APPENDIX A

Species and NCCP Communities Considered, but not Evaluated in the EWA ASIP

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Table A-1 at the end of this appendix presents the list of MSCS species initially evaluated for incorporation into this ASIP. The species list was initially reviewed for species that do not inhabit habitats the lie within the EWA Action Area. The next screening was based on the relationship of rice farmland to the life cycle of the species. Species whose a portion of or the entire life history/cycle may rely on rice farmland have been retained for detailed analysis in this ASIP. Species that may visit riceland occasionally, but do not rely on the habitat, are described in this appendix. Chapter 3 provides additional details regarding the screening process.

1.4.2.2 Species Associated with Seasonally Flooded Agriculture that will not be Affected by EWA Actions

There are a number of MSCS-covered species that occupy habitats in or near seasonally flooded agriculture land (e.g., flooded rice land) that will not be affected by EWA land fallowing actions. The rationales to support determinations of no effects to the species are provided in the following text.

Western Spadefoot Toad
Levees and drainage ditches are potential habitat for the western spadefoot toad. The proposed action would not affect levees or ditches adjacent to rice fields.

Double-Crested Cormorant
Double-crested cormorant use levees adjacent to rice fields to dry their wings. The proposed action would not affect levees adjacent to rice fields.

American Bittern
American bitterns forage in flooded rice fields and adjacent irrigation ditches during the winter primarily for invertebrates. The proposed action would not prevent flooding of fields in the winter.

White-tailed Kite
During the winter white-tailed kites forage for small rodents, insects, frogs, and snakes over flooded and idled rice fields. The proposed action would not prevent the winter flooding of fields. The proposed action has the potential to increase the overall acreage of idled rice fields increasing the forage base for this species.

Bald Eagle
Bald eagles forage for ducks, geese, and sometimes fish over large areas including rice fields. However, this species is highly mobile with a home range radius of approximately 1 mile, whereas the largest possible block of idled land will be 160 acres (½ mile X ½ mile). The EWA proposed action would not reduce the forage supply of waterfowl and fish within the Sacramento Valley.

Swainson's Hawk
Swainson's hawks forage in idled rice fields. The proposed action has the potential to increase the overall acreage of idled rice fields increasing the forage base for this species.

Ferruginous Hawk
Ferruginous hawks forage for small mammals in idled rice fields. The proposed action has the potential to increase the overall acreage of idled rice fields.

Golden Eagle
Golden eagles forage over large areas including rice fields near their nests in the foothills surrounding the Central Valley. However, this species is highly mobile with an extensive home range, whereas the largest possible block of idled land will be 160 acres (½ mile X ½ mile).

Merlin
During the winter merlins forage for songbirds and shorebirds over flooded and idled rice fields. The proposed action would not prevent the winter flooding of fields. The proposed action has the potential to increase the overall acreage of idled rice fields.

Peregrine Falcon
During the winter peregrine falcons forage for ducks and shorebirds over flooded and idled rice fields. The proposed action would not prevent flooding of fields. The proposed action has the potential to increase the overall acreage of idled rice fields.

Prairie Falcon
During the winter the prairie falcon forages over flooded and idled rice fields. The proposed action would not prevent flooding of fields. The proposed action has the potential to increase the overall acreage of idled rice fields.

Mountain Plover
The mountain plover uses disked rice fields in late winter to find insects. The proposed action would not prevent disking of these fields. This would ensure forage habitat is maintained for the mountain plover.

Short-eared Owl
The short-eared owl could find a suitable prey base in idled rice fields. The proposed action has the potential to increase the overall acreage of idled rice fields.

Northern Harrier
The northern harrier could find a suitable prey base in idled rice fields. The proposed action has the potential to increase the overall acreage of idled rice fields.

Long-eared Owl
Long-eared owls can be found in trees along rice fields and forage over idled fields at night. The proposed action has the potential to increase the overall acreage of idled rice fields and would not affect woodlands.

Burrowing Owl
Burrowing owls can be found on the levees bordering rice fields. These levees would not be affected by rice idling.

Bank Swallow
During the spring and summer, bank swallows can be found foraging for insects over rice fields. However, this species is highly mobile with a foraging range of 8-10 km, whereas the largest possible block of idled land will be 160 acres (½ mile X ½ mile).

Bewick's Wren
Bewick's wrens are casual visitors to rice fields in the fall and winter. They are sometimes found feeding along weedy irrigation ditches or in fallow rice fields. The proposed action would not affect irrigation ditches and would increase the acreage of idled rice fields.

Loggerhead Shrike
Loggerhead shrikes can be found hunting along the borders of rice fields and in fallow rice fields. The proposed action would increase the acreage of idled rice fields and would not affect adjacent ditches.

Lark Sparrow
Lark Sparrows are casual visitors to rice fields in the fall and winter. They are sometimes found feeding along weedy irrigation ditches or in fallow rice fields. The proposed action would increase the acreage of idled rice fields and would not affect adjacent ditches.

AMERICAN BITTERN (*Botarus lentiginosus*)

Legal Status. The American bittern is listed as a California Special Animal (CDFG 2003), a Migratory Nongame Bird of Management Concern (USFWS 1995), a Bird of Conservation Concern (USFWS 2002), and a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). This species is considered a Federal Species of Concern (formerly a species under consideration for listing), but is not listed under the CESA (CDFG 2003).

Historical and Current Distribution and Status. The wintering range of the American bittern ranges from southern California to the south Atlantic Coast; the breeding range extends from mid-United States to Canada (Gibbs et al. 1992). In California, American bitterns live mainly in fresh emergent wetlands west of the Sierra Nevada and they commonly breed in the Central Valley from October to April. The lowland breeding population may be nonmigratory; bitterns often migrate from Northern California during the winter to augment the nonmigratory populations in

Southern California. The current abundance of this species is largely unknown due to its secretive nature.

Distribution in the CALFED Solution Area and EWA Area of Analysis. The American Bittern occurs in all 14 ecological zones and throughout the EWA Area of Analysis during some portion of its annual cycle.

Life History and Habitat Requirements. American bitterns forage in fresh or saline, tall emergent wetlands, and less frequently in shallow water of lakes, rivers or estuaries. American bitterns have also been seen visiting artificial impoundments at wildlife management areas (NatureServe Explorer 2002). This species seems to require wetlands of a minimum of 2.5 to 5 hectares in area, but smaller wetlands may serve as important alternate feeding sites and “stepping stones” on movements between larger wetlands (NatureServe Explorer 2002). Bitterns feed on insects, amphibians, fish, crayfish, small mammals, snakes, invertebrates, and birds. These birds hunt by standing motionless or slowly stalking, and then striking and grasping prey quickly with the bill (Granholm 1990). Feeding occurs most actively at dusk and during the evening hours. Their striped coloration may serve to conceal them from prey, competitors, and predators in habitats with dense, vertical emergent vegetation (NatureServe Explorer 2002). Bitterns are solitary, taking cover in tall dense emergent vegetation, near logs or stumps or on emergent plants (Granholm 1990).

American bitterns breed in seasonal, semipermanent, temporary, permanent, fen, and restored wetlands, and in hayland, cropland, and idle grasslands. Nests are constructed in shallow water, on the ground, or floating in areas concealed in tall, dense, fresh emergent vegetation using materials such as matted emergent aquatics, herbaceous stems, sticks and leaves (Granholm 1990). Bitterns have also been observed nesting in grassy upland areas (NatureServe Explorer 2002). Egg-laying begins in late April to early May and continues to mid-June (NatureServe Explorer 2002). Bitterns are solitary nesters with a clutch size of 3 to 5 eggs; hatchlings leave the nest after 2 weeks. The approximate lifespan of an American bittern is 8.5 years (Klimkiewicz 2002).

Reasons for Decline. Populations have been threatened due to loss and degradation of wetland habitat as a result of drainage, filling, siltation, pollution, eutrophication, non-native plant invasion, and overgrazing of emergent vegetation (Granholm 1990, NatureServe Explorer 2002). Bitterns could also be affected by amphibian declines, incidental illegal shooting, ecological succession, and human disturbance along the edges of wetlands (NatureServe Explorer 2002).

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Bitterns are solitary and elusive birds that inhabit fairly inaccessible habitat, and little is known about the abundance and biology of this species (NatureServe Explorer 2002). Point-counts using tape-recorded vocalizations would help to ascertain more accurate abundance and population trend data for this species. In addition, a detailed, autecological study would elucidate the basic features of the breeding biology and specific habitat requirements of this species (NatureServe Explorer 2002). No information is currently available about the role of predation in limiting bittern population sizes (NatureServe Explorer 2002).

American Bittern Citations

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AMERICAN PEREGRINE FALCON *(Falco peregrinus anatum)*

Legal Status. The American peregrine falcon is listed as endangered under the CESA and as fully protected under the California Fish and Game Code (CDFG 2003). The American peregrine falcon was delisted from the FESA list, and is now considered a recently recovered species being monitored as part of a 5-year review plan.

Historical and Current Distribution and Status. Historically, resident American peregrine falcons occurred throughout most of California (CDFG 1980, USFWS 1982). The population increased during winter, when migrating birds arrived from the north (Grinnell and Miller 1944). Peregrine falcons nested throughout the state, with breeding pairs concentrated along the coast and around the Channel Islands (Grinnell and Miller 1944). Interior nesting locations included Tule Lake in Siskiyou County, Mono Lake in Mono County, and the inner Coast Ranges in Kern County (Grinnell and Miller 1944).

The population of California peregrine falcons began to seriously decline in the 1950s. Based on a conservative historical estimate, there were 100 pairs breeding in California before 1947. By 1969, fewer than 10 nesting sites were believed to be active (Herman et al. 1970). In 1970, only two nesting pairs were confirmed, with probably fewer than five nesting pairs statewide (Herman 1971). In 1992, there were approximately 140 breeding pairs of American peregrine falcons in California, primarily in mountains of the central and northern Coast Ranges and Cascade Range (CDFG 1987). According to more recent information the California breeding range, which has been expanding, now includes the Channel Islands, coast of southern and central California, inland north coastal mountains, Klamath and Cascade ranges, and the Sierra Nevada.

Distribution in the CALFED Solution Area and EWA Area of Analysis. The peregrine falcon occurs when migrating and as a winter visitor in all 14 ecological zones.

Life History and Habitat Requirements. The range includes most of California, except in deserts, during migrations and in winter. Nesting sites are typically on ledges of large cliff faces, but some pairs are nesting on city buildings and bridges. Nesting and wintering habitats are varied, including wetlands, woodlands, other forested habitats, cities, agricultural areas and coastal habitats (CDFG 2002).

American peregrine falcons nest on protected ledges of high cliffs, primarily in woodland, forest, and coastal habitats (CDFG 1980, USFWS 1982). They have been known to nest at elevations as high as 10,000 feet, but most occupied nest sites are below 4,000 feet (Shimamoto and Airola 1981). Falcons prefer to nest near marshes, lakes, and rivers that support an abundance of birds, but they may travel several miles from their nesting grounds to forage on pigeons, shorebirds, waterfowl, and songbirds (Grinnell and Miller 1944, CDFG 1980). Coastal and inland marsh habitats are especially important in fall and winter, when they attract large concentrations of water birds (CDFG 1980). The peregrine falcon breeds near wetlands, lakes, rivers, or other water on high cliffs, banks, dunes, mounds (Polite 1988-1990).

Peregrine falcons feed primarily on other birds, such as songbirds, shorebirds, ducks, and in urban areas, starlings and pigeons. Flying high above their intended prey, peregrines will "stoop" or dive and strike in mid-air, killing the prey with a sharp blow. Scientists estimate the speed of a diving peregrine to be more than 200 miles per hour (USFWS 1999).

Sexual maturity occurs at three years of age. Peregrine falcons usually nest in depressions on the edge of cliffs. These sites are known as aeries. Some aeries in Europe have been occupied for more than 300 years. Peregrine falcons may use nests built by eagles, hawks or other birds. Peregrine falcons have also nested on tall buildings. A clutch of 3 to 4 eggs is laid in April. Incubation lasts about 33 days with both adults partaking in incubating and feeding the young. Young birds can fly in 35 to 42 days (USGS).

Reasons for Decline. The widespread use of organochloride pesticides, especially DDT (dichlorodiphenyltrichloroethane), was a primary cause of the decline in peregrine falcon populations (USFWS 1982). High levels of these pesticides and their metabolites (byproducts of organic decompositions) have been found in the tissues of peregrine falcons, leading to thin eggshells, abhorrent reproductive behavior, and reproductive failure. Other causes of decline include illegal shooting, illegal falconry activities, and habitat destruction (CDFG 1980).

Designated Critical Habitat. None.

Conservation Efforts. The CDFG has been working with the California Peregrine Falcon Working Group and USFWS to develop and implement post-delisting monitoring guidelines (CDFG 2000).

Recovery Plan and Recovery Guidance. USFWS developed a recovery plan for the Pacific population of the peregrine falcon in 1982 (USFWS 1982). The objectives of the recovery plan are to re-establish a self-sustaining population in the Pacific region (California, Oregon, and Washington). A sustainable population was estimated to be 185 nesting pairs, with a minimum fledgling-success average of 1.5 per active pair. Of this minimum number of pairs required before consideration of delisting the species, 120 pairs are to be in California.

These objectives must be met through habitat and population management. Both essential breeding and nonbreeding habitats must be maintained and enhanced. Efforts must be made to maintain and increase the productivity of wild populations through prevention of human disturbances; identification and reduction of mortality factors; establishment of peregrine falcon pairs in suitable habitats; and manipulative management techniques, such as habitat modifications and rehabilitation of sick or injured birds (USFWS 1982).

Populations of peregrine falcons are now estimated at 1,650 breeding pairs in the U.S. and Canada, with additional birds in Mexico. In August 1999, the USFWS removed the American peregrine falcon from the list of endangered and threatened species, marking one of the most dramatic successes of the FESA (USFWS 1999).

Research and Monitoring Gaps. The role of falcons in ecological communities and the effect of falcon predation on other species of endangered birds is currently being studied by the USFWS and CDFG (CDFG 2000).

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BALD EAGLE (*Haliaeetus leucocephalus*)

Legal Status. The bald eagle is listed as endangered under the CESA and as fully protected under the California Fish and Game Code (CALFED 2000). The bald eagle is protected under the Federal Bald and Golden Eagle Protection Act. The bald eagle is listed as threatened under the FESA but was proposed for delisting in 1999 (CDFG 2003).

Historical and Current Distribution and Status. Historically, the bald eagle nested throughout California; however, the breeding distribution in 1992 was restricted primarily to the mountainous habitats in the northern quarter of the state, in the northern Sierra Nevada, Cascades, and northern Coast Ranges (California Department of Fish and Game 1992). Bald eagles winter at lakes, reservoirs, and along major river systems throughout most of central and northern California and in a few southern California localities. In 1992 species appeared to be increasing in most portions of the state (CDFG 1992). Today, most breeding territories are in northern California, but the eagles also nest in scattered locations in the central and southern Sierra Nevada mountains and foothills, in several locations from the central coast range to inland southern California, and on Santa Catalina Island (CDFG 2000).

Distribution in the CALFED Solution Area and EWA Area of Analysis. Bald eagles are resident in the North Sacramento Valley and Butte Basin Ecological Zones. They winter or are regular visitors in Cottonwood Creek, Colusa Basin, Yolo Basin, Feather River/Sutter Basin, American River Basin, Eastside Delta Tributaries, East San Joaquin Basin, West San Joaquin Basin, Sacramento-San Joaquin Delta, and Suisun Marsh/North San Francisco Bay Ecological Zones (CALFED 2000).

Life History and Habitat Requirements. Bald eagle nesting territories in California are found primarily in Ponderosa pine and mixed conifer forests. Bald eagle nest sites are always associated with a lake, river, or other large water body and are usually within one mile of water (CALFED 2000). Nests are usually constructed in a tree that provides an unobstructed view of the water body and that is almost always the dominant or co-dominant tree in the surrounding stand. Snags and dead-topped live trees are important habitat components in a bald eagle nesting territory, providing perch and roost sites. The species winters throughout most of California at lakes, reservoirs, river systems, and some rangelands and coastal wetlands (CDFG 2000).

In most of California, the breeding season lasts from about January through July or August. One or two eggs (occasionally three) are laid in late winter or early spring, and incubation lasts about 35 days. Chicks fledge when they are 11 or 12 weeks old. In a matter of weeks after leaving the nest, many of the still naive young birds suddenly strike out on their own and rapidly migrate hundreds of miles to the north. In these post-nesting dispersal areas, the young birds join other bald eagles to feed on salmon and other plentiful food. Telemetry studies show that some of these young birds reach northern and western Canada before returning to California a few months later. California's resident breeding pairs remain in California during winter, typically in the vicinity of their nesting areas, except when winter conditions are too severe and they must move to lower elevations (CDFG 2000). Sometimes only about half of these chicks will survive their first year because of disease, lack of food, bad weather, or human interference (Herron 1999).

Reasons for Decline. Early declines in bald eagle populations have been attributed to human persecution and destruction of riparian, wetland, and coniferous forest habitats. The most important factor that contributed to the decline of bald eagle populations, however, was a reduction in reproductive success resulting from eggshell thinning caused by DDE (dichloro-diphenyl-dichloroethylene), a metabolite of the agricultural pesticide DDT.

Designated Critical Habitat. None.

Conservation Efforts. The CDFG coordinates statewide and interagency breeding surveys to monitor the status of the bald eagle. This species has recovered as a result of extensive conservation efforts (CDFG 2000). Measures under the CALFED Bay-Delta Program are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. USFWS developed a recovery plan for the Pacific population of bald eagles in 1986 (CALFED 2000). The status of the breeding population was considered the most important criterion for delisting the population. Numerical goals for wintering populations were not established in the recovery plan because of annual fluctuations in migration patterns and habitat use. Wintering habitat must be managed, however, to support existing populations and allow for the proposed increase in the bald eagle population.

Delisting would be considered on a regional basis if four criteria were met: (1) a minimum of 800 pairs nested in the seven-state Pacific recovery area; (2) the nesting pairs produced an average of at least one fledged young per pair, with an average success rate per occupied site of no less than 65 percent over a 5-year period; (3) population recovery goals were being met in at least 80 percent of the management zone with nesting potential; and (4) there was no persistent long-term decline in any sizable wintering population (greater than 100 birds).

Research and Monitoring Gaps. Research and monitoring gaps for this species have not been identified.

Bald Eagle Citations

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BANK SWALLOW (*Riparia riparia*)

Legal Status. The bank swallow is listed as threatened under the CESA and is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003).

Historical and Current Distribution and Status. The bank swallow historically occurred along the larger lowland rivers throughout California, with the exception of southern California, where the species occurred principally along the coast and at the mouths of large rivers such as the Los Angeles River (Humphrey and Garrison 1987, Laymon et al. 1988). This species has now been extirpated from southern California and its range has been reduce by 50 percent since 1900 (Laymon et al. 1988, California Department of Fish and Game 1997).

The bank swallow is currently confined to the Sacramento River above the town of Colusa and other scattered colonies in northern California. During a survey conducted in 1987, 111 colonies were located statewide and the statewide population was estimated at 18,800 pairs, about 70 percent of which occurred along the Sacramento River (Laymon et al. 1988, CDFG 1993). The last stronghold for the bank swallow is along the banks of the Sacramento River (CDFG 1992) and its major tributaries (Humphrey and Garrison 1987). The current population estimate of 4,990 nesting pairs, based on annual CDFG monitoring surveys, indicates a population decline of about 73 percent since 1987.

Distribution in the CALFED Solution Area and EWA Area of Analysis. The bank swallow breeds principally along the Sacramento River; smaller populations may occur along the San Joaquin River, North Sacramento Valley, Feather River/Sutter Basin, Eastside Delta Tributaries, Butte Basin, Yolo Basin, and American River Basin Ecological Zones (however, monitoring has focused on the Sacramento River since 1988 and relatively little population information exists for other parts of the known or historical range of the species). This species also occurs as a migrant in all ecological zones.

Life History and Habitat Requirements. The bank swallow is a migrant that breeds primarily in the Central Valley of California and winters in South America. It arrives in California in mid-March, with bird numbers peaking in May (Humphrey and

Garrison 1987, Laymon et al. 1988). The bank swallow requires bluffs or banks with soft sand and sandy loam soil primarily adjacent to still or running water. The species constructs burrows of 2-3 feet deep into the nearly vertical eroding banks where it chooses to establish nesting colonies. Nests are lined with grasses, other plant material, and feathers (Green 1990). The bank swallow breeds and lays a clutch of 4-5 eggs in April; the young hatch in May, and 2-3 young are fledged by July each year in a single breeding attempt. The adults and young of the year remain along the riverbanks until they migrate in fall.

Most nesting colonies in the state are along the Sacramento River, where colonies averaging about 250-410 burrows each have been documented since 1986 (Humphrey and Garrison, Laymon et al. 1987, CDFG monitoring files). Gravel extraction sites, such as those along Cache Creek in Yolo County, are sometimes used for nesting. Sacramento River colonies have ranged from 78 in 1987 to the current total of 42.

The bank swallow forages by hawking insects during long, gliding flights. It feeds primarily over grassland, shrub land, savannah, and open riparian areas during breeding season and over grassland, brush land, wetlands, and cropland during migration. Bank swallows feed on a wide variety of aerial and terrestrial soft-bodied insects including flies, bees, and beetles (Green 1990).

Reasons for Decline. The bank swallow has been eliminated from southern California because almost every river and natural waterway has been converted into flood control channels. Elsewhere in California, rip-rapping of natural riverbanks and flood control projects have been the major causes for the decline of this species (CDFG 1997).

Designated Critical Habitat. None.

Conservation Efforts. The CDFG has mitigated habitat loss through natural habitat improvements and artificial bank creation. They have also developed a state recovery plan for this species (CDFG 2000). Measures under the CALFED Bay-Delta Program are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plans and Recovery Guidance. A State Recovery Plan was prepared and adopted by the Department of Fish and Game in 1992 but has yet to be implemented. The Recovery Plan identifies habitat preserves and a return to a natural, meandering riverine ecosystem as the two primary strategies for recovering the bank swallow. A recovery planning team has also been established and has had periodic meetings since 1990. The group discusses bank swallow research and recovery issues. The group cited the return to naturally functioning riparian ecosystems as the best way to preserve, recover, and conserve the many species, including the bank swallow, that are dependent on this unique ecosystem (CDFG 2000).

Research and Monitoring Gaps. Monitoring programs will be important to assess bank swallow abundance following implementation of restoration recommendations in the recovery plan.

Bank Swallow Citations

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BEWICK'S WREN (*Thryomanes bewickii*)

Legal Status. Bewick's wren is listed as a Bird of Conservation Concern (USFWS 2002) and a Migratory Nongame Bird of Management Concern (USFWS 1995). This species is not listed under the CESA or FESA.

Historical and Current Distribution and Status. Bewick's wren is a widely distributed species with breeding and wintering ranges that stretch from southern

Canada to Mexico (NatureServe Explorer 2002). Wrens are typically year-round residents in California, but populations may migrate from the north or higher elevations to southern and downslope areas during the winter (Dobkin 1990).

Populations of Bewick's wren in the central, eastern, and northwestern parts of its range have been steeply declining for some time and this species is on the verge of extirpation in the eastern U.S. (NatureServe Explorer 2002). A decline of at least 6 percent has recently been noted for populations in important foothill habitat areas of California and Washington, but the extent of or reasons for the declines have yet to be researched (NatureServe 2002).

Distribution in the CALFED Solution Area and EWA Area of Analysis. The Bewick's Wren breeds and winters in all 14 ecological zones and throughout the EWA Area of Analysis.

Life History and Habitat Requirements. Bewick's wrens are typically found in mixed and montane chaparral and pinyon-juniper habitats, but may move into riparian habitats, woodland borders or coniferous forests with brushy understory (Dobkin 1990). Their main diet consists of insects, such as beetles, stinkbugs, boll weevils, spiders, and grasshoppers. These wrens forage diurnally in dense, shrubby vegetation within 1.3 meters of the ground, typically searching and gleaning prey in the lower limbs and branches of small trees in chaparral, pinyon-juniper, live oak and mesquite habitats (Dobkin 1990). Common predators of wrens are hawks, owls, roadrunners and rattlesnakes (NatureServe Explorer 2002).

Bewick's wrens compete with other species (e.g., House wrens, Plain titmice) for nesting sites in ground cavities, snags, rock crevices, human made structures, and other cavities. Reproduction occurs from mid-February to early August with peaks from Mid-May to late June. Clutch sizes for this species are typically 5 to 7, and young leave the nest 14 days after hatching. Parents tend to feed their young for two weeks after they leave the nest. The approximate lifespan of Bewick's Wren is 8 months (Klimkiewicz 2002).

Reasons for Decline. The factors causing declines of Bewick's wren are poorly known, but this species may be negatively affected by suburbanization, forest regrowth, nest parasitism, interspecific competition, and harsh winters. Island subspecies have been extirpated by habitat destruction caused by introduced livestock (NatureServe Explorer 2002).

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species. NatureServe Explorer (2002) discusses conservation and restoration issues for this species. Conservation measures could include protecting and managing open scrub woodlands, implementing an experimental nest box program, and monitoring populations.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. The factors causing population declines of wrens in North America remain unexplained (NatureServe Explorer 2002). Studying the current abundance, distribution, and reproductive success throughout the range is critical. Interactions with potential competitors and sources of predation are also important areas for research.

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DOUBLE-CRESTED CORMORANT (*Phalacrocorax auritus*)

Legal Status. The double-crested cormorant is designated as a Species of Special Concern by the CDFG. This species is not listed under the CESA or FESA (CDFG 2003).

Historic and Current Distribution and Status. The breeding range of the double-crested cormorant stretches from Canada to Belize. The breeding range in North America has expanded in recent years (Johnsgard 1993). Non-breeding populations can also be found from Canada to Belize primarily along the east and west coasts.

The double-crested cormorant is a yearlong resident of California. August to May, double-crested cormorants are fairly common to locally very common along the coast and in estuaries and salt ponds; uncommon in marine subtidal habitats from San Luis Obispo Co. south, and very rare to the north. In the same season, they are fairly common at the Salton Sea and Colorado River reservoirs, and rare to fairly common in lacustrine and riverine habitats of the Central Valley and coastal slope lowlands

(Granholm 1990). Cormorants are more common from fall to spring in the Central Valley than during summer months (Remsen 1978). While historic nesting grounds existed in the Sacramento and San Joaquin Valleys the double-crested cormorant is not able to breed in these areas today. Coastal populations in southern California have declined significantly. The shores of the Salton Sea also once provided nesting opportunities but these areas are currently not used for breeding.

Distribution in the CALFED Solution Area and EWA Area of Analysis. The double-crested cormorant occurs in the Colusa Basin, Yolo Basin, Sacramento-San Joaquin Delta, and Suisun Marsh/North San Francisco Bay Ecological Zones. It also winters in the North Sacramento Valley, Cottonwood Creek, Butte Basin, Feather River/Sutter Basin, American River Basin, Eastside Delta Tributaries, East San Joaquin Basin, and West San Joaquin Basin Ecological Zones.

Life History and Habitat Requirements. The double-crested cormorant is the only one of the three species of cormorants (that occur in California) that can be regularly found in freshwater habitats (Cogswell 1977). The double-crested cormorant commonly inhabits lakes, ponds, rivers, lagoons, swamps, coastal bays, marine islands, and seacoasts; usually within sight of land. It nests on the ground or in trees in freshwater situations, and on coastal cliffs (usually high sloping areas with good visibility) (NatureServe Explorer 2001).

The species' breeding period is from April to July, but it may breed considerably earlier in southern rookeries. Cormorants nest in large colonies of up to several hundred pairs (Zeiner et al. 1990). Nesting sites are often in secluded areas because this species is particularly sensitive to human disturbance (Remsen 1978). They require undisturbed nest-sites beside water, on islands or mainland. They use wide rock ledges on cliffs; rugged slopes; and live or dead trees, especially tall ones (Granholm 1990). Clutch size is usually one to seven (average typically three or four). Incubation is 24-33 days (average around 28-30), by both sexes in turn. Hatching success was 54-75 percent in three studies. Survival from hatching to fledging was 72-95 percent in two studies. First flight to water takes place at about 35-42 days. They are independent at about 9-10 weeks. Usually they first breed at three years, sometimes at two years, rarely at one year (NatureServe Explorer 2001).

The double-crested cormorant feeds mainly on fish (Cogswell 1977); also on crustaceans and amphibians. They dive from the water surface and pursue prey underwater, usually remaining submerged for about 30 sec. They prefer water less than 9 m (30 ft) deep with rocky or gravel bottom, but may catch fish as deep as 22 m (72 ft). Sometimes they feed cooperatively in flocks of up to 600, often with pelicans (Granholm 1990). Suitable nest-sites must be within 8-16 km (5-10 mi) of a dependable food supply (Palmer 1962).

Reasons for Decline. Pesticides, especially DDT, caused the reproductive failure of many nests. Loss of nesting habitat and disturbance from humans has been the main cause of inland population declines. El Nino events can also cause widespread population declines by reducing prey. Over harvest by hunters may also have contributed to the species decline earlier in this century.

Designated Critical Habitat. None.

Conservation Efforts. Measures under CALFED are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. The CDFG Habitat Conservation Planning Branch recommends the following steps to recovery for the double-crested cormorant: (1) maintain ban on the use of persistent pesticides; (2) eliminate boating and other human disturbance in vicinity of nesting colonies during the breeding season; and (3) maintain habitat integrity at inland breeding areas, with particular attention to maintaining a constant water level in reservoirs (Granholm 1990).

Research and Monitoring Gaps. Additional information is needed to understand the potential competition for food and nest sites between the cormorant and other threatened species (NatureServe Explorer 2002).

Double-Crested Cormorant Citations

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FERRUGINOUS HAWK (*Buteo regalis*)

Legal Status. The ferruginous hawk is listed as a CSC (CDFG 2002), a Migratory Nongame Bird of Management Concern (USFWS 1995), a Bird of Conservation Concern (USFWS 2002), a BLM Sensitive Species (CDFG 2003), and a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). This species is also listed on the Audubon Watchlist (CDFG 2003). This species is considered a Federal Species of Concern (formerly a species under consideration for listing), but is not listed under the CESA (CDFG 2003).

Historical and Current Distribution and Status. The distribution of the ferruginous hawk includes wintering habitat in the southwestern U.S. stretching from northern California south to Baja California, east through southwestern Nevada, southern Utah, Arizona, and New Mexico to central Kansas, and south to northern Mexico; and breeding habitat stretching from southern Canada (Alberta, Saskatchewan, Manitoba) to northern Arizona and New Mexico (Brown 1997, NatureServe Explorer 2002). In California, ferruginous hawks can be found throughout the state during the winter months, except for the extreme northeastern and northwestern corners (Brown 1997); they have been recorded from every California county during Christmas Bird Counts (Hunting 2000). These hawks are most common in the state in the grasslands of southwestern California and are uncommon migrants and winter residents in the grasslands of the Modoc Plateau, Central Valley and Coast Ranges. Ferruginous hawks typically reside in California from August to mid-April and leave to breed in Oregon and Canada during the spring and summer months (Brown 1997, Dechant et al. 1999). The ferruginous hawk generally does not breed in California, however, it has recently been recorded breeding in California (NatureServe Explorer 2002).

Abundance and distribution data on the ferruginous hawk outside California suggest that this species may be declining in certain locations, while showing slight population increases in other areas (Brown 1997, NatureServe Explorer 2002). Distribution of the ferruginous hawk in California has probably changed little from historical times, except for some local extirpation from the southern California coastal plain and valleys due to habitat loss. For example, suitable grassland habitat in the San Joaquin valley has decreased considerably as a result of conversion to agricultural and urban land uses (Hunting 2000). Current wintering abundance of ferruginous hawks in California could be between 400 to 500 individuals, and the population trends appear stable to increasing despite habitat loss. However, abundance data is based largely on the Christmas Bird Count, which may include survey biases, such as increased raptor survey effort (Hunting 2000).

Distribution in the CALFED Solution Area and EWA Area of Analysis. The ferruginous hawk winters in all 14 ecological zones and throughout the EWA Area of Analysis except for the northern most counties such as Shasta and Tehama.

Life History and Habitat Requirements. Ferruginous hawks can be seen visiting open grasslands, sagebrush flats, desert scrub, hayland, cropland, shrubsteppe, low foothills and edges of pinyon-juniper habitats. They generally prefer open grassland communities and avoid high elevations, narrow canyons, and interior regions of forests (Brown 1997). Their diet consists of lagomorphs (rabbits and hares), pocket gophers, prairie dogs, ground squirrels, mice, insects, birds, reptiles and amphibians (Polite and Pratt 1990, Brown 1997, NatureServe Explorer 2002). Hawks hunt their prey during the day from perches or glide close to the ground in open, treeless area such as cropland or rangeland (Polite and Pratt 1990). Communal roosting of up to 24 individuals has been observed in some wintering areas and communal hunting has also been recorded (Brown 1997). The density and productivity of the ferruginous hawk are thought to be correlated with prey abundance cycles (NatureServe Explorer 2002).

Ferruginous hawks build their nests in exposed or remote trees and large shrubs, cliffs, utility poles, artificial platforms, ground outcrops, roofs of abandoned buildings, and river cutbanks, ranging from 0 to 25 m above the ground (Hunting 2000). Nests are constructed of 1-inch long sticks, twigs, litter, and dried manure (Polite and Pratt 1990). Territory, nestsite, and mate fidelity are common for ferruginous hawks (Dechant et al. 1999). Egg-laying begins in April, with a clutch size of 2 to 6 eggs. Incubation takes about 28 days and the young fledge at 38 to 50 days (Polite and Pratt 1990). Young hawks in tree nests may be preyed upon by eagles and owls, while young in ground nests may be preyed upon by badgers, foxes, and coyotes (Polite and Pratt 1990, Hunting 2000). These hawks are very sensitive to disturbance, especially during incubation and when prey is scarce (Dechant et al. 1999, Hunting 2000). The ferruginous hawk defends nesting territories, competes with other diurnal predators of small mammals, and tends to displace red-tailed and Swainson’s hawks (Polite and Pratt 1990, Hunting 2000). The life span of a ferruginous hawk is approximately 18 years and reproductive age is 2 years (Brown 1997, Klimkiewicz 2002).

Reasons for Decline. The ferruginous hawk is declining in some areas of its range, but the specific factors causing the decline are poorly understood (Hunting 2000). The loss and degradation of grassland habitat and reductions in the prey base by factors such as conversion to agriculture, urbanization, forest invasion, and invasive exotic annuals, are implicated as the major long-term threats to this species (NatureServe Explorer 2002). Shooting, poisoning small mammals, and mining are also potential threats to this species and its habitat (Brown 1997).

Designated Critical Habitat. None.

Conservation Efforts. The California Partners in Flight program (Allen and Pitkin 2000) has prepared a Draft Grassland Bird Conservation Plan that describes grasslands in the Central Valley and focuses on seven focal grassland bird species (including ferruginous hawk). This plan outlines the need to collect more information about the basic biology of these species to help design conservation recommendations. Dechant et al. (1999) and NatureServe Explorer (2002) provide management suggestions for the conservation of ferruginous hawks and their habitat.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. The current distribution, abundance, and wintering ecology of the ferruginous hawk in California is not well known (Hunting 2000). Studying winter habitat requirements, winter range, site fidelity, population limiting factors, foraging ecology, territory size, communal roost areas, and relationship with lagomorph abundance would help elucidate the ecology of this species in California (Hunting 2000). Monitoring communal roosting areas and surveying unfragmented grasslands and desertlands would also provide abundance and population trend data.

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GOLDEN EAGLE (*Aquila chrysaetos)*

Legal Status. The golden eagle is designated as a species of special concern by the CDFG, and is a fully protected species under the California Fish and Game Code and Federal Bald and Golden Eagle Protection Act (CDFG 2003).

Historical and Current Distribution and Status. The golden eagle has historically and is currently found throughout most of western North America (Udvardy 1998). The golden eagle is a permanent resident throughout California, except in the center of the Central Valley, although it winters in this area (Zeiner et al. 1990). Golden eagle populations have declined near human population centers but, overall, its population appears stable (Remsen 1978).

Distribution in the CALFED Solution Area and EWA Area of Analysis. The golden eagle nests in the Cottonwood Creek, North Sacramento Valley, Feather River/Sutter Basin, Eastside Delta Tributaries, West San Joaquin Basin, and Suisun Marsh/North

San Francisco Bay Ecological Zones. It could also nest in the Butte Basin, American River Basin, and East San Joaquin Basin Ecological Zones. This eagle winters in all of the ecological zones.

Life History and Habitat Requirements. The golden eagle generally inhabits open country, in prairies, arctic and alpine tundra, open wooded country, and barren areas, especially in hilly or mountainous regions (NatureServe Explorer 2001). This species avoids dense coastal and mountain coniferous forests (Small 1994). Golden eagles do not migrate, with the exception that some of the northernmost populations withdraw southward for winter, then return to northern breeding areas in March-April. The golden eagle tends to vacate hot deserts during summer.

The golden eagle breeds from late January through August, peaking from March though July. This eagle nests on cliffs and in large trees, primarily oaks in California, near open areas. Golden eagles often maintain alternative nest sites and old nests are frequently reused (Zeiner et al. 1990). Nests are built from sticks and range from three to eight feet across. A golden eagle typically lays 1-3 eggs, usually two. Siblicide is widely known in this species and more common among golden eagles than bald eagles. Generally, the larger eaglet will attack the smaller one eventually causing its death. This usually occurs when the young are under three weeks of age. The parents make no attempt to distribute food equally among the brood nor do they interfere when one nestling acts aggressively toward another. Eaglets are about 65 days old when they make their first flight.

The golden eagle needs open areas for hunting. Its diet consists mostly of lagomorphs and rodents, but also includes other mammals, reptiles, birds, and some carrion (Zeiner et al. 1990). They may also eat insects and juvenile ungulates. They rarely attack large, healthy mammals (e.g., pigs, sheep, deer) (Terres 1980). A positive correlation between breeding success and jackrabbit number was reported in Idaho, Colorado, and Utah.

Reasons for Decline. This species has declined near human population centers (Remsen 1978). The loss and alteration of grasslands, shooting, and human disturbance at nest sites have contributed to the decline of the species (Remsen 1978). The golden eagle is also extremely susceptible to power line electrocution because wings can span phase-to-phase or phase-to-ground wires (Biosystems Analysis 1989); modifications have been made in problem areas. Other threats include poison intended for coyotes and habitat loss to agriculture and suburban land uses.

Designated Critical Habitat. None.

Conservation Efforts. Measures under CALFED are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Disturbance by humans during the breeding season was found to be a major source of nest failure in other western states (Remsen 1978). Identifying possible sources of human disturbance around eagle nesting sites would help pinpoint human threats to populations.

Golden Eagle Citations

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LARK SPARROW (*Chondestes grammacus*)

Legal Status. The lark sparrow is listed as a California Special Animal (CDFG 2003) and a Migratory Nongame Bird of Management Concern (USFWS 1995). This species is considered a Federal Species of Concern (formerly a species under consideration for listing), but is not listed under the CESA (CDFG 2003).

Historical and Current Distribution and Status. The lark sparrow is a widely distributed species with breeding and wintering ranges that stretch from southern Canada to Mexico. This species is a long-range migrant, moving from breeding areas in Canada and most of the U.S. to wintering areas in the southwestern U.S. and Mexico (NatureServe Explorer 2002). Yearlong resident populations occur in Oregon, California, Idaho, Arizona, New Mexico, Texas, Baja California, and Mexico. In California, lark sparrows are typically present year round in lowland and foothill habitat, although they migrate from northern areas to southern deserts to breed (Granholm 1990). They are most common around the edge of the Central Valley in oak woodland habitats (Granholm 1990). Populations of lark sparrows throughout its range have declined 62 percent from 1966 to 1999 (NatureServe Explorer 2002).

Distribution in the CALFED Solution Area and EWA Area of Analysis. The California Partners in Flight program has mapped two confirmed breeding areas for this species in the Bay-Delta bioregion and many confirmed and possible breeding areas in the Sacramento Valley bioregion (CalPIF 2001).

Life History and Habitat Requirements. Lark sparrows inhabit a variety of foothills habitats including sparse valley foothill hardwood, valley foothill hardwood-conifer, open mixed chaparral, and brushy habitats with sparse trees and shrubs (Granholm 1990). Other habitats include shortgrass, mixed-grass, and tallgrass prairie, parkland, sandhills, old fields, cultivated fields, and riparian areas (NatureServe Explorer 2002). The diet of lark sparrows consists of seeds, grains, and insects (e.g., grasshoppers), recovered from plants and ground litter. Plant foods predominate their diet in the fall and winter (NatureServe Explorer 2002). This species is gregarious, and may feed in flocks even during the breeding season. Sparrows seek cover and lookout perches among trees, small shrubs, fence posts, and large rocks (Granholm 1990).

The breeding season of the lark sparrow begins in April. Nests are generally built on the ground near the base of a shrub or grass tussock, in shrubs less than 2 meters from the ground, or occasionally in cliff crevices. Clutches are usually 3 to 6 eggs and young leave nest around 9 to 10 days. The life span of a lark sparrow is approximately 8 years (Klimkiewicz 2002).

Reasons for Decline. Populations are threatened by brood parasitism and use of pesticides for grasshopper and tick control (NatureServe Explorer 2002).

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species. NatureServe Explorer (2002) discusses conservation and restoration issues for this species. Conservation measures could include protecting and managing suitable open grassland habitat and avoiding land management activities during the breeding season.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. The current abundance and distribution of the lark sparrow in California is not well known and warrants study. Identifying possible causes for decline is important for the conservation of this species.

Lark Sparrow Citations

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LOGGERHEAD SHRIKE (*Lanius ludovicianus*)

Legal Status. The loggerhead shrike is listed as a CSC (CDFG 2002), a California Special Animal (CDFG 2003), a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003), a Bird of Conservation Concern (USFWS 2002), and a Migratory Nongame Bird of Management Concern (USFWS 1995). This species is considered a Federal Species of Concern (formerly a species under consideration for listing), but is not listed under the CESA (CDFG 2003). The subspecies *L.I. mearnsi*, of San Clemente is listed as a Federal Endangered Species (NatureServe Explorer 2002).

Historical and Current Distribution and Status. The loggerhead shrike frequents lowlands and foothills throughout California in the winter and often remains throughout the year. Shrike populations between the Great Basin and Inyo County depart from the area November through March. During the winter, this species is more widespread than during the breeding season (Granholm 1990). The shrike may also be found breeding in eastern Washington, Oregon, across southern Canada and in several southern states. During the non-breeding season this species is found in central Washington, eastern Oregon, California, southern Nevada, northern Arizona, northern New Mexico, and other southern areas such as the Gulf Coast, southern Florida and Mexico. (NatureServe Explorer 2002).

Loggerhead shrike populations have remained consistent in the Pacific states (Granholm 1990). Populations across North America have declined since the 1960's, particularly in the northeastern and north central regions. Current suitable habitat for shrikes remain unoccupied, therefore the decline remains unexplained, however some possible reasons include pesticides, loss of wintering habitat quality and reforestation (NatureServe Explorer 2002).

Distribution in the CALFED Solution Area and EWA Area of Analysis. The Loggerhead Shrike occurs in all 14 ecological zones and throughout the EWA Area of Analysis.

Life History and Habitat Requirements Most loggerhead shrikes are found in open-canopied valley foothill hardwood, valley foothill hardwood-conifer, valley foothill riparian, pinyon-juniper, juniper, desert riparian, and Joshua tree habitats. Shrikes can be found in open areas with scattered shrubs, trees, posts, and utility lines, preferring perches on barbed wire fences or thorny plants suitable for impaling their prey. Shrikes commonly feed on large insects (e.g., beetles), invertebrates, small birds, mammals, amphibians, reptiles, fish, and carrion; usually foraging over areas of shorter vegetation.

Shrikes prefer to nest in shortgrass pastures with slight woodland cover and build their nests in tree crotches about 1.5 to 3 meters from the ground. In California, the breeding season generally extends from March into May, with the young leaving the nest after 18 to 19 days, and becoming independent in July or August. Eggs are laid at an interval of one per day, and clutch size averages 4 to 6 eggs.

Reasons for Decline. The reasons for decline of loggerhead shrikes are still somewhat unknown, although it is predicted that populations are threatened by pesticides, loss of habitat, and predation.

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Shrike population declines in North America still remain unexplained. Critical habitat features also need to be identified so recovery plans can be implemented.

Loggerhead Shrike Citations

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LONG-EARED OWL (*Asio otus*)

Legal Status. The long-eared owl is designated as a species of special concern by the CDFG. This species is not listed under the CESA or FESA (CDFG 2003).

Historical and Current Distribution and Status. The long-eared owl breeds from southern and eastern British Columbia to northern Saskatchewan and Prince Edward Island, south to northwestern Baja California, southern New Mexico, northern Mexico, Arkansas, and Virginia. This species of owl winters from southern Canada to northern Baja California, central Mexico, and Gulf Coast.

The long-eared owl was once a common resident throughout California. Numbers have been declining since the 1940's, most severely in the Sacramento Valley, San

Joaquin Valley, and the San Diego area (Remsen 1978). The species is an uncommon breeder in the northeastern part of the state, in the Owens Valley, and the foothills east of the Central Valley. The long-eared owl winters in the Central Valley from Tehama County to Kern County (Zeiner et al. 1990).

Distribution in the CALFED Solution Area and EWA Area of Analysis. The long-eared owl is a year-round resident in the Suisun Marsh/North San Francisco Bay Ecological Zone. This owl occurs as a breeding species in the foothills of the Butte Basin, Feather River/Sutter Basin, American River Basin, Eastside Delta Tributaries, and East San Joaquin Basin Ecological Zones. The long-eared owl winters in the Butte Basin, Feather River/Sutter Basin, American River Basin, Cottonwood Creek, Colusa Basin, Yolo Basin, Sacramento River, Eastside Delta Tributaries, Sacramento-San Joaquin Delta, West San Joaquin Basin, and East San Joaquin Basin Ecological Zones.

Life History and Habitat Requirements. Long-eared owls occur in riparian habitats as well as oak thickets and conifer forests at higher elevations (Zeiner et al. 1990). This species is also found in deciduous and evergreen forests, orchards, wooded parks, farm woodlots, river woods, and desert oases. Dense tree stands near open areas are required for hunting, and wooded areas with dense vegetation are needed for roosting and nesting (Small 1994). Nesting sites are usually old nests of crows, squirrels, hawks, magpies, or herons; sometimes in a tree cavity; rarely on the ground (Maples et al. 1995). The long-eared owl nests mainly from mid-March to mid-May in many areas and has a breeding season from early March to late July (Zeiner et al. 1990). High rodent numbers are essential for nesting success.

The long-eared owl is an opportunistic feeder that primarily feeds on small mammals. Voles, other rodents, shrews, and birds make up the majority of the long-eared owl's diet. Hunting areas vary with locality but the long-eared owl typically forages in open grassy area, e.g., marsh, old field, but may forage in forest in some areas (NatureServe Explorer 2001).

Reasons for Decline. Loss and fragmentation of riparian and oak woodlands have been major causes for the decline of this species (Zeiner et al. 1990). Harassment, shootings, and collision with cars can also have negative effects on local populations (Remsen 1978).

Designated Critical Habitat. None.

Conservation Efforts. Measures under CALFED ram are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Additional information is needed to identify the factors leading to population declines.

Long-eared Owl Citations

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MERLIN (*Falco columbarius*)

Legal Status. The merlin is listed as a CSC and California Special Animal (CDFG 2002, 2003). This falcon is not listed under FESA or CESA.

Historical and Current Distribution and Status. The merlin is a widely distributed species. The merlin's breeding range is from northern treeline in North America and Eurasia to Oregon, Idaho, South Dakota, New York, Maine, Nova Scotia, British Isles, and Russia. The wintering range is from southern British Columbia to Venzuela and Peru, as well as northern Africa and China (NatureServe Explorer 2002). In California, merlins can be present in the western half of the state, mostly concentrated along the coast and in the Central Valley (Polite 1990, CDFG 2002). This species does not breed in California and is an uncommon winter migrant from September to May (Polite 1990).

Merlin populations throughout the range declined drastically from the 1950's to 1970's mainly as a result of reproductive failure following pesticide use (NatureServe Explorer 2002). The merlin used to be a common winter visitor in California, but in the 1970s there were only 6 to 10 birds in southern California and 20 to 30 birds in northern California (CDFG 2002). The current abundance of this species in California is not known. Merlin populations outside California have shown increases in abundance in recent decades (NatureServe Explorer 2002).

Distribution in the CALFED Solution Area and EWA Area of Analysis. The Merlin winters in 14 ecological zones and throughout the EWA Area of Analysis.

Life History and Habitat Requirements. Merlins hunt around a wide variety of habitats below elevations of 1500 meters, including open grasslands, savannahs, woodlands, lakes, marshes, deserts, lagoons, and along coastlines. They generally prefer open habitats at low elevation near both water and tree stands, such as lakeshores, coastlines, and wetlands (NatureServe Explorer 2002). These falcons feed on small birds, shore birds, small mammals, reptiles, toads and insects (Polite 1990). Merlins hunt during the day by flying at a low level and striking prey with a short dive from above. While merlins are not interspecifically territorial, they are intolerant of and drive away other accipiters (Polite 1990).

Merlins rely on dense tree stands close to bodies of water during the breeding season (Polite 1990). Nests are usually constructed of sticks, built in a conifer tree close to the water; nests have also been observed in cavities, cliffs, or within a crow, magpie, hawk or squirrel nest (NatureServe Explorer 2002). Eggs are laid from late May into June. Clutch sizes are typically 3 to 5 eggs and chicks leave the nest after 24 days. However, the chicks continue to depend on the parents for another 25 to 35 days (Polite 1990). Young merlins feed on insects such as dragonflies while sharpening their predatory skills. The average lifespan of a merlin is 12 years (Klimliewicz 2002).

Reasons for Decline. The reasons for drastic declines of the merlin in California have not been identified. The merlin in Canada experienced massive reproductive failure in the 1970s as a result of DDE contamination combined with falconry pressures (CDFG 2002). Habitat loss throughout its range and continued use of organochlorine biocides in Central and South America are also threats to the merlin (NatureServe Explorer 2002).

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species. CDFG (2002) and NatureServe Explorer (2002) provide management suggestions for the conservation of merlins and their habitat.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. The current distribution, abundance, and wintering ecology of the merlin in California are not well known and require study (CDFG 2002).

Merlin Citations

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MOUNTAIN PLOVER (*Charadrius montanus*)

Legal Status. The mountain plover is designated as CSC and is proposed as threatened under the FESA (CDFG 2003).

Historical and Current Distribution and Status. The mountain plover is endemic to open, sparsely vegetated habitats in North America (CALFED 2000). The breeding range is the dry tablelands of the western Great Plains and the Colorado Plateau. The winter range extends from northern California (rarely) through southern California, southern Arizona, and central and coastal Texas to north-central Mexico (Cogswell 1977, Knopf 1996).

Mountain plovers do not breed in California, but approximately 70 percent of the continental population winters in the state. The major wintering areas in California are in the Sacramento, San Joaquin, and Imperial Valleys. Smaller numbers winter in the west Mojave Desert, San Jacinto Valley, Santa Maria Valley, Salinas Valley, the Carrizo Plain, Seal Beach, Tijuana River Valley, and the Lower Colorado River Valley.

In 1994, the North American population of the mountain plover was estimated to be 8,000-10,000 individuals. Small (1994) reported that numbers are declining in coastal California; in the interior, the species is declining and occurs only locally.

Distribution in the CALFED Solution Area and EWA Area of Analysis. This species winters in the Colusa Basin, Yolo Basin, East San Joaquin Basin, and West San Joaquin Basin Ecological Zones. It could also occur in the Sacramento-San Joaquin Delta Ecological Zone (CALFED 2000).

Life History and Habitat Requirements. Mountain plovers nest in relatively high elevation (2,000 to 8,500 feet) short-grass prairies and plains (CALFED 2000). Dense and tall cover is avoided during all seasons and, unlike most other plovers, mountain plovers are seldom found near water. The nest is a shallow depression in the ground, often lined with plant material. The clutch of (usually) three eggs is incubated for 28-31 days by both adults. The female may lay consecutive clutches in separate nests and each clutch is incubated by one of the adults. Breeding occurs in the Rocky Mountain States from Canada south to Mexico with most breeding birds occurring in Montana or Colorado.

After the breeding season (late March to early August), mountain plovers disperse across the southern and western Great Plains before migrating to their wintering areas. The migration of the species to and from California is more of an east-west movement than the typical north-south movement of migrating shorebirds in North America (CALFED 2000). In California, many of the preferred wintering sites are grazed by domestic livestock, or are within giant kangaroo rat precincts or California ground squirrel colonies (USFWS, 1999). Historically, the mountain plover has been reported from a variety of habitats during the wintering period, including grasslands and agricultural fields; however, more recently, mountain plovers are reported from natural, non-cultivated sites such as alkali sink scrub, valley sink scrub, alkali playa, and annual grasslands (USFWS, 1999)

In California, mountain plovers have been recorded rarely in late July, but most arrive in mid-October or later. Mid-November to early February is the period of peak abundance in California. Most birds are back on the breeding grounds by late March or early April (CALFED 2000).

Reasons for Decline. Threats to mountain plovers include natural predation, severe weather during the nesting/fledging period, direct persecution by humans, and loss and degradation of breeding and wintering habitat (Knopf 1996). Eggs and young preyed upon by ground squirrels, kit foxes, coyotes, badgers, skunks, and snakes. Adults are caught by raptors. Habitat degradation and destruction is the greatest threat to the species. In the early 1900's, large numbers of mountain plovers were reported in California on both grasslands and agricultural lands. At that time, California supported approximately 8,900,000 ha (22 million acres) of grasslands with about 20 percent occurring in the Central Valley (Moore et al 1990). Currently, grassland habitat has been nearly extirpated in the San Joaquin valley with less than 60,700 ha (150,000 acres) remaining. In the intervening period, conversion of grassland habitats to urban and agricultural uses proportionately exceeded conversion of any other habitat type (Ewing et al 1988, Moore et al 1990). As a consequence of this loss, native habitats used by the mountain plover have been reduced to less than four percent of their original abundance (CALPIF 2000).

Wintering mountain plovers in California are exposed to pesticides in agricultural fields, where they may spend up to 75 percent of the time, but there is no evidence that reproductive success or survival has been affected (Knopf 1996).

Designated Critical Habitat. None.

Conservation Efforts. Measures under CALFED are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Principle decline factors for the mountain plover include loss of habitat and indirect or direct effects of pesticide application (CalPIF 2001). Characterizing specific habitat needs would help ascertain key limiting factors for the distribution and abundance of this species. Additional studies on the effects of pesticide application are warranted.

Mountain Plover Citations

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NORTHERN HARRIER *(Circus cyaneus)*

Legal Status. The northern harrier is designated as a state species of special concern by the CDFG. This species is not listed under the CESA or FESA (CDFG 2003).

Historical and Current Distribution and Status. Northern harriers historically bred throughout California except in deserts, woodlands, and forested mountains. Breeding localities in California included the interior from Siskiyou County south to western Riverside and San Bernardino Counties and coastal regions from Marin County to San Diego County (Grinnell and Miller 1944).

Currently, two main populations of northern harriers exist: one at the Klamath Basin refuges and the other in the Sacramento-San Joaquin Delta. The breeding range of the northern harrier includes most of the Central Valley, Sacramento-San Joaquin Delta, Suisun Marsh, and portions of the San Francisco Bay (Zeiner et al. 1990).

Distribution in the CALFED Solution Area and EWA Area of Analysis. The northern harrier's breeding and wintering range includes the Butte Basin, Colusa Basin, Feather River/Sutter Basin, American River Basin, Yolo Basin, Eastside Delta Tributaries, Sacramento-San Joaquin Delta, San Joaquin River, West San Joaquin Basin, and Suisun Marsh/North San Francisco Bay Ecological Zones. Its range could also include the East San Joaquin Basin Ecological Zone.

Life History and Habitat Requirements. The northern harrier uses tall grasses and forbs in wetlands and field borders for cover (Zeiner et al. 1990). The species' breeding season is between April and September, with peak activity in June and July. It roosts on the ground in shrubby vegetation, often near the marsh edge (Brown and Amadon 1968). Nests are built of a large mound of sticks on wet areas, and a smaller cup of grasses on dry sites. Northern harriers mostly nest in emergent wetland or along rivers or lakes, but may also nest in grasslands, grain fields, or on sagebrush flats several miles from water. Harrier nests in upland fields are predominately surrounded by grasses, and forbs, and harrier nests in wet sites are surrounded by marsh grasses and cattails (CalPIF, 2000). The northern harrier feeds mainly on voles and other small mammals, birds, small reptiles, crustaceans, and insects. It also feeds on fish, although this is rare.

Northern harriers winter throughout California where suitable habitat is found. Wintering habitat includes fresh and saltwater wetlands, coastal dunes, grasslands, deserts, meadows, and croplands. Harriers are rarely found in forested areas (CalPIF, 2000).

Reasons for Decline. North American populations have declined during the 20th century, with the major causes being the extensive draining of wetlands, implementation of monoculture farming, and reforestation of open farmlands (MacWhirter and Bildstein 1996). White (1994) considers this species of variable, but possibly decreasing, trends in western North America, citing habitat alterations (particularly wetlands loss) as the most important cause of possible declines.

Designated Critical Habitat. None.

Conservation Efforts. Measures under CALFED are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Further study is needed to determine if survival and reproduction of the harrier differ between disturbed and natural habitats (CalPIFD 2000).

Northern Harrier Citations

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PRAIRIE FALCON (*Falco mexicanus*)

Legal Status. The prairie falcon is listed as a CSC (CDFG 2002), a Special Animal (CDFG 2003), and a Bird of Conservation Concern (USFWS 2002). This species is not listed under the CESA or FESA.

Historical and Current Distribution and Status. The breeding range of this species is from southern Canada, and northern North Dakota south to Baja California, southern areas of New Mexico, Arizona, northern and western areas of Texas, and Mexico. Non- breeding ranges are southern Canada, south to Baja California and central Mexico, although falcons are most common in the Great Basin and central and central-southern latitudes of the Great Plains (NatureServe Explorer 2002). In California this species will be found in southeastern desert areas northwest along the inner Coast Ranges and Sierra Nevada. Falcons are not typically found in the northern coastal fog belt or coastline (Polite 1990).

Pesticides have historically caused declines in falcon populations, specifically organochlorine contaminants and mercury. Current pesticide restrictions have allowed populations to recover, but populations that live near areas of heavy agricultural use still suffer from low reproduction (Tesky 1994). Falcons have also been negatively affected by declines in squirrel populations (NatureServe Explorer 2002). Surveys conducted around the perimeter of the Central Valley in 1969-1972 showed low reproduction rates due to high percentages of non-reproductive pairs, however populations appear to be recovering and nearing carrying capacity in California (Remsen 1978).

Distribution in the CALFED Solution Area and EWA Area of Analysis. The Prairie Falcon occurs in all 14 ecological zones and throughout the EWA Area of Analysis.

Life History and Habitat Requirements. Prairie falcons rely on large expanses of short vegetation, including annual grasslands, alpine meadows, savannahs, rangeland, desert scrub areas, and agricultural fields. Falcons catch their prey in midair, or dive from a high perch, feeding around sunrise and sunset hours on small mammals, insects, birds, reptiles, and amphibians. Specific prey in western shrubsteppe areas are jackrabbits but also include ground squirrels and pocket gophers (NatureServe Explorer 2002).

Nests are found in canyons, cliffs and rock outcrops with direct access to open fields for hunting and foraging. Falcons may also use old eagle, raven or hawk nests constructed of sticks (NatureServe Explorer 2002). Falcons breed from mid-February through mid-September with peaks from April to early August (Polite 1990). Clutch sizes tend to be 3 to 6 eggs and young become independent after 29 to 33 days. Falcons and their nestlings are preyed upon by hawks, eagles, owls, coyotes, and bobcats.

Reasons for Decline. Loss of breeding habitat for falcons is probably the most important cause of population decline. Populations are sensitive to human disturbance and will abandon nests if they feel threatened. Alteration of prey habitat by cultivation, water impoundments, or heavy grazing also affect populations. Despite pesticide regulations, agricultural chemicals still threaten species reproduction (Tesky 1994).

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species. CDFG (2002) and NatureServe Explorer (2002) provide management suggestions for the conservation of prairie falcons and their habitat.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Research and monitoring gaps for this species have not been identified.

Prairie Falcon Citations

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SHORT-EARED OWL (*Asio flammeus*)

Legal Status. The short-eared owl is designated as a species of special concern by the CDFG and as a migratory nongame bird of management concern by the USFWS. This species is not listed under the CESA or FESA (CDFG 2003).

Historical and Current Distribution and Status. The short-eared owl historically bred throughout California, west of the deserts (Grinnell and Miller 1944). This species has declined dramatically throughout the state. It is more numerous in winter, concentrating in areas with little snow cover and abundant prey, but even winter numbers have declined (Remsen 1978). Breeding populations have been extirpated from the southern coast and from the San Joaquin Valley (Remsen 1978). The species still breeds in the southern portion of the Sacramento Valley (Yolo and Solano Counties), the Sacramento-San Joaquin Delta, Suisun Marsh, northeastern portion of the state, in the Coast Ranges from Sonoma to Santa Barbara Counties, and in the Owens Valley (Small 1994, Zeiner et al. 1990).

Distribution in the CALFED Solution Area and EWA Area of Analysis. The short-eared owl breeds in the Suisun Marsh/North San Francisco Bay and Yolo Basin Ecological Zones but it could also breed in the Sacramento-San Joaquin Delta Ecological Zone. It winters in the Colusa Basin, Butte Basin, Feather River/Sutter

Basin, Yolo Basin, American River Basin, Eastside Delta Tributaries, Sacramento-San Joaquin Delta, East San Joaquin Basin, West San Joaquin Basin, and Suisun Marsh/North San Francisco Bay Ecological Zones.

Life History and Habitat Requirements. The short-eared owl is a migrating species and a resident in California (Zeiner et al. 1990). Short-eared owls are more numerous in winter, with migrating birds arriving in September and October and leaving in April (Zeiner et al. 1990). This owl requires dense vegetation for roosting and resting cover. Habitat types frequently mentioned as suitable include fresh and saltwater marshes, bogs, dunes, prairies, grassy plains, old fields, tundra, moorlands, river valleys, meadows, savanna, open woodland, and heathland (NatureServe Explorer 2001). Open, treeless areas containing elevated sites for perching are also needed. In general, any area that is large enough, has low vegetation with some dry upland for nesting, and that supports suitable prey may be considered potential breeding habitat. Nearby water may also be a requirement for nesting habitat (Nature Serve Explorer, 2001). Nests are built on the ground in tall stands of grasses in lowland habitats near hunting grounds in marshes, meadows, and even agricultural fields (Grinnell and Miller 1944). The breeding season is from late March to July (Zeiner et al. 1990).

The short-eared owl feeds primarily on voles and other small mammals, but also eats reptiles, amphibians, and arthropods. They frequently search in low, gliding flights, 1-6 m (3.3 to 20 ft) above the ground from which they swoop and pounce to capture prey. Short-eared owls also hunt from perches. The short-eared owl is commonly found in treeless areas, therefore often uses fence posts and small mounds as perches (CDFG 2002).

Reasons for Decline. The destruction of breeding and foraging habitat has been the primary cause for the decline of the short-eared owl. In many parts of their range declines are due to destruction and degradation of marshes, grasslands, and low-use pastures (NatureServe Explorer 2001). This may be a result of development, changing land-use patterns (e.g., farmlands to woodlands, or to development), changing farming practices (e.g., hay fields to row crops), reforestation, wetland loss, or a combination of these factors. Loss of open grasslands to later successional stages of community development reduces available hunting and breeding habitat. In areas where necessary habitats are still in tact, grazing and shooting have led to the further decline of this species (Remsen 1978).

As a ground-nesting bird, short-eared owl eggs and young may fall prey to various mammalian ground predators such as foxes, raccoons, and mustelids (NatureServe Explorer, 2001).

Designated Critical Habitat. None.

Conservation Efforts. Measures under CALFED are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. The current status and abundance of this species in California is not well known.

Short-eared Owl Citations

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SWAINSON'S HAWK (*Buteo swainsoni*)

Legal Status. The Swainson's hawk is listed as threatened under the CESA and is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003).

Historical and Current Distribution and Status. The Swainson's hawk's breeding range is from southwestern Canada to northern Mexico (Godfrey 1986, Semenchuk 1992, Howell and Webb 1995, Smith 1996, England et al. 1997). Nearly all North American populations of Swainson's hawks winter in South America and Mexico; however, some small populations regularly winter in southern Florida (Stevenson and Anderson 1994) and in the Sacramento-San Joaquin Delta of central California (Yee et al. 1991, Herzog 1996).

Historically, the Swainson's hawk's breeding range in California included the Great Basin; the Sacramento and San Joaquin Valleys; along the coast in Marin, Monterey, Ventura, Los Angeles, and San Diego Counties; along Catalina Island; and a few scattered sites in the Colorado and Mojave Deserts (Bloom 1980). Today, Swainson's hawks nest in some previously occupied regions of the state, but the number of breeding birds has been greatly reduced throughout major portions of the species' range and the species has been extirpated in coastal central and southern California (Bloom 1980, CDFG 1994). Approximately 30 birds have wintered in the Sacramento-San Joaquin Delta annually since 1991 and are the only confirmed regularly wintering population in California (Yee et al. 1991, Herzog 1996).

Bloom (1980) estimated that the breeding population of Swainson's hawks in California had declined by over 90 percent from historical times and estimated the current number at about 400 pairs statewide. A statewide survey conducted in 1988 found 320 active territories; approximately 241 were in the Central Valley and 78 were in the Great Basin in northeastern California (CDFG 1988). Additional surveys done in California during the 1990s indicate that the total statewide population estimate is 500-1,000 breeding pairs, with a likely average of about 700 pairs; 80 percent of which are in the Central Valley, with Yolo, San Joaquin, and Sacramento Counties being the most important nesting areas that remain in the state (CDFG 1994).

Distribution in the CALFED Solution Area and EWA Area of Analysis. Swainson's hawks are a breeding species in the Sacramento River, North Sacramento Valley, Cottonwood Creek, Butte Basin, Feather River/Sutter Basin, American River Basin, Yolo Basin, San Joaquin River, Eastside Delta Tributaries, Sacramento-San Joaquin Delta, East San Joaquin Basin, West San Joaquin Basin, and the eastern portion of the Suisun Marsh/North San Francisco Bay Ecological Zones.

Life History and Habitat Requirements. Swainson's hawks migrate long distances, are highly gregarious, and are largely insectivorous during migration. During the breeding season, small mammals are the primary prey items (Estep 1989). Their annual round-trip migration between North America and Argentina covers approximately 12,500 miles (England et al. 1997). Recent studies using satellite telemetry indicate that parts of Mexico may constitute the primary wintering range of birds breeding in the Central Valley. Birds typically return to nest sites in California from early March to April (later in more northern areas of the state). Migratory flocks begin to form in late August and September and most birds are on the wintering grounds by November (Bradbury unpubl. data).

The natural foraging habitat of Swainson's hawks throughout the majority of their North American range in the Great Basin, plains states, and prairie provinces of Canada is relatively open stands of grass-dominated vegetation and relatively sparse shrub lands. Swainson's hawks can forage in many crops, and Schmutz (1987) found that the species is more abundant in areas of moderate cultivation than in either grassland or areas of extensive cultivation. Alfalfa is routinely used by foraging Swainson's hawks (Estep 1989, Woodbridge 1991), but the ability of the hawk to use cultivated lands for foraging is a complex interaction of crop phenology and cultural practices (Schmutz 1987,. Estep 1989, Woodbridge 1991). Orchards and vineyards, in general, are not suitable foraging habitat for Swainson's hawks because of the dense woody cover, and rice is unsuitable most of the season because it is flooded (Estep 1989).

Throughout its range, the Swainson's hawk nests almost exclusively in only a few species of trees (Schlorff and Bloom 1983). A survey of nesting birds in California during 1979 revealed that Swainson's hawks nested in large, sparsely vegetated flatlands characterized by valleys, plateaus, broad floodplains, and large expanses of desert (Bloom 1980). In a study of movements and habitat use, it was found that single trees or riparian areas were used most often for nesting (Estep 1989).

Reasons for Decline. Several hypotheses have been suggested to explain the decline of Swainson's hawks in California: (1) mortality during migration and on the wintering grounds in South America; (2) poisoning by toxic chemicals, including pesticides, in South America; (3) thin eggshells resulting from pesticides; (4) habitat loss on wintering grounds; (5) disturbance on breeding grounds; (6) loss or degradation of habitat on breeding grounds; and (7) increased competition with other species.

Designated Critical Habitat. None.

Conservation Efforts. A group of researchers has formed a Swainson's hawk Technical Advisory Committee (TAC) to help develop a draft recovery plan for the species. CDFG has developed GIS tools to aid in management for this species (CDFG 2002). Measures under CALFED are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared but several CDFG studies identify sufficient essential habitat requirements to constitute a basis for recovery actions. These data have formed the factual foundation for several planning documents and habitat conservation efforts.

Research and Monitoring Gaps. It does not appear that there are research and monitoring gaps for this species.

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WESTERN BURROWING OWL (*Athene cunicularia*)

Legal Status. The western burrowing owl is designated as a species of special concern by the CDFG. This species is not listed under the CESA, and is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003).

Historic and Current Distribution and Status. The western burrowing owl maintains breeding populations from south-central British Columbia, southern Alberta, southern Saskatchewan, southern Manitoba south through the western U.S. and central Mexico to Panama (AOU 1983, Haug et al. 1993). During the winter the northernmost populations of the western burrowing owl can be found as far south as El Salvador and western Panama (AOU 1983). California, New Mexico, and Arizona are important wintering areas in the U.S. (James and Ethier 1989) (NatureServe Explorer 2001).

The burrowing owl is a permanent resident throughout most of California. This species was historically more abundant, but since the 1940's, numbers have been declining in all areas. Although it is still locally common in the southeastern deserts, around agricultural fields, and along canal and ditch banks. State and Federal lands appear to be the last stronghold for this species (Remsen 1978).

Distribution in the CALFED Solution Area and EWA Area of Analysis. The burrowing owl is a year-round species in the Butte Basin, Colusa Basin, Yolo Basin, Feather River/Sutter Basin, American River Basin, Eastside Delta Tributaries, East San Joaquin Basin, West San Joaquin Basin, and Suisun Marsh/North San Francisco Bay Ecological Zones.

Life History and Habitat Requirements. The burrowing owl is found in open grasslands, especially prairies, plains, and savannas. Occasionally it can be found in agricultural fields, desert habitats, seacoast bluffs, and open areas such as vacant lots near human habitation (e.g., campuses, airports, golf courses, perimeter of agricultural fields, banks of irrigation canals) (Small 1994). Optimum habitat is typified by short vegetation and the presence of fresh small mammal burrows (Zarn 1974). Burrowing owls spend a large amount of time on the ground or on low perches such as fence posts or dirt mounds.

Burrowing owls breed from March to August, peaking in April and May. This species nests in abandoned ground squirrel and other small mammal burrows (Zeiner et al. 1990). They rarely excavate their own burrows, preferring instead to enlarge or modify an existing burrow. Patterns of burrow use are influenced by availability, soils, prairie dog population dynamics, and other owls (Desmond and Savidge 1998, NatureServe Explorer 2001). Weather plays a strong and unpredictable role in abundance and availability of small mammal prey, which in turn can limit reproductive success (Wellicome 1998).

Burrowing owls feed on a variety of prey, but Conroy and Chesmore (1987) found that insects and mammals make up the majority of their diet, although they will also feed on arachnids, amphibians, and reptiles. Owls concentrate nocturnal foraging efforts in areas with high small mammal abundance, which accounts for the bulk of their caloric intake (Wellicome 1997b). They catch their prey in flight or drop to the ground (NatureServe Explorer 2001).

Reasons for Decline. The greatest threat to the burrowing owl is the conversion of grassland habitat for agricultural and urban uses. Other causes that have contributed to the decline of this species include pesticide use in nesting areas, rodent-control programs, and habitat fragmentation (Remsen 1978).

Designated Critical Habitat. None.

Conservation Efforts. The Burrowing Owl Research Program is an interagency effort to survey and research this species (IBP 2002). Measures under CALFED are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Research on the demography, vital rates, and dispersal of this species will help understand factors affecting the reproduction and survival of burrowing owls. Additional research should focus on the effect of habitat features on home range size and shape (IBP 2002).

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WHITE-TAILED KITE (*Elanus leucurus*)

Legal Status. The white-tailed kite is a fully protected species under the California Fish and Game Code and is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003).

Historical and Current Distribution and Status. White-tailed kite populations have fluctuated greatly over the past century. Grinnell and Miller (1944) stated that this species was common and widespread in valley and foothill territories before 1895 but, by the 1940's, it was rare or entirely gone from many areas. From the 1940's through the 1970's, kite populations have increased and their range has extended north into Oregon, south into Central America, and east into Texas (Shuford 1993).

White-tailed kites have steadily decreased throughout much of California since the late 1970's. Declines have been especially evident in southern California (Garrett and Dunn 1981), along the south coast (Marantz 1986), and in the San Joaquin Valley (Small 1994). Local populations appear to still be relatively healthy along the north and east San Francisco Bay and in the Sacramento-San Joaquin Delta.

Distribution in the CALFED Solution Area and EWA Area of Analysis. The white-tailed kite nests in all 14 ecological zones.

Life History and Habitat Requirements. White-tailed kites inhabit open lowland grassland, riparian woodland, marshes, and scrub areas; foraging in undisturbed, open grasslands, meadows, farmlands and emergent wetlands. Kites do not seem to associate with particular plant species, but are more tied to prey abundance and vegetation structure (CalPIF 2000). They typically soar, glide, and hover less than 30 m (100 ft) above ground in search of prey (Zeiner et. al. 1990). White-tailed kite prey consists mostly of voles and other small, diurnal mammals; occasionally including birds, insects, reptiles, and amphibians. Habitats supporting larger prey populations, such as ungrazed lands versus grazed lands, are more suitable. Alfalfa and sugar beets support the highest vole populations, relative to other agriculture (CalPIF 2000).

White-tailed kites breed in lowland grasslands, agriculture lands, wetlands, oak-woodland, savannah, and riparian habitats associated with open foraging areas. White-tailed kites make their nest with loosely piled sticks and twigs, lining them with grass, straw, or rootlets. Nests are placed near the top of dense oak, willow, or other tree stands; usually 6-20 m (20-100 ft) above ground near open foraging areas (Zeiner et. al. 1990). Nest building occurs January through August, and egg laying begins in February, probably peaking in March and April. Fledging probably occurs in May and June with most fledging complete by October (CalPIF, 2000).

Reasons for Decline. Declines during the early part of the century were probably the result of habitat loss, shooting (this kite was considered a pest species), and, to a much lesser extent, egg collecting (Shuford 1993). In the past 20 years, habitat loss has been accelerated, including conversion of agricultural lands to urban/residential; however, declines have occurred even in areas such as Santa Barbara County, where agricultural lands have experienced little conversion. Kite populations also fluctuate greatly with cycles of prey abundance, which, in turn, are significantly correlated with rainfall (Pruett-Jones et al. 1980). Such cycles result in natural bottlenecks when the species may be extremely vulnerable to human disturbance. These fluctuations make determination of long-term population trends difficult.

The most important threat still facing this species is loss of habitat. Although kites appear able to withstand some habitat alteration because of grazing and farming, large stretches of agricultural areas devoid of natural vegetation and urbanized areas are not suitable habitat.

Designated Critical Habitat. None.

Conservation Efforts. Measures under CALFED are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. The white-tailed kite might compete for nesting sites with other raptors. Research into these interactions would help identify possible limiting factors for the kite. Additionally, information about current abundance and population trends for this species is warranted (CalPIF 2000).

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WESTERN SPADEFOOT TOAD (*Scaphiopus hammondii*)

Legal Status. The western spadefoot toad is designated as a species of special concern by the CDFG. It has also been identified by CALFED as a species of concern. This species is not listed under the CESA or FESA (CDFG 2003).

Historical and Current Distribution and Status. The western spadefoot toad occurs in much of California west of the Sierra Nevada from Redding south to Mexico (Jennings and Hayes 1994). Serious population reductions have occurred throughout its range. More than 80 percent of its habitat in southern California has been developed or altered and more than 30 percent of its habitat in the Central Valley has been converted such that it is unusable (Jennings and Hayes 1994).

Distribution in the CALFED Solution Area and EWA Area of Analysis. The western spadefoot toad is present in the North Sacramento Valley, Cottonwood Creek, Butte Basin, Colusa Basin, Feather River/Sutter Basin, American River Basin, Yolo Basin, Eastside Delta Tributaries, San Joaquin River, East San Joaquin Basin, and West San Joaquin Basin Ecological Zones.

Life History and Habitat Requirements. The western spadefoot toad occupies a wide range of habitats; lowlands to foothills; grasslands, open chaparral, and pine-oak woodlands. However, this species prefers shortgrass plains and sandy or gravelly soil (e.g., alkali flats, washes, alluvial fans). Spadefoot toads are numerous where soil conditions are favorable for burrowing (Behler & King, 1996).

Intermittent pools of water, irrigation canals, reservoirs, edges of streams, and rain pools are frequented for breeding (Stebbins, 1951). Pools must last more than three weeks to allow for successful metamorphosis (Jenning and Hayes 1994). As pools dry, adults dig down into the soil and create a burrow where they estivate for most of the year (Zeiner et al. 1988). Eggs, consisting of 300-500 eggs per female (Stebbins, 1954), are laid in cylindrical masses attached to vegetation. Eggs can hatch in two to seven days. The development of larva is rapid and frequently speeds up with the evaporation of water, the concentration of chemicals in water, increases in temperature, or other factors (Stebbins, 1954). The larval period ranges from 25 days to 51 days.

Adults feed on most types of insects and other invertebrates; larvae are carnivorous and feed on dead amphibians, even their own species, as well as plankton and algae (Zeiner et al. 1988). Tadpoles are carnivores and feed on mosquito larvae.

Reasons for Decline. Loss of suitable habitat to development and agriculture is the primary reason for western spadefoot toad decline. Other factors include the introduction of mosquitofish and bullfrogs, which eat larvae and metamorphs, vulnerability to pesticides, atmospheric pollution, and human predation (Jennings and Hayes 1994, Beebee, 1996). Since the 1950's, drastic declines have been noted in the Central Valley and southern California. In southern California, more than 80 percent of the previously occupied habitat has been developed or converted to incompatible uses; in northern and central California more than 30 percent has been converted or developed (Jennings and Hayes 1994, NaturServe Explorer 2001).

Designated Critical Habitat. None.

Conservation Efforts. Measures under CALFED are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Significant gaps exist in understanding basic life history traits such as longevity and movements; identifying suitable habitat features; identifying habitat fragmentation effects on metapopulation structure; and identifying factors affecting long-term survival structure (Jennings and Hayes 1994).

Western Spadefoot Toad Citations

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INLAND DUNE SCRUB COMMUNITY

Description: Inland dune scrub habitat comprises vegetated stabilized sand dunes associated with river and estuarine systems (MSCS 2000). This habitat is home to numerous rare and endangered endemic species such as the Antioch Dunes evening primrose and Lange's metalmark butterfly.

Historical and Current Distribution and Status: Historic dunes within the Delta may have covered 15, 560 acres based on soil surveys (ERPP 2000). Existing remaining habitat areas are protected such as the Antioch Dunes National Wildlife Refuge and Brannan Island State Park.

Major factors that limit this habitat's contribution to the health of the Delta are related to adverse effects of sand mining, dune conversion to other land uses, dune stabilization, and land use practices that maintain the dominance of non-native plants (ERPP 2000).

Relationship to EWA Area of Analysis: Inland dune scrub is in restricted areas of the Delta in the Antioch Dunes National Wildlife Refuge.

CALFED NCCP Community Goal: The goal is to enhance 50–100 acres of inland dune scrub habitat in the CALFED Delta Region to increase the population of associated evaluated species. Additionally the goal is to avoid, minimize, and compensate for all CALFED effects on inland dune scrub habitat.

GRASSLAND

Description: Grassland habitat includes upland vegetation communities dominated by introduced and native annual and perennial grasses and forbs, including nonirrigated and irrigated pasturelands (MSCS 2000). Grasslands in California are dominated by wild oats, soft chess, brome, ryegrass, mustard, foxtail, California oatgrass, hairgrass, sweet vernal grass, and barley. Common forbs include filaree, clover, popcorn flower, and mullein. Grassland wildlife include western fence lizard, common garter snake, western rattlesnake, black-tailed jackrabbit, California ground squirrel, Botta's pocket gopher, harvest mouse, California vole, badger, and coyote. Bird species include western meadowlark, turkey vulture, and American kestrel. Special-status species include valley elderberry longhorn beetle, recurved larkspur, palmate-bracted bird's-beak, San Joaquin kit fox, western burrowing owl, short-eared owl, horned lark, northern harrier, white-tailed kite, and prairie falcon.

Historical and Current Distribution and Status: Perennial grassland was historically common throughout the Central Valley. Most perennial grassland has been lost or converted into annual grassland. Perennial grasslands and associated vernal pools historically were present at drier, higher elevations in the Delta. Grasslands developed adjacent to wetland and riparian habitats that occupied wetter, lower elevation. Much of the perennial grasslands have been converted for other uses. Non-native annual grasses now dominate most remaining grasslands. Annual grasses out competed and replaced perennial bunch grasses over most of the Central Valley (ERPP 2000).

Extent and health of perennial grasslands in the Bay-Delta estuary are declining. Large areas of historic perennial grassland have been converted for agriculture, urban, and industrial uses. Remaining grasslands have been invaded by non-native annual grass. Many of the annual grass species out-compete native grasses. Fire-resistant, non-native species have been given an additional competitive edge from current fire suppression techniques (ERPP 2000).

Relationship to EWA Area of Analysis: Grassland vegetation can be found surrounding Lake Shasta, Keswick Reservoir, Folsom Lake, Lakes McClure and McSwain, and San Luis Reservoir.

CALFED NCCP Community Goal: The goal is to (1) restore 9,000–11,000 acres of perennial grassland in the CALFED Bay and Delta Regions; (2) enhance grassland adjacent to wetlands and in the CALFED Sacramento River Region; and (3) replace the habitat functions and values lost for evaluated species as a result of effects on grassland habitat.

UPLAND SCRUB

Description: Upland scrub habitat includes habitat areas dominated by shrubs characteristic of coastal scrub, chaparral, and saltbush scrub communities (MSCS 2000). Upland scrub habitat is dominated by several types of vegetation including, ceanothus, manzanita, bitter cherry, oaks, poison oak, coffee berry, buckbrush, California buckeye, toyon, sugar sumac, chamise, saltbush, sagebrush, and creosote bush. Wildlife species found in upland scrub habitats include brush rabbit, black-tailed jackrabbit, mule deer, rufous-sided towhee, California quail, California thrasher, red-tailed hawk, prairie falcon, and Cooper's hawk.

Historical and Current Distribution and Status: Montane chaparral is associated with mountainous terrain from mid to high elevation at 3,000 – 9,000 feet. It occurs in southern California above 7,000 feet in the Transverse Range of Los Angeles, and in San Bernadino, Riverside and San Diego Counties; from Siskiyou to Kern counties in the Cascade and Sierra Nevada mountains; as a minor type from Tehama to Lake Counties; and in Del Norte, Siskiyou, Trinity, and Shasta counties in the North Coast Ranges and Klamath mountains. As a successional stage following disturbance, its distribution coincides with the ponderosa pine and mixed coniferous forest habitat types (CDFG 2003).

Mixed chaparral generally occurs below 5,000 feet on mountain ranges throughout California except in the deserts. Upper and lower elevational limits vary considerably with precipitation regime, aspect, and soil type. Mixed chaparral occurs throughout the transverse, peninsular, and central coast ranges and the Tehachapi Mountains. In the Sierra Nevada, this type is a broken band along middle and lower elevations of the western slope. It also occupies large areas in the north coast ranges, especially on the interior slopes, and is found as large discontinuous patches in the Siskiyou Mountains and Cascade and Klamath ranges (CDFG 2003).

Chamise-Redshank chaparral is usually found below 4,000 feet on mountain ranges outside the desert. In the north, chamise more frequently mixes with other shrubs, especially several species of ceanothus. This type of vegetation covers large areas in the central coast ranges and on the eastern exposures of the north coast ranges; as isolated stands in the Cascade and Klamath ranges and the Siskiyou Mountains; and in a broken band on the western slope of the Sierra Nevada (CDFG 2003).

Alkali scrub vegetation occurs in California throughout the Mojave Desert, parts of the Colorado Desert, parts of northeastern California within the Great Basin, and in the southern San Joaquin Valley. Examples of the halophytic phase of alkali scrub are common in California deserts, but are scattered and usually associated with dry lakes and flood plains of rivers such as the Mojave, Colorado, and Amargosa. Alkali scrub phases occur from below sea level in Death Valley to over 5,900 feet in some Great Basin locations (CDFG 2003).

Relationship to EWA Area of Analysis: Upland scrub habitat can be found immediately above the drawdown zones of Lake Shasta, Keswick Reservoir, Lake Oroville, New Bullards Bar Reservoir, Folsom Lake, Lakes McClure and McSwain, Castaic Lake, Silverwood Lake, Lake Perris, Lake Mathews, and Diamond Valley Lake.

CALFED NCCP Community Goal: The goal is to replace the habitat functions lost for evaluated species as a result of effects on upland scrub habitat.

VALLEY/FOOTHILL WOODLAND AND FOREST

Description: Valley/foothill woodland and forest habitat includes nonriparian forest, woodland, and savanna of valleys and foothills. These vegetation communities are commonly dominated by valley oak, blue oak, interior live oak, coast live oak, and foothill pine (MSCS 2000). Additionally valley/foothill woodland and forest habitat in often dominated by sycamore, black walnut, juniper, and California buckeye. Wildlife associated with valley/foothill woodland and forest include acorn woodpecker, northern flicker, wild turkey, plain titmouse, black-tailed jackrabbit, American crow, California quail, Bewick's wren, western fence lizard, coyote, mule deer, California ground squirrel, western gray squirrel, and scrub jay.

Historical and Current Distribution and Status: Blue Oak woodlands occur along the western foothills of the Sierra Nevada-Cascade Ranges, the Tehachapi Mountains, and in the eastern foothills of the Coast Range, forming a nearly continuous ring around the Central Valley. The habitat is discontinuous in the valleys and on lower slopes of the interior and western foothills of the Coast Range from Mendocino County to Ventura County. It is generally found at elevations from 500 to 2,000 feet at the northern end of its range and on the western slopes of the Sierra Nevada, from 250 to 3,000 feet in the central Coast Range, and from 550 to 4,500 feet in the Transverse and Peninsular Ranges (CDFG 2003).

Blue Oak-Digger Pine habitat generally rings the foothills of the Central Valley, between 500 and 3,000 feet in elevation. The Pit River drainage in the Cascade Range and the foothills of the Klamath Mountains mark the approximate northern limit. The habitat is nearly continuous in the western foothills of the Sierra Nevada, except for a gap of 60 miles between Kings and Kern Rivers, where digger pine is missing. The distribution extends south in to the Liebre Mountains of northern Los Angeles County and the drainages of Piru Creek and Santa Clara River in Ventura County. It is discontinuous in the Coast Range west of the Central Valley from Ventura to Mendocino Counties. And it extends westward to within 10 miles of the coast in a few places (CDFG 2003).

Remnant patches of Valley Oak woodland are found in the Sacramento Valley from Redding south, in the San Joaquin Valley to the Sierra Nevada foothills, in the Tehachapi Mountains, and in valleys of the Coast Range from Lake County to western Los Angeles County. Usually it occurs below 2,000 feet, although a reported ridge-top stand at 5,000 feet in the Santa Lucia Mountains exists (CDFG 2003).

Relationship to EWA Area of Analysis: Valley/foothill woodland forest can be found immediately above the drawdown zones of Lake Oroville, Folsom Lake, Lake McClure, Lake McSwain and San Luis Reservoir; and often immediately adjacent to the Valley/Foothill riparian corridor along the Sacramento, San Joaquin, Feather, Yuba, American, and Merced rivers.

CALFED NCCP Community Goal: The goal is to replace the habitat functions lost as a result of effects on valley/foothill woodland and forest habitat.

MONTANE WOODLAND AND FOREST

Description: Montane woodland and forest habitat includes nonriparian forest and woodland above the foothills. These vegetation communities are commonly dominated by pine, fir, cedar, and black oak (MSCS 2000). More specifically montane woodland and forest vegetation is dominated by white fir, Douglas fir, ponderosa pine, Jeffery pine, red fir, lodgepole pine, sugar pine, live oak, tanoak, incense cedar, coulter pine, willows, alders, black cottonwood, aspens, black oak, and knobcone pine.

Historical and Current Distribution and Status: The Sierran mixed conifer habitat generally forms a vegetation band ranging 2,500 to 4,000 feet in the north to 4,000 to 10,000 feet in the southern Sierra Nevada. The Sierra Nevada mixed conifer forest occupies between 4.5 to 7.8 million acres in southern Oregon and California, dominating western middle elevation slopes of the Sierra Nevada. Disjunct populations of mixed conifer are founding the Peninsular, Transverse, and Coast ranges of California (CDFG 2003).

Douglas-fir habitat occurs in the north Coast Range from Sonoma County north to the Oregon border and in the Klamath Mountains of California and Oregon. This habitat usually occurs at elevations from 500 to 2,000 feet in the Coast Range and from 1,000 to 4,000 feet in the Klamath Mountains. It can occur at higher elevations if plentiful precipitation is present (CDFG 2003).

Most aspen habitats in California are found within 50 miles of the Nevada border from Mono County to Plumas County. Small stands are scattered generally north and westward from there into northern Trinity and western Siskyou Counties. Disjunct populations occur in the White and San Bernardino Mountains. Elevational limits generally range from 6,550 to 9,850 feet, although quaking aspen occurs as low as 3,000 feet at McArthur-Burney Falls State Park, Shasta County. Aspen stands do not extend to the upper tree line in any locality (CDFG 2003).

Ponderosa pine habitat is found on suitable mountain and foothill sites throughout California except in the immediate area of San Francisco Bay, in the north coast area, south of Kern County in the Sierra Nevada and east of the Sierra Nevada Crest. Elevational ranges include 800 – 5,000 feet in the northern Sierra Nevada and Cascades, 3,937 – 6,890 feet in the Transverse and Peninsular Ranges, although it may be found as low as 3,445 feet in moist south-coastal sites. The ponderosa pine habitat is replaced by Jeffrey pine on the Mojave Desert slopes of the Transverse Range and often on the eastern side of the Peninsular and Coast Ranges (CDFG 2003).

The Montane Hardwood habitat ranges throughout California mostly west of the Cascade-Sierra Nevada crest. East of the crest, it is found in localized areas of Placer, El Dorado, Alpine, and San Bernardino Counties. Elevations range from 300 feet near the Pacific Ocean to 9,000 feet in southern California (CDFG 2003).

Relationship to EWA Area of Analysis: Montane woodland and forest can be found immediately above the drawdown zones of Lake Shasta, Keswick Reservoir, New Bullards Bar Reservoir, Sly Creek Reservoir, Little Grass Valley Reservoir, Lake Oroville, Hell Hole and French Meadows Reservoirs, Folsom Lake, and Silverwood Lake.

CALFED NCCP Community Goal: The goal is to replace the habitat functions lost as a result of effects on the montane woodland and forest habitat.

Table A-1 Species considered for inclusion in the ASIP.

Decision Criteria

A Species included because the species occurs in habitat that has the potential to be affected by EWA actions.

B Species not included because the species occurs in areas outside the EWA area of analysis.

C Species not included because the species occurs in habitats that would not be adversely affected by EWA actions. (See Section 1.4.2.)

D Species not included because the species is not likely to be affected by EWA actions because habitat is not limiting and the species is mobile. (See species paragraphs after Table 1-1.)

E Fish species not included because life history requirements would not be affected by EWA actions.

[1]**Species Goals:**

R = Recovery. Recover species' populations within the MSCS focus area to levels that ensure the species' long-term survival in nature.
r = Contribute to recovery. Implement some of the actions deemed necessary to recover species' populations within the MSCS focus area.
m = Maintain. Ensure that any adverse effects on the species that could be associated with implementation of CALFED actions will be fully offset through implementation of actions beneficial to the species.

[2]**Status:**

Federal

E = Listed as endangered under FESA.
T = Listed as threatened under FESA.
PE = Proposed for listing as endangered under FESA.
PT = Proposed for listing as threatened under FESA.
C = Candidate for listing under FESA.
PR = Protected under the Bald and Golden Eagle Protection Act.
FPD= Federally proposed (Delisting)

State

CE = Listed as endangered under CESA.
CT = Listed as threatened under CESA.
CCE = Candidate for listing as endangered under CESA.
CCT = Candidate for listing as threatened under CESA.
R = Listed as rare under California Native Plant Protection Act.
CSC = California species of special concern.
FP = Fully protected under California Fish and Game Code.
SB = Specified birds under California Fish and Game Code.

Other

1A = CNPS List 1A.
1B = CNPS List 1B.
2 = CNPS List 2.
3 = CNPS List 3.
SC = Other species of concern identified by CALFED.
BO = Species covered by the CALFED Programmatic Biological Opinions

Species Goals[1]	Common Name	Scientific Name	Status[2]			Covered Species Determination		
			Federal	State	Other	Species evaluated in the EWA ASIP	Species considered but not further evaluated in the EWA ASIP	Decision Criteria
Mammals								
	American badger	*Taxidea taxus*	-	CSC	-		X	B
	Berkeley kangaroo rat	*Dipodomys heermanni berkeleyensis*	-	-	SC		X	B
	Buena Vista Lake Shrew	*Sorex ornatus relictus*	E	CSC	BO		X	B
	California bighorn sheep	*Ovis canadensis californiana*	E	CE	BO		X	B
	California red tree vole	*Phenacomys longicaudus*	-	CSC	SC		X	B
m	California wolverine	*Gulo gulo luteus*	-	CT/FP	SC		X	B
	Fresno Kangaroo Rat	*Dipodomys nitratoides exilis*	E	CE	BO		X	B
	Fringed myotis	*Myotis thysanodes*	-	-	SC		X	D
m	Giant kangaroo rat	*Dipodomys ingens*	E	CE	BO		X	B
m	Greater western mastiff-bat	*Eumops perotis californicus*	-	CSC	SC		X	D
	Hoary bat	*Laiurus cinereus*	-	CSC	-		X	D
	Long-eared myotis	*Myotis evotis*	-	-	SC		X	D
	Long-legged myotis	*Myotis volans*	-	-	SC		X	D
	Marysville California kangaroo rat	*Dipodomys heermanni eximus*	-	CSC	SC		X	B
m	Merced kangaroo rat	*Dipodomys heermanni dixoni*	-	-	SC		X	B
m	Nelson's antelope ground squirrel	*Ammospermophilus nelsoni*	-	CT	SC		X	B
	Pacific fisher	*Martes pennanti pacifica*	-	CSC	SC		X	B
	Pacific pocket mouse	*Perognathus longimembris pacificus*	E				X	B
	Pacific western big-eared bat	*Plecotus townsendii townsendii*	-	CSC	SC		X	D
	Pale Townsend's big-eared bat	*Plecotus townsendii pallescens*	-	CSC	SC		X	D
	Pallid bat	*Antrozous pallidus*	-	CSC	-		X	D
	Red bat	*Lasiurus borealis*	-	-	SC		X	D
m	Ringtail	*Bassariscus astutus*	-	FP	-		X	C
r	Riparian brush rabbit	*Sylvilagus bachmani riparius*	E	CE	BO		X	C
r	Salt marsh harvest mouse	*Reithrodontomys raviventris*	E	CE/FP	BO		X	C
	San Bernardino kangaroo rat (critical habitat)	*Dipodomys merriami parvus*	E				X	B
m	San Joaquin kit fox	*Vulpes macrotis mutica*	E	CT	BO		X	B
	San Joaquin pocket mouse	*Perognathus inornatus*	-	-	SC		X	B
r	San Joaquin Valley woodrat	*Neotoma fuscipes riparia*	E	CSC	BO		X	C
r	San Pablo California vole	*Microtus californicus sanpabloensis*	-	CSC	-		X	B
	Short-nosed kangaroo rat	*Dipodomys nitratoides brevinasus*	-	CSC	SC		X	B
	Silver-haired bat	*Lasionycteris noctivagans*	-	CSC	-		X	D
	Small-footed myotis	*Myotis ciliolabrum*	-	-	SC		X	D
	Spotted bat	*Euderma maculatum*	-	CSC	SC		X	D
	Stephens' kangaroo rat	*Dipodomys stephensi*	E				X	C
R	Suisun ornate shrew	*Sorex ornatus sinuosus*	-	CSC	SC		X	B
	Tehachapi pocket mouse	*Perognathus alticola inexpectatus*		CSC			X	B
	Tipton Kangaroo Rat	*Dipodomys nitratoides nitratoides*	E	CE	BO		X	B

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	Tulare grasshopper mouse	*Onychomys torridus tularensis*	-	-	SC		X	B
	Yuma myotis	*Myotis yumanensis*	-	-	SC		X	D
Birds								
	Alameda song sparrow	*Melospiza melodia pusillula*	-	CSC	SC		X	D
m	Aleutian Canada goose	*Branta canadensis leucopareia*	-	-	BO	X		A
m	American peregrine falcon	*Falco peregrinus anatum*	-	CE/FP	-			D
	American white pelican	*Pelecanus erythrorhynchos*	-	CSC	SC		X	D
m	Bald eagle	*Haliaeetus leucocephalus*	T/PR	CE/FP	BO		X	D
r	Bank swallow	*Riparia riparia*	-	CT	-		X	C
	Belding's savannah sparrow	*Passerculus sandwichensis beldingi*		E			X	B
	Bell's sage sparrow	*Amphispiza belli belli*	-	CSC	SC		X	B
	Belted kingfisher	*Ceryle alcyon*	-	-	SC		X	C
m	Black tern	*Chlidonias niger*	-	CSC	SC	X		A
m	Black-crowned night heron (rookery)	*Nycticorax nycticorax*	-	-	SC		X	C
	Black swift (nesting)	*Cypseloides niger*			SC		X	D
r	California black rail	*Laterallus jamaicensis coturniculus*	-	CT/FP	SC		X	C
m	California brown pelican (critical habitat)	*Pelecanus occidentalis californicus*	E	CE/FP	BO		X	D
r	California clapper rail	*Rallus longirostris obsoletus*	E	CE/FP	BO		X	C
m	California condor (critical habitat)	*Gymnogyps californianus*	E	CE/FP	BO		X	B
	Coastal California gnatcatcher (critical habitat)	*Polioptila californica californica*	T				X	B
m	California gull	*Larus californicus*	-	CSC	-		X	D
	California horned lark	*Eremophila alpestris actia*	-	-	SC		X	C
m	California least tern	*Sterna antillarum browni*	E	CE/FP	BO		X	C
	California spotted owl	*Strix occidentalis occidentalis*	-	CSC	SC		X	D
r	California yellow warbler	*Dendroica petechia brewsteri*	-	CSC	-		X	C
m	Cooper's hawk	*Accipiter cooperii*	-	CSC	-		X	D
m	Double-crested cormorant (rookery)	*Phalacrocorax auritus*	-	CSC	-		X	D
	Ferruginous hawk	*Buteo regalis*	-	CSC	SC		X	D
m	Golden eagle	*Aquila chrysaetos*	PR	CSC/FP	-		X	D
	Grasshopper sparrow	*Ammodramus savannarum*	-	-	SC		X	C
m	Great blue heron (rookery)	*Ardea herodias*	-	-	SC		X	D
m	Great egret (rookery)	*Casmerodius albus*	-	SB	SC	X		A
r	Greater sandhill crane	*Grus canadensis tabida*	-	CT/FP	-	X		A
	Harlequin duck	*Histrionicus histrionicus*	-	CSC	SC		X	D
r	Least Bell's vireo (critical habitat)	*Vireo bellii pusillus*	E	CE	BO		X	C
	Le Conte's thrasher	*Toxostoma lecontei*			SC		X	B
r	Little willow flycatcher	*Empidonax traillii brewsteri*	-	CE	SC		X	C
	Loggerhead shrike	*Lanius ludovicianus*	-	CSC	-		X	D
m	Long-billed curlew	*Numenius americanus*	-	CSC	-	X		A
m	Long-eared owl	*Asio otus*	-	CSC	-		X	D
	Marbled Murrelet	*Brachyramphus marmoratus*	T	CE	BO		X	C

Species Goals[1]	Common Name	Scientific Name	Status[2]			Covered Species Determination		
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	Merlin	*Falco columbarius*	-	CSC	-		X	D
m	Mountain plover	*Charadrius montanu*	PT	CSC	BO		X	D
	Northern goshawk	*Accipiter gentilis*	-	-	SC		X	C
m	Northern harrier	*Circus cyaneus*	-	CSC	-		X	D
m	Northern spotted owl (critical habitat)	*Strix occidentalis caurina*	T	-	BO		X	C
	Oregon vesper sparrow	*Pooecetes gramineus affinis*	-	-	SC		X	B
m	Osprey	*Pandion haliaetus*	-	CSC/SB	-		X	D
	Pacific-slope flycatcher	*Empidonax difficilis insulicola*	-	-	SC		X	B
	Prairie falcon	*Falco mexicanus*	-	CSC	-		X	D
	Purple martin	*Progne subis*	-	CSC	-		X	C
	Sacramento Valley song sparrow	*Melospiza melodia mailliardi*	-	-	SC		X	C
r	Saltmarsh common yellowthroat	*Geothlypis trichas sinuosa*	-	CSC	SC		X	C
R	San Pablo song sparrow	*Melospiza melodia samuelis*	-	CSC	SC		X	B
	Sharp-shinned hawk	*Accipiter striatus*	-	CSC	-		X	D
m	Short-eared owl	*Asio flammeus*	-	CSC	-		X	D
	Short-tailed albatross	*Phoebastria albatrus*	E				X	B
m	Snowy egret (rookery)	*Egretta thula*	-	SB	SC	X		A
	Sora	*Porzana carolina*	-	-	SC		X	C
	Southwestern willow flycatcher	*Empidonax traillii extimus*	E	CE	BO		X	C
R	Suisun song sparrow	*Melospiza melodia maxillaris*	-	CSC	SC		X	C
r	Swainson's hawk	*Buteo swainsoni*	-	CT	-		X	D
m	Tricolored blackbird	*Agelaius tricolor*	-	CSC	SC	X		A
m	Western burrowing owl	*Athene cunicularia hypugea*	-	CSC	SC		X	D
m	Western least bittern	*Ixobrychus axilis*	-	CSC	SC		X	D
m	Western snowy plover (critical habitat)	*Charadrius alexandrinus nivosus*	T	CSC	BO		X	D
r	Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	-	CE	-		X	C
m	White-faced ibis	*Plegadis chihi*	-	CSC	SC	X		A
m	White-tailed kite	*Elanus leucurus*	-	FP	-		X	D
	Yellow rail	*Coturnicops noveboracensis*	-	CSC	-		X	C
m	Yellow-breasted chat	*Icteria virens*	-	CSC	-		X	C
	Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	-	-	SC		X	C
Reptiles								
m	Alameda whipsnake	*Masticophis lateralis euryxanthus*	E	CT	BO		X	B
m	Blunt-nosed leopard lizard	*Gambelia sila*	E	CE/FP	BO		X	B
	California horned lizard	*Phrynosoma coronatum frontale*	-	CSC	SC		X	C
r	Giant garter snake	*Thamnophis gigas*	T	CT	BO	X		A
	Orange throated whiptail	*Cnemidophorus hyperythrus*			SC			C
	San Diego horned lizard	*Phrynosoma coronatum blainvillei*			SC			C
	San Francisco garter snake	*Thamnophis sirtalis tetrataenia*	E	CE	BO		X	B
m	San Joaquin whipsnake	*Masticophis flagellum ruddocki*	-	CSC	SC		X	B
	Silvery legless lizard	*Anniella pulchra pulchra*	-	CSC	SC		X	B

Species Goals[1]	Common Name	Scientific Name	Status[2]			Covered Species Determination		
			Federal	State	Other	Species evaluated in the EWA ASIP	Species considered but not further evaluated in the EWA ASIP	Decision Criteria
	Two-striped garter snake	*Thamnophis hammondii*			SC		X	B
m	Western pond turtle	*Clemmys marmorata*	-	CSC	SC	X		A
	Amphibians							
	Arroyo Toad (critical habitat)	*Bufo californicus*	E				X	B
m	California red-legged frog (critical habitat)	*Rana aurora draytonii*	T	CSC	BO		X	C
m	California tiger salamander	*Ambystoma californiense*	C	CSC	BO		X	C
	Cascades frog	*Rana cascadae*	-	-	SC		X	B
m	Foothill yellow-legged frog	*Rana boylii*	-	CSC	SC		X	C
m	Limestone salamander	*Hydromantes brunus*	-	CT/FP	SC		X	B
	Mountain yellow-legged frog- So. Calif. Pop.	*Rana muscosa*	PE				X	B
m	Shasta salamander	*Hydromantes shastae*	-	CT	SC		X	C
	Tailed frog	*Ascaphus truei*	-	CSC	SC		X	B
m	Western spadefoot	*Scaphiopus hammondii*	-	CSC	SC		X	C
	Fish							
m	Central California Coast steelhead evolutionarily significant unit (ESU)	*Oncorhynchus mykiss*	E	-	BO		X	B
R	Central Valley fall-/late-fall-run chinook salmon ESU (essential fish habitat)	*Oncorhynchus tshawytscha*	C	CSC	-	X		A
R	Sacramento River winter-run chinook salmon ESU (essential fish habitat)	*Oncorhynchus tshawytscha*	E	CE	BO	X		A
R	Central Valley spring-run chinook salmon ESU (critical habitat) (essential fish habitat)	*Oncorhynchus tshawytscha*	T	CT	BO	X		A
R	Central Valley steelhead ESU	*Oncorhynchus mykiss*	T	-	BO	X		A
R	Delta smelt (critical habitat)	*Hypomesus transpacificus*	T	CT	BO	X		A
R	Green sturgeon	*Acipenser medirostris*	-	CSC	-		X	E
m	Hardhead	*Mylopharodon conocephalus*	-	CSC	-		X	E
	Kern brook lamprey	*Lampetra hubbsi*	-	CSC	SC		X	B
R	Longfin smelt	*Spirinchus thaleichthys*	-	CSC	-		X	E
m	McCloud River redband trout	*Oncorhynchus mykiss* ssp 2	C	CSC	BO		X	B
	Northern Anchovy (essential fish habitat)	*Engraulis mordax*	-	-	-	X		A
	Pacific lamprey	*Lampetra tridentata*	-	-	SC		X	E
	Pacific Sardine (essential fish habitat)	*Sardinops sagax*	-	-	-	X		A
	Pit roach	*Lavinia symmetricus mitrulus*	-	CSC	SC		X	B
	River lamprey	*Lampetra ayresi*	-	CSC	-		X	E
m	Rough sculpin	*Cottus Asperrimus*	-	CT/FP	SC		X	E
r	Sacramento perch	*Archoplites interruptus*	-	CSC	SC			E
R	Sacramento splittail	*Pogonichthys macrolepidotus*	T	CSC	BO	X		A
m	San Joaquin roach	*Lavinia symmetricus* ssp.*(San Joaquin)*	-	CSC	SC			E
	Santa Ana sucker	*Carosromus santaanae*	T				X	B
	Shortnose sucker	*Choasmistes brevirostris*	E	CE	BO		X	B
	Southern Steelhead	*Oncorhynchus mykiss irideus*	E		SC		X	B

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	Starry Flounder (essential fish habitat)	*Platichtys stellatus*	-	-	-	X		A
	Tidewater goby	*Eucyclogobius newberryi*	E	CSC	BO		X	B
	Unarmored threespine stickleback (proposed critical habitat)	*Gasterosteus aculeatus williamsoni*	E				X	B
Insects								
	Amphibious caddisfly	*Desmona bethula*	-	-	SC		X	C
	Antioch andrenid bee	*Perdita scitula antiochensis*	-	-	SC		X	C
	Antioch cophuran robberfly	*Cophura hurdi*	-	-	SC		X	C
	Antioch Dunes anthicid beetle	*Anthicus anthiochensis*	-	-	SC		X	C
	Antioch efferian robberfly	*Efferia anticohi*	-	-	SC		X	C
	Antioch mutillid wasp	*Myrmosula pacifica*	-	-	SC		X	C
	Antioch sphecid wasp	*Philanthus nasilis*	-	-	SC		X	C
	Bay checkerspot butterfly	*Euphydryas editha bayensis*	T		BO		X	B
	Bohart's blue butterfly	*Philotiella speciosa bohartorum*	-	-	SC		X	B
	Bridges' Coast Range shoulderband snail	*Helminthoglypta nickliniana bridgesi*	-	-	SC		X	B
m	California freshwater shrimp	*Syncaris pacifica*	E	CE	BO		X	C
	California linderiella	*Linderiella occidentalis*	-	-	SC		X	B
m	Callippe silverspot butterfly	*Speyeria callippe callippe*	E	-	BO		X	B
	Ciervo aegialian scarab beetle	*Aegialia concinna*	-	-	SC		X	B
m	Conservancy fairy shrimp	*Branchinecta conservatio*	E	-	BO		X	C
	Curved-foot hygrotus diving beetle	*Hygrotus curvipes*	-	-	SC		X	C
r	Delta green ground beetle (critical habitat)	*Elaphrus viridis*	T	-	BO		X	C
	Globose dune beetle	*Coelus globosus*	-	-	SC		X	B
	Gold Rush hanging fly	*Orbittacus obscurus*	-	-	SC		X	C
	Ground beetle (no species-specific name)	*Scaphinotus behrensi*	-	-	SC		X	B
	Hurd's metapogon robberfly	*Metapogon hurdi*	-	-	SC		X	B
	Kern primrose sphinx moth	*Euproserpinus euterpe*	T		BO		X	B
R	Lange's metalmark	*Apodemia mormo langei*	E	-	BO		X	C
	Leech's skyline diving beetle	*Hydroporus leechi*	-	-	SC		X	C
m	Longhorn fairy shrimp	*Branchinecta longiantenna*	E	-	BO		X	C
	Marin elfin butterfly	*Incisalia mossii*	-	-	SC		X	B
	Merced Canyon shoulderband snail	*Helminthoglypta allynsmithi*	-	-	SC		X	B
	Middlekauf's shieldback katydid	*Idiostatus middlekaufi*	-	-	SC		X	B
m	Mid-valley fairy shrimp	*Brachinecta n.* sp. "mid-valley"	-	-	SC		X	C
	Mission blue butterfly	*Icaricia icarioides missionensis*	E		BO		X	B
	Moestan blister beetle	*Lytta moesta*	-	-	SC		X	B
m	Monarch butterfly (roost)	*Danaus plexippus*	-	-	-		X	C
	Morrison's blister beetle	*Lytta morrisoni*	-	-	SC		X	B
	Myrtle's silverspot butterfly	*Speyeria zerene myrtleae*	E		BO		X	B
	Opler's longhorn moth	*Adela oplerella*	-	-	SC		X	B
	Redheaded sphecid wasp	*Eucerceris ruficeps*	-	-	SC		X	B
	Ricksecker's water scavenger beetle	*Hydrochara rickseckeri*	-	-	SC		X	B

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	Riverside fairy shrimp	*Streptocephalus wootoni*	E				X	C
	Sacramento anthicid beetle	*Anthicus sacramento*	-	-	SC		X	C
	Sacramento Valley tiger beetle	*Cicindela hirticollis abrupta*	-	-	SC		X	C
	San Bruno elfin butterfly	*Incisalia mossii bayensis*	E		BO		X	B
	San Joaquin dune beetle	*Coelus gracilis*	-	-	SC		X	B
	San Joaquin tiger beetle	*Cicindela tranquebarica* ssp.	-	-	SC		X	B
	Sandy beach tiger beetle	*Cicindela hirticollis gravida*	-	-	SC		X	B
	Shasta crayfish	*Pacifastacus fortis*	E	CE	BO		X	C
m	Shasta sideband	*Monadenia troglodytes*	-	-	SC		X	C
R	Valley elderberry longhorn beetle (critical habitat)	*Desmocerus californicus dimorphus*	T	-	BO		X	C
m	Vernal pool fairy shrimp	*Branchinecta lynchi*	T	-	BO		X	C
m	Vernal pool tadpole shrimp	*Lepidurus packardi*	E	-	BO		X	C
	Williams' bronze shoulderband snail	*Helminthoglypta arrosa williamsi*	-	-	SC		X	B
	Yellow-banded andrenid bee	*Perdita hirticeps luteocincta*	-	-	SC		X	B
Plants								
m	Adobe-lily	*Fritillaria pluriflora*	-	-	1B/SC		X	
m	Ahart's dwarf rush	*Juncus leiospermus* var. *ahartii*	-	-	1B/SC		X	
m	Ahart's paronychia	*Paronychia ahartii*	-	-	1B/SC		X	
r	Alkali milkvetch	*Astragalus tener* var. *tener*	-	-	1B/SC		X	
	American scheuchzeria	*Scheuchzeria palustris* var. *americana*	-	-	2		X	
	Anthony Peak lupine	*Lupinus antoninus*	-	-	1B/SC		X	
R	Antioch Dunes evening-primrose (critical habitat)	*Oenothera deltoides* ssp. *howellii*	E	CE	1B/BO		X	
m	Arburua Ranch jewelflower	*Streptanthus insignis* ssp. *lyonii*	-	-	1B/SC		X	
	Baja California birdbush	*Ornithostaphylos oppositifolia*		CE			X	
m	Baker's larkspur	*Delphinium bakeri*	E	R	1B/BO		X	
m	Baker's manzanita	*Arctostaphylos bakeri* ssp. *bakeri*	-	R	1B/SC		X	
	Baker's navarretia	*Navarretia leucocephala* ssp. *bakeri*	-	-	1B		X	
	Bakersfield cactus	*Opuntia treleasei*	E	CE	BO		X	
	Beach layia	*Layia carnosa*	E	CE	BO		X	
m	Beaked clarkia	*Clarkia rostrata*	-	-	1B/SC		X	
	Bearded popcornflower	*Plagiobothrys hystriculus*	-	-	1A		X	
m	Bellinger's meadowfoam	*Limnanthes floccosa* ssp. *bellingeriana*	-	-	1B/SC		X	
m	Ben Lomond buckwheat	*Eriogonum nudum* var. *decurrens*	-	-	1B		X	
	Ben Lomond spineflower	*Chorizanthe pungens var. hartwegiana*	E		BO		X	
	Ben Lomond wallflower	*Erysimum teretifolium*	E	CE	BO		X	
m	Big Bear Valley woollypod	*Astragalus leucolobus*	-	-	1B/SC		X	
m	Big tarplant	*Blepharizonia plumosa* ssp. *plumosa*	-	-	1B		X	
	Big-scale balsamroot	*Balsamorhiza macrolepis* var. *macrolepis*	-	-	1B		X	
	Bisbee Peak rush-rose	*Helianthemum suffrutescens*	-	-	3		X	
m	Boggs Lake hedge-hyssop	*Gratiola heterosepala*	-	CE	1B		X	
m	Brandegee's eriastrum	*Eriastrum brandegeae*	-	-	1B/SC		X	

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	Braunton's milk-vetch	*Astragalus brauntonii*	E				X	
m	Brewer's western flax	*Hesperolinon breweri*	-	-	1B/SC		X	
r	Bristly sedge	*Carex comosa*	-	-	2		X	
m	Brittlescale	*Atriplex depressa*	-	-	1B/SC		X	
	Burke's goldfields	*Lasthenia burkei*	E	CE	BO		X	
	Butte County checkerbloom	*Sidalcea robusta*	-	-	1B/SC		X	
	Butte County fritillary	*Fritillaria eastwoodiae*	-	-	1B/SC		X	
m	Butte County meadowfoam	*Limnanthes floccosa* ssp. *californica*	E	CE	1B/BO		X	
	Butte County morning-glory	*Calystegia atriplicifolia* ssp. *buttensis*	-	-	3/SC		X	
m	California beaked-rush	*Rhynchospora californica*	-	-	1B/SC		X	
	California jewelflower	*Caulanthus californicus*	E	CE	BO		X	
	California orcutt grass	*Orcuttia californica*	E				X	
m	California seablite	*Suaeda californica*	E	-	1B/BO		X	
	California sycamore	*Platanus racemosa*	-	-	SC		X	
m	California vervain	*Verbena californica*	T	CT	1B/BO		X	
	Calistoga ceanothus	*Ceanothus divergens*	-	-	1B/SC		X	
m	Calistoga popcornflower	*Plagiobothrys strictus*	E	CT	1B/BO		X	
	Camatta Canyon amole	*Chlorogalum pupureum var. reductum*	T	R			X	
	Cantelow's lewisia	*Lewisia cantelovii*	-	-	1B		X	
	Canyon Creek stonecrop	*Sedum paradisum*	-	-	1B/SC		X	
	Caper-fruited tropidocarpum	*Tropidocarpum capparideum*	-	-	1A/SC		X	
m	Carquinez goldenbush	*Isocoma arguta*	-	-	1B/SC		X	
	Cascade alpine campion	*Silene suksdorfii*	-	-	2		X	
m	Chinese Camp brodiaea	*Brodiaea pallida*	T	CE	1B/BO		X	
m	Clara Hunt's milkvetch	*Astragalus clarianus*	E	CT	1B/BO		X	
	Closed-throated beardtongue	*Penstemon personatus*	-	-	1B/SC		X	
	Clustered lady's-slipper	*Cypripedium fasciculatum*	-	-	SC		X	
	Cobb Mountain lupine	*Lupinus sericatus*	-	-	1B		X	
m	Colusa grass	*Neostapfia colusana*	T	CE	1B/BO		X	
	Colusa layia	*Layia septentrionalis*	-	-	1B		X	
	Conejo dudley	*Dudleya abramsii* spp. *parva*	T				X	
m	Congdon's lomatium	*Lomatium congdonii*	-	-	1B/SC		X	
m	Congdon's tarplant	*Hemizonia parryi* ssp. *congdonii*	-	-	1B/SC		X	
m	Contra Costa goldfields	*Lasthenia conjugens*	E	-	1B//BO		X	
m	Contra Costa manzanita	*Arctostaphylos manzanita* ssp. *laevigata*	-	-	1B		X	
R	Contra Costa wallflower (critical habitat)	*Erysimum capitatum* ssp. *angustatum*	E	CE	1B/BO		X	
	Coulter's goldfields	*Lasthenia glabrata* ssp. *coulteri*	-	-	1B		X	
	Coyote ceanothus	*Ceanothus ferrisae*	E		BO		X	
r	Crampton's tuctoria	*Tuctoria mucronata*	E	CE	1B/BO		X	
	Cut-leaved ragwort	*Senecio eurycephalus* var. *lewisrosei*	-	-	1B		X	
r	Delta coyote-thistle	*Eryngium racemosum*	-	CE	1B/SC		X	

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r	Delta mudwort	*Limosella subulata*	-	-	2		X	
r	Delta tule pea	*Lathyrus jepsonii* var. *jepsonii*	-	-	1B/SC		X	
m	Diablo helianthella	*Helianthella castanea*	-	-	1B/SC		X	
m	Diamond-petaled California poppy	*Eschscholzia rhombipetala*	-	-	1A/SC		X	
m	Dimorphic snapdragon	*Antirrhinum subcordatum*	-	-	1B		X	
	Dissected-leaf toothwort	*Cardamine pachystigma* var. *dissectifolia*	-	-	3		X	
	Douglas' pogogyne	*Pogogyne douglasii* ssp. *parviflora*	-	-	3		X	
m	Drymaria-like western flax	*Hesperolinon drymarioides*	-	-	1B/SC		X	
	Dubious pea	*Lathyrus sulphureus* var. *argillaceus*	-	-	3		X	
	Dwarf downingia	*Downingia pusilla*	-	-	2		X	
m	Dwarf soaproot	*Chlorogalum pomeridianum* var. *minus*	-	-	1B		X	
m	Eel-grass pondweed	*Potamogeton zosteriformis*	-	-	2		X	
m	El Dorado bedstraw	*Galium californicum* ssp. *sierrae*	E	R	1B/BO		X	
	El Dorado County mule ears	*Wyethia reticulata*	-	-	1B/SC		X	
	Engelmann spruce	*Picea engelmannii*	-	-	2		X	
m	English Peak greenbriar	*Smilax jamesii*	-	-	1B		X	
	English sundew	*Drosera anglica*	-	-	2		X	
	Enterprise clarkia	*Clarkia mosquinii* ssp. *xerophila*	-	-	1B/SC		X	
	Feather River stonecrop	*Sedum albomarginatum*	-	-	1B		X	
m	Ferris' milkvetch	*Astragalus tener* var. *ferrisiae*	-	-	1B/SC		X	
m	Few-flowered navarretia	*Navarretia leucocephala* ssp. *pauciflora*	E	CT	1B/BO		X	
	Forked fiddleneck	*Amsinckia vernicosa* var. *furcata*	-	-	SC		X	
	Fountain thistle	*Cirsium fontinale var. fontinale*	E	CE	BO		X	
m	Four-angled spikerush	*Eleocharis quadrangulata*	-	-	2		X	
	Fox sedge	*Carex vulpinoidea*	-	-	2		X	
	Fragrant fritillary	*Fritillaria liliacea*	-	-	1B/SC		X	
	Freed's jewelflower	*Streptanthus brachiatus* ssp. *hoffmanii*	-	-	1B/SC		X	
	Gambel's watercress	*Rorippa gambellii*	E				X	
	Gaviota tarplant	*Hemizonia increscens ssp. villosa*	E	CE			X	
	Gairdner's yampah	*Perideridia gairdneri* ssp. *gairdneri*	-	-	SC		X	
	Golden draba	*Draba aureola*	-	-	1B		X	
m	Greene's tuctoria	*Tuctoria greenei*	E	R	1B/BO		X	
	Hairless popcornflower	*Plagiobothrys glaber*	-	-	1A		X	
m	Hairy orcutt grass	*Orcuttia pilosa*	E	CE	1B/BO		X	
m	Hall's bush mallow	*Malacothamnus hallii*	-	-	1B		X	
	Hall's madia	*Madia hallii*	-	-	1B/SC		X	
	Hall's rupertia	*Rupertia hallii*	-	-	1B		X	
m	Hall's tarplant	*Hemizonia halliana*	-	-	1B		X	
m	Hartweg's golden sunburst	*Pseudobahia bahiifolia*	E	CE	1B/BO		X	
	Hayfield tarplant	*Hemizonia congesta* ssp. *leucocephala*	-	-	3		X	
m	Heartscale	*Atriplex cordulata*	-	-	1B/SC		X	

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m	Heckard's peppergrass	*Lepidium latipes* var. *heckardii*	-	-	1B		X	
m	Henderson's bent grass	*Agrostis hendersonii*	-	-	3/SC		X	
	Hickman's Potentilla	*Potentilla hickmanii*	E	CE	BO		X	
m	Hispid bird's-beak	*Cordylanthus mollis* ssp. *hispidus*	-	-	1B/SC		X	
	Hooked popcornflower	*Plagiobothrys uncinatus*	-	-	1B/SC		X	
	Hoover's calycadenia	*Calycadenia hooveri*	-	-	1B/SC		X	
m	Hoover's eriastrum	*Eriastrum hooveri*	T	-	BO		X	
m	Hoover's spurge	*Chamaesyce hooveri*	T	-	1B/BO		X	
	Horned butterwort	*Pinguicula vulgaris*	-	-	2		X	
m	Hospital Canyon larkspur	*Delphinium californicum* ssp. *interius*	-	-	1B/SC		X	
	Howell's lewisia	*Lewisia cotyledon*	-	-	3		X	
m	Indian Valley brodiaea	*Brodiaea coronaria* ssp. *rosea*	-	CE	1B		X	
	Indian Valley bush mallow	*Malacothamnus aboriginum*	-	-	1B		X	
m	Ione buckwheat	*Eriogonum apricum* var. *apricum*	E	CE	1B/BO		X	
m	Ione manzanita	*Arctostaphylos myrtifolia*	T	-	1B/BO		X	
m	Irish Hill buckwheat	*Eriogonum apricum* var. *prostratum*	-	CE	1B/BO		X	
	Island rush-rose	*Helianthemum greenei*	T				X	
m	Jepson's milkvetch	*Astragalus rattanii* var. *jepsonianus*	-	-	1B		X	
	Jepson's onion	*Allium jepsonii*	-	-	1B/SC		X	
	Keck's checker-mallow	*Sidalcea keckii*	E		BO		X	
m	Kenwood Marsh checkerbloom	*Sidalcea oregana* ssp. *valida*	E	CE	1B/BO		X	
	Kern mallow	*Eremamlche kernensis*	E		BO		X	
m	Klamath manzanita	*Arctostaphylos klamathensis*	-	-	1B/SC		X	
	Kneeland Prairie penny-cress	*Thlaspi montanum var. californicum*	E		BO		X	
	Kruckeberg's jewelflower	*Streptanthus morrisonii* ssp. *kruckebergii*	-	-	1B/SC		X	
	La Graciosa thistle	*Cirsium loncholepis*	E	CT			X	
	Lake County stonecrop	*Parvisedum leiocarpum*	E	CE	BO		X	
m	Large-flowered fiddleneck (critical habitat)	*Amsinckia grandiflora*	E	CE	1B/BO		X	
	Lassen Peak smelowskia	*Smelowskia ovalis* var. *congesta*	-	-	1B/SC		X	
m	Layne's ragwort	*Senecio layneae*	T	R	1B/BO		X	
m	Legenere	*Legenere limosa*	-	-	1B/SC		X	
m	Lesser saltscale	*Atriplex minuscula*	-	-	1B/SC		X	
	Little mousetail	*Myosurus minimus* ssp. *apus*	-	-	3/SC		X	
m	Loch Lomond button-celery	*Eryngium constancei*	E	CE	1B/BO		X	
	Lompoc yerba santa	*Eriodictyon capitatum*	E	R			X	
	Long-haired star-tulip	*Calochortus longebarbatus* var. *longebarbatus*	-	-	1B		X	
	Long-leaved starwort	*Stellaria longifolia*	-	-	2		X	
m	Lost Hills crownscale	*Atriplex vallicola*	-	-	1B/SC		X	
	Lyon's pentachaeta	*Pentachaeta lyonii*	E				X	
m	Mad-dog skullcap	*Scutellaria lateriflora*	-	-	2		X	
m	Madera linanthus	*Linanthus serrulatus*	-	-	1B		X	

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m	Many-flowered navarretia	*Navarretia leucocephala* ssp. *plieantha*	E	E	1B/BO		X	
	Marcescent dudleya	*Dudleya cymosa* spp. *marcescens*	T				X	
m	Marin checkerbloom	*Sidalcea hickmanii* ssp. *viridis*	-	-	1B/SC		X	
	Marin County navarretia	*Navarretia rosulata*	-	-	1B		X	
m	Marin knotweed	*Polygonum marinense*	-	-	3/SC		X	
m	Marin western flax	*Hesperolinon congestum*	T	CT	1B/BO		X	
m	Mariposa clarkia	*Clarkia biloba* ssp. *australis*	-	-	1B		X	
	Mariposa pussy-paws	*Calyptridium pulchellum*	T		BO		X	
m	Marsh checkerbloom	*Sidalcea oregana* ssp. *hydrophila*	-	-	1B/SC		X	
	Marsh sandwort	*Arenaria paludicola*	E	CE	BO		X	
m	Marsh skullcap	*Scutellaria galericulata*	-	-	2		X	
m	Mason's ceanothus	*Ceanothus masonii*	-	R	1B/SC		X	
R	Mason's lilaeopsis	*Lilaeopsis masonii*	-	R	1B/SC		X	
	Merced monardella	*Monardella leucocephala*	-	-	1A/SC		X	
m	Merced phacelia	*Phacelia ciliata* var. *opaca*	-	-	1B/SC		X	
	Metcalf Canyon jewelflower	*Streptanthus albidus ssp, albidus*	E		BO		X	
	Mingan moonwort	*Botrychium minganense*	-	-	2		X	
	Monterey spineflower	*Chorizanthe pungens var. pungens*	T		BO		X	
	Morrison's jewelflower	*Streptanthus morrisonii* ssp. *morrisonii*	-	-	1B/SC		X	
	Mosquin's clarkia	*Clarkia mosquinii*	-	-	1B		X	
	Moss phlox	*Phlox muscoides*	-	-	2		X	
m	Most beautiful jewel-flower	*Streptanthus albidus* ssp. *peramoensus*	-	-	1B		X	
m	Mt. Diablo bird's-beak	*Cordylanthus nidularius*	-	R	1B/SC		X	
	Mt. Diablo buckwheat	*Eriogonum truncatum*	-	-	1A/SC		X	
m	Mt. Diablo fairy lantern	*Calochortus pulchellus*	-	-	1B		X	
m	Mt. Diablo jewelflower	*Streptanthus hispidus*	-	-	1B/SC		X	
m	Mt. Diablo manzanita	*Arctostaphylos auriculata*	-	-	1B		X	
m	Mt. Diablo phacelia	*Phacelia phacelioides*	-	-	1B/SC		X	
m	Mt. Hamilton coreopsis	*Coreopsis hamiltonii*	-	-	1B/SC		X	
m	Mt. Hamilton jewelflower	*Streptanthus callistus*	-	-	1B/SC		X	
	Mt. Hamilton thistle	*Cirsium fontinale* var. *campylon*	-	-	1B/SC		X	
	Mt. Saint Helena morning-glory	*Calystegia collina* ssp. *oxyphylla*	-	-	SC		X	
	Mt. Tamalpais jewelflower	*Streptanthus glandulosus* ssp. *pulchellus*	-	-	1B		X	
m	Mt. Tedoc linanthus	*Linanthus nuttallii* ssp. *howellii*	-	-	1B/SC		X	
	Munz's onion	*Allium munzii*	E				X	
	Munz's tidy-tips	*Layia munzii*	-	-	1B		X	
m	Napa blue grass	*Poa napensis*	E	CE	1B/BO		X	
m	Napa western flax	*Hesperolinon serpentinum*	-	-	1B		X	
	Narrow-leaved daisy	*Erigeron angustatus*	-	-	1B		X	
	Nelson's pepperwort	*Marsilea oligospora*	-	-	3		X	
	Nevin's barberry	*Berberis nevinii*	E				X	

Species Goals[1]	Common Name	Scientific Name	Status[2]			Covered Species Determination		
			Federal	State	Other	Species evaluated in the EWA ASIP	Species considered but not further evaluated in the EWA ASIP	Decision Criteria
	Niles madia	*Madia doris-nilesiae*	-	-	1B		X	
	Nissenan manzanita	*Arctostaphylos nissenana*	-	-	1B/SC		X	
m	North Coast semaphore grass	*Pleuropogon hooverianus*	-	CCE	1B/SC		X	
r	Northern California black walnut (native stands)	*Juglans californica* var. *hindsii*	-	-	1B/SC		X	
	Northern daisy	*Trimorpha acris* var. *debilis*	-	-	2		X	
	Northern spleenwort	*Asplenium septentrionale*	-	-	2		X	
	Nuttall's pondweed	*Potamogeton epihydrus ssp nuttallii*	-	-	2		X	
	Obtuse starwort	*Stellaria obtusa*	-	-	2		X	
	Orcutt's hazardia	*Hazardia orcuttii*		CCE			X	
	Oregon fireweed	*Epilobium oreganum*	-	-	1B/SC		X	
m	Pale-yellow layia	*Layia heterotricha*			1B/SC		X	
m	Pallid manzanita	*Arctostaphylos pallida*	T	CE	1B/BO		X	
m	Palmate-bracted bird's-beak	*Cordylanthus palmatus*	E	CE	1B/BO		X	
m	Panoche peppergrass	*Lepidium jaredii* ssp. *album*	-	-	1B/SC		X	
	Parish's daisy (proposed critical habitat)	*Erigeron parishii*	T				X	
m	Parry's horkelia	*Horkelia parryi*	-	-	1B/SC		X	
	Petaluma popcornflower	*Plagiobothrys mollis* var. *vestitus*	-	-	1A		X	
m	Pincushion navarretia	*Navarretia myersii*	-	-	1B		X	
m	Pine Hill ceanothus	*Ceanothus roderickii*	E	R	1B/BO		X	
m	Pine Hill flannelbush	*Fremontodendron decumbens*	E	R	1B/BO		X	
m	Pitkin Marsh lily	*Lilium pardalinum* ssp. *pitkinense*	E	CE	1B/BO		X	
	Pleasant Valley mariposa lily	*Calochortus clavatus* var. *avius*	-	-	1B/SC		X	
r	Point Reyes bird's-beak	*Cordylanthus maritimus* ssp. *palustris*	-	-	1B/SC		X	
	Point Reyes checkerbloom	*Sidalcea calycosa* ssp. *rhizomata*	-	-	1B		X	
	Pointed broom sedge	*Carex scoparia*	-	-	2		X	
	Prairie wedge grass	*Sphenopholis obtusata*	-	-	2		X	
	Presidio clarkia	*Clarkia franciscana*	E	CE	BO		X	
	Presidio manzanita	*Arctostaphylos hookeri ssp. Ravenii*	E	CE	BO		X	
	Pubescent needlegrass	*Achnatherum lemmonii* var. *pubescens*	-	-	3		X	
	Purple amonle	*Chlorogalum prupureum var. prupureum*	T				X	
	Quincy lupine	*Lupinus dalesiae*	-	-	1B		X	
m	Rawhide Hill onion	*Allium tuolumnense*	-	-	1B		X	
	Rayless layia	*Layia discoidea*	-	-	1B		X	
	Rayless ragwort	*Senecio aphanactis*	-	-	2		X	
m	Recurved larkspur	*Delphinium recurvatum*	-	-	1B/SC		X	
	Red Bluff dwarf rush	*Juncus leiospermus* var. *leiospermus*	-	-	1B		X	
m	Red-flowered lotus	*Lotus rubriflorus*	-	-	1B/SC		X	
m	Red Hills ragwort	*Senecio clevelandii* var. *heterophyllus*	-	-	1B		X	
	Red Hills soaproot	*Chlorogalum grandiflorum*	-	-	1B/SC		X	
	Rincon manzanita	*Arctostaphylos stanfordiana* ssp. *decumbens*	-	-	1B		X	
	Rincon Ridge ceanothus	*Ceanothus confusus*	-	-	1B/SC		X	

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	Robust monardella	*Monardella villosa* ssp. *globosa*	-	-	1B		X	
	Robust spineflower	*Chorizanthe robusta*	E		BO		X	
m	Rock sanicle	*Sanicula saxatilis*	-	R	1B/SC		X	
m	Rose-mallow	*Hibiscus lasiocarpus*	-	-	2		X	
m	Sacramento orcutt grass	*Orcuttia viscida*	E	CE	1B/BO		X	
m	San Antonio Hills monardella	*Monardella antonina* ssp. *antonina*	-	-	3		X	
m	San Benito evening-primrose	*Camissonia benitensis*	T	-	1B/BO		X	
	San Benito spineflower	*Chorizanthe biloba* var. *immemora*	-	-	1B		X	
	San Diego ambosia	*Ambrosia pumila*	PE				X	
	San Diego button-celery	*Eryngium aristulatum* var, *parishii*	E				X	
	San Fernando Valley spineflower	*Chorizanthe parryi var. fernandina*	E	CE			X	
	San Francisco lessingia	*Lessingia germanorum*	E	CE	BO		X	
	San Francisco owl's-clover	*Triphysaria floribunda*	-	-	1B		X	
	Hidden Lake bluecurls	*Trichostema austromontanum ssp. compactum*	T				X	
	San Jacinto Valley crownscale	*Atriplex coronata var. notatior*	E				X	
m	San Joaquin adobe sunburst	*Pseudobahia peirsonii*	T	CE	1B/BO		X	
m	San Joaquin spearscale	*Atriplex joaquiniana*	-	-	1B/SC		X	
m	San Joaquin Valley orcutt grass	*Orcuttia inaequalis*	T	CE	1B/BO		X	
m	San Joaquin woolythreads	*Lembertia congdonii*	E	-	1B/BO		X	
	San Mateo thornmint	*Acanthomintha duttoni*	E	CE	BO		X	
	San Mateo woolly sunflower	*Eriophyllum latilobum*	E	CE	BO		X	
m	Sanford's arrowhead	*Sagittaria sanfordii*	-	-	1B/SC		X	
	Santa Ana River woolly-star	*Eriastrum densiflorum ssp. Sanctorum*	E				X	
	Santa Clara red ribbons	*Clarkia concinna* ssp. *automixa*	-	-	1B/SC		X	
	Santa Clara Valley dudleya	*Dudleya setchellii*	E		BO		X	
	Santa Cruz Mtns. Pussypaws	*Calyptridium parryi* var. *hesseae*	-	-	3		X	
m	Santa Cruz tarplant	*Holocarpha macradenia*	T	CE	1B/BO		X	
	Santa Monica Mountains dudleya	*Dudleya cymosa* spp. *ovatifolia*	T				X	
m	Saw-toothed lewisia	*Lewisia serrata*	-	-	1B/SC		X	
	Scalloped moonwort	*Botrychium crenulatum*	-	-	1B/SC		X	
	Scott's Valley polygonum	*Polygonum hickmanii*	PE				X	
m	Sebastopol meadowfoam	*Limnanthes vinculans*	E	CE	1B/BO		X	
	Serpentine cryptantha	*Cryptantha clevelandii* var. *dissita*	-	-	1B		X	
	Serpentine monkeyflower	*Mimulus brachiatus*	-	-	3		X	
m	Shaggyhair lupine	*Lupinus spectabilis*	-	-	1B/SC		X	
m	Sharsmith's harebell	*Campanula sharsmithiae*	-	-	1B/SC		X	
m	Sharsmith's onion	*Allium sharsmithae*	-	-	1B		X	
m	Shasta clarkia	*Clarkia borealis* spp. *arida*	-	-	1B/SC		X	
m	Shasta snow-wreath	*Neviusia cliftonii*	-	-	1B		X	
	Shining navarretia	*Navarretia nigelliformis* ssp. *radians*	-	-	1B		X	
	Shore sedge	*Carex limosa*	-	-	2		X	

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m	Showy Indian clover	*Trifolium amoenum*	E	-	1B/BO		X	
m	Showy madia	*Madia radiata*	-	-	1B		X	
m	Silky cryptantha	*Cryptantha crinita*	-	-	1B/SC		X	
	Siskiyou Mtns. Huckleberry	*Vaccinium coccineum*	-	-	3		X	
	Slender bulrush	*Scirpus heterochaetus*	-	-	2		X	
m	Slender orcutt grass	*Orcuttia tenuis*	T	CE	1B/BO		X	
	Slender sedge	*Carex lasiocarpa*	-	-	2		X	
	Slender-horned spineflower	*Dodecahema leptoceras*	E				X	
	Slender-leaved pondweed	*Potamogeton filiformis*	-	-	2		X	
m	Slough thistle	*Cirsium crassicaule*	-	-	1B/SC		X	
	Small's southern clarkia	*Clarkia australis*	-	-	1B		X	
	Snow Mountain buckwheat	*Eriogonum nervulosum*	-	-	1B/SC		X	
	Socrates mine jewelflower	*Streptanthus brachiatus* ssp. *brachiatus*	-	-	1B/SC		X	
R	Soft bird's-beak	*Cordylanthus mollis* ssp. *mollis*	E	R	1B		X	
m	Sonoma alopecurus	*Alopecurus aequalis* var. *sonomensis*	E	-	1B/BO		X	
	Sonoma beardtongue	*Penstemon newberryi* var. *sonomensis*	-	-	1B		X	
	Sonoma ceanothus	*Ceanothus sonomensis*	-	-	1B/SC		X	
	Sonoma manzanita	*Arctostaphylos canescens* ssp. *sonomensis*	-	-	1B		X	
m	Sonoma spineflower	*Chorizanthe valida*	E	CE	1B/BO		X	
m	Sonoma sunshine	*Blennosperma bakeri*	E	CE	1B/BO		X	
m	Spiny-sepaled button-celery	*Eryngium spinosepalum*	-	-	1B/SC		X	
	Spreading navarretia	*Navarretia fossalis*	T				X	
	Springville clarkia	*Clarkia springvillensis*	T	CE	BO		X	
	Stebbins' lewisia	*Lewisia stebbinsii*	-	-	1B/SC		X	
	Stebbins' madia	*Madia stebbinsii*	-	-	1B/SC		X	
m	Stebbins' morning-glory	*Calystegia stebbinsii*	E	CE	1B/BO		X	
	Stebbins' phacelia	*Phacelia stebbinsii*	-	-	1B/SC		X	
	Sticky pyrrocoma	*Pyrrocoma lucida*	-	-	1B		X	
	Stinkbells	*Fritillaria agrestris*	-	-	4		X	
	Streamside daisy	*Erigeron biolettii*	-	-	3		X	
m	Succulent owl's-clover	*Castilleja campestris* ssp. *succulenta*	T	CE	1B/BO		X	
R	Suisun Marsh aster	*Aster lentus*	-	-	1B/SC		X	
R	Suisun thistle	*Cirsium hydrophilum* var. *hydrophilum*	E	-	1B/BO		X	
	Suksdorf's milkvetch	*Astragalus pulsiferae* var. *suksdorfii*	-	-	1B/SC		X	
	Sweet marsh ragwort	*Senecio hydrophiloides*	-	-	3		X	
	Talus collomia	*Collomia larsenii*	-	-	2		X	
	Talus fritillary	*Fritillaria falcata*	-	-	1B/SC		X	
m	Tehama County western flax	*Hesperolinon tehamense*	-	-	1B/SC		X	
	The Lassics sandwort	*Minuartia decumbens*	-	-	1B/SC		X	
m	Thread-leaved beardtongue	*Penstemon filiformis*	-	-	1B/SC		X	
	Thread-leaved brodiaea	*Brodiaea filifolia*	T				X	

Species Goals[1]	Common Name	Scientific Name	Status[2]			Covered Species Determination		
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	Three Peaks jewelflower	*Streptanthus morrisonii* ssp. *elatus*	-	-	1B/SC		X	
	Tiburon buckwheat	*Eriogonum luteolum* var. *caninum*	-	-	3		X	
m	Tiburon Indian paintbrush	*Castilleja affinis* ssp. *neglecta*	E	CT	1B/BO		X	
m	Tiburon jewelflower	*Streptanthus niger*	E	CE	1B/BO		X	
m	Tiburon Mariposa lily	*Calochortus tiburonensis*	T	CT	1B/BO		X	
	Tracy's sanicle	*Sanicula tracyi*	-	-	1B/SC		X	
m	Tree-anenome	*Carpenteria californica*	-	CT	1B/SC		X	
	Triple-ribbed milk-vetch	*Astragalus tricarinatus*	E				X	
	Tuolumne fawn lily	*Erythronium tuolumnense*	-	-	1B		X	
	Two-carpellate western flax	*Hesperolinon bicarpellatum*	-	-	1B/SC		X	
	Upswept moonwort	*Botrychium ascendens*	-	-	2/SC		X	
	Veiny monardella	*Monardella douglasii* ssp. *venosa*	-	-	1B/SC		X	
	Ventura Marsh milk-vetch	*Astragalus pycnostachyus var. lanosissimus*	E	CE			X	
	Verity's dudleya	*Dudleya verityi*	T				X	
m	Vernal pool smallscale	*Atriplex persistens*	-	-	1B		X	
	Water bulrush	*Scirpus subterminalis*	-	-	2		X	
	Water howellia	*Howellia aquatilis*	T		BO		X	
	Western campion	*Silene occidentalis* ssp. *longistipitata*	-	-	3/SC		X	
	Western goblin	*Botrychium montanum*	-	-	2		X	
	Western leatherwood	*Dirca occidentalis*	-	-	1B		X	
m	White-rayed pentachaeta	*Pentachaeta bellidiflora*	E	CE	1B/BO		X	
m	White sedge	*Carex albida*	E	CE	1B/BO		X	
	White-stemmed clarkia	*Clarkia gracilis* ssp. *albicaulis*	-	-	1B		X	
	White-stemmed pondweed	*Potamogeton praelongus*	-	-	2		X	
	Wilkin's harebell	*Campanula wilkinsiana*	-	-	1B/SC		X	
	Woolly meadowfoam	*Limnanthes floccosa* ssp. *floccosa*	-	-	2		X	
	Woolly violet	*Viola tomentosa*	-	-	1B		X	
	Woolly-headed lessingia	*Lessingia hololeuca*	-	-	3		X	
	Wright's trichocoronis	*Trichocoronis wrightii* var. *wrightii*	-	-	2		X	
	Yadon's piperia	*Piperia yadonii*	E		BO		X	
m	Yellow larkspur	*Delphinium luteum*	E	R	1B/BO		X	

APPENDIX B
MODELING DESCRIPTION

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List of Acronyms

(AFRP) .... Anadromous Fisheries Restoration Program
(ASIP) .... Action Specific Implementation Plan
(ATSP) .... Automated Temperature Selection Procedure
(CDFG) .... California Department of Fish and Game
(CESA) .... California Endangered Species Act
(COA) .... Coordinated Operations Agreement
(CVP) .... Central Valley Project
(DMC) .... Delta-Mendota Canal
(DSA) .... Depletion Study Area
(DSM2) .... Delta Simulation Model II
(DWR) .... California Department of Water Resources
(E/I) .... Export/Inflow
(EIS/EIR) .... Environmental Impact Statement/Environmental Impact Report
(ESA) .... Federal Endangered Species Act
(EWA) .... Environmental Water Account
(FERC) .... Federal Energy Regulatory Commission
(FRSA) .... Feather River Service Area
(GATAER) .... Graphical and Tabular Analysis for Environmental Resources
(ID) .... Irrigation District
(IMPLAN) .... Impact Analysis for Planning
(I-O) .... input-output
(JPOD) .... Joint Point of Diversion
(LOD) .... level of development
(M&I) .... municipal and industrial
(MAF) .... million acre-feet
(MAF/Yr) .... MAF per year
(MOU) .... Memorandum of Understanding
(NOAA Fisheries) .... National Oceanic and Atmospheric Administration, National Marine Fisheries Service
(NWR) .... national wildlife refuge
(PG&E) .... Pacific Gas and Electric Company
(Reclamation) .... U.S. Bureau of Reclamation
(ROD) .... Record of Decision
(RWQCB) .... Regional Water Quality Control Board
(SWP) .... State Water Project
(SWRCB) .... State Water Resources Control Board
(TAF) .... thousand acre-feet
(TCD) .... Temperature Control Device
(TUs) .... Temperature units
(UCCE) .... University of California Cooperative Extension
(USFWS) .... U.S. Fish and Wildlife Service
(WA) .... Water Agency
(WD) .... Water District

APPENDIX B
MODELING DESCRIPTION

1.0 Introduction

The Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the Environmental Water Account (EWA) Program includes an evaluation of potential impacts upon environmental resources that may result from the purchase, storage, and conveyance of EWA assets and the actions taken by the EWA to benefit fish populations. Flow-related effects for the resource areas included for analysis in the EWA EIS/EIR are based upon the results of hydrologic modeling, including the CALSIM II 2001 benchmark study (BST_2001D10A), and other related studies as described in this attachment.

The EWA EIS/EIR provides an assessment of the Flexible Purchase Alternative, the Fixed Purchase Alternative, and the No Action/No Project Alternative. Under the Flexible Purchase Alternative, EWA agencies may purchase between 35 thousand acre-feet (TAF) and 600 TAF annually from areas in the Upstream from the Delta Region and the Export Service Area. The Fixed Purchase Alternative represents management of annual EWA water assets of 185 TAF from areas within the Upstream from the Delta Region and the Export Service Area, with a maximum of 35 TAF obtained from the Upstream from the Delta Region. The No Action/No Project Alternative is defined as the reasonable foreseeable future condition without the EWA, based on legal and regulatory constraints. Detailed descriptions of these alternatives are provided in Chapter 2 of the EWA EIS/EIR. For purposes of the ASIP, the EWA Proposed Action is identical to the Flexible Purchase Alternative and the basis of comparison is identical to the Baseline Condition, as referred to in this document.

The resource effect analyses evaluate the potential effects of the Proposed Action in a quantitative manner, based on the hydrologic, water temperature, salmon mortality modeling, and the CVP and SWP pumping plants salvage calculations performed for the project, and described in this document. Additionally, as described in Chapter 2 of the EWA EIS/EIR, the Baseline Condition represents the No Action/No Project Alternative, therefore, there would be no utility in developing an additional simulation and conducting such a comparison. The Fixed Purchase Alternative is not a part of the EWA Proposed Action, therefore, the Fixed Purchase Alternative and the No Action/No Project Alternative are not specifically addressed in this document.

This document provides detailed information regarding the hydrologic modeling tools, primary assumptions, model inputs, and methodologies used to evaluate potential environmental effects of the EWA Proposed Action upon the resource areas that may be affected by the coordinated operations of the SWP and CVP facilities (Projects) within the EWA action area. The evaluation of potential effects compares the effects of conveying water from the area of purchase to the Delta and the effect of pumping that water from the Delta via the California Aqueduct and the Delta Mendota Canal to O'Neill Forebay. The area of analysis (study region or action area) for each resource topic is defined within the resource-specific chapter of the EWA EIS/EIR.

The effect assessments in the EWA EIS/EIR for fishery resources are based on comparisons made between computer model simulations developed to represent hydrologic, regulatory, structural and operational parameters for a Baseline Condition (existing, without project) and the Flexible Purchase Alternative (future, with project). Modeling tools used to simulate these conditions include the Department of Water Resource's (DWR's) CALSIM II (released July 23, 2002, with a 2001 level of development [LOD]) the U.S. Bureau of Reclamation's (Reclamation's) water temperature and salmon mortality models, as well as related pre- and post-processing applications utilized to develop the simulations and evaluate the Proposed Action relative to the basis of comparison.

Because there can be no certainty in forecasting which combination of potential water assets will be available to the EWA Program on a year to year basis, the resource area analyses are subject to error regardless of the assets selected for evaluation. In an effort to capture the maximum effect of EWA purchases by resource area, multiple methods of simulation post processing were employed. Specifically, the first method describes the maximum effects on the locations of water purchase and the second method describes the maximum effects of utilizing the purchased water.

In the first method, four post-processing simulations were performed to identify regional effects of EWA water purchases. Each simulation utilized a single specific asset from the Upstream from the Delta Region (Sacramento River, Feather River, Yuba River, American River, and San Joaquin River) to meet the available July through September EWA export. The simulation was performed for each year of the modeling period of record. Since no single region has sufficient assets to meet a 600 TAF export need, there are many years when all of a region's assets are used but EWA exports are not met. For this methodology, however, regional upstream effects on vegetation, wildlife, visual, recreation, and flood control resource areas are maximized (magnitude of reservoir drawdown, amount of idled acreage) due to the frequent and total use of the assets. Detailed results from these four simulations are provided in Appendix H, Summary and Technical Output for the Graphical and Tabular Analysis for Environmental Resources (GATAER), of the EWA EIS/EIR.

Because any single simulation in the first method cannot meet the total EWA export potential, a second method was used to maximize effects associated with EWA exports. This second method was incorporated in a single simulation using all available EWA assets from the Upstream from the Delta Region to meet the maximum EWA export potential (limited to 600 TAF). The simulation was performed for each year of the modeling period of record. This methodology was used for the analysis of potential effects on fish, water quality, Project water supply & management, and power resource areas because it imposes the largest overall change to instream flows and Delta operations. Detailed results from this simulation are provided in Appendix H of the EWA EIS/EIR.

Additionally, two water purchase scenarios that are subsets of the second method described above were created to better evaluate potential effects on aquatic resources within the Delta Region. The Delta assessment involved consideration of two separate EWA water purchase scenarios under the Proposed Action: 1) Maximum Water Purchase Scenario; and 2) Typical Water Purchase Scenario. The Typical Water Purchase Scenario assumes a range of EWA asset water purchases from the Upstream from the Delta Region depending upon water year type. Although referred to as a "typical" scenario, this scenario, like the Maximum Water Purchase

Scenario, assumes that all unused Delta export pumping capacity for the summer months (July through September) would be available to the EWA Program. While this assumption permits evaluation of the potential worst-case for EWA export pumping, there are other water acquisition and transfer programs and SWP/CVP programs that have priority access to use this available pumping capacity. Therefore, this scenario does not necessarily represent the conditions that would be expected to occur for any given year of the program. Instead, this scenario may be considered to represent conditions that are more likely to occur than those assumed for the Maximum Water Purchase Scenario. The reasons for developing these two separate water purchase scenarios and the key assumptions for each are provided in Section 2.2.2.2.

This document also describes the evaluation assumptions and methodologies developed to determine the net benefit to Delta fish species of primary management concern based upon an assessment of anticipated reductions in fish salvage at the Projects' Delta facilities. The results of the Delta salvage evaluation are included in this document, as well as in Chapter 9 of the EWA EIS/EIR, and in Chapter 4 of the Action Specific Implementation Plan (ASIP).

1.1 Purpose and Implementation of the EWA Program

The purpose of the EWA is to provide a highly flexible, immediately implementable, water management strategy with a primary focus of protecting at-risk native fish species affected by CVP/SWP operations and facilities through improvement of aquatic habitat conditions and contribution to the recovery of Delta-dependent native fish species of concern. The EWA is intended to improve aquatic habitat conditions primarily by using EWA assets to reduce CVP/SWP Delta export pumping during periods (months) critical to fish species listed as threatened, endangered or as candidate species under either the Federal Endangered Species Act (ESA) or the California Endangered Species Act (CESA), or both. Additionally, the EWA Program is designed to provide for the timely management of water resources in response to changing environmental conditions and fish protection needs, delivery of reliable water supplies to south of Delta water users, and prevention of uncompensated water costs to the Projects' water users.

The EWA Proposed Action (Flexible Purchase Alternative) would permit the purchase and acquisition of up to 600 TAF of water assets annually, to apply toward the attainment of CALFED goals and EWA objectives to reduce existing conflicts between the various uses of water resources in the Delta. Implementation of the Proposed Action assumes maximum surface water contributions from identified available contributory sources (see ASIP, Chapter 2). Asset acquisition and water management under the Proposed Action encompasses areas both in the Upstream from the Delta Region and the Export Service Area.

The EWA agencies can utilize variable operational assets and acquire fixed assets (assets), and then allocate water to improve targeted fisheries resources (fish actions or EWA actions). Variable operational assets include flexibility in regulatory requirements (relaxation of Export/Inflow (E/I) ratio for the purpose of providing benefits to fish) and SWP pumping of instream improvement flows upstream from the Delta utilizing Central Valley Project Improvement Act section 3406 b(2) (CVPIA b(2)) and Ecosystem Restoration Program (ERP) water. Fixed assets are water purchased from willing sellers. The EWA agencies evaluate the available assets and select appropriate actions according to a monthly accounting system and practices as determined by the needs of the system and availability of water.

The CALFED agencies managing the EWA Program consider a variety of factors or variables in their decision-making process regarding water purchases prior to and during each water year. In this manner, the agencies must adaptively manage the program to ensure sufficient assets are acquired to enable the agencies to provide benefit to Delta fish resources. Several key factors that affect this decision-making process are listed below:

- The amount of funding available for that years water purchases.
- The amount of export capacity available to the EWA at the Banks and Tracy pumping plants during periods that the EWA must convey water through the Delta to O'Neill Forebay.
- The amount of water that will be purchased upstream of the Delta, which depends on the available export capacity, the amount of funds available for water purchases, the amount of EWA water required that year, and the amount of water available for purchase.
- The amount of variable assets that may be available in a specific year, especially with respect to the amount of water the EWA may gain through relaxation of the E/I ratio.
- The amount of CVPIA b(2) water available to support pumping reductions at the CVP's Tracy Pumping Plant.
- Unknown and variable hydrologic conditions.
- Unknown and variable climatic conditions, with ambient temperature being the most important climatic variable because of the affect of water temperature on fish migration, spawning, and other life stages.

2.0 Effect Analysis Framework

This section describes the effect analysis framework developed to evaluate potential flow-related effects upon aquatic resources due to implementation of the EWA Program. Specifically, the hydrologic and related modeling analyses (water temperature and salmon mortality) and post-processing applications were utilized to simulate the operations associated with the Proposed Action. The overall intent of the modeling simulation comparisons was to evaluate the potential effects of conveying EWA assets (water) from the area of purchase (Upstream from the Delta Region) to the Delta and the effects within the Delta associated with pumping the water from the Delta via the CVP and SWP facilities to the O'Neill Forebay. The results of the modeling simulation comparisons are presented in the EWA EIS/EIR Chapter 9, Fisheries and Aquatic Ecosystems; and Chapter 4 of the ASIP.

The effect analysis framework also describes the evaluation of the benefits realized for Delta-dependent fish species that result from the implementation of the EWA fish actions. The level of benefit derived from the Proposed Action (Flexible Purchase Alternative) is determined based upon calculations of anticipated reductions in fish salvage at the Projects' Delta pumping facilities. Reductions in fish salvage would occur due to implementation of the EWA fish actions that reduce export pumping volumes during months when fish species of concern are known to be present in the Delta.

2.1 Models Used for the Hydrologic Effect Analysis

Computer simulation models of water systems provide a means for evaluating changes in system characteristics such as carryover storage, reservoir water elevation, river flow rate and power generation, as well as the effects of these changes on environmental parameters such as water temperature and early-lifestage Chinook salmon survival. The models used to simulate the basis of comparison (Baseline Condition) and Proposed Action (Flexible Purchase Alternative) include the following:

- DWR and Reclamation Simulation (CALSIM II) model of the integrated CVP and SWP system operations;
- Yuba River Basin Model (HEC-5) developed by Bookman-Edmonston Engineering, Inc. in collaboration with DWR;
- Post Processing Tool for the evaluation of EWA water purchases (EWA Water Purchases.xls);
- Post Processing Tool to route the EWA water purchases and produce the “virtual” CALSIM II output databases (EWA Routing.xls);
- Reclamation Trinity, Shasta, Whiskeytown, Oroville, and Folsom reservoir water temperature models;
- Reclamation American, Feather, and Sacramento river water temperature models;
- Reclamation American and Sacramento river early-lifestage Chinook salmon mortality models;
- GATAER Tool; and
- DWR Delta Simulation Model II (DSM2); the delta hydrodynamic and salinity model for water quality.

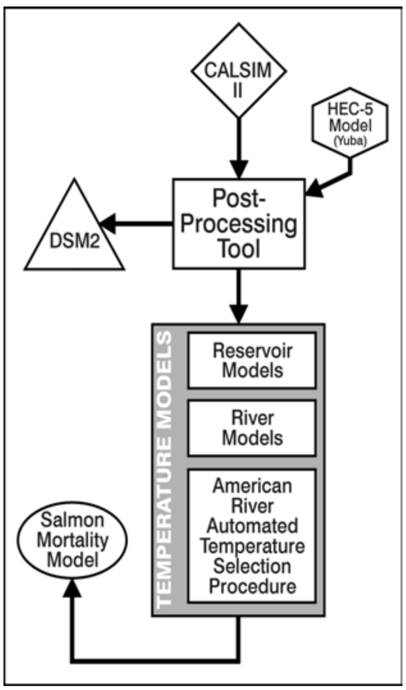

Figure 1
Schematic diagram of the hydrologic modeling process

A schematic diagram illustrating the hydrologic modeling process is provided in Figure 1. CALSIM II provides a benchmark monthly simulation of the CVP and SWP water operations without any EWA actions. Output from CALSIM II and the HEC-5 model were then used as input to post-processing tools, EWA Water Purchase.xls and EWA Routing.xls, to develop the EWA Actions and the “virtual” CALSIM II output databases for the EWA analysis. CALSIM II provides hydrologic information for the reservoirs (inflows, reservoir releases, and storage), rivers (flow), and other operating parameters (Project pumping). Many of these parameters are used as effect indicators in the EIS/EIR (see Chapters 9 for additional detail; also see GATAER output in Appendix H of the EWA EIS/EIR).

The "virtual" CALSIM II output databases were then used to generate the inputs required for the DSM2 and temperature models. The temperature model output was then used to generate the inputs to the early lifestage Chinook salmon mortality models.

Finally, the GATAER tool was used to generate the information needed for the effect analysis in the form of tables and graphs for the outputs of the previous modeling.

These models and related post-processing tools are described in the following sections.

2.1.1 CALSIM II Model

CALSIM II is currently DWR's and Reclamation's primary operations and planning model for SWP and CVP project operations. The model simulates CVP and SWP system operations and the hydrologic effects of those operations within the geographical area affected by CVP and SWP facilities, including the Delta. The major Central Valley rivers, reservoirs and Project facilities are represented by a network of computation points or nodes.

CALSIM II uses a mass balance approach to simulate the occurrence, regulation, and movement of water from one river reach (computation point or node) to another. At each node, various physical processes (e.g., surface water inflow or accretion, flow from another node, groundwater accretion or depletion, and diversion) can be simulated or assumed. Operational constraints, such as reservoir size and seasonal storage limits or minimum flow requirements, also are defined for each node. The model uses a monthly time step. Accordingly, flows are specified as a mean flow for the month, and reservoir storage volumes are specified as end-of-month content.

CALSIM II simulates monthly operations of the following water storage and conveyance facilities:

- Trinity, Lewiston, Whiskeytown, and Shasta/Keswick reservoirs (CVP);
- Spring Creek and Clear Creek tunnels (CVP);
- Lake Oroville (SWP);
- Folsom Reservoir and Lake Natoma (CVP);
- New Melones Reservoir (CVP);
- Millerton Lake (CVP);
- Tracy (CVP), Contra Costa (CVP), and Banks (SWP) pumping plants;
- San Luis Reservoir (shared by CVP and SWP); and
- East Branch and West Branch SWP reservoirs.

To varying degrees, nodes also define SWP/CVP conveyance facilities including the Tehama-Colusa, Corning, Folsom-South, and Delta-Mendota Canals and the California Aqueduct.

Other non-SWP/CVP systems tributary to the Delta are also modeled in CALSIM II, including:

- New Don Pedro Reservoir;
- Lake McClure; and
- Eastman and Hensley Lakes.

The model simulates one month of operation at a time, sequentially from one month to the next, and from one year to the next for 72 years. Each decision that the model makes regarding stream flow regulation is the result of defined operational requirements and constraints (e.g., flood control storage limitations, minimum instream flow requirements, Delta outflow requirements, diversion assumptions) or operational rules (e.g., preference among reservoirs for releasing water). Certain decisions, such as the definition of water year type, are triggered once a year, which affects water delivery allocations and specific stream flow requirements. Other decisions, such as specific Delta outflow requirements, are dynamic from month-to-month. CALSIM II output is represented by flow or storage conditions at each node on a mean monthly basis.

Although a set of EWA actions is built into the CALSIM II model, the actions in the model do not match the EWA actions evaluated in the EWA EIS/EIR. Because the intent of the analysis performed in the EIS/EIR is specifically to evaluate the EWA Program, the modeling operations performed with CALSIM II were halted before the model encountered the conditions specific to EWA implementation. The CALSIM II benchmark study "wrapper" included regulatory constraints defined to include D-1485 through CVPIA b(2).

This was done so that the program conditions pertinent to the EWA Proposed Action (Flexible Purchase Alternative) would be analyzed separately from all of the other CALSIM II parameters. After the modeling process utilizing CALSIM II was halted, the post processing tools (EWA Water Purchase.xls and EWA Routing.xls) were used to evaluate the conditions specific to EWA and its implementation.

2.1.2 Yuba River Basin Model

The Yuba River Basin Model is a HEC-5 model that has been developed and maintained by Bookman-Edmonston Engineering, Inc. in cooperation with DWR. Bookman-Edmonston Engineering, Inc. continues to collaborate with DWR to refine the system's operating criteria and update information on facilities, inflows (unimpaired flows), demands, and fishery flow requirements (Bookman-Edmonston 2000). The original HEC-5 operational parameters and criteria were obtained from DWR's HEC-3 model and these assumptions have undergone periodic modifications to reflect operational changes within the system as they have occurred.

HEC-5 is a general purpose program that simulates the operation of flood control and water conservation systems. Like CALSIM II, it relies on mass balance reservoir routing logic to simulate the occurrence, regulation, and movement of water from one river reach (computation point or node) to another. Various physical processes (e.g., surface water inflow or accretion, evaporation rates, flow from another node, groundwater accretion or depletion, and diversions) are simulated or assumed. Operational constraints, such as reservoir size, seasonal storage limits, minimum power generation quotas, or minimum flow requirements, also are defined for each node. The HEC-5 model uses a monthly time-step and an upstream-to-downstream procedure to simulate the operations of major water facilities in the Yuba River Basin (Bookman-Edmonston 2000).

2.1.3 EWA Water Purchases.xls Post Processing Tool

The EWA Water Purchase.xls spreadsheet post-processing tool was developed to compute the magnitude and timing of potential EWA actions. Development of this tool was necessary because the CALSIM II model is presently incapable of simulating the range of EWA actions contemplated for the Flexible Purchase Alternative evaluated in the EWA EIS/EIR. Results obtained using EWA Water Purchase.xls post processing tool were then used in the EWA Routing.xls post processing tool. (Refer to Section 2.1.4.)

The EWA Water Purchases.xls spreadsheet post-processor tool was utilized to perform the following functions:

- Redistribute SWP and CVP Delta exports during July, August, and September;
- Identify EWA Delta export volumes for July, August, and September;
- Identify EWA upstream from the Delta water sources used for exports;
- Perform an initial upstream from the Delta routing to check operational constraints; and
- Identify carriage water requirements associated with the EWA actions.

These functions are described in greater detail in the following sections.

2.1.3.1 Redistribution of State Water Project/Central Valley Project Delta Exports

The CALSIM II simulation results include Delta export operations at the Banks and Tracy pumping plants. An examination of the pattern of SWP/CVP exports during the summer months (July through September) shows a model preference for using nearly all of the available Delta export capacity in September with decreasing usage in August and July. This export pattern makes it difficult or, in some cases, impossible to export EWA assets that are available in August and September. For example, EWA assets obtained from crop idling in August and September would be unusable by the EWA program if the water cannot be exported in those same months. Similarly, use of water assets obtained from groundwater substitution or surface water purchases would be limited to those months when Delta export capacity is available to the EWA Program at the Projects' pumps.

The EWA Water Purchase.xls Tool was utilized to redistribute SWP/CVP summer exports during the July through September period to provide for use of EWA assets throughout these months. This redistribution assumed that the total amount of SWP/CVP exports for the summer would not be altered from the amount in the CALSIM II simulation results (referred to as the unaltered condition) and that DWR and Reclamation would cooperatively resolve any issues that arise related to SWP/CVP Coordinated Operations Agreement (COA) responsibilities, as is done on a regular basis under current practices.

Because the redistribution of SWP/CVP Delta exports over the summer months would alter the timing of releases from upstream Project reservoirs, control was maintained on maximum and minimum releases. Redistribution of exports was not allowed to increase Keswick releases above 15,000 cubic feet per second (cfs), Oroville releases above 12,000 cfs, and Nimbus releases above 5,000 cfs. Minimum releases from the Project reservoirs were identified as those necessary for instream environmental requirements or diversion (Wilkins Slough). In the post processor tool, releases from the Project reservoirs for the summer period were temporally altered in response to the redistribution of exports, but were in total volume no more or less than under the "unaltered condition". In real-time, however, DWR and Reclamation operators would have to approve this type of operation on a case-by-case basis.

2.1.3.2 EWA Delta Export Volumes (July through September)

Subsequent to the redistribution of SWP/CVP exports, the EWA Water Purchase.xls tool was used to determine the amount of export capacity available for EWA assets. These calculations were based on the unused Banks and Tracy pumping plant capacities and allowable E/I ratio, as described below.

The initial determination of export capacity available for EWA asset water was calculated for the Tracy Pumping Plant as the difference between the monthly CVP export (average flow rate) and the pumping plant capacity, 4,600 cfs. At the Banks Pumping Plant, the initial export capacity available for EWA asset water was calculated as half of the difference between the monthly SWP export (average flow rate) and the authorized pumping plant capacity, 6,680 cfs, plus, the EWA variable asset, 500 cfs. In instances where CVP pumping at the Banks Pumping Plant did not require half of the difference, the unused share of this capacity was available for EWA use (see EWA EIS/EIR, Chapter 2, Relaxation of the Section 10 Constraint).

SWP/CVP exports from the Delta are subject to restrictions imposed by the E/I ratio. EWA exports were assumed to comply with this ratio; therefore in some months, available EWA exports were further limited (or controlled) by the E/I ratio. Because increasing EWA exports above the E/I ratio to 0.65 during the July to September period would incur an immediate 35 percent (1.00 - 0.65) loss in EWA water entering the Delta, there was no attempt to maximize EWA exports with the E/I ratio controlled.

2.1.3.3 EWA Upstream from the Delta Region Water Sources

Potential upstream from the Delta EWA assets are described in Chapter 2 of the EWA EIS/EIR. Identifying the location, amount, and type of potential individual water purchases in the Upstream from the Delta Region is critical to determining the instream flow, water temperature, reservoir storage change, and potential water quality effects of the EWA Program. There are numerous possible combinations of water purchases in the Upstream from the Delta Region. Multiple studies to analyze all of the combinations were not feasible because of the time and cost of such an effort.

Because the assets are of varying quantity and type (surface water supplies and/or groundwater supplies), priorities should be assigned to the assets based on the ability of the source to effectively correspond with the temporal EWA export capability. To that end, as listed below, surface water supplies generally were given high priority because of their ability to be used at nearly any time; groundwater substitution supplies were assigned the next highest priority, and supplies made available from crop idling was given the lowest priority. In many years, some portion of all of the available asset types were used in order to maximize the amount of EWA export water.

The EWA agencies prioritized the types and amounts of water purchases in the Upstream from the Delta Region, as follows:

- Water will be purchased first from the Upstream from the Delta Region, limited by the available SWP and CVP export capacity, and second from sellers in the Export Service Area.

- Purchases from reservoir storage will be used before any other purchase option is pursued.
- Stored groundwater purchases will be pursued as a second option after all reservoir storage purchases have been utilized.
- Groundwater substitution purchases will occur if more water were needed than can be obtained from reservoir storage and stored groundwater purchases.
- Water purchases obtained from idling rice will be pursued as a final option if more water were required to satisfy EWA requirements.
- Idling rice in the Feather River Basin will be pursued before idling rice in the Sacramento River Basin because some water from Sacramento River purchases could not be stored in Lake Shasta during April, May, and June when instream water temperature obligations require the water to be released.

2.1.3.4 Upstream from the Delta Region EWA Water Routing

Once the Upstream from the Delta Region EWA assets were selected and total quantity assumed for the specific analysis for a given month, the water was routed through the system of reservoirs and rivers conveying the water to and through the Delta. This routing imposed the appropriate operational constraints and allowed for the computation of changes in reservoir storage resulting from the proposed EWA operations. Physical system limitations were complied with in all months that EWA assets were acquired or used.

<u>Oroville Reservoir Storage</u>

The following discussion on reservoir storage is specific to Oroville Reservoir and is presented to illustrate why there are monthly operational changes in upstream reservoirs caused by EWA purchases. A similar discussion would describe the conditions at Shasta Reservoir, although the actual net changes in reservoir storage would be less.

CVP/SWP monthly reservoir operations would be altered by the implementation of the EWA Flexible Purchase Alternative. Exactly how the reservoirs would be affected is a function of the monthly pattern of CVP/SWP Delta exports, which in turn dictates the availability of monthly export capacity for the EWA.

CALSIM II modeling of the Baseline Condition favors SWP Delta export pumping in September with less reliance on export pumping in August and July. Oroville releases for SWP export pumping also uses the same export-pumping pattern. As a consequence of the timing of releases for SWP export pumping, Oroville storage remains higher in July and August than it would be if SWP export pumping (and consequently releases) occurred more evenly throughout July through September.

To illustrate differences in monthly Oroville storage associated with alternative timing of SWP exports, the CALSIM II Baseline Condition simulation was post-processed to simulate a more even distribution of SWP exports from July through September. This post-processing did not alter the total July through September SWP export volume; it only changed the monthly pattern of export pumping. In the following discussion, this post-processed simulation is referred to as the "Alternative (Alt) Baseline."

Figure 2 illustrates the average Oroville end-of-month storage for the 1922-1993 modeling period for the Baseline Condition, Alt Baseline, and Flexible Purchase Alternative simulations. The end of June reservoir storages for the Baseline and Alt Baseline are identical as are the end of September storages for the Baseline and Alt Baseline. Only the July and August storages differ between these simulations, reflecting the alternative SWP Delta export patterns. As Figure 2 shows, SWP export pumping in September under the Baseline Condition simulation results in higher Oroville storage during July and August.

Also shown in Figure 2 is a trace of Oroville storage from the EWA Flexible Purchase Alternative simulation. This trace shows that Oroville storage at the end of June is higher than both of the Baseline and Alt Baseline Conditions simulations because of the preservation of water from idled lands in months prior to July. In July and August, the Oroville storage under the Flexible Purchase Alternative falls below the Baseline Condition storage but is higher than the "Alt Baseline" storage. By the end of September, Oroville storage is essentially identical for all three simulations.

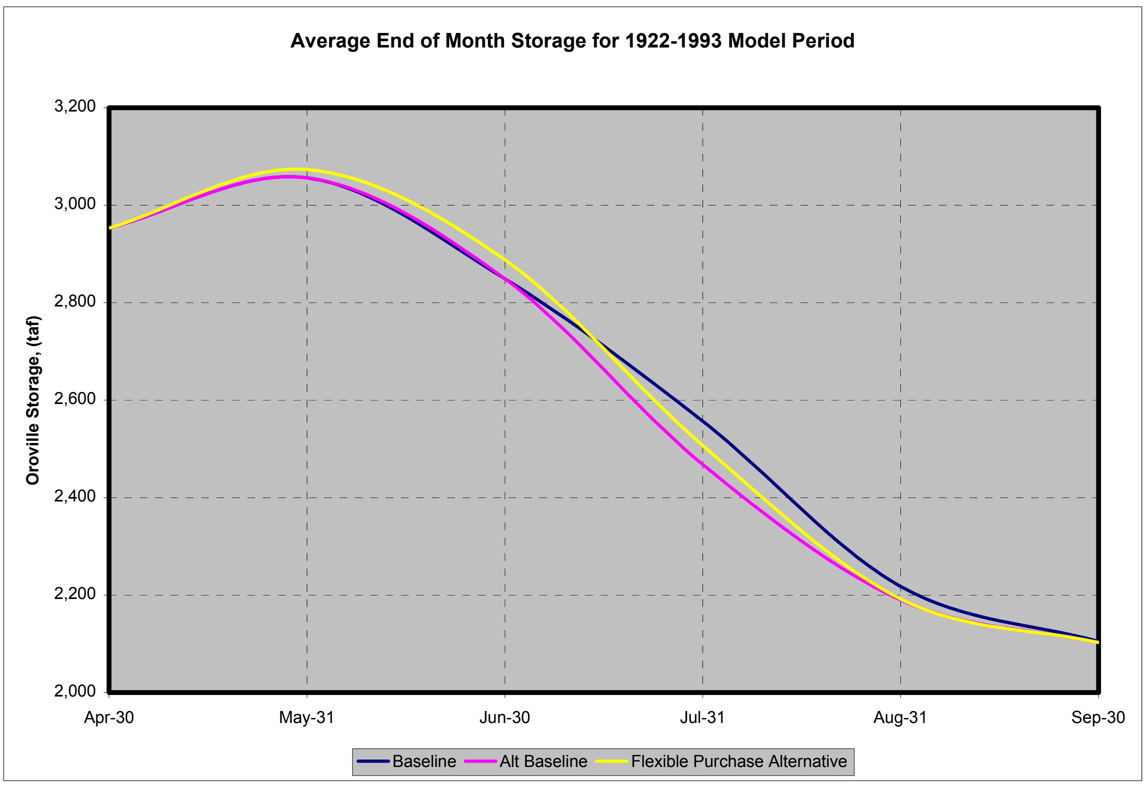

Figure 2 Average Oroville End-of-Month Storage for the 1922-1993 Model Period

Figure 3 illustrates the pattern of end-of-month water use by those entities idling land in the Feather River Region for the purpose of EWA sales. The general agricultural water use pattern, without the EWA, is shown in the Figure 3 as Pre EWA Use. The Flexible Purchase Alternative in Figure 3 shows the water use pattern with EWA actions. The chart shows the periods when water purchased by the EWA would be released into the rivers. As shown in Figure 4, by the end of July and continuing through August, the cumulative (agriculture and EWA) water use by the Flexible Purchase Alternative exceeds the typical agricultural water use. However, agricultural water use (Pre EWA use) is greater than the Flexible Purchase Alternative use in September and the cumulative volume difference in water use of the purchased water nets to zero by the end of September.

In the instance of the Alt Baseline, there is a presumption that the SWP will alter its Delta export pumping from that assumed in the CALSIM II Baseline Condition simulation. If this is true, then the Flexible Purchase Alternative operation would result in comparatively higher Oroville reservoir storage in July and August. Alternatively, if the SWP maintains the pattern of Delta exports assumed in the Baseline Condition simulation, the Flexible Purchase Alternative would cause lower Oroville reservoir storage in July and August. The Project operators would determine if this pattern of use were acceptable on a real-time case-by-case basis.

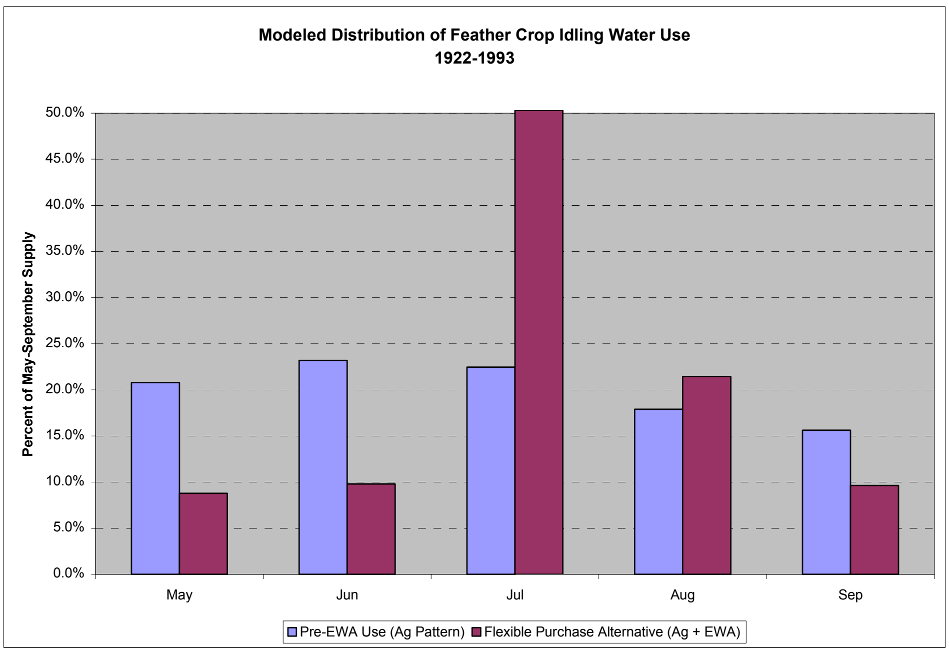

Figure 3
Modeled Distribution of Feather River Crop Idling Water Use (1922-1993)

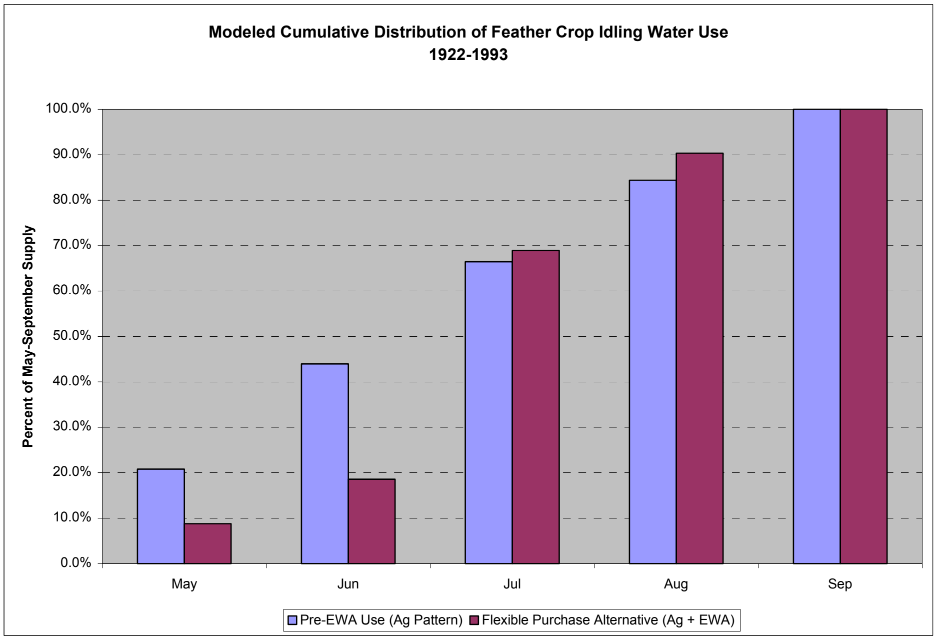

Figure 4
Modeled Cumulative Distribution of Feather River Crop Idling Water Use (1922-1993)

In order to not preclude any future operational flexibility by the SWP, it was determined that the EWA EIS/EIR should not suggest any change in the Baseline Condition during the July through September Project exports (no redistribution of SWP and CVP exports) presented in the CALSIM II simulation, which was provided by DWR. This determination is consistent with the full disclosure of potential effects of the proposed action and does not impose an obligation on the SWP to alter its own characterization of SWP operations. Also, throughout the analyses presented in the EIS/EIR, an assumption is made that presenting the worst-case condition is most defensible in identifying effects of the proposed action. In view of this conservative assumption, the effect of the Flexible Purchase Alternative on reservoir storage is identified as the comparison of the Flexible Purchase Alternative to the Baseline Condition. This assumption acknowledges worst-case conditions caused by the Flexible Purchase Alternative on reservoir fisheries and recreation.

2.1.3.5 Carriage Water

Exporting additional water from the Delta can adversely affect water quality in the Delta; therefore; the EWA routing procedure was developed to account for upstream river flows and Delta operations. Because additional Delta exports can have an adverse effect on water quality in the Delta, the routing procedure reflects the influence of increased exports on water quality. Carriage water is the term used for the amount of additional water assumed to be required as increased Delta inflow and outflow to maintain water quality standards in the Delta. Estimated carriage water costs associated with EWA exports range between 15 percent and 35 percent of the EWA share of Delta inflow. In application, if EWA exports were 150 TAF or less in a given month, EWA exports would be 85 percent (100 percent – 15 percent = 85 percent) of purchases, with the excess purchase going to Delta outflow. This percentage varied to 65 percent (100 percent – 35 percent = 65 percent) in months when the EWA export was greater than 400 TAF.

Carriage water is included in the EWA asset purchases and routed through the reservoir and river system in the same manner.

2.1.3.6 EWA Water Purchases.xls Post Processing Tool Output

The EWA Water Purchases.xls post processing tool provides the following output:

- Revised Shasta, Oroville, and Folsom storage;
- Revised flows for the Sacramento River at Keswick Reservoir, Feather River at Oroville Dam, and American River at Nimbus Reservoir;
- Revised flows for the Yuba River basin, Feather River basin, and Sacramento River basin; and
- Revised total Delta exports.

These outputs were then used in the EWA Routing.xls Tool (refer to Section 2.1.4) to produce the final "virtual" CALSIM II output database for use in the effect assessment.

2.1.4 EWA Routing.xls Post Processing Tool

This tool was developed to take the results of the CALSIM II Baseline Condition simulation and the EWA Water Purchases.xls tool (refer to Section 2.1.3), simulate or "route" the output (reservoir storage, releases, instream flows, etc.) through the Project system, and provide output (results) for a "virtual" CALSIM II output database.

The EWA Routing.xls tool has several basic functions:

- Final upstream of Delta Routing;
- Implementation of EWA fish actions in December through July;
- Final implementation of export shifting and additional EWA exports in July through September;
- Split of total Delta export into CVP and SWP exports (Tracy and Banks pumping plants);
- Full Delta routing; and
- "Virtual" CALSIM II output development.

2.1.4.1 Upstream from the Delta Routing

The EWA Routing.xls post processing tool involved determining and assigning the EWA assets to individual schematic nodes relative to the CALSIM II structure and calculating how the SWP and CVP system operations would change in response to a list of assumed EWA fish actions. Decisions were made regarding the location within a particular river basin (node) where individual fish actions would first influence system operations. Then, the initial results (reservoir storage, dam releases, and stream flows) from the CALSIM II benchmark study were recomputed from that location throughout the system upstream of the Delta. These assumptions are provided in Table 1. As shown in Table 1, the EWA asset actions that would take place within the Sacramento River Basin were split between two different nodes, 118 and 129.

Table 1
Assignment of EWA Asset Actions to CALSIM II Nodes

Description/EWA Asset Location	CALSIM Schematic Node
Shasta Reservoir Storage	4
Keswick Reservoir Release	6
Sacramento River Basin Assets (50 percent)	118
Sacramento River Basin Assets (50 percent)	129
Oroville Reservoir Storage	6
Oroville Reservoir Release	6
Yuba River Basin Assets	211
Feather River Basin Assets	223
Folsom Reservoir Storage	8
Nimbus Reservoir Release	9[a]
Lake McClure Storage	20
Lake McClure Release	20

[a] Includes flow modification upstream to Folsom (Node 8).

2.1.4.2 *Split of Total Delta Export Into CVP/SWP Exports*

An intermediate step made by this tool evaluated and redistributed the total Delta exports relative to the CALSIM II Baseline Condition simulation results. During the summer months, if the total Delta export result obtained through post-processing was greater than the result in the CALSIM II Baseline Condition, the additional export amount was assigned first to the CVP Tracy Pumping Plant (up to a maximum of 4,600 cfs), then any remaining amount was assigned to the SWP Banks Pumping Plant. If the total Delta export result obtained through post-processing was less than the CALSIM II Baseline Condition simulation (e.g., winter/spring export curtailment months), then the baseline export values were recalculated. Reductions in exports were first applied to the SWP Banks Pumping Plant (maintaining a minimum diversion of 750 cfs), then any additional reductions were imposed at the CVP Tracy Pumping Plant.

2.1.4.3 *Delta Routing*

A final routing of the Delta was then done using Delta inflow values from the upstream routings and the final exports. Revised Delta Cross Channel flows, X2 location, and QWEST values were computed from the final routed values.

2.1.4.4 *"Virtual" CALSIM II Output Creation*

The EWA Routing.xls post processing tool was then used to create a "virtual" CALSIM II output database. This was accomplished by copying the CALSIM II baseline output database and saving the newly recomputed storages, flows, and exports from the spreadsheet into the database. This produces a CALSIM II output database with all revised values in it, which to the other post-processor tools appears to have come directly from a CALSIM II simulation. This allows other tools designed to work with CALSIM II simulation output to be used for output analysis and linkage to other models without modification.

2.1.5 Water Temperature Models

Reclamation has developed water temperature models for the Sacramento, Feather, and American Rivers. The models have both reservoir and river components to simulate water temperatures in five major reservoirs (Trinity, Whiskeytown, Shasta, Oroville, and Folsom); four downstream regulating reservoirs (Lewiston, Keswick, Thermalito, and Natoma); and three main river systems (Sacramento, Feather, and American).

These temperature models were designed to estimate water temperatures that would occur for conditions simulated by PROSIM, a Reclamation-developed operation model that is a predecessor to the CALSIM II model. They are used to assess changes in average monthly water temperature caused by changes in CVP/SWP operations. A spreadsheet post-processor tool was developed to allow use of CALSIM II-computed reservoir storage and stream flows to generate the required water temperature model inputs. There were no internal changes to any of the water temperature models.

The PROSIM operations model used a time period of 70 years from 1922 to 1991. Because the water temperature models were designed to operate using PROSIM results, and they operate on a calendar year, rather than on a water year basis, the period of record is 1922 to 1990 (69 years). Extension of the water temperature models to fully cover the CALSIM II time period of 1922 to 1993 (72 years) would have required extensive data development and model calibration effort and was not performed for this analysis.

Sections 2.1.5.1 and 2.1.5.2 provide additional detail regarding the reservoir and river components of the water temperature models, respectively. Additional details regarding Reclamation's water temperature models are well documented in the CVPIA *Draft Programmatic EIS (PEIS) Technical Appendix, Volume Nine*. These temperature models also are documented in the report titled: *U.S. Bureau of Reclamation Monthly Temperature Model Sacramento River Basin*, June 1990.

2.1.5.1 Reservoir Water Temperature Component

Reclamation's reservoir models simulate monthly water temperature profiles in five major reservoirs: Trinity, Whiskeytown, Shasta, Oroville, and Folsom. Vertical water temperature profile in a reservoir is simulated in one dimension using monthly storage, inflow and outflow water temperature and flow rate, evaporation, precipitation, solar radiation, and average air temperature. The models also compute the water temperatures of dam releases. Release water temperature control measures in reservoirs, such as the penstock shutters in Folsom Reservoir, the temperature control device in Lake Shasta, and the temperature curtains in Whiskeytown Reservoir are incorporated into the models.

Reservoir inflow, outflow, and end-of-month storage content as calculated by CALSIM II are input to the reservoir water temperature models. Additional input data include meteorological information and monthly water temperature targets that are used by the model to select the level from which reservoir releases are drawn. Model output includes water temperature at each level in the reservoir as well as temperature of the reservoir release. The reservoir release temperature is then used in the downstream river water temperature model, as described in the next section.

2.1.5.2 River Water Temperature Component

Reclamation's river water temperature models utilize the calculated temperatures of reservoir release, much of the same meteorological data used in the reservoir models (described in Section 2.1.5.1), and CALSIM II output on river flow rates, gains and diversions. Mean monthly water temperatures are calculated at multiple locations on the Sacramento, Feather, and American Rivers.

Release rate and water temperature of regulating reservoir storage serve as the boundary conditions for the river water temperature model. The river temperature model computes water temperatures at 52 locations on the Sacramento River from Keswick Dam to Freeport, and at multiple locations on the Feather and American Rivers. The river temperature model also calculates water temperature within Lewiston, Keswick, Thermalito, and Natoma Reservoirs. This model is used to simulate water temperatures in these reservoirs because they are relatively small bodies of water with short residence times; thereby, on a monthly basis, the reservoirs act as if they have physical characteristics approximating those of riverine environments.

2.1.5.3 Automated Temperature Selection Procedure

The Folsom Reservoir and lower American River water temperature model components are utilized in an iterative manner referred to as the Automated Temperature Selection Procedure (ATSP). This procedure operates the reservoir and river water temperature models with the objective of achieving monthly target temperatures in the lower American River at Watt Avenue. The target water temperatures have been set by qualified fisheries biologists who have determined a range of water temperatures that are the most biologically favorable to the fish species that are present in the river, at any given time of year. Targets are achieved through a choice of reservoir levels from which the release is drawn. This modeling procedure is conducted for the purpose of allowing the most optimal utilization of the available coldwater pool in Folsom Lake and to ensure that the species-specific needs of anadromous fish in the river are met over the course of the entire year.

2.1.5.4 Folsom Reservoir Model Code Modifications

The Folsom Reservoir water temperature model component was modified to simulate a Temperature Control Device (TCD) for the Folsom Dam Pumping Plant. The TCD has been authorized by Congress and is expected to be in place in the next few years. The TCD was incorporated into the model by defining numerous levels from which Folsom Dam diversions could occur. The TCD is operated to maximize the use of warm water; thus, the diversion level is set as close to 25 feet below the reservoir water surface as possible.

2.1.6 Salmon Mortality Models

Water temperatures calculated for specific reaches of the Sacramento and American Rivers are used in Reclamation's Chinook salmon mortality models to estimate annual percentage mortality of early-lifestage Chinook salmon. Reclamation's Chinook salmon mortality models produce a single estimate of early life stage Chinook salmon mortality for each year of the simulation. This estimate consolidates calculations of salmon mortality for three separate early-life stages 1) pre-spawned eggs; 2) fertilized eggs; and 3) pre-emergent fry. For the Sacramento River, the model computes mortality for each of the four Chinook salmon runs: fall, late-fall, winter, and spring. For the American River, the model produces estimates of fall-run Chinook salmon mortality only. The mortality estimates are based on output temperatures from Reclamation's water temperature models. Temperature units (TUs), defined as the difference between river temperatures and 32°F, are accounted for on a daily basis by the mortality model, and are used to track life-stage development. For example, incubating eggs exposed to 42°F water for one day would experience 10 TUs. Eggs are assumed to hatch upon exposure to 750 TUs following fertilization. Similarly, the salmon mortality model assumes that fry emerge from the gravel after being exposed to 750 TUs following egg hatching into the pre-emergent fry stage.

2.1.7 Graphic and Tabular Analysis of Environmental Resources (GATAER) Tool

The GATAER tool produces figures and tables for the analysis of output from CALSIM II, the water temperature models, salmon mortality models, and other post-processing applications. Data is loaded from these models into a DSS database, which is then used as input to a series of spreadsheets, which generate the figures and tables for environmental resource analyses. The figures and tables generated for the evaluations of specific resource areas are included in Appendix H of the EWA EIS/EIR.

2.1.8 Delta Simulation Model II (DSM2)

DSM2 is the Delta hydrodynamic and salinity model currently in use by DWR. The model is capable of simulating physical conditions in riverine systems and estuaries, and the effects of land-based processes (agricultural runoff and consumptive use). These wide-ranging capabilities make it a valuable tool for analyzing the potential effects of proposed EWA actions in the Delta.

The hydrodynamic module simulates the channel flows, velocities, and water surface elevations in the Bay-Delta estuary. The water movement information developed by the hydrodynamic module is then used as input into the other two modules (water quality and particle-tracking), which can be used to determine the movement of constituents. The water quality module calculates the changes in water quality (primarily salinity) resulting from different source water qualities and from the mixing caused by water movement throughout the system. The particle-tracking module is used to evaluate mass transport processes.

DSM2 can calculate stages, flows, velocities, and many mass transport processes, including salts, multiple non-conservative constituents, and water temperature, and individual particles. For the EWA EIS/EIR, results from the EWA Routing.xls post processing tool (Section 2.1.4) provided input for the calculation of Delta export salinity and water level changes caused by the EWA actions.

Additional information on DSM2 model and documentation is publicly available from the DWR, Bay-Delta Office, Modeling Support Branch web site. A detailed discussion of the model and its assumptions are contained at this location: http://modeling.water.ca.gov/delta/models/dsm2/documentation.html.

2.1.9 Application of Hydrologic Modeling Output

The models and post-processing tools used in this analysis have been developed for comparative planning purposes, rather than for predicting actual reservoir or river conditions at specific locations at specific times. The 72-year and 69-year periods of record for CALSIM II and water temperature modeling, respectively, provide an index of the kinds of changes that would be expected to occur with implementation of a specified set of operational conditions. Reservoir storage, river flows, water temperature, and salmon mortality output for the period modeled should not be interpreted or used as definitive absolutes depicting actual conditions that will occur in the future. Rather, output for the Proposed Action can be compared to output for the basis of comparison to determine:

- Whether reservoir storage or river flows and water temperatures would change with implementation of the alternative;
- The months in which potential reservoir storage and river flow and water temperatures changes could occur; and
- A relative index of the magnitude of change that could occur during specific months of particular water year types, and whether the relative magnitude would result in effects on aquatic resources within the area studied.

The models used, although mathematically precise, should be viewed as having reasonable detection limits. Establishing reasonable detection limits is useful to those using the modeling output for effect assessment purposes, and prevents making inferences beyond the capabilities of the models and beyond an ability to actually measure changes. Although data from the models are reported to the nearest 1) 1,000 acre-feet in reservoir storage; 2) foot in water surface elevation; 3) cubic foot per second in river flow; 4) 0.1 °F in water temperature; and 5) tenth of a percent in salmon mortality, these values were rounded when interpreting differences for a given parameter between two modeling simulations. For example, two simulations having river flows at a given location within one percent of each other were considered to be essentially equivalent (represent no measurable change). Because the models provide reservoir storage data on a monthly time-step, measurable differences in reservoir storage were evaluated on a similar basis. Similar rounding of modeled output was performed for other output parameters as well in order to assure the reasonableness of the effect assessments.

In-situ temperature loggers were used to collect water temperature data used for the model. These loggers typically have a precision of +/-0.36 °F, yielding a potential total error of 0.72 °F (Sacramento River Temperature Modeling Project 1997). Therefore, modeled differences in water temperature of 0.36 °F or less could not be consistently detected in the river by actual monitoring of water temperatures. In addition, as mentioned above, output from Reclamation's water temperature models provides a relative index of water temperatures under the various operational conditions modeled. Output values indicate whether the water temperatures would be expected to increase, remain unchanged, or decrease, and provide insight regarding the relative magnitude of potential changes under one operational condition compared to another. For the purposes of the EWA effect assessment, modeled water temperature changes that were within 0.3 °F between modeled simulations were considered to be essentially equivalent. A level of detection of measurable change of 0.3 °F was used because 1) model output is reported to 0.1 °F; 2) rounding the level of error associated with in-situ temperature loggers used for model temperature data up to 0.4 °F would eliminate the possibility of detecting measurable change between 0.36 °F and 0.4 °F; and 3) rounding the level of detection down to 0.3 °F is the more conservative approach in detecting a change in temperature between the modeling results. Temperature differences between modeling results of more than 0.3 °F were assessed for their biological significance. This approach is considered very rigorous, because it utilizes a more conservative threshold of detection for potential water temperature changes than used in other fisheries effect assessments. For example, USFWS and Reclamation, in the Trinity River Mainstem Fishery Restoration Draft EIS/EIR (USFWS *et al*. 1999), used a change in long-term average water temperature of 0.5 °F as a threshold of significance, and the Central Valley Regional Water Quality Control Board generally uses a change of 1.0 °F as a threshold of significance.

2.2 Model Simulations and Assumptions/Effect Analysis Approach

Modeling simulations were developed to evaluate potential environmental effects of the Proposed Action (Flexible Purchase Alternative). Because there are no other known foreseeable State or private actions that would be implemented during the period of time defined by the EWA Program (2000-2007), a separate cumulative modeling run was not performed. Conditions under the cumulative condition would be the same as those that were modeled under the Proposed Action.

The development of the modeling simulations and consideration of available information or data resulted in the development of two different approaches to model and evaluate Upstream from the Delta Region and Delta Region effects of the Proposed Action on aquatic resources. These two approaches are described in the following sections.

2.2.1 Upstream from the Delta Region

The hydrologic analysis performed for the Upstream from the Delta Region includes the CVP and SWP facilities on the Sacramento River (Shasta Reservoir, Keswick Reservoir), Feather River (Lake Oroville), and American River (Folsom Reservoir). The Delta Region analysis is evaluated with a separate set of simulations and assumptions as described in Section 2.2.2.

2.2.1.1 Upstream from the Delta Region – Basis of Comparison Simulation

The CALSIM II benchmark study (BST_2001D10A_ANNBENCHMARK_1_2_B2_7-23-2002) was used as the basis for all hydrologic modeling presented in the EWA EIS/EIR. As described earlier, the CALSIM II simulation utilized the wrapper representing D-1485 through CVPIA b(2) regulatory constraints.

CALSIM II documentation is publicly available from the DWR, Bay-Delta Office, Modeling Support Branch web site. A detailed discussion of the model and its assumptions are contained in the document entitled "BST_2020D09D_ANNBENCHMARK_2_2, Benchmark Studies Assumptions and Appendices." This document includes the assumptions for the CALSIM II 2001 benchmark study (BST_2001D10A) identified above.

The basis of comparison simulation represents the hydrologic conditions within the CVP/SWP system prior to CALFED Record of Decision (ROD) and implementation of the EWA Program (prior to 2001). As discussed in Chapter 2 of the EWA EIS/EIR, the No Action/No Project Alternative conditions are represented by the Baseline Condition. The simulation includes surface water diversion and operation practices and policies (such as minimum instream flows, flood control, and Delta water quality standards) of the CVP/SWP and assumptions associated with accretion and depletions from the system that incorporate the exercise of water rights by non-CVP/SWP users.

The modeling assumptions incorporated into the CALSIM II benchmark study and utilized in further development of the Baseline Condition simulation are summarized in Table 2. More detailed descriptions of these assumptions follow the table.

Table 2
EWA Modeling Assumptions Included in the CALSIM II Benchmark Study

Parameter	Benchmark Study Assumption
PERIOD OF RECORD	1922-1993 (72 years)
HYDROLOGY	
Level of Land Use	2001 Level, DWR Bulletin 160-98[1] 2020
DEMANDS	
North of Delta (excluding American River)	
CVP	Land Use based, limited by Full Contract
SWP (FRSA)	Land Use based, limited by Full Contract
non-Project	Land Use based
CVP Refuges	Firm Level 2
American River Basin Water Rights CVP	 2001[2] 2001[2]
San Joaquin River Basin Friant Unit Lower Basin Stanislaus River Basin	 Regression of historical Fixed annual demands New Melones Interim Operations Plan
South of Delta	
CVP	Full Contract
Contra Costa Water District	140 TAF/YR[3]
SWP (w/ North Bay Aqueduct)	3.0-4.1 MAF/YR
SWP Article 21 Demand	MWDSC up to 50 TAF/month, Dec-Mar, others up to 84 TAF/month
FACILITIES	**Existing Facilities (2001)**
RESERVOIR REFILL CRITERIA	Annual refill occurs
REGULATORY STANDARDS	
Trinity River	
Minimum Flow below Lewiston Dam	Trinity EIS Preferred Alternative (369-815 TAF/YR)
Trinity Reservoir End-of-September Minimum Storage	Trinity EIS Preferred Alternative (600 TAF as able)
Clear Creek	
Minimum Flow below Whiskeytown Dam	Downstream water rights, 1963 USBR Proposal to USFWS and NPS, and USFWS discretionary use of CVPIA 3406(b)(2)
Upper Sacramento River	
Shasta Lake End-of-September Minimum Storage	SWRCB WR 1993 Winter-run Biological Opinion (1900 TAF)
Minimum Flow below Keswick Dam	Flows for SWRCB WR 90-5 and 1993 Winter-run Biological Opinion temperature control, and USFWS discretionary use of CVPIA 3406(b)(2)
Feather River	
Minimum Flow below Thermalito Diversion Dam	1983 DWR, DFG Agreement; (600 cfs)
Minimum Flow below Thermalito Afterbay outlet	1983 DWR, DFG Agreement; (1000 – 1700 cfs)
Yuba River	
Minimum Flow below Englebright Dam (as measured at the Marysville and Smartville gauging stations)	2001 SWRCB decision D-1644; Interim (100-1500)
American River	
Minimum Flow below Nimbus Dam	SWRCB D-893 (see accompanying Operations Criteria), and USFWS discretionary use of CVPIA 3406(b)(2)
Minimum Flow at H Street Bridge	SWRCB D-893
Lower Sacramento River	
Minimum Flow near Rio Vista	SWRCB D-1641
Mokelumne River	
Minimum Flow below Camanche Dam	FERC 2916-029, 1996 (Joint Settlement Agreement); (100 – 325 cfs)
Minimum Flow below Woodbridge Diversion Dam	FERC 2916-029, 1996 (Joint Settlement Agreement); (25 – 300 cfs)
Stanislaus River	
Minimum Flow below Goodwin Dam	1987 USBR, DFG agreement, and USFWS discretionary use of CVPIA 3406(b)(2)
Minimum Dissolved Oxygen	SWRCB D-1422

Table 2
EWA Modeling Assumptions Included in the CALSIM II Benchmark Study

Parameter	Benchmark Study Assumption
Merced River	
Minimum Flow below Crocker-Huffman Diversion Dam	Davis-Grunsky (180 – 220 cfs, Nov – Mar), and Cowell Agreement;
Minimum Flow at Shaffer Bridge	FERC 2179; (25 – 100 cfs)
Tuolumne River	
Minimum Flow at Lagrange Bridge	FERC 2299-024, 1995 (Settlement Agreement) (94 – 301 TAF/YR)
San Joaquin River	
Maximum Salinity near Vernalis	SWRCB D-1641
Minimum Flow near Vernalis	SWRCB D-1641, and Vernalis Adaptive Management Program per San Joaquin River Agreement
Delta Outflow Index (Flow and Salinity)	
Delta Cross Channel Gate Operation	SWRCB D-1641
Delta Exports	SWRCB D-1641, USFWS discretionary use of CVPIA 3406(b)(2), and CALFED Fisheries Agencies discretionary use of EWA
OPERATIONS CRITERIA	
Upper Sacramento River	
Flow Objective for Navigation (Wilkins Slough)	Discretionary 3,500 – 5,000 cfs based on Lake Shasta storage condition
American River	
Folsom Dam Flood Control	SAFCA, Interim-Reoperation of Folsom Dam, Variable 400/670 (without outlet modifications)
Flow below Nimbus Dam	Discretionary operations criteria corresponding to SWRCB D-893 required minimum flow
Sacramento Water Forum Mitigation Water	None
Stanislaus River	
Flow below Goodwin Dam	1997 New Melones Interim Operations Plan
San Joaquin River	
Flow near Vernalis	San Joaquin River Agreement in support of the Vernalis Adaptive Management Program
System-wide	
CVP Water Allocation	
CVP Settlement and Exchange	100% (75% in Shasta Critical years)
CVP Refuges	100% (75% in Shasta Critical years)
CVP Agriculture	100% - 0% based on supply (reduced by 3406(b)(2) allocation)
CVP Municipal & Industrial	100% - 50% based on supply (reduced by 3406(b)(2) allocation)
SWP Water Allocation	
North of Delta (FRSA)	Contract specific
South of Delta	Based on supply; Monterey Agreement
CVP/SWP Coordinated Operations	
Sharing of Responsibility for In-Basin-Use	1986 Coordinated Operations Agreement
Sharing of Surplus Flows	1986 Coordinated Operations Agreement
Sharing of Restricted Export Capacity	Equal sharing of export capacity under SWRCB D-1641; use of CVPIA 3406(b)(2) only restricts CVP exports; EWA use restricts CVP and/or SWP as directed by CALFED Fisheries Agencies
CVPIA 3406(b)(2)	
Allocation	800 TAF/YR (600 TAF/YR in Shasta Critical years)
Actions	1995 WQCP (non-discretionary), Fish flow objectives (Oct-Jan), CVP export reduction (Dec-Jan), VAMP (Apr 15- May 16) CVP export restriction, 3000 cfs CVP export limit in May and June (D1485 Striped Bass continuation), Post (May 16-31) VAMP CVP export restriction, Ramping of CVP export (Jun), Pre (Apr 1-15) VAMP CVP export restriction, CVP export reduction (Feb-Mar), Upstream Releases (Feb-Sep)

Table 2 ***EWA Modeling Assumptions Included in the CALSIM II Benchmark Study***	
Parameter	***Benchmark Study Assumption***
Accounting Adjustments	Per February 2002 Interior Decision, no limit on responsibility for non-discretionary D1641 requirements, no Reset with the Storage metric and no Offset with the Release and Export metrics
1 2001 Level of Development defined by linearly interpolated values from the 1995 Level of Development and 2020 Level of Development from DWR Bulletin 160-98. 1 1998 Level Demands defined in Sacramento Water Forum's EIR with a few updated entries. 2 Delta diversions include operations of Los Vaqueros Reservoir operations.	

Period of Record

The period of record used in the hydrologic modeling (CALSIM II) extends from October 1922 through September 1993 (72 years). The period of record used for water temperature modeling and the associated simulations for early lifestage Chinook salmon mortality extends from 1922 through 1990 (69 years). These periods are considered representative of the natural variation in climate and hydrology experienced in the Central Valley during recent times, and include periods of extended drought, high precipitation and runoff, and variations in-between.

Hydrology/Level of Development

The hydrology used is based on DWR Bulletin 160-98. The assumptions used for land use result from aggregation of historical survey and projected data developed for the California Water Plan Update (Bulletin 160). The Baseline Condition uses a 2001 level of land use, estimated by DWR as a linear interpolation between 1995 and 2020 land uses. Because the timeframe for EWA is relatively short (2001 to 2007) compared to the future condition demands (2020) that are used by the model, there is little variation between 2001 demands and projected 2007 demands. As a result, the hydrology used by CALSIM II for the future condition (2007 system demands) is consistent with 2001 land use and development projections.

Demands

The following sections describe how CALSIM II represents water demands within the system represented by the model.

CALSIM II classifies demands for water diversions as CVP project, SWP project, or non-project demands. CVP project demands are separated into four classes based on contract type: agricultural, municipal and industrial (M&I), Settlement and Exchange contractors, and refuges. Demands also are designated by geographic location: Sacramento River Basin, Feather River Service Area (FRSA), American River Basin, San Joaquin River Basin, Delta, and south of the Delta. Demands may be represented as a time series, varying by month and year, or more simply as twelve repeating monthly values. CVP project demands are modeled based on the conditions that apply to the contract type. SWP demands are simulated as defined and referred to by DWR's Office of Planning.

Demands in the Sacramento River Basin, including the Feather River and American River basins, and the Delta are determined based on land use and vary by month and year according to hydrologic conditions. Demands in the East Side Streams area and San Joaquin River Basin are set to fixed values each year. CVP and SWP demands south of the Delta are based on contract amounts, CVP demands are constant each year, and SWP demands vary depending on a wetness index.

Demands Upstream from the Delta (Excluding the American River Basin)
Demands in the Sacramento River Basin, including the Feather River, are determined based on land use for each Depletion Study Area (DSA). The land use acreage used to develop water demands is based on the indicated LOD. A consumptive use model is used to estimate demands for each DSA.

Demands within each DSA must be disaggregated into CVP and/or SWP project and non-project demands. Project demands are subject to reduced water allocations based on contracts with the CVP and SWP, while non-project demands are satisfied from sources other than the CVP and SWP project facilities. Non-project demands can be associated with senior riparian water rights, groundwater pumping, or private storage projects. Releases from the CVP and SWP system are increased to satisfy project demands, but no additional releases are made to satisfy non-project demands.

Demands in the Sacramento River Basin are divided into project/non-project in CALSIM II using a GIS snapshot of the crop and urban acreage (based on county surveys done in the 1990's). CVP contracts in the Sacramento Valley, excluding the American River Basin, consist of Settlement contracts (approximately 2.2 million acre feet [MAF]) and agricultural service contracts (approximately 460 TAF). The FRSA demands are the only SWP demands north of the Delta. These users are entitled to approximately 1.0 MAF per year (MAF/Yr) diversion from the Feather River. Although diversion requirements for contractors north of the Delta are determined using the consumptive use model based on land use, CALSIM II limits their deliveries to the maximum amount under their contract.

CVP Refuges: Firm Level 2
Firm Level 2, current annual average, national wildlife refuge (NWR) water demands are used for the Sacramento, San Joaquin, and Tulare basins. The refuge demands are consistent with the Reclamation Report On Refuge Water Supply Investigations, Central Valley Hydrologic Basin, California - March 1989, with the exception of East Bear Creek Unit data that is from Reclamation's Draft Refuge Water Supply - Long Term Water Supply Agreements, San Joaquin River Basin - November 2000 (Table 1-1). The refuge water demand quantities presented in Table 3 represent the amount of water required to meet refuge demands at the refuge boundaries (firm) and include conveyance losses.

American River Basin
The Water Forum Agreement provides for surface diversion reductions from the American River in "dry" through "driest" years. "Driest" year diversions are no greater than the "1995 Baseline" defined by the Water Forum participants. A "dry" year is defined as a year in which the forecasted Folsom Unimpaired Inflow for March through November (modeled as March 1 through September 30 plus 60 TAF) is less than 950 TAF. A "driest" year is defined as a year in which the forecasted Folsom Unimpaired Inflow for March through November is less than 400 TAF. A summary of demands for the American River Basin is presented in Table 4.

Table 3 CVP Refuge Water Demand - Firm Level 2			
Location	**Demand**	**Location**	**Demand**
Sacramento Basin	**Total (AF)**	**San Joaquin Basin**	**Total (AF)**
Sacramento NWR Complex		San Luis NWR Complex	
Sacramento NWR	61,867	San Luis Unit	17,800
Delevan NWR	29,267	West Bear Creek Unit	9,609
Colusa NWR	33,333	Kesterson Unit	7,647
Sutter NWR	26,111	Freitas Unit	4,702
Gray Lodge WMA	40,602	Merced Unit	13,500
Modoc NWR	23,752	East Bear Creek Unit	8,863
Total	214,932	Los Banos WMA	13,253
		Volta WA	13,000
		North Grassland WMA	
Tulare Basin	**Total (AF)**	China Island Unit	8,196
Pixley NWR	1,280	Salt Slough Unit	7,859
Kern NWR	11,437	Mendota WMA	27,594
Total	12,717	Grassland RCD	147,059
		Total	279,082
NWR–National Wildlife Refuge; WMA–Wildlife Management Area; WA–Wildlife Area; RCD–Resource Conservation District			

Table 4 American River Basin Demand Summary (TAF/Yr)						
	CVP Agricultural Contracts	***CVP M&I Contracts***	***Water Rights/ non-Project***	***Total***	***Total "Driest" Year***	***Approximate "Driest" Year Reduction***
Total 2001 Level	0	65,850	231,350	297,200	0	0
Total 2020 Level	15,000	180,850	400,850	596,700	450,100	146,600

San Joaquin River Basin

Demands in the San Joaquin River Basin generally are set to fixed annual amounts rather than based on land use and hydrologic conditions as with the Sacramento Valley demands presented above. The operation of the Friant Unit is extracted from a SANJASM model simulation and is not operated in CALSIM II. Table 5 presents average annual diversions and fixed annual demands for projects in the San Joaquin River Basin. These demands are incorporated into the CALSIM II benchmark study used for the EWA EIS/EIR modeling.

Demands South of the Delta

CVP and SWP demands south of the Delta are based on contract amounts; SWP demands vary depending on a wetness index.

CVP South of the Delta

CVP demands south of the Delta include agricultural and M&I needs served from the San Luis Reservoir and San Felipe Unit, the Cross Valley Canal, the Delta-Mendota Canal (DMC) and Mendota Pool. CVP demands south of the Delta are always set to contract amount and do not vary based on hydrologic conditions. These demands also include Exchange Contractors, refuge water supplies and operational losses. CVP demands are aggregated based on contract type and the following geographic locations: Upper DMC, Lower DMC, Mendota Pool, San Felipe Unit, and California Aqueduct.

Table 5 San Joaquin River Basin Demand Assumptions	
Location	**Demand (TAF)**
Friant-Kern Canal*	1,100
Madera Canal to Madera ID*	145
Madera Canal to Chowchilla ID*	98
Madera ID**	386
Chowchilla **	293
Merced ID **	620
Turlock ID **	733
Modesto ID **	417
Tri-dams**	574
*Annual average delivery **Fixed annual demand ID – Irrigation District	

Monthly demand patterns are determined for Exchange, M&I, and agricultural contractors based on recent historical CVP deliveries. Table 6 contains a summary of the total CVP demands south of the Delta, not including refuge demands.

Table 6 CVP South-of-Delta Contract-Based Demands	
Contract Type	**Demand Amount (AF)**
Water Right	40,813
Project Agricultural	1,824,758
Exchange	840,000
M&I	154,150
Losses	183,700
Total	3,043,421

SWP South of the Delta

Twenty-nine agencies have contracts for a long-term water supply from the SWP totaling about 4.2 MAF annually, of which about 4.1 MAF are for contracting agencies with service areas south of the Delta. About 70 percent of this amount is the contract entitlement for urban users and the remaining 30 percent is for agricultural users.

Demands are set in accordance with the Monterey Agreement. They are calculated from the 1996 Table A entitlements. Aqueduct deliveries to San Joaquin Valley agricultural contractors are reduced in wetter years using a wetness index developed from annual Kern River inflows to Lake Isabella. Deliveries to the Metropolitan Water District of Southern California (Metropolitan WD) are reduced in wetter years using the 10-station, two-year average precipitation index or based upon Metropolitan WD integrated operations with Eastside Reservoir in future scenarios.

When available, Article 21 water is delivered to SWP south-of-Delta contractors in accordance with the Monterey Agreement. Article 21 water results from direct diversions from Banks Pumping Plant; it is not stored in San Luis Reservoir for later delivery to contractors. A contractor may accept Article 21 water in addition to its monthly scheduled entitlement water. Article 21 water deliveries do not effect Table A entitlement water allocations. If demand for Article 21 water is greater than supply in any month, the supply is allocated in proportion to the entitlements of those contractors requesting Article 21 water.

CVP and SWP Facilities and Operations

The major water storage and conveyance facilities included in CALSIM II, are identified in Table 7 and Table 8, respectively. Specific criteria have been defined for each of these facilities for incorporation into the model. Criteria include physical characteristics (storage and conveyance capacity), evaporation and loss estimates, regulatory and operational requirements, and incorporation of each facility into the overall system.

Table 7
Major Central Valley Project and State Water Project Storage Facilities Included in CALSIM II

Storage Facility	***Gross Storage Capacity (TAF)***
Sacramento Basin	
Trinity Reservoir	2447
Whiskeytown Reservoir	240
Lake Shasta	4552
Keswick Reservoir	24
Lake Oroville	3558
Thermalito Forebay	12
Folsom Lake	975
Lake Natoma	9
CVP/SWP South-of-Delta	
CVP San Luis Reservoir	972
SWP San Luis Reservoir	1067
Lake Del Valle	77
Silverwood Lake	75
Perris Lake	131
Pyramid Lake	171
Castaic Lake	324
San Joaquin River Basin	
Millerton Lake	521
Hensley Lake	90
Eastman Lake	151
Lake McClure	1024
New Don Pedro Reservoir	2030
New Melones Reservoir	2420
Tulloch Lake	67
New Hogan Reservoir	325
Pardee Reservoir	210
Camanche Reservoir	438

Table 8
Major Central Valley Project and State Water Project Conveyance Facilities Included in CALSIM II

Conveyance Facility	***Conveyance Capacity (cfs)***
Clear Creek Tunnel	3300
Spring Creek Tunnel	4200
California Aqueduct upstream of O'Neill Forebay	10000
California Aqueduct downstream of O'Neill Forebay	13100
California Aqueduct downstream of end of joint use reach	8100
California Aqueduct upstream of Cross Valley Canal	5950
California Aqueduct downstream of Cross Valley Canal	5350
California Aqueduct downstream of Wheeler Ridge Pump Plant	4600
California Aqueduct beginning of East Branch	3149
California Aqueduct beginning of West Branch	3129
San Luis Pumping Plant	11000
Delta Mendota Canal upstream of O'Neill Forebay	4200
Delta Mendota Canal downstream of O'Neill Forebay	3500
Delta Mendota Canal upstream of Delta Mendota Pool	3200

Regulatory Standards

The following sections describe the major CVP and SWP operations and regulatory constraints that are specific to, and occur within, the various regional river basins that are evaluated as part of the modeling applications and hydrologic analyses. These operational and regulatory conditions influence several aspects of water management and availability of water supplies (e.g., conveyance capacities) for the basis of comparison.

Various laws and regulatory decisions provide for protection of environmental conditions. These protections include minimum instream flow requirements, minimum reservoir storage levels, and protection of the Delta against excessive salinity. Specifics regarding these requirements, including references to the regulatory documentation, are provided in the individual resource chapters of the EWA EIS/EIR. As an overview, Table 9 summarizes the locations and applicable regulatory conditions that are either incorporated directly into the model, pre- or post-processing applications, or used as evaluation criteria in interpreting the modeling results.

Table 9
Regulatory Standards and Modeling Applications

Location	Regulatory Standard	Modeling Application
Trinity River/Reservoir	Minimum instream flow requirements Minimum end-of-year reservoir storage	Both incorporated into CALSIM II
Clear Creek	Minimum instream flow requirements below Whiskeytown Reservoir	Incorporated into CALSIM II
Upper Sacramento River	Minimum end-of-year storage in Shasta Lake	Objective evaluated in interpretation of CALSIM II results
	Minimum instream flow requirements below Keswick Dam	Incorporated into CALSIM II
	Navigation flow requirement upstream of City of Sacramento (at Wilkins Slough-navigation control point)	Incorporated into CALSIM II
Feather River	Minimum instream flow requirements	Incorporated into CALSIM II
Yuba River*	Minimum instream flow requirements	Incorporated into CALSIM II
Lower American River	Minimum instream flow requirements (1) below Nimbus Dam and (2) for the reach from Nimbus Dam to the confluence with the Sacramento River	Incorporated into CALSIM II
Lower Sacramento River	Minimum instream flow requirements at (1) Freeport and (2) Rio Vista	Incorporated into CALSIM II
Mokelumne River*	Minimum release rates from Camanche Reservoir	Incorporated into CALSIM II
Stanislaus River	Minimum instream flows below Goodwin Dam	Incorporated into CALSIM II
Tuolumne River	Minimum instream flow requirements at LaGrange Bridge	Incorporated into CALSIM II
San Joaquin River	Minimum instream flow requirements at Vernalis	Incorporated into CALSIM II
Delta	Maximum salinity, minimum dissolved oxygen, minimum outflow, and maximum export	Incorporated into CALSIM II

* Regulatory standards for these rivers are included in pre-processed data. This output is then incorporated into CALSIM II as a single data point.

<u>CVP and SWP Operation</u>

The respective operations of the CVP and SWP are coordinated to manage stream flows in many Central Valley streams and the Delta. Many factors are considered in the operation of the CVP and SWP facilities. Releases from CVP and SWP reservoirs must be sufficient to achieve downstream environmental conditions; such as instream flow, water quality, and water temperature objectives as required at various locations within the river systems and in the Delta.

Operators must meet environmental obligations and also attempt to meet competing demands for Project water. Considerations in determining the required releases include the diversions of CVP and SWP water contractors from the river system, diversions by non-CVP and SWP entities, the contribution of flow into the river system from streams not controlled by the CVP and SWP, the contribution of return flows into the system from agricultural drains and wastewater treatment plants, and operations of other projects.

Sacramento-San Joaquin Delta

Instream flow objectives for the Delta are governed by State and Federal laws and regulations established for the protection of fishery and aquatic resources. Requirements are defined in the following:

- SWRCB Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan) (SWRCB 1995);
- National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries) Winter-run Chinook Salmon Biological Opinion (NMFS 1995); and
- U.S. Fish and Wildlife Service (USFWS) Delta Smelt and Sacramento Splittail Biological Opinion (USFWS 1995).

The Bay-Delta Plan establishes measures to protect the beneficial uses of the Bay-Delta and includes objectives that influence the operations of the CVP and SWP. Some of these objectives (specific flow, water temperature, reservoir storage, and diversion requirements) in the Delta were developed through consultation with NOAA Fisheries for the Winter-run Chinook Salmon Biological Opinion. Reclamation operates the CVP in accordance with the terms and conditions in all the various water rights orders, permits, and licenses for the project. Reclamation and DWR both operate their respective facilities in a manner that is consistent with applicable Biological Opinions.

Sacramento River

In addition to the State and Federal laws and regulations governing instream flow objectives in the Delta, the following requirements have been established to protect the fisheries and aquatic resources in the Sacramento River:

- SWRCB water rights terms and conditions for instream flow and flow fluctuation for Keswick Dam and Red Bluff Diversion Dam (SWRCB 1995);
- Central Valley Regional Water Quality Control Board (RWQCB) Basin Plan Water Quality Objectives for temperature and water quality constituents established to maintain fishery uses as approved by the SWRCB under the Federal Clean Water Act (RWQCB 1998);
- Iron Mountain Mine Interim Superfund Site ROD and the Memorandum of Understanding (MOU) with Reclamation concerning dilution manipulation of Spring

Creek Debris Dam releases using Shasta Dam releases (EPA 1997; Reclamation *et al*. 1980);

- NOAA Fisheries Winter-run Chinook Salmon Biological Opinion (NMFS 1995);
- NOAA Fisheries Spring-run Chinook Salmon and Central Valley Steelhead Biological Opinion on interim operations of the CVP and SWP (NMFS 2001); and
- ROD for the Trinity River Restoration Project that contributes to the timing and amount of flow releases at Keswick Dam (USFWS 2000).

Feather River

DWR operates the Oroville Facilities to comply with current Federal Energy Regulatory Commission (FERC) license requirements and other environmental protection measures. These measures include the NOAA Fisheries, NMFS Spring-run Chinook Salmon and Central Valley Steelhead Biological Opinion on interim operations of the CVP and SWP. Instream flows and water quality are managed according to the terms of a 1983 agreement between DWR and the California Department of Fish and Game (CDFG). This agreement establishes criteria for flow and water temperatures in the low-flow channel (Feather River between the Fish Barrier Dam and Thermalito Afterbay outlet) of the Feather River and the reach of the Feather River below the Thermalito Afterbay outlet to the confluence with the Sacramento River. Water temperatures also are regulated under a 1999 agreement between the licensee (DWR) and Joint Water Districts in an effort to assist farmers in achieving agricultural production objectives that rely on warm water. The FERC license requires that DWR attempt to release water that is as close as possible to the maximum allowable under the 1983 DWR-CDFG agreement.

Yuba River

The Yuba River is subject to instream flow requirements according to SWRCB Decision 1644 (D-1644), which came into effect on March 1, 2001. The intent of these requirements is to provide protection for fishery resources and other issues relating to water use and diversion activities in the lower Yuba River (the Yuba River below Englebright Dam). D-1644 specifies new minimum flow requirements (interim and long-term) and flow fluctuation criteria for the lower Yuba River. Because several of the conditions specific to D-1644 are currently being contested and undergoing litigation, they may be subject to revision; SWRCB is soon expected to make a decision soon. Until those proceedings are finalized, the conditions described in D-1644 apply and are incorporated into the hydrologic modeling assumptions.

Additionally, Yuba River operations must comply with the conditions established in the Yuba County Water Agency Act, water rights permits and licenses administered by the SWRCB, FERC License #2246 for the Yuba River Development Project, FERC 1993 License to Pacific Gas and Electric Company (PG&E) for continued operation at the Narrows I Power House, Section 7 of the Flood Control Act of 1944 (at New Bullards Bar Dam and Reservoir), and the 1966 Power Purchase Contract between Yuba County Water Agency (YCWA) and PG&E (Bookman-Edmonston 2000).

Lower American River

Reclamation operates Folsom Reservoir and Dam to comply with the objectives and environmental obligations of the Bay-Delta Plan, NOAA Fisheries Winter-run Chinook Salmon

Biological Opinion, NOAA Fisheries Spring-run Chinook Salmon and Central Valley Steelhead Biological Opinion on interim operations of the CVP and SWP, USFWS Delta Smelt Biological Opinion; USFWS Splittail Biological Opinion, and the management of CVPIA (b)(2) water. Reclamation also operates Folsom Dam according to year round flow requirements established by SWRCB Decision 893 (D-893). When possible, CVP operations also try to meet the Anadromous Fisheries Restoration Program (AFRP) flow objective for the lower American River as set forth in the November 20, 1997 Department of the Interior Final Administrative Proposal on the Management of Section 3406(b)(2) Water.

<u>CVP and SWP Allocation</u>
Reclamation operates the CVP to balance many competing objectives including water quality, fish and wildlife protection, irrigation and domestic water supply, hydroelectric power production, and flood control. In some years, the demand for water exceeds available supplies or exceeds export or conveyance capacities and Reclamation must adjust its allocation of water among the uses. Authorizing legislation, statutes, regulations, and agreements guide Reclamation's decisions in determining water allocations. In a similar manner, DWR balances the SWP's many competing objectives.

One of the critical operating decisions for the CVP and SWP is the annual water supply allocation. When specific water supply indices indicate an insufficient amount of water supply to meet all demands, allocation deficiencies are imposed depending upon the contract type. The Settlement and Exchange Contractors and the CVP wildlife refuges receive either 100 percent (normal and wet years) or 75 percent (critical years) allocation based on the Shasta Index.

The remaining and majority of CVP contracts receive allocations on a sliding scale based on a comparison of forecast demand and supply for the March through September period. As the simulation is run, CALSIM II compares water demand and available water supply for the March through September period. If the supply is greater than the demand, a full allocation is made. If the supply is less than the demand, allocations are reduced incrementally in response to the severity of the simulated shortfall. CVP M&I contracts receive allocations ranging from 50 to 100 percent. CVP agricultural contracts receive allocations ranging from 0 to 100 percent. Agricultural allocations are reduced first and reductions to the M&I allocations start after the agricultural allocations have been reduced to 75 percent of the full contract allocation. SWP allocations impose deficiencies equally to agricultural and M&I water users.

2.2.1.2 Upstream from the Delta Region – Proposed Action Simulation

This section describes the assumptions applied to the CALSIM II modeling and pre- and post-processing applications to simulate implementation of the EWA water purchases and fish actions proposed to occur under the Proposed Action.

The Proposed Action simulation represents the conditions that would occur with implementation of the EWA Flexible Purchase Alternative. It is assumed that the EWA Program would be implemented between 2004 and 2007. Preliminary EWA activities occurred in water years 2000, 2001 and 2002, under a series of agreements executed by the Project Agencies to provide the required water for the EWA. (See EIS/EIR Executive Summary and http://wwwoco.water.ca.gov/calfedops/2001ops.html or http://wwwoco.water.ca.gov/calfedops/2002ops.html.)

Development of the Proposed Action simulation utilizes the CALSIM II benchmark study used in the Baseline Condition (refer to Section 2.2.1.1). The Proposed Action simulation, therefore, involves the same period of record and hydrology LOD. Because the timeframe for the EWA Program is relatively short (lasting only until 2007), relative to future condition demands (represented by 2020) that are used by CALSIM II, there is little variation between 2001 demands and projected 2007 demands. As a result, the hydrology used in the CALSIM II benchmark study (LOD 2001) was determined appropriate for use in the evaluation of "future" (2007) EWA conditions.

The modeling assumptions incorporated into the CALSIM II benchmark study and utilized in further development of the Flexible Purchase Alternative results are summarized in Table 2. The sections following Table 2 provide additional detailed explanation of these parameters and assumptions.

The Proposed Action would allow the EWA agencies to purchase up to 600 TAF of water and would not restrict acquisition quantities upstream from the Delta or within the Export Service Area. The EWA agencies could freely combine acquisition methods, water sources, and operational flexibilities to effectively respond to annual changes in hydrology and fish behavior in the Delta.

Although the flexibility in water acquisitions incorporated into the Proposed Action enables and enhances the success of the program, determining the appropriate manner in which to represent the various elements of the Proposed Action in the modeling effort becomes complicated. Because the program is designed to be highly responsive to different conditions that may occur in any given year, there are a number of unknowns associated with its implementation.

The following sections describe the assumptions and tools used to simulate the Proposed Action. These methods were developed with input from and through coordination with the project agencies (DWR and Reclamation) and the management agencies (NOAA Fisheries, USFWS, and CDFG), and were determined to be the best approach considering available information or data sets and current modeling tools and applications.

Proposed Action Operations

The EWA Program allows for operational changes of the CVP and SWP facilities that benefit fish. Fish actions that could be implemented to protect and enhance fish species recovery include 1) reductions in Delta export pumping at the CVP and SWP pumping plants; 2) closure of the Delta Cross Channel Gates; 3) increases in instream flow; and 4) increases in Delta outflow. Additionally, EWA assets acquired by the Project Agencies will be used to repay CVP and SWP contractors for water used for fish actions that would have otherwise been delivered to the Export Service Area.

The Project Agencies determine the quantity of water that can be made available each year to agricultural and urban contractors within the Export Service Area. The agencies then move that amount of water, either from natural flows within the Sacramento River and San Joaquin River Basins or from Project reservoirs upstream from the Delta, through the Delta using the export pumping plants.

For the purposes of modeling and associated effect assessment of the Proposed Action purchases on CVP and SWP operations, instream flows, and instream water temperatures of conveying the water from the area of water purchase to the Delta assumes 1) EWA would purchase 600 TAF[1] of water from the Upstream from the Delta Region in every year, limited only by the availability of CVP and SWP export capacity to pump the purchased water; and 2) the EWA would have up to 600 TAF of water available to implement EWA fishery protection and recovery actions in the Delta. The assumed acquisitions up to 600 TAF of EWA assets would be used solely to repay the CVP and SWP for water foregone due to export pumping reductions generally implemented during the December through July period.

The effect analyses for flow-related issues for fisheries does not depend on the location of a particular seller but on the total amount of EWA water to be transferred via a particular tributary and receiving water body. Therefore, these resources were evaluated based on the largest amount of water that EWA agencies could manage for Delta fish actions (600 TAF), from the Upstream from the Delta Region, regardless of whether the specific water sellers could be identified at this time.

Water Purchases

The Proposed Action covers a range of EWA water purchases extending from a minimum of 75 TAF to a maximum of 600 TAF in the Upstream from the Delta Region. The actual water purchases in any given year to support the EWA would vary based on fisheries needs, budgetary constraints and other factors. The total amount of water available for purchase by the EWA Program as assets generally would be dependent upon water year type. Assumptions (transfer allocations) specific to each river, basin or seller were developed for the long-term hydrologic record, which represents a variety of water year types. Two scenarios were developed to aid in the evaluation of the Proposed Action water purchase and the potential effects upon environmental resources affected by: 1) transfer of water assets from areas within the Upstream from the Delta Region and the Export Service Area to the Delta; and 2) modifications to pumping practices at the CVP and SWP pumping plants. Constraints on the scenarios include:

- The maximum volume of water that would be obtainable from all upstream contributing sources to support a 600 TAF export at the Delta.
- The minimum water volume available from any individual upstream contributing source is zero acre-feet.

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1 Although the Proposed Action calls for the purchase from the Upstream from the Delta Region of up to 600 TAF and that carriage water cost would be deducted from that quantity, for this scenario it was assumed that sufficient water would be purchased to allow the export of 600 TAF at the CVP and SWP pumping plants. See discussion of carriage water at Section 2.1.2.5. This is more water than the EWA would purchase under this alternative resulting in an effect analysis of potentially greater effects than would occur under the Proposed Action. This was done so this analysis could also serve as the cumulative effect analysis. The cumulative case would be that the EWA and other water purchase programs would purchase the full 600 TAF when sufficient export capacity was available. In that case the other water purchasers would purchase sufficient water to allow the full 600 TAF to be exported at Banks and Tracy and, therefore, would purchase sufficient water to cover carriage water cost. This will require very few years during which more than the 650 TAF shown available in Table 10 will be purchased. To cover this shortage, annual crop idling was assumed to be as great as 250 TAF in both the Feather and Sacramento River regions to account for potential, presently unidentified, water purchase assets. These assumptions result in an evaluation of the worst possible case for environmental effect analysis.

The Proposed Action would utilize various combinations of the elements described in Chapter 2 of the ASIP as a means of achieving the desired water allocation. As shown in Table 10, each river system or potential selling entity may have a certain amount of water available to EWA; however, it may come from one individual source within the system or a combination of sources. As such, there could be no water available for purchase from any individual river or source for any given year. This analysis must consider the possibility of these situations because in any given year, a particular river, basin, or seller may provide no contribution to EWA. For the purpose of a comprehensive analysis, the minimum amount of purchased water that would be considered under the Proposed Action is zero acre-feet. However, to comply with CALFED ROD prescriptions for the minimum annual acquired surface water assets from the Upstream from the Delta Region, it is expected that a total quantity of 35 TAF will be exported, regardless of water year type. This volume of water is a relatively small amount that does not exceed the EWA's dedicated conveyance capacity in the Delta, even during wet years. The total may come from any individual river, basin, seller, or a combination of multiple sources.

Because of the uncertainty in where and what amounts water will be purchased for the EWA, it was determined that information and analyses provided in the EIS/EIR should encompass all reasonable actions. Two factors that affect the estimated EWA water purchases include 1) presently identified estimates of potential water assets (Table 10); and 2) the desire to purchase 600 TAF of water assets from the Upstream of the Delta region for the Proposed Action.

Table 10
Potential Range of EWA Asset Acquisitions for the Flexible Purchase Alternative

CALFED Region	Range of Possible Acquisitions (TAF)				Management Actions (TAF)		Transfers (TAF)	
	Stored Reservoir Water	Groundwater Substitution	Crop Idling	Stored Groundwater Purchase	Source Shifting	Groundwater Storage Services	Maximum Transfer Volume	Probable Transfer Period
Upstream North of Delta								
Sacramento River Region								
GCID		20-60	100				135	Jun-Sep
Reclamation District 108		5	45				20	Jun-Sep
Anderson Cottonwood ID		10-40					40	Jun-Sep
Natomas Central MWC		15					15	Jun-Sep
Other Sacramento River Contractors								
Feather River Region								
Oroville Wyandotte ID	10-15						15	Nov-Dec
Western Canal WD		10-35	70				50	Apr-Sep
Joint Water District Board		20-60	65				110	Apr-Sep
Garden Highway MWC		15					15	Jun-Sep
Other Feather River Contractors								
Yuba River Region								
Yuba County Water Agency	100						100	Jul-Sep
Yuba County Water Agency		85					85	May-Feb
American River Region								
Placer County Water Agency	20		10				30	Jul-Sep
Sacramento Groundwater Authority				10			10	Jul-Sep
Merced/San Joaquin Region								
Merced Irrigation District		10-25					25	Oct-Dec
Export Service Areas								
Tulare Lake Sub-Basin								
Kern County Water Agency			115	50-165	X	X	250	Jan-Dec
Semi-Tropic Water Storage District[1]						X	X	Jan-Dec
Arvin-Edison Water Storage District[1]						X	X	Jan-Dec
Westlands Water District			195				195	Apr-Sep
Tulare Lake Basin WSD			110				110	Apr-Sep
Southern California Region								
Metropolitan WD of Southern California					100-200		200	Jan-Dec

[1] Semi-Tropic WSD and Arvin-Edison WSD are within Kern County Water Agency. Their groundwater storage facilities are separate from the Agency, but they may participate in other programs that the agency helps administer, such as crop idling.
X = unknown quantity

To compensate in part for the perpetual availability of maximum individual asset quantities, modeling performed for the Flexible Purchase Alternative, in some cases, used EWA asset quantities less than the maximum identified for a particular river, basin or seller. The result from this procedure identifies maximum EWA instream flow effects, but could misidentify maximum reservoir, landside, and economic effects. To ensure that the EWA EIS/EIR presents a thorough picture of reasonable effects in these non-instream flow areas, some analyses in the EIS/EIR take the additional step of looking at maximum utilization of identified assets. This two-level procedure guarantees that all of the effects of the EWA (instream, landside, and economic) are addressed. Identifying the location, amount, and type of potential individual water purchases in the Upstream from the Delta Region is critical to determining the instream flow, water temperature, reservoir storage change, and potential water quality effects of the EWA Program. There are numerous possible combinations of water purchases in the Upstream from the Delta Region. Multiple studies to analyze all of the combinations were not feasible because of the time and cost of such an effort. It was decided to design one set of assumptions that could be adjusted to account for all other potential water purchase combinations and allow for qualitative assessments of the potential environmental effects.

The EWA agencies prioritized the types and amounts of water purchases in the Upstream from the Delta Region, as follows (water purchase decision priority):

- Water would be purchased first from the Upstream from the Delta Region, limited by the available SWP and CVP export capacity, and second from sellers in the Export Service Area.
- Purchases from reservoir storage would be used before any other purchase option is pursued.
- Stored groundwater purchases would be pursued as a second option after all reservoir storage purchases have been utilized.
- Groundwater substitution purchases would occur if more water were needed than can be obtained from reservoir storage and stored groundwater purchases.
- Water purchases obtained by idling rice would be pursued as a final option if more water were required to satisfy EWA requirements.
- Idling rice in the Feather River Basin would be pursued before idling rice in the Sacramento River Basin because some water from Sacramento River purchases could not be stored in Lake Shasta during April, May, and June when instream water temperature obligations require the water to be released.

These assumptions and priorities were utilized in the post-processing applications to develop model output results for the Flexible Purchase Alternative.

Fish Actions

The behavior of fish at the Delta pumps, such as the timing of their arrival (typically late winter /early spring) and the length of their stay, varies from year to year and cannot be predicted in advance. Years in which the fish arrive late and leave early may have fewer pumping reductions than other years and would have adequate assets to cover those reductions as well as providing water for upstream fish enhancements (increased instream flows).

EWA actions would be implemented primarily in the winter and spring months, which are months that the SWP and/or CVP would be required to reduce export pumping to protect and assist in restoration of listed and candidate fish species. The water supply lost due to pumping reductions during these months would be repaid in whole or in part during the summer by water acquired upstream from the Delta Region and pumped through the Delta to the downstream CVP/SWP water users. It is assumed that the water acquired reaches the Delta during July through September and is pumped at the Projects' pumping plants during that same period.

The CALSIM II benchmark study does not include the CALFED EWA actions, therefore, the post-processing tools, EWA Water Purchases.xls and EWA Routing.xls (Sections 2.1.3 and 2.1.4, respectively), were utilized to integrate the appropriate EWA actions into the modeling process to develop the Flexible Purchase Alternative simulation results used in the Upstream from the Delta Region effect analysis.

The EWA Water Purchases.xls post processing tool incorporates the assumed EWA Actions (export reductions) to simulate the CVP/SWP reservoirs changes and changes in their associated rivers in the Upstream from the Delta Region. The EWA water purchases used to represent the Flexible Purchase Alternative for this region are described in detail in Sections 2.2.1.2 and 2.2.2.2.

Delta Export Capacity

EWA asset management activities also involve use of the Delta pumps when capacity is available. Generally, drier water year types provide greater opportunities for conveyance of EWA water. In wet years, most of the Delta export conveyance is utilized by the SWP and CVP. During wet years, the Delta pumps export water at nearly 100 percent of their capacity during the summer transfer window, leaving minimal export capacity available for moving EWA assets. In drier years, the Delta export pumps are not running at capacity, leaving more capacity available to move EWA assets during the summer transfer window. During dry years, the EWA agencies would have fewer requirements to replace water lost during pumping reductions because the pumps would not have been operating at full capacity without the EWA. Therefore, the EWA project agencies may need to make fewer water acquisitions during dry years.

These EWA transfers require the utilization and implementation of various upstream combinations of groundwater substitution, stored reservoir water, and crop idling activities in order to achieve the maximum annual EWA purchase allowance (600 TAF) of effective water. Effective water is the total volume of water that is made available for export at the Delta pumping stations. To compensate for losses incurred through conveyance and the seasonality of crop idling activities, initial asset purchases may exceed 600 TAF. It is estimated that purchase losses may range between 20 to 50 percent of the initial acquisition. Table 10 considers these conditions by listing the range of the total purchases required to provide the maximum quantity (600 TAF) of water from EWA's suite of sources available for export at the Delta. In the Export

Service Area, source shifting and borrowed project water also may be employed, in addition to groundwater substitution, stored reservoir water and crop idling activities.

The amount of water that would be purchased in the Upstream from the Delta Region was limited to that amount which could be exported by the SWP and CVP pumping plants after all project pumping requirements were fulfilled.

The EWA Water Purchases.xls and EWA Routing.xls post-processing tools were used to determine the amount of available Delta export capacity at the CVP and SWP pumping plants that was in excess of Project requirements and that could be used to transfer EWA assets purchased from the Upstream from the Delta Region. As discussed in Section 2.1.3.2, two limiting factors were considered in the assessment of the CALSIM II results: 1) unused export capacity (physical capacity); and 2) E/I ratio (using inflow to Delta and Delta export variables). Using pooled seasonal export capacities (July through September total), limited when necessary by the E/I ratio, from all years in the modeled period of record, the potential annual EWA export amounts ranges between 75 TAF and 600 TAF.

For modeling purposes, it was assumed that the EWA Program would have the ability to utilize the full available capacity. However, it is recognized that there are other programs with authority to utilize Delta export capacity when it is available, and that the full amount likely would not be available to the EWA Program. Therefore, this assumption provides a conservative or worst-case representation of the effect associated with using this capacity, but the effects would not be due solely to the EWA Program (see discussion of Cumulative Considerations below).

It is recognized that in real-time, there are a number of factors that would limit the ability of the EWA Program to utilize the full amount of export capacity including competing transfers, hydrology (including the timing of precipitation and runoff), facility outages, operational constraints, and other environmental factors and variables. Additionally, the CALFED ROD and the EWA 2003 Interim EWA Protocols establish priorities for determining and assigning the use of any excess capacity available at the CVP and SWP pumping plants. Those priorities are described below.

SWP pumping (from highest to lowest):

- First priority - SWP Pumping[2]
- Second priority - Water Transfers for SWP contractors
- Third priority - Joint Point of Diversion (JPOD) use for specific CVP Contractors (example: Cross Valley Canal)
- Fourth priority - Wheeling for CVP and EWA
- Fifth priority - Water transfers for others

[2] The water that will be produced by the Sacramento Valley Water Management Agreement will be used to meet D-1641 water flow requirements, which are now being met, by the CVP and SWP. This will result in the SWP dedicating less water to meeting D-1641 flow requirement and this “saved” water would be pumped as by the SWP to SWP contractors south of the Delta. Therefore, the analysis assumes that any water produced by the Sacramento Valley Water Management Agreement for the SWP would be considered as included in SWP pumping.

CVP pumping (from highest to lowest):

- First priority - CVP Pumping[3]
- Second priority - Refuge Level IV
- Third priority - Cross Valley Canal
- Fourth priority - EWA water
- Fifth priority - Water transfers for others

Although estimates of the excess capacity that might remain for EWA purposes after other priority programs utilize what they need could be made, those estimates would not be absolutely correct in all years. If the estimates are high in any year, the potential effects of conveying EWA water from the areas where the water is purchased to, and through the Delta, could be underestimated. For this and other reasons it was assumed that all of the capacity available would be used by EWA and the resultant environmental effects analyzed for conveying the water purchased in the Upstream from the Delta Region and exporting that water. Therefore, any quantity of water purchased and utilized by the EWA and the environmental effects associated with such action would be analyzed in the EIS/EIR.

Cumulative Considerations

The Flexible Purchase Alternative, as described for modeling and effect assessment purposes, represents a cumulative condition. Although it is recognized that the EWA program may not actually purchase and transfer 600 TAF in each year of the program, there are other water acquisition and transfer programs that would purchase water and utilize excess capacity at the Delta pumping facilities. Therefore, the evaluation of purchasing and transferring 600 TAF from the Upstream from the Delta Region to the Delta and the summer exports from the Delta to the Export Service Area represents a cumulative condition in addition to a year of maximum EWA purchases from the Upstream of the Delta Region.

The other programs considered as reasonably foreseeable future actions include: implementation of the Sacramento Valley Water Settlement Agreement, other water purchases by the SWP and CVP on behalf of the Projects' water contractors, and water purchases by SWP contractors.

The Sacramento Valley Water Management Agreement ultimately will require export of up to 185 TAF in critical, dry, below normal, and in some above normal water years. However, this agreement involves staged implementation, increasing the agreed upon water exports incrementally over time, and it is anticipated that the full 185 TAF would be required sometime after 2007 (which represents the end of the EWA study period for the EWA EIS/EIR).

Because the SWP is not capable of meeting the SWP contractors' water supply requirements in many years, the contractors purchase water from areas upstream of the Delta in critically dry, dry, and some below normal water years. The CVP will utilize its share of unused SWP pumping plant export pumping capacity to export CVP stored water to CVP water contractors, the CVP's share of the Sacramento Valley Water Management Agreement water, and water purchased by CVP water contractors.

[3] The Sacramento Valley Water Management Agreement affects the CVP in the same way the agreement affects the SWP as explained in footnote #2. Therefore, the analysis assumes that the water produced by the Sacramento Valley Water Management Agreement for the CVP would be considered as included in CVP pumping.

Application of Analysis

The analysis of the Flexible Purchase Alternative is based on the maximum amount of purchases (600 TAF) that might occur Upstream from the Delta on a very infrequent basis (less than 15 percent of the time). As such, this analysis depicts the maximum EWA fishery benefits achievable as well as the maximum offsetting of those benefits due to summer pumping of the EWA water. The accompanying analysis of potential environmental effects provides the EWA Project Agencies the maximum decision-making flexibility for utilizing EWA assets of any amount up to 600 TAF of water, and the maximum flexibility for pumping water purchased from the Upstream from the Delta Region to O'Neill Forebay. It also provides for flexibility in making decisions regarding EWA fish actions, not only for reducing CVP and SWP export pumping from the Delta to improve aquatic habitat, but also to perform other identified EWA fish actions such as: closing the Delta Cross-Channel gates, increasing instream flows, increasing Delta outflow, or any other aquatic habitat improvements to benefit targeted fish resources.

The analysis of the Flexible Purchase Alternative assumes all unused Delta export capacity is used by EWA. The analysis provides an evaluation of maximum effects within the Delta because the maximum level of pumping would occur during summer months. This pumping offsets the benefits to fish achieved at other times of year due to the pumping reductions implemented under the fish actions, thereby lowering the overall benefits to fish that would be achieved with pump reductions alone. However, not all of the unused Delta export capacity would be available to the EWA Program, so overall, the fishery benefits associated with the Proposed Action likely are underestimated.

By providing an assessment of regulatory compliance with the maximum water purchase amount, the agencies are afforded greater latitude in making operational decisions to implement fish actions while also keeping the Project contractors whole. The alternative also provides greater opportunities for Delta outflow benefits and for upstream flow enhancements.

The analysis represents a worst-case simulation of effects that may occur in the Upstream from the Delta Region. Therefore, purchase and transfer of less than the maximum amount generally would be expected to result in reduced environmental effects.

This analysis also may prove useful to other agencies considering water transfer programs by providing an indication of potential effects related to individual project and cumulative conditions.

<u>Effect Assessment Comparison – Upstream from the Delta Region</u>

The Proposed Action simulation was compared to the basis of comparison simulation to identify the potential changes in the CVP/SWP hydrologic conditions (e.g., instream flow, reservoir elevations, end-of-month storage, and water temperature) that could influence aquatic resources. The evaluation of environmental effects was performed by considering the modeling results from the comparison in light of the effect indicators and evaluation criteria developed for the flow-related resource areas. The effect indicators and evaluation criteria are provided in the individual resource chapters of the Draft EIS/EIR and in Chapter 4 of the ASIP, and identify the parameters evaluated, including specific locations and seasonal considerations within the area of analysis specific to the resource being evaluated.

Due to the relatively short-term nature of the EWA Program, the Proposed Action includes all reasonably foreseeable future projects or actions that would typically be incorporated into a cumulative condition simulation, therefore, a separate modeling simulation for the cumulative condition was not performed. As described in the EIS/EIR (Chapter 3), the modeling for a cumulative effect assessment comparison would be the same as the assessment comparing the Proposed Action to the basis of comparison. Similarly, the basis of comparison represents existing conditions as well as future No Action/No Project conditions. Therefore, a separate modeling simulation was not developed for the No Action/No Project Alternative.

2.2.2 Delta Region Analysis

Separate modeling simulations and assumptions were developed for the evaluation of flow-related resource effects for the Delta Region analysis. The following sections describe the approach utilized to assess fisheries in the Delta.

2.2.2.1 Delta Region – Basis of Comparison Simulation

The basis of comparison for the Delta Region analysis was developed using the same modeling tools and pre- and post-processing applications as described for the Upstream from the Delta Region (Section 2.2.1), with the exception of the hydrologic period of record. The hydrologic period of record for the Delta Region analysis extends over a 15-year period, from 1979 through 1993. Although not as extensive as the 72-year period utilized for the Upstream from the Delta Region simulations, the 15-year period of record encompasses a variety of water year types and is considered representative of conditions that may occur over the EWA Program period (2004 to 2007).

The 15-year period of record for the Delta Region analyses corresponds with the data available to conduct the Delta fish salvage modeling. (Refer to Section 3.0.) It was determined appropriate that the evaluation of flow-related issues within the Delta Region analyses be consistent for all effect indicators utilized for aquatic resources.

2.2.2.2 Delta Region – Proposed Action Simulation

The Proposed Action simulation for the Delta Region analysis was developed using the same modeling tools and pre- and post-processing applications as described for the Upstream from the Delta Region with some modifications. As for the Delta Region basis of comparison described above, the Proposed Action simulation used in the Delta Region analyses is based upon a 15-year period of record.

The Proposed Action incorporates a high amount of flexibility into the purchases; however, exact amounts of water to be purchased every year remain unknown. To account for variability from one year to the next, the modeling effort evaluated two scenarios. The first scenario, the Maximum Water Purchase Scenario, examined a worst case for environmental effects and a best case for fish benefits: the EWA project agencies purchased the maximum amount possible from the Upstream from the Delta Region. The second scenario, the Typical Water Purchase Scenario, examined a more typical year of operations to quantify adverse and beneficial effects. This scenario, however, like the Maximum Water Purchase Scenario, assumes that all unused Delta export pumping capacity for the summer months (July through September) would be available to the EWA Program. While this assumption permits evaluation of the potential worst-case for EWA export pumping, there are other water acquisition and transfer programs and SWP/CVP programs that have priority access to use this available pumping capacity.

Therefore, this scenario does not necessarily represent the conditions that would be expected to occur for any given year of the program.

In effect, these two scenarios "bracket" the evaluation of aquatic resource effects related to changes in Delta pumping associated with implementation of the EWA Program. Assumptions specific to each scenario are described in the following sections.

Maximum Water Purchase Scenario

Operation of the Proposed Action under this scenario assumes 1) EWA would purchase 600 TAF of water from the Upstream from the Delta Region in every year, limited only by the availability of CVP and SWP export capacity to pump the purchased water; and 2) the EWA would have up to 600 TAF of water available to implement EWA fishery protection and recovery actions in the Delta. The assumed acquisitions of up to 600 TAF of EWA assets are used solely to repay the CVP and SWP for water not pumped during export pumping reductions (associated with EWA fish actions generally implemented during the December through July period).

Based on these assumptions, the results of this analysis describe the maximum adverse environmental effects within water bodies (reservoirs and river systems) in the Upstream from the Delta Region because it assumes purchases from this region are based upon the maximum amount of water that that can be pumped from the Delta. This analysis also provides an analysis of the maximum potential fishery benefits that could be provided by the EWA Program under the Proposed Action because the maximum amount of water that could be transferred to the Delta would be purchased each year.

The modeling results for the Proposed Action assumes all unused Delta export capacity is used by EWA. The analysis provides an evaluation of maximum effects within the Delta because the maximum level of pumping would occur during summer months. This pumping offsets the fishery benefits achieved at other times of year due to the pumping reductions implemented under the fish actions, thereby lowering the overall fishery benefit that would be achieved with pump reductions alone. However, not all of the unused Delta export capacity would be available to the EWA Program, so overall, the fishery benefits associated with the Proposed Action likely are underestimated.

The purchase of EWA assets is modeled assuming that the program would first obtain EWA variable assets such as relaxation of the allowable E/I ratio in the D-1641 water rights decision as allowed by that decision for fishery aquatic habitat improvement, then, additional purchases would be made from the Upstream from the Delta Region (to the extent that Delta export capacity is available).

Maximum Purchase Scenario - Specific EWA Fish Actions

The development of modeling assumptions for this scenario included the identification of potential specific EWA actions that would likely be imposed for the conditions represented by the historical hydrologic period of record, assuming current level of demand and regulatory conditions.

Because of the complexities inherent in developing a specific list of actions applied to historical conditions, it is possible that the EWA actions selected and used in the modeling of this scenario do not exactly reflect what the management and project agencies may decide each year. Still, the advantages of providing a quantitative evaluation of potential conditions outweighs the uncertainties associated with this method. A substantial amount of information and data are available and were utilized in the determination and assignment of specific actions for each of the study years (1979 to 1993). These sources include:

- CALFED agencies' staff and stakeholder representatives studied how the CVP and SWP would be operated to determine how EWA would have been implemented for the period 1981 to 1994. They used operations model output, fish salvage data, water temperature and turbidity data. This work was relied on heavily for the EWA EIS/EIR Delta Region analysis; in particular, to estimate the EWA asset requirements to allow the EWA management agencies to ensure provision of ESA commitments of the CVP and SWP. Additionally, review of these studies provides insight into the decision-making strategies developed by the agencies to determine the likely EWA actions that would occur and the priorities used by the management and project agencies to determine EWA assets when the total amount is insufficient to implement all EWA actions the if unlimited assets were available.

- The EWA management agencies implemented EWA actions over the past three years. (2001 through 2003), Actions were generally one-year water transfers with willing sellers approved under CEQA initial studies/negative declarations and NEPA environmental assessments/findings of no significant impact. Experience gained in making these purchase, water transfers and in implementing EWA fish actions provides valuable real-time information regarding the types of actions the agencies select with limited data during the year as well as some indication of how the fish may behave under various hydrologic and operational conditions.

- The historical fish salvage at the Tracy Pumping Plant and Banks Pumping Plant.

- Delta flow conditions available from CALSIM II.

- Delta water quality conditions available from DSM2 (using input data from the CALSIM II model).

The EWA actions and the purpose for selecting each action assumed in the Maximum Water Purchase Scenario are shown in Table 11. Export pumping of purchased water begins on July 1 unless an EWA action occurs in July or it is otherwise delayed if fish species of concern are observed in the Delta. Under such conditions, export pumping of purchased water would not start until the EWA action is completed.

Table 11 ***EWA Actions Simulated for the Maximum Water Purchase Scenario***			
Water Year	***Year Type***	***EWA Actions***	***Reason for Action***
1979	Below Normal	Dec – Reduce export pumping by 30 TAF	Export reductions required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 30 TAF	Same as above
		Feb - Reduce export pumping by 30 TAF	Reduce spring and possibly winter-run Chinook salmon salvage. Also reduces adult delta smelt salvage.
		Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 4,000 cfs.	Reduce delta smelt salvage going into VAMP. Also reduces steelhead, splittail, and salmon salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study.
		May 16th – May 31st - Reduce export pumping to 5,000 cfs.	Reduce delta smelt, steelhead, splittail, and salmon salvage.
		Jun - Reduce exports by 60 TAF	Reduce delta smelt and heavy splittail salvage.
1980	Above Normal	Dec – Reduce export pumping by 60 TAF	Export reductions required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage.
		Jan - Reduce export pumping by 30 TAF	Reduce spring-run Chinook salmon and splittail salvage.
		Feb - Reduce export pumping by 30 TAF	Reduce winter-run Chinook salmon, and adult delta smelt salvage.
		Mar -Reduce export pumping by 20 TAF	Reduce winter-run Chinook salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 3,000 cfs.	Reduce delta smelt salvage going into VAMP. Also reduces splittail, and salmon salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs total pumping.	Implement VAMP study.
		Jun - Reduce Banks P.P. export pumping to 2,000 cfs.	Reduce delta smelt and heavy splittail salvage.
		Jul 1st – Jul 15th - Reduce export pumping by 1,500 cfs	Reduce salvage of delta smelt
1981	Dry	Dec – Reduce export pumping by 20 TAF	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Feb - Reduce export pumping by 20 TAF	Reduce winter/spring-run Chinook salmon, splittail, steelhead, and adult delta smelt salvage.
		Mar -Reduce export pumping by 200 TAF	Reduce winter-run Chinook salmon, steelhead, and adult delta smelt salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 4,000 cfs	Reduce delta smelt, steelhead, splittail, and salmon salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study.
		May 16^{th} – 31^{st} – Reduce export pumping to 2,500 cfs	Reduce delta smelt and heavy splittail salvage.
		Jun - Reduce export pumping by 30 TAF,	Reduce delta smelt and heavy splittail salvage
		Jul - Reduce export pumping by 90 TAF	Reduce delta smelt salvage

Table 11
EWA Actions Simulated for the Maximum Water Purchase Scenario

Water Year	Year Type	EWA Actions	Reason for Action
1982	Wet	Dec – Reduce export pumping by 40 TAF	Export reductions may be required in Dec to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan – Reduce export pumping by 40 TAF	Reduce spring-run salmon salvage
		Feb - Reduce export pumping by 60 TAF	Reduce winter-run salmon, splittail, steelhead, and adult delta smelt.
		Mar -Reduce export pumping by 60 TAF	Reduce salvage of winter/spring-run salmon, steelhead and adult delta smelt salvage.
		Apr –Reduce export pumping by 120 TAF	Reduce heavy salvage of steelhead and salmon salvage.
		May - Reduce export pumping by 120 TAF.	Reduce splittail, steelhead and salmon salvage.
		Jun - Reduce export pumping by 90 TAF,	Reduce delta smelt and splittail salvage
1983	Wet	Dec – Reduce export pumping by 150 TAF	Reduce heavy spring-run Chinook salmon salvage
		Jan – Reduce export pumping by 120 TAF	Reduce spring-run salmon and adult delta smelt salvage
		Feb - Reduce export pumping by 120 TAF	Reduce spring/winter-run salmon and adult delta smelt salvage.
		Mar -Reduce export pumping by 60 TAF	Reduce winter/spring-run salmon, steelhead, and adult delta smelt salvage.
		Apr –Reduce export pumping by 60 TAF.	Reduce salmon salvage and heavy splittail salvage.
		May - Reduce export pumping by 60 TAF.	Reduce heavy splittail and salvage of steelhead salvage.
		Jun - Reduce export pumping by 120 TAF,	Reduce delta smelt and splittail salvage.
1984	Wet	Feb - Reduce export pumping by 20 TAF	Reduce winter/spring-run Chinook salmon and splittail salvage.
		Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 5,000 cfs.	Reduce splittail, and salmon salvage
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study.
		May 16th – May 31st - Reduce export pumping to 4,000 cfs.	Reduce delta smelt and splittail salvage.
		Jun 1st – Jun 15th - Reduce export pumping by 60 TAF.	Reduce delta smelt and splittail salvage.
1985	Dry	Dec – Reduce export pumping by 60 TAF.	Reduce spring run Chinook salmon salvage.
		Feb - Reduce export pumping by 20 TAF	Reduce winter/spring-run Chinook salmon and splittail salvage.
		Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon, steelhead and splittail salvage
		Apr. 1st – Apr. 14th –Reduce export pumping to 4,000 cfs	Reduce splittail and salmon salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study
		Jun 1st – Jun 20th - Reduce export pumping by 150 TAF.	Reduce heavy delta smelt and splittail salvage.

Table 11
EWA Actions Simulated for the Maximum Water Purchase Scenario

Water Year	Year Type	EWA Actions	Reason for Action
1986	Wet	Dec – Reduce export pumping by 30 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage.
		Jan - Reduce export pumping by 30 TAF.	Reduce spring-run Chinook salmon salvage.
		Feb - Reduce export pumping by 90 TAF	Reduce spring-run salmon and adult delta smelt salvage.
		Mar -Reduce export pumping by 150 TAF	Reduce splittail, steelhead, and winter-run salmon salvage.
		Apr - Reduce export pumping by 90 TAF.	Reduce salmon, delta smelt and splittail salvage.
		May - Reduce export pumping by 90 TAF.	Reduce delta smelt salvage and the heavy salvage of splittail.
		Jun - Reduce export pumping by 120 TAF.	Reduce delta smelt salvage and the heavy salvage of splittail.
1987	Dry	Dec – Reduce export pumping by 30 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 30 TAF.	Same as above
		Feb - Reduce export pumping by 30 TAF	Reduce winter/spring-run Chinook salmon salvage
		Mar -Reduce export pumping by 200 TAF	Reduce salvage of winter-run Chinook salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 3,000 cfs	Reduce steelhead, and salmon salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study.
		Jun 1st – Jun 20th - Reduce export pumping by 70 TAF.	Reduce delta smelt and splittail salvage.
		Jul – Reduce export pumping by 30 TAF the first week of July.	Reduce delta smelt salvage
1988	Critical	Dec – Reduce export pumping by 120 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 90 TAF.	Reduce spring-run Chinook salmon salvage.
		Feb - Reduce export pumping by 90 TAF	Reduce winter/spring-run Chinook salmon salvage.
		Apr 1st –Apr 14th – reduce export pumping to 3,500 cfs.	Reduce salmon, delta smelt, and splittail salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export	Implement VAMP study
		May 16th – May 31st - Reduce export pumping to 1,500 cfs.	Reduce delta smelt and splittail salvage
1989	Dry	Jan - Reduce export pumping by 30 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Feb - Reduce export pumping by 30 TAF	Reduce spring-run Chinook salmon and adult delta smelt salvage.

Table 11 ***EWA Actions Simulated for the Maximum Water Purchase Scenario***			
Water Year	***Year Type***	***EWA Actions***	***Reason for Action***
		Mar -Reduce export pumping by 90 TAF	Reduce winter/spring-run Chinook salmon and splittail salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export pumping.	Implement VAMP study.
		May 16th – May 31st - Reduce export pumping to 4,500 cfs.	Reduce delta smelt and splittail salvage
		Jun – Reduce export pumping by 30 TAF.	Reduce delta smelt and splittail salvage
		Jul - Reduce export pumping by 90 TAF	Reduce delta smelt and splittail salvage
1990	Critical	Dec – Reduce export pumping by 30 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 90 TAF.	Same as above.
		Feb - Reduce export pumping by 90 TAF	Reduce winter/spring-run Chinook salmon salvage
		Mar -Reduce export pumping by 120 TAF	Reduce winter-run Chinook salmon, split, and adult delta smelt salvage
		Jun – Reduce export pumping to 1,500 cfs	Reduce delta smelt salvage.
1991	Critical	Mar -Reduce export pumping by 120 TAF	Reduce winter-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage.
		Apr 1st –Apr 14th – reduce export pumping to 1,500 cfs.	Reduce salmon, adult delta smelt, and splittail salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export	Implement VAMP study
		May 16th – May 31st - Reduce export pumping to 1,500 cfs.	Reduce delta smelt and splittail salvage
1992	Critical	Jan - Reduce export pumping by 30 TAF	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Feb - Reduce export pumping by 90 TAF	Reduce winter/spring-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage.
		Mar -Reduce export pumping by 120 TAF	Reduce winter-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage.
		Apr 1st –Apr 14th – reduce export pumping to 2,500 cfs.	Reduce salmon salvage
		Apr 15th – 30th – reduce export pumping to 1,500 cfs	Reduce salmon salvage
1993	Above Normal	Jan - Reduce export pumping by 30 TAF	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon, splittail, and steelhead salvage
		Feb - Reduce export pumping by 30 TAF	Reduce winter/spring-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage.
		Mar -Reduce export pumping by 90 TAF	Reduce winter-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage.
		Apr 1st –Apr 14th – reduce export pumping to 10,000 cfs.	Reduce salmon and steelhead salvage.
		Apr 15th – May15th - VAMP @ 1,500 cfs export.	Implement VAMP
		Jun 1st – 15th - Reduce export pumping to 6,000 cfs	Reduce delta smelt and splittail salvage

The Maximum Water Purchase Scenario assumes that up to 600 TAF of EWA assets are available each year and that those 600 TAF would be purchased from the Upstream from the Delta Region limited only by available Delta export pumping capacity at the CVP and SWP pumping plants. The EWA actions assumed to occur under the Maximum Water Purchase Scenario (Table 11) do not require 600 TAF of EWA assets in every year. In those years, the modeling assumes that only the amount of EWA assets required are purchased from the Upstream from the Delta Region or the amount of available export pumping capacity at the CVP and SWP pumping plants, whichever is less.

Calculations were performed to determine the amount of export reductions associated with the EWA actions assumed under the Maximum Water Purchase Scenario (Table 12), the EWA assets required to implement the EWA actions, and the amount of purchased water pumped at the Banks and Tracy pumping plants to CVP and SWP contractors during the July through September period for each of the 15 years studied in this analysis.

Table 12
Maximum Water Purchase Scenario - EWA Export Reductions, EWA Assets Required, and Water Purchase Pumping (TAF)

Analysis Year	***EWA Export Reductions***	***EWA Assets Required***	***Pumping of EWA Water at Banks and/or Tracy Pumping Plants***
1979	604	484[a]	213
1980	674	534[a]	320
1981	623	623[b]	116
1982	530	0[c]	530[d]
1983	690	0	690[b]
1984	472	392[a]	234
1985	443	443	75
1986	600	600	455
1987	525	525	328
1988	406	406	444
1989	326	326	80
1990	376	376	360
1991	241	241	241
1992	258	258	258
1993	380	380	287

a San Luis Reservoir reaches full storage even with the EWA export reductions and with SWP Article 21 water deliveries.
b The amount of EWA cost over 600,000 acre-feet would be covered by available CVPIA (b)(2) water and/or Variable EWA assets.
c 1982 & 1983 were very wet years. The water loss due to EWA required export pumping curtailments can be recovered by export pumping of Delta surplus flows during the summer months. The loss of unused CVP and SWP export pumping during the summer months would not affect any other water user or the CVP because no water purchases of water from the Upstream from the Delta Region by SWP contractors, the CVP on behalf of the Project's contractors, or transfer of upstream CVP stored water would be done in these very wet water years.
d This is pumping of Delta surplus water and not purchased water.

As discussed in Section 1.1, EWA assets are made up of variable operational assets, water purchased from the Upstream from the Delta Region, and water purchased from the Export Service Area. The amount of variable operational assets available is not known, although some amount of variable operational assets will be available in almost every year. The problem of not knowing the quantity of variable operational assets available is handled in the Proposed Action analyses (Maximum Water Purchase Scenario and Typical Water Purchase Scenario) by assuming that all assets will be developed through water purchases. This means that the environmental effects of more water purchases than will actually occur are analyzed because the amount of water available from variable operational asset would reduce the assumed water purchases. For, example, Table 12 shows that in three years (1988, 1991, and 1992) all of the required EWA assets for those years are produced from purchases from the Upstream from the Delta Region. In real-time operation, the amount of water required to be purchased from the Upstream from the Delta Region would be reduced by the amount of water available from those years' variable operational assets.

Another use of the variable operational assets is shown in 1981. In that year more than the assumed 600 TAF of assets would be required to implement the EWA actions. The additional assets would come from that year's variable operational assets.

<u>Typical Water Purchase Scenario</u>
The Typical Water Purchase Scenario is intended to characterize more typical EWA purchases in contrast to the Maximum Water Purchase Scenario. However, this scenario, like the Maximum Water Purchase Scenario, assumes that all unused Delta export pumping capacity for the summer months (July through September) would be available to the EWA Program. While this assumption permits evaluation of the potential worst-case for EWA export pumping, there are other water acquisition and transfer programs and SWP/CVP programs that have priority access to use this available pumping capacity. Therefore, this scenario does not necessarily represent the conditions that would be expected to occur for any given year of the program. The assumptions used in the Typical Water Purchase Scenario are as follows:

- It is anticipated that the EWA Program would only infrequently require 600 TAF of water to achieve fish protection objectives in the Delta.

- The EWA project agencies may not have the funding required in all years to develop 600 TAF of EWA assets.

- The actual purchases from the Upstream from the Delta Region are limited by available CVP and SWP unused export pumping capacity. The studies using the CALSIM II current demand benchmark studies (see Figure 1) show that the Projects have sufficient excess export capacity to pump 600 TAF only 15 percent of the time (based on an assessment of pooled seasonal export capacities for July through September for the years included in the study) during the 1922-1993 period of analysis, and that those occasions all occur in critically dry years. Studies also have shown that the EWA's greatest need for assets (from 400 TAF to 600 TAF) occurs during above normal and wet years and that during very dry years the EWA requires the least amount of water (200 TAF to 250 TAF) to achieve the fish protection objectives in the Delta. Therefore, it is more likely that the EWA need for as much as 600 TAF would occur when capability to export that water from the Delta is limited. Further, when the export capacity is available, the EWA would require a much smaller amount of water to achieve the EWA fish protection objectives in the Delta.

- Additionally, it is unlikely that all of the available unused CVP and SWP export pumping capacity would be available to the EWA Program as other projects and programs have priority access/use of the export capacity.

Assumptions for the Typical Water Purchase Scenario reflect EWA operations that are likely closer to how the EWA actually would be operated in the next few years. The water purchase assumptions for the Typical Water Purchase Scenario incorporate consideration of water year types, as listed shown below.

- In wet and above normal years, EWA assets would total 400 TAF. The amount of water purchased from the Upstream from the Delta Region and pumped at the CVP and SWP pumping plants would be either 400 TAF, or the total unused CVP and SWP export pumping capacity available in a specific water year, whichever is less.
- In below normal and dry years, except during the second dry year in a multi–year drought period, EWA assets would total 300 TAF. The amount of water purchased from the Upstream from the Delta Region and pumped at the CVP and SWP pumping plants would be either 300 TAF, or the total unused CVP and SWP export pumping capacity available in a specific water year, whichever is less.
- In the second dry year of a multi-year drought period and the first critical year to occur during a drought period, EWA assets would total 250 TAF. The amount of water purchased from the Upstream from the Delta Region and pumped at the CVP and SWP pumping plants would be either 250 TAF, or the total unused CVP and SWP export pumping capacity available in a specific water year, whichever is less.
- In critical water years that occur during drought periods other than the first critical year to occur in the drought, EWA assets would total 200 TAF. The amount of water purchased from the Upstream from the Delta Region and pumped at the CVP and SWP pumping plants would be either 200 TAF, or the total unused CVP and SWP export pumping capacity available in a specific water year, whichever is less.

The assumptions identified above will provide an estimate of the most likely fishery benefits that would be provided by the EWA Program considering implementation of EWA fish actions (generally between December and July) and summer pumping (July or August through September) of EWA water purchased from the Upstream from the Delta Region at the CVP and SWP pumping plants. The determination of net benefits considers the potential adverse effects of EWA exports during the summer that are then offset by the EWA fishery benefits achieved by pumping reductions during other times of the year.

Typical Water Purchase Scenario - Specific EWA Fish Actions

Table 13 shows the EWA actions and the reason for selecting each action assumed for the Typical Water Purchase Scenario.

Table 13 ***EWA Actions Simulated for the Typical Water Purchase Scenario***			
Water Year	***Year Type***	***EWA Actions***	***Reason for Action***
1979	Below Normal	Dec – Reduce export pumping by 10 TAF	Export reductions required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 10 TAF	Same as above
		Feb - Reduce export pumping by 20 TAF	Reduce spring and possibly winter-run Chinook salmon salvage. Also reduces adult delta smelt salvage.
		Mar -Reduce export pumping by 40 TAF	Reduce salvage of winter-run Chinook salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping by 30 TAF.	Reduce delta smelt salvage going into VAMP. Also reduces steelhead, splittail, and salmon salvage
		April 15th – May 15th – VAMP @ 3,200 cfs export.	Implement VAMP study.
		May 16th – May 31st – Reduce export pumping to 5,500 cfs	Reduce delta smelt and splittail salvage.
		Jun - Reduce exports by 60 TAF	Reduce delta smelt and heavy splittail salvage.
1980	Above Normal	Dec – Reduce export pumping by 60 TAF	Export reductions required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage. Same as above plus reduce adult delta smelt salvage
		Jan - Reduce export pumping by 30 TAF	Reduce winter/spring-run Chinook and splittail salvage
		Feb - Reduce export pumping by 30 TAF	Reduce winter-run Chinook salmon, and adult delta smelt salvage.
		Mar -Reduce export pumping by 20 TAF	Reduce winter-run Chinook salmon salvage
		Apr. 1st – Apr. 14th –Reduce export pumping to 4,000 cfs.	Reduce delta smelt salvage going into VAMP. Also reduces splittail, and salmon salvage
		April 15th – May 15th – VAMP @ 3,200 cfs total pumping.	Implement VAMP study
		Jun - Reduce Banks P.P. export pumping to 1,500 cfs.	Reduce delta smelt and heavy splittail salvage
		Jul - Reduce export pumping by 1,500 cfs	Reduce delta smelt salvage
1981	Dry	Dec – Reduce export pumping by 20 TAF	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage.
		Feb - Reduce export pumping by 20 TAF	Reduce salvage of winter-run Chinook salmon, steelhead, and adult delta smelt salvage
		Mar -Reduce export pumping by 60 TAF	Reduce delta smelt, steelhead, splittail, and salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 5,000 cfs.	Implement VAMP study
		April 15th – May 15th – VAMP @ 1,500 cfs export	Reduce delta smelt and heavy splittail salvage
		May 16th – 31st – Reduce export pumping to 4,000 cfs	Reduce delta smelt salvage
		Jun - Reduce export pumping by 30 TAF	Reduce delta smelt salvage
		Jul - Reduce export pumping by 30 TAF.	Reduce delta smelt salvage.

Table 13 ***EWA Actions Simulated for the Typical Water Purchase Scenario***			
Water Year	***Year Type***	***EWA Actions***	***Reason for Action***
1982	Wet	Dec – Reduce export pumping by 40 TAF	Export reductions may be required in Dec to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan – Reduce export pumping by 40 TAF	Reduce spring-run salmon salvage.
		Feb - Reduce export pumping by 60 TAF	Reduce winter-run salmon, splittail, steelhead, and adult delta smelt salvage
		Mar -Reduce export pumping by 60 TAF	Reduce winter/spring-run salmon, steelhead and adult delta smelt salvage.
		Apr –Reduce export pumping by 120 TAF	Reduce heavy steelhead and salmon salvage
		May - Reduce export pumping by 120 TAF.	Reduce splittail, steelhead and salmon salvage
		Jun - Reduce export pumping by 90 TAF	Reduce delta smelt and splittail salvage
1983	Wet	Dec – Reduce export pumping by 150 TAF	Reduce heavy spring-run Chinook salmon salvage.
		Jan – Reduce export pumping by 120 TAF	Reduce spring-run salmon and adult delta smelt salvage
		Feb - Reduce export pumping by 120 TAF	Reduce run/winter-run salmon and adult delta smelt salvage
		Mar -Reduce export pumping by 60 TAF	Reduce winter/spring-run salmon, steelhead, and adult delta smelt salvage.
		Apr –Reduce export pumping by 60 TAF.	Reduce salmon salvage and heavy splittail salvage.
		May - Reduce export pumping by 60 TAF.	Reduce heavy splittail salvage and steelhead salvage.
		Jun - Reduce export pumping by 90 TAF	Reduce delta smelt and splittail salvage
1984	Wet	Feb - Reduce export pumping by 20 TAF	Reduce winter/spring-run Chinook salmon and splittail salvage
		Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 6,000 cfs	Reduce splittail, and salmon salvage
		April 15th – May 15th – VAMP @ 3,200 cfs export	Implement VAMP study.
		May 16th – May 31st - Reduce export pumping to 4,000 cfs.	Reduce delta smelt and splittail salvage.
		Jun - Reduce export pumping by 90 TAF.	Reduce delta smelt and splittail salvage.
1985	Dry	Dec – Reduce export pumping by 30 TAF.	Reduce spring run Chinook salmon salvage
		Feb - Reduce export pumping by 20 TAF	Reduce winter/spring-run Chinook salmon and splittail salvage
		Mar -Reduce export pumping by 30 TAF	Reduce winter-run Chinook salmon, steelhead and splittail salvage.
		Apr. 1st – Apr. 14th –Reduce export pumping to 5,000 cfs	Reduce splittail and salmon salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study
		May 16th – May 31st - Reduce export pumping to 1,000 cfs	Reduce delta smelt and splittail salvage
		Jun 1st – Jun 15th - Reduce export pumping by 90 TAF.	Reduce heavy delta smelt and splittail salvage

Table 13 ***EWA Actions Simulated for the Typical Water Purchase Scenario***			
Water Year	***Year Type***	***EWA Actions***	***Reason for Action***
1986	Wet	Dec – Reduce export pumping by 30 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage.
		Jan - Reduce export pumping by 30 TAF.	Reduce spring-run Chinook salmon salvage
		Feb - Reduce export pumping by 90 TAF	Reduce spring-run salmon and adult delta smelt salvage
		Mar -Reduce export pumping by 90 TAF	Reduce splittail, steelhead, and winter-run salmon salvage.
		Apr - Reduce export pumping by 90 TAF	Reduce salmon, delta smelt and splittail salvage
		May - Reduce export pumping by 60 TAF.	Reduce delta smelt salvage and the heavy splittail salvage.
		Jun - Reduce export pumping by 60 TAF	Reduce delta smelt salvage and the heavy splittail salvage.
1987	Dry	Dec – Reduce export pumping by 20 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Feb - Reduce export pumping by 20 TAF	Reduce winter/spring-run Chinook salmon salvage
		Mar -Reduce export pumping by 100 TAF	Reduce winter-run Chinook salmon salvage
		Apr. 1st – Apr. 14th –Reduce export pumping to 5,000 cfs	Reduce salvage of steelhead, and salmon salvage
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study
		Jun 1st – Jun 20th - Reduce export pumping by 70 TAF	Reduce delta smelt and splittail salvage
1988	Critical	Dec – Reduce export pumping by 60 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan – Reduce export pumping by 30 TAF	Same as above
		Feb - Reduce export pumping by 30 TAF	Reduce winter/spring-run Chinook salmon salvage.
		Apr 1st –Apr 14th – reduce export pumping to 4,000 cfs.	Reduce salmon, delta smelt, and splittail salvage
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study
		May 16th – May 31st - Reduce export pumping to 1,500 cfs.	Reduce delta smelt and splittail salvage.
		Jun 1st – Jun 20th – Reduce export pumping by 30 TAF	Reduce delta smelt and splittail salvage.
1989	Dry	Dec – Reduce export pumping by 20 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 30 TAF.	Same as above.
		Feb - Reduce export pumping by 30 TAF	Reduce spring-run Chinook salmon and adult delta smelt salvage.
		Mar -Reduce export pumping by 90 TAF	Reduce winter/spring-run Chinook salmon and splittail salvage.

Table 13
EWA Actions Simulated for the Typical Water Purchase Scenario

Water Year	Year Type	EWA Actions	Reason for Action
		April 15th – May 15th – VAMP @ 1,500 cfs export pumping	Implement VAMP study
		May 16th – May 31st - Reduce export pumping to 4,500 cfs	Reduce delta smelt and splittail salvage
		Jun – Reduce export pumping by 30 TAF	Reduce delta smelt and splittail salvage
1990	Critical	Dec – Reduce export pumping by 30 TAF.	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Jan - Reduce export pumping by 30 TAF	Same as above
		Feb - Reduce export pumping by 30 TAF	Reduce winter/spring-run Chinook salmon salvage.
		Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon, splittail, and adult delta smelt salvage
		Jun – Reduce export pumping to 1,500 cfs	Reduce delta smelt salvage
		Jul 1st – 15th – Reduce export pumping to 1,500 cfs	Reduce delta smelt salvage
1991	Critical	Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage
		Apr 1st –Apr 14th – reduce export pumping to 1,500 cfs.	Reduce salmon, adult delta smelt, and splittail salvage.
		April 15th – May 15th – VAMP @ 1,500 cfs export.	Implement VAMP study
		May 16th – May 31st - Reduce export pumping to 2,500 cfs.	Reduce delta smelt and splittail salvage
		Jun – Reduce export pumping by 60 TAF	Reduce delta smelt and splittail salvage
1992	Critical	Jan - Reduce export pumping by 30 TAF	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon salvage
		Feb - Reduce export pumping by 90 TAF	Reduce winter/spring-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage
		Mar -Reduce export pumping by 120 TAF	Reduce winter-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage.
		Apr 1st –Apr 14th – reduce export pumping to 2,500 cfs	Reduce salmon salvage
		Apr 15th – Apr 30th – reduce export pumping to 1,500 cfs	Reduce salmon salvage
1993	Above Normal	Jan - Reduce export pumping by 20 TAF	Export reductions may be required to meet Delta water quality standards when the Delta Cross Channel gates are closed for more than 45 days and for reduction of spring-run Chinook salmon, splittail, and steelhead salvage
		Feb - Reduce export pumping by 30 TAF	Reduce winter/spring-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage
		Mar -Reduce export pumping by 60 TAF	Reduce winter-run Chinook salmon, steelhead, adult delta smelt, and splittail salvage
		Apr 15th – May15th - VAMP @ 3,200 cfs export	Implement VAMP
		Jun 1st – 10th - Reduce export pumping to 6,000 cfs	Reduce delta smelt and splittail salvage

The Typical Water Purchase Scenario assumes that the EWA asset purchases would vary according to water year type and that those assets would be provided by water purchased from the Upstream from the Delta Region, limited only by available export pumping capacity at the CVP and SWP pumping plants. The export pumping of this purchased water starts on July 1st unless an EWA action occurs in July, or if it is determined that fish species of concern are observed within the Delta. In that case, export pumping of the purchased water does not start until the EWA action is completed. Table 14 displays the amount of export reductions due to the EWA actions shown in Table 13, the EWA cost due to the EWA actions, and the amount of purchased water pumped during the July through September period for each of the study year.

Table 14
Typical Water Purchase Scenario EWA Export Reductions, EWA Assets Required, and Water Purchase Pumping (TAF)

Analysis Year	Export Reductions	EWA Assets Required	Pumping of EWA Water at Banks and/or Tracy Pumping Plants
1979	341	271[a]	213
1980	560	430[a]	254
1981	348	348	116
1982	530	330[a]	282
1983	690	0[b]	690[c]
1984	370	290[4]	234
1985	326	326	75
1986	450	450	380
1987	290	290	290
1988	242	242	242
1989	256	256	120
1990	202	202	202
1991	210	210	210
1992	258	258	258
1993	242	242	242

a San Luis Reservoir reaches full storage even with the EWA export reductions and with SWP Article 21 water deliveries.
b 1982 & 1983 were very wet years. The water loss due to EWA required export pumping curtailments can be recovered by export pumping of Delta surplus flows during the summer months. The loss of unused CVP and SWP export pumping during the summer months would not affect any other water user or the CVP because no water purchases of water from the Upstream from the Delta Region by SWP contractors, the CVP on behalf of the Project's contractors, or transfer of upstream CVP stored water would be done in these very wet water years.
c This is pumping of Delta surplus water and not purchased water.

3.0 Sacramento-San Joaquin Delta – Fish Salvage/Benefit Analysis

The CVP and SWP facilities that pump water from the Delta can entrain and kill fish, some of which are Federally- and State-listed species. As described in Section 1, Introduction, of this document, the purpose of the EWA is to improve aquatic habitat conditions to protect and assist in the recovery of Delta-dependent fish species of concern through the management of EWA assets to reduce CVP/SWP Delta export pumping during periods critical to at-risk in-Delta fish species while also providing the CVP and SWP contractors and customers water supply reliability.

This section describes the methodology, assumptions, and results of the evaluation specifically developed to determine the potential benefits of implementing the EWA Proposed Action. This evaluation uses historical fish salvage data from the CVP and SWP pumping plants to evaluate the overall affect of 1) reducing Project exports on an annual basis, as determined appropriate during the months of December through June or July (EWA fish actions); and 2) changes in Delta exports (increased pumping) July through September to repay the Projects.

3.1 Salvage

Salvage is used as an indicator of fish loss resulting from SWP and CVP export operations from the south Delta. Salvage operations at the CVP and SWP export facilities (the John E. Skinner Fish Protection Facility and the Tracy Fish Collection Facility) are performed to reduce the number of fish adversely affected by entrainment (direct loss). Salvage estimates are defined as the number of fish entering a salvage facility and subsequently returned to the Delta through a trucking and release operation. Because survival of fish species sensitive to handling is believed to be low (delta smelt), increased salvage at these facilities is considered an adverse effect of an action or project upon fish resources.

3.2 Methodology

Salvage modeling was performed to develop an indication of the relative effect of the SWP and CVP pumping operations under the basis of comparison and with implementation of the Proposed Action. The evaluation uses historical fish salvage data from the CVP and SWP pumping plants to quantify the effect of the Proposed Action upon specific fish species in the Delta.

3.2.1 Historical Data

Historical salvage records provide data for delta smelt, Chinook salmon, steelhead, splittail salvage for both the SWP and CVP facilities. These data were used to develop estimates of salvage loss. The salvage data prior to 1979 does not sufficiently identify the fish species salvaged to allow an estimate of benefits for the key species of concern. Since 1979 the salvage data provides daily densities, in numbers of fish salvage per 1,000 acre-feet pumped at the SWP Banks Pumping Plant and the CVP Tracy Pumping Plant, for Chinook salmon, steelhead, Sacramento splittail, and delta smelt.

Data selected for use in these analyses extended over a 15-year period from 1979 to 1993. This period was selected based on consideration of the reliability of salvage data (e.g., accurate species identification, expansion calculations, etc.) and correspondence with the hydrologic model period used for the CALSIM II and related modeling applications that extends through 1993. This 15-year period also provides a range of water year conditions (e.g., wet, above normal, below normal, dry, and critical years).

3.2.2 Simulations/Assumptions

The CALSIM II study used for analyses in the EWA EIS/EIR provides an operational simulation of how the CVP and SWP would be operated if the historical hydrology were to repeat. The CALSIM II simulation encompasses the 1922 through 1993 period. Because usable historical salvage is only available beginning in 1979 and the last year of the CVP/SWP operational simulation is 1993, the study period for the Delta environmental effects analyses is necessarily 1979 to 1993.

Simulations are performed assuming 1) the 1979 through 1993 hydrologic period repeats; 2) the Projects are operated during this period utilizing the current system-wide water demand and regulatory requirements; and 3) the historical fish salvage that occurred during this period would occur again. Further, as described in Section 2.2.1.1, the CALSIM II benchmark study includes 2001 LOD (demands, facilities, infrastructure) and water allocation/regulatory standards.

3.2.2.1 Basis of Comparison

The basis of comparison for the evaluation of Delta fish salvage is taken from the CALSIM II benchmark study and related post-processing tools used to create the "virtual" CALSIM II output database specifically for the 15-year period of record (1979 to 1993).

3.2.2.2 Proposed Action (Flexible Purchase Alternative)

The Proposed Action (Flexible Purchase Alternative) for the evaluation of Delta fish salvage is taken from the CALSIM II benchmark study as modified by post-processing applications to incorporate implementation of the EWA Program. Specifically, the 15-year period of record, 1979 to 1993 is used for the determination of EWA Program affects upon salvage.

As described in Section 2.2.2.2, EWA water asset acquisitions were examined under two different scenarios 1) Maximum Water Purchase Scenario; and 2) Typical Water Purchase Scenario.

3.2.3 Salvage Calculations

Calculations of salvage loss at the SWP and CVP, as a function of changes in the seasonal volume of water diverted, have been used as an indicator of potential effects resulting from changes in water project operations. The magnitude of direct losses resulting from export operations is a function of the magnitude of monthly water exports from each facility and the density (number per acre-foot) of fish vulnerable to entrainment at the facilities. Results of the hydrologic modeling performed for the basis of comparison and the Proposed Action scenarios provide estimates of the average monthly Delta export operations for both the SWP and CVP. Salvage data are available on species-specific level at both the SWP and CVP facilities for use in estimating the risk of fishery loss. Average densities (number per acre-foot) were calculated monthly for both the SWP and CVP facilities for selected fish species over a 15-year period (1979 to 1993). Estimates of direct loss from SWP and CVP facilities were calculated for Chinook salmon, steelhead, delta smelt, splittail.

An index of salvage was developed for the purposes of evaluating the incremental effects of EWA operations on the direct losses at the Delta export facilities. The salvage index was derived using records of species-specific salvage data at the SWP and CVP to calculate average monthly density (number of fish per TAF), which could then be multiplied by the calculated SWP and CVP monthly exports (in TAF) obtained from the hydrologic modeling output. The salvage index was calculated separately for the SWP and CVP export operations under the basis of comparison and Proposed Action. The resulting salvage index was then used to determine the incremental benefits (reduced salvage) and adverse effects (increased salvage) calculated to result from EWA operations.

Average monthly salvage densities for each species were calculated from daily salvage records over the period from 1979 through 2001 (R. Brown, unpublished data; CDFG, unpublished data). Based on the daily salvage, expanded for sub-sampling effort, a daily density estimate was calculated using the actual water volume diverted at each of the two export facilities. The daily density estimates were then averaged to calculate an average monthly density. For consistency, the average monthly density of each of the individual target species was then used to calculate the salvage index for the period from January 1979 through September 1993 using hydrologic modeling results for the basis of comparison and Proposed Action (Flexible Purchase Alternative). After calculating the monthly salvage index for each species, assuming EWA operations, the baseline estimate was subtracted from the monthly salvage index for each species to determine the net difference in salvage estimates (EWA operations - baseline estimate = net change) that are anticipated to occur with implementation of the Proposed Action. These calculations were performed for both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario.

3.2.4 Limitations

It is recognized that during the historical period, 1979 to 1993, the Projects were operated under Delta water quality, flow, and export constraint requirements that were much less stringent than the Delta requirements in place today. This suggests that the historical fish salvage was likely higher than it would be if the 1979 to 1993 period reoccurred with the Projects operated under today's Delta requirements, as assumed in this analysis. As a result, the Delta effects analyzed in this document likely will over-estimate the amount of EWA assets required to achieve the State and Federal fishery agencies' habitat conditions improvement goals.

The current populations of some of the listed species, such as winter-run Chinook salmon, are larger today than they were during the 1979 to 1993 period. Because of this, neither the timing, duration, nor the quantity of water needed for most operational curtailments can be accurately estimated until shortly before the action is scheduled. Differences in conditions between the historical 1979 to 1993 period and what would occur if that hydrologic period reoccurred today, indicate that the historical fish salvage at the Projects' pumping plants that occurred during the 1979 to 1993 period would not be the same today.

However, despite the inaccuracies within the analyses caused by assuming historical fish salvage at the pumping plants, the evaluations were performed to provide some approximate quantification of the overall potential EWA benefits that may be realized with implementation of the EWA program, using the best available data. Without some quantification, the discussion and analysis of benefits of the EWA and the cost of exporting water would have to be qualitative and based upon scientific opinion. Therefore, the results provided by the analyses must be considered as only part of the information (quantitative and qualitative) that should be used to evaluate the effects of implementing the EWA in the Delta.

3.2.5 Effect Analysis Comparisons

The results for the Maximum Water Purchase Scenario under the Proposed Action (Flexible Purchase Alternative) were compared to the basis of comparison to determine the overall maximum net benefits that may result from implementation of the EWA program. These results are described in Section 3.2.6.1 and in Chapter 9 of the EWA EIS/EIR, and Chapter 4 of the ASIP.

Additionally, the results for the Proposed Action (Flexible Purchase Alternative), under the Typical Water Purchase Scenario were compared to the basis of comparison to determine the overall, more likely, net benefits that may result from implementation of the EWA program.

These results are described in Section 3.2.6.2 and in Chapter 9 of the EWA EIS/EIR, and Chapter 4 of the ASIP.

3.2.6 Results

The results from the evaluation of each scenario, summarized in the following sections, indicate that implementation of the EWA fish actions would result in overall long-term net benefits to the fish species of concern in the Delta Region, relative to the basis of comparison. A more detailed presentation of overall net benefits to the individual species is presented in Chapter 9 of the EWA EIS/EIR and Chapter 4 of the ASIP.

For the purposes of evaluating potential effects of the EWA program on fish salvage, the incremental difference in the annual salvage indices reflect the benefit (reduced salvage under the EWA Program) as a negative index and an incremental adverse effect (increased salvage under the EWA Program) as a positive index.

3.2.6.1 Maximum Water Purchase Scenario – EWA Benefits

The salvage modeling indicates that the Maximum Water Purchase Scenario would result in overall net benefits as determined by estimated reductions in salvage loss, as presented in Tables 15 through 26 for Chinook salmon, delta smelt, Sacramento splittail, and steelhead. It is noted that the values provided in these tables indicate the maximum possible salvage benefits based on the assumptions for this scenario (described in Section 2.2.2.2). Therefore, these results represent an upper boundary for the level of benefit that could occur with implementation of the proposed EWA fish actions.

Three tables are shown for each species. The first table shows the salvage for the basis of comparison (Baseline Condition), the second table is an intermediate step that shows the reduction in the base salvage after the assumed EWA pump reductions are implemented, and the third table shows the overall net result of the combined influences from the assumed EWA pump reductions and the increased summer Delta export pumping to repay SWP and CVP customers.

The EWA provides benefits to all fish species studied during the 1979 to 1993 study period. There are two years when the EWA does not result in a net decrease of salvage for listed species. However, it is noted that, in real-time operations, if fish species of concern were observed near the pumps, the Management Agencies could avoid effects by delaying the start of summer export pumping until it is determined the fish are out of the area, or until the EWA fish action is completed.

Table 15 ***Delta Smelt Salvage (Baseline Condition)***													
Year	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
1979				4,263	5,501	3,901	1,966	9,079	15,466	12,250	3,413	83	55,923
1980	25,751	1,300	0	6,540	5,479	10,622	2,307	989	19,170	15,604	11,530	2,251	101,543
1981	16,254	3,914	11,500	29,526	25,537	14,389	3,750	80,903	66,163	114,229	55,870	4,268	426,301
1982	2,757	9,008	1,356	12,822	12,371	5,945	297	529	2,946	868	2,380	1,907	53,188
1983	1,469	1,505	922	2,130	798	323	40	12	7,775	6,241	0	1,195	22,412
1984	0	0	426	0	74	1,005	125	15,533	9,276	2,762	875	48	30,125
1985	210	135	3,161	316	675	417	697	2,664	10,745	3,942	2,228	1,264	26,454
1986	77	0	569	1,688	3,276	928	720	137	198	265	1,366	0	9,225
1987	194	35	232	120	1,137	760	8,384	7,787	11,721	2,590	3,339	342	36,641
1988	54	31	8,533	7,077	335	15	0	7,901	7,452	658	0	0	32,056
1989	141	0	272	797	24	307	2,494	2,076	5,986	9,065	1,304	412	22,878
1990	109	138	0	256	204	173	952	2,706	23,168	3,393	28	0	31,126
1991	0	0	47	388	209	1,372	450	1,450	2,708	2,463	980	1,264	11,332
1992	101	0	0	99	871	636	101	494	637	17	0	0	2,954
1993	0	0	0	3,118	1,822	444	0	37,725	24,146	647	25	0	67,925
Total	47,119	16,065	27,018	69,141	58,312	41,236	22,283	169,983	207,557	174,996	83,339	13,034	930,082

Table 16 ***Change in Delta Smelt Salvage (EWA with Pump Reductions – Maximum Water Purchase Scenario)***													
Year	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
1979				-125	-188	-337	-1,350	-3,121	-2,440	0	0	0	-7,561
1980	0	0	0	-188	-348	-408	-816	-238	-9,006	-4,752	0	0	-15,754
1981	0	0	-416	0	-1,128	-6,552	-1,522	-37,501	-3,836	-15,305	0	0	-66,261
1982	0	0	-63	-781	-1,257	-634	-73	-218	-36	0	0	0	-3,062
1983	0	0	-161	-862	-254	-61	-10	-8	-2,932	0	0	0	-4,288
1984	0	0	0	0	-2	-186	-50	-5,046	-1,553	0	0	0	-6,838
1985	0	0	-340	0	-30	-57	-282	-456	-7,955	0	0	0	-9,120
1986	0	0	-20	-71	-356	-241	-128	-26	-39	0	0	0	-881
1987	0	0	-22	-5	-53	-357	-3,402	-3,886	-5,925	-901	0	0	-14,552
1988	0	0	-1,337	-862	-100	0	0	-4,816	0	0	0	0	-7,115
1989	0	0	0	-44	-6	-32	-40	-366	-581	-1,884	0	0	-2,953
1990	0	0	0	-27	-80	-56	0	0	-7,656	0	0	0	-7,819
1991	0	0	0	0	0	-213	-121	-857	0	0	0	0	-1,191
1992	0	0	0	-10	-102	-164	-20	0	0	0	0	0	-295
1993	0	0	0	-89	-59	-49	0	-5,389	-1,681	0	0	0	-7,268
Total	0	0	-2,358	-3,063	-3,964	-9,347	-7,814	-61,929	-43,642	-22,842	0	0	-154,959

Table 17 Change in Delta Smelt Salvage (EWA with Pump Reductions and Summer Export Pumping – Maximum Water Purchase Scenario)													
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-125	-188	-337	-1,350	-3,121	-2,440	2,463	181	15	-4,902
1980	0	0	0	-188	-348	-408	-816	-238	-9,006	915	3,314	105	-6,668
1981	0	0	-416	0	-1,128	-6,552	-1,522	-37,501	-3,836	-15,305	235	24	-66,002
1982	0	0	-63	-781	-1,257	-634	-73	-218	-36	712	414	39	-1,897
1983	0	0	-161	-862	-254	-61	-10	-8	-2,932	852	0	245	-3,191
1984	0	0	0	0	-2	-186	-50	-5,046	-1,553	761	3	9	-6,065
1985	0	0	-340	0	-30	-57	-282	-456	-7,955	63	34	50	-8,973
1986	0	0	-20	-71	-356	-241	-128	-26	-39	112	166	0	-603
1987	0	0	-22	-5	-53	-357	-3,402	-3,886	-5,925	-892	75	150	-14,319
1988	0	0	-1,337	-862	-100	0	0	-4,816	0	418	0	0	-6,697
1989	0	0	0	-44	-6	-32	-40	-366	-581	-1,884	74	31	-2,848
1990	0	0	0	-27	-80	-56	0	0	-7,656	960	2	0	-6,857
1991	0	0	0	0	0	-213	-121	-857	0	880	261	448	398
1992	0	0	0	-10	-102	-164	-20	0	0	3	0	0	-293
1993	0	0	0	-89	-59	-49	0	-5,389	-1,681	293	5	0	-6,970
Total	0	0	-2,358	-3,063	-3,964	-9,347	-7,814	-61,929	-43,642	-9,651	4,763	1,117	-135,887

Table 18 Steelhead Salvage (Baseline Condition)													
Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				649	1,181	1,979	2,392	1,041	0	0	0	0	7,242
1980	0	16	33	519	911	173	966	897	108	0	0	0	3,623
1981	74	0	320	495	3,299	7,139	3,155	205	0	0	0	0	14,687
1982	0	0	686	1,691	2,040	1,027	10,063	7,644	1,647	0	0	0	24,799
1983	24	0	1,985	108	40	0	0	466	0	0	0	0	2,624
1984	0	36	0	0	0	184	400	66	0	0	0	0	685
1985	0	0	31	0	395	1,069	793	471	0	0	0	0	2,759
1986	0	0	0	21	932	257	2,095	711	34	32	0	0	4,082
1987	0	0	1,450	150	215	8,628	1,229	243	0	0	0	0	11,915
1988	0	0	589	363	485	179	1,097	686	2	0	0	0	3,401
1989	0	0	110	32	145	10,533	3,465	493	0	0	0	0	14,777
1990	0	0	0	0	1,472	2,228	196	82	0	0	0	0	3,979
1991	0	0	18	74	79	11,261	905	105	0	0	0	0	12,441
1992	25	292	0	4,550	7,920	4,869	342	14	0	0	0	0	18,011
1993	0	0	14	1,356	14,819	7,001	1,268	738	40	0	0	0	25,236
Total	123	344	5,235	10,008	33,933	56,527	28,364	13,861	1,832	32	0	0	150,260

Table 19
Change in Steelhead Salvage (EWA with Pump Reductions – Maximum Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-34	-93	-260	-1,425	-775	0	0	0	0	-2,588
1980	0	0	-2	-15	-48	-7	-738	-671	-55	0	0	0	-1,536
1981	0	0	-12	0	-132	-2,397	-1,452	-92	0	0	0	0	-4,085
1982	0	0	-32	-65	-130	-90	-1,790	-1,526	-373	0	0	0	-4,005
1983	0	0	-755	-40	-16	0	0	-75	0	0	0	0	-887
1984	0	0	0	0	0	-24	-261	-8	0	0	0	0	-293
1985	0	0	-2	0	-18	-145	-353	-163	0	0	0	0	-682
1986	0	0	0	-2	-144	-71	-423	-182	0	0	0	0	-820
1987	0	0	-138	-9	-12	-2,715	-546	-81	0	0	0	0	-3,500
1988	0	0	-83	-55	-189	0	-164	-170	0	0	0	0	-661
1989	0	0	0	-2	-42	-1,464	-34	-26	0	0	0	0	-1,568
1990	0	0	0	0	-383	-846	0	0	0	0	0	0	-1,230
1991	0	0	0	0	0	-1,988	-206	-31	0	0	0	0	-2,225
1992	0	0	0	-289	-1,016	-1,247	-39	0	0	0	0	0	-2,590
1993	0	0	0	-39	-588	-928	-395	-314	0	0	0	0	-2,264
Total	0	0	-1,024	-550	-2,810	-12,182	-7,826	-4,114	-428	0	0	0	-28,934

Table 20
Change in Steelhead Salvage (EWA with Pump Reductions and Summer Export Pumping – Maximum Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-34	-93	-260	-1,425	-775	0	0	0	0	-2,588
1980	0	0	-2	-15	-48	-7	-738	-671	-55	0	0	0	-1,536
1981	0	0	-12	0	-132	-2,397	-1,452	-92	0	0	0	0	-4,085
1982	0	0	-32	-65	-130	-90	-1,790	-1,526	-373	0	0	0	-4,005
1983	0	0	-755	-40	-16	0	0	-75	0	0	0	0	-887
1984	0	0	0	0	0	-24	-261	-8	0	0	0	0	-293
1985	0	0	-2	0	-18	-145	-353	-163	0	0	0	0	-682
1986	0	0	0	-2	-144	-71	-423	-182	0	5	0	0	-815
1987	0	0	-138	-9	-12	-2,715	-546	-81	0	0	0	0	-3,500
1988	0	0	-83	-55	-189	0	-164	-170	0	0	0	0	-661
1989	0	0	0	-2	-42	-1,464	-34	-26	0	0	0	0	-1,568
1990	0	0	0	0	-383	-846	0	0	0	0	0	0	-1,230
1991	0	0	0	0	0	-1,988	-206	-31	0	0	0	0	-2,225
1992	0	0	0	-289	-1,016	-1,247	-39	0	0	0	0	0	-2,590
1993	0	0	0	-39	-588	-928	-395	-314	0	0	0	0	-2,264
Total	0	0	-1,024	-550	-2,810	-12,182	-7,826	-4,114	-428	5	0	0	-28,928

Table 21
Chinook Salmon Salvage (Baseline Condition)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				15,754	5,111	6,669	78,404	100,415	10,579	5,236	439	338	222,946
1980	2,244	6,431	6,700	8,308	470	498	119,475	93,503	40,724	1,976	32	1,690	282,050
1981	3,124	2,563	3,148	3,137	5,138	15,279	44,955	28,292	4,639	0	83	0	110,360
1982	6,466	5,712	33,275	25,872	42,724	34,027	31,819	290,241	137,177	1,643	224	0	609,180
1983	0	32,194	75,216	8,684	9,719	6,530	27,102	30,693	108,466	2,819	0	0	301,422
1984	3,695	1,095	51	219	175	8,615	82,697	95,424	75,191	1,019	536	0	268,716
1985	28,854	23,118	19,885	350	8,481	5,379	40,758	97,778	13,600	661	0	30	238,892
1986	8,953	4,225	6,249	3,707	541,376	92,284	286,376	260,372	196,795	7,221	0	0	1,407,557
1987	707	187	1,388	516	1,490	12,384	41,486	40,467	8,798	580	84	89	108,176
1988	3	17	32,416	7,207	3,037	633	15,334	36,453	2,425	363	18	9	97,915
1989	41	466	709	2,139	35	15,568	17,357	32,969	2,361	0	125	0	71,771
1990	24	254	63	2,817	464	2,282	1,796	18,052	4,116	6	0	0	29,873
1991	7	0	23	31	115	8,028	13,816	19,395	863	0	0	0	42,278
1992	18	4,990	138	1,315	13,624	21,902	17,320	2,621	0	0	0	6	61,934
1993	0	0	199	1,743	1,726	946	8,935	18,233	3,823	3	96	0	35,705
Total	54,135	81,253	179,459	81,799	633,686	231,025	827,631	1,164,908	609,555	21,526	1,637	2,161	3,888,774

Table 22
Change in Chinook Salmon Salvage (EWA with Pump Reductions – Maximum Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-586	-197	-700	-55,499	-55,646	-1,570	0	0	0	-114,198
1980	0	0	-466	-238	-27	-20	-86,314	-54,922	-16,405	-567	0	0	-158,960
1981	0	0	-102	0	-156	-5,630	-24,295	-15,608	-64	0	0	0	-45,854
1982	0	0	-2,161	-1,300	-3,084	-3,354	-6,557	-71,783	-15,742	0	0	0	-103,981
1983	0	0	-15,916	-3,451	-3,350	-1,593	-6,707	-19,821	-37,634	0	0	0	-88,473
1984	0	0	0	0	-6	-1,290	-45,834	-46,789	-16,714	0	0	0	-110,633
1985	0	0	-1,625	0	-362	-829	-16,828	-48,989	-10,555	0	0	0	-79,187
1986	0	0	-399	-190	-93,319	-25,239	-57,136	-86,099	-59,386	0	0	0	-321,769
1987	0	0	-94	-27	-78	-4,394	-16,697	-11,139	-4,062	0	0	0	-36,491
1988	0	0	-4,804	-1,015	-913	0	-1,902	-14,700	0	0	0	0	-23,333
1989	0	0	0	-118	-9	-2,071	-770	-6,591	-148	0	0	0	-9,706
1990	0	0	-51	-298	-164	-744	0	0	-1,273	0	0	0	-2,531
1991	0	0	0	0	0	-1,355	-3,919	-7,895	0	0	0	0	-13,169
1992	0	0	0	-108	-1,814	-5,750	-2,877	0	0	0	0	0	-10,548
1993	0	0	0	-51	-67	-122	-4,429	-4,236	-238	0	0	0	-9,144
Total	0	0	-25,617	-7,383	-103,545	-53,091	-329,762	-444,219	-163,792	-567	0	0	-1,127,976

Table 23
Change in Chinook Salmon Salvage (EWA with Pump Reductions and Summer Export Pumping – Maximum Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-586	-197	-700	-55,499	-55,646	-1,570	1,450	75	28	-112,645
1980	0	0	-466	-238	-27	-20	-86,314	-54,922	-16,405	-567	10	519	-158,431
1981	0	0	-102	0	-156	-5,630	-24,295	-15,608	-64	0	14	0	-45,839
1982	0	0	-2,161	-1,300	-3,084	-3,354	-6,557	-71,783	-15,742	32	4	0	-103,945
1983	0	0	-15,916	-3,451	-3,350	-1,593	-6,707	-19,821	-37,634	284	0	0	-88,189
1984	0	0	0	0	-6	-1,290	-45,834	-46,789	-16,714	4	133	0	-110,496
1985	0	0	-1,625	0	-362	-829	-16,828	-48,989	-10,555	29	0	2	-79,156
1986	0	0	-399	-190	-93,319	-25,239	-57,136	-86,099	-59,386	1,244	0	0	-320,526
1987	0	0	-94	-27	-78	-4,394	-16,697	-11,139	-4,062	15	2	3	-36,471
1988	0	0	-4,804	-1,015	-913	0	-1,902	-14,700	0	248	21	2	-23,062
1989	0	0	0	-118	-9	-2,071	-770	-6,591	-148	0	6	0	-9,701
1990	0	0	-51	-298	-164	-744	0	0	-1,273	1	0	0	-2,529
1991	0	0	0	0	0	-1,355	-3,919	-7,895	0	0	0	0	-13,169
1992	0	0	0	-108	-1,814	-5,750	-2,877	0	0	0	0	0	-10,547
1993	0	0	0	-51	-67	-122	-4,429	-4,236	-238	2	21	0	-9,120
Total	0	0	-25,617	-7,383	-103,545	-53,091	-329,762	-444,219	-163,792	2,742	286	555	-1,123,826

Table 24
Splittail Salvage (Baseline Condition)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				34	1,122	4,615	2,157	60,479	70,254	15,807	5,254	1,202	160,925
1980	72	86	1,310	56,194	61,187	1,621	6,020	140,563	187,723	45,984	9,770	1,318	511,847
1981	265	0	598	1,557	8,581	5,781	5,242	64,198	27,671	2,539	1,203	0	117,636
1982	0	290	1,577	32,429	44,207	13,705	5,413	45,730	169,164	193,840	121,238	4,172	631,762
1983	227	0	2,409	1,164	13,451	4,668	2,082	16,054	304,327	112,646	55,782	5,300	518,109
1984	1,477	36	63	96	3,945	7,479	5,640	9,307	56,464	46,887	10,337	1,060	142,790
1985	0	396	1,989	282	8,360	4,514	3,851	3,219	25,057	14,605	4,072	758	67,103
1986	286	1,103	0	246	2,281	7,461	74,203	971,878	1,095,083	29,690	14,404	7,452	2,204,087
1987	1,094	418	976	1,411	4,854	6,291	1,443	1,466	107,463	7,716	939	350	134,422
1988	34	13	3,581	23,499	3,589	638	1,901	2,999	2,434	1,268	20	168	40,145
1989	0	129	77	485	265	10,674	7,193	9,775	7,567	4,449	10,305	1,409	52,328
1990	49	48	7	1,279	1,932	3,197	322	3,224	11,623	1,071	0	0	22,752
1991	0	0	0	491	133	7,132	2,673	2,265	10,196	843	0	0	23,733
1992	78	0	25	485	4,324	3,247	181	244	2,508	0	88	3	11,183
1993	0	0	12	34,322	11,430	3,110	2,718	74,866	112,327	10,923	482	82	250,270
Total	3,581	2,519	12,623	153,974	169,661	84,134	121,038	1,406,268	2,189,862	488,266	233,894	23,273	4,889,093

Table 25
Change in Splittail Salvage (EWA with Pump Reductions – Maximum Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-1	-38	-398	-1,479	-9,931	-10,819	0	0	0	-22,666
1980	0	0	-91	-1,613	-3,254	-69	-4,310	-23,974	-66,341	-6,029	0	0	-105,683
1981	0	0	-20	0	-299	-1,819	-2,823	-29,018	0	0	0	0	-33,980
1982	0	0	-73	-1,241	-3,442	-1,371	-1,274	-9,822	-23,597	0	0	0	-40,821
1983	0	0	-737	-497	-3,791	-1,437	-515	-8,712	-59,762	0	0	0	-75,452
1984	0	0	0	0	-218	-1,114	-2,807	-2,315	-3,868	0	0	0	-10,323
1985	0	0	-138	0	-371	-677	-1,662	-700	-14,563	0	0	0	-18,112
1986	0	0	0	-10	-356	-2,094	-16,567	-368,329	-339,879	0	0	0	-727,235
1987	0	0	-89	-74	-268	-2,357	-642	-373	-54,289	-666	0	0	-58,758
1988	0	0	-518	-2,602	-1,315	0	-259	-1,378	0	0	0	0	-6,072
1989	0	0	0	-32	-83	-1,351	-104	-2,308	-670	-994	0	0	-5,542
1990	0	0	-6	-132	-757	-1,192	0	0	0	0	0	0	-2,087
1991	0	0	0	0	0	-1,337	-648	-1,329	0	0	0	0	-3,314
1992	0	0	0	-35	-642	-839	-22	0	0	0	0	0	-1,537
1993	0	0	0	-1,439	-457	-448	-1,459	-2,489	-2,114	0	0	0	-8,407
Total	0	0	-1,673	-7,675	-15,292	-16,502	-34,572	-460,681	-575,902	-7,690	0	0	-1,119,988

Table 26
Change in Splittail Salvage (EWA with Pump Reductions and Summer Export Pumping – Maximum Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-1	-38	-398	-1,479	-9,931	-10,819	2,979	778	71	-18,838
1980	0	0	-91	-1,613	-3,254	-69	-4,310	-23,974	-66,341	46	2,198	341	-97,068
1981	0	0	-20	0	-299	-1,819	-2,823	-29,018	0	0	16	0	-33,963
1982	0	0	-73	-1,241	-3,442	-1,371	-1,274	-9,822	-23,597	13,903	20,387	166	-6,365
1983	0	0	-737	-497	-3,791	-1,437	-515	-8,712	-59,762	9,261	4,804	194	-61,192
1984	0	0	0	0	-218	-1,114	-2,807	-2,315	-3,868	8,776	1,941	208	603
1985	0	0	-138	0	-371	-677	-1,662	-700	-14,563	383	78	20	-17,630
1986	0	0	0	-10	-356	-2,094	-16,567	-368,329	-339,879	22,726	3,675	1,748	-699,086
1987	0	0	-89	-74	-268	-2,357	-642	-373	-54,289	-436	96	106	-58,326
1988	0	0	-518	-2,602	-1,315	0	-259	-1,378	0	1,178	24	47	-4,824
1989	0	0	0	-32	-83	-1,351	-104	-2,308	-670	-994	455	79	-5,008
1990	0	0	-6	-132	-757	-1,192	0	0	0	1,459	0	0	-628
1991	0	0	0	0	0	-1,337	-648	-1,329	0	459	0	0	-2,855
1992	0	0	0	-35	-642	-839	-22	0	0	0	55	0	-1,482
1993	0	0	0	-1,439	-457	-448	-1,459	-2,489	-2,114	675	89	16	-7,627
Total	0	0	-1,673	-7,675	-15,292	-16,502	-34,572	-460,681	-575,902	60,415	34,596	2,996	-1,014,290

3.2.6.2 Typical Water Purchase Scenario – EWA Benefits

The calculation of the EWA benefits for the Typical Water Purchase Scenario are shown in Tables 27 through 38 for delta smelt, steelhead, Chinook salmon, Sacramento splittail. Three tables are shown for each species. The first table shows the salvage under the Baseline Condition; the second table shows reduced base salvage after the assumed EWA pump reductions are implemented, and the third table shows the overall net affect on base salvage with the assumed EWA pump reduction and the increase in summer export pumping of the EWA assets. As indicated by these results for the analysis period, 1979 to 1993, the Typical Water Purchase Scenario would result in a net beneficial effect as measured by estimated annual net salvage data. These results indicate that the EWA provides net benefits to all fish species studied. Changes in salvage estimates are indicated for each year for each species. Additional species-specific discussions of these results are provided in Chapter 9 of the EWA EIS/EIR and in Chapter 4 of the ASIP.

Table 27
Delta Smelt Salvage (Baseline Condition)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				4,263	5,501	3,901	1,966	9,079	15,466	12,250	3,413	83	55,923
1980	25,751	1,300	0	6,540	5,479	10,622	2,307	989	19,170	15,604	11,530	2,251	101,543
1981	16,254	3,914	11,500	29,526	25,537	14,389	3,750	80,903	66,163	114,229	55,870	4,268	426,301
1982	2,757	9,008	1,356	12,822	12,371	5,945	297	529	2,946	868	2,380	1,907	53,188
1983	1,469	1,505	922	2,130	798	323	40	12	7,775	6,241	0	1,195	22,412
1984	0	0	426	0	74	1,005	125	15,533	9,276	2,762	875	48	30,125
1985	210	135	3,161	316	675	417	697	2,664	10,745	3,942	2,228	1,264	26,454
1986	77	0	569	1,688	3,276	928	720	137	198	265	1,366	0	9,225
1987	194	35	232	120	1,137	760	8,384	7,787	11,721	2,590	3,339	342	36,641
1988	54	31	8,533	7,077	335	15	0	7,901	7,452	658	0	0	32,056
1989	141	0	272	797	24	307	2,494	2,076	5,986	9,065	1,304	412	22,878
1990	109	138	0	256	204	173	952	2,706	23,168	3,393	28	0	31,126
1991	0	0	47	388	209	1,372	450	1,450	2,708	2,463	980	1,264	11,332
1992	101	0	0	99	871	636	101	494	637	17	0	0	2,954
1993	0	0	0	3,118	1,822	444	0	37,725	24,146	647	25	0	67,925
Total	47,119	16,065	27,018	69,141	58,312	41,236	22,283	169,983	207,557	174,996	83,339	13,034	930,082

Table 28
Change in Delta Smelt Salvage (EWA with Pump Reductions – Typical Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-42	-125	-225	-442	-1,874	-2,440	0	0	0	-5,148
1980	0	0	0	-188	-348	-408	-498	-127	-6,754	-8,217	0	0	-16,540
1981	0	0	-416	0	-1,128	-1,966	-1,036	-13,130	-3,836	-5,102	0	0	-26,614
1982	0	0	-63	-781	-1,257	-634	-73	-218	-36	0	0	0	-3,062
1983	0	0	-161	-862	-254	-61	-10	-8	-2,199	0	0	0	-3,555
1984	0	0	0	0	-2	-186	-21	-2,895	-1,165	0	0	0	-4,269
1985	0	0	-170	0	-30	-29	-255	-906	-6,524	0	0	0	-7,912
1986	0	0	-20	-71	-356	-145	-128	-18	-19	0	0	0	-756
1987	0	0	-15	0	-35	-208	-1,301	-3,886	-5,925	0	0	0	-11,371
1988	0	0	-668	-287	-35	0	0	-4,816	-487	0	0	0	-6,293
1989	0	0	-21	-44	-6	-32	-40	-366	-581	0	0	0	-1,090
1990	0	0	0	-9	-27	-28	0	-28	-7,656	0	0	0	-7,748
1991	0	0	0	0	0	-106	-121	-531	-2,708	0	0	0	-3,467
1992	0	0	0	-10	-102	-164	-20	0	0	0	0	0	-295
1993	0	0	0	-60	-59	-33	0	-7,318	-1,022	0	0	0	-8,491
Total	0	0	-1,533	-2,352	-3,765	-4,223	-3,945	-36,121	-41,354	-13,319	0	0	-106,611

Table 29
Change in Delta Smelt Salvage (EWA with Pump Reductions and Increased Summer Export Pumping – Typical Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-42	-125	-225	-442	-1,874	-2,440	2,463	181	15	-2,489
1980	0	0	0	-188	-348	-408	-498	-127	-6,754	-8,217	3,314	105	-13,121
1981	0	0	-416	0	-1,128	-1,966	-1,036	-13,130	-3,836	-5,102	235	24	-26,355
1982	0	0	-63	-781	-1,257	-634	-73	-218	-36	712	414	39	-1,897
1983	0	0	-161	-862	-254	-61	-10	-8	-2,199	852	0	245	-2,458
1984	0	0	0	0	-2	-186	-21	-2,895	-1,165	761	3	9	-3,496
1985	0	0	-170	0	-30	-29	-255	-906	-6,524	63	34	50	-7,765
1986	0	0	-20	-71	-356	-145	-128	-18	-19	91	104	0	-561
1987	0	0	-15	0	-35	-208	-1,301	-3,886	-5,925	-19	-21	132	-11,279
1988	0	0	-668	-287	-35	0	0	-4,816	-487	290	0	0	-6,004
1989	0	0	-21	-44	-6	-32	-40	-366	-581	441	74	31	-543
1990	0	0	0	-9	-27	-28	0	-28	-7,656	136	0	0	-7,612
1991	0	0	0	0	0	-106	-121	-531	-2,708	1,240	368	277	-1,582
1992	0	0	0	-10	-102	-164	-20	0	0	3	0	0	-293
1993	0	0	0	-60	-59	-33	0	-7,318	-1,022	250	5	0	-8,237
Total	0	0	-1,533	-2,352	-3,765	-4,223	-3,945	-36,121	-41,354	-6,036	4,711	928	-93,690

Table 30
Steelhead Salvage (Baseline Condition)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				649	1,181	1,979	2,392	1,041	0	0	0	0	7,242
1980	0	16	33	519	911	173	966	897	108	0	0	0	3,623
1981	74	0	320	495	3,299	7,139	3,155	205	0	0	0	0	14,687
1982	0	0	686	1,691	2,040	1,027	10,063	7,644	1,647	0	0	0	24,799
1983	24	0	1,985	108	40	0	0	466	0	0	0	0	2,624
1984	0	36	0	0	0	184	400	66	0	0	0	0	685
1985	0	0	31	0	395	1,069	793	471	0	0	0	0	2,759
1986	0	0	0	21	932	257	2,095	711	34	32	0	0	4,082
1987	0	0	1,450	150	215	8,628	1,229	243	0	0	0	0	11,915
1988	0	0	589	363	485	179	1,097	686	2	0	0	0	3,401
1989	0	0	110	32	145	10,533	3,465	493	0	0	0	0	14,777
1990	0	0	0	0	1,472	2,228	196	82	0	0	0	0	3,979
1991	0	0	18	74	79	11,261	905	105	0	0	0	0	12,441
1992	25	292	0	4,550	7,920	4,869	342	14	0	0	0	0	18,011
1993	0	0	14	1,356	14,819	7,001	1,268	738	40	0	0	0	25,236
Total	123	344	5,235	10,008	33,933	56,527	28,364	13,861	1,832	32	0	0	150,260

Table 31
Change in Steelhead Salvage (EWA with Pump Reductions – Typical Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-11	-62	-173	-707	-473	0	0	0	0	-1,428
1980	0	0	-2	-15	-48	-7	-507	-458	-41	0	0	0	-1,078
1981	0	0	-12	0	-132	-719	-1,016	-24	0	0	0	0	-1,903
1982	0	0	-32	-65	-130	-90	-1,790	-1,526	-373	0	0	0	-4,005
1983	0	0	-755	-40	-16	0	0	-75	0	0	0	0	-887
1984	0	0	0	0	0	-24	-151	-5	0	0	0	0	-180
1985	0	0	-1	0	-18	-73	-220	-221	0	0	0	0	-532
1986	0	0	0	-2	-144	-43	-423	-121	0	0	0	0	-732
1987	0	0	-92	0	-8	-1,213	-302	-81	0	0	0	0	-1,695
1988	0	0	-42	-18	-103	0	-78	-170	0	0	0	0	-411
1989	0	0	-5	-2	-42	-1,464	-34	-26	0	0	0	0	-1,573
1990	0	0	0	0	-128	-423	0	-3	0	0	0	0	-554
1991	0	0	0	0	0	-994	-206	-24	0	0	0	0	-1,224
1992	0	0	0	-289	-1,016	-1,247	-39	0	0	0	0	0	-2,590
1993	0	0	0	-26	-588	-618	-165	-200	0	0	0	0	-1,597
Total	0	0	-941	-468	-2,434	-7,088	-5,636	-3,407	-414	0	0	0	-20,389

Table 32
Change in Steelhead Salvage (EWA with Pump Reductions and Increased Summer Export Pumping – Typical Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-11	-62	-173	-707	-473	0	0	0	0	-1,428
1980	0	0	-2	-15	-48	-7	-507	-458	-41	0	0	0	-1,078
1981	0	0	-12	0	-132	-719	-1,016	-24	0	0	0	0	-1,903
1982	0	0	-32	-65	-130	-90	-1,790	-1,526	-373	0	0	0	-4,005
1983	0	0	-755	-40	-16	0	0	-75	0	0	0	0	-887
1984	0	0	0	0	0	-24	-151	-5	0	0	0	0	-180
1985	0	0	-1	0	-18	-73	-220	-221	0	0	0	0	-532
1986	0	0	0	-2	-144	-43	-423	-121	0	3	0	0	-728
1987	0	0	-92	0	-8	-1,213	-302	-81	0	0	0	0	-1,695
1988	0	0	-42	-18	-103	0	-78	-170	0	0	0	0	-411
1989	0	0	-5	-2	-42	-1,464	-34	-26	0	0	0	0	-1,573
1990	0	0	0	0	-128	-423	0	-3	0	0	0	0	-554
1991	0	0	0	0	0	-994	-206	-24	0	0	0	0	-1,224
1992	0	0	0	-289	-1,016	-1,247	-39	0	0	0	0	0	-2,590
1993	0	0	0	-26	-588	-618	-165	-200	0	0	0	0	-1,597
Total	0	0	-941	-468	-2,434	-7,088	-5,636	-3,407	-414	3	0	0	-20,386

Table 33
Chinook Salmon Salvage (Baseline Condition)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				15,754	5,111	6,669	78,404	100,415	10,579	5,236	439	338	222,946
1980	2,244	6,431	6,700	8,308	470	498	119,475	93,503	40,724	1,976	32	1,690	282,050
1981	3,124	2,563	3,148	3,137	5,138	15,279	44,955	28,292	4,639	0	83	0	110,360
1982	6,466	5,712	33,275	25,872	42,724	34,027	31,819	290,241	137,177	1,643	224	0	609,180
1983	0	32,194	75,216	8,684	9,719	6,530	27,102	30,693	108,466	2,819	0	0	301,422
1984	3,695	1,095	51	219	175	8,615	82,697	95,424	75,191	1,019	536	0	268,716
1985	28,854	23,118	19,885	350	8,481	5,379	40,758	97,778	13,600	661	0	30	238,892
1986	8,953	4,225	6,249	3,707	541,376	92,284	286,376	260,372	196,795	7,221	0	0	1,407,557
1987	707	187	1,388	516	1,490	12,384	41,486	40,467	8,798	580	84	89	108,176
1988	3	17	32,416	7,207	3,037	633	15,334	36,453	2,425	363	18	9	97,915
1989	41	466	709	2,139	35	15,568	17,357	32,969	2,361	0	125	0	71,771
1990	24	254	63	2,817	464	2,282	1,796	18,052	4,116	6	0	0	29,873
1991	7	0	23	31	115	8,028	13,816	19,395	863	0	0	0	42,278
1992	18	4,990	138	1,315	13,624	21,902	17,320	2,621	0	0	0	6	61,934
1993	0	0	199	1,743	1,726	946	8,935	18,233	3,823	3	96	0	35,705
Total	54,135	81,253	179,459	81,799	633,686	231,025	827,631	1,164,908	609,555	21,526	1,637	2,161	3,888,774

Table 34 ***Change in Chinook Salmon Salvage (EWA with Pump Reductions – Typical Water Purchase Scenario)***													
Year	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
1979				-195	-131	-467	-31,668	-32,892	-1,570	0	0	0	-66,923
1980	0	0	-466	-238	-27	-20	-60,802	-35,637	-12,304	-567	0	0	-110,061
1981	0	0	-102	0	-156	-1,689	-21,608	-12,312	-64	0	0	0	-35,930
1982	0	0	-2,161	-1,300	-3,084	-3,354	-6,557	-71,783	-15,742	0	0	0	-103,981
1983	0	0	-15,916	-3,451	-3,350	-1,593	-6,707	-19,821	-28,226	0	0	0	-79,064
1984	0	0	0	0	-6	-1,290	-24,188	-29,496	-25,410	0	0	0	-80,389
1985	0	0	-812	0	-362	-415	-13,751	-56,365	-9,911	0	0	0	-81,615
1986	0	0	-399	-190	-93,319	-15,144	-57,136	-57,399	-29,693	0	0	0	-253,281
1987	0	0	-63	0	-52	-2,167	-13,631	-11,139	-4,062	0	0	0	-31,114
1988	0	0	-2,402	-338	-320	0	-1,348	-14,700	-53	0	0	0	-19,162
1989	0	0	-52	-118	-9	-2,071	-770	-6,591	-148	0	0	0	-9,759
1990	0	0	-51	-99	-55	-372	0	-266	-1,273	0	0	0	-2,117
1991	0	0	0	0	0	-678	-3,919	-5,484	-500	0	0	0	-10,581
1992	0	0	0	-108	-1,814	-5,750	-2,877	0	0	0	0	0	-10,548
1993	0	0	0	-34	-67	-81	-1,957	-2,136	-205	0	0	0	-4,481
Total	0	0	-22,424	-6,073	-102,751	-35,090	-246,917	-356,022	-129,162	-567	0	0	-899,006

Table 35 ***Change in Chinook Salmon Salvage (EWA with Pump Reductions and Increased Summer Export Pumping – Typical Water Purchase Scenario)***													
Year	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
1979				-195	-131	-467	-31,668	-32,892	-1,570	1,450	75	28	-65,370
1980	0	0	-466	-238	-27	-20	-60,802	-35,637	-12,304	-567	10	519	-109,532
1981	0	0	-102	0	-156	-1,689	-21,608	-12,312	-64	0	14	0	-35,916
1982	0	0	-2,161	-1,300	-3,084	-3,354	-6,557	-71,783	-15,742	32	4	0	-103,945
1983	0	0	-15,916	-3,451	-3,350	-1,593	-6,707	-19,821	-28,226	284	0	0	-78,780
1984	0	0	0	0	-6	-1,290	-24,188	-29,496	-25,410	4	133	0	-80,252
1985	0	0	-812	0	-362	-415	-13,751	-56,365	-9,911	29	0	2	-81,584
1986	0	0	-399	-190	-93,319	-15,144	-57,136	-57,399	-29,693	784	0	0	-252,497
1987	0	0	-63	0	-52	-2,167	-13,631	-11,139	-4,062	-4	-1	-1	-31,120
1988	0	0	-2,402	-338	-320	0	-1,348	-14,700	-53	168	15	2	-18,978
1989	0	0	-52	-118	-9	-2,071	-770	-6,591	-148	0	6	0	-9,753
1990	0	0	-51	-99	-55	-372	0	-266	-1,273	0	0	0	-2,117
1991	0	0	0	0	0	-678	-3,919	-5,484	-500	0	0	0	-10,581
1992	0	0	0	-108	-1,814	-5,750	-2,877	0	0	0	0	0	-10,547
1993	0	0	0	-34	-67	-81	-1,957	-2,136	-205	2	18	0	-4,461
Total	0	0	-22,424	-6,073	-102,751	-35,090	-246,917	-356,022	-129,162	2,181	274	551	-895,433

Table 36
Splittail Salvage (Baseline Condition)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				34	1,122	4,615	2,157	60,479	70,254	15,807	5,254	1,202	160,925
1980	72	86	1,310	56,194	61,187	1,621	6,020	140,563	187,723	45,984	9,770	1,318	511,847
1981	265	0	598	1,557	8,581	5,781	5,242	64,198	27,671	2,539	1,203	0	117,636
1982	0	290	1,577	32,429	44,207	13,705	5,413	45,730	169,164	193,840	121,238	4,172	631,762
1983	227	0	2,409	1,164	13,451	4,668	2,082	16,054	304,327	112,646	55,782	5,300	518,109
1984	1,477	36	63	96	3,945	7,479	5,640	9,307	56,464	46,887	10,337	1,060	142,790
1985	0	396	1,989	282	8,360	4,514	3,851	3,219	25,057	14,605	4,072	758	67,103
1986	286	1,103	0	246	2,281	7,461	74,203	971,878	1,095,083	29,690	14,404	7,452	2,204,087
1987	1,094	418	976	1,411	4,854	6,291	1,443	1,466	107,463	7,716	939	350	134,422
1988	34	13	3,581	23,499	3,589	638	1,901	2,999	2,434	1,268	20	168	40,145
1989	0	129	77	485	265	10,674	7,193	9,775	7,567	4,449	10,305	1,409	52,328
1990	49	48	7	1,279	1,932	3,197	322	3,224	11,623	1,071	0	0	22,752
1991	0	0	0	491	133	7,132	2,673	2,265	10,196	843	0	0	23,733
1992	78	0	25	485	4,324	3,247	181	244	2,508	0	88	3	11,183
1993	0	0	12	34,322	11,430	3,110	2,718	74,866	112,327	10,923	482	82	250,270
Total	3,581	2,519	12,623	153,974	169,661	84,134	121,038	1,406,268	2,189,862	488,266	233,894	23,273	4,889,093

Table 37
Change in Splittail Salvage (EWA with Pump Reductions – Typical Water Purchase Scenario)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				0	-26	-266	-474	-4,595	-10,819	0	0	0	-16,179
1980	0	0	-91	-1,613	-3,254	-69	-2,861	-12,446	-49,756	-10,584	0	0	-80,674
1981	0	0	-20	0	-299	-546	-2,541	-8,210	0	0	0	0	-11,616
1982	0	0	-73	-1,241	-3,442	-1,371	-1,274	-9,822	-23,597	0	0	0	-40,821
1983	0	0	-737	-497	-3,791	-1,437	-515	-8,712	-44,822	0	0	0	-60,511
1984	0	0	0	0	-218	-1,114	-1,615	-1,609	-6,445	0	0	0	-11,001
1985	0	0	-69	0	-371	-339	-963	-1,602	-7,063	0	0	0	-10,407
1986	0	0	0	-10	-356	-1,256	-16,567	-245,553	-169,939	0	0	0	-433,682
1987	0	0	-60	0	-178	-1,208	-389	-373	-54,289	0	0	0	-56,497
1988	0	0	-259	-867	-666	0	-136	-1,378	-614	0	0	0	-3,920
1989	0	0	-7	-32	-83	-1,351	-104	-2,308	-670	0	0	0	-4,555
1990	0	0	-6	-44	-252	-596	0	-111	0	-58	0	0	-1,068
1991	0	0	0	0	0	-668	-648	-825	-5,886	0	0	0	-8,028
1992	0	0	0	-35	-642	-839	-22	0	0	0	0	0	-1,537
1993	0	0	0	-959	-457	-298	-648	-6,489	-1,910	0	0	0	-10,763
Total	0	0	-1,322	-5,298	-14,036	-11,357	-28,759	-304,034	-375,810	-10,642	0	0	-751,259

Table 38 **Change in Splittail Salvage (EWA with Pump Reductions and Increased Summer Export Pumping – Typical Water Purchase Scenario)**													
Year	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Total**
1979				0	-26	-266	-474	-4,595	-10,819	2,979	778	71	-12,351
1980	0	0	-91	-1,613	-3,254	-69	-2,861	-12,446	-49,756	-10,584	2,198	341	-78,134
1981	0	0	-20	0	-299	-546	-2,541	-8,210	0	0	16	0	-11,600
1982	0	0	-73	-1,241	-3,442	-1,371	-1,274	-9,822	-23,597	13,903	20,387	166	-6,365
1983	0	0	-737	-497	-3,791	-1,437	-515	-8,712	-44,822	9,261	4,804	194	-46,251
1984	0	0	0	0	-218	-1,114	-1,615	-1,609	-6,445	8,776	1,941	208	-75
1985	0	0	-69	0	-371	-339	-963	-1,602	-7,063	383	78	20	-9,925
1986	0	0	0	-10	-356	-1,256	-16,567	-245,553	-169,939	19,755	3,198	1,472	-409,257
1987	0	0	-60	0	-178	-1,208	-389	-373	-54,289	13	63	89	-56,332
1988	0	0	-259	-867	-666	0	-136	-1,378	-614	724	16	32	-3,147
1989	0	0	-7	-32	-83	-1,351	-104	-2,308	-670	205	455	79	-3,815
1990	0	0	-6	-44	-252	-596	0	-111	0	780	0	0	-230
1991	0	0	0	0	0	-668	-648	-825	-5,886	490	0	0	-7,539
1992	0	0	0	-35	-642	-839	-22	0	0	0	50	0	-1,487
1993	0	0	0	-959	-457	-298	-648	-6,489	-1,910	585	76	14	-10,088
Total	0	0	-1,322	-5,298	-14,036	-11,357	-28,759	-304,034	-375,810	47,272	34,061	2,687	-656,597

4.0 Effect Assessment Approach for Non-Project Reservoirs

There are several non-Project reservoirs that could serve as potential water sources for the EWA. Because these non-Project reservoirs are not managed under the operations of either the CVP or SWP, they are not included in the modeling simulations described above. As such, another method of evaluating the potential effects from EWA actions was developed to analyze possible EWA-related effects on these non-Project reservoirs.

4.1 Assumptions for Non-Project Reservoirs

The following assumptions have been established with regard to the status and operation of the non-Project reservoirs. These assumptions were applied to the analysis for each of the non-Project reservoirs where the EWA could purchase water (see Chapter 2 of the EWA EIS/EIR).

- Non-project reservoir operations will continue to function under the same set of demands and assumptions that have previously been employed by each system in earlier years, including reservoir drawdown to targeted storage levels.

- Analysis relating to the timing, magnitude, and duration of water transport activities and their potential effects on riverine flow processes will be developed using a monthly time-step, culminating at the end of the water year in late-September. Where applicable, the period of time that will be used to evaluate resource-specific effects (e.g., fisheries, vegetation and wildlife) will concur with the timeframe associated with potential asset transfers, as identified in the modeling output.

- EWA asset availability from non-Project reservoirs and any associated potential effects will be evaluated by reviewing hydrologic data and reservoir specific area-capacity curves to predict changes in surface water elevation and reservoir refill frequencies. This information will provide an indication of the target storage capacities, minimum pool volume, and range of surface water elevations under normal operating conditions, and the probability of annual refill for each reservoir. Estimations for flow changes will be translated into relative changes in surface water elevations and will be used to evaluate resource specific effects.

Limitations have been placed on the maximum volume of water potentially available to EWA from each non-Project reservoir, based upon reservoir size, operational constraints and the existing refill patterns within each basin. Additionally, EWA asset acquisitions must not result in a reduction of reservoir surface water elevation beyond the minimum reservoir drawdown levels as stated in the corresponding FERC license, where applicable. This documentation and any related materials would also be reviewed to ensure compliance with all appropriate regulatory requirements.

The following discussion describes how EWA actions are expected to utilize and influence storage capacities of the non-Project reservoirs. This discussion serves as a description of the most utilitarian implementation of non-Project reservoir water supplies that could be used as potential EWA assets. It is intended to provide the set of conditions describing the relationships between each non-Project reservoir and the Proposed Action (Flexible Purchase Alternative), as applied in all resource-specific effect analyses.

4.1.1 Placer County Water Agency (WA) Non-Project Reservoirs

EWA assets may be acquired from two reservoirs under Placer County WA management, French Meadows and Hell Hole Reservoirs. Placer County WA's ability to sell water to EWA is also dependent upon PG&E objectives and operations. The decision to sell water to the EWA is dependent upon two factors: 1) the normal combined operational drawdown level (typically 150 TAF) that is maintained for both reservoirs; and 2) FERC minimum requirements for combined carryover storage, which are stated as 50 TAF.

When available, EWA would only purchase 20 TAF annually from Placer County WA, with the assumption that reservoirs would be refilled on an annual basis. Under the most severe conditions, refill may not occur. In that event, 20 TAF may be purchased within two sequential years for a total asset acquisition of 40 TAF. With regard to French Meadows and Hell Hole Reservoirs, if both reservoirs had a combined water debt of 40 TAF, EWA would not purchase additional water from Placer County WA until all or part of the 40 TAF was replenished. If only a portion of the 40 TAF were refilled, any new EWA acquisition that could be purchased would only be up to the volume of water refilled, not to exceed the original total of 40 TAF. Imposing a limit of a 40 TAF total reduction on EWA asset availability also serves as a conservation measure to ensure that reservoir storage is not depleted below historic levels.

4.1.2 Oroville-Wyandotte Irrigation District (ID) Non-Project Reservoirs

Under normal operating conditions, combined winter baseline storage during November and December is around 60 TAF in Little Grass Valley and Sly Creek Reservoirs, with approximately 80 percent of storage (48 TAF) in Little Grass Valley Reservoir and 20 percent of storage (12 TAF) in Sly Creek Reservoir. Minimum reservoir storage for each water body is set at 500 AF, according to FERC requirements. There are refill criteria for this system. Although the reservoirs refill annually, a debt to the SWP could occur if the stored water could have been utilized by the SWP absent the EWA acquisition. Oroville-Wyandotte ID may have up to 15 TAF of water assets available to EWA from Little Grass Valley and Sly Creek Reservoirs.

4.1.3 Yuba County Water Agency Non-Project Reservoirs

Yuba County WA may be able to provide EWA with up to 100 TAF of stored water from New Bullards Bar Reservoir. Yuba County WA could sell stored reservoir water to the EWA as long as local needs, instream flows, and system demand requirements were met. This action would result in a reduction in the volume of stored water in New Bullards Bar Reservoir and would cause a decrease in surface water elevation of approximately 29 feet. Under the minimum surface water utilization scenario, New Bullards Bar Reservoir storage would be decreased by 30 TAF, thereby providing EWA with up to 30 TAF in asset acquisitions by the end of September.

Unlike the other non-Project reservoirs operated by Placer County WA and Oroville-Wyandotte ID, there is a possibility that Yuba County WA transfers could result in an effect caused by changes in downstream operations. Depending upon Delta conditions and the effect of the transfer on Lake Oroville, there may be a need to increase releases from Lake Oroville in order to compensate for the reduced flows into the Delta during periods of time when New Bullards Bar Reservoir is being refilled upstream. Under these conditions, Oroville Reservoir operations may need to be altered to accommodate downstream demands in the Delta. While Lake Oroville surface water elevations would remain within the range of targeted storage levels, the operational response associated with releasing additional water might be regarded as a change in project operations. This response might be considered a result indirectly arising from EWA actions.

5.0 References

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APPENDIX C

Fish Decision Trees

Table 2 The Delta Smelt Decision Tree

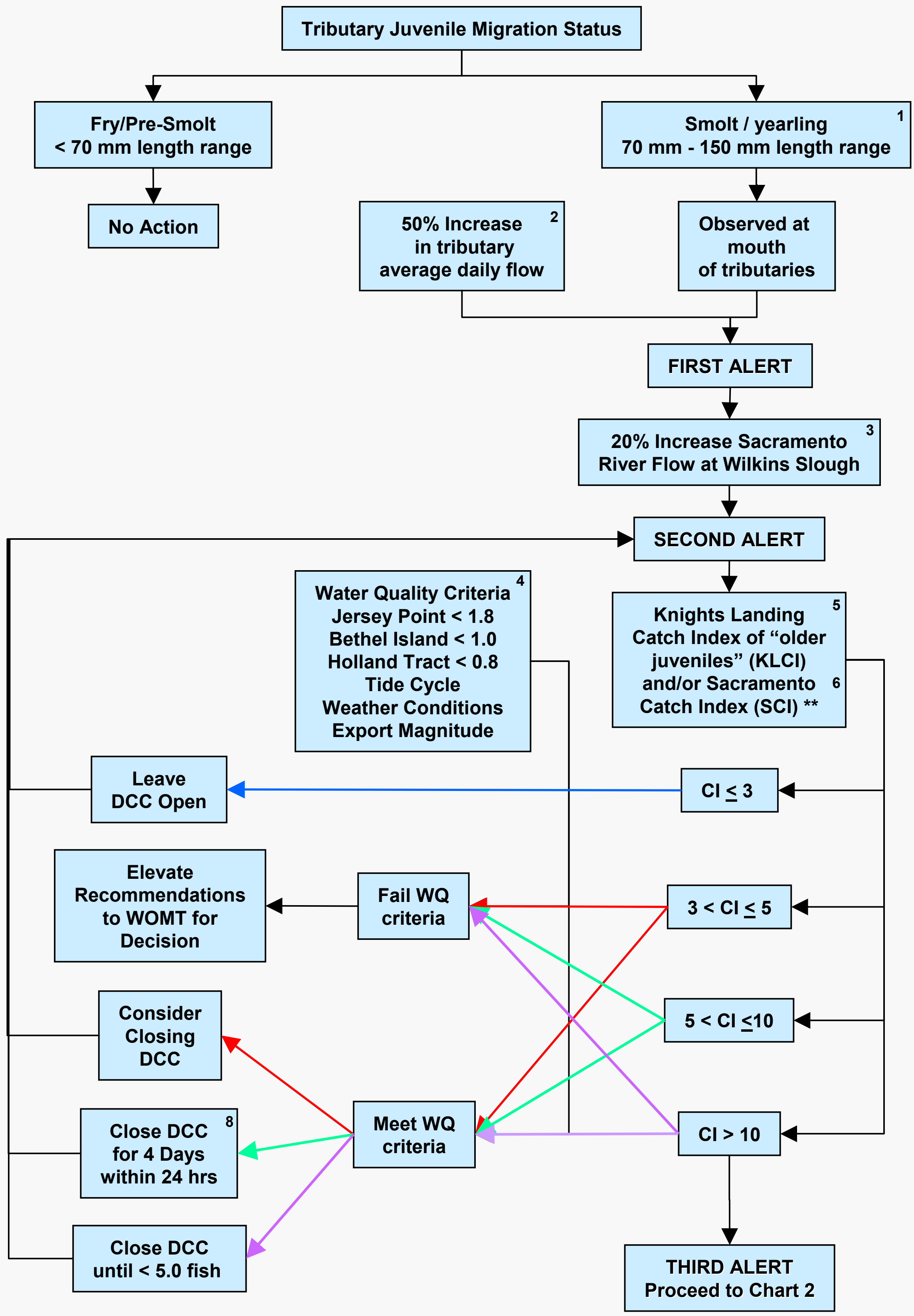
Life stage	Adults
Timing	Pre-VAMP (February 1 through April 15)
Concerns	1) High relative densities of adults in the south Delta are a concern due to the potential for increase entrainment at the SWP and CVP.
	2) High relative densities of delta smelt in the south Delta also suggest spawning may occur in the south Delta, increasing the chances for exceeding the red light level[a] of incidental take in the late spring and early summer.
Data of interest	Before pre-VAMP, consider fall midwater trawl indices
	Spring midwater trawl
	Salvage
	Beach seine
	Chipps Island trawl
	Hydrology (wet or dry year; placement of X2)
	Water quality conditions and water temperature
	Condition of the fish
Assessment of conditions	Adult distribution in Delta and downstream of the Delta
	Salvage levels/densities, yellow light
	Potential high numbers in juvenile salvage if high numbers of adults are concentrated in the south Delta
Tools for change	Reduction in exports, either concurrently at both facilities or at the facility that is salvaging the most fish
Biological questions using the available data	1) Is the adult distribution broad or not?
	2) Is salvage elevated or not?
	3) Is previous FMWT index high or low?
	4) Are water quality conditions (e.g. water temperatures) conducive to spawning?
	5) Are fish ripe for spawning? (Both of above may help determine if there will be a protracted spawn.)
Questions concerning operations	1) Is there a need to reduce exports at either or both facilities based on either the distribution of adults and/or an increase in the salvage of adult delta smelt?
	2) Is it likely to be a difficult spring or summer? That is, do we expect high levels of delta smelt salvage in the spring or summer?
Assessment of concern	I. If the stated recovery criteria index is lower than 239, then concern is high.
	II. If distribution information shows adults delta smelt are concentrated in the south and central Delta, then concern is high.
	III. If the observed or predicted salvage of adults increases sharply, then concern is high.
	IV. If fish at the salvage facilities are on the verge of spawning and temperatures are conducive to spawning, then concern is high.
Recommendations	A) If concern is high and salvage increases abruptly, then recommendations for action is likely.
	B) If the observed or predicted salvage is at or approaching the red light or at the yellow light, then a recommendation for action is likely.
	C) If assessments II and I are true, then we expect a difficult spring or summer (June and July).
Life stage	**Larvae**
Timing	VAMP (April 15 through May 15)
Concerns	High numbers of larvae in the south Delta will likely result in higher numbers of fish rearing to juvenile stages and higher levels of entrainment.
Data of interest	Light traps surveys
	20-mm survey[b]
	Water temperatures
	Salvage[c]
	Hydrology (wet or dry year; placement of X2)
Assessment of conditions	Spawning distribution
	Percent distribution

[a] Yellow light and red light as defined in the 1995 OCAP opinion.
[b] If fortnightly 20-mm survey is occurring and red light occurs, then effort will increase to weekly sampling.
[c] Salvage levels at this time will likely not reflect the number of delta smelt in the south Delta, since smelt begin to be counted at the salvage facilities at about 25 mm.
[d] The barriers shall be operated as stated in the USFWS biological opinion (1-1-96-F-53), April 26, 1996.
[e] Changes considered under “a” and “b” would aim to increase net positive flows in Old and Middle rivers downstream of the export facilities.

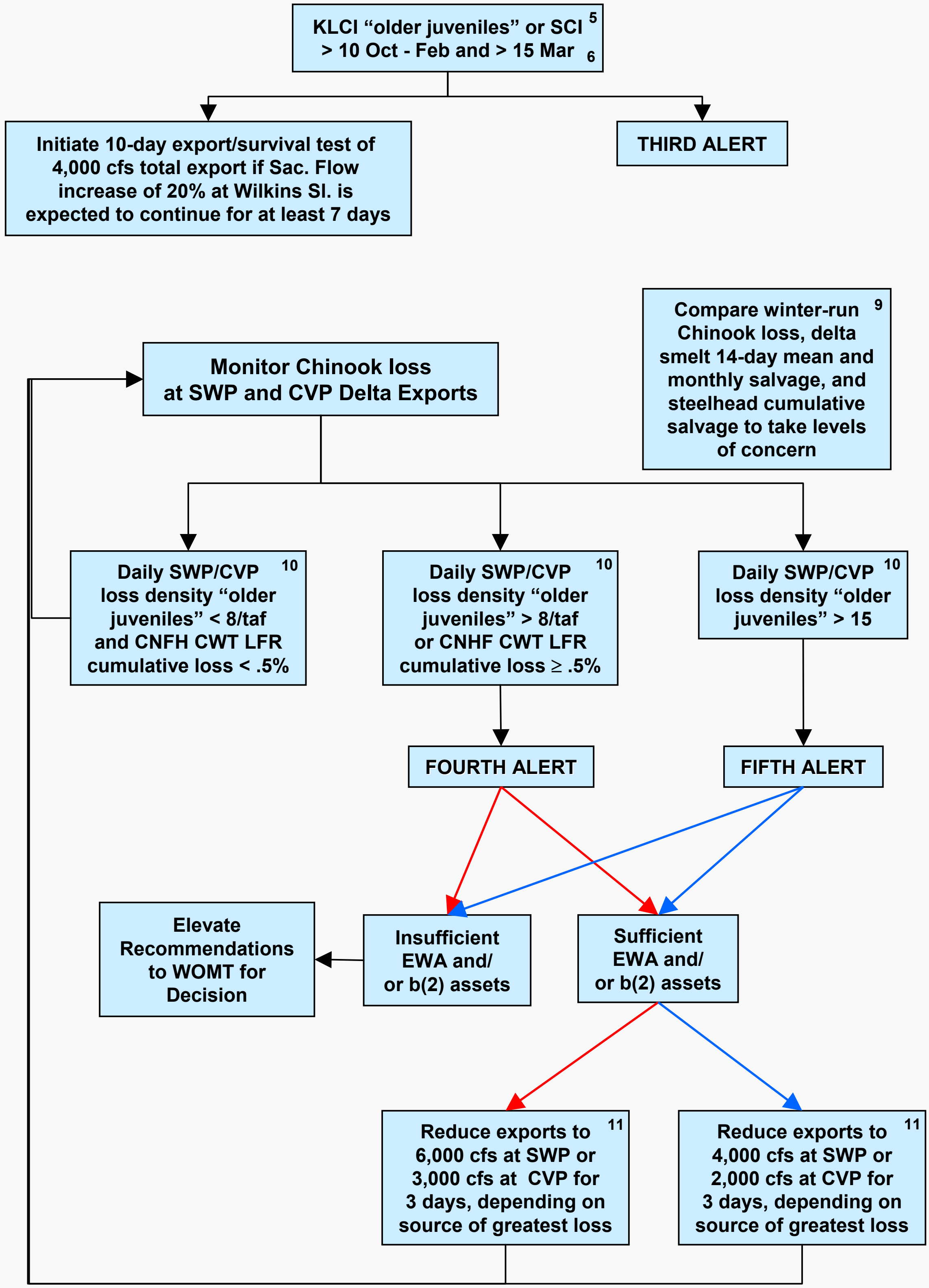
Table 2 The Delta Smelt Decision Tree (Continued)

Assessment of conditions (continued)	Timing: start and duration of spawning
	Implement model to predict future salvage (end of VAMP)
	Water quality conditions, water temperature
Tools for change	Change in San Joaquin River flows
	Change in export reductions (1–3 = net flow)
	Change in barrier operations
Biological questions using the available data	1) Is distribution of spawning broad or restricted?
	2) Is larval distribution broad or restricted?
	3) When does spawning start?
	4) Do we expect punctuated or protracted spawning?
	5) Do we expect SWP and CVP to reach red light salvage levels?
Questions concerning operations	Do we consider changing net flows in Old and Middle rivers?
Assessment of concern	I. If light trap results demonstrates that spawning has occurred in the south Delta, then concern is high
	II. If the 20-mm survey shows 50% of the delta smelt are in the zone of influence (e.g,. east of the confluence), then concern is high.
	III. If abundance in the 20-mm survey is low relative to other years, then concern is high.
	IV. If substantial larval recruitment is expected to occur in the south and central Delta post-VAMP, then concern is high
Recommendation	If concern is high and salvage is at or approaching red light or at yellow light, then recommendations to improve net flow in Old and Middle Rivers are likely. (This recommendation applies during VAMP and post-VAMP, although the tool used will vary.)
Life stage	Juveniles
Timing	Post-VAMP (May 15 through July 1)
Concerns	High numbers of delta smelt juveniles in the south and central Delta will likely result in increased entrainment when export levels increase at the end of VAMP
Data of interest	20-mm survey[b]
	Salvage
	Summer townet
	Hydrology (wet or dry year; placement of X2)
	Export rates
Assessment of conditions	Percent of the distribution outside the zone of influence (e.g., east and west of the confluence)
	Salvage level (number)
	Salvage density
Tools for change	Change in exports
	Change in agricultural barrier operations[d]
	Removal of HORB[d]
	Position of cross-channel gates
	Flow changes in San Joaquin, Old, and Middle rivers
Biological questions using the available data	1) What is the relative distribution in and outside the zone of influence (e.g. upstream and downstream of the confluence)?
	2) Is abundance high?
	3) Is salvage at or approaching red light or at yellow light?
	4) Are fish migrating west from the Delta?
Questions concerning operations	1) Do we consider changing exports?[e]
	2) Do we consider changing agricultural barrier/HORB operations?[e]
	3) Do we consider changing the position of the cross channel gates after May 20?
Assessment of concern	I. If the 20-mm survey shows 50% of the delta smelt are in the zone of influence (e.g. east of the confluence), then concern is high.
	II. If abundance in the 20-mm survey is low, relative to other years, then concern is high.
Recommendation	If concern is high and salvage is at or near red light, then recommendation for action is likely.

[a] Yellow light and red light as defined in the 1995 OCAP opinion.
[b] If fortnightly 20-mm survey is occurring and red light occurs, then effort will increase to weekly sampling.
[c] Salvage levels at this time will likely not reflect the number of delta smelt in the south Delta, since smelt begin to be counted at the salvage facilities at about 25 mm.
[d] The barriers shall be operated as stated in the USFWS biological opinion (1-1-96-F-53), April 26, 1996.
[e] Changes considered under "a" and "b" would aim to increase net positive flows in Old and Middle rivers downstream of the export facilities.



2002/2003 Chinook decision process October through March (Chart 1 of 2).



2002/2003 Chinook decision process October through March (Chart 2 of 2).

Chapter 1
Introduction

1.1 Background

The CALFED Bay-Delta Program is a collaborative effort of 23 Federal and State agencies that seek to resolve the water supply conflicts. The CALFED Bay-Delta Program Programmatic Record of Decision (ROD) set forth a collaborative means for addressing the environmental effects (adverse and beneficial) of CALFED Program actions related to improving water supply reliability and recovery/restoration of the Delta environment and species dependent on the Delta. Through the implementation of the Multi-Species Conservation Strategy (MSCS), the CALFED agencies assessed the effects of potential CALFED Program actions on the environment, and then developed initial conservation measures that when implemented would meet the overall CALFED Program objectives.

The MSCS is an appendix of the CALFED Bay-Delta Program Programmatic Environmental Impact Statement/Environmental Impact Report (PEIS/EIR). One of the goals of the CALFED Program MSCS is to explain how CALFED Program actions will comply with the Federal Endangered Species Act (ESA), California Endangered Species Act (CESA), and the California Natural Community Conservation Planning Act (NCCPA) requirements. The MSCS presents a program-level environmental analysis of the CALFED Preferred Program Alternative that expands upon the PEIS/EIR analysis to address the conservation strategy and certain other issues pertinent to ESA and NCCPA compliance. The US Fish and Wildlife Service (USFWS) and the National Marine Fishery Service (NOAA Fisheries) used the MSCS as the program-level biological assessment to develop the programmatic Biological Opinions (BOs) for the CALFED Preferred Program Alternative. The California Department of Fish and Game (CDFG) used the MSCS for compliance with the CESA and NCCPA.

The MSCS created a two-tiered approach to ESA and NCCPA compliance that corresponds to CALFED Program's two-tiered approach to compliance with the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). The first tier of compliance is embodied in the MSCS itself. For the CALFED Program project actions identified in the PEIS/EIR and ROD, an Action Specific Implementation Plan (ASIP) is developed to address the ESA, CESA, and NCCPA consultation requirements of Federal and State agencies. As a second tier document, this ASIP focuses on issues specific to the Environmental Water Account (EWA) Proposed Action. This ASIP therefore addresses the biological assessment requirements related to the EWA water acquisition and management actions described in Chapter 2. The USFWS and NOAA Fisheries will use this ASIP to develop action-specific BOs relative to the EWA. The CDFG will use this ASIP to address compliance with the CESA and NCCPA.

This ASIP provides the environmental effects analyses on aquatic and terrestrial species and NCCP habitats based on the EWA Proposed Action. The USFWS, NOAA Fisheries, and CDFG may issue take authorization for covered species using information and analyses contained in the EWA ASIP and will use the ASIP to further MSCS recovery goals for these species.

1.1.1 Project Overview

The EWA program, as introduced in the CALFED ROD, consists of two primary elements: implementing fish actions that protect species of concern (see Section 2.4.2) and acquiring and managing assets to compensate for the supply effects of these actions (see Section 2.4.3). Actions that protect fish species include reduction of pumping at the SWP and CVP export pumping plants. Project pumping varies by season and hydrologic year and can affect fish at times when fish are near the pumps or moving through the Delta. Reducing pumping can reduce water supply reliability for the SWP and CVP service areas, causing conflicts between fishery and water supply interests. A key feature of the EWA is use of water assets to replace supplies that are lost during pump reductions. The EWA assets can also provide other benefits such as augmenting instream flows and Delta outflows. Chapter 2 provides greater detail on the EWA program.

Under the EWA Proposed Action (the Flexible Purchase Alternative), the EWA agencies would conduct purchases to provide a potentially higher level of fish protection in response to differing hydrologic conditions and to take advantage of water acquisition/storage possibilities throughout the CVP/SWP service areas. The EWA Proposed Action would allow the EWA Project Agencies to purchase up to 600,000 acre-feet of water based on the water acquisition strategies, conservation, and mitigation measures introduced in the EWA EIS/EIR. The EWA Agencies would also use variable assets and changes in CVP/SWP operations to manage water assets, in accordance with the CALFED ROD, in order to effectively respond to annual changes in hydrology and fish behavior in the Delta.

Allowing flexibility to acquire and manage EWA assets differently each year could increase the EWA Agencies' capability to respond to varying hydrologic conditions. During dry years when export pumps have more capacity to convey EWA assets, the agencies could acquire quantities up to that capacity (potentially up to 500,000 acre-feet) upstream from the Delta for storage, pre-delivery, or delayed delivery actions within the Export Service Area. The EWA Proposed Action would allow the EWA Agencies to respond to changes in existing operations and allow for additional upstream fish actions, such as instream flow enhancements.

Under the EWA Proposed Action, the Project Agencies would acquire and manage water using stored reservoir surface water, groundwater substitution, groundwater purchase, or crop idling actions. These actions would be conducted following conservation measures identified to minimize their effects on the environment or water supplies. Although EWA actions may affect some covered species and their habitats, the effects will be temporary, and the conservation measures minimize or avoid the effects. Chapter 2 of this ASIP describes those measures applicable to the covered species and NCCP communities addressed in this ASIP.

1.1.2 Implementing Entities

Five Federal and State agencies are involved in administering the EWA. The California Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (Reclamation), or the "Project Agencies," are responsible for acquiring water assets and for storing and conveying the assets through use of the State Water Project (SWP) and Central Valley Project (CVP)[1] and private project facilities. The "Management Agencies," which include the State and Federal fishery agencies USFWS, NOAA Fisheries, and the CDFG, manage EWA assets to protect and restore fish. The three Management Agencies are responsible for making recommendations for actions to be taken to protect fish populations and the Project Agencies are responsible for implementing operational changes based on the recommendations.

1.1.3 ASIP Contents

To fulfill the requirements of ESA Section 7 and California Fish and Game Code Sections 2835 and 2081, as applicable, the EWA ASIP includes the following information pursuant to the November 2001 Guide to Regulatory Compliance for Implementing CALFED Actions (CALFED 2001).

- A detailed project description (Proposed Action; Chapter 2);
- The list of covered species and any other special-status species[2] that occur in the action area (Chapter 3);
- A discussion of essential habitat (Chapter 3);
- The analyses identifying the direct, indirect, and cumulative impacts on the covered species, other special-status species occurring in the action area (along with an analysis of impacts on any designated critical habitat) likely to result from the Proposed Action, as well as actions related to and dependent on the EWA Proposed Action (Chapter 4);
- The conservation measures the EWA Project Agencies will undertake to minimize adverse effects to species (Chapters 2 and 4), and as appropriate, measures to enhance the condition of NCCP communities (Chapters 2 and 6) and covered species along with a discussion of:
    - A plan to monitor the impacts and the implementation and effectiveness of these measures (Chapter 7),

[1] DWR operates the SWP by storing available water upstream from the Delta and moving it along with unstored natural flows through the Delta to serve agricultural and urban users in the Central Valley, central coast, and southern California. Reclamation operates the CVP in the same fashion, providing water to agricultural and urban users in the Central Valley.
[2] Please see the glossary for definitions of covered and special status species.

- The funding that will be made available to undertake the measures (Chapter 7), and
- The procedures to address changed circumstances (Chapter 8);

- The measures the EWA agencies will undertake to provide commitments to cooperating landowners that EWA actions will not alter their land classification (Chapter 7);
- The alternative actions considered by the EWA agencies that would not result in adverse effects, and the reasons why such alternatives are not being utilized (Chapter 7);
- The additional measures USFWS, NOAA Fisheries, and CDFG may require as necessary or appropriate for compliance with ESA, CESA, and NCCPA; and a description of how and to what extent the action or group of actions addressed in the ASIP will help the CALFED Program to achieve the MSCS's goals for the affected species (Chapters 4 and 6).

The EWA ASIP is based in large part on the biological data, CALFED Program information, and the impact analysis and conservation measures in the MSCS. The EWA ASIP has been developed to be consistent with the species goals, prescriptions, and conservation measures in the MSCS for covered species affected by the Proposed Action. Conservation measures developed for the MSCS have been reviewed for use in minimizing or eliminating the effects of EWA actions. The ASIP includes additional conservation measures to address actions not considered in the MSCS relative to EWA water acquisition and management effects.

1.2 ASIP Process

The relationship of the ESA, CESA and State NCCPA is illustrated on Figure 1-1. Because neither the programmatic BOs nor the programmatic NCCPA determination for the CALFED Program authorized incidental take of MSCS covered species, individual consultation documents, or ASIPs, are required for each project. Take authorization for entities implementing CALFED Program actions will follow a simplified compliance process that tiers from the MSCS and programmatic determinations. Entities implementing actions that may affect covered species are required to prepare an ASIP for each action or group of actions. The ASIP will be based on and tier from the data, information, analyses, and conservation measures in the MSCS. The implementing entity will coordinate development of the ASIP with USFWS, NOAA Fisheries, and CDFG to ensure that the ASIP incorporates appropriate conservation measures for the proposed CALFED Program action(s), consistent with the MSCS.

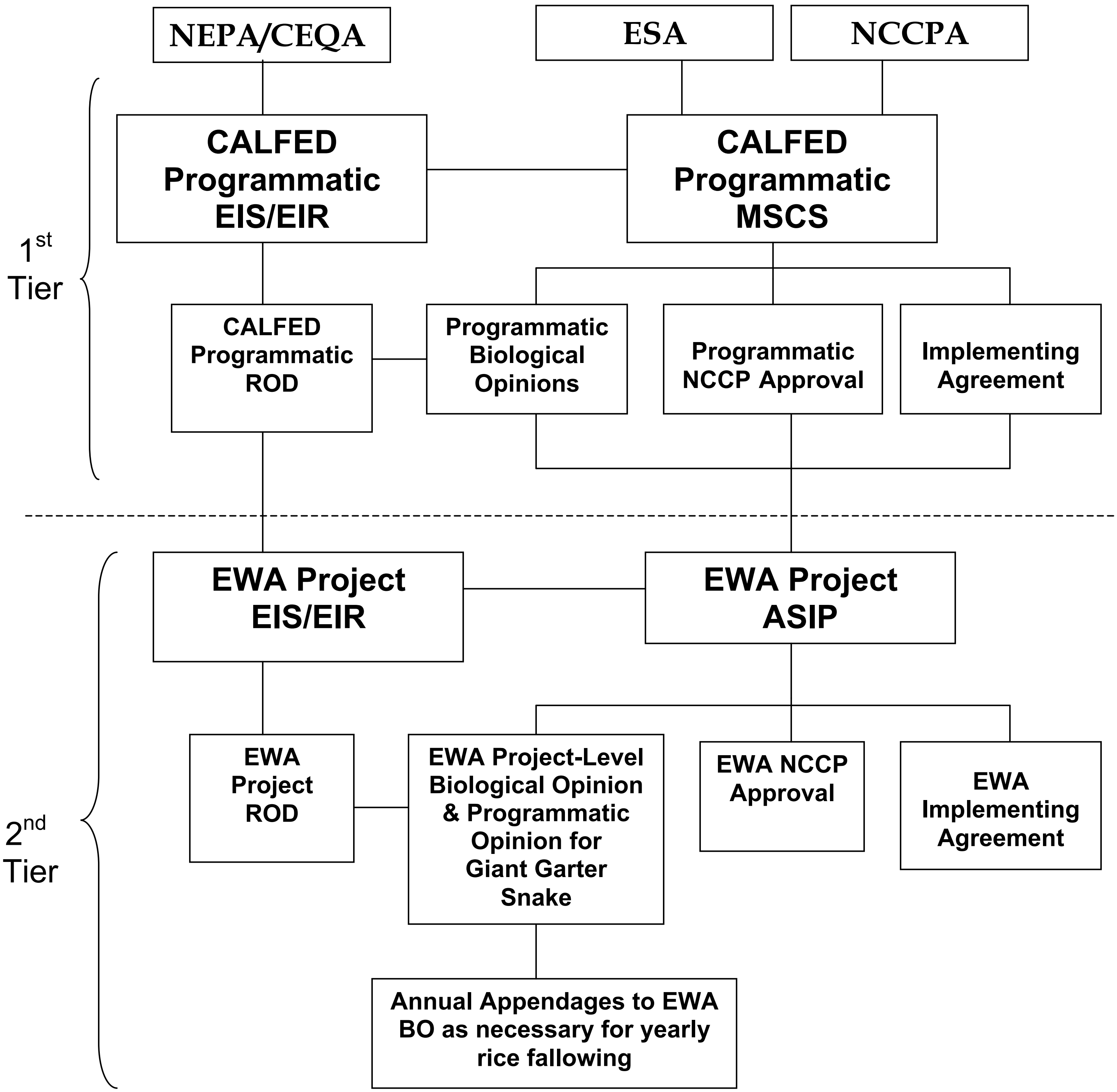


Figure 1-1
Relationships of CALFED Programmatic and EWA Compliance with NEPA/CEQA and ESA/NCCPA

The CALFED Program MSCS evaluates 244 species and 20 natural communities. Included within the MSCS are species identified by USFWS, NOAA Fisheries, and CDFG that are covered under BOs and NCCP determination. An ASIP, including the EWA ASIP, is prepared for ESA- and NCCP-covered species potentially affected by a CALFED Program project. Typically, as in the case with the EWA ASIP, the species evaluated are a subset of the overall 244 species included in the MSCS.

1.2.1 Informal and Formal Consultation Processes

ASIPs are developed for individual CALFED Program actions or groups of actions when enough detailed information is available about the actions to analyze fully their impacts on covered species and habitats. Informal consultation is often conducted in coordination with the development of an ASIP. For the EWA program, the EWA agencies initiated informal consultation with USFWS and NOAA Fisheries in April 2002, pursuant to the ESA, the Fish and Wildlife Coordination Act, and the Magnuson-Stevens Fisheries Conservation and Management Act regarding essential fish habitat (EFH). In addition, informal consultation also was initiated with CDFG under the NCCPA. Under these acts, the EWA agencies held meetings throughout the development of this ASIP to (1) identify covered species and endangered, threatened, and proposed or candidate species that may occur in the Action Area; (2) develop an appropriate approach for assessing species listed and proposed for listing as part of the Section 7 consultations required by ESA; and (3) determine to what extent the action may affect any of the identified species, including impacts to EFH.

Once complete, the EWA ASIP will be submitted by the EWA agencies to USFWS, NOAA Fisheries, and CDFG to initiate formal consultation. USFWS and NOAA Fisheries will review the ASIP for compliance with ESA, under Section 7. NOAA Fisheries will also review the ASIP for compliance with the Magnuson-Stevens Fishery Conservation Act (MSFCA). The conclusion of the formal consultation process is for USFWS and NOAA Fisheries to prepare BOs on the species that the action is likely to adversely affect. As part of these BOs, USFWS and NOAA Fisheries may authorize incidental take of endangered and threatened species.

DFG will determine whether the EWA ASIP complies with the NCCPA and CESA. If the ASIP is in compliance with the NCCPA, CDFG will prepare an NCCPA approval and issue supporting findings. As part of these findings, CDFG may authorize take of covered species, including endangered and threatened species, whose conservation and management are provided for in an approved NCCP. Because the NCCPA allows CDFG to authorize incidental take of endangered and threatened species, an NCCP also may be used to comply with CESA (Fish and Game Code Sections 2081[b] and 2835).

1.2.2 Current Management Direction

The EWA program and ASIP have been developed against a backdrop of existing and ongoing Federal, State, and local efforts intended to conserve covered and other sensitive species within the EWA Action Area. Implementation of the EWA Proposed Action would be consistent with existing wildlife protection and recovery programs.

Consultation with USFWS, NOAA Fisheries, and CDFG regarding effects of EWA actions on special-status species is based on the ESA policy for each agency and existing BOs and NCCPA guidance. The opinions and guidance documents used to support the development of the EWA ASIP are listed below:

- The CALFED Programmatic EIS/EIR;
- The CALFED Multi-Species Conservation Strategy;
- The 1995 USFWS opinion for CVP/SWP operations effects on delta smelt; and
- The 1993 NOAA Fisheries opinion for CVP/SWP operations effects on Sacramento River winter-run Chinook salmon ESU.
- USFWS' Programmatic BO on the CALFED Bay-Delta Program dated August 28, 2000;
- NOAA Fisheries' CALFED Bay-Delta Program Programmatic BO dated August 28, 2000; and
- CDFG's Natural Community Conservation Planning Act Approval of the CALFED Bay-Delta Program Multi-Species Conservation Strategy dated August 28, 2000.

1.2.3 Consultation to Date

The EWA Program was included in the programmatic BOs for the CALFED PEIS/EIR (Section 1.3.3). Reclamation and DWR initiated informal ESA Section 7 consultation with USFWS and NOAA Fisheries in April 2002 regarding the EWA Program. In addition, informal NCCPA consultation also was initiated with CDFG. The lead agencies have held meetings with USFWS, NOAA Fisheries, and CDFG throughout the development of the EWA Proposed Action and this ASIP. At these meetings, issues pertaining to development of the ASIP were discussed by the ASIP team members, which included representatives from Reclamation, DWR, CALFED agencies, USFWS, NOAA Fisheries, and CDFG.

1.2.4 Compliance with Federal Endangered Species Act

USFWS and NOAA Fisheries share responsibility for administering ESA. NOAA Fisheries has primary responsibility for implementing ESA with respect to marine fishes and mammals, including migratory or anadromous fish species such as salmon and steelhead. USFWS has primary responsibility for other species.

The purpose of the ESA section 7(a)(2) consultation requirement is to ensure that any action authorized, funded, or carried out by any Federal agency is not likely to jeopardize the continued existence of any covered species or result in the destruction or adverse modification of critical habitat. Typically, a biological assessment is prepared to analyze effects on listed and proposed species and designated and proposed critical habitat in order to comply with ESA. This ASIP is intended to act as a biological assessment and fulfill the requirements of the EWA pursuant to the ESA as amended.

1.2.5 Compliance with Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA)

The MSFCMA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance EFH. Federal agencies are required to consult with NOAA Fisheries on all actions that may adversely affect EFH (MSFCMA Section 305(b)(2)). The EFH mandate applies to all species managed under a Federal Fishery Management Plan (FMP). In California there are three FMPs covering Pacific salmon, coastal pelagic species, and groundfish. NOAA Fisheries, under Section 305(b)(1) of the MSFCMA, is required to provide EFH conservation and enhancement recommendations to Federal and State agencies for actions that adversely affect EFH.

The objective of an EFH assessment is to determine whether the proposed action(s) "may adversely affect" designated EFH for relevant commercially, federally managed fisheries species within the Action Area. It also describes conservation measures proposed to avoid, minimize or otherwise offset potential adverse effects to designated EFH resulting from the proposed action.

This ASIP will meet all the compliance requirements that have been identified for consulting with NOAA Fisheries on effects to EFH, as outlined in the MSFCMA.

1.2.6 Compliance with California Endangered Species Act and the Natural Community Conservation Planning Act

The CESA (Fish and Game Code Sections 2050 to 2097) is similar to the ESA. California's Fish and Game Commission is responsible for maintaining lists of threatened and endangered species under the CESA. CESA prohibits the "take" of listed and candidate (petitioned to be listed) species. "Take" under California law means to "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch capture, or kill." (California Fish and Game Code, section 86.) Because CDFG may authorize incidental take of listed species pursuant to a CDFG approved NCCP, EWA agencies will not require a separate incidental take permit pursuant to CESA for ASIP covered species if the EWA actions adhere to MSCS goals and CDFG's NCCP Approval.

The NCCPA, California Fish and Game Code, section 2800, et seq., was enacted to form a basis for broad-based planning to provide for effective protection and conservation of the State's wildlife heritage, while continuing to allow appropriate development and growth. State of California NCCP General Process Guidelines define an NCCP as "…a plan for the conservation of natural communities that takes an ecosystem approach and encourages cooperation between private and governmental interests. The plan identifies and provides for the regional or area-wide protection and perpetuation of plants, animals, and their habitats, while allowing compatible land use and economic activity. An NCCP seeks to anticipate and prevent the controversies caused by species' listings by focusing on the long-term stability of natural communities" (NCCP 2002). The purpose of natural community conservation planning is to sustain and restore those species and their habitat identified by CDFG that are necessary to maintain the continued viability of biological communities impacted by human changes to the landscape. A NCCP identifies and provides for those measures necessary to conserve and manage natural biological diversity within the plan area while allowing compatible use of the land. CDFG may authorize the take of any identified species, including listed and non-listed species, pursuant to Section 2835 of the NCCPA, if the conservation and management of such species is provided for in an NCCP approved by CDFG.

The CALFED Programmatic Multi-Species Conservation Strategy was approved by CDFG as a program-level NCCP. The MSCS' project-level compliance process centers on a multi-purpose project-level environmental document called an "ASIP," which is intended to provide one format for all information necessary to initiate project-level compliance with the ESA and the NCCPA. EWA agencies will comply with the NCCPA through the ASIP, which contains all the necessary components of a project-level NCCP for the EWA study area.

On February 2, 2002, Governor Davis signed SB 107, which completely repealed and replaced the NCCPA with a new NCCPA. SB 107 became effective on January 1, 2003. However, in accordance with Section 2830 (c) of SB 107, the MSCS will remain in place as an approved NCCP, and CDFG may authorize take of Covered Species pursuant to the MSCS and CDFG's NCCP Approval.

This ASIP serves as the project-specific NCCP for EWA water acquisition and management actions. The document meets all the compliance requirements that have been identified for (a) preparing an NCCP and (b) other requirements associated with CESA consultation. This ASIP will fulfill the requirements of the California Fish and Game Code Sections 2835 and 2081. Additionally, it will incorporate appropriate conservation measures relevant to the EWA proposed action. This approach is consistent with the NCCP conservation strategy for the conservation of natural communities and related species before these species reach a point for having to become listed.

1.3 Relationship to CALFED Program and CALFED Documents

1.3.1 CALFED Program

The purpose of the CALFED Program is to develop and implement a comprehensive, long-term plan that will restore ecological health to the Bay-Delta system and improve management of water for beneficial uses, and the EWA is one component of the overall CALFED Program strategy. To achieve its overall purpose, the CALFED agencies will address problems of the Bay-Delta system within four critical resource categories:

- ecosystem quality;
- water quality;
- water supply reliability; and
- levee system integrity.

There are important physical, ecological, and socioeconomic linkages between the problems and possible solutions in each of these categories. Accordingly, the CALFED agencies cannot work to solve problems in one resource category without addressing problems in the other resource categories. The CALFED planning effort was divided into a three-phase cooperative planning process. This process should make it easier to determine the most appropriate strategy and actions to reduce conflicts in the Bay-Delta system. During Phase I, begun in May 1995, decision-makers defined problems of the Bay-Delta system and began to develop a range of alternatives to solve them. An initial group of actions was developed and refined into three preliminary categories of solutions to be considered in Phase II. Phase II ended when the final Programmatic EIS/EIR was approved. Implementation of the Preferred Program Alternative began Phase III and will continue in stages over many years. Phase III includes any necessary studies and site-specific environmental review and permitting. The CALFED Program is currently in Stage 1 of Phase II, which includes the implementation of CALFED Program actions through the initial 7 years till September 2007 (See Glossary under CALFED Program Phases).

A component of the CALFED Program is the Ecosystem Restoration Program (ERP). The goal of the ERP is to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species. In addition, the ERP, along with the Water Management Strategy (WMS), is designed to achieve or contribute to the recovery of covered and at-risk species found in the Bay-Delta and, thus, achieve goals in the MSCS. Improvements in ecosystem health will reduce the conflict between environmental water uses and other beneficial uses and allow more flexibility in water management decisions. EWA agencies are coordinating EWA actions with the ERP to ensure that EWA is consistent with the ERP goals.

Representative ERP actions identified in the CALFED Programmatic ROD include:

- Protecting, restoring, and managing diverse habitat types representative of the Bay-Delta and its watershed;
- Acquiring water from sources throughout the Bay-Delta's watershed to increase flows and improve habitat conditions for fish protection and recovery;
- Restoring critical instream and channel-forming flows in Bay-Delta tributaries;

- Improving Delta outflow during key periods;
- Reconnecting Bay-Delta tributaries with their floodplains through the construction of setback levees, the acquisition of easements, and the construction and management of flood bypasses for both habitat restoration and flood protection;
- Developing assessment, prevention, and control programs for invasive species;
- Restoring aspects of the sediment regime by relocating instream and floodplain gravel mining by artificially introducing gravels trapped by dams; modifying or eliminating fish passage barriers, including the removal of some dams; constructing fish ladders; and constructing fish screens that use the best available technology; and
- Targeting research to provide information that is needed to define problems sufficiently and to design and prioritize restoration actions.

1.3.2 Programmatic Environmental Impact Statement/Environmental Impact Report and Record of Decision

The CALFED Bay-Delta Program PEIS/EIR was prepared in compliance with the National Environmental Policy Act (NEPA), Reclamation policy and procedures for implementing NEPA, and the California Environmental Quality Act (CEQA). The PEIS/EIR document describes, in a broad sense, the environmental consequences of the preferred program alternative and alternatives and enabled decisions to be made regarding program direction and content. Information from this document will be incorporated by reference into this ASIP, where applicable.

The CALFED PEIS/EIR and ROD and CEQA findings represent the culmination of the NEPA and CEQA processes. The ROD identifies the final selection of a long-term plan (Preferred Program Alternative), which includes specific actions to restore natural biological function of the Bay-Delta, describes a strategy for implementing the plan, and identifies complementary actions the CALFED agencies will also pursue. The EWA Proposed Action will be carried out in a manner consistent with the PEIS and ROD and CEQA Findings. A detailed description of the EWA Proposed Action can be found in Chapter 2 of this document.

1.3.3 Programmatic Biological Opinions and Natural Community Conservation Plan

As stated in Section 1.2.2, the following programmatic BOs and the NCCP Agreement address implementation of the CALFED Bay-Delta Program and provide direction for development of the EWA ASIP. It is expected that the CALFED Programmatic BOs will be appended based on USFWS, NOAA Fisheries, and CDFG determinations on this ASIP. Key elements of the project description in these documents are as follows.

- USFWS Programmatic BO on the CALFED Bay-Delta Program dated August 28, 2000; key elements of the USFWS BO regarding the EWA.

- NOAA Fisheries CALFED Programmatic BO dated August 28, 2000; key elements of the NOAA Fisheries BO repeat those of the USFWS BO on the EWA.

- CDFG's Natural Community Conservation Planning Act Approval of the CALFED Bay-Delta Program Multi-Species Conservation Strategy dated August 28, 2000; key elements of the NCCP Determination for the EWA repeat those of the USFWS BO on the EWA.

Pertinent elements of the BO's and NCCP Agreement include the following items

- All EWA fixed assets (purchases) are acquired each year.

- The EWA Operational Principles Agreement is signed and fully implemented.

- The Project Agencies shall request clarification with USFWS, CDFG, and NOAA Fisheries on any points that appear to be ambiguous related to fishery actions for the EWA.

- If EWA assets are depleted and the USFWS, NOAA Fisheries, and CDFG determine Tier 3 is necessary, Tier 3 assets will be available to protect fish.

- As new water storage and conveyance projects are being planned, potential fishery impacts will be assessed. If necessary to offset potential impacts and to provide for recovery of fish populations, operational rules will be developed that will provide for protection of fish. These operational rules may include but are not limited to 1) limits on the timing and magnitude of exports and water supply releases at key periods of fish concern and 2) new sharing formula to increase EWA assets, which would allow the EWA to offset impacts and implement restoration actions. EWA coverage for such actions would come from separate consultation for operating criteria and procedures or in consultations tiered from this opinion, as appropriate.

- If the EWA is not fully implemented, project operations will return to the regulatory baseline.

1.3.4 Multi-Species Conservation Strategy

Five documents establish CALFED agencies' program-level compliance with ESA and NCCPA:

- CALFED Bay-Delta Program Multi-Species Conservation Strategy;

- Conservation Agreement regarding the CALFED Bay-Delta Program Multi-Species Conservation Strategy;

- USFWS's Programmatic BO on the CALFED Bay-Delta Program;

- NOAA Fisheries' Programmatic BO on the CALFED Bay-Delta Program; and
- CDFG's NCCPA Approval of the CALFED Bay-Delta Program Multiple Species Conservation Strategy.

Collectively, these documents cover the jurisdictions of USFWS, NOAA Fisheries, and CDFG and fulfill the various requirements of ESA and the NCCPA pertaining to the CALFED Preferred Program Alternative. USFWS, NOAA Fisheries, and CDFG along with cooperating CALFED agencies have coordinated their efforts to ensure that ASIP documents create a single, coherent approach for regulatory compliance.

The MSCS is an appendix of the CALFED Bay-Delta Program Final Programmatic EIS/EIR that explains how the CALFED agencies will meet the requirements of ESA, CESA, and the NCCPA. The MSCS draws on key elements of the CALFED Preferred Program Alternative, such as the Ecosystem Restoration Program (ERP) and the EWA to outline a comprehensive strategy for the conservation of numerous species of fish, wildlife, and plants, and their habitats. The MSCS presents a program-level environmental analysis of the Preferred Program Alternative that expands upon the PEIS/EIR analysis to address the conservation strategy and certain other issues pertinent to ESA and NCCPA compliance. The MSCS served as the program-level biological assessment of the Preferred Program Alternative for purposes of initiating consultations with USFWS and NOAA Fisheries under Section 7 of ESA. The MSCS also served as the program-level NCCP for DFG approval for NCCPA compliance.

The MSCS creates a two-tiered approach to ESA and NCCPA compliance that corresponds to the CALFED agencies' two-tiered approach to compliance with NEPA and CEQA. The first tier of compliance is embodied in the MSCS itself and in the program-level compliance documents. For the second tier, the MSCS outlines a single project-level compliance process for both ESA and the NCCPA that complements the second tier project-level environmental review of CALFED Program actions under NEPA and CEQA.

For first tier or program-level compliance, the MSCS identifies 244 "evaluated" species and 20 natural communities (habitat types) that could be affected by CALFED Program actions. The MSCS identifies:

- Conservation goals for NCCP communities and covered species;
- Prescriptions for achieving NCCP community and species goals;
- Potential CALFED Program impacts on NCCP communities, covered species, and ESA designated critical habitats;
- Conservation measures that:
    - have been incorporated into the ERP that temporally and spatially direct ERP actions to help achieve or contribute to the recovery of selected species;

- refine other CALFED Program elements to achieve species goals;
- will be incorporated into the CALFED Science Program to achieve species monitoring and research needs; and
- apply to all CALFED Program elements that are designed to avoid, minimize, and compensate for impacts on NCCP communities and covered species; and

■ A framework for CALFED Program compliance with ESA, CESA, and NCCPA at both the programmatic and project-specific levels.

This first tier of compliance is intended to ensure that, at the program level, the Preferred Program Alternative will not jeopardize the continued existence of a covered species or destroy or adversely modify habitat critical to their survival, as required by ESA Section 7, and will conserve certain evaluated species, as required by the NCCPA.

For the second-tier compliance, the MSCS explains how individual CALFED Program actions can be designed to comply with ESA and the NCCPA and can be analyzed and authorized in a single, multipurpose compliance process. The MSCS's project-level compliance process centers on use of the ASIP, a multi-purpose project-level environmental document that is intended to provide one format for all information necessary to initiate project-level compliance with ESA and the NCCPA. An ASIP must be prepared for any CALFED Program action that may adversely affect a covered species.

The MSCS provided direction for development of the EWA ASIP. Also, information from this document is incorporated by reference into this ASIP, where applicable.

1.4 Species Addressed in This ASIP

To comply with ESA, CESA, and NCCP requirements, the EWA agencies must identify a list of special-status species to be evaluated in the EWA ASIP. Special-status species include those species that fit into at least one of the following categories:

■ MSCS covered species identified in the programmatic BOs and NCCP approval for the CALFED Program;

■ Listed as threatened or endangered under ESA;

■ Proposed for listing under ESA;

■ Candidates for listing under ESA;

■ Has been identified as EFH by NOAA Fisheries;

■ Listed as threatened or endangered under CESA;

- Candidates for listing under CESA;
- Plants listed as rare under the California Native Plant Protection Act;
- Fully protected species or specified birds under various sections of the California Fish and Game Code;
- California species of special concern (CSC);
- Plants included on California Native Plant Society (CNPS) List 1A, 1B, 2, or 3; or
- Other native species of concern to CALFED Program.

The section below presents these species.

Using the list of species developed from reviewing the species provided from the sources above, literature research was performed to identify those species most likely to be affected by EWA asset acquisition and management actions. The process used to identify the species that are covered in this ASIP is described in the following subsection.

1.4.1 Identification of Species Analyzed in Detail in the ASIP

Pursuant to Section 7(c) of ESA, the EWA Agencies requested species lists from USFWS and NOAA Fisheries regarding any species listed or proposed for listing as threatened or endangered, including designated or proposed critical habitats under ESA and CESA, that may be present in the EWA Action Area. Additionally, the EWA agencies developed a list of special-status species known to occur or with the potential to occur within the Action Area compiled from the California Natural Diversity Database (CNDDB) and California Native Plant Society's Inventory of Rare and Endangered Plants. More than 400 special-status fish, wildlife, and plant species considered in the MSCS were combined with the results from the species request lists and the database search to generate a preliminary species list. Table A-1 in Appendix A provides the list of species considered for incorporation into this ASIP. Section 3.1 outlines the criteria used for the selection of species addressed in this ASIP. The species addressed in this ASIP are listed in Table 1-1.

Initial screening of the overall species list eliminated from further consideration those species that only inhabited areas outside areas where EWA actions would take place. The second level of screening was based on species that occasionally visited (their life cycles are not dependent on) habitats affected by EWA actions. These included mostly migratory species that may be observed infrequently in areas where EWA actions could occur. Details regarding the life histories and status of the species that may be observed within the EWA Action Area (See Section 2.1 for definition of EWA Action Area), and the rationales why they are not covered in this ASIP, are presented in Appendix A.

1.4.2 Critical Habitat

ESA-designated critical habitat for two covered species is present in the EWA Action Area. The entire legal Delta as defined by California Water Code of 1969 and portions of Suisun Bay and Suisun Marsh are designated critical habitat for the delta smelt. Portions of the Sacramento River and its tributaries are also designated as critical habitat for the Sacramento River winter-run Chinook salmon. Pursuant to ESA requirements, the EWA ASIP also analyzes potential effects of EWA actions on designated critical habitats in the EWA Action Area.

1.4.3 Essential Fish Habitat (EFH)

Six species within the EWA Action Area require consultation under the Magnuson-Stevens Fishery Conservation and Management Act. These species include:

- Sacramento River winter-run Chinook salmon (Oncorhynchus tshawytscha);
- Central Valley spring-run Chinook salmon;
- Central Valley fall and late-run Chinook salmon;[3]
- Northern anchovy (Engraulis mordax);
- Pacific Sardine (Sardinops sagax); and
- Starry flounder (Platichthys stellatus).

Table 1-1
Species Addressed in the EWA ASIP

Species	Scientific Name	Status
Central Valley Fall/Late Fall Run Chinook Salmon	*Oncorhynchus tshawytscha*	Federal candidate
Sacramento River Winter Run Chinook Salmon	*Oncorhynchus tshawytscha*	Federal and State listed endangered species
Central Valley Spring Run Chinook Salmon	*Oncorhynchus tshawytscha*	Federal threatened species; State threatened species
Central Valley Steelhead	*Oncorhynchus mykiss*	Federal threatened species
Delta Smelt	*Hypomesus transpacificus*	Federal threatened species; State threatened species
Sacramento Splittail	*Pogonichthys macrolepidotus*	Federal threatened species
Green Sturgeon	*Acipsenser medirostirs*	Federal candidate; CDFG species of special concern
Aleutian Canada Goose	*Branta canadensis sp. leucopareia*	Federal species of concern
Black Tern	*Chlidonias niger*	CDFG species of special concern
Black Crowned Night Heron	*Nycticorax nycticorax*	CDFG sensitive species
Greater Sandhill Crane	*Grus canadensis tabida*	California threatened species; California fully-protected species
Long-billed Curlew	*Numenius americanus*	CDFG species of special concern

[3] Not specifically listed by the Pacific Fisheries Management Council but addressed in the NOAA Fisheries BO.

Table 1-1 Species Addressed in the EWA ASIP		
Species	**Scientific Name**	**Status**
Tricolored Blackbird	*Agelaius tricolor*	CDFG species of special concern
White-faced Ibis	*Plegadis chici*	CDFG species of special concern
Great Blue Heron	*Ardea herodius*	CDFG species of special concern
Great Egret (rookery)	*Casmerodius albus*	CDFG species of special concern
Snowy Egret (rookery)	*Egretta thulla*	Federal species of concern
Giant Garter Snake	*Thamnophis gigas*	Federal threatened species; State threatened species
Western Pond Turtle	*Clemmys marmoratata*	CDFG species of special concern

This ASIP addresses EWA effects on the habitats of the salmon and steelhead fish species. The life cycles of these species incorporate much of the aquatic (stream and Delta) habitats affected by EWA actions. The ASIP does not address the northern anchovy, Pacific sardine, or starry flounder because the majority of the habitats occupied by these species lies outside the Action Area for EWA effects.

1.5 NCCP Habitats

A total of 20 natural communities were analyzed on a broad, programmatic basis in the MSCS – 18 habitats and 2 ecologically based fish groups. The term "NCCP communities" refers to both habitats and fish groups. All 20 communities analyzed in the MSCS were considered for analysis in this ASIP. Of the 20 community types, 5 have not been evaluated in this ASIP for the reasons given below. Detailed descriptions of the 20 habitats and fish groups, including their assigned conservation goal from the MSCS, can be found in Chapter 3. Section 10.2.4 in the EWA EIS/EIR contains a detailed analysis for each NCCP community. Appendix B provides a crosswalk of MSCS NCCP communities to other community and habitat classification systems.

1.5.1 Grassland

EWA actions not will affect this habitat because the root zone of the plant species is elevated above any EWA-induced water level change.

1.5.2 Upland Scrub

EWA actions will not affect this habitat because the root zone of the plant species is elevated above any EWA-induced water-level change.

1.5.3 Valley/Foothill Woodland and Forest

EWA actions will not affect this habitat because the root zone of the plant species is elevated above any EWA-induced water-level change.

1.5.4 Montane Woodland and Forest

EWA actions will not affect this habitat because the root zone of the plant species is elevated above any EWA-induced water-level change.

1.5.5 Inland Dune Scrub

EWA actions will not affect this habitat because the root zone of the plant species is elevated above any EWA-induced water-level change.

1.6 Organization of This ASIP

This ASIP is a combined Federal ESA and California NCCPA compliance document. To address the requirements of both acts, the ASIP is organized as follows:

Chapter 1, "Introduction" provides an introduction to the project and the ASIP process, describes the relationship of the ASIP to CALFED Program, lists the species and habitats to be addressed in this document, and outlines the organization of the document.

Chapter 2, "Description of the Proposed Action" describes the EWA Action Area and EWA Proposed Action.

Chapter 3, "Environmental Basis of Comparison – Special Status Species Accounts and Status in EWA Action Area" provides the species accounts for ASIP covered species.

Chapter 4, "Species Assessment Methods and Impact Analyses" provides an analysis of the direct, indirect, and cumulative effects on covered species within the Action Area likely to result from implementation of the EWA Proposed Action, as well as actions related to and dependent on that action. This analysis also includes a discussion of the conservation measures to avoid, minimize, and compensate for such effects, as appropriate.

Chapter 5, "Environmental Basis of Comparison – NCCP Community Descriptions" presents descriptions of NCCP communities within the EWA Action Area mostly likely affected by EWA actions.

Chapter 6, "Effects of the Proposed Action on NCCP Communities inside the Action Area" provides an analysis of the direct, indirect, and cumulative effects on NCCP communities within the Action Area (along with an analysis of effects on any designated critical habitat) likely to result from implementation of the EWA Proposed Action, as well as actions related to and dependent on that action. This analysis also includes a discussion of the conservation measures to avoid, minimize, and compensate for such effects, as appropriate.

Chapter 7, "Monitoring, Adaptive Management, and other Disclosures" assesses the cumulative effects of the EWA Proposed Action. Chapter 7 also outlines a plan to monitor the effects and the implementation and effectiveness of the conservation measures; discusses the funding sources available and that will be provided for implementation of the EWA Proposed Action; identifies measures the implementing entity will undertake to provide commitments to cooperating landowners; and discusses the alternatives that were considered that would not result in take and the reasons why such alternatives are not being utilized.

Chapter 8, “Changed Circumstances” describes anticipated changed circumstances that would affect implementation of the project. This chapter also describes strategies and protocols for addressing anticipated changes.

Chapter 9, “Effects Determination Conclusion” summarizes the potential cumulative effects with implementation of the EWA Proposed Action.

Chapter 10, “References” is a list of all the sources cited in the document.

The “Appendices” contain supporting technical data, including species lists and critical habitat descriptions. Hydrologic modeling output is provided on a separate CD and is available upon request.

Appendix A contains species and NCCP community accounts for those species and NCCP communities not covered by this ASIP.

Appendix B contains a detailed description of the modeling methods used to analyze effects to special-status fish species.

Appendix C contains the fish decision trees.

Chapter 2
Description of the EWA Proposed Action

2.1 EWA Action Area

The EWA Action Area encompasses a portion of the overall CALFED Study Area (See Figure 2-1). The Action Area for the EWA ASIP includes all areas affected directly or indirectly by EWA water asset acquisition, storage, conveyance, transfer, or release activities performed to support fish actions (as described later in this Chapter). This includes the majority of the Sacramento and San Joaquin Valleys, south San Francisco Bay area (Santa Clara County), the south central California coast, and southern California service area. No new facilities would be constructed and no existing facilities would be altered for the management of EWA water assets. EWA agencies would use existing facilities of the CVP, SWP, and non-Project entities to manage the assets.

For purposes of effects analysis in the EWA ASIP, the EWA Action Area has been divided into three primary regions and sub-regions based on the types of actions proposed in each region. The three regions are Upstream from the Delta, the Delta, and the Export Service Area. The sub-regions of the Export Service Area include the northern San Joaquin Valley, the Tulare Basin in southern San Joaquin Valley, and southern California.

The Upstream from the Delta region addresses the Sacramento River from Lake Shasta to the Delta and the San Joaquin River from its confluence with the Merced River to the Delta. On-stream reservoirs included in the analyses include Lake Shasta (CVP), Lake Oroville (SWP), and Folsom Lake (CVP), and the non-project reservoirs of New Bullards Bar, Little Grass Valley, Sly Creek, Hell Hole, French Meadows, and Lake McClure. The Upstream from the Delta Region also includes the lower stretches of the Feather, Yuba, American, and Merced Rivers below their respective reservoirs (see Figure 2-1). The Upstream from the Delta region also addresses agricultural land where water could be acquired from crop idling and groundwater substitution actions.

The Delta Region includes the confluence of the Sacramento and San Joaquin rivers, the Bay-Delta, and the outflow of the Delta into the tidally influenced Suisun Bay. The Delta region incorporates a complex array of water channels, sloughs, islands, and diked farmland. SWP/CVP facilities in the Delta used to pump water to the Export Service Area and the Project modifications that change Delta flow patterns are included in the Delta Region. It is from the Delta Region that EWA assets would be pumped to the Export Service Area. There would be no other EWA actions in the Delta involving acquiring or storing EWA assets.

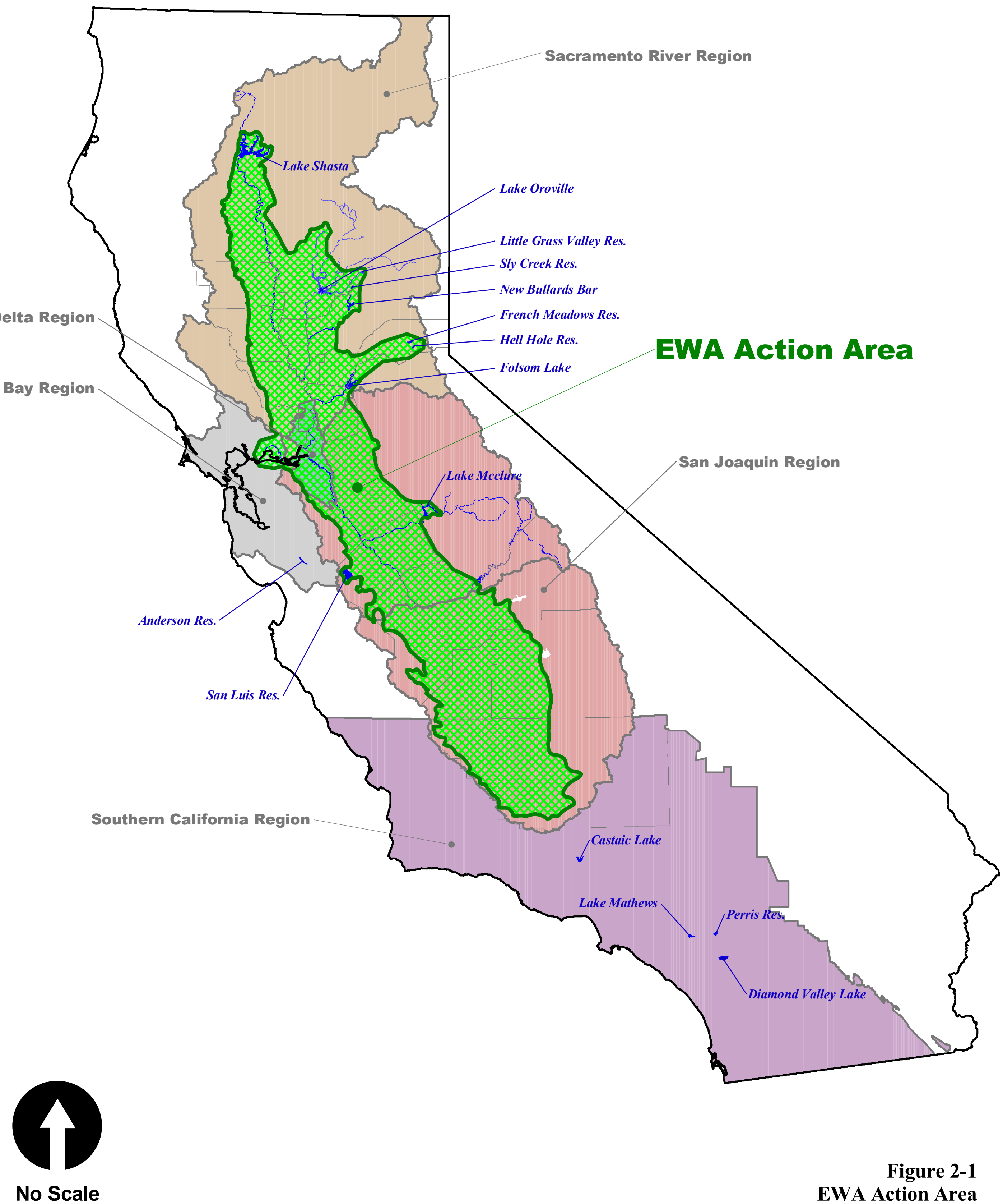


Figure 2-1
EWA Action Area

The Export Service Area Region includes the water conveyance systems of the CVP and SWP and several off-stream reservoirs. San Luis Reservoir is used to store Project water and EWA assets in the northwest San Joaquin Valley; Anderson Reservoir in the Santa Clara Valley for source shifting; while Castaic Lake, Diamond Valley, Lake Perris, Lake Mathew would be used for management of EWA assets and for source shifting actions in southern California. The San Joaquin Valley Region would also be used for acquiring and managing EWA assets via groundwater purchase and storage and from crop idling.

The species inhabiting each of the regions, rivers, and reservoirs, and their relationship to the regional setting are described in Chapter 3. Descriptions of the NCCP habitats and their relationships to each regional setting are presented in Chapter 5.

2.2 EWA Program Overview

The EWA is a cooperative management program, the purpose of which is to provide protection to at-risk native fish species of the Bay-Delta estuary through environmentally beneficial changes in SWP/CVP operations at no uncompensated water cost to the Projects' water users. This approach to fish protection involves changing Project operations to benefit fish and the acquisition of alternative sources of project water supply, called the "EWA assets," which the EWA agencies use to replace the regular project water supply lost by pumping reductions. The following EWA program overview is excerpted from the CALFED PEIS/EIR Record of Decision (CALFED ROD).

The EWA program consists of two primary elements: implementing fish actions that protect at-risk native fish species (see Section 2.4.2) and increasing water supply reliability by acquiring and managing assets to compensate for the supply effects of these actions (see Section 2.4.3). Actions that protect fish species include reduction of pumping at the Delta SWP and CVP export pumping plants. Project export pumping varies by season and hydrologic year and can adversely affect fish at times when fish are near the pumps or moving through the Delta. Pumping reductions can reduce water supply reliability for the SWP and CVP Export Service Areas, causing conflicts between fishery and water supply interests. A key feature of the EWA is use of water assets to replace supplies that are interrupted during pumping reductions. The EWA assets can also provide other benefits such as augmenting instream flows and Delta outflows.

The CALFED agencies established an EWA to provide water for the protection and recovery of fish beyond that which would be available through the existing baseline of regulatory protection related to project operations. The EWA involves neither new sources of water nor new construction.

The CVP and SWP export project water through the Delta pumps. This pumping can change internal flow patterns within the Delta, and entrain and kill fish at the intakes to the SWP and CVP pumping facilities. The EWA agencies take actions to protect and restore fish in the Delta and to provide additional benefits upstream. Actions in the

Delta to protect fish can involve temporary pumping reductions in the Delta or closure of the Delta Cross Channel gates. Closing the Delta Cross Channel improves the survival of anadromous fish migrating downstream on the Sacramento River because it blocks a route to the central Delta where survival is poor and helps fish migrate out to the Bay. Management agency biologists use real-time data on fish abundance and distribution, flow, and fish salvage at the Delta export pumps to develop recommendations for fishprotection. Actions providing secondary benefits include increasing instream flows in rivers upstream from the Delta or augmenting Delta outflows.

The EWA seeks to benefit ESA native fish species that spend some portion of their life cycle in the Delta. The fish species of concern, their life stages, and location in the Delta are described in Chapter 3.

2.3 Baseline Level of Fishery Protection

This section presents the existing environmental regulation, biological opinions, and SWP/CVP operational parameters currently being implemented to protect at-risk native fish species in the Delta. These items all represent the "baseline level of fishery protection" that the EWA program builds upon in addressing the EWA goal of providing protection to the fish of the Bay-Delta estuary through environmentally beneficial changes in SWP/CVP operations at no uncompensated water cost to the Projects' water users.

2.3.1 Overview

The CALFED ROD identified a baseline level of fishery protection requirements for SWP/CVP Project operations. Existing regulatory programs established these requirements prior to implementation of the CALFED ROD. These requirements alter Project operations in ways that improve Delta water conditions for fish. The baseline level of fishery protection includes the environmental requirements identified below, updated to include the September 2002 BO on Spring-run Chinook and Steelhead.

- **1993 Winter-run Biological Opinion (NOAA Fisheries).** In 1993, the National Marine Fisheries Service (NOAA Fisheries) assessed the potential effects of operation of the CVP and SWP on the Federally-listed winter-run Chinook salmon. Based on this assessment, NOAA Fisheries issued a biological opinion concluding that operation of the CVP would likely jeopardize the continued existence of winter-run chinook salmon. Reasonable and prudent alternatives to CVP operations were developed to avoid jeopardy, including specific flow, temperature, reservoir storage, and diversion requirements in the Sacramento River and in the Delta. NOAA Fisheries reinitiated consultation on CVP and SWP operations when the "Principles for Agreement" that formed the basis for the Bay-Delta Plan were originally signed. NOAA Fisheries subsequently issued a revised biological opinion in 1995. Reclamation and DWR currently operate the CVP and SWP, respectively, in accordance with the NOAA Fisheries 1995 Winter-run Chinook Salmon Biological Opinion.

- **1995 Delta Water Quality Control Plan (1995 Delta WQCP) and SWRCB's Decision 1641.** The SWP and CVP met the flow-related objectives of this plan at the time the CALFED ROD was signed. The SWRCB has subsequently issued Decision 1641 (D-1641), which provided an interim decision regarding the obligations of the SWP and CVP to meet the flow-related objectives in the Water Quality Control Plan (SWRCB 1995).

- **Vernalis Adaptive Management Plan (VAMP).** The Vernalis Adaptive Management Plan (VAMP) is a science-based, adaptive management plan designed to determine and protect the survival and transport of salmon smolts through the Delta in relation to the flow of the San Joaquin River, SWP/CVP exports, and the operation of a fish barrier at the head of Old River. This study calls for a regulated pulse flow level at Vernalis and a predetermined SWP/CVP export rate for a 31-day period during April and May. Table 2-1 shows the allowable export rates as a function of the flow at Vernalis. The San Joaquin River Agreement stipulates the target flow rate of the San Joaquin River and the water suppliers during this period, based on the San Joaquin Valley Water Year Hydrologic Classification (index of water supply availability and wetness). VAMP was included in D-1641, a water rights decision that implemented the 1995 Delta WQCP. As part of the baseline level of fisheries protection, Reclamation would use CVPIA (b)(2) water to account for export reductions due to the limited pumping during April and May. CVPIA (b)(2) water has been used to account for decreased SWP exports in the past; the SWP would be unlikely to participate in VAMP as part of the baseline level of fisheries protection without a method to repay the SWP contractors for export losses.

Table 2-1
VAMP Export Limitations

Export Rates (cfs)	Vernalis Flow Rate (cfs)			
	7,000	5,700	4,450	3,200
1,500	X		X	X
2,250		X		
3,000	X			

- **1995 Delta Smelt Biological Opinion.** On March 6, 1995, the US Fish and Wildlife Service (USFWS) issued a biological opinion on the effects of the long-term operation of the CVP and SWP on the Federally listed, threatened Delta smelt and its critical habitat (USFWS 1995). The biological opinion concluded that CVP and SWP operations, as proposed,[1] are not likely to jeopardize the continued existence of the Delta smelt or result in the destruction or adverse modification of proposed critical habitat for the Delta smelt. To promote recovery of the species and to ensure that project operations would not interfere with the survival and recovery of the species, USFWS issued a number of recommendations relating to (1) incidental take

1 Operations "as proposed" included provisions from prior biological opinions, water quality standards, and the implementation of the Recovery Plan, which were expected to result in improved habitat.

at various locations in the Delta; (2) fish salvage; (3) monitoring of Delta parameters such as X_2 and outflow; and (4) conservation of the species. The CVP and SWP currently operate in accordance with the USFWS 1995 Delta Smelt Biological Opinion.

The 1995 Delta Smelt Biological Opinion contains an export pump reduction (item 2 on page 19 of the opinion), commonly referred to as the "2 to 1 Vernalis flow/export ratio." This pump reduction objective calls for the SWP and CVP to reduce combined exports, below that allowed in the 1995 Delta WQCP, during a 31-day period in April and May. The 1995 Delta WQCP allows exports to be 100 percent of the base flow at Vernalis[2] during the April-May pulse period, when additional water is released to simulate historic snowmelt flows for fish. The 1995 Delta smelt opinion reduces exports even further, so that exports can only be 50 percent of the base flow at Vernalis. CVPIA 3406(b)(2) water would be used to account for this decrease and this water is part of the baseline fishery protection. Multiple interpretations of this requirement led to conflict between the SWP and USFWS, and the SWP would be unlikely to meet this requirement under the baseline level of fisheries protection without compensation for water supply loss.

- **2002 Spring-run Chinook and Steelhead Biological Opinion.** On September 20, 2002, NOAA Fisheries issued a biological opinion on CVP and SWP Operations, April 1, 2002, through March 31, 2004, on Federally listed threatened Central Valley spring-run Chinook salmon and threatened Central Valley steelhead (NMFS 2002). The Biological Opinion established non-discretionary terms and conditions that are intended to minimize the adverse effects of flow fluctuations associated with upstream reservoir operations on the incubating eggs, fry and juvenile steelhead, and spring-run Chinook salmon. These terms and conditions pertain to flow and water temperature requirements, ramping criteria, flow fluctuations, and incidental take/fish salvage of the species.

- **Full Use of 800 TAF Supply of Water Pursuant to Section 3406(b)(2) of the CVPIA**. At the August 2000 signing of the CALFED ROD, the decision by the Department of the Interior regarding the use of (b)(2) water included "reset" and "offset,"[3] provisions that were further clarified in the CALFED ROD. The 2002 Federal District Court decision, however, determined that (b)(2) implementation should not include these reset and offset provisions. The Ninth District Court upheld the District Court's ruling on offset and reset. The baseline level of fisheries protection includes the dedication and management of the 800,000 acre-feet using a policy that reflects the opinion of the court.

- **Level 2[4] Refuge Water Supplies.** Section 3406(d) of the CVPIA authorizes and directs the Secretary of the Interior to provide firm water supplies of suitable

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2 Vernalis is a town on the San Joaquin River just downstream from the confluence with the Stanislaus River where San Joaquin River flow and water quality are measured.

3 "Reset" and "offset" are defined on Page 56 of the CALFED ROD (CALFED 2000b).

4 The USBR Report on Refuge Water Supply Investigations (March 1989) defined four levels of refuge water supplies: existing firm water supply (Level 1), current average annual water deliveries (Level 2), full use of existing development (Level 3), and to permit full habitat development (Level 4).

quality to certain national wildlife refuges in the Central Valley of California, certain State of California wildlife management areas, and the Grassland Resource Conservation District (collectively referred to below as "refuges") in accordance with the 1989 *Report on Refuge Water Supply Investigations and the 1989 San Joaquin Basin Action Plan/Kesterson Mitigation Plan* (USFWS and USBR 2002). Level 2 supplies are defined in the Investigations Report as the historic annual average water deliveries to each refuge prior to enactment of the CVPIA and two-thirds of the water supplies identified for the Action Plan Lands (USFWS and USBR 2002). These firm water supplies must be provided at the refuge boundaries, as required by the CVPIA. To the extent available, the CVP would use its share of the benefits from Joint Point of Diversion (as explained in Section 2.4.3.2.2) to comply with its Level 2 refuge water supply mandates, but using such benefits would not create any limitation on the overall Level 2 supply that is available for refuges.

To implement these fish protection requirements, Management and Project agencies could take several actions described in the sections below.

2.3.2 Delta Export Pumping Reductions

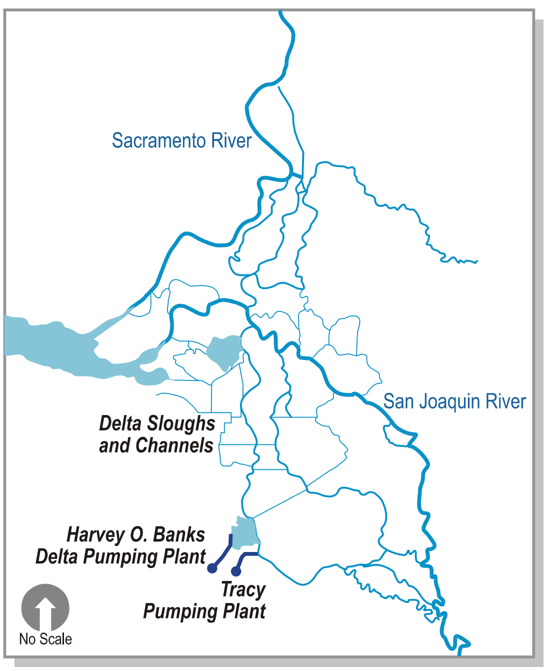

Figure 2-2
Location of Delta Export Pumps

On going pumping water through the Tracy and Banks pumping plants (see Figure 2-2) alters Delta hydrodynamics, changing conditions for fish rearing and migration. Fish mortality at the pumps can result directly from entrainment[5] through fish screens, impingement,[6] losses to predators, and handling of captured fish in the salvage process. The operation of the pumping plants may also have indirect effects on fish. Altered net flow patterns sometimes changes migratory patterns and increases the likelihood of predation. Pumping reductions help to reduce these effects on Delta hydrodynamics and reduce entrainment of fish at the pumping facilities.

Under the baseline level of fishery protection, Project Agencies would implement pumping reductions when the fish protection requirements mandated the

CVPIA Section 3406(d) committed to providing firm water through long-term contractual agreements for Level 2 water supply.

5 "Entrainment" occurs when fish are drawn into the pumps, which can injure fish or place them into unsuitable habitat. (Reclamation 2003).

6 "Impingement" occurs when fish are trapped against the outer surface of a fish screen. (Environmental Protection Agency 2001)

reduction. The biological opinions result in pump reductions when fish take at the pumps reached the "reconsultation level" established in the applicable opinion.[7] Table 2-2 shows the times that these protections are likely to require pump reductions and the reasons that reductions help fish.

Table 2-2
Pump Reductions Under the Existing Baseline Level of Fisheries Protection

Timeframe	*Benefiting Fish*[8]	*Reason*	*Regulatory Mechanism*
December – January	Juvenile salmonids	Protect outmigrating juvenile salmonids	Biological opinion
	Adult smelt[9]	Protect upmigrating adult smelt	Biological opinion
February – March	Juvenile salmonids	Protect outmigrating juvenile salmonids	Biological opinion
	Adult smelt	Protect upmigrating adult smelt	Biological opinion
April – May 31 days	Salmon smolts	Determine how export pumping affects survival and passage of salmon smolts through the Delta	D-1641 (VAMP) (SWP may not follow if it were not reimbursed)
June	Juvenile smelt	Protect juvenile smelt near the pumps	Biological opinion

Under the baseline level of fisheries protection, the CVP and SWP would attempt to recover the water from reduced pumping through a variety of actions. The CVP would use (b)(2) water to account for the pumping reductions required in the Delta for biological and water quality control purposes within the 800,000 acre-foot upper limit. Both the SWP and CVP use operational flexibility to recover additional water. These sources are not likely to be sufficient to compensate for all pumping reductions.

2.3.3 Delta Cross Channel Gates Closure

The Delta Cross Channel (DCC), near the town of Walnut Grove, diverts Sacramento River water eastward to the Mokelumne River system where it more directly affects flows across the central Delta to the Project pumps (Figure 2-3). Movement of water in a southerly direction through the Delta is not a natural hydrological process and can confuse migrating salmon that are attempting to follow stream flows. Avoiding this effect is particularly important during the winter, when the winter-run Chinook salmon, a Federal- and State-listed endangered species, is migrating upstream to spawn. (The late fall-runs are also migrating at this time, classified as candidate species.) DCC gate closure during the winter also helps the chance that emigrating

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7 The biological opinions establish levels that define responses to fish mortality: "warning level" indicates that caution should be used, "reconsultation level" indicates that the action leading to fish mortality triggers reinitiation of consultation, and "jeopardy" indicates that the action could place the continued existence of the fish species in jeopardy.

8 "Benefiting Fish" only include the fish that require pumping reductions through a regulatory mechanism. Incidental benefits to other fish would also result from some reductions.

9 Effects on adult delta smelt at the pumps have not yet exceeded allowable take limits specified in the 1995 biological opinion, but the effects could trigger a reduction at the pumps.

spring-run and winter-run chinook salmon and steelhead smolts, might travel through the central Delta and swim toward the pumps instead of taking their natural route to the Bay.

Closing the DCC gates ensures that juvenile spring-run and winter-run chinook salmon and steelhead smolts remain in the mainstem Sacramento River, improving their likelihood of successful outmigration through the western Delta and San Francisco Bay. The closure also reduces the direct flow of Sacramento River to the export pumps, which can reduce the quality of water being exported to project users. With the DCC closed, for the same exports, more comes from the western Delta, which is closer to the Bay and has lower water quality. The Project Agencies may reduce export pumping in response to the changes in flow direction.

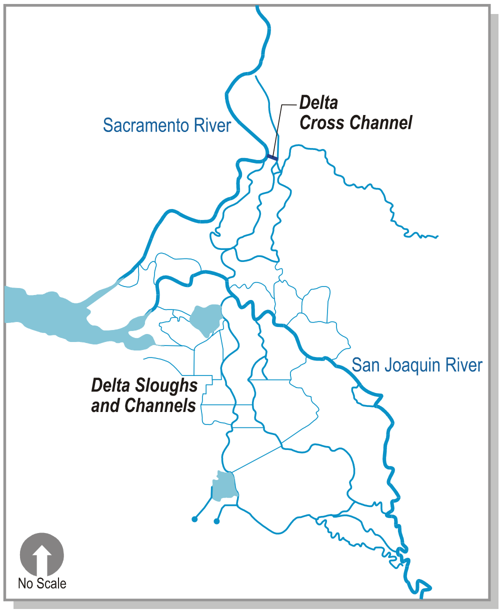

Figure 2-3
Location of Delta Cross Channel

The regulatory baseline for fishery protection dictates DCC gate closures as follows:

1) USBR standing operating procedures call for gate closure when flow on the Sacramento River reaches 20,000 to 25,000 cfs.

2) State Water Resources Control Board Decision 1641 allows for the following operations of the DCC gates:

   – From November 1 through January 31 the gates would be closed for up to 45 days as requested by FWS, NOAA Fisheries, and DFG. These closures are determined as follows:

      - If the Knight's Landing catch index (KLCI) is > 5 and ≤ 10 salmon, the DCC gates would be closed for 4 days within 24 hours. If after 4 days the KLCI still exceeds 5, the gates would remain closed for another 4 days.

      - If the KLCI is > 10 salmon, the DCC gates are to be closed until the KLCI is ≤ 5.

   – The gates would be closed continuously from February 1 through May 20.

   – From May 21 through June 15 the gates would be closed for a total of 14 days, again as requested by USFWS, NOAA Fisheries, and CDFG.

2.3.4 Increasing Instream Flows

Increasing flows year-round in upstream river reaches improves habitat conditions for anadromous and resident fish populations. Reclamation and USFWS use CVPIA (b)(2) supplies within the 800,000 acre-foot upper limit to meet these objectives;

therefore, the water is used to increase flows on CVP-controlled streams, such as the Sacramento, American, and Stanislaus Rivers and Clear Creek. The improved flows:

- Provide improved spawning and rearing habitat for salmon and steelhead;
- Improve survival of downstream migrating chinook salmon smolts;
- Improve habitat conditions for white sturgeon, green sturgeon, American shad, and striped bass to migrate upstream, spawn, and allow progeny to survive;
- Aid in the downstream transport of striped bass eggs and larvae;
- Improve water temperatures and increase habitat for rearing juvenile steelhead; and
- Benefit Delta smelt and other estuarine species.

The rationale and scientific basis for the improved flows are found in a variety of sources (including the Anadromous Fish Restoration Program[10] documents, published literature, CDFG reports, and other restoration programs) and are generally based on results of instream flow and temperature studies conducted by the FWS, CDFG, or others, as well as relationships between flow and adult fish returns, correlation analyses, and other life-history information.

The flow objectives for each stream are generally consistent with the Anadromous Fish Restoration Program's January 2001 Final Restoration Plan (AFRP Plan). These flow objectives would be higher than current minimum flow requirements in each stream. The targeted flow objectives are based on thresholds of CVP reservoir storage and forecasted inflow and the amount of (b)(2) water available to meet the objectives. Fisheries and hydrologic monitoring trigger higher flow releases. In general, spawning flows are initiated in October or November when adult salmon are observed in the streams and river temperatures are 60 degrees or less.

2.3.5 Augmenting Delta Outflows

Water from the Delta flows to the San Francisco Bay, which is more saline than the Delta estuary. The water mixes in the Suisun Bay area, and the mixing zone location varies depending on the Delta outflow. Higher amounts of Delta outflow push the saltwater mixing zone farther out to the Bay, and lower flows allow the saltwater zone to move farther into the Delta. The baseline level of fisheries protection includes actions related to Delta outflow required by the SWRCB's Decision 1641.

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10 The U.S. Department of the Interior established the Anadromous Fish Restoration Program to satisfy Section 3406 (b)(1) of the CVPIA: "develop within three years of enactment and implement a program which makes all reasonable efforts to ensure that, by the year 2002, natural production of anadromous fish in Central Valley rivers and streams would be sustainable, on a long-term basis, at levels not less than twice the average levels attained during the period of 1967-1991..."

2.3.6 Non-Flow Related Actions

In the absence of the EWA, a number of ongoing projects and programs are expected to continue, the purpose of which is to improve the condition of species and habitats. Under the CVPIA, funding was dedicated to projects in 2002 that would be designed and implemented during the EWA timeframe. Under the CALFED Ecological Restoration Program (ERP), funding was dedicated to projects in 2002 that would be designed and implemented during the EWA timeframe. These activities are considered a part of the baseline level of fisheries protection because their purpose is for fish protection and environmental protection and because they may create beneficial and/or adverse effects during the EWA timeframe on similar resources, in the absence of the EWA.

2.3.7 Water Management

Under the CALFED baseline for fisheries protection, it was reasonably predicted that pumping reductions for biological opinions result in reduced CVP and SWP exports. The CVP and SWP use operational flexibility within the Delta to try to make up for the water deliveries lost during pump reductions. If the Projects do not access enough water, they reduce their deliveries to water users. The water users then implement actions to reduce or address their shortages. The actions taken by the CVP and SWP are described below.

2.3.7.1 Delta Operational Flexibility

Under the baseline for fisheries protection, the Projects access water from flexible operations of the Delta export facilities. These types of flexible operations were defined prior to the EWA and are available for the Projects to help replace their users for pump reductions. Only the third item, relaxing the export/inflow ratio, provide additional water for the Projects. The other two options provide additional capacity for the Projects to move water through the Delta, but they do not provide additional water to reimburse water users for lost water. Under the baseline for fisheries protection, these actions are unlikely to provide enough water or capacity to replace the water lost during fish actions. The sections below describe the available options to increase water and capacity.

2.3.7.1.1 Joint Point of Diversion

The Joint Point of Diversion, established by D-1641,[11] allows the SWP and CVP to pump water for each other during times of restriction for one set of pumps. D-1641 established a staged implementation, in which the Projects would gradually begin to use facilities jointly.

- **Stage 1:** the CVP can use Banks Pumping Plant to divert water for selected CVP contractors, and either Project could use the others' facilities to recover export reductions to protect fish if the Projects complete a Water Level Response Plan that outlines the responses to changing water levels in the south Delta.

[11] Water rights Decision 1641 is explained in more detail in Chapter 1.

- **Stage 2:** the Projects can divert water from either pumping plant for any of their permitted purposes up to permitted capacity. The Projects must submit an operations plan to protect fish and wildlife and other legal users of water.

- **Stage 3:** the Projects can divert water from either pumping plant up to the physical plant capacity if they completed an operations plan to protect aquatic resources and their habitat and protect other legal users of water and if they implement water barriers or other water level protection.

Prior to the CALFED ROD, the Projects were in Stages 1 and 2 of the implementation process and could use Joint Point of Diversion to replace water that had been lost during pump reductions to protect fish. It is reasonably foreseeable that without the CALFED ROD, the Project Agencies would have completed the requirements to move into Stage 3 in which they could use the Joint Point of Diversion to supply water to their contractors in the Export Service Area.

Under the baseline for fisheries protection, the Joint Point of Diversion could provide additional capacity to pump water into the Export Service Area, but the Projects would need to provide the water to be pumped.

2.3.7.1.2 Relaxation of the Section 10 Constraint

The SWP is limited under Section 10 of the Rivers and Harbors Act,[12] pursuant to U.S. Army Corps of Engineers (USACE) Public Notice 5820-A, to a 3-day average rate of diversion of water into Clifton Court Forebay of 13,250 acre-feet per day, or 6,680 cfs. Between December 15 and March 15, the SWP can increase diversions above 6,680 cfs by one-third of the San Joaquin River flow at Vernalis when this flow is greater than 1,000 cfs.

The USACE granted permission to the SWP to relax the Section 10 constraint and increase the base diversion rate by the equivalent of 500 cfs to an average of 7,180 cfs for the months of July through September. The relaxation was initially permitted for summer 2000–02. Another application for relaxation in 2003 and 2004 has been submitted and is expected to be approved in 2003. Under the baseline for fisheries protection, this 500 cfs is used to replace water lost during pump reductions to benefit fish. The conveyance capacity would yield approximately 50,000 to 60,000 acre-feet per year, depending on operational restrictions.

2.3.7.1.3 Relaxation of the Export/Inflow Ratio

Under the SWRCB's D-1641 and Orders 2000-10 and 2001-5, Project exports are limited to a percentage of Delta inflow, usually 35 or 65 percent. This limitation is commonly called the Export/Inflow, or E/I, ratio, and the values throughout the year are shown in Table 2-3. D-1641 allows for these ratios to be relaxed at the discretion of

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[12] Section 10 of the Rivers and Harbors Act prohibits the obstruction or alteration of navigable waters of the U.S. without a permit from the USACE. Under Section 10, the USACE regulates projects or construction of structures that could interfere with navigation. A Department of the Army permit is needed to construct any structure on any navigable water of the United States, to excavate or deposit material in such waters, or to do any work affecting the course, location, condition, or physical capacity of such waters.

the NOAA Fisheries, USFWS, and CDFG. Under the existing regulatory baseline for fishery protection, water that is diverted during periods of E/I ratio relaxation approved by the fish agencies would be used to reimburse the Projects for water lost during pump reductions to protect fish. No relaxations of the E/I standard are depicted in regulatory baseline operations modeling because they would be short-term opportunistic events.

Table 2-3
Export/Inflow Ratio

Period	Percent of Total Delta Inflow
October – January	65
February	35 – 45
March – June	35
July – September	65

2.3.8 Existing Regulatory Commitments

As part of the MSCS Conservation Agreement and the USFWS and the NOAA Fisheries Biological Opinions, several CALFED agencies (USFWS, Reclamation, Bureau of Land Management, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, Natural Resources Conservation Service, the Resources Agency of California, California Department of Fish and Game, and the Department of Water Resources) provided a commitment, subject to specified conditions and legal requirements, that for the first 4 years of CALFED Stage 1 Implementation (2000 to 2007), there would be no additional CVP or SWP export reductions resulting from actions to protect fish under the federal ESA, California Endangered Species Act (CESA), or Natural Community Conservation Planning Act (NCCPA) beyond exports allowed under the existing regulatory baseline of fishery protection.. This commitment was based on the conditions in Section VIII-B of the MSCS Conservation Agreement and the availability of three tiers of EWA assets:

- Tier 1 is baseline water, provided by existing regulations and existing operational flexibility. The baseline level of fishery protection consists of the biological opinions on winter-run salmon and Delta smelt, 1995 Delta Water Quality Control Plan as implemented by SWRCB Decision 1641 and Order 2001-05, and 800,000 acre-feet of CVP Yield pursuant to the Central Valley Project Improvement Act (CVPIA) Section 3406(b)(2).

- Tier 2 consists of the water assets from the EWA combined with the benefits of a fully funded Ecosystem Restoration Program (ERP) and would be an insurance mechanism that would allow water to be provided for fish when needed without reducing deliveries to water users. Tier 1 and Tier 2 would be, in effect, a water budget for the environment and would be used to avoid the need for Tier 3 assets.

- Tier 3 consists of assets beyond Tiers 1 and 2 and would be based upon the commitment and ability of the CALFED agencies to make additional water available should it be needed. It would be unlikely that assets beyond those in Tier 1 and Tier 2 would be needed to meet ESA requirements. If further assets were needed, however, the third tier would be provided in specific circumstances. To determine the need for Tier 3 assets, the fishery agencies would consider the views of an independent science panel. Tier 3 measures would be used only when Tier 1 and Tier 2 measures are insufficient to avoid jeopardy, as determined by the USFWS or NOAA Fisheries. The USFWS and NOAA Fisheries define jeopardy as a situation in which an action is likely to jeopardize the continued existence of a species listed as endangered or threatened under the ESA. If USFWS and NFMS trigger Tier 3, measures could include increased EWA acquisitions or uncompensated fish actions.

2.4 Proposed Action (Flexible Purchase Alternative)

2.4.1 EWA Overview

The Proposed Action is based on taking adequate actions to protect fish to allow the EWA to meet the regulatory commitments in the CALFED ROD and Operating Principles Agreement. The Proposed Action would allow the EWA agencies to use water for a broad range of fish actions. These actions would include reduction of Delta export pumping, closing the Delta cross channel, augmenting Delta outflow, or increasing instream flows. The EWA agencies would have the flexibility to choose from these actions to best protect at-risk fish, and would not need to solely focus on actions within the Delta. The Proposed Action would allow the EWA agencies to respond to changes in base condition operations, such as modifications to (b)(2), and at the same time providing for anticipated levels of fish actions. The Proposed Action would be limited primarily by funding in that the EWA agencies would determine the amount of assets to acquire largely based on available funding and asset prices. The Proposed Action would have flexibility to respond to changing fish and hydrologic conditions midway through a year.

The Proposed Action would allow the EWA agencies to vary water asset purchases from those defined in the CALFED ROD to meet water needs in a specific year. The CALFED ROD identified a minimum of 185,000 acre-feet of water purchases per year, with at least 35,000 acre-feet coming from areas that are upstream from the Delta and 150,000 acre-feet from the export service areas. The Proposed Action would allow the EWA Project Agencies to purchase up to 600,000 acre-feet of water, although the EWA agencies would typically acquire 200,000 to 300,000 acre-feet except in wet years or years with high fish needs (see Section 2.4.3 for a discussion of a typical year). Water purchases under the Proposed Action would be neither fixed at 185,000 acre-feet per year nor held to specific purchase quantities upstream from the Delta or in the export service areas. The EWA agencies would use the concept of functional equivalence (as defined in Section 2.2.2.3) to combine methods, water sources, and operational flexibilities under the Proposed Action to provide a broad range of fish actions, help offset changes in levels of protection provided by (b)(2) assets or to increase the EWA in the future. Variable assets would be acquired at the same manner as specified in the EWA Operating Principles Agreement.

The Proposed Action would allow the EWA Project Agencies to acquire up to 200,000 acre-feet of storage capabilities if a reasonably priced option were available; this

EIS/EIR assesses the environmental effects of groundwater storage because it is the most likely storage option. If groundwater storage could not be implemented for financial or technical reasons, the Proposed Action would allow other actions to achieve similar objectives.

If the EWA assets were fully used but were not sufficient to prevent jeopardy, then the EWA Management Agencies would initiate Tier 3. In the Proposed Action, the EWA Management Agencies would not likely need to initiate Tier 3 frequently because the Proposed Action includes high upper limits for purchases. If Tier 3 were needed, additional acquisitions would be covered by this environmental document as long as the total assets (Tier 2 and Tier 3) were less than 600,000 acre-feet. Asset purchases above 600,000 acre-feet would require additional environmental analysis. The Proposed Action would cost more, have greater benefits for fish (supporting protection and recovery), and would likely result in a reduced frequency of initiating Tier 3 water acquisitions.

Providing flexibility to operate differently each year could help the EWA agencies address varying needs for water in different year types. Fish actions at the export pumps are dependent on the presence of the fish near the pumps, a factor that is not always dependent on the hydrologic year type. After the EWA agencies undertake a fish action, the program must repay water to the affected CVP or SWP water users. As explained previously, the EWA agencies owe the projects the amount of water that could have been pumped during the time of a pump reduction. During a typical dry year the pumps are not very active because there is less exportable water in the Delta. The Projects do not pump as much water in dry years because supplies are limited. Therefore, the level of compensation required to the Projects would be less than in below normal to wet years. In wet years, the amounts of water in the Delta allow the Project Agencies to operate the export pumps at their maximum permitted capacity. The water that would have been pumped in a wet year is much greater than in a dry year. In wet years, the EWA agencies must be able to provide more water to repay the projects than in dry years.

The next two sections (2.4.2 and 2.4.3) describe the components of the Proposed Action, including the EWA agencies' actions to protect fish and benefit the environment, and the actions to acquire and manage assets. Section 2.5 includes the environmental commitments required to mitigate any potential effects of the Proposed Action.

2.4.2 Actions to Protect Fish and Benefit the Environment

The EWA agencies have established operating tools that allow them to protect fish. These operational tools include (1) reducing export pumping, (2) closing the Delta Cross Channel gates, (3) increasing instream flows, and (4) augmenting Delta outflow. These actions were described in the baseline level of fisheries protection, Section 2.3. These actions would take place throughout the year, under various conditions. The EWA agencies would use their acquired assets, in addition to actions specified in the regulatory baseline level of fishery protection, to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta. Each tool, its timing, the protection it provides, and why and how each action will be undertaken is described below. These descriptions are followed by an explanation of the process used to decide when actions should be taken.

2.4.2.1 Export Pumping Reductions

As described in the baseline level of fishery protection (Section 2.3.2), reducing export pumping can protect fish in the vicinity of the Project export pumps, and also can provide secondary benefits to fish throughout the Delta. The Management Agencies would use pump reductions from December to June, but vary them each year depending on the behavior of the fish and hydrologic conditions and water quality. The general timing of pump reductions to benefit specific fish types is the same as for the baseline level of fishery protection. The EWA agencies would not necessarily wait to reach the reconsultation level conditions identified in the Biological Opinions before calling for export reductions. For the Proposed Action, the EWA agencies would use the assets to take fish actions when they deem most appropriate.

Actual EWA pump reductions would vary each year depending on fish conditions, hydrology, available EWA assets, and other factors. The potential reductions are discussed below by time of year.

2.4.2.1.1 Export Reductions in December and January

Reducing exports in December and January during critical outmigration periods would increase survival of outmigrating salmonids from the Sacramento basin, including listed winter-run Chinook, spring-run Chinook, steelhead trout, and candidate late-fall and fall-run Chinook. Adult Delta smelt and Sacramento splittail are also migrating upstream to spawning areas at this time.

This reduction would increase the survival of juvenile Chinook salmon smolts (including winter-run presmolts and spring-run yearlings) migrating through the Delta in the winter. It is scientifically supported by several years (1993 – 2002) of mark/capture data that indicate the survival of juvenile late fall-run Chinook salmon in the central Delta decreases as exports increase. Further support for pumping reduction is based on a recent analysis that indicates that December is an important migration period for winter run pre-smolts and that the Delta Cross Channel gate closures during December appear to be correlated with low winter-run salvage at the export facilities later in the year.

Typical actions would reduce pumping to 6,000 cfs for 5 days at a time, and in some years those reductions would occur several times during these months. For example, the EWA in past years reduced pumping for 10 days total in January and used 65,000 to 70,000 acre-feet of assets. During these months, the EWA agencies usually reduce pumping in conjunction with closing the Delta Cross Channel gates.

2.4.2.1.2 Export Pumping Reductions in February and March

Reducing export pumping in the critical out-migration period in February and March would increase survival of out-migrating juvenile Chinook salmonids from the Sacramento basin, with a focus on ESA listed winter-run Chinook salmon and steelhead trout. Adult Delta smelt and Sacramento splittail also are migrating upstream to spawning areas at this time.

This reduction would increase the survival of juvenile salmonid smolts migrating through the Delta in the late winter. Several years (1993 – 2002) of mark/recapture data indicate that the survival of juvenile late fall-run Chinook salmon in the central Delta decreases as exports increase. These export reductions would supplement the primary protective action of closing the Delta Cross Channel gates during this period. Reduced exports also decrease ESA incidental take of juvenile winter-run salmon, spawning adult Delta smelt and Sacramento splittail when the species are in the south/central Delta. Typical actions would reduce pumping to 6,000 cfs –8,000 cfs for 5-10 days at a time in February through March.

2.4.2.1.3 Export Reductions in April and May

Reducing Delta exports during April and May would help out-migrating juvenile fall-run Chinook salmon. As described in the baseline level of fisheries protection (Section 2.3.3), the VAMP program calls for specific flow releases from the Stanislaus, Tuolumne, and Merced Rivers and specific pump reductions during 31 days, generally from mid-April to mid-May. These actions would evaluate the relative effects of export and inflow to juvenile San Joaquin basin Chinook salmon survival and assist in providing protection for both anadromous and estuarine species. The CVP would use (b)(2) water to undertake the VAMP study in the baseline level of fisheries protection condition, but the SWP may not have water to contribute to the study. As part of the Proposed Action, the EWA agencies could provide water for the SWP to participate in VAMP.

The Proposed Action could also include pumping reductions before April 15 to protect juvenile anadromous or resident species (including Delta smelt). After May 15, the EWA agencies could request that exports continue at some reduced stable level or allow exports to ramp up gradually between May 16 and June 1. These additional days of reduced exports would provide additional protection for juvenile anadromous and resident estuarine species.

2.4.2.1.4 Export Reductions in June and July

Delta pumping reductions in June could decrease losses of juvenile Delta smelt and splittail. Also, a gradual increase (ramp up) rather than a rapid increase of exports during June may be used to increase survival of both anadromous and resident estuarine species in the south/central Delta. In some years, these actions may continue into the early part of July.

Pumping reductions would decrease the effects of CVP/SWP export facilities on listed resident fish in the south Delta and would enable juvenile resident estuarine and anadromous species to migrate away from the export pumping facilities where they are less vulnerable to direct loss and/or direct mortalities associated with export operations. Data indicate “incidental take” is greater when fish population densities are high near the export facilities or when exports increase. Additional information indicates that, generally, when the export rate increases rapidly under low Delta inflow and fish densities are high in the south/central Delta, the fish losses at the facilities can be high.

2.4.2.2 Delta Cross Channel Gates Closure

As discussed for the baseline level of fishery protection (Section 2.3.3), closing the DCC gates would increased the likelihood that juvenile spring-run and winter-run Chinook salmon and steelhead smolts remain in the mainstem Sacramento River, which would improve their survival and likelihood of successful out-migration through the western Delta and San Francisco Bay.

When DCC gates are closed outside the regulatory baseline, EWA agencies would compensate water users for water supply losses from these reductions. Additional gate closures would typically occur in November, December, January, May, or June, if additional closures were needed after the regulatory requirements of the baseline level of fisheries protection were met.

2.4.2.3 Increasing Instream Flows

Increasing instream flows would improve habitat conditions for anadromous and resident fish. The Proposed Action would include flow increases beyond those in the baseline level of fisheries protection (Section 2.3.4). Table 2-4 shows fish species that could require supplemental flows in various rivers and tributaries to meet habitat requirements for the various life history stages. The table also displays the timing of each life history stage and the rivers (those affected by EWA actions) in which each fish species can be found.

Supplemental flows above the existing baseline level of fishery protection for instream flows would provide additional water that primarily benefits salmon and steelhead adult immigration, spawning, egg incubation, rearing, and emigration of juveniles through the regulation of pulse flows, water temperature, water quality, and the maintenance of attraction and flushing flows. Instream flows may also aid white and green sturgeon emigration, spawning, egg incubation, and rearing and American shad spawning, incubation, and rearing.

The EWA instream flow actions would occur on the waterways where the EWA purchases assets, including the Sacramento, Feather, Yuba, American, Merced, and San Joaquin Rivers. The EWA actions to increase instream flows would use the AFRP as a guide to identify the times and locations that supplemental flows are needed. The CALFED Environmental Water Program (EWP) and the CVPIA (b)(2) water both help to meet the above objectives. CVPIA (b)(2) water can currently be used to augment instream flows, and the EWP may be able to take these actions in the future.

Table 2-4
Anadromous Fish Life History Stages and Locations

Fish	Run	Stage	Month	Location
Chinook Salmon	Fall	Immigrating adult	July – December	Sacramento, Feather, Yuba, American, San Joaquin, Merced
		Spawning	October – December	
		Emigrating juvenile	January – June	
	Late-fall	Immigrating adult	October – April	Sacramento, Feather, Yuba
		Spawning	December – April	
		Emigrating juvenile	May – December	
	Winter	Immigrating adult	December – July	Sacramento
		Spawning	Late April - mid-August	
		Emigrating juvenile	August – March	
	Spring	Immigrating adult	March – September	Sacramento, Feather, Yuba
		Spawning	Mid-August – October	
		Emigrating juvenile	November – June	
Steelhead	Central Valley	Immigrating adult	August – March	Sacramento, Feather, Yuba, American, San Joaquin, Merced
		Spawning	December – April	
		Emigrating juvenile	January - October	
American shad		Immigrating adult	April – May	Sacramento, Feather, Yuba, American, San Joaquin
		Spawning	June – July	
		Emigrating juvenile	August – October	
Green Sturgeon		Immigrating adult	February – June	Sacramento
		Spawning	March – July	
		Emigrating juvenile	June – August	
White Sturgeon		Immigrating adult	February – May	Sacramento, American, San Joaquin
		Spawning	May – June	
		Emigrating juvenile		

Source: Final Restoration Plan for the Anadromous Fish Restoration Program (AFRP Plan) (USFWS 2003)

2.4.2.4 Augmenting Delta Outflows

Fresh water from the Delta flows to the San Francisco Bay, which is more saline than the Delta estuary. The fresh water mixes with salt water in the Suisun Bay area, and the mixing zone location varies depending on the Delta outflow. Higher amounts of Delta outflow push the saltwater mixing zone farther out to the Bay, and lower flows allow the saltwater zone to move farther into the Delta. Augmenting Delta outflows could move the saltwater mixing zone farther into the Bay, improving the water quality within the Delta. The Proposed Action could include actions to augment Delta outflow in addition to outflows required by the SWRCB's Decision 1641 and the existing baseline of fishery protection. Augmenting Delta outflow would also help to restore a more natural flow pattern through the Delta, which would help outmigrating fish.

In addition to taking direct actions to augment Delta outflows, other actions within the Proposed Action would have the secondary benefit of increasing Delta outflows. When the EWA agencies reduce Delta export pumping, the water that would have been pumped becomes Delta outflow. Delta outflow would also increase during the summer months when EWA assets are moved through the Delta because the transfers must include outflow water to maintain water quality (see Section 2.4.3.1 for additional information).

2.4.2.5 Decision-Making Process

A multi-agency team called the EWA Team (EWAT) would recommend when fish actions should be taken, using a consensus process based on biological indicators for the species considered to be at immediate risk. EWAT would consider the technical input of the Data Assessment Team (DAT), which includes stakeholder representatives, when deciding when fish actions should be taken. When the EWAT cannot reach consensus or decides issues should be elevated, issues would be presented to the Water Operations Management Team (WOMT) for resolution. Decisions would be reported to the CALFED Operations Group involving agency and stakeholder representatives. Appendix C includes the existing decision trees for Delta smelt and Chinook salmon used by the DAT. Their decisions are not solely based on the take limits at the export pumps.

In November and December, the EWA agencies would begin the process of identifying placeholders[13] for the next year in coordination with the (b)(2) interagency team. These placeholders would be determined based upon biological objectives and hydrology (which includes the latest forecast/allocation study for both the CVP and SWP). These placeholders would then be evaluated monthly to determine whether they are still applicable for the current month or for the following months (up until June). The use of the EWA placeholders in a particular month would be based upon the biological decision trees for salmon and Delta smelt and real-time monitoring. If not used in a particular month the placeholders would be reassigned and used in another month. The purposes in identifying these placeholders is to assist the Project Agencies in acquiring contracts for water purchases and to inform the EWA agencies of upcoming EWA actions.

2.4.3 Asset Acquisition and Management

This section is organized according to the geographic areas in which the EWA Project Agencies acquire and/or manage assets for the Proposed Action: upstream from the Delta (Section 2.4.3.1), the Delta (Section 2.4.3.2), and the export service areas (Section 2.4.3.3). Figure 2-4 shows each of these areas.

The EWA Project Agencies would use any of the acquisition methods described below to purchase water. Flexibility to purchase from any of these sources is critical to helping the EWA run efficiently because it would allow the Project Agencies to purchase the least expensive water available in any given year. Table 2-5 lists agencies that may be willing to sell water to the EWA or have sold water to the EWA in past years,[14] along with a general range of potentially available water volumes. None of

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13 Placeholders are the best available estimate of the water that the fish would need in the upcoming year.

14 Information on past EWA transactions can be found online at http://wwwoco.water.ca.gov/calfedops/2001ops.html or http://wwwoco.water.ca.gov/calfedops/2002ops.html

the purchases in Table 2-5 are guaranteed; the EWA Project Agencies could only make purchases if a seller is willing to participate.

Figure 2-4
Asset Acquisition and Management Areas

The numbers presented in Table 2-5 are estimates and do not necessarily reflect the amount of water that would be available in any given year. Generally, these estimates reflect the potential upper limit of available water in order to include the maximum extent of potential transfers in the environmental analysis. Some of the agencies listed in Table 2-5 indicated an interest in transferring water to the EWA, but could not provide a range of potential available water supplies. The numbers in the table include estimates provided either by water sellers or the Project Agencies. Actual purchases would depend on the year type, EWA funding, and the amounts that sellers would be willing to transfer in a given year.

The potential acquisitions in Table 2-5 would not all occur within a single year. The table is simply a menu that illustrates the flexibility the EWA Project Agencies have in making purchases. Figure 2-5 shows the locations of the water agencies listed in Table 2-5.

Table 2-5 does not contain an exhaustive list of potential EWA sellers; additional agencies may decide at any time that they wish to sell water to the EWA. An analysis of the potential environmental effects of transferring water, however, requires information on the transfer sources. The environmental analysis in this document includes the effects associated with the potential transfers in Table 2-5. Other future water transfers that require a supplemental Environmental Assessment or ASIP would tier from this document. Water transfers that meet and implement the conservations measures developed in this document for the specific resources identified may not need second-tier environmental documentation once the transfers have been reviewed by the Project Agencies and are found to be in compliance with these conservation measures.

Table 2-5
Potential Asset Acquisitions and Management for the Proposed Action (Upper Limits)

	Range of Possible Acquisitions (TAF)				*Management*	
Water Agency	***Stored Reservoir Water***	***Groundwater Substitution***	***Crop Idling/ Subst.***	***Stored Groundwater Purchase***	***Ground-water Storage Services***	***Source Shifting/ Pre-Delivery***
Upstream from the Delta Region						
Sacramento River Area of Analysis						
Glenn-Colusa ID		20-60	100			
Reclamation District 108		5	45			
Anderson Cottonwood ID		10-40				
Natomas Central MWC		15				
Feather River Area of Analysis						
Oroville Wyandotte ID	10-15					
Western Canal WD		10-35	70			
Joint Water Districts		20-60	65			
Garden Highway MWC		15				
Yuba River Area of Analysis						
Yuba County WA	100	85				
American River Area of Analysis						
Placer County WA	20		10			
Sacramento GW Authority				10		
Merced/San Joaquin River Area of Analysis						
Merced Irrigation District		10-25				
Export Service Area						
San Joaquin Valley						
Kern County WA			115	50-165	X	X
Semi-Tropic WSD[1]					X	
Arvin-Edison WSD[1]					X	
Westlands WD			195			
Tulare Lake Basin WSD			110			
Santa Clara Valley						
Santa Clara Valley WD						X
Southern California						
Metropolitan WD						X

Abbreviations:
GW: Groundwater
ID: Irrigation District
MWC: Mutual Water Company
WA: Water Agency
WD: Water District
WSD: Water Storage District
Footnote 1: Semi-Tropic WSD and Arvin-Edison WSD are within Kern County Water Agency. Their groundwater storage facilities are separate from the Agency, but they may participate in other programs that the agency helps administer, such as crop idling.

2.4.3.1 Upstream from the Delta Region

As shown in Figure 2-5, the Sacramento and San Joaquin Rivers both flow into the Delta; therefore, these rivers and their tributaries are designated in this document as the Upstream from the Delta Region. Potential asset acquisitions in the Upstream of Delta Region include stored reservoir water, groundwater substitution, crop idling/substitution, and stored groundwater purchase (See sections 2.4.3.1.1 – 2.4.3.1.4.). The EWA agencies could use assets acquired in this region for multiple purposes, but would generally use assets to protect and restore fish species that are affected by the conflicts at the Delta export pumps, which is the primary objective of the EWA. The EWA actions would protect and restore fish at the pumps by reducing pumping when it would help at-risk fish species, then transferring EWA assets across the Delta at other times to repay CVP and SWP users for water lost during pump reductions.

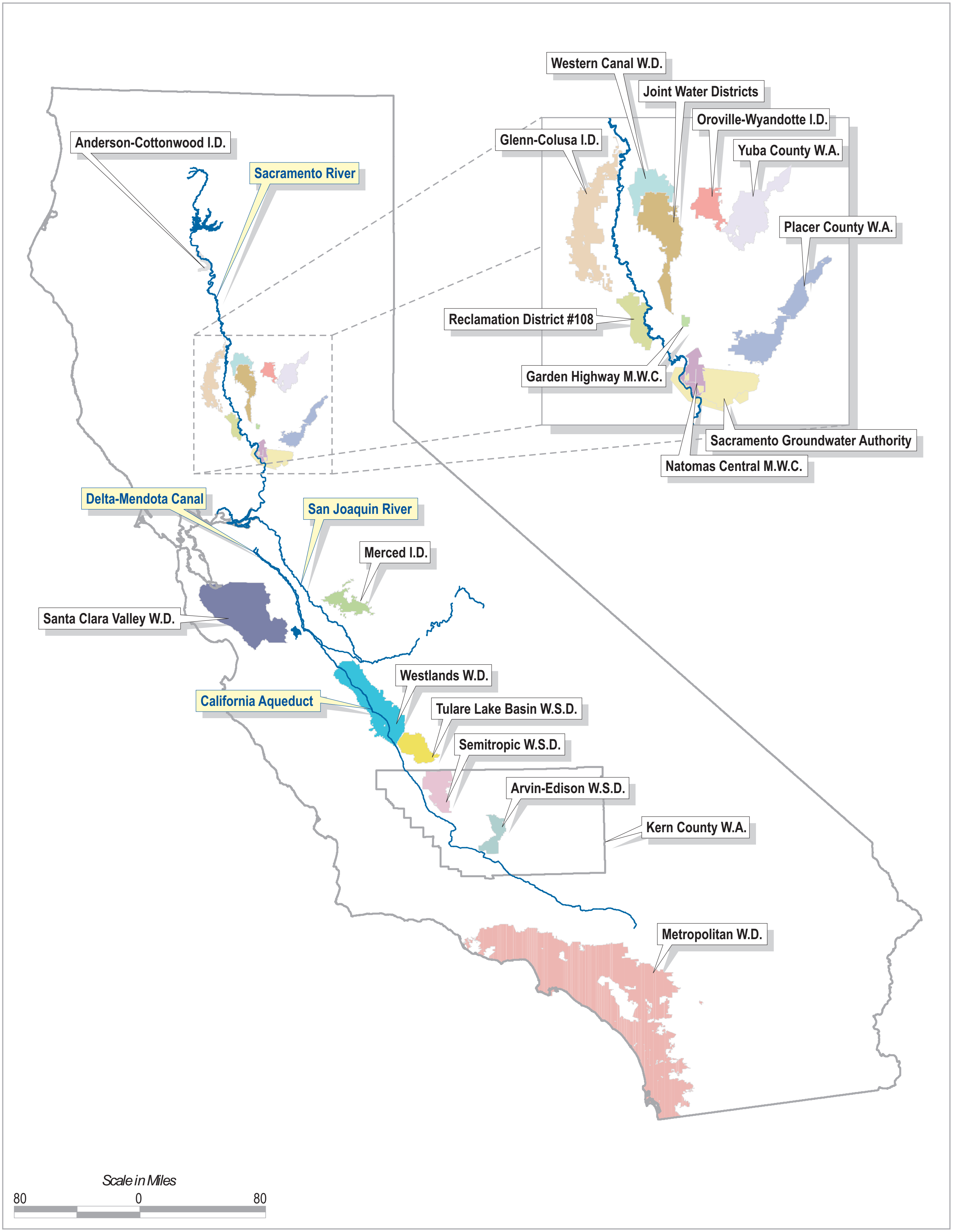

Figure 2-5
Potential Asset Acquisition and Management Participants

Both the CVP and SWP both have pumping plants in the southern portion of Delta - the Tracy Pumping Plant and the Harvey O. Banks Delta Pumping Plant, respectively. The Project Agencies use these pumping plants to pump water to users in the Export Service Area. Cross-Delta transfer capacity would be generally available to the EWA when the Delta is in balanced conditions, the SWP pumps are operating below their maximum permitted capacity to deliver water to contractors, and there is no reduction for fish purposes. Typically, the CVP pumps are operating at full capacity for most of the year (except in dry years), so the EWA would primarily use the SWP pumps.

Delta pump availability varies by year type. The pumps are active during the wet season when the winter rains and spring snowmelt provide high flows into the Delta. New Bay-Delta standards,[15] however, impose pumping restrictions during some of the high-flow periods. During wet years, high flows and the opportunity to divert those flows occur later in the spring than during dry years. In dry years, more unused capacity at the Delta pumps would be available, and more transfer water can be moved through the Delta. Typically, EWA water is moved through the Delta from July through September, although the Project operators could start moving EWA water in mid-June if fish were not in the area of the export pumps.

The asset acquisition types have associated date ranges (discussed in each section below) during which water may be transferred, depending on local conditions and Delta conveyance availability. The ranges listed cover the entire length of time when transfers may occur, but the transfers would not usually continue for the entire period. For example, if a reservoir takes approximately 1 month to release water, the range may include 3 months because water could be released at any time during that timeframe.

Shifting pumping to times that are less sensitive to fish would increase pumping during times when fish are absent, which sometimes requires increased Delta outflow to comply with water quality regulations in the Delta. Carriage water is defined as the additional water needed for Delta outflow to compensate for the additional exports made on behalf of a transfer to assure compliance with water quality requirements of the SWP and CVP. Generally, more water must be released during a transfer than could reach the pumps, as some of the transferred water would flow to the ocean as Delta outflow. The Project Agencies computed the carriage requirements at 15 percent of the transfer volume for the 2001 summer transfer season and 20 percent for the 2002 summer transfer season (Pettit-Polhemus 2003b). EWA transfers from the Upstream from the Delta region would incorporate enough carriage water to maintain water quality within the Delta at without-EWA constituent levels. The EWA's process for incorporating carriage water is described in more detail in Chapter 5.

Transfers along the San Joaquin River are charged a 10 percent conveyance loss to include seepage and evaporation losses. The EWA agencies must factor Delta carriage

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[15] These standards include requirements from several biological opinions and the 1995 Delta WQCP, as defined in Section 2.3.1.1.

and conveyance losses into the determination of the total amount of water that must be acquired to fully compensate for EWA actions to benefit fish and the environment.

2.4.3.1.1 Stored Reservoir Water

The EWA Project Agencies could acquire water by purchasing surface water stored in reservoirs owned by non-Project entities (those that are not part of the CVP or SWP). To ensure that purchasing this water would not affect downstream users, EWA agencies would limit assets to water that would not have otherwise been released downstream. In most cases, the stored reservoir water sellers could demonstrate that they would have maintained water in storage without the transfer.

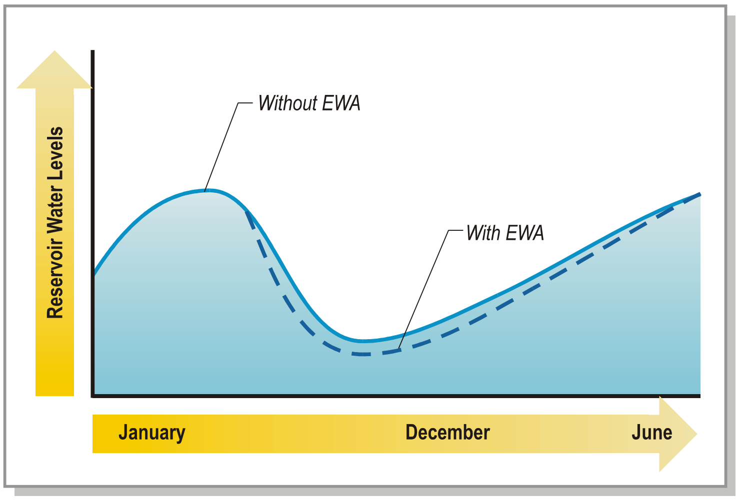

Figure 2-6
Reservoir Level Changes Due to Stored Reservoir Water Purchases

When the EWA purchases stored reservoir water, these reservoirs would be drawn down to lower levels than without the EWA, as shown in Figure 2-6. To refill the reservoir, a seller must prevent some flow from going downstream. Sellers must refill the storage at a time when downstream users would not have otherwise captured the water, either in downstream project reservoirs or with project pumps in the Delta.[16] In these cases, instream flow caused by refill would decrease during the wet season, but would not decrease below minimum flow requirements. Stored reservoir water is released in addition to reservoir water that would be released without the EWA, thereby increasing flows in downstream waterways.

The EWA Project Agencies may purchase stored reservoir water from Oroville-Wyandotte Irrigation District (Sly Creek and Little Grass Valley Reservoirs), Yuba County Water Agency (New Bullards Bar Reservoir), and Placer County Water Agency (French Meadows and Hell Hole Reservoirs). The sections below describe operations associated with each of these potential acquisitions.

<u>Feather River</u>

Oroville-Wyandotte Irrigation District has multiple reservoirs as part of its South Fork Project and would sell water to the EWA out of Little Grass Valley and Sly Creek Reservoirs (see Figure 2-7). Water from Little Grass Valley Reservoir would flow through the South Fork Diversion tunnel into Sly Creek Reservoir. Sly Creek Reservoir receives water from upstream tributaries, Little Grass Valley and Slate

16 Section 4.2.8 of the Draft EIS/EIR describes the refill criteria established for non-project reservoirs to prevent EWA purchases from affecting downstream users.

Creek (a tributary to the Yuba River). The water from Sly Creek Reservoir would pass into Lost Creek Reservoir, where it would enter a series of tunnels to generate power between Lost Creek and Ponderosa Reservoirs. The water released from these reservoirs would not typically enter the South Fork of the Feather River or Lost Creek as it flows downstream to Lake Oroville.

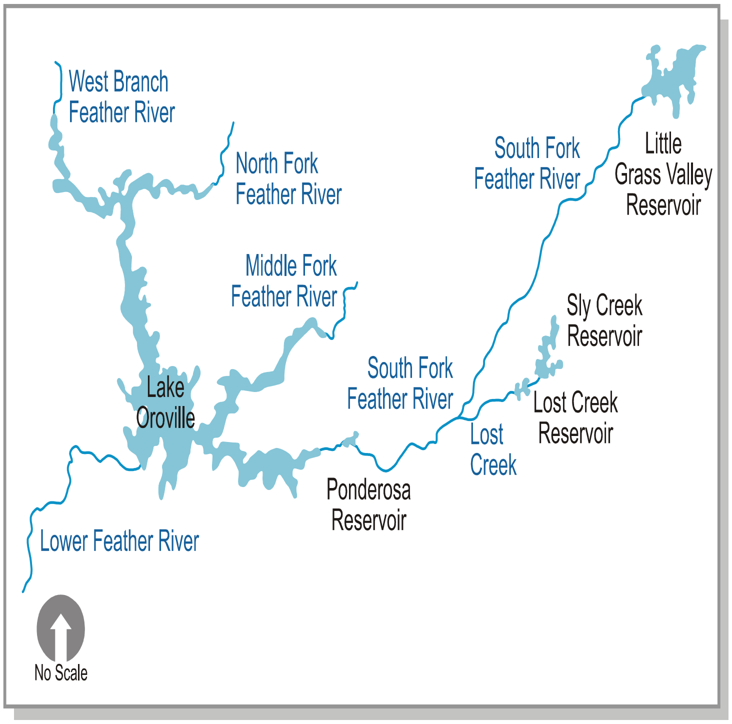

Figure 2-7
Feather River Water Facilities

Oroville-Wyandotte's water is available from October to December, prior to the typical EWA transfer season and the time when the assets would be used, so it would be stored in Lake Oroville through the winter and into the following summer when the Delta pumps have available capacity.

As a result of an acquisition from Oroville-Wyandotte Irrigation District, water levels in Sly Creek and Little Grass Valley Reservoirs would be lower than under non-EWA conditions from November until the reservoirs refill. Lake Oroville would store the releases until the following summer, increasing Oroville water elevations relative to non-EWA conditions from October until September. The acquisition water would be released from Lake Oroville in mid-June through September, increasing downstream flows over the conditions without the EWA.

Sly Creek and Little Grass Valley Reservoirs would refill, as excess water is available, decreasing releases from these reservoirs. Of the releases from these reservoirs that exceed the required downstream flows, most are diverted into the power generation facilities; therefore, refilling the reservoirs should not change riverflows. Sly Creek, however, receives some water from Slate Creek, a tributary of the Yuba River, and refill may also affect the Yuba River.

This pattern of releases results in EWA water stored in Lake Oroville through the wet season, but as the EWA has the lowest priority for storage, EWA assets would be the first to spill if the reservoir storage reaches flood control levels. This option carries a risk that the assets may not be available in the spring. As part of the purchase contract, the EWA agencies would include a “spill protection term” to ensure that if the water spills from Oroville, the EWA would not have to pay for it.

Yuba River

Yuba County Water Agency (YCWA) would sell water to the EWA from New Bullards Bar Reservoir, on the North Fork of the Yuba River. These acquisitions would be stored in New Bullards Bar Reservoir until the Delta pumps have available capacity to transfer the water south. Once released from New Bullards Bar Reservoir, the water would travel through a series of tunnels to generate power, and enter the upstream end of Englebright Lake (Figure 2-8).

Withdrawing water from the reservoir would lower the surface water elevations relative to the non-EWA conditions from mid-June until the reservoir is refilled. If assets were released in mid-June through September, flows would increase in the Yuba River downstream from Englebright Lake. New Bullards Bar Reservoir would refill as water is available in the Yuba River, which would decrease flows downstream from the reservoir.

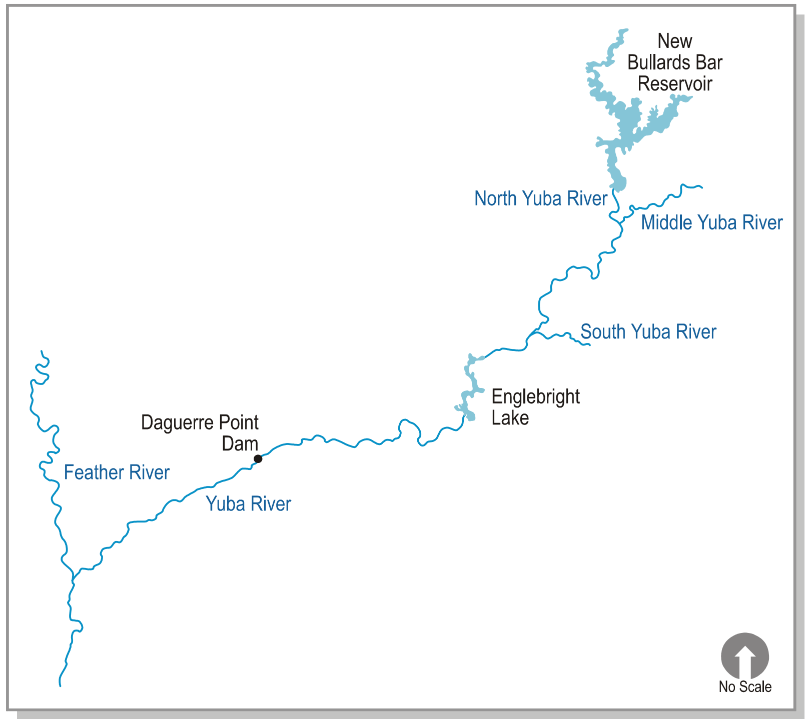

Figure 2-8
Yuba River Water Facilities

American River

Placer County Water Agency would sell water to the EWA Project Agencies from Hell Hole and French Meadows Reservoirs, on the Middle Fork of the American River (see Figure 2-9). It would take the agency 2-3 months to move the water downstream to Folsom Lake, where the water could be held until the EWA agencies are ready to release it. The water could be released from Hell Hole and French Meadows as early as June and until as late as October. Hell Hole and French Meadows would have lower surface water elevations than they would without the EWA from June until the reservoirs refill. Refilling the reservoirs would decrease flows downstream from the Ralston Afterbay.

Water from both French Meadows and Hell Hole Reservoirs would enter a series of tunnels through power generation facilities, and these tunnels would release the water at Ralston Afterbay. While water is being released, the Middle Fork of the American would convey increased flows from Ralston Afterbay downstream to Folsom Lake. These releases could occur from June through October. Folsom Lake would hold the water until the EWA agencies are ready for it to be released. Folsom

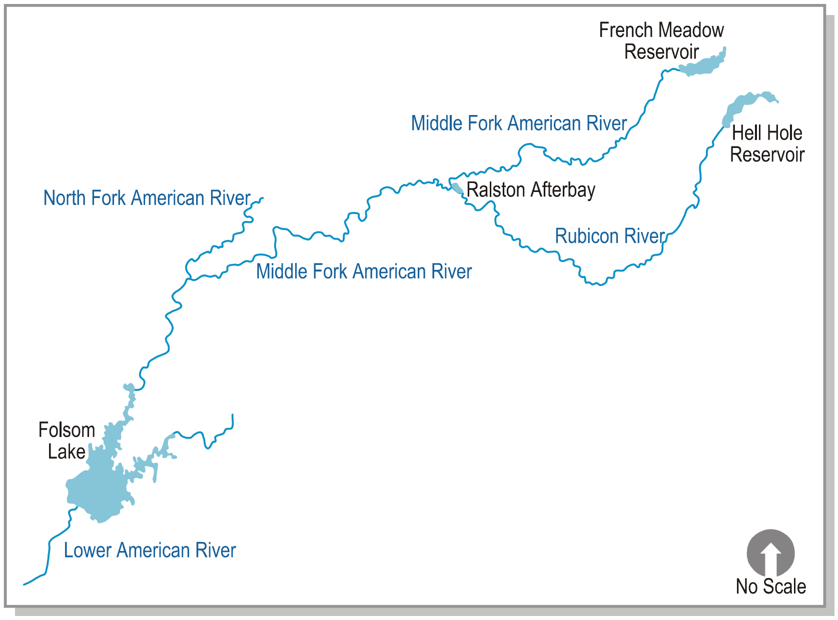

Figure 2-9
American River Water Facilities

Lake elevations would be higher with the EWA water than would be the case without the water. As the EWA assets were released, the lake level would be restored to the non-EWA levels.

On the American River, the EWA agencies may use assets to accomplish instream objectives and may move assets to users downstream from the Delta to make up for pumping reductions. If used for additional instream flows, the water may be released at a time when it could not be pumped through the Delta. During the summer (mid-May to mid-October), water may be released for steelhead temperature requirements. Additional instream flows are needed in October to December for Chinook salmon and steelhead spawning. The EWA agencies would release the water from Folsom to meet these multiple objectives, resulting in release periods from June through December.

2.4.3.1.2 Groundwater Substitution

Groundwater substitution transfers occur when users forego their surface water supplies and pump an equivalent amount of groundwater as an alternative supply. Because the EWA's potential groundwater substitution transfers are from agricultural users, the water from this acquisition method would be available during the irrigation season of April through October. Typically, surface water made available through groundwater substitution is stored upstream until the Delta pumps have the capacity available for EWA assets (except on the Sacramento River, as described later).

Groundwater substitution transfers would withdraw additional water from the groundwater basin below the participating users, so this option could only be used in basins that are not in a state of groundwater overdraft, or in areas where the water supplier determines that the water transfer would not contribute to the groundwater overdraft.[17]

The Delta pumps would be unlikely to have available capacity for the EWA at the start of the irrigation season. EWA water that would have been released for irrigation would instead be held in reservoirs until later in the season, which would cause reservoir levels to be slightly higher than without the EWA while the water is held back (except on the Sacramento River, as described later). The reservoir levels would not reverse their typical summer declines because the EWA program would not add new water to the reservoir; rather, the levels would decrease more slowly (see Figure 2-10). EWA water acquired through groundwater substitution would be released later in the irrigation season, typically mid-June through September, at times when through-Delta conveyance capacity is available. The change in reservoir elevations as the water is released would depend on the Delta conveyance capacity. If the conveyance capacity were available constantly throughout the period of mid-June through September, then the reservoir elevations would slowly return to the without-EWA levels (see Scenario 1 on Figure 2-10). If more conveyance capacity were available in July than later in the summer, then the EWA could borrow water from the storage facility and release additional water at those times that the conveyance capacity is available (see Scenario 2 on Figure 2-10).

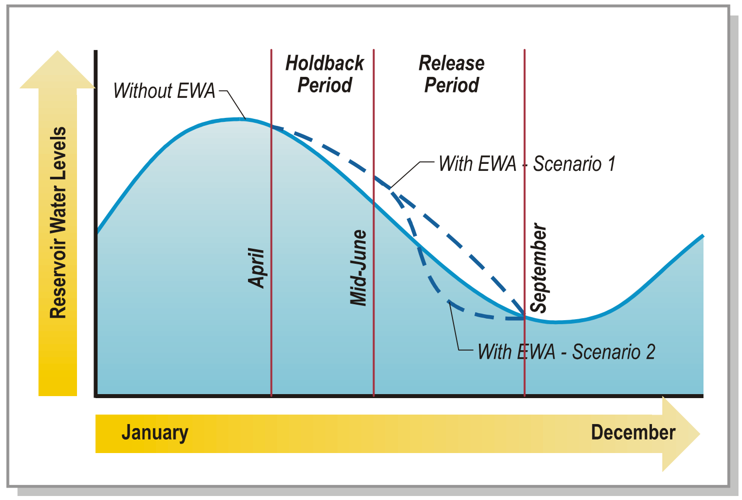

Figure 2-10
Reservoir Level Changes Due to Groundwater Substitution Transfers

The EWA Project Agencies may engage in groundwater substitution transfers with Glenn-Colusa Irrigation District, Reclamation District 108, Natomas Central Mutual Water Company, Anderson Cottonwood Irrigation District, Western Canal Water District, Joint Water District, Garden Highway Mutual Water Company, Yuba County Water Agency, and Merced Irrigation District. The sections below describe operations associated with each of these potential acquisitions.

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17 According to California Water Code 1745.10: A water user that transfers surface water pursuant to this article may not replace that water with groundwater unless the groundwater use is either of the following:

(a) Consistent with a groundwater management plan adopted pursuant to state law for the affected area.

(b) Approved by the water supplier from whose service area the water is to be transferred and that water supplier, if a groundwater management plan has not been adopted, determines that the transfer would not create, or contribute to, conditions of long-term overdraft in the affected groundwater basin.

Sacramento River

Sacramento River agencies (Glenn-Colusa Irrigation District, Reclamation District 108, and Natomas Central Mutual Water Company) receive CVP water that is stored upstream from their service areas in Lake Shasta, a CVP facility. While theoretically possible, the EWA agencies would probably not be able to reduce releases from Lake Shasta to sore water until Delta pumps become available because all of the flow released from Lake Shasta is needed to meet downstream temperature requirements or the flow requirement at Wilkins Slough.[18] There is a possibility that EWA water could be held back in Lake Shasta during certain years (usually dry or critical years) when releases are not needed to meet downstream requirements. In most years, however, the EWA agencies would ask that water agencies agreeing to groundwater substitution transfers only transfer water when the Delta pumps have available capacity (where irrigators would continue to use their surface water supply until around June, then switch to groundwater). Less water would be available with this strategy than with others, but the water has a higher likelihood of being usable for EWA actions. It would be possible for each scenario to occur in different year types.

If water were held back in Lake Shasta, the water surface elevations during the hold-back period (April through June) would be slightly higher than they would be without the EWA. As the water is released, the reservoir levels may be higher or lower than the without-EWA levels and would slowly return to the without-EWA levels by the end of September. The river, between Shasta and the water agencies' usual diversion point, would convey less water than it would without the EWA during the hold-back period (April through June) because the EWA water would be held in Shasta. Flows would not decrease below those needed for flow or temperature requirements. The river would then carry more water than during non-EWA conditions in mid-June through September, when the Delta pumps have availability for EWA water.

If users shift from surface water to groundwater after the Delta pumps are available, the riverflows would not decrease because no water would be held back in Shasta. Riverflows would increase from the water agencies' usual diversion point downstream to the Delta pumps. The effect analysis focuses on the option of holding water back because the analysis includes the potential adverse effect of decreasing riverflows as well as increasing riverflows when the Delta pumps have available capacity.

Feather River

The Feather River districts, including Western Canal Water District and the Joint Water District Board, receive SWP water stored in Lake Oroville (an SWP facility). Water levels in Lake Oroville would be higher than without the EWA from April through June, while water would be held back because of Delta pump unavailability. The water levels in Lake Oroville may be lower or higher than without the EWA from July to September, depending on when cross-Delta conveyance is available. These districts do not divert from the river, but rather divert water that is released from Lake Oroville directly into the Thermalito Afterbay (see Figure 2-11). This water does

[18] These requirements are described in detail in the Modeling Description, Appendix B.

not flow through the river without the EWA, so an EWA acquisition would not change riverflows if assets were held in Lake Oroville early in the season. The assets would be conveyed through the river later in the season (from mid-June through September), when the Delta pumps are available, increasing flows over the conditions without the EWA.

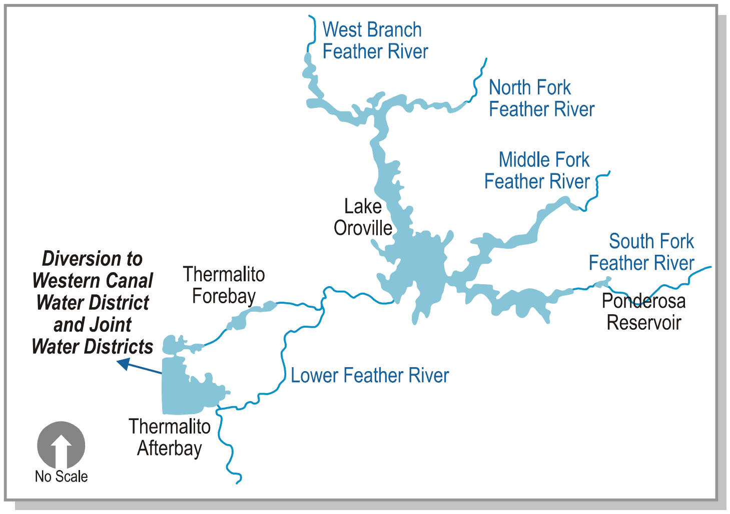

Figure 2-11
Diversion Locations for Feather River Sellers

Yuba River
Yuba County Water Agency, on the Yuba River, owns New Bullards Bar Reservoir and would store groundwater substitution assets there until release. Water elevations in New Bullards Bar Reservoir would be slightly higher than without the EWA from April through June as a result. During the release period, the EWA agencies would try to maintain relatively constant flows on the Yuba River because of fish concerns; therefore, the water levels in New Bullards Bar Reservoir would stay higher than the levels without the EWA from July to September. Many of the Yuba County Water Agency's customers divert at Daguerre Point Dam, which is downstream of New Bullards Bar Reservoir. Flows between New Bullards Bar Dam and Daguerre Point Dam would decrease relative to the conditions without the EWA early in the season (April through mid-June). Flows downstream from New Bullards Bar Dam would increase relative to the conditions without the EWA later in the season, when the Delta pumps have availability (mid-June through September).

Merced River
The Merced Irrigation District is on the Merced River and would store EWA water in its reservoir, Lake McClure, until release (see Figure 2-12). Water elevations in Lake McClure would be slightly higher from April through November than they would be without the EWA. The EWA agencies would convey a Merced Irrigation District groundwater substitution transfer through the Merced and San Joaquin Rivers. EWA agencies have worked together to schedule these transfers for periods when the temperature would be acceptable for fish migration. Assets would be transferred via

the rivers in October and November, increasing flows during those times and providing an attraction flow for spawning salmon.

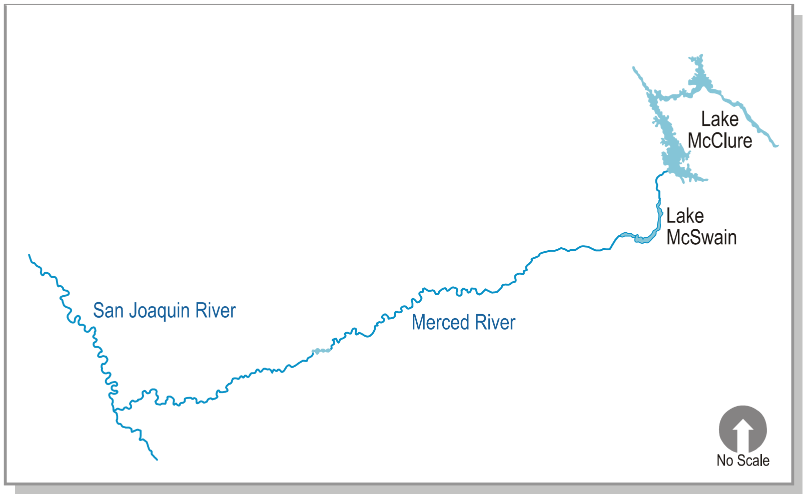

Figure 2-12
Merced River Water Facilities

2.4.3.1.3 Crop Idling or Crop Substitution

Crop idling transfers come from water that would otherwise have been used for agricultural production. For crop idling acquisitions, the EWA agencies would pay farmers to idle land that they would otherwise have placed in production. Crop idling acquisition assets would be retained in reservoirs upstream from the selling water agencies until they could be transferred through the Delta and pumped south. Payment by the EWA agencies for water transferred would be computed based on pre-agreed consumptive use values, which may be refined as the science for generating these values improves. The EWA agencies are considering purchasing water from idled rice crops only in the Upstream of Delta Region for several reasons:

- Rice provides the largest amount of water per acre idled (approximately 3.3 acre-feet per acre);
- Rice crops are less labor-intensive than other potential crops, requiring approximately 2.7 full-time labor equivalents per 1000 acres;
- Rice farmers have expressed interest and have participated in idling programs in the past; and
- Like other small grain crops, rice is not a permanent crop and brings in less revenue than permanent, horticultural crops (e.g., fruits and nuts), so farmers would likely be more willing to fallow.

The potential also exists for the EWA agencies to purchase water through crop substitution, in which water users substitute a crop with lower water needs than the crop that they would have otherwise planted. The associated decrease in water use could be transferred to the EWA. Crop substitution would have similar but lesser effects than crop idling, so it is considered to be a part of the crop idling discussion for the remainder of the document.

To minimize socioeconomic effects on local areas, the EWA agencies would not purchase water via crop idling if more than 20 percent of recent harvested rice acreage in the county would be idled through EWA or other program water acquisitions. The EWA agencies chose this figure because of historical precedents and Water Code Section 1745.05 (b).

The EWA Project Agencies may purchase water through crop idling transfers from Glenn-Colusa Irrigation District, Reclamation District 108, Western Canal Water District, and the Joint Water District. The mechanisms for transferring water from crop idling would be very similar to those described above for groundwater substitution. The transferred water would be held in reservoirs during months when it could not be pumped through the Delta export pumps, then released during the months when the Delta pumps have availability.

Sacramento River

The EWA Project Agencies could purchase water through crop idling from Glenn-Colusa Irrigation District and Reclamation District 108 on the Sacramento River. As described above for groundwater substitution transfers, releases from Lake Shasta would probably need to be maintained during April and May to meet downstream temperature and flow requirements. Therefore, water acquired from sellers on the Sacramento River could not be backed up into Lake Shasta and cannot be transferred until the Delta pumps are available to the EWA. Unlike groundwater substitution, farmers could not postpone crop idling until June. Crop idling water would be available at the beginning of the season as soon as the crop is not planted. The EWA agencies would likely receive less water from crop idling transfers along the Sacramento River than from crop idling transfers along other rivers because the water made available along the Sacramento River in April, May, and possibly June might be pumpable in the Delta. The modeling efforts indicate that the EWA agencies could not capture and use approximately 30-50 percent of the water, except in extremely dry years when added flows in April and May would provide system-wide benefits that the EWA agencies could use.

Feather River

Crop idling transfers from Western Canal Water District and the Joint Water District on the Feather River would function in the same way as transfers from groundwater substitution. Water elevations in Lake Oroville would be higher than they would be without the EWA during the April through June holdback period. From July to September, the levels would be higher or lower than they would be without the EWA, depending on the through-Delta conveyance capacity. The participating districts do not divert water directly from the Feather River, but instead divert water that is released from Lake Oroville directly into the Thermalito Afterbay. This water does not flow through the river without the EWA, so an EWA acquisition would not change riverflows if assets were held in Lake Oroville early in the season. Riverflows would increase when the Delta pumps have availability, typically during July through September.

2.4.3.1.4 *Stored Groundwater Purchