasonable to assume that an increase in visitor use at the Refuge may reflect visitors' choosing the Refuge as their destination rather than another location offering similar opportunities in the San Francisco Bay area (such as China Camp State Park, approximately 10 miles away). For this reason the Service anticipates that there would be no new vehicle trips, but if there is an increase in tailpipe emissions resulting from increased visitor opportunities, it is likely to be minimal.

Alternative A

Under Alternative A (no action), no significant air quality or climate disturbances are expected. Existing impacts on air quality are localized and incidental to transportation; staff and visitor transport currently cause short-term increases in air emissions. Earth-moving equipment needed for maintenance (e.g., mowing) and restoration activities would also emit particulates into the local environment. However, these activities are expected to be infrequent and not to occur on a daily basis. Moreover, the equipment that is used complies with current emission controls to reduce pollutants. The Service has not engaged in any other activities that would permanently affect the surrounding air quality or climate.

Alternatives B and C

Planning, prioritization, and implementation of tidal restoration activities (at sites such as Sonoma Creek, Tolay Creek, and Lower Tubbs Island) under Alternatives B and C will increase localized and temporary dust from heavy equipment operation. Construction of additional public use infrastructure such as trails and fishing piers will also increase localized dust particles vehicle emissions. Again, these activities are expected to be infrequent, one-time projects with short-term increases to air emissions. Measures to mitigate for dust include avoiding activities during extreme dry seasons or wetting down soil during construction activities to reduce dust.

Herbicide application in all the alternatives is not likely to affect air quality. Application of chemicals to control non-native vegetation would not occur during inclement weather such as high

winds to avoid the possibility of chemical drift. Prescribed burns for reducing non-native vegetation could increase particulate matter. Prior to burns, permits will be obtained from the San Francisco Bay Area Air Quality Management District to comply with permit requirements and determine best management practices.

Alternatives B and C are designed to increase visitation (an estimate of an additional 5,000 visitors) to the Refuge and thus may create overall long-term increases in tailpipe emissions to the area. However, these increases are not expected to significantly affect the overall air quality of the area. It is reasonable to assume that an increase in visitor use at the Refuge may reflect visitors' choosing the Refuge as their destination rather than another location offering similar opportunities in the San Francisco Bay area (such as China Camp State Park, approximately 10 miles away). For this reason the Service anticipates that there would be no new vehicle trips, but if there is an increase in tailpipe emissions resulting from increased visitor opportunities, it is likely to be minimal. Overall, increased management and visitor activities prescribed in Alternatives B and C are not expected to adversely affect Refuge resources or ambient air quality.

Hazardous Materials and Safety Issues

All Alternatives

Under all the alternatives, herbicides and pesticides are the only known hazardous materials that will be used on the Refuge. Pesticide application for mosquito control is addressed in a separate Mosquito Management Plan and Environmental Assessment being developed by the Service. Herbicides are not expected to result in any significant impacts to the Refuge or local environment. Herbicide will be stored in an approved spill-proof locker, according to label directions, California regulations, and Service policy. Crews applying the herbicide will be trained in storage and application to these same standards. In the long-term, the use of herbicides is expected to decrease with the reduction of nonnative vegetation.

Tidal restoration activities in all the alternatives may mobilize the contaminants found in the soils on the Refuge. Removal of levees to increase tidal circulation may facilitate the movement of contaminants to different areas of the Refuge or possibly off the Refuge into navigable waters.

Alternative A

The effects of Alternative A are expected to be those described above.

Alternatives B and C

The location of Refuge access points poses safety concerns to visitors. The two-lane Highway 37 cuts through the Refuge, but there are no deceleration/acceleration lanes to safely turn into the Refuge offices or public access locations. Alternatives B and C would improve safe access to the Refuge by including a deceleration/acceleration lane to the Cullinan Ranch unit. A new entry road will also be developed at the Sears Point unit (when acquired) to provide safe access to the office headquarters.

Wilderness

Because there is no designated wilderness at the Refuge, none of the alternatives will impact wilderness.

Biological Resources

Vegetation and Habitat

All Alternatives

All proposed alternatives would have a beneficial impact to native plants. Herbicides and manual (e.g., mowing, pulling) methods would be used for removal of non-native and invasive vegetation, allowing for native plants to replace them. The application of herbicides will be properly calibrated to needs. Use of herbicides would result in reduced nonnative vegetation and allow for expansion of native plant communities. Herbicides will be used when native plants are not in their growing season. Refuge staff would use different planting pallets and compare results to determine how best to encourage the growth of native plant communities.

All the alternatives prescribe restoration of the marsh-upland transition zone with targeted removal of pepperweed and monitoring (and removal when detected) of invasive *Spartina* species. These removal activities will allow native vegetation to thrive, improving the marsh-upland ecotone. In the short-term, tidal restoration activities prescribed for the Cullinan Ranch unit in all the alternatives will result in the conversion of seasonal freshwater wetland to tidal marsh. Over time, sediment will begin to accrete in these areas to facilitate formation of tidal marsh vegetation. Tidal restoration activities will eventually result in improved habitat for tidal marsh species, including the listed salt marsh harvest mouse and California clapper rail. These impacts are discussed in more detail in the Cullinan Ranch Wetland Restoration Project the Service completed an EIS/EIR in 2009.

Habitat restoration fulfills the Service's congressional mandate to preserve, restore, and enhance habitat for threatened and endangered species, songbirds, waterfowl, other migratory birds, interjurisdictional fish, marine mammals, resident wildlife, and plants. The plant and habitat restoration activities prescribed under all the alternatives will result in loss of seasonal freshwater wetland and upland habitat, but will result in an increase in tidal marsh habitat and enhancement of existing tidal marsh habitat. Further NEPA and Section 7 analysis may be done on enhancement and restoration projects as identified at a later time.

Alternative A

Under Alternative A, 80 acres of tidal salt marsh habitat at Tolay Creek and Lower Tubbs Island would be enhanced through hydrological modification. These improvements would result in higher quality pickleweed and associated vegetation ideal for salt marsh harvest mouse and California clapper rail. As noted above, 1,500 acres of diked upland area at the Cullinan Ranch unit would be converted from seasonal wetlands to tidal marsh. The conversion of freshwater wetlands and upland to tidal habitat will impact mammals and birds, including migratory waterfowl that use the Cullinan Ranch unit for breeding and foraging. These impacts are discussed in more detail in the Cullinan Ranch Wetland Restoration Project the Service completed an EIS/EIR in 2009.

Removal of invasive vegetation and monitoring for invasive *Spartina* will help maintain the salt marsh plant community and support native shorebird and mammal species that rely upon this habitat.

Current wildlife-oriented recreation opportunities (e.g., wildlife observation, photography, fishing, and hunting) would not adversely affect vegetation. The construction of a fishing pier, non-

motorized boat launch (e.g., kayak), and other related infrastructure (signage and benches) at the Cullinan Ranch unit is expected to result in a loss of habitat and vegetation. It is anticipated that less than a 0.25 acre of habitat will be lost to the development of this fishing area. Public access areas are and plan to be located away from sensitive vegetation. Signage also indicates closed areas near publicly accessible areas.

