Appendix G5. Summary of Jurisdictional Wetland Impacts and Mitigation

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Appendix G5. Summary of Jurisdictional Wetland Impacts and Mitigation

This appendix describes methods used to delineate areas on the Delta Wetlands (DW) project islands considered jurisdictional wetlands under Section 404 of the Clean Water Act, the impacts of DW project operations under Alternatives 1 and 2 on those project areas considered to be jurisdictional wetlands, and compensation for impacts on jurisdictional wetlands that would be provided with project implementation.

GEOMORPHOLOGICAL SETTING

The Delta islands formed from the remains of hydrophytic plants and fine-textured mineral deposits associated with the floodplains of the Sacramento and San Joaquin Rivers and their tributaries and historical Delta tidal marshlands (U.S. Soil Conservation Service [SCS] 1977). The soils of the four project islands are part of the Rindge-Kingile Association of general soil types, characterized by nearly level, very poorly drained muck soils and occasional sand hills. Topographic elevation is primarily below sea level, and the islands are prevented from flooding by an elaborate system of artificial perimeter levees and drainage pumps. Average annual precipitation is 12-16 inches per year, and the average annual temperature is 60°F with 250-310 frost-free days.

EXISTING CONDITIONS

Most land on the DW project islands is intensively farmed in row and grain crops, and small amounts are temporarily fallow and abandoned farmland, primarily located on Webb and Holland Tracts. Each of the four islands is drained regularly by perimeter interior levee toe drains and high-output drainage pumps. The primary lateral drainage ditches are excavated below the field elevations, preventing saturation of surface soil and surface ponding of shallow groundwater. The island interiors are no longer subject to natural wetland hydrology or annual flooding from the Delta.

PRELIMINARY IDENTIFICATION OF JURISDICTIONAL WETLANDS

In 1987, DW applied to the U.S. Army Corps of Engineers (Corps) for a permit under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899 to discharge dredged or fill material into waters of the United States and for other project activities in navigable waters.

Between 1987 and 1990, preliminary interpretation and mapping of vegetation types was performed on the DW project islands, probable wetlands were identified, and general field surveys were conducted; however, a formal jurisdictional wetland delineation was never verified by the Corps. Color infrared aerial photography was used for preliminary reconnaissance-level interpretation and mapping of vegetation types and identification of probable wetlands. The aerial photographs were taken October 5, 1987, and printed at a scale of 1 inch = 1,000 feet. General field surveys of vegetation and surface soil hydrology were performed in fall and spring 1988 and in July and August 1989. Although some changes to the DW islands have occurred in response to annual agricultural market fluctuations since 1989, these conditions were determined to best represent typical preproject conditions.

Most of the surface area of the island interiors consists of hydric soil types (e.g., organic mucks and peaty mucks) formed when the islands were marshland or floodplains of the Delta rivers. These areas do not function as wetlands today because the islands have been reclaimed for agriculture. Fields on the island interiors typically undergo frequent, systematic subdraining to prevent reversion to wetland or riparian vegetation types

and allow agricultural tillage to continue on a regular basis.

The primary indicator of jurisdictional wetlands on the DW project islands was wetland hydrology. The presence of wetland hydrology was determined through:

- direct field observation of shallow flooding or deep open water;
- indirect interpretation of open water, flooding, or saturated soil as shown in color infrared photographs; or
- observation of soil saturation within 24 inches of the surface in representative samples obtained in July and August 1989 with a hand-held soil core auger.

Soil conditions were presumed to support hydrophytic wetland vegetation if soil samples indicated anaerobic saturation within 12-24 inches of the surface in midsummer. Vegetation indicators were sometimes present, but fields are frequently disked for crop planting, after harvest, or for weed control even if the field is fallow (i.e., abandoned or set-aside lands). Disking eliminates the presence of naturalized plants, including typical agricultural weeds, that may indicate the pattern of site hydrology. Fields are also commonly flooded in spring or fall to attract waterfowl or to control crop weeds. This type of flooding is a standard agricultural practice that often promotes the presence of opportunistic wetland plant and weed species but is not recognized by the Corps as an indicator of jurisdictional wetlands. The most reliable field indicator of jurisdictional wetlands on the DW project islands is therefore direct observation of soil hydrology and shallow saturation during the dry season.

DELINEATION AND VERIFICATION OF JURISDICTIONAL WETLANDS

In January 1994, the Corps, U.S. Department of Agriculture (USDA), U.S. Environmental Protection Agency (EPA), and U.S. Department of the Interior (Interior) entered into a Memorandum of Agreement (MOA) recognizing that USDA's Natural Resources Conservation Service (NRCS) (then known as SCS) was the lead federal agency for delineating wetlands on agricultural lands. The agencies agreed to delay full implementation of the MOA in the San Francisco Bay Area (encompassing nine counties, including Contra Costa County but not San Joaquin County) until certain issues were resolved by the Corps and EPA. Therefore, for the San Francisco Bay Area, the Corps and EPA, in consultation with NRCS, retain the authority for wetland delineations. In July 1994, the Corps, USDA, EPA, and Interior entered into an MOA entitled "California Inter-Agency Mapping Conventions for Waters of the United States" to assist NRCS in preparing wetland delineations pursuant to the Clean Water Act and the Food Security Act.

Because the DW project islands are currently in agricultural production and considered "agricultural lands" for purposes of administering the 1994 MOA, NRCS is responsible for verifying the delineation of wetlands on the project islands located outside the San Francisco Bay Area (Bacon and Bouldin Islands). The Corps and EPA are responsible for verifying the delineation of wetlands on the project islands in the San Francisco Bay Area (Holland and Webb Tracts).

The current delineation for the DW project islands was jointly conducted by NRCS, the Corps, EPA, and U.S. Fish and Wildlife Service (USFWS). The group met on October 4, 1994, to categorize the wetlands on the DW project islands according to the wetland mapping convention categories described in the MOA. Jones & Stokes Associates (JSA) received field maps of the delineations from the October 4, 1994 meeting (as transmitted by Jim Monroe of the Corps) and, using a computer-aided design (AutoCAD) system, prepared maps and determined the acreage of jurisdictional wetlands by wetland category for each of the DW project islands. Areas were determined to be either "artificial wetlands," and therefore jurisdictional under Section 404 of the Clean Water Act, or "prior converted cropland" and not considered to be jurisdictional.

In December 1994, DW requested that NRCS and the Corps issue letters of verification of the delineated jurisdictional wetlands. Verifications of delineated jurisdictional wetlands were issued by NRCS and the Corps on January 13, 1995, and December 28, 1994, respectively.

SECTION 404 JURISDICTIONAL WETLAND HABITATS

This section describes the typical soils, vegetation, wildlife values, and hydrology associated with jurisdictional wetlands on the DW project islands. Assessment of wildlife habitat values associated with each jurisdic-

tional habitat is based on typical wildlife species that would be expected to use these habitats in the Delta; species described, however, may not necessarily be found or use these habitats on DW project islands.

All jurisdictional wetlands on the DW project islands are designated as artificial wetlands under NRCS's wetland mapping convention. NRCS defines artificial wetlands as lands that were not wetlands under natural conditions but now exhibit wetland characteristics as a result of human activities (e.g., construction of drainage ditches and canals). Table G5-1 describes the jurisdictional wetland habitat types on the DW project islands, and Table G5-2 summarizes the acreages of these habitat types.

Riparian Woodland and Scrub

Typical Soils

Soils underlying riparian vegetation (R1 and R2) include large areas of organic mucks and mucky clays listed in Hydric Soils of the United States (SCS 1990). These soils include Kingile muck, Rindge muck, Shima muck, Webile muck, and Egbert mucky clay. These soils are all very poorly drained organic mucks with inclusions of coarse sand and undecomposed peat layers. A typical upper soil profile is 0-14 inches of dark, acidic muck (10YR, 2/2 soil color) with common fine roots; 14-24 inches of dark gray muck (10YR, 3/1 with 5YR 2/2 coatings on ped faces); and very black, strongly acidic, anaerobic muck (N 2/0) below 24 inches.

Riparian vegetation may also be underlain by nonhydric soil series (e.g., Piper loamy sand and Ryde silt loam) at sites near the interior toes of exterior levees on low-lying depressions formed from previous levee blowouts or borrow pits used to build up eroded levees.

Typical Vegetation

Table G5-3 lists typical riparian habitat vegetation found at field sampling sites on the DW project islands. Two woody riparian habitat types are found on the DW project islands: cottonwood-willow woodland (type R1) and willow scrub (type R2). Type R2 is generally less than 5 years old, and consists of four species of willows mixed with cottonwood seedlings; type R1 is generally older than 5 years and contains cottonwood saplings and trees taller than the willow shrub understory.

Most riparian vegetation on the DW project islands is in an early stage of development. Small linear stands of willow and cottonwood are often found in or along ditches or at the toes of perimeter levees that have not been regularly maintained. Growth of riparian vegetation, including trees, on the farmed portions of the islands is controlled. Farmers consider such vegetation to be weeds that compete with crops for ditch water and sunlight and that clog drainage and irrigation ditches. Therefore, riparian vegetation is often associated with low-lying areas where the land has been idle for several years and ditches are no longer maintained. Poor ditch maintenance further exacerbates poor drainage, causing more shallow ponding and saturation of soil at the periphery of ponds and marshy areas. The exceptions to the above pattern are the somewhat older and more diverse stands of riparian and marsh vegetation surrounding the blowout ponds on Webb and Holland Tracts.

Riparian vegetation began to become established around the Holland Tract blowout pond in summer 1980 after floodwaters had been pumped from the island. Floodwaters were not pumped from Webb Tract until February 1981 (Kjeldsen pers. comm.). Therefore, most riparian vegetation on Holland Tract was 15 years old in December 1994, whereas on Webb Tract it was 14 years old in December 1994.

Typical Hydrology

Soils underlying riparian stands qualified as having jurisdictional wetland hydrology in almost all cases where riparian habitat was sampled in the field. Freshwater marsh is typically found midway between open-water ponds and riparian shorelines or tree-lined shallow drainage ditches. Shallow ponded water or saturated soil within 1-2 feet of the surface was observed under riparian trees in August at almost all sampling sites.

Typical Wildlife Habitat Values

Riparian habitats support the most diverse wildlife community among DW project islands habitats. More than 65 wildlife species that potentially would use riparian woodland and scrub habitats were observed during wildlife surveys conducted on the DW project islands in 1988 (see Appendix H2, "Wildlife Inventory Methods and Results").

Large trees in riparian woodland habitats provide nesting structures for larger birds, such as hawks, owls, American crows, great egrets, and great blue herons. The

open forest canopy also provides hunting perches for aerial-foraging species, such as the western flycatcher, and species that forage for prey on the ground, such as American robin and northern flicker. Woodpeckers, wood ducks, bats, raccoons, and other species use cavities that often form in older trees as nesting sites. Furrowed bark surfaces provide foraging areas for species that glean insects, such as Nuttall's woodpeckers.

Large numbers of insects are associated with dense willow thickets. Consequently, these thickets sometimes support high densities of migratory and resident insectivorous birds, such as flycatchers. Species that forage in open herbaceous or agricultural habitats, including black-shouldered kites, American kestrels, and western kingbirds, use narrow bands of willow along ditches and drainages as hunting and resting perches. Willows also provide perches and cover for species that forage near water (i.e., snowy egrets, belted kingfishers, black phoebes, and several species of swallows and bats).

Freshwater Marsh

Typical Soils

Soil series underlying freshwater marsh (type M1) on the project islands are similar to soils found at riparian vegetation sites (see discussion above).

Typical Vegetation

Table G5-4 lists typical freshwater marsh vegetation found at field sampling sites on the DW project islands. Marsh vegetation intergrades with open water (i.e, permanent ponds) and floating aquatic vegetation where water depths are greater, and with riparian vegetation where water is shallower or the soil is saturated but not ponded. Cattail, bulrush, and tule are the dominant plants of marsh habitat on island interiors.

Typical Hydrology

Freshwater marsh is most closely associated with sites near the interior toes of exterior levees on low-lying depressions formed from previous levee blowouts or from borrow pits used to build up adjacent eroded levees. The phreatic zone of soil saturation (i.e., groundwater elevation) reaches the surface at these sites because the Delta slough water level is typically 5-15 feet higher than the island interiors. If the levee is narrow or composed of porous material (e.g., sand or peat), the phreatic zone causes surface ponding or soil saturation within 1-2 feet of the surface. These saturated conditions may also apply to low areas near major interior cross-island ditches and sloughs where areas of open water form as a result of the presence of a permanent, high water table.

Typical Wildlife Habitat Values

Emergent marsh vegetation provides important habitat values for some wildlife species. More than 40 wildlife species that potentially would use freshwater marshes were observed during wildlife surveys conducted on the DW project islands in 1988 (see Appendix H2, "Wildlife Inventory Methods and Results").

The structure provided by dense stands of cattails and tules provide nesting habitat for red-winged blackbirds, yellow-headed blackbirds, and marsh wrens. During spring and early summer, marsh vegetation adjacent to open water provides escape cover for duck and other water birds and their broods. Invertebrates that inhabit marsh vegetation provide prey for ducks, grebes, and other water birds; wading birds, such as great blue herons and great egrets; and migrant and wintering shorebirds. Garter snakes, Pacific treefrogs, and bullfrogs are common reptile and amphibian inhabitants of freshwater marshes.

Exotic Marsh

Typical Soils

Soil series underlying exotic marsh (M3 habitat) are similar to soils found at riparian vegetation sites (see "Riparian Woodland and Scrub" above).

Typical Vegetation

Table G5-5 lists typical exotic marsh weedy vegetation found at field sampling sites on the DW project islands. Exotic marsh consists of former agricultural fields, which, for various reasons, were abandoned or left fallow for more than 2 years and subsequently had been invaded by dense stands of exotic herbaceous weeds. The depth to the water table and the condition of the field drainage network determined whether these abandoned fields were invaded by exotic marsh weeds or herbaceous upland weeds. This wetland type sometimes occupies small untilled sites within actively farmed fields.

Water-dependent species tend to dominate vegetation at exotic marsh sites that qualify as having jurisdictional wetland hydrology.

Typical Hydrology

Exotic marsh weeds are found near freshwater marsh and riparian vegetation types where soil is saturated within 1-2 feet of the surface during the growing season (see "Typical Hydrology" under "Freshwater Marsh"). The soil surface becomes saturated in winter because of poor drainage and the presence of a shallow water table. Riparian trees and cattails gradually colonize these sites in a few years, taking advantage of plentiful soil moisture near the surface.

Section 404 wetland sites for M3 are commonly located in areas that are periodically disturbed, such as the interior toes of exterior levees and fallow, crop set-aside fields that border freshwater and riparian areas. The phreatic zone appears to lie deeper below the surface as the distance from the perimeter levees increases, limiting the extent of exotic marsh weeds as upper soil moisture decreases.

Typical Wildlife Habitat Values

Wildlife associated with exotic marsh habitats is similar to that associated with herbaceous upland habitats. More than 25 wildlife species that potentially would use exotic marsh habitat were observed during wildlife surveys conducted on the DW project islands in 1988 (see Appendix H2, "Wildlife Inventory Methods and Results").

Exotic marsh habitats are used by wildlife species associated with grasslands and other open habitats. Seed-eating birds, such as ring-necked pheasants, savannah sparrows, white-crowned sparrows, and house finches, frequently forage in these areas because annual plants typically produce large quantities of seed. Rank growths of herbaceous vegetation also provide ideal conditions for voles and other small mammals. Consequently, although exotic marsh vegetation is typically too dense to be effectively hunted by raptors, exotic marsh sites provide refugia for prey when adjacent agricultural fields are flooded for weed control or are bare following harvest and plowing. Rodents and other wildlife associated with exotic marsh habitat would seasonally repopulate adjacent agricultural fields when they have become revegetated.

Canals and Ditches

Permanent major canals and ditches associated with the DW project islands are considered jurisdictional wetlands. Small or temporary irrigation and drainage ditches are not considered to be jurisdictional wetlands.

Typical Vegetation

Canals and ditches are used for irrigation and drainage and are permanently inundated. Detailed botanical surveys were not conducted on the DW project islands to identify aquatic plant species. Aquatic plants associated with canals and ditches presumably would be those present in the Delta. Wetland and riparian species grow along the zone of the fluctuating water line. Weedy upland exotics (e.g., yellow star-thistle) grow on the higher spoils berm that is deposited along ditches during maintenance dredging.

Typical Hydrology

The canals and ditches supply irrigation water and receive drainage water. They are also underfed by seepage from the high water table. Water level fluctuates with the drainage pumping cycle for the island. Ditches are generally located in the lowest lying land elevations on each island.

Typical Wildlife Habitat Values

Wildlife habitat values associated with open-water portions of canals and ditches are similar to those described for permanent ponds below, except that they do not provide suitable loafing habitat for large numbers of water birds or foraging habitat for large fish-eating birds, such as the double-crested cormorant. Wildlife species typically associated with freshwater marsh, exotic marsh, and riparian scrub habitats would also use vegetation growing along canals and ditches; the species and magnitude of use, however, would vary depending on the type and extent of vegetation.

Permanent Ponds

Typical Vegetation

Permanent ponds consist primarily of the three blowout ponds on Webb and Holland Tracts and are lined with dense riparian or emergent wetland vegetation. Detailed botanical surveys were not conducted to identify aquatic plant species. The blowout ponds were formed by high-velocity floodwaters that entered the islands through levee breaks and scoured the island bottoms. Presumably, therefore, aquatic plant species associated with the ponds would be species present in the Delta, such as pondweed, bladderwort, and elodea. Probably as a result of the activity of carp and other fish, however, aquatic vegetation in the Webb Tract blowout ponds is sparse.

Typical Hydrology

Permanent ponds were created by levee breaks on Webb and Holland Tracts. Water is maintained in ponds by groundwater seepage and runoff of irrigation water and rainfall.

Typical Wildlife Habitat Values

More than 35 wildlife species that potentially would use open water habitats were observed during wildlife surveys conducted on the DW project islands in 1988 (see Appendix H2, "Wildlife Inventory Methods and Results").

Open-water areas provide habitat for water birds, including wood ducks, mallards, and other waterfowl; pied-billed grebes; American coots; and double-crested cormorants. Ponds also provide brood habitat for ducks, pied-billed grebes, and other water birds. Larger bodies of water (i.e., the blowout ponds) provide loafing habitat for large numbers of birds. Water birds forage on submerged aquatic plants, small fish, and invertebrates associated with open-water areas.

Other Jurisdictional Wetland Habitats

Some lands mapped in 1987 as grain and seed crop, herbaceous upland (i.e., annual grassland and exotic perennial grassland), and developed lands (i.e., unvegetated disturbed areas) (Table G5-1) were delineated as jurisdictional wetlands in 1994 by NRCS and the Corps (Table G5-2). The soil and hydrologic conditions associated with these lands were not investigated. Some generalized soil and hydrologic characteristics, however, can be inferred from data collected for other jurisdictional habitats found at similar topographical sites for which data are available.

Grain and Seed Crops

Approximately 3 acres of jurisdictional wetlands on Webb Tract were planted in corn in 1987. The soil and hydrologic characteristics of this site probably resemble most closely those described for exotic marsh habitat because the vegetation associated with exotic marshes on the DW project islands typically is composed of the same species that invade agricultural fields when they are fallowed.

Cornfields are used by a variety of wildlife species typically associated with agricultural habitats, including waterfowl, ring-necked pheasants, crows, and blackbirds. In the Delta, cornfields are of particular importance to wintering ducks, geese, and swans as foraging habitats because of the waste corn left in fields following harvest (see Chapter 3H, "Wildlife", and Appendix H2, "Wildlife Inventory Methods and Results", for additional information).

Annual Grassland and Exotic Perennial Grassland

Most annual and exotic perennial grassland habitats considered jurisdictional are associated with interior perimeter levee slopes. These habitats appear to exist on sites that maintain soil moisture conditions ranging between those of annual grassland habitat that is not considered jurisdictional wetlands and exotic marsh. Soil moisture is generally adequate year round to support lush growths of vegetation but not sufficient enough through the dry season to support typical wetland species, such as cattails and tules.

Typical annual grassland species include canary grass, ripgut brome, mustard, and bur-clover. Exotic perennial grasslands support perennial species, such as Bermuda grass, Johnson grass, perennial ryegrass, saltgrass, and annual grasses. Wildlife and wildlife habitat values associated with grassland habitats are similar to those described for exotic marsh.

Unvegetated Disturbed Areas

Approximately 22 acres adjacent to levees on Webb Tract are graded and, consequently, unvegetated. Because grassland habitats surround these areas, these sites would be expected to reestablish as annual or exotic perennial grasslands.

SECTION 404 JURISDICTIONAL WETLAND IMPACTS OF THE DW PROJECT

Direct impacts of Alternatives 1 and 2 on jurisdictional wetlands would result from dredge and fill activities associated with placement of pumps and siphons; construction of some recreational facilities and other project facilities; refurbishment of levees; and grading activity for the construction of wildlife habitat on the habitat islands. Water storage on the reservoir islands would result in indirect impacts on jurisdictional wetlands associated with dredge and fill activities.

Table G5-6 summarizes the acreage of jurisdictional wetlands that would be affected by implementation of Alternatives 1 and 2.

Bacon Island and Webb Tract

All existing wetlands would be lost on the reservoir islands as a result of deep flooding for water storage on island interiors and riprapping of upper inner levee slopes. A total of 393.6 acres of Section 404 jurisdictional wetland habitats would be affected under Alternatives 1 and 2.

Bouldin Island and Holland Tract

A total of 175.2 acres of Section 404 jurisdictional wetlands would be affected by construction of recreational facilities on and adjacent to levees (3.9 acres of freshwater marsh and willow scrub), conversion of exotic marsh habitats to higher value wetland habitats (78.2 acres), and levee maintenance activities (93.1 acres of annual grassland) under Alternatives 1 and 2.

WETLAND MITIGATION FOR ALTERNATIVES 1 AND 2

Table G5-7 summarizes mitigation for impacts on jurisdictional wetlands of the DW project islands. Mitigation requirements and mitigation for jurisdictional wetlands were developed by the habitat management plan (HMP) team formed by the California State Water Resources Control Board (SWRCB) staff to design the HMP for the habitat islands (see Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands"). To determine mitigation acreage requirements, the HMP team determined ratios of mitigation acreage that must be established to offset impacts on riparian woodland, riparian scrub, freshwater marsh, exotic marsh, and permanent pond habitats. To ensure that wetland habitat values would be replaced, the HMP team established mitigation implementation and management guidelines for each of the mitigation habitat types. The HMP team has coordinated the mitigation proposed in the HMP with the Corps.

Loss of jurisdictional wetlands under Alternative 1 or 2 would be mitigated with construction of riparian woodland, riparian scrub, emergent marsh, mixed agriculture/seasonal wetland, seasonal managed wetland, permanent lake, corn/wheat, small grain, herbaceous upland, canal, and ditch habitats on habitat islands.

Bacon Island and Webb Tract

Mitigation to fully offset project impacts will be established on the habitat islands. Wetland habitats created on the reservoir islands are not intended to provide mitigation because the duration and periods these habitats would be available are unpredictable and may not coincide with wildlife needs during some periods. At DW's discretion, approximately 7,530 acres of shallow-water wetland could be created on the reservoir islands during nonstorage periods in some years (JSA 1993). Open-water habitat would be created during water storage periods (the acreage of open water habitat would vary depending on the amount of water stored) (see Appendix G2, "Prediction of Vegetation on the Delta Wetlands Reservoir Islands").

Bouldin Island and Holland Tract

A total of 4,490.2 acres of riparian woodland and scrub, emergent marsh, seasonal wetland, and permanent lake habitats would be created on the habitat islands to offset project impacts on 80.7 acres of jurisdictional wetlands of comparable or lower value (Table G5-7). Approximately 3,467.0 acres of exotic marsh (i.e., mixed agriculture/seasonal wetland, and seasonal managed wetland habitats) would be created in addition to the 294.2 acres that are required to compensate for exotic marsh (Table G5-7). Establishment and management of 7,335.0 acres of agricultural, herbaceous upland, and seasonal wetland habitats and canals and ditches would also be managed to offset project impacts on 188.1 acres of jurisdictional wetlands consisting of open water in canals and ditches, grain and seed crops, annual and exotic perennial grassland, and unvegetated disturbed areas (Table G5-7).

Section 404 Jurisdictional Wetland Mitigation Habitats on the DW Habitat Islands

Figures G5-1 and G5-2 show the locations and sizes of jurisdictional wetland habitats that would be created on the habitat islands. In addition to providing mitigation for loss of jurisdictional wetlands, emergent marshes and seasonal wetlands would also be managed to mitigate project impacts on greater sandhill cranes and Swainson's hawks, state-listed threatened species, and wintering waterfowl. A detailed description of habitat construction guidelines and management prescriptions for these habitats is presented in Table G5-8 (see also Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands"). Specific planting and grading plans for construction of each mitigation habitat will be determined as site-specific construction plans are developed. The following sections, however, describe the conceptual approach for construction and maintenance of mitigation habitats.

Riparian Woodland and Scrub

A total of 143.1 acres of cottonwood-willow woodland and 122.0 acres of willow scrub would be created on the habitat islands. Mitigation acreage for riparian woodland and scrub is combined and is not distinguished in Figures G5-1 and G5-2. Specific sites suited to development of each of these riparian habitats will be identified during the development phase of detailed mitigation construction plans.

Ecological Conditions. Ecological conditions on the Delta islands that determine the establishment, distribution, and composition of riparian habitats are unique among ecological conditions in central California. Conditions in the Delta especially favor the establishment of cottonwood and willow and, consequently, riparian habitats typically support fewer species than riparian habitats associated with river and stream courses.

Several factors contribute to the uniqueness of growing conditions on Delta islands. Peat soils are organic and very fertile compared with most inorganic soils and are the predominant soil type on the habitat islands. Islands are also very humid and temperate and therefore provide ideal conditions for rapid plant growth. Delta islands are isolated from Delta channels and do not receive floodflows. Consequently, the diversity of riparian plant species is limited because plants that disperse seeds in water have difficulty becoming established. With the exception of the northwestern portion of Holland Tract, most of the habitat islands have been leveled for farming. As a result, the topography and hydrology on the habitat islands are relatively uniform and therefore also contribute to there being less diversity of plant species because the only plants that become established are those adapted to the narrow range of soil moisture conditions present on the islands.

Diversity of riparian plant species in and among riparian woodland and scrub stands is desirable. To increase species diversity in some stands, shrub and tree species that are currently uncommon or that are not currently found on the habitat islands would need to be seeded or planted to become established.

Stands composed primarily of a single species, such as Fremont cottonwood or yellow willow, are also desirable to provide habitat for some wildlife species associated with monotypic stands. Monotypic woodlands are expected to develop naturally on some habitat island sites.

Riparian Woodland. Riparian woodland overstory would be dominated by mature Fremont cottonwood, Goodding's willow, and yellow willow trees. Midstory shrubs and trees would include white alder, boxelder, flowering ash, wild grape, willows, and elderberry. Riparian woodland sites would initially function and provide habitat values similar to riparian scrub until trees have matured sufficiently to provide an overstory canopy. DW

will plant species that DFG, SWRCB, and the Corps have determined are necessary.

Willow Scrub. Riparian scrub would be dominated by near-monotypic stands of willow shrub and tree species, including red, yellow, sandbar, and Goodding's willow. In the Delta environment, willow scrub would eventually be succeeded by cottonwood-willow woodland. Consequently, periodic treatment, such as mechanical removal or burning, will be required to maintain willow scrub habitats.

Riparian Woodland Establishment. Techniques that would be used to mitigate for riparian woodland habitats provide DW with flexibility to ensure establishment of riparian vegetation on a variety of hydrologic and soil conditions that are found on the habitat islands. These techniques may include:

- broadcasting seed of cottonwood, willow, ash, boxelder, and other species collected from the DW project islands or other sites in the Delta region;
- changing existing groundwater hydrology in limited areas by blocking localized drainage to raise groundwater levels;
- altering soil conditions by grading, disking, or other means to create seed beds that mimic soil conditions under which seedlings of some species naturally become established;
- flood-irrigating mitigation planting areas to mimic natural flood events under which some species naturally become established;
- planting stem cuttings of cottonwood, willow, and other suitable species; and
- planting rooted stock.

Riparian woodland habitats would be created in relatively large tracts adjacent to levees, canals, and existing riparian habitats. Riparian vegetation would become established naturally on some mitigation sites without a network of drainage ditches to lower groundwater tables. Riparian vegetation is currently treated as an agricultural weed and must periodically be removed from fields, ditches, and canals. The primary method, therefore, of establishing riparian vegetation would be to alter groundwater hydrology by eliminating or modifying drainage ditches and allowing riparian vegetation to naturally become reestablished. More intensive techniques may be required to establish vegetation on drier mitigation sites.

Some desirable species, which currently are not found or are not well established on the islands, such as alder, box elder, and elderberry, could also be planted in riparian mitigation areas to enhance plant species diversity. Cottonwoods and willow would not initially be planted, except in sites that are not suited to natural colonization. Cottonwood and willow would also be planted in areas where these species failed to naturally become established.

Establishment of existing riparian woodlands adjacent to the blowout ponds on Webb Tract and Holland Tract began 14-15 years ago after floodwaters that created the blowout ponds were pumped from the islands. Trees and shrubs in these woodlands have since grown sufficiently to have formed closed overstory canopies. Tree canopy heights averaged approximately 12 feet in stands estimated to have been 5 years old and 20 feet in stands 8 years old. Observations in other cottonwood stands in the Delta region suggest that tree heights will average at least 25 feet by year 10, 40 feet by year 20, and 60 feet by year 30.

Riparian Scrub Establishment. The primary method for establishment of willow scrub would be similar to that described above for riparian woodland. Because scrub habitats are expected to be succeeded by woodland habitats, early establishment of willow-dominated stands would increase the period required for succession to occur. Eventually, some or all of the willow scrub mitigation habitats would need to be treated periodically to set succession back if these habitats were to be maintained.

Narrow strips of willow shrubs would be planted as stem cuttings along the boundary of the eastern closed hunting zone on Bouldin Island (see Appendix G3). Willow cuttings would be planted on approximate 6-foot centers of two staggered rows approximately 10 feet apart. Low woody vegetation cover is desired in this area to screen the closed hunting zone from adjacent human activities. Consequently, this site would be planted with sandbar willow or other willow shrub species. Willows planted in these areas would periodically need to be treated mechanically to maintain a height sufficient to serve as a screen but not impede bird flights. Willow scrub would also naturally become reestablished along drainage and irrigation ditches, canals, and levee slopes. Willows would periodically be removed from ditches and levees to maintain water flows and levee stability.

Wildlife. Wildlife habitat values provided by mitigation riparian habitats would be similar to those described for affected riparian habitats. Wildlife habitat quality, however, would be higher because stands of riparian woodland and scrub would be larger than affected stands and vegetation species diversity would be greater than that of affected stands.

Freshwater Marsh

A total of 353.1 acres of freshwater emergent marsh would be created on the habitat islands, 54 acres of which are required to compensate for project impacts (Table G5-7, Figures G5-1 and G5-2).

Vegetation. Emergent marshes would be dominated by tule and cattail. Emergent marshes would be created through diking and contouring of existing agricultural fields (i.e., creating wetland cells) and contouring of portions of permanent lake shorelines in a manner that encourages establishment of tules and cattails. Tule and cattail would also naturally occur in association with mixed agriculture/seasonal wetland, seasonal managed wetland, and seasonal pond habitats. Emergent vegetation associated with these habitats, however, would not mitigate project impacts on freshwater marsh because these habitats would be managed as seasonal wetlands, which have specific management criteria that limit the extent of emergent vegetation. Consequently, emergent vegetation would have to be periodically controlled at these sites.

Tule and cattail plugs would be planted to initially establish these emergents in marsh cells. Plugs may be obtained from cattail and tule stands on the reservoir islands prior to initiation of project operations, on the habitat islands, or at offsite locations. If plugs are obtained from the habitat islands or offsite locations, no more than 30% of the vegetation from a single emergent stand would be removed. Open-water areas may be seeded with duck potato, pondweed, and other aquatic plant species important to wildlife.

Cells would be graded and contoured to provide water depths ranging from saturated soil to 3 feet and interior islands that would support tule and cattail stands. Channels with water depths in excess of 4 feet, which would be too deep to support tules and cattails, would also be excavated in marsh cells. Channels would improve water circulation and would provide for rapid drawdown of water to maintain water quality or for mosquito control. Marshes would periodically be drained and vegetation controlled when emergent vegetation cover exceeds 60% to maintain between 40% and 70% open water.

Portions of permanent lake shorelines and lake bottoms would be contoured to provide summer water depths of 1-3 feet on which emergent marsh vegetation would be allowed to naturally become reestablished (Figures G5-1 and G5-2). Emergent vegetation would not be controlled in lake perimeter or island areas.

Wildlife. Wildlife habitat values provided by mitigation emergent marshes would be greater than those described for affected freshwater marsh habitats. In addition to the values described for affected habitats, shallow open-water areas in mitigation marshes would attract species not typically associated with dense marsh vegetation, including waterfowl (primarily dabbling ducks), grebes, wading birds, shorebirds, gulls, and terns. Wildlife habitat quality would also be higher because marshes would be larger and vegetation species diversity would be greater than for many of the existing affected marshes.

Exotic Marsh

A total of 3,895 acres of exotic marsh would be created on the habitat islands, 294.2 acres of which are required to compensate for the loss of existing exotic marshes (Table G5-7, Figures G5-1 and G5-2). Mitigation exotic marshes would include seasonal managed wetland and mixed agriculture/seasonal wetland habitats that would be dominated by a different mixture of plant species than is found in existing exotic marsh habitats. Unlike affected exotic marsh habitats that typically do not maintain surface water, mitigation habitats would be seasonally flooded to enhance habitat values for waterfowl and other water birds.

Mixed Agriculture/Seasonal Wetland. A total of 1,645 acres of mixed agriculture/seasonal wetland would be established on the habitat islands (Table G5-9). This habitat type consists of planted strips of corn interspersed among seasonal wetlands dominated by watergrass and smartweeds. Corn would be planted within these seasonal wetlands to increase the availability of preferred forage for geese, swans, and greater sandhill cranes.

Following initial grading to create agriculture/seasonal wetland cells, cells could be planted with seeds of watergrass, smartweeds, and other important wetland waterfowl forage plants. Narrow strips of corn would also be planted on drier sites within the cells. Corn would be planted annually following spring drawdown.

A portion of each cell may be annually disked to maintain productivity of desirable wetland plants. Prior to development of seed (early summer), up to 50% of wetland portions of the cells may be mowed to encourage plants to develop a low-growth form. This procedure would provide Swainson's hawk foraging areas and open areas that would be accessible to waterfowl following fall flooding of the cells.

Mixed agriculture/seasonal wetland cells would be flooded and drawn down on staggered schedules. Cells would be flooded to an average depth of 12 inches, with no more than 25% of each cell in a dry condition. Flooding would be initiated on October 1 and the last cells would be drawn down by April 1.

Seasonal Managed Wetland. A total of 2,116 acres of seasonal managed wetland would be established on the habitat islands (Table G5-9). These wetlands are expected to support a mixture of wetland plants similar to mixed agriculture/seasonal wetlands, except that corn would not be planted in seasonal managed wetland cells. However, because seasonal managed wetlands would be managed specifically to encourage wetland forage plants, plant density is expected to be greater than in mixed agriculture/seasonal wetland cells. Cells would be flooded and drawn down on a staggered schedule. Cell flooding would be initiated on September 1, and the last cells would be drawn down by June 1.

Wildlife. Wildlife habitat values provided by mitigation seasonal wetlands would be substantially greater than those described for affected existing exotic marsh habitats. Seasonal wetlands would provide upland herbaceous habitat values similar to those described for existing exotic marsh habitats, except that rodent populations would be expected to be smaller because wetlands would be flooded annually. Small islands that would be constructed in seasonal managed wetland and mixed agriculture/seasonal wetland cells will serve as refugia for rodents during flood periods, which will serve to accelerate repopulation of wetlands following drawdown.

During flood periods, seasonal wetlands would provide wildlife habitat values that are typically not associated with existing exotic marshes, including foraging habitat for wintering waterfowl and other water birds, greater sandhill cranes, wading birds, and shorebirds; brood habitat for ducks and other water birds; and waterfowl and water bird resting areas.

Canals and Ditches

Approximately 80 acres of existing canals and ditches would be maintained on the habitat islands to provide infrastructure for water management of wetland and agricultural habitats (Table G5-9). Additional canals and ditches may be constructed if necessary to manage mitigation habitats. The acreage of additional canals and ditches necessary for management of the habitat islands, however, will not be determined until the final construction design has been prepared.

Vegetation and wildlife associated with canals and ditches would be the same as those described for existing conditions (see "Section 404 Jurisdictional Wetland Habitats" above).

Permanent Ponds

Two permanent lakes, one 50 acres and one 60 acres in area, would be constructed on Bouldin Island to mitigate project impacts on existing permanent ponds.

Vegetation. Permanent lakes would be constructed to mimic conditions associated with the existing blowout ponds on Webb Tract. Lake bottoms would be unevenly contoured to provide water depths ranging from 3 feet to 6 feet during summer (Table G5-8). Variation in water depths would encourage establishment of a diversity of aquatic and emergent plant species and would more closely mimic functional values of the existing lakes on Webb Tract. Lake designs would include a dedicated water supply and water delivery and control structures that would allow lake levels to be raised or lowered to ensure that mitigation objectives are achieved.

Shorelines would be contoured to allow establishment of tule, cattail, and other emergents along shoreline edges and riparian woodland and scrub on shoreline slopes or beaches at higher elevations. Herbaceous vegetation along the shoreline in some areas may be mowed to provide suitable waterfowl loafing areas during fall and winter. Approximately 10 small islands ranging from 0.2 acre to 0.5 acre in size would be constructed in each lake. These islands would be contoured to encourage establishment of emergents and could be submerged during high-water periods (i.e., during winter).

Wildlife. Permanent lakes would provide wildlife habitat values greater than those described for the existing blowout ponds because they are expected to support a greater density of emergent and aquatic vegetation used by wildlife. Populations of wildlife that use

permanent lakes are also expected to be greater than for affected ponds because adjacent wetland habitats would attract large numbers of water birds to habitat islands and lakes would not be hunted. Waterfowl and other water birds therefore may be expected to congregate on lakes during periods when hunting is taking place in other wetland habitats on the islands.

Other Mitigation Habitats

Grain and Seed Crops. A total of 2,584 acres of corn will be established initially on the islands (Table G5-9). Table G5-8 describes management of cornfields in a wheat rotation. To maintain productivity in the Delta, corn should be rotated with wheat every fourth year. In any one year, 25% of the acreage of this habitat on each island will be planted in wheat.

Cornfields are to be managed primarily to compensate for project impacts on foraging habitat for wintering swans, geese, and greater sandhill cranes. This habitat also provides high forage value for wintering ducks and moderate forage value for Swainson's hawks during a short period following harvest and fall flooding.

Corn will be rotated with spring wheat at suitable sites. In the Delta, corn is typically rotated with winter wheat; use of spring wheat, however, would provide higher waterfowl and crane forage value during fall and early winter. Wheat fields also provide nesting cover for ducks and other ground-nesting birds and, following harvest, foraging habitat for Swainson's hawks.

A total of 258 acres of fields will also be planted in small grains (Table G5-9). This habitat type initially will be planted in winter wheat; however, barley, oats, or other grains may be used on suitable sites. To maintain productivity and provide diversity, approximately 25% of each wheat field will be planted with a barley/vetch seed mix, which will be rotated through fields every 4 years (Table G5-8).

Small grain fields are primarily to be managed to provide nesting cover for ducks. Fields will also provide herbaceous forage for waterfowl and cranes following germination in spring, and suitable Swainson's hawk foraging habitat following harvest in July.

Herbaceous Upland. A total of 732 acres of herbaceous upland initially will be established on the islands (Table G5-9). Herbaceous uplands will consist of a mix of native and exotic grasses and forbs. Most uplands will be associated with perimeter levees. Seasonal managed wetland and mixed agriculture/ seasonal wetland habitats (when dry), internal levees, and field border strips will also provide habitat values similar to those associated with herbaceous uplands.

Herbaceous uplands will be managed primarily to compensate for project impacts on Swainson's hawk, greater sandhill crane, and other upland nesting or foraging species, such as red-tailed hawk, mallard, ring-necked pheasant, western meadowlark, and voles. A portion of herbaceous uplands will be mowed after July 15, following the nesting season, to reduce vegetative cover and increase raptor and crane foraging values associated with these habitats (Table G5-8). Unmowed areas will provide refugia for rodents and other species associated with dense upland vegetation.

MITIGATION IMPLEMENTATION SCHEDULE

Construction of wetland mitigation habitats on the habitat islands would be initiated in spring following issuance of DW project operating permits and would be completed over a 2-year period.

MONITORING PROGRAM AND PERFORMANCE STANDARDS

This section describes methods for monitoring mitigation wetland habitats, mitigation performance standards, and remedial actions that may be instituted if performance standards are not achieved. The purpose of establishing monitoring and performance standards is to identify the minimum quantity and quality of mitigation wetland habitat that must be maintained by DW and to ensure that mitigation activities meet the conditions of DW's Clean Water Act (Section 404) permit. The California Department of Fish and Game (DFG), the Habitat Management Advisory Committee (HMAC), and the Corps, with DW's approval, may implement changes in the monitoring methods and performance standards and goals described below if such changes will provide a more realistic basis for assessing mitigation success.

Two types of wetland mitigation monitoring programs will be implemented: construction monitoring and compliance monitoring.

DW and DFG Program Responsibilities

DW is responsible for implementing monitoring programs and remedial measures and for submitting monitoring reports to the Corps, SWRCB's Chief of the Division of Water Rights, DFG, and the HMAC. Monitoring will be conducted by a qualified biologist or habitat restoration specialist funded by DW to supervise all phases of the monitoring program.

DFG will be responsible for ensuring DW's compliance with the HMP through review of construction specifications and performance of onsite inspections. Compensation for DFG's responsibilities in the monitoring program will be addressed in a separate memorandum of understanding between DW and DFG.

Construction Monitoring

Construction monitoring is required to ensure that compensation habitats are constructed in conformance with approved construction specifications.

Monitoring Responsibility

Construction monitoring will be implemented by the Corps and DFG. Detailed grading and planting plans for construction of compensation habitats will be submitted to the Corps and DFG for review. The Corps and DFG will review these plans to ensure that contours, planting methods, and hydrology are sufficient for successful establishment of each habitat type. DFG will also conduct onsite inspections to ensure that habitats are graded, planted, and maintained in accordance with the approved specifications. If site-specific conditions warrant deviation from the construction specifications, DFG will also have the authority to approve such deviations.

Monitoring Schedule

Construction monitoring will be performed throughout the construction period. The frequency of monitoring will be determined by DFG and may consist of both scheduled and unscheduled site inspections. Approximately 2 years are estimated for completion of construction (i.e., monitoring years -1 and 0).

Monitoring Methods

The Corps and DFG will inspect the habitat islands during construction to ensure that the compensation habitats are constructed as detailed in the approved construction specifications. After the compensation habitats are constructed, DW will provide DFG and the Corps with aerial photographs of the habitat islands. Aerial photographs will be used to determine acreages of compensation habitats and ensure that the minimum compensation acreage requirements described in the HMP have been achieved.

Performance Standards

Construction performance standards will consist of compliance with construction specifications to be developed by DW and approved by the Corps and DFG (Table G5-10). Variance from construction specifications is permissible to allow for site constraints identified during construction if such variance is approved by the Corps or DFG for jurisdictional wetland mitigation habitats. Any disagreements that arise between DW and DFG during the construction period may be submitted to the Corps or SWRCB for resolution.

Habitat Compliance Monitoring and Performance Standards and Goals

Monitoring

Compliance monitoring will be implemented to ensure that the appropriate acreage of each habitat type is constructed and that the management prescriptions for each habitat type are implemented as described in the HMP and in subsequent annual operating plans (AOPs) (Figures G5-1 and G5-2; Tables G5-8 and G5-9).

The monitoring of compensation habitats will begin the year after construction of these habitats has been completed (designated monitoring year 1). The purpose of monitoring is to:

- document the footprint and acreage of each habitat type;
- document successes in achieving performance standards and goals (see below);
- assess the adequacy and efficiency of methods used to establish habitats;

- document compliance with the prescriptions for seasonal management of habitats; and
- determine whether remedial measures must be implemented.

Performance Standards and Goals

Performance standards are minimum management standards that must be achieved within a specified period to maintain compliance with the HMP goals and objectives. Failure to achieve performance standards may require DW to implement remedial measures to maintain compliance with project permits.

Compliance performance standards, presented in Table G5-10, have been established for monitoring years 4 and 10 and for the project life. Performance standards for all compensation habitats over the life of the project are based on the prescriptions for habitat management, habitat acreages, and recreation programs described in the HMP or in subsequent approved AOPs.

Performance goals, presented in Table G5-11, are established for monitoring years 1, 2, 3, 6, and 8. The purpose of performance goals is to identify the need for management changes to improve the success of compensation habitat and to ensure compliance with performance standards (Table G5-10) in order to avoid the potential imposition of mandatory remedial measures in monitoring years 4 and 10.

Agricultural, Seasonal Wetland, and Herbaceous Upland Habitats

Agricultural habitats include corn fields rotated with wheat, small grain fields in a barley/vetch rotation, and pasture/hay fields. Seasonal wetland habitats include seasonal managed wetlands and mixed agriculture/seasonal wetlands. Seasonal ponds will be constructed by DW to provide high wildlife values (e.g., duck brood habitat). These ponds do not require monitoring or compliance with performance standards because they are not required to offset project impacts. DW, however, will be required to demonstrate that design and management of seasonal ponds provide high habitat functions and values for wildlife. If DW chooses to discontinue or change management of seasonal ponds, DFG and the HMAC will be notified and replacement habitats will be identified and constructed. The replacement habitats must be approved by DFG in consultation with the HMAC and must be compatible with the goals of the HMP.

Monitoring Responsibility. DW, the Corps, and DFG are responsible for monitoring agricultural, seasonal wetland, and herbaceous upland habitats to ensure that management prescriptions described in Table G5-8 are implemented. DW is required to record habitat management activities, such as flooding and drawdown dates. The Corps and DFG are responsible for conducting field inspections to ensure that management prescriptions are implemented in compliance with the HMP.

Monitoring Schedule. Monitoring of agricultural, seasonal wetland, and herbaceous upland habitats is required annually for the project life. The monitoring activities will occur throughout each year. The timing and frequency of DFG site inspections are at the discretion of DFG.

Monitoring Methods. Agricultural, seasonal wetland, and herbaceous upland habitats will be monitored to confirm compliance with acreages, field locations, and management prescriptions described in the HMP and in subsequent approved AOPs. DW will maintain maps showing the location and acreage of each habitat type; a description of annual vegetation control activities; and planting, flooding, drawdown, and mowing dates for each field that will be available for review by DFG. DFG will also conduct field visits to confirm compliance.

Performance Standards. Performance standards are presented in Table G5-10. Performance standards in future years will be based on management prescriptions described in approved AOPs.

Riparian Woodland

Monitoring Responsibility. DW is responsible for monitoring riparian woodland habitats. The Corps, DFG, and the HMAC will review monitoring results. The Corps and DFG may conduct site inspections to verify monitoring results.

Monitoring Schedule. Riparian woodlands will be monitored for a 10-year period, which will begin the year following completion of construction. Monitoring will be performed in June and July of monitoring years 1, 2, and 3 and in September of monitoring years 4, 6, 8, and 10.

Monitoring Methods. Riparian woodland habitats will be monitored to determine the number of seedlings/saplings established per acre of habitat, the species composition, and the percent canopy cover.

Seedling/Sapling Establishment and Species Composition. Each stand of riparian woodland will be sampled to determine the average per-acre seedling/sapling density and percent occurrence of cottonwood and willow trees, other native trees, and native shrubs among all tree and shrub species that have established. Seedling/sapling density and species composition will be determined through establishment and monitoring of a statistically significant number of random quadrants established in each riparian woodland stand.

Percent Canopy Cover. Percent canopy cover will be measured in monitoring years 4, 6, 8, and 10. Percent canopy cover will be determined using aerial photographs obtained in September of each monitoring year. If necessary, the canopy cover estimates will be reviewed qualitatively in the field.

Photographic Documentation. A minimum of five permanent photographic documentation sampling points will be established in each riparian woodland HMP map unit to provide a visual record of plant growth and canopy closure after planting unless complete photographic coverage of a unit can be obtained with fewer sampling points. Sampling points will be established before compensation is implemented, and locations will be identified in the first-year monitoring report.

Performance Standards and Goals. Performance standards are presented in Table G5-10 and performance goals are presented in Table G5-11. For monitoring years 1 through 3, performance goals are applicable for each habitat island and for each stand of riparian woodland. The performance goals for the habitat islands establish the minimum percentages of total woody riparian plants on the islands that should be cottonwood or willow trees, other native trees, and native shrubs. Performance goals for individual stands require that a certain minimum number of seedlings/saplings be established per acre and specify the minimum and maximum percentages of total woody riparian plants in a stand that must be cottonwood or willow trees, other native trees, and native shrubs. These performance goals allow for flexibility in composition of a stand relative to the capabilities of a specific mitigation site.

To meet the Corps' desire that mitigation stands be self-sustaining (i.e., intensive management practices, such as continued irrigation or drainage, are not required to maintain stands), plant species diversity would be assumed to achieve its natural composition after 3 years of establishment. Some plant species other than cottonwood or willow initially planted in the mitigation sites may die out because they are not suited to specific site conditions or as a result of competition with other plant species that are better suited to the site conditions. This approach therefore provides the opportunity to increase plant species diversity in riparian woodland stands by initially establishing some plant species that are presently absent or that are uncommon on Delta Islands but also recognizes that some species may not survive unless long-term intensive management practices are applied to maintain them. Performance standards and goals in monitoring years 4, 6, 8, and 10 therefore are based on percent canopy cover, regardless of species composition.

Riparian Scrub

Riparian scrub will be established in linear and nonlinear configurations and will be dominated by willow species. Linear willow scrub will be established adjacent to the south side of the east Bouldin Island closed hunting zone (see Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands") to provide a visual screen to reduce disturbance of wildlife using the closed hunting zone by hunters in adjacent hunting zones.

Monitoring Responsibility. DW is responsible for monitoring riparian scrub habitats. The Corps, DFG, and the HMAC will review monitoring results. The Corps and DFG may conduct site inspections to verify monitoring results.

Monitoring Schedule. Willow scrub habitats will be monitored for a 10-year period. The monitoring period will begin the year following completion of construction. Monitoring will occur in June and July of monitoring years 1, 2, and 3 and in September of monitoring years 4, 6, 8, and 10.

Following the 10-year monitoring period, DW, DFG, and the HMAC will review monitoring data to determine future monitoring requirements and schedules. Periodic monitoring will be required in future years to determine the need for maintenance of willow scrub habitats (see below).

Monitoring Methods. Riparian scrub habitats would be monitored to determine percent survival of initial plantings, percent canopy cover, and percent linear closure.

Willow Establishment. Nonlinear and linear stands of willow scrub will be sampled to determine the average density of established willow seedlings. In nonlinear stands, per-acre density of seedlings will be determined through establishment and monitoring of a

statistically significant number of random quadrants in each habitat unit. In linear willow scrub stands, line transects will be established to determine the number of willows established per 100 linear feet of habitat.

Percent Canopy Cover. Percent canopy cover in nonlinear willow scrub will be measured in monitoring years 4, 6, 8, and 10. Percent canopy cover will be determined using aerial photographs obtained in September of each monitoring year. If necessary, these photographs will be reviewed qualitatively in the field.

Percent Linear Closure. After monitoring year 3, the percent linear closure in linear willow scrub will be measured in monitoring years 4, 6, 8, and 10. Percent linear closure will be determined using aerial photographs obtained in September of each monitoring year. If necessary, the photographs will be reviewed qualitatively in the field.

Photographic Documentation. A minimum of five permanent photographic documentation sampling points will be established in each riparian scrub HMP map unit to provide a visual record of plant growth and canopy closure after planting unless complete photographic coverage of a unit can be obtained with fewer points. Sampling points will be established before compensation is implemented, and locations will be identified in the first-year monitoring report.

Performance Standards and Goals. Performance standards are presented in Table G5-10 and performance goals are presented in Table G5-11.

Long-Term Maintenance of Willow Scrub. DW may be required to periodically mechanically hedge the linear willow plantings adjacent to the east Bouldin Island closed hunting zone to maintain a shrub height that visually screens wildlife using the east Bouldin Island closed zone from hunters but does not impede wildlife access to and from the closed zone.

Nonlinear willow scrub habitats are expected to be succeeded eventually by willow-dominated riparian woodland. Consequently, through mechanical or other means, willow scrub habitats will require periodic treatment to set back succession to maintain this habitat type. DW is required, therefore, to treat willow scrub stands when percent canopy cover of trees more than 20 feet tall exceeds 30% of total canopy cover for each stand. With approval of the Corps and DFG in consultation with the HMAC, some stands may be permitted to achieve succession to riparian woodland.

Emergent Marsh

Monitoring Responsibility. DW is responsible for monitoring emergent marsh habitats. The Corps, DFG, and the HMAC will review monitoring reports. The Corps and DFG may conduct site inspections to verify monitoring results.

Monitoring Schedule. Emergent marsh habitats will be monitored for a 10-year period, which will be initiated in the year following completion of construction. Monitoring will be performed in June and July of monitoring years 1, 2, and 3 and in September of monitoring years 4, 6, 8, and 10.

Following the 10-year monitoring period, DW, the Corps, DFG, and the HMAC will review monitoring data to determine future monitoring requirements and schedules. Periodic monitoring will be required in future years to determine the need for maintenance of emergent marsh habitats (see below).

Monitoring Methods. Emergent marsh habitat will be monitored to determine percent of emergent vegetation cover. Percent cover will be determined using measurements obtained along randomly placed transects during monitoring years 1, 2, and 3. Aerial photographs obtained in September would be used to determine percent cover in monitoring years 4, 6, 8, and 10.

Photographic Documentation. A minimum of five permanent photographic documentation sampling points will be established in each emergent marsh HMP map unit to provide a visual record of plant growth and canopy closure after planting unless complete photographic coverage of a unit can be obtained with fewer points. Sampling points will be established before compensation is implemented, and locations will be identified in the first-year monitoring report.

Performance Standards and Goals. Performance standards are presented in Table G5-10 and performance goals are presented in Table G5-11.

Long-Term Maintenance of Emergent Marshes. Emergent vegetation may eventually become established in solid stands in marsh habitats, reducing the value of the habitat to waterfowl and other water birds. Periodic removal of emergent vegetation to maintain open water areas is therefore desirable. The HMP recommends, as a best management practice, that DW drain marshes periodically and remove emergent vegetation mechanically (Table G5-8).

Permanent Lake

Monitoring Responsibility. DW and DFG are responsible for monitoring permanent lakes to ensure that the required distribution of summer water depths is maintained (Table G5-8). DW is required to record lake management activities, including flooding and drawdown dates. DFG is responsible for conducting field inspections to ensure that management prescriptions are implemented in compliance with the HMP.

Monitoring Schedule. Monitoring of permanent lakes is required annually throughout the project life. DW is responsible for recording habitat management activities at the time they are implemented. The timing and frequency of DFG site inspections are at the discretion of DFG.

Monitoring Methods. Permanent lakes will be monitored to assess compliance with the requirements for lake acreages and water depths. To determine that appropriate water depths are maintained, DW will establish and maintain staff gages in lakes. DW will maintain records of lake management activities that will be available for review by DFG. DFG will also conduct site visits to assess compliance.

Photographic Documentation. A minimum of five permanent photographic documentation sampling points will be established in each permanent lake HMP map unit to provide a visual record of habitat development unless complete photographic coverage of a unit can be obtained with fewer points. Sampling points will be established before compensation is implemented, and locations will be identified in the first-year monitoring report.

Performance Standards and Goals. Performance standards are presented in Table G5-10. Performance standards in future years will be based on management prescriptions described in approved AOPs. Performance goal are presented in Table G5-11.

Monitoring Reports

A construction monitoring report describing changes made to the approved construction specifications will be prepared by DW in consultation with DFG. This report will be submitted to the Corps, the SWRCB Chief of the Division of Water Rights, and the HMAC on May 15 in the year following completion of construction.

Compensation monitoring reports will be submitted by DW to the Corps, the SWRCB Chief of the Division of Water Rights, DFG, and the HMAC on May 15 of each monitoring year. Submittal of monitoring reports will coincide with DW's submittal of habitat island AOPs (see Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands"). Compensation monitoring reports will include:

- a summary of monitoring results for each compensation habitat;
- a qualitative description of the growth and vigor of woody plants in riparian habitats;
- a description of environmental factors that may be affecting mitigation success;
- a description of hunter use levels and other recreationist use levels, and a summary of violations of use restrictions;
- a summary of hunting harvest;
- a description of proposed and implemented remedial measures; and
- a description of and justification for proposed amendments to the compensation program that result from monitoring and from practical experience gained during implementation.

Remedial Measures

If DW has failed to meet construction and compliance performance standards (Table G5-10), DFG and the HMAC may recommend to the Corps and to SWRCB's Chief of the Division of Water Rights that DW be required to implement remedial measures. If performance goals (Table G5-11) are not achieved, DW may request authorization from DFG and the HMAC to implement additional management measures in monitoring years 1, 2, 3, 6, and 8 to increase the likelihood that performance standards (Table G5-10) will be met.

Based on monitoring data, DFG, inconsultation with the HMAC, will identify remedial measures that must be implemented by DW in the event that compensation efforts fail. The specific remedial measures and level of effort required will be determined based on the magnitude and causes of failure. DFG and the HMAC may recommend to the Corps and the SWRCB Chief of the

Division of Water Rights that remedial measures not be implemented if monitoring data indicate that compensation efforts are in an upward trend and compensation objectives would be achieved without implementation of remedial measures.

Table G5-12 lists examples of remedial measures that could be applied to improve compensation success.

Monitoring of compensation habitats that require implementation of remedial measures would be performed for a 10-year period after measures are implemented or until performance standards are met.

Long-Term Dedication of Compensation Habitats

Compensation areas will be protected for the project life under provisions of DW's water right permits, Section 404 permit, and conservation easements and memorandums of understanding between DW and DFG required under the California Endangered Species Act. Failure to maintain compensation areas in conformance with the water right permits or the Section 404 permit could result in revocation of the DW project operating permits by SWRCB and the Corps.

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Table G5-1. Classification of Jurisdictional Wetland Habitat Types on the DW Project Islands

Habitat Group	Habitat Code	Description	Comments	Dominant or Typical Plant Species
Riparian	R1	Cottonwood-willow woodland	Cottonwood and willow trees	Fremont cottonwood, red willow, yellow willow
	R2	Great Valley willow scrub	Willow shrubs and trees	Red willow, yellow willow, sandbar willow, Goodding's willow
Marsh	M1	Freshwater marsh	Inside islands	Cattail, bulrush, yellow nutsedge, pondweed, buttonbush
	M3	Exotic marsh[a]	Dense upland and wetland weeds (sometimes dry in summer)	Annual smartweed, peppergrass, amaranth, wild radish, nettles, cocklebur, watergrass
Herbaceous upland	H1	Annual grassland	Tree uplands and sand hills	Wild oats, barley, rip-gut brome, Italian rye-grass
	H2	Exotic perennial grassland[a]	Mixed weeds in fields and on levee slopes	Bermuda grass, perennial ryegrass, Johnson grass
Agriculture	A1	Grain and seed crops		Corn, wheat, sunflowers, potatoes
Open water	O1	Canals and ditches	Permanent water	Dallis grass, knot grass, Himalaya berry, smartweed
	O2	Permanent ponds	Still water	Water hyacinth, water primrose, azolla
Developed	D2	Paving and exposed earth	Roads, landfills, and unvegetated exposed areas	Largely unvegetated

[a] Exotic habitats are dominated by weedy plant species that are not native to the Delta.

Source: JSA 1988.

Table G5-2. Acreages of Section 404 Jurisdictional Wetland Habitat Types on the DW Project Islands

Wetland Habitat Type[a]	Habitat Code[a]	Bacon Island	Webb Tract	Bouldin Island	Holland Tract	All Islands
Riparian woodland	R1	0.0	47.5	6.9	67.7	122.1
Riparian scrub	R2	2.4	56.2	7.9	14.3	80.8
Freshwater marsh	M1	1.0	24.7	16.5	13.9	56.1
Exotic marsh	M3	2.0	66.9	65.3	12.9	147.1
Annual grassland	H1	0	17.0	93.1	0.3	110.4
Exotic perennial grassland	H2	0	16.6	0	0	16.6
Grain and seed crops	A1	0.0	2.6	0.0	0.0	2.6
Canals and ditches	O1	17.8	19.7	35.3	21.8	94.6
Permanent ponds	O2	0.8	97.1	0.0	13.2	111.1
Unvegetated disturbed areas	D2	0.0	21.3	0.0	0.0	21.3
Total		24.0	369.6	225.0	144.1	762.7

Note: Acreages of jurisdictional wetlands were determined and verified by the Corps and NRCS (Coe and Simpson pers. comms.).

[a] See Table G5-1 for habitat definitions.

Table G5-3. Typical Plant Species of Cottonwood/Willow Woodland and Willow Scrub on the DW Project Islands

Common Name	Scientific Name
Arroyo willow	*Salix lasiolepis*
Barbara sedge	*Carex barbarae*
Black walnut	*Juglans nigra*
Boxelder	*Acer negundo*
Button bush	*Cephalanthus occidentalis* var. *californicus*
California blackberry	*Rubus vitifolius*
California wild rose	*Rosa californica*
Creeping wildrye	*Elymus triticoides*
Douglas seep-willow	*Baccharis douglasii*
Fremont cottonwood	*Populus fremontii*
Giant reed	*Arundo donax*
Goodding's willow	*Salix gooddingii*
Himalaya blackberry	*Rubus procerus*
Mugwort	*Artemisia douglasiana*
Sandbar willow	*Salix exigua*
Smooth willow	*Salix laevigata*
White alder	*Alnus rhombifolia*
Wild grape	*Vitus californica*
Yellow willow	*Salix lasiandra*

Source: JSA 1991.

C-062257

Table G5-4. Typical Plant Species of Freshwater Marsh Vegetation on the DW Project Islands

Common Name	Scientific Name
Button bush	*Cephalanthus occidentalis* var. *californicus*
Cattail	*Typha latifolia*
Common reed	*Phragmites communis*
Common tule	*Scirpus acutis* var. *occidentalis*
Horsetail	*Equisetum arvense*
Olney's bulrush	*Scirpus olneyi*
Perennial smartweed	*Polygonum coccineum*
Pondweed	*Potamogeton nodosus*
Stinging nettle	*Urtica urens*
Wappato	*Sagittaria latifolia*
Water smartweed	*Polygonum punctatum*

Source: JSA 1991.

Table G5-5. Typical Plant Species of Exotic Marsh Vegetation on the DW Project Islands

Common Name	Scientific Name
Beggarticks	*Bidens frondosa*
Burhead	*Echinodorus berteroi*
Cocklebur	*Xanthium strumarium*
Common sunflower	*Helianthus annuus*
Curly dock	*Rumex crispus*
Dallis grass	*Paspalum dilatatum*
Fall panicum	*Panicum dichotomiflorum*
Jimson weed	*Datura stramonium*
Johnson grass	*Sorghum halapense*
Mustard	*Brassica* spp.
Peppergrass	*Lepidium latifolium*
Pigweed	*Amaranthus albus*
Slender nettle	*Urtica dioica* ssp. *holosericea*
Smartweed	*Polygonum lapathifolium*
Velvetleaf	*Abutilon theophrasti*
Watergrass	*Echinochloa crusgalli*
Wheat	*Triticum aestivum*
White clover	*Melilotus alba*
Wild radish	*Raphanus sativus*

Source: JSA 1991.

Table G5-6. Section 404 Jurisdictional Wetlands Affected under Alternatives 1 and 2

Habitat Group	Affected Habitat Type	Bacon Island		Webb Tract		Bouldin Island		Holland Tract		All Islands	
		Acres[a]	Percentage of Habitat Type Affected[b]	Acres[a]	Percentage of Habitat Type Affected[b]	Acres[a]	Percentage of Habitat Type Affected[b]	Acres[a]	Percentage of Habitat Type Affected[b]	Acres[a]	Percentage of Habitat Type Affected[b]
Riparian	Cottonwood-willow woodland (R1)	0.0	100.0	47.5	100.0	0.0	0.0	0.0	0.0	47.5	38.9
	Willow scrub (R2)	2.4	100.0	56.2	100.0	0.0	0.0	2.4	16.8	61.0	75.5
Marsh	Freshwater marsh (M1)	1.0	100.0	24.7	100.0	0.8	4.8	0.7	5.0	27.2	48.4
	Exotic marsh (M3)	2.0	100.0	66.9	100.0	65.3	100.0	12.9	100.0	147.1	100.0
Herbaceous upland	Annual grassland (H1)	0.0	100.0	17.0	100.0	93.1	0.0	0.0	0.0	110.1	99.7
	Exotic perennial grassland (H2)	0.0	100.0	16.6	100.0	0.0	0.0	0.0	0.0	16.6	100.0
Agriculture	Grain and seed crops (A1)	0.0	100.0	2.6	100.0	0.0	0.0	0.0	0.0	2.6	100.0
Open water	Canals and ditches (O1)	17.8	100.0	19.1	100.0	0.0	0.0	0.0	0.0	37.5	39.6
	Permanent pond (O2)	0.8	100.0	97.7	100.0	0.0	0.0	0.0	0.0	97.9	88.2
Developed	Paving and exposed earth (i.e., unvegetated disturbed areas) (D2)	0.0	100.0	21.3	100.0	0.0	0.0	0.0	0.0	21.3	100.0
Total acres and average percentages		24.0	100.0	369.6	100.0	159.2	70.8	16.0	11.1	568.8	74.6

[a] Acreages of jurisdictional wetlands determined and verified by the Corps and NRCS (Coe and Simpson pers. comms.).

[b] Percentages derived using total acres of jurisdictional wetlands presented in Table G5-2.

Table G5-7. Summary of Section 404 Jurisdictional Wetland Mitigation Requirements and Mitigation to Be Provided

Affected Habitat Type[a]	Affected Acreage	Mitigation Requirement	Mitigation Acreage Required	Mitigation Acreage Provided on Habitat Islands			Mitigation Habitats	Mitigation Ratio Achieved
				Bouldin Island	Holland Tract	Total		
Cottonwood-willow (R1)	47.5	Replace affected acreage with in-kind habitat at a 3:1 ratio (from guidelines formulated by the HMP team)	142.5	N/A[b]	N/A[b]	143.1	1. Cottonwood-willow woodland	3:1
Willow (R2)	61.0	Replace affected acreage with in-kind habitat at a 2:1 ratio (from guidelines formulated by the HMP team)	122.0	N/A[b]	N/A[b]	122.0	1. Willow scrub	2:1
Freshwater marsh (M1)	27.2	Replace affected acreage with in-kind habitat at a 2:1 ratio (from guidelines formulated by the HMP team)	54.4	186.9	166.2	353.1	1. Emergent marsh	13:1
Exotic marsh (M3)	147.1	Replace affected acreage with out-of-kind habitat at a 2:1 ratio (from guidelines formulated by the HMP team)	294.2	2,803	1,092	3,761	1. Seasonal managed wetland 2. Mixed agriculture/seasonal wetland	26:1
Permanent pond (O2)	97.9	Replace affected acreage with in-kind habitat of higher quality than affected habitat at a 1:1 ratio (from guidelines formulated by the HMP team)	97.9	111.0	0.0	111.0	1. Permanent lake	1:1
Canals and ditches (O1), grain and seed crops (A1), annual grasslands (H1), exotic perennial grasslands (H2), and unvegetated disturbed areas (D2)	188.1	Manage similar habitats to be established on habitat islands to provide greater wildlife values than are associated with those habitats under existing conditions	N/A[c]	4,951	2,384	7,335[d]	1. Corn/wheat fields 2. Mixed agriculture/seasonal wetland 3. Small grain fields 4. Herbaceous upland 5. Seasonal managed wetland 6. Canals and ditches	39:1

Notes: N/A = not applicable.

[a] See Table G5-1 for habitat-type descriptions.

[b] Total acreage of riparian habitats to be created on each island has been identified; however, the specific acreages of riparian woodland and scrub habitats to be established on each island has not been determined.

[c] Specific mitigation acreage objectives were not established by the HMP team for these habitat types.

[d] Does not include the acreage of canals and ditches that would be established on the habitat islands.

C-062261

Compensation Management Goals[a]	Compensation Management Guidelines[a]	Species Management Goals[b]	Best Management Practice Guidelines[b]
Seasonal Managed Wetland			
■ Provide foraging habitat for wintering greater sandhill crane. ■ Provide foraging habitat for wintering swans, geese, and dabbling ducks. ■ Provide late spring, summer, and fall foraging habitat for Swainson's hawk.	■ Seasonal managed wetlands shall be located as shown in Figures G5-1 and G5-2. ■ Wetland cells shall be at least 65 acres in size and dominated by watergrass, smartweeds, and other desirable wetland waterfowl food plants. ■ Bottom contouring of wetlands shall be irregular to provide for vegetative diversity. ■ Wetlands shall be contoured and have water control structures that will allow for rapid flooding and drawdown to control mosquito production. ■ Annually, approximately 10% (or more if required) of each wetland cell shall be disked to maintain field productivity. Cells shall also be disked to control cattail and tule encroachment so that these species occupy ≤ 25% of a cell. If portions of cells require mowing to meet some species management objectives, mowing will be implemented in a manner that avoids destruction of nests and complies with federal waterfowl baiting regulations. Fields shall be irrigated as necessary to ensure optimal seed production. ■ Cells shall be slowly flooded and drained over 2 weeks on a staggered schedule. Cells shall be flooded to depths of 0-12 inches, with no more than 25% of each cell in a dry condition. Cell flooding and draining schedules shall be 25% flooded from September 1 to October 1 and drained from March 1 to March 15, 25% flooded from November 1 to November 15 and drained from March 15 to April 15, 25% flooded from November 1 to November 15 and drained from April 15 to May 1, and 25% flooded from December 1 to December 15 and drained from May 15 to June 1.	■ Provide suitable duck nesting habitat. ■ Provide greater sandhill crane roost sites. ■ Provide waterfowl loafing habitat.	■ Islands should be constructed to provide waterfowl loafing habitat and small mammal refugia. ■ Islands should be constructed at a density of approximately one island per 10 acres of seasonal managed wetland habitat. ■ Islands should be 0.01-0.02 acre in size with lengths 3-10 times longer than island widths. ■ To encourage establishment of a greater sandhill crane roost site, wetland cells in the closed hunting zone area on east Bouldin Island should be managed as described in the compensation guidelines, except that: A. water depths should not exceed 6 inches; B. at least 75% of cell vegetation should be mowed by October 15 to a height of less than 4 inches; C. islands should be constructed as described above; and D. island vegetation should be mowed to a height of less than 1 inch.

Compensation Management Goals[a]	Compensation Management Guidelines[a]	Species Management Goals[b]	Best Management Practice Guidelines[b]
Mixed Agriculture/Seasonal Wetland			
■ Provide foraging habitat for wintering greater sandhill crane. ■ Provide foraging habitat for wintering swans, geese, and dabbling ducks. ■ Provide late spring, summer, and fall foraging habitat for Swainson's hawk.	■ Mixed agriculture/seasonal wetlands shall be constructed as shown in Figures G5-1 and G5-2. ■ This habitat type shall be managed to provide strips of corn interspersed among watergrass- and smartweed-dominated wetlands. Minimum wetland cell size shall be 65 acres. ■ A dwarf corn variety shall be planted in July. Corn shall be planted in strips no more than 12 rows in width separated by unplanted strips equivalent to no less than 36 corn planting rows. Corn shall not be harvested; however, following drawdown and the waterfowl hunting season, remaining standing corn shall be mowed or chopped to increase food availability for wildlife. ■ Areas not planted with corn shall be managed as seasonal wetland dominated by naturally occurring watergrass, smartweed, and other wetland-associated plants. Approximately 50% of wetlands shall be mowed as required between July 1 and August 15 to maintain plants in a low growth form. ■ Wetland cells shall be flooded on a staggered schedule to depths of 0-12 inches, with no more than 25% of each cell in a dry condition. Cell flooding and draining schedules shall be 25% flooded from October 1-15 and drained from January 1-15, 25% flooded from October 15 to November 15 and drained from January 15 to March 15, and 50% flooded from November 15 to December 15 and drained from March 15 to April 1.	■ Provide suitable duck nesting habitat. ■ Provide waterfowl loafing areas. ■ Provide refuge for rodents to maintain prey populations for foraging raptors during flood periods.	■ Islands should be constructed to provide waterfowl loafing habitat and small mammal refugia. ■ Islands should be constructed at a density of approximately one island per 10 acres of mixed agriculture/seasonal wetland habitat. ■ Islands should be 0.01-0.02 acre in size with lengths 3-10 times longer than island widths.

Compensation Management Goals[a]	Compensation Management Guidelines[a]	Species Management Goals[b]	Best Management Practice Guidelines[b]
Fields of Corn Rotated with Wheat			
■ Provide foraging habitat for wintering greater sandhill crane. ■ Provide foraging habitat for wintering swans, geese, and dabbling ducks. ■ Provide fall foraging habitat for Swainson's hawk.	■ Corn fields shall be located as shown in Figures G5-1 and G5-2. ■ Minimum field size shall be 65 acres. ■ Corn/wheat rotations shall be approximately 50% corn to corn; 25% corn to wheat; and 25% wheat to corn. Except as noted below, fields shall be flooded on a staggered schedule to depths of 0-12 inches, with no more than 25% of each field in a dry condition. ■ Fields in a corn-to-corn rotation shall be planted in mid- to late April. Approximately 67% of the corn shall be harvested in a manner that leaves 20-yard-wide strips of standing corn separated by 40 yards of harvested corn. Fields shall not be disked until spring. Following the end of waterfowl hunting season, standing corn shall be mowed or chopped to increase food availability for wildlife. Field flooding and draining schedules shall be 25% flooded from October 1-15 and drained from January 15 to February 1, 25% flooded from November 1 to November 15 and drained from March 1 to March 15, 25% flooded from December 1 to December 15 and drained from March 15 to April 1, and 25% flooded by February 1 following mowing or chopping after the end of waterfowl hunting season and drained from April 1 to April 15. ■ Fields in a corn-to-wheat rotation shall be planted with an early corn variety and harvested by September 1. Approximately 66% of each field shall be harvested in a manner that leaves 20-yard-wide strips of standing corn separated by 40-yard-wide strips of harvested corn. Field flooding and drainage schedules shall be approximately 25% flooded from September 1-15 and drained from January 1 to January 15, 25% flooded from September 15 to October 15 and drained from February 1 to February 15, and 50% flooded from October 15 to November 1 and drained from February 15 to March 1. Standing corn in fields drained by January 15 and February 15 shall be chopped following drainage. ■ Fields in a wheat-to-corn rotation shall be planted with a fast maturing spring wheat variety following field drawdown. Approximately 50% of the fields shall be harvested after July 15 in a manner that leaves equal-width strips of harvested and unharvested wheat. Field flooding and drainage schedules shall be approximately 25% flooded between October 1 and November 1 and drained between January 15 and February 1, 25% flooded between December 1 and December 15 and drained between March 1 and March 15, and 50% remaining dry.	■ Provide dabbling duck nesting habitat. ■ Provide waterfowl loafing areas. ■ Provide refuge for rodents to maintain prey populations for foraging raptors during flood periods. ■ Provide optimal greater sandhill crane foraging areas adjacent to wetlands managed as crane roost sites.	■ Spud ditches in wheat fields should be configured in a manner that allows ducklings to cross or escape the ditches. ■ Islands should be constructed at a density of approximately one island per 10 acres of corn/wheat fields. ■ Islands should be 0.01-0.02 acre in size with lengths 3-10 times longer than island widths. ■ Fields shall be managed as described in compensation guidelines, except that 80% of fields shall be harvested.

Compensation Management Goals[a]	Compensation Management Guidelines[a]	Species Management Goals[b]	Best Management Practice Guidelines[b]
Small Grain Fields with a Barley/Vetch Rotation			
■ Provide summer and fall foraging habitat for Swainson's hawk. ■ Provide winter foraging habitat for greater sandhill crane. ■ Provide winter foraging habitat for swans, geese, and dabbling ducks.	■ Fields shall be located as shown in Figures G5-1 and G5-2. ■ Fields shall be initially planted with winter wheat. ■ Approximately 25% of each field shall be planted with a barley/vetch mix. ■ Fields shall not be flooded. ■ Fields shall be at least 65 acres in size. ■ Field preparation and planting shall begin by November 1 and be completed by December 31.	■ Provide dabbling duck nesting habitat. ■ Provide nesting habitat for other ground-nesting birds.	■ Seedbeds should be 36-48 inches wide to protect the nests of ducks and other ground-nesting bird species from flooding during irrigation periods. ■ Fields should be 50% harvested after July 15. Barley/ vetch stands should be completely rotated through each field every 4 years. ■ Spud ditches should be configured in a manner that allows ducklings to cross or escape from the ditches.
Permanent Lakes			
■ Replace acreage of two Section 404 jurisdictional lakes lost on reservoir islands at a ratio of 1:1.	■ Lakes shall be located as shown in Figures G5-1 and G5-2. ■ Create two lakes ranging between 40 acres and 70 acres in size, with a combined total acreage of at least 108 acres. ■ Lake bottoms shall be unevenly contoured to provide water depths ranging from 3 feet to 6 feet during summer. Approximately 25% shall be <3 feet deep, 25% between 4 and 6 feet deep, and 50% between 3 and 4 feet.	■ Provide waterfowl resting areas. ■ Provide nesting and escape cover for waterfowl.	■ The lakeshore should be contoured to slopes that will encourage growth of emergent marsh and riparian forest and scrub vegetation. ■ Approximately 40% of the lakeshore should be managed to provide herbaceous cover ≤ 1 inch high from October through March to provide suitable waterfowl loafing sites. ■ Approximately 10 islands should be established in each lake ranging from 0.2 acre to 0.5 acre in size to provide waterfowl loafing and nesting habitat and escape cover. Islands should be contoured to allow tule and cattail to become established on the islands.
Herbaceous Upland			
■ Provide suitable foraging habitat for Swainson's hawk. ■ Provide suitable foraging habitat for greater sandhill crane.	■ Herbaceous uplands shall be located as shown in Figures G5-1 and G5-2. ■ Approximately 75% of uplands associated with island levees and 50% of other upland areas shall be mowed as needed to maintain low vegetation height after July 15.	■ Provide suitable duck nesting habitat. ■ Provide habitat for small mammals and other upland wildlife species.	■ Herbaceous uplands should be seeded and managed to provide a desirable mix of native and exotic grasses and forbs. ■ Upland border strips approximately 5 acres in size should remain unflooded between seasonal wetland cells (not shown in Figures G5-1 and G5-2).

Compensation Management Goals[a]	Compensation Management Guidelines[a]	Species Management Goals[b]	Best Management Practice Guidelines[b]
Emergent Marsh			
■ Replace the acreage of jurisdictional emergent marsh on reservoir islands at a ratio of 2:1.	■ Emergent marshes shall be located as shown in Figures G5-1 and G5-2. ■ Create 390 acres of emergent marsh dominated by cattail and tule. Some wetland cells shall be managed specifically to establish and maintain emergent marsh habitat. Cattails and tule will also naturally occur in association with seasonal managed wetlands, mixed agriculture/seasonal wetlands, summer seasonal ponds, and permanent lakes. ■ Areas managed specifically as emergent marsh shall be flooded all year, except during vegetation control periods. Water depths shall vary from saturated soil to 36 inches.	■ Create suitable duck brood habitat. ■ Provide nesting and foraging habitat for duck species associated with emergent marsh habitats.	■ Marshes should be managed in a condition that maintains 40%-70% open water. Marshes should be drained and dense vegetation controlled to maintain open water areas when 60% vegetation cover is achieved. A minimum of 30% vegetation cover should be allowed to remain and marshes re-flooded following treatment. ■ Open water areas should be seeded with duck potato, pondweeds, and other aquatic species important to wildlife.
Riparian Scrub			
■ Replace the acreage of jurisdictional riparian scrub lost on reservoir islands at a ratio of 2:1.	■ Riparian scrub shall be located as shown in Figures G5-1 and G5-2. ■ Existing riparian scrub shall be maintained and approximately 123 additional acres of riparian scrub shall be created. ■ Riparian scrub habitats shall be dominated by willow shrubs and trees. Scrub habitats shall be managed to provide between 35% to 70% shrub cover.	■ Provide foraging habitat for some wintering waterfowl species.	■ Riparian scrub should not be developed within waterfowl nesting areas to reduce the likelihood of nest predation. ■ Approximately 10% of riparian scrub habitats should be shallow-flooded during winter after woody vegetation has become dormant to provide duck foraging areas.
Riparian Woodland			
■ Replace the acreage of jurisdictional riparian forest lost on reservoir islands at a ratio of 3:1.	■ Riparian woodland shall be located as shown in Figures G5-1 and G5-2. ■ Existing riparian woodland shall be maintained and approximately 143 additional acres of riparian woodland shall be created. ■ Riparian woodland habitats shall be dominated by willow and cottonwood trees. Forest habitats shall be managed to provide 65%-80% crown cover.	■ Provide foraging habitat for some duck species.	■ Riparian woodland should not be developed within waterfowl nesting areas to reduce the likelihood of nest predation. ■ Approximately 10% of riparian forest habitats should be shallow-flooded during winter after woody vegetation has become dormant to provide duck foraging areas. ■ Riparian woodland habitats should also be planted with other native tree and shrub species such as white alder, flowering ash, coast live oak, valley oak, boxelder, button-bush, dogwood, elderberry, California rose, California blackberry, and wild grape to increase woodland diversity and wildlife values.

Notes: Table adapted from Table 2 in Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands".

Canals and ditches will be part of the infrastructure used to manage the other compensation habitats.

[a] Compensation management goals and guidelines are required to offset significant project impacts.

[b] Species management goals and best management practice guidelines are recommended to enhance overall wildlife habitat values associated with compensation habitats.

Table G5-9. Acreages of Habitat to Be Developed on the Habitat Islands

Habitat Type	Bouldin Island		Holland Tract		Habitat Islands Combined	
	Total Acres	Percentage of Total Acres	Total Acres	Percentage of Total Acres	Total Acres	Percentage of Total Acres
Corn/wheat	1,629	27	955	31	2,584	29
Small grains	106	2	152	5	258	3
Mixed agriculture/seasonal wetland	1,014	17	631	21	1,645	18
Seasonal managed wetland	1,723	29	393	13	2,116	23
Seasonal pond	66	1	68	2	134	1
Pasture/hay	132	2	72	2	204	2
Emergent marsh[a]	208	3	194	6	402	4
Riparian[a]	170	3	217	7	387	4
Lake[a]	111	2	33	1	144	2
Herbaceous upland[a]	479	8	253	8	732	8
Developed	177	3	58	2	235	3
Canal[a]	70	1	10	0	80	1
Borrow pond	89	1	0	0	89	1
Total	5,974	100	3,036	100	9,010	100

Note: Minor discrepancies in totals are the result of rounding.

[a] Includes existing jurisdictional wetland acres unaffected by the DW project.

Table G5-10. Construction and Compliance Performance Standards for Compensation Habitats

Habitat Type or Activity	Plant Species	Monitoring Parameter	Construction Monitoring Periods		Compliance Monitoring Periods		
			Year -1	Year 0	Year 4	Year 10	Project Life
Agricultural, seasonal wetland, and herbaceous upland	N/A	Construction specifications	Construct to construction specifications approved by DFG and the Corps	Construct to construction specifications approved by DFG and the Corps	N/A	N/A	N/A
	N/A	Management prescriptions	N/A	N/A	N/A	N/A	Compensation management guidelines in Table G5-8 or approved annual operating plans (AOPs) are implemented
Riparian woodland	N/A	Construction specifications	Construct to construction specifications approved by DFG and the Corps	Construct to construction specifications approved by DFG and the Corps	N/A	N/A	N/A
	N/A	Management prescriptions	N/A	N/A	N/A	N/A	Compensation management guidelines in Table G5-8 or approved AOPs are implemented
	All species	Percent canopy cover	N/A	N/A	>30%	65%-80%	Compensation management guidelines in Table G5-8 or approved AOPs are implemented

Table G5-10. Continued

Habitat Type or Activity	Plant Species	Monitoring Parameter	Construction Monitoring Periods		Compliance Monitoring Periods		
			Year -1	Year 0	Year 4	Year 10	Project Life
Riparian scrub	Nonlinear willow scrub	Construction specifications	Construct to construction specifications approved by DFG and the Corps	Construct to construction specifications approved by DFG and the Corps	N/A	N/A	N/A
		Management prescriptions	N/A	N/A	N/A	N/A	Compensation management guidelines in Table G5-8 or approved AOPs are implemented
		Percent shrub canopy cover	N/A	N/A	>30%	>65%	Compensation management guidelines in Table G5-8 or approved AOPs are implemented
	Linear willow scrub	Construction specifications	Construct to construction specifications approved by DFG and the Corps	Construct to construction specifications approved by DFG and the Corps	N/A	N/A	N/A
		Management prescriptions	N/A	N/A	N/A	N/A	Compensation management guidelines in Table G5-8 or approved AOPs are implemented

C-062270

Table G5-10. Continued

Habitat Type or Activity	Plant Species	Monitoring Parameter	Construction Monitoring Periods		Compliance Monitoring Periods		
			Year -1	Year 0	Year 4	Year 10	Project Life
		Percent linear closure	N/A	N/A	50%	90%	N/A
Emergent marsh	Bulrushes and cattail	Construction specifications	Construct to construction specifications approved by DFG and the Corps	Construct to construction specifications approved by DFG and the Corps	N/A	N/A	N/A
		Management prescriptions	N/A	N/A	N/A	N/A	Compensation management guidelines in Table G5-8 or approved AOPs are implemented
		Percent emergent cover	N/A	N/A	40%-70%	40%-70%	N/A
Permanent lake	Open water	Construction specifications	Construct to construction specifications approved by DFG and the Corps	Construct to construction specifications approved by DFG and the Corps	N/A	N/A	N/A
		Management prescriptions	N/A	N/A	N/A	N/A	Compensation management guidelines in Table G5-8 or approved AOPs are implemented

C-062271

Table G5-10. Continued

Habitat Type or Activity	Plant Species	Monitoring Parameter	Construction Monitoring Periods		Compliance Monitoring Periods		
			Year -1	Year 0	Year 4	Year 10	Project Life
Hunting and other use restrictions	N/A	Use restrictions	N/A	N/A	N/A	N/A	Hunting and other use restrictions in the HMP or approved AOPs are implemented

Note: Table adapted from Tables 19, 21, and 24 of Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands".

C-062272

Table G5-11. Compliance Performance Goals

Habitat Type	Plant Species	Monitoring Years 1, 2, and 3				Monitoring Years 6 and 8		
		Monitoring Parameter	Year 1	Year 2	Year 3	Monitoring Parameter	Year 6	Year 8
Riparian woodland	All species	Seedlings/saplings per acre	>200	>300	>350	Percent canopy cover	50%-80%	60%-80%
	Fremont cottonwood and willow tree species	Percent composition on each island	≥50%	≥50%	≥50%	N/A	N/A	N/A
		Percent composition in each stand	20%-100%	20%-100%	20%-100%	N/A	N/A	N/A
	Other native tree species	Percent composition on each island	≥5%	≥5%	≥5%	N/A	N/A	N/A
		Percent composition in each stand	0%-50%	0%-50%	0%-50%	N/A	N/A	N/A
	Native shrubs and vines	Percent composition on each island	≥5%	≥5%	≥5%	N/A	N/A	N/A
		Percent composition in each stand	0%-50%	0%-50%	0%-50%	N/A	N/A	N/A
Riparian scrub	Nonlinear willow scrub	Seedlings per acre	>200	>300	>350	N/A	N/A	N/A
	Linear willow scrub	Seedlings per 100 feet	≥10	≥8	≥6	N/A	N/A	N/A
Emergent marsh	Bulrushes, cattail, and other emergent species	Percent cover	>5%	>20%	>30%	Percent cover	40%-70%	40%-70%

Habitat Type or Activity	Monitoring Parameter	Potential Remedial Measure
Agricultural habitat, seasonal wetland, and herbaceous upland	Construction specifications	■ Reconstruct or replant agricultural fields, seasonal wetlands, and herbaceous uplands to conform with construction specifications
		■ Construct and manage additional compensation habitats
		■ Adjust management of other habitat island habitats to increase wildlife values
		■ Reduce disturbance levels on islands to increase wildlife values
	Management prescriptions	■ Construct and manage additional compensation habitats
		■ Adjust disturbance levels on islands to increase wildlife values
Riparian woodland	Construction specifications	■ Reconstruct or replant riparian woodland habitats to conform with construction specifications
	Management prescriptions	■ Burn, cut, or use herbicides to thin stands to desired canopy cover
	Percent canopy cover	■ Plant or seed additional trees to increase tree density
		■ Alter groundwater hydrology or irrigate to increase rate of tree growth and survival
		■ Establish additional riparian woodland habitat in locations better suited for establishment of riparian habitats
Riparian scrub (nonlinear and linear)	Construction specifications	■ Reconstruct or replant riparian scrub habitats to conform with construction specifications
	Management prescriptions	■ Burn, cut, or use herbicides to prevent succession to a woodland condition

Habitat Type or Activity	Monitoring Parameter	Potential Remedial Measure
	Percent shrub cover	■ Plant willow cuttings or other suitable shrub species to increase shrub density
		■ Alter groundwater hydrology or irrigate to increase rate of shrub growth and survival
		■ Establish additional riparian scrub habitat in locations better suited for establishment of riparian habitats
		■ Burn, cut, or use herbicides to prevent succession to a woodland condition
	Percent linear closure	■ Plant willow cuttings or other suitable shrub species to increase shrub density
		■ Alter groundwater hydrology or irrigate to increase rate of shrub growth and survival
		■ Burn, cut, or use herbicides to prevent succession to a woodland condition
Emergent marsh	Construction specifications	■ Reconstruct or replant marsh habitats to conform with construction specifications
	Management prescriptions	■ Construct and manage additional marsh habitats
		■ Adjust disturbance levels in marshes to increase wildlife values
	Percent cover	■ Plant additional plugs of emergent vegetation
		■ Manage water levels in a manner that encourages establishment of desirable emergent plants
Permanent lake	Construction specifications	■ Recontour lake bottoms and shorelines or reinstall water control structures to conform with construction specifications
		■ Construct additional permanent lakes
		■ Reduce disturbance levels on islands to increase wildlife values
	Management prescriptions	■ Change lake level management or install additional water control structures
		■ Construct additional permanent lakes
		■ Reduce disturbance levels on islands to increase wildlife values

Habitat Type or Activity	Monitoring Parameter	Potential Remedial Measure
Hunting and other use restrictions	Use restrictions	■ Increase level of compliance monitoring ■ Implement more effective compliance monitoring methods ■ Adjust hunter or other disturbance levels on islands to increase wildlife values ■ Construct and manage additional high value wildlife habitats

Note: Table adapted from Table 26 of Appendix G3, "Habitat Management Plan for the Delta Wetlands Habitat Islands".

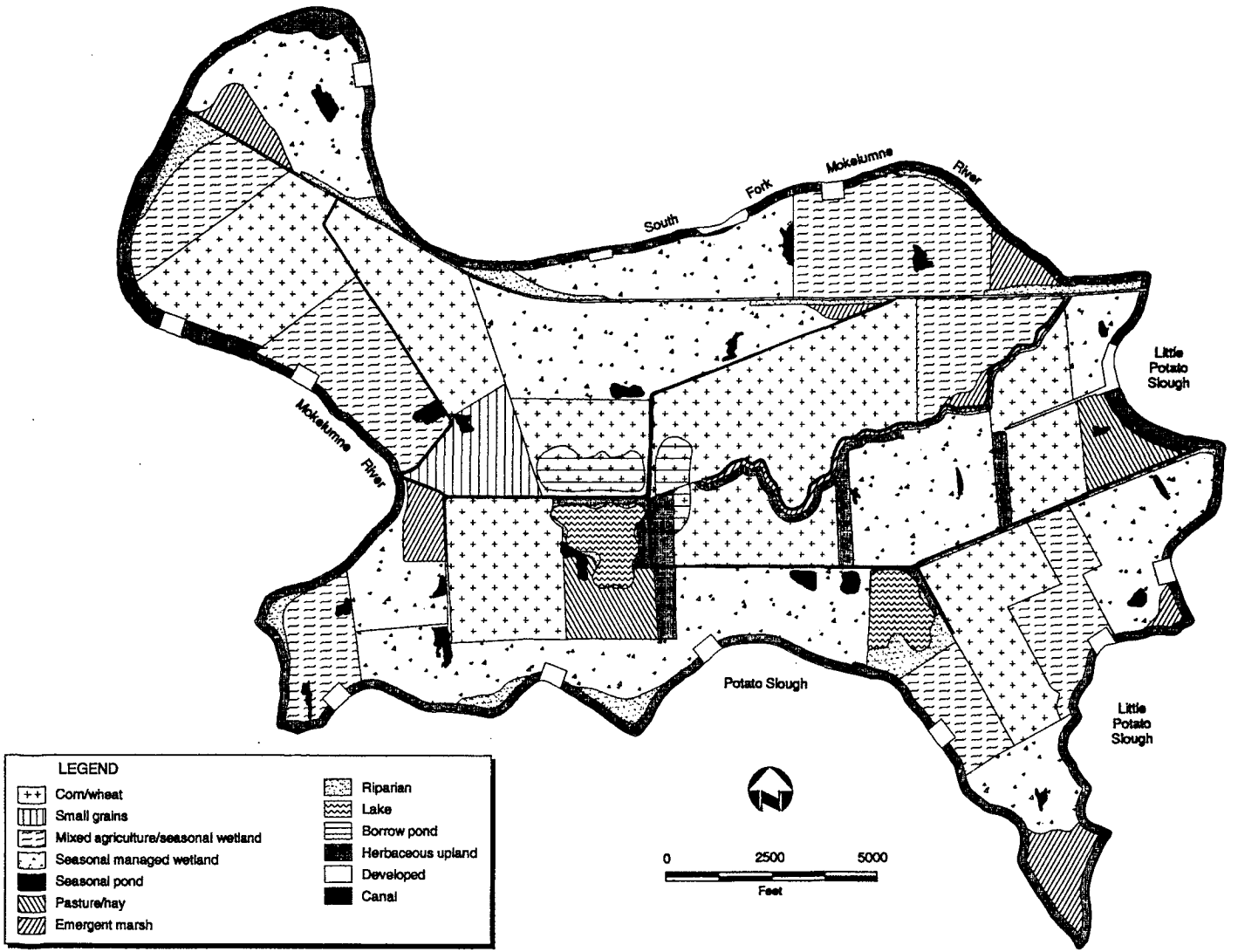

Figure G5-1.
Bouldin Island Habitats under Alternatives 1 and 2

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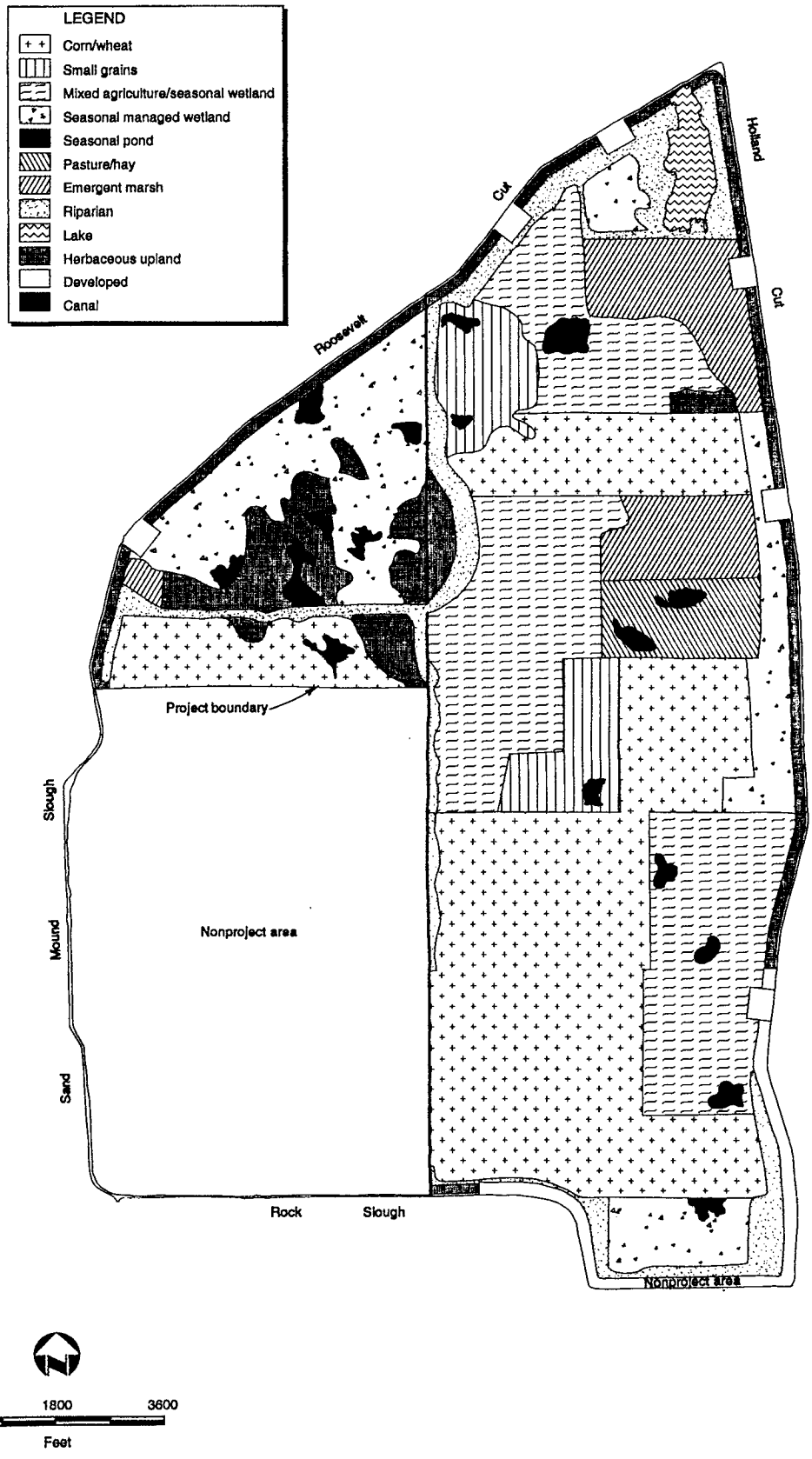

Figure G5-2.
Holland Tract Habitats under
Alternatives 1 and 2

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