Alternative B

In addition to the activities proposed in Alternative A, Alternative B would result in additional enhancements to existing tidal marsh to improve habitats and vegetation at units including Tolay Creek, Lower Tubbs, and Sonoma Creek. These areas currently have low quality marsh plants due to poor water circulation. Specific enhancements have not been identified yet, but potential methods could include lowering of levees and breaches. These actions are not expected to replace one habitat type with another, but instead enhance tidal circulation in the tidal marsh habitat to improve vegetation for tidal marsh species. The pepperweed control plan and marsh-upland ecotone restoration plan developed under Alternative B would also improve native plant communities and control nonnative grasses and other vegetation.

According to the California Natural Diversity Database, a program that inventories the status and location of rare animal and plant species in California, soft bird's beak is present on the Refuge. However, recent vegetation surveys have not detected this species on the Refuge. Alternative B will result in improved understanding and protection of this species through surveying and monitoring.

Sub-tidal surveys will improve understanding and management needs of subtidal resources such as native eel grass. Climate change modeling will inform refuge management of habitats over the long-term. Models will provide information on anticipated habitat change scenarios for the Refuge.

The environmental education and volunteer opportunities prescribed under Alternative B will also benefit Refuge habitat and vegetation. School groups and planting days will support habitats through native plant propagation, weeding of nonnative vegetation, and planting of native plants. Sensitive wildlife areas will be avoided.

Hunting activities are not expected to impact vegetation under Alternative B. There are limited hunting areas (Tolay Creek and Lower Tubbs Setback) and low participation is expected. The development of fishing area and other related infrastructure at Guadalcanal are expected to result in a loss of habitat and vegetation. It is anticipated that less than a 0.25 acre of habitat will be lost to the development of this fishing area. Low quality habitat will be selected to reduce impacts on sensitive wildlife. Fishing participation is expected to increase. The Refuge does not currently have an accurate count of the number of people who fish on the Refuge as most of it occurs from boats in the open bay waters and sloughs which are accessed from boat launches outside of the Refuge. Therefore, it is estimated that by providing a land based angling access point at Guadalcanal fishing participation may increase by as many as a few hundred people per year.

Trail construction at Figueras, Guadalcanal, Sears Point, Skaggs Island and Sonoma Baylands would also result in loss of vegetation and habitat. However, loss of habitat for this use would be minimal in size (less than an acre) because trails will be improved along existing trail alignments and levees. Increased foot traffic under Alternative B could degrade vegetation near public areas.

As a mitigation strategy, fencing and signage would be placed to discourage visitors from wandering off designated trails. Sensitive habitat will be closed to access and would also be signed or fenced as needed. Increased law enforcement presence would also protect habitat. The environmental education program focused on native plant propagation and planting will be beneficial to the native plant communities on the Refuge. Sensitive habitat would also be avoided when conducting the environmental education program.

Alternative C

In addition to improvements in tidal influence noted in Alternative A and B, Alternative C will further improve tidal marsh habitats on the Refuge with the development of an action plan to identify hydrological connectivity among Refuge units. Alternative C will also support sub-tidal habitats by assessing historical information and identifying conservation priorities for these habitats.

The *Spartina* control plan and habitat management plan developed under Alternative C would improve native plant communities and control nonnative grasses and other vegetation. Grazing and haying activities prescribed for Sears Point would be used to control non-native grasses consistent with the farm landscape of the area. The early detection and rapid response program and invasive plant monitoring in Alternative C is one of the most effective means of avoiding costly long-term control measures. Identifying threats at an early stage and at an ecosystem level would maintain native plant communities, improve control effectiveness, and reduce costs.

The increase in public access opportunities under Alternative C may result in loss or damage of vegetation. Expanding outreach and education about hunting and fishing on the Refuge may result in increased number of hunters and minor impacts such as trampling of vegetation. However, outreach may also improve hunt protocols by educating hunters about avoiding sensitive areas on the Refuge. Docent-led kayak and walking tours may result in trampling of vegetation, but groups will be limited in size and in the areas allowed to access in order to protect sensitive habitat. Under Alternative C, the creation of infrastructure such as entry road, sitting area, parking area and interpretive panels for the environmental education program at Sonoma Baylands, Sears Point, and Guadalcanal would result in a loss of vegetation. Sensitive vegetation and habitat will be avoided. Sensitive habitat near publicly accessible areas will be fenced and/or signed as needed to deter disturbance. Increased law enforcement presence would also protect habitat. All visitors would be directed to stay in designated areas.

Wildlife

All Alternatives

All proposed alternatives would result in short-term and long-term benefits for wildlife species due to the implementation of tidal restoration projects, invasive vegetation control, and native plant restoration activities. These activities would result in short-term disturbance to wildlife, but are not expected to result in population-level effects and would be outweighed by the creation of additional native habitat for wildlife.

Public access opportunities in all proposed alternatives could result in some disturbance and mortality to wildlife. Wildlife observation (through biking, boating, and walking), photography, and environmental education could result in temporary disturbance to wildlife.

Hunting

Hunting would occur in all the alternatives resulting in disturbing, injuring and killing pheasant and waterfowl. Waterfowl hunting on the open bay and navigable sloughs will result in the direct loss of waterfowl, migratory species protected under the Migratory Bird Treaty Act. Pheasant hunting, only allowed at the Tolay Creek/Tubbs Island units, will result in the direct loss of pheasants, but this domesticated species is not managed by the Refuge or by the State and originate from a nearby hunt club. Waterfowl hunt statistics are unknown for the Refuge because hunters access Refuge hunt areas by boat and must launch from outside the Refuge (e.g., Vallejo) because the Refuge lacks a launch site. Pheasant hunting is accessed by the trail to the Tolay Creek/Tubbs Island units. It is surmised that only a small number of pheasant hunters (less than 15 hunters annually) use the Refuge due to the difficulty of accessing hunt areas, shallow waters within the Refuge making boating difficult, and quality of hunt available. Also, waterfowl species that are present are not considered high quality such as scaup. Hunting on the Refuge requires the purchase of a Duck Stamp, and is regulated by the State and is not expected to result in population level effects to waterfowl species. Law enforcement monitoring is also used to control over harvest. Promoting the hunt program may increase the number of birds taken, but is not expected to exceed population levels due to regulatory requirements.

Direct effects of hunting include mortality, wounding, and disturbance (DeLong 2002). Hunting can alter behavior (i.e., foraging time), population structure, and distribution patterns of wildlife (Owens 1977; Raveling 1979; White-Robinson 1982; Thomas 1983; Madsen 1985; Bartelt 1987; Cole and Knight 1990). There also appears to be an inverse relationship between the numbers of birds using an area and hunting intensity (DeLong 2002). In Connecticut, lesser scaup were observed to forage less in areas that were heavily hunted (Cronan 1957). In California, the numbers of northern pintails on Sacramento Refuge non-hunt areas increased after the first week of hunting and remained high until the season was over in early January (Heitmeyer and Raveling 1988). Following the close of hunting season, ducks generally increased their use of the hunt area; however, use was lower than before the hunting season began. Human disturbance associated with hunting includes loud noises and rapid movements, such as those produced by shotguns and boats powered by outboard motors. This disturbance, especially when repeated over a period of time, compels waterfowl to change food habits, feed only at night, lose weight, or desert feeding areas (Wolder 1993; Madsen 1995).

These impacts can be reduced by the presence of adjacent sanctuary areas where hunting does not occur and birds can feed and rest relatively undisturbed. Sanctuaries or non-hunt areas have been identified as the most common solution to disturbance problems caused from hunting (Havera et al. 1992). Prolonged and extensive disturbances may cause large numbers of waterfowl to leave disturbed areas and migrate elsewhere (Paulus 1984; Madsen 1995). In Denmark, hunting disturbance effects were experimentally tested by establishing two sanctuaries (Madsen 1995). Over a five-year period, these sanctuaries became two of the most important staging areas for coastal waterfowl. Numbers of dabbling ducks and geese increased 4 to 20 fold within the sanctuary (Madsen 1995). Thus, sanctuary and non-hunt areas are very important to minimize disturbance to waterfowl populations to ensure their continued use of the Refuge.

Intermittent hunting can be a means of minimizing disturbance, especially if rest periods in between hunting events are weeks rather than days (Fox and Madsen 1997). It is common for refuges to manage hunt programs with non-hunt days. At Sacramento Refuge, 3 to 16 percent of pintails were located on hunted units during non-hunt days, but were almost entirely absent in those same units on hunt days (Wolder 1993). In addition, northern pintails, American wigeon,

and northern shovelers decreased time spent feeding on days when hunting occurred on public shooting areas, as compared to non-hunt days (Heitmeyer and Raveling 1988). The intermittent hunting program of three hunt days per week at Sacramento Refuge results in lower pintail densities on hunt areas during non-hunt days than non-hunt areas (Wolder 1993). However, intermittent hunting may not always greatly reduce hunting impacts.

The CDFG is California's lead agency for management of fish, wildlife, and native plants - collectively called "wildlife." CDFG has trustee responsibility for the conservation and management of wildlife for the benefit and enjoyment of the public.

Resident game species are protected on refuges by both Federal and State laws and regulations to ensure that harvest rates do not negatively affect populations. The potential impacts of hunting on migratory bird and resident upland game birds are discussed and evaluated in the California Environmental Quality Act process (California Department of Fish and Game 2001, 2004a). This process results in periodically updated and publicly reviewed documents. Based on the findings of these documents, the State ensures that game animal hunting in California does not adversely impact its wildlife populations at an unacceptable level (California Department of Fish and Game 2004b).

Wildlife populations on the Refuge are able to sustain hunting and to support other wildlife-dependent priority uses. To manage the populations to support hunting, the Refuge adopts harvest regulations set by the State within Federal framework guidelines. The regulatory procedures that govern harvest are described in the section below.

By its very nature, hunting has very few positive effects on the target species while the activity is occurring. However, in the Service's experience, hunting has given many people a deeper appreciation of wildlife and a better understanding of the importance of conserving their habitat, which has ultimately contributed to the Refuge System's mission. Furthermore, despite the potential impacts of hunting, a goal of the Refuge is to provide visitors of all ages an opportunity to enjoy wildlife-dependent recreation. Of key concern is to offer a safe and quality program and ensure adverse impacts remain at an acceptable level.

Recreational hunting will remove individual animals, but does not negatively affect wildlife populations. To assure that populations are sustainable, the California Fish and Game Commission, in consultation with the CDFG, annually review the population censuses to establish season lengths and harvest levels.

Harvest Management – Regulatory Procedures

Waterfowl populations throughout the United States are managed through an administrative process known as flyways, of which there are four (Pacific, Central, Mississippi, and Atlantic). The review of the policies, processes, and procedures for waterfowl hunting are covered in the following documents.

NEPA considerations by the Service for hunted migratory game bird species are addressed by the programmatic document, Final Supplemental Environmental Impact Statement: Issuance of Annual Regulations Permitting the Sport Hunting of Migratory Birds (FSES 88-14), " filed with the Environmental Protection Agency on June 9, 1988. The Service published a Notice of Availability in the Federal Register on June 16, 1988 (53 FR 22582) and the Record of Decision on

August 18, 1988 (53 FR 31341). Annual NEPA considerations for waterfowl hunting frameworks are covered under a separate EA and FONSI. Further, in a notice published in the September 8, 2005, Federal Register (70 FR 53776); the Service announced its intent to develop a new Supplemental EIS for the migratory bird hunting program. Public scoping meetings were held in the spring of 2006, as announced in a March 9, 2006, Federal Register notice (71 FR 12216).

Because the Migratory Bird Treaty Act stipulates that all hunting seasons for migratory game birds are closed unless specifically opened by the Secretary of the Interior, the Service annually promulgates regulations (50 CFR Part 20) establishing the Migratory Bird Hunting Frameworks. The frameworks are essentially permissive in that hunting of migratory birds would not be permitted without them. Thus, in effect, Federal annual regulations both allow and limit the hunting of migratory birds.

The Migratory Bird Hunting Frameworks provide season dates, bag limits, and other options for the States to select that should result in the level of harvest determined to be appropriate based upon Service-prepared annual biological assessments detailing the status of migratory game bird populations. In North America, the process for establishing waterfowl hunting regulations is conducted annually. In the United States, the process involves a number of scheduled meetings (Flyway Study Committees, Flyway Councils, Service Regulations Committee, etc.) in which information regarding the status of waterfowl populations and their habitats is presented to individuals within the agencies responsible for setting hunting regulations. In addition, public hearings are held and the proposed regulations are published in the Federal Register to allow public comment.

For waterfowl, these annual assessments include the Breeding Population and Habitat Survey, which is conducted throughout portions of the United States and Canada, and is used to establish a Waterfowl Population Status Report annually. In addition, the number of waterfowl hunters and resulting harvest are closely monitored through both the Harvest Information Program (HIP) and Parts Survey (Wing Bee). Since 1995, such information has been used to support the adaptive harvest management (AHM) process for setting duck-hunting regulations. Under AHM, a number of decision-making protocols render the choice (package) of pre-determined regulations (appropriate levels of harvest) which comprise the framework offered to the States that year. California's Fish and Game Commission then selects season dates, bag limits, shooting hours, and other options from the Pacific Flyway package. Their selections can be more restrictive, but cannot be more liberal than AHM allows. Thus, the level of hunting opportunity afforded each State increases or decreases each year in accordance with the annual status of waterfowl populations.

Waterfowl – Flyway Analysis

The 2008 annual waterfowl harvest estimate for the Pacific Flyway is 3.3 million ducks, similar to 2007. This estimate represents almost 25 percent of the estimated total harvest for the U.S. of 13.7 million ducks (Raftovich et al. 2009).

Waterfowl harvested in California are made up of wintering waterfowl (coming from breeding grounds to the north) and the resident breeding population. For comparison, the Mid-Winter Survey Index for 2008 estimated 5.3 million total ducks for the Flyway (Trost and Sanders 2008). Waterfowl breeding 2008 breeding estimates for California were 554,000 ducks down from 627,600 in 2007 (USFWS 2008). These numbers serve to demonstrate the relative importance of these

areas (especially California) in the Pacific Flyway for wintering waterfowl, rather than for waterfowl production.

Waterfowl - Regional Analysis

Most recent available annual harvest estimates for California indicate that approximately 1.6 million ducks have been harvested by 53,200 and 58,100 waterfowl hunters in 2007 and 2008, respectively (Raftovich et al. 2009) in recent years. However, this may not be reflective of the exact hunter participation as estimates are based off voluntarily survey participation.

The most recent available estimate for the breeding duck population in California in 2009 was 510,800 birds, which was an 8.0 percent decrease from the 2008 estimate (CDFG 2009b). Mallards generally comprise more than half of each year's breeding population estimate. In contrast, the 2009 Midwinter Waterfowl Survey index for California totals 3.6 million ducks, further illustrating the relative importance of California's overall wintering waterfowl capacity within the Pacific Flyway (CDFG 2009a).

Waterfowl - Local Analysis

Waterfowl harvest numbers are unknown on the Refuge because hunters must access Refuge hunt areas by boat at boat launches off the Refuge (the Refuge does not have any launch points). The Refuge consists of 8,000 acres of open bay and navigable sloughs for waterfowl hunting. However, Refuge staff surmises that very few hunters (less than a dozen) hunt on the Refuge given this difficulty and the challenging tide conditions of two low tides per day.

Midwinter Waterfowl Surveys for 2009 estimated 551,035 ducks for the San Francisco Bay (CDFG 2009a). 2009 California Waterfowl Breeding Populations Surveys estimated about 19,000 ducks in Suisun Marsh and about 26,000 ducks in the Napa area (CDFG 2009b)

Significance Conclusion for Waterfowl

The hunting of waterfowl in the United States is based upon a thorough regulatory process that involves numerous sources of waterfowl population and harvest monitoring data. As a result of the regulatory options produced (AHM) in recent years, California hunter's estimated harvest of nearly 1.6 million ducks is approximately 12 percent of the total U.S. harvest of 13.7 million and nearly 50 percent of the Pacific Flyway's 3.3 million harvest estimate (Raftovich et al. 2009). Refuge staff estimates that hunting on the Refuge likely represents a negligible amount of all the waterfowl harvests conducted in California. Based on this analysis, the Service has concluded that hunting associated with each of the alternatives will not have a significant impact on local, regional, or Pacific Flyway waterfowl populations.

Alternative A

Under Alternative A (no action), tidal marsh restoration plans will revert the Cullinan Ranch unit from seasonal freshwater wetland and upland to tidal marsh, resulting in a conversion to sub-tidal habitat in the medium term until sedimentation increases and eventually tidal marsh. Upland species that use Cullinan such as mammals, raptors, and songbirds will be permanently displaced as it evolves into a tidal marsh that will support California clapper rail, salt marsh harvest mouse, and other marsh species. However, upland habitat will be available nearby. Refugia will also still be available for tidal marsh mammal species such as salt marsh wandering shrew and California vole. Conservation measures will be employed such as avoiding sensitive breeding seasons; surveying areas before activities take place; and trapping, relocating, and fencing before activities

begin. These impacts and other mitigation measures are discussed in more detail in the Cullinan Ranch Wetland Restoration Project the Service completed an EIS/EIR in 2009.

Enhancements under this alternative to Tolay Creek and Lower Tubbs Island units would also significantly improve the quality of habitat for tidal marsh species. These areas currently have poor tidal circulation which results in poor quality salt marsh vegetation and poor quality habitat for wildlife species. Species may be temporarily disturbed by restoration activities that may involve earth-moving equipment, foot traffic, heavy equipment, and vehicles. The hydrological improvements being conducted on Tolay Creek and Lower Tubbs Island will have less of an effect on tidal marsh species because they are existing marshes.

Native plant restoration will directly cause disturbance in wildlife habitat and may temporarily flush wildlife. Manual and chemical removal of nonnative species such as pepperweed may adversely affect individuals, but not negatively affect wildlife populations because pepperweed is not considered habitat for native wildlife species. The use of herbicides for controlling invasive vegetation is not expected to affect wildlife species. Herbicides will be applied by hand directly to plants to avoid non-target species. Sensitive breeding seasons and locations will be avoided. The use of herbicides and pesticides is highly regulated through the Service's Pesticide Use Proposal (PUP) process. This approach notes environmental hazards, efficacy, costs, and vulnerability of the pest. All herbicides approved by the Service through the PUP process would be applied at label rates and all label recommendations would be followed. Mitigation measures that may be employed include conducting surveys prior to removal activities to determine presence of nests or young. In the long-term, plant community restoration activities will benefit species by providing additional habitat.

Existing wildlife-dependent recreation opportunities such as fishing, wildlife observation and photography may result in temporary disturbance to wildlife. However, this activity is limited to the Tolay Creek/Lower Tubbs Island and Cullinan Ranch (once restoration is completed) units during daylight hours only. Signage is used to deter the public from entering closed areas to protect sensitive habitat.

Alternative B

Acquisition objectives of nearby sites such as Guadalcanal, Sears Point, and Sonoma Baylands, are expected to add additional habitat for tidal marsh and upland species native to the area. These sites may require restoration or enhancement to benefit native wildlife species. Existing wildlife in these areas may be displaced by such restoration or enhancement activities. Further site-specific planning will include mitigation measures such as consideration for existing wildlife habitat needs and slow flooding of areas to be restored to tidal influence to prevent mortality.

Additional inventory and monitoring through additional staff will benefit wildlife through additional data on species that will inform management decisions. The marsh-upland ecotone plan, pepperweed control, and invasive *Spartina* control will benefit wildlife species by enhancing native plant communities.

Under this alternative, developing and implementing a program for invasive vegetation control, early detection, and rapid response would help to maintain high quality habitat and vegetation for wildlife species. Short-term effects of control would include disturbance to birds through the use of chemical and manual removal of nonnative vegetation. Individuals may be temporarily flushed

from the area, but these actions are not expected to result in negative impacts to the overall population levels of wildlife species.

A predator management program may also benefit wildlife species by first identifying whether or not major predator threats exist to individual species populations on San Pablo Bay, where they exist and then developing a phased control program to reduce predation if needed. Predator control will only be initiated when and if a protected or sensitive species will benefit and where a direct cause and effect can be measured in the field.

The addition of trails, fishing pier/boardwalk, entry points, and other associated infrastructure will increase number of visitors to the Refuge. Increased visitor use in the form of wildlife observation, photography, recreation, and environmental education will result in more traffic in habitat areas and may cause wildlife to temporarily flush from the area. Additional trails and access points for wildlife observation and photography may result in temporary disturbance to birds. However, visitation will also promote stewardship of habitat and wildlife. Additional signage and fencing will be installed as needed to deter the public from entering sensitive wildlife habitat. Increased law enforcement presence will also reduce wildlife disturbance. This activity is not expected to result in a population-level effect on wildlife. To mitigate disturbance, public access areas will be designated where the least disturbance to wildlife would occur. Increased outreach through signage and interpretive panels/material will be available to deter disturbance to wildlife. Expanded environmental education opportunities such as the Garden Education Program will improve wildlife habitat with nursery propagation and planting opportunities.

Alternative C

Alternative C would include those activities and effects in Alternative B. In addition, there would be increased benefits and disturbances from activities prescribed in this alternative. The evaluation of population health and viability for the listed species and other native wildlife will be beneficial to wildlife in the long-term. Additional studies on use of interior tidal ponds and mapping of high tide roost environments for protection will benefit birds and improve their habitat. Developing a predator management plan will provide benefit wildlife populations.

Additional hydrological enhancements in this alternative would benefit wildlife by providing higher quality habitat. The development of grazing, haying and soil stabilization plans for the Sears Point unit will control non-native vegetation and enhance native species appropriate for grassland-dependent species. Developing a Spartina control plan and an early detection and rapid response program for invasive species would have a positive benefit to habitat for wildlife. Sub-tidal wildlife resources will benefit from the implementation of sub-tidal restoration or enhancement activities that will be conducted by staff and partners. Climate change assessments and monitoring will also benefit long-term needs (such as identifying additional habitat) for wildlife.

Guided walking and kayaking tours will be conducted in a manner that reduces disturbance and will also encourage visitors to avoid disturbing wildlife. Conducting a fishing day (catch and release only) at the Cullinan and/or Guadalcanal units may cause temporary disturbance to wildlife. This event will be directed by staff that would oversee the activity and limit potential impacts to wildlife. Environmental education programs at Sonoma Baylands and Guadalcanal could increase disturbance to wildlife. In order to reduce impacts to wildlife, staff will educate students on precautions to reduce disturbance to wildlife during these programs. Programs will

also take place away from sensitive habitat and special-status species. Increased law enforcement presence will also reduce wildlife disturbance.

Fish and Marine Invertebrates

All Alternatives

Tidal restoration activities in all of the alternatives could result in entrapment of fish and marine invertebrates during low tide conditions. Potential mitigation elements that may be employed include avoiding construction activities during migration periods and use of water control structures such as culverts to prevent entrapment. Tidal restoration activities will result in open water habitat appropriate for fish and invertebrate habitat, until sedimentation begins to take place. In the long-term, sub-tidal habitat is expected to increase and expected to result in a benefit to fish and marine invertebrate populations.

Fish mortality occurs from fishing activities that are permitted in the open bay of the Refuge and is expected from the opening of a fishing pier at the Cullinan Ranch unit (once restoration is complete). However, fishing is enforced by the CDFG regulations and is not expected to result in a population-level affect on fish species.

Alternative A

The effects of Alternative A are expected to be those described above.

Alternatives B and C

Monitoring efforts will also be established for subtidal habitats. Sub-tidal habitats are not understood or actively managed, despite encompassing well over 8,000 acres of the Refuge. Under Alternatives B and C, staff will work with partners such as National Oceanic and Atmospheric Administration (NOAA) and specialists in sub-tidal habitats to conduct monitoring to better understand the fish and invertebrate species present in this habitat in order to develop management needs. Alternative C will include identifying conservation priorities for restoration or enhancement which will support fish and invertebrate needs.

Under Alternatives B and C, additional fishing will be prescribed including shoreline fishing locations such as a pier. Direct impacts include a probable higher fish loss than Alternative A. However, fishing will continue to be implemented according to CDFG regulations and is not expected to adversely affect fish populations.

Endangered species

All Alternatives

Individual wildlife may be affected, but restoration activities in all the alternatives are expected to benefit the long-term population of tidal marsh species including listed species such as the California clapper rail and the salt marsh harvest mouse. There would be a temporary loss of tidal marsh habitat from inundated areas where breaching occurs. Restoration activities could disturb and flush California clapper rail from the area. Activities could result in direct mortality of salt marsh harvest mice if they were present in areas where proposed breaches were implemented. In the long-term additional tidal marsh habitat would off-set the temporary loss of habitat. Potential mitigation measures to reduce impact to individuals may include surveying for presence or absence of individuals; providing a buffer near nest locations; avoiding activities during the nesting season; trapping and transplanting mice to other sites; installing barrier fence to prevent re-entry; and slow flooding to allow mammals to seek refugia in higher elevation pickleweed.

Use of herbicides, mechanical removal, and hand-pulling of nonnative plants under all the alternatives has the potential to impact wildlife. Short-term impacts of plant removal are likely to include disturbance of roosting (non-breeding) clapper rails or mice within close proximity to the field crews conducting the removal. Such disturbance may force wildlife to relocate to other parts of the Refuge temporarily. Herbicide spraying would not be conducted during the breeding or nesting season to reduce exposure to wildlife.

All the alternatives include native plant restoration and invasive plant management activities. Increasing native plant cover will provide additional habitat and refugia for listed tidal marsh species in high tide events.

Alternative A

The impacts in Alternative A are the same as those described above.

Alternatives B and C

Under Alternative B, Refuge staff will standardize and analyze monitoring protocol for listed species. These changes in methodology will improve understanding of listed species and their recovery needs. Alternative B also prescribes the development of a monitoring and control program to respond specifically to nonnative cordgrass if and when it is found on the Refuge. This response plan will benefit wildlife, including endangered species, by protecting food and cover habitat from invasive plants. Similar to pepperweed, cordgrass infiltrates tidal marshes and drives out native plant communities. While dense patches have formed in the South Bay, it has yet to invade the North Bay. Only individual plants have been found and quickly removed. A rapid response plan will also be developed for dealing with other invasive plants as well.

Predator management activities as described earlier may be used to control predators of native wildlife if necessary and in specific cases where it will help protect population levels and direct cause and effect can be measured in the field.

Climate change actions under Alternative B will have added benefit to wildlife. Through climate change modeling and monitoring, staff will identify habitat changes and identify adaptive changes or acquisition needs that may be required to support wildlife. Modeling will help staff identify which species are most at risk of climate change effects and prioritize management actions to protect them. Staff will conduct monitoring activities that measures indicator resources (e.g., water gauges, temperature, arrival and departure dates of species) that are a result of climate change.

In addition to activities in Alternative B, improved hydrological connectivity between tidal marsh units as prescribed in Alternative C will improve connectivity between the different refuge units. These access points would be beneficial to listed species in high tide events or over time as climate change alters habitats. Alternative C would support recovery needs for the California clapper rail and salt marsh harvest mouse by evaluating population health, viability and goals to preserve and enhance existing populations. The development of grazing, haying, and soil stabilization management plans for Sears Point (when acquired) in Alternative C is expected to benefit California red-legged frog by enhancing upland grassland dispersal habitat.

Wildlife-oriented recreational activities prescribed in Alternatives B and C are not expected to

impact endangered species. These activities will not take place in listed species habitat. Further, signage and fencing will be installed to protect sensitive habitat. Increase law enforcement presence will also protect listed species.

Social and Economic Environment

None of the alternatives are expected to adversely affect the social and economic environment of Solano, Sonoma, and Napa Counties. Tourism revenue is potentially generated through activities and events held at the Refuge such as guided walks and plant restoration activities. If an increase in visits to the Refuge occurs or there is a net increase in visitors to the area, this could benefit the local economy and employment if visitors utilize local businesses such as gas stations, markets, and restaurants. Increased visitation provides an opportunity for public education, which can foster value for these native habitats.

Recreation

All Alternatives

All alternatives offer some level of wildlife-dependent recreational opportunities which include wildlife observation, photography, hunting, and fishing. All the alternatives provide some social benefit to nearby communities by providing access to open space.

Alternative A

Alternative A (no action) provides limited recreational opportunities on the Refuge. Currently, there is only one self-guided trail (for walking and biking) available for wildlife observation and photography which is located at the Tolay Creek/Tubbs Island Unit. Hunting and fishing are allowed in the open bay waters and navigable sloughs. Hunting is not expected to conflict with wildlife observation or photography. Hunting is allowed on a small segment (less than one acre) of the Refuge (Tolay Creek) for pheasant only. Hunters walk through Refuge property to hunt in California Department of Fish and Game property. Once tidal restoration activities are completed for the Cullinan Ranch unit non-motorized boating (e.g., kayaking), wildlife observation, interpretation, photography, and fishing will be permitted.

Alternative B

Alternative B would encourage increased visitor use by offering more access sites and a larger variety of recreational activities. In addition to those elements described in Alternative A, Alternative B would provide more refuge involvement in hunting activities on the Refuge by offering hunting brochures. Staff would also add a shoreline fishing pier location and develop fishing information materials. Additional self-guided access (for walking and biking) would be developed at Guadalcanal, Sears Point, Figueras, and Sonoma Baylands.

Alternative B would also expand environmental education opportunities directed towards the local community. A Garden Education Program for families would encourage the local community on the use of native plants and offer service opportunities, events, or workshops on the Refuge.

Alternative C

Alternative C would include those activities described in Alternative A and B, but also include more outreach on hunting and fishing activities. Outreach to the local community and other visitors would be improved through hunting and fishing program events such as the hunter cleanup day, hunter orientation workshop, and fishing day event. Additionally, kayak tours at the

Cullinan Ranch unit would be offered twice a year, while a docent-led tour program would be developed for Guadalcanal, Sears Point, Sonoma Baylands, Skaggs Island and Lower Tubbs units.

Also under Alternative C, the environmental education program would provide more field-based opportunities for local schools and the community. The environmental education field trip program would bring local elementary schools to the Sonoma Baylands, Sears Point, and Guadalcanal units, to learn about migratory birds, wetlands, and habitat restoration. Staff would also collaborate with non-profit partners to implement in-class programs to support experiences on the Refuge.

Economy

All Alternatives

None of the alternatives are expected to negatively impact the economic environment of the area. Under all the alternatives, some employment opportunities will be created for the surrounding community.

Alternative A

Alternative A is not expected to negatively impact the economic environment of the area.

Alternatives B and C

Alternatives B and C would add staff positions including a law enforcement officer, outdoor recreation planner, administrative officer, maintenance worker, range conservationist, and two biological technician positions. Construction projects, restoration projects, and management activities could benefit local companies, though projects would have to be sent out for competitive bid. Grazing and haying activities to manage nonnative vegetation would also be conducted by a local farmer and rancher.

Both Alternatives B and C could result in an increase in recreational spending related to additional visitor recreational opportunities offered on the Refuge. Tourism dollars to local businesses (e.g., gas stations, restaurants, markets) may be generated from visitation to the Refuge.

Cultural Resources

All Alternatives

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. There are no identified historic and cultural elements on the Refuge. However, the office headquarters are located on an old farm property. While not identified as historically significant, any renovations, repairs, or modifications to the farm structure will strive to maintain their character. In addition, new structures will mimic the farm aesthetic of the area.

Site specific refuge management activities, such as construction or tidal restoration, have the potential to disturb cultural resources. To preserve Refuge historic resources, all undertakings, including but not limited to construction activities, will comply with Section 106 of the National Historic Preservation Act of 1966, as amended, as outlined in the existing Programmatic Agreement between the Service and the California State Historic Preservation Officer. Staff will

also coordinate with the Service's Regional Archaeologist to comply with Federal laws relating to cultural resources.

The area where the Refuge is located was once open water and marsh making it difficult to locate physical evidence of human activity. Moreover, archaeological sites also tend to be situated on higher land than the Refuge (N. Valentine, pers. comm.). There are no known accounts or evidence of Native American use on the Refuge, though several Native American tribes are known to have inhabited the area including Pomo (central and western Sonoma County), Miwok (southern Sonoma County), Yuki (northern Sonoma County), Sotoyome (northern Sonoma County) and Suysune (eastern Sonoma County), Wappo (Solano County), and Suisun (Solano County) (Drake 1978, Hunt 1926). Therefore, it is unlikely that actions under any of the alternatives would affect cultural resources.

Alternatives B and C

Alternatives B and C include an outreach and education component that will include a history of the cultural resources on the Refuge. Environmental education brochures for visitors and local residents will include a discussion of the farming and ranching history of the area.

Climate Change

All Alternatives

Climate change could have a profound effect on the Refuge because most of the area is below sea-level. Sea-level rise as a consequence of climate change could reduce the total land area of the Refuge. Based on a continuous record of mean sea level for the San Francisco Bay Estuary, the rate of relative sea level rise at the Presidio from 1855 to the present is estimated to be 0.12 centimeter per year (Moffatt and Nichol et al. 1988). Neglecting the unusual values associated with all El Niño events during the recent 19-year period from 1967 to 1985, sea-level rose at a rate of 0.18 centimeter per year, which still indicates that the rate of rise is increasing (Moffatt and Nichol et al. 1988). Climate change in conjunction with tidal wetland restoration and nonnative vegetation removal activities will result in an increase in wetland or open water habitat, and a decrease in upland habitat. However, much of the diked upland on the Refuge was historically tidal wetland.

A SLAMM model was conducted in 2010 to assess habitat changes as a result of climate change on the Refuge (Clough and Larson 2010). The SLAMM identified habitat changes on the Refuge units that may be expected under five sea-level rise scenarios. The middle scenario of a 1-meter rise in sea level predicts losses of 13 percent dry land, 64 percent irregularly flooded marsh, 58 percent tidal flat, and 23 percent developed dry land. Increases would be in estuarine open water and salt marsh habitats (Clough and Larson 2010). However, there were a number of assumptions that were made, suggesting the need to consider other modeling efforts to confirm these findings.

Climate change could also result in changing habitat which would affect wildlife and plant communities. Not only could habitats shift, but also when birds migrate and leaves begin to bud (IPCC 2007). Climate change could magnify impacts on wildlife habitat, reduce native vegetation, and increase occurrence of nonnative (plant and animal) species on the Refuge. Climate change can result in physiological changes, phenological (lifecycle) changes, range shifts, community changes, ecosystem process shifts, and multiple stressor conditions (Parmesan and Galbraith 2004). Global warming may require organisms to migrate at much higher rates than they have done in the recorded past (Malcolm and Pitelka 2000). Native plants may not thrive in the Refuge

boundaries due to changing temperatures. Moreover, climate change could result in changes to local food web dynamics, altering prey resources in the bay waters adjacent to the Refuge. The potential changes to food availability near the Refuge could deter or attract wildlife affecting productivity.

Over time, climate change could result in significant ramifications for wildlife and vegetation. Tidally-influenced habitat for wildlife at the shoreline could disappear, forcing wildlife to move onto higher ground, possibly competing with other wildlife for habitat. Plant communities at the shore could be inundated or be forced to migrate to higher ground, competing with other vegetation (Smerling et al. 2005).

The U.S. Department of Interior issued an order in January 2001 requiring its land management agencies to consider potential climate change impacts as part of long-range planning endeavors. The increase of carbon within the earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. In relation to comprehensive conservation planning for national wildlife refuges, carbon sequestration constitutes the primary climate related impact to be considered in planning. The U.S. Department of Energy's report Carbon Sequestration Research and Development (1999) defines carbon sequestration as — the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere.”

Terrestrial biomes of all sorts – grasslands, forests, wetlands, tundra, perpetual ice, and desert – are effective in preventing carbon emissions and in acting as a biological “sinks” for atmospheric carbon monoxide. The Department of Energy's report conclusions note that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere. Preserving natural habitat for wildlife is the heart of any long-range plan for national wildlife refuges. The actions proposed under any of the alternatives would conserve or restore land and water, and would thus enhance carbon sequestration. This in turn contributes positively to efforts to mitigate human-induced global climate changes. Several impacts of climate change have been identified (Hassol 2004) that may need to be considered and addressed in the future:

- Habitat available for cold water fish such as trout and salmon in lakes and streams could be reduced.
- Forests may change, with some species shifting their range northward or dying out, and other trees moving in to take their place.
- Ducks and other waterfowl could lose breeding habitat due to stronger and more frequent droughts.
- Changes in the timing of migration and nesting could put some birds out of sync with the life cycles of their prey species.

Alternative A

Alternative A would have benefits against climate change because restoration and enhancement of tidal marsh would increase carbon sequestration.

Alternative B

Under Alternative B, increased habitat restoration and reduced carbon footprint (e.g., hybrid transportation, solar, wind technology) would result in a positive impact on reducing climate

change. Increased visitation would result in a negligible impact on increasing climate change effects.

Alternative C

Under Alternative C, we would anticipate that further increases in habitat restoration, further reduced climate change impacts, and increased visitation would result in a moderate positive impact on climate change. Alternative C would have a slightly greater positive impact than Alternative B due to the implementation of the methods to reduce carbon footprint by developing further climate mitigation measures.

Environmental Justice

Executive Order 12898 (“Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations”) requires all Federal agencies achieve environmental justice by “identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.” Environmental justice is defined as the “fair treatment for peoples of all races, cultures, and incomes, regarding the development of environmental laws, regulations, and policies.

The mission of the Service is working with others to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people. The developing environmental justice strategy of the Service extends this mission by seeking to ensure that all segments of the human population have equal access to America’s fish and wildlife resources, as well as equal access to information that will enable them to participate meaningfully in activities and policy shaping.

No minority and low-income populations or communities would be disproportionately affected by any of the alternatives. Outreach opportunities will be directed towards local minority and low-income populations. The Service has concluded that none of the alternatives would disproportionately affect any one population or community.

Cumulative Effects

Cumulative effects are those effects on the environment resulting from incremental consequences of the Service’s proposed actions when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes those actions. Cumulative effects can be the result of individually minor impacts that can become significant when added over a period of time. It is difficult to accurately analyze cumulative effects because one action may increase or improve a resource in one area, while other unrelated actions may decrease or degrade that resource in another area. Moreover, CCP actions may be inhibited or accelerated by other activities or management plans occurring in the same area. This section assesses how these other activities in addition to the CCP actions would affect the physical, biological, cultural, and social and economic environment.

Cumulative effects will take into account several ongoing projects where the Refuge is located. These projects are described in the CCP and include:

The San Pablo Bay Watershed Restoration Program. The U.S. Army Corps of Engineers, California Coastal Conservancy and the Bay Institute are working to restore 50,000 acres of

wetlands to provide habitat for endangered species such as the California clapper rail (*Rallus longirostris obsoletus*) and the salt marsh harvest mouse (*Reithrodontomys raviventris halicoetes*). Also, tributary streams will provide valuable habitat for fish such as Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*Oncorhynchus mykiss*), as well as other aquatic animals.

Sears Point Restoration Project. Sonoma Land Trust will restore the 2,300-acre site to tidal marsh, diked marsh, riparian, vernal pool, seasonal marsh, and grasslands. This project began in 2004 and is not slated for completion until 2012.

Napa-Sonoma Marsh Restoration Project. In 1994, the CDFG purchased about 9,000 acres of salt-making ponds from Cargill Salt Company. The State is planning to restore the historic wetlands upon which the salt ponds were originally built. In order to accomplish that goal, the salinity of several ponds needs to be reduced to levels that are harmless to fish and wildlife. The Bay Institute is working with the CDFG and the Sonoma County Water Agency to import reclaimed water from surrounding communities and use the water to dilute the salty ponds. This innovative approach not only will enable faster restoration of the marshes, but will also reduce the amount of discharge to the Bay from North Bay water treatment plants.

Petaluma Marsh Expansion. Sponsored by Marin Audubon Society, California State Coastal Conservancy, and Calfed. This project will restore approximately 100 acres of diked tidal marsh as part of 2,000 acres of Petaluma tidal marsh, the largest undiked tidal marsh remaining in the Bay. The project will benefit special status bird and fish species.

Sonoma Baylands Restoration. This 348-acre former diked farmland was returned to full tidal action in 1996 through a partnership with Sonoma Land Trust, the California State Coastal Conservancy, and the U.S. Army Corp of Engineers. The San Francisco Bay Trail (Bay Trail) runs along the levee top.

Cumulative Effects on the Physical Environment

All the alternatives are anticipated to enhance or restore the natural physical environment of the Refuge to provide long-term benefit native wildlife and vegetation. The projects mentioned above, such as the Napa-Sonoma Marsh Restoration Project, will have the added benefit of providing additional habitat for native wildlife and vegetation. However, the Refuge is surrounded by an increasingly urbanized area with impacts from not only agricultural activities, but also development pressure which could result in profound cumulative effects to the physical environment of the area. Any nearby developments, such as agriculture or other commercial activities, could have negative implications on the Refuge environment such as the introduction of invasive vegetation and contaminants. The Refuge has little control over these external impacts, but has and will continue to work with partners during their planning process to protect important native habitat.

Cumulative Effects on Biological Resources

All proposed alternatives would have long-term benefits for native wildlife species and habitats within the area. The alternatives integrate wildlife conservation activities with compatible wildlife-dependent opportunities that would represent a cumulative benefit for local wildlife, native plant communities, and human communities.

The conversion of neighboring agricultural lands to tidal marsh, as mentioned in the projects above, could also result a positive cumulative effect to biological resources. The Napa-Sonoma Marsh Restoration Project occurring northeast of the Refuge has the potential to restore nearly 10,000 acres of tidal marsh and wetlands to the area. These former Cargill salt ponds will provide extensive habitat for endangered species, special status species, migratory waterfowl and shorebirds, and fish and other aquatic species. The project will most likely incorporate a broad, upland transition zone and may make use of the expansive, compacted former salt ponds for use as seasonal wetlands habitat. This project, along with the objectives described in the CCP will result in a positive net benefit to the ecosystem by restoring natural habitat for endangered species and migratory birds. Increased tidal wetlands restoration prescribed for both the CCP and Napa-Sonoma Marsh Restoration Project will also provide additional fish and invertebrate habitat for nursery and foraging. Enhancing upland grassland habitat in the CCP and Sears Point Restoration Project will benefit California red-legged frog. The activities will cumulatively support the goals of the Refuge and the region in restoring and conserving wildlife resources.

Visitor activities prescribed in the alternatives and other public access opportunities such as The Bay Trail (administered by the Association of Bay Area Governments) would result in increased visitation to the area. The increased visitor uses of hiking, bicycling, boating, guided tours, environmental education programs combined would add more visits to the Refuge which could result in increased disturbance to wildlife and degradation of habitat. This increased visitation would add to the total visitation to the area that is already being generated by the Bay Trail system. The Refuge will work with The Bay Trail staff to mitigate any potential disturbance and avoid sensitive habitat areas on the Refuge.

Hunting on Refuge lands as well as hunting on neighboring California Department of Fish and Game lands is an existing activity that took place prior to the Refuge's establishment. The hunt season, type of waterfowl hunted, and hunt limits are regulated under State regulations. These regulations are designed to ensure that harvest does not reduce populations to unsustainable levels. Although hunting will result in direct loss of individuals, this activity is not expected to cause population-level changes in any of the hunted species. Moreover, the amount of hunting on the Refuge under any of the alternatives is not expected to substantially increase.

Cumulatively, these activities could potentially increase disturbance to wildlife and damage habitat. Some activities will be led by docents who will supervise visitors. These new visitor uses are not expected to generate large demand, potentially an additional 5,000 visits annually. Access points and associated infrastructure will only be able to accommodate small groups or single school groups in appropriate areas. Signage, closure of sensitive areas, and increased law enforcement would be required elements to provide prior to increased visitor access in order to prevent or reduce disturbance and degradation. Fencing as needed will be placed near sensitive sites to deter visitors from disturbing wildlife.

Cumulative Effects on Cultural Resources

In general, the Service adheres to the policies and regulations pertaining to the protection of cultural resources in order to avoid or mitigate for any significant adverse effects resulting from management activities. The actions in the CCP will continue to adhere to those policies and regulations. No adverse effects on cultural resources are anticipated from any of the alternatives or other local activities. Increased funding will be needed for addressing increasing maintenance needs of the office structures that represent the farm aesthetic of the area.

Cumulative Effects on the Social and Economic Environment

The action alternatives, particularly those involving expansion of wildlife-dependent recreation and environmental education, would provide benefits to the residents of San Francisco. In addition, the environmental education and outreach programs would attempt to reach a diverse audience. Additional recreational opportunities in the form of hiking trails, fishing locations, and hunting outreach will act in concert with the Bay Trail and Water Trail systems.

Tourism dollars could be generated from the increased recreation opportunities. Local restaurants, stores, lodging and gas stations could benefit under any of the alternatives. Contract work may benefit the local economy, particularly grazing and haying activities contracted to a local farmer or rancher.

Table 2. Summary Impacts of Alternatives

	No Action	Alternative B Develop an inventory and monitoring program; expand tidal restoration and enhancement activities; provide additional visitor access and limited environmental education	Alternative C Same as B; additionally, develop wildlife populations goals; expand environmental education and interpretation opportunities
<i>Physical Environment</i>			
Hydrology	Minor impacts from higher velocity water flows, but long-term improved hydrological benefit	Additional hydrological benefits	Same as Alternative B
Water Quality/Contaminants	Minor impacts with increases in turbidity, but long-term positive benefit	Same as Alternative A	Same as Alternative A
Geology	Erosion from tidal restoration activities, but with long-term sedimentation benefits	Increased erosion due to additional restoration and construction activities, but with long-term sedimentation benefits	Same as Alternative B
Air Quality/Climate	Minor impacts from restoration activities	Increased minor impacts from additional restoration activities, increased tailpipe emissions from increased visitors	Same as Alternative B
Hazardous Materials/Safety	No adverse effects from continued use of herbicides. Ongoing safety concerns related to vehicular access.	Beneficial impact to public safety	Same as Alternative B

<i>Biological Environment</i>			
Vegetation	Conversion of seasonal and emergent marsh wetlands to tidal habitat; beneficial impact to native plant communities	Additional beneficial improvements to native plant communities; minor impact due to wildlife-oriented activities	Same as Alternative B; minor impact due to public use and environmental education activities
Wildlife	Loss of habitat for upland species; beneficial impacts to tidal marsh species; minor disturbance and waterfowl mortality from hunting	Same as Alternative A; improved inventory and monitoring of species; minor impact due to wildlife-oriented activities	Same as Alternative B; minor impact due to public use and environmental education activities
Fish and Marine Invertebrates	Minor impact due to tidal restoration and fishing; beneficial impact due to increased habitat	Same as Alternative A; beneficial impact due to surveying and monitoring	Same as Alternative B ; beneficial impact due to developing conservation and restoration priorities
Endangered species	Beneficial impacts due to habitat restoration; minor disturbance due to habitat and tidal restoration	Same as Alternative A; improved inventory and monitoring of species	Same as Alternative B
<i>Social and Economic Environment</i>			
Recreation	Beneficial impact due to recreational opportunities	Beneficial impact due to additional recreational opportunities	Same as Alternative B
Economy	No negative effects identified	Minor beneficial impact due to increased staffing and contract needs, and increased visitation to area due to recreational activities	Same as Alternative B
Climate Change	Minor beneficial impact	Moderate beneficial impact	Same as Alternative B
Cultural Resources	No impacts anticipated	No significant impact	No significant impact
Environmental Justice	No impacts anticipated	No significant impact	No significant impact

Chapter 5. List of Planning Team Members and Persons Responsible for Preparing this Document

Giselle Block	U.S. Fish and Wildlife Service
Winnie Chan	U.S. Fish and Wildlife Service
Christy Smith	U.S. Fish and Wildlife Service

Chapter 6. Coordination, Consultation, and Compliance

Agency Coordination and Public Involvement

The CCP and EA were prepared with the involvement of technical experts, community groups, and private citizens. The Service has invited and continues to encourage public participation through planning updates and public comment periods.

Notice of Intent

A Notice of Intent to prepare a CCP for San Pablo Bay NWR was published in the Federal Register on July 26, 2006.

Environmental Review and Consultation

As a federal agency, the Service must comply with provisions of NEPA. An EA was developed to evaluate reasonable alternatives that would meet stated goals and assess the possible environmental, social, and economic impacts on the human environment. This EA serves as the basis for determining whether implementation of the preferred alternative would result in a federal action significantly affecting the quality of the environment. The EA also acts as a vehicle for consultation with other government agencies and interface with the public in the decision-making process.

Other Federal Laws, Regulations, and Executive Orders

In undertaking the preferred alternative, the Service would comply with the following federal laws, Executive Orders (EOs), and legislative acts: Intergovernmental Review of Federal Programs (EO 12372); Archaeological Resources Protection Act of 1979, as amended; Fish and Wildlife Act of 1956; Fish and Wildlife Conservation Act of 1980 (16 USC 661-667e); Fish and Wildlife Improvement Act of 1978; Endangered Species Act of 1973 (16 USC 1531 et seq.); National Environmental Policy Act of 1969; Federal Noxious Weed Act of 1990; Floodplain Management (EO 11988); Protection of Wetlands (11990); National Historic Preservation Act of 1966, as amended; National Wildlife Refuge System Improvement Act of 1997; Antiquities Act of 1906; Protection and Enhancement of the Cultural Environment (EO 11593); Archaeological and Historic Preservation Act of 1974 (PL 93-291; 88 STAT 174; 16 USC 469); Environmental Justice (EO 12898); Management and General Public Use of the National Wildlife Refuge System (EO 12996); Refuge Recreation Act of 1962, as amended; Invasive Species (EO 13112); Migratory Bird Treaty Act of 1918, as amended (MBTA); and Responsibilities of Federal Agencies to Protect Migratory Birds (EO 13186).

Distribution and Availability

The draft CCP and EA has been sent to various agencies, organizations, community groups, and individuals for review and comment. Copies of this EA are available from the San Pablo Bay NWR, 7715 Lakeville Highway, Petaluma, CA, 94954 (phone 707/769 4200), and San Francisco Bay National Wildlife Refuge Complex, 1 Marshlands Road, Fremont, CA, 94536 (phone 510/792 0222).

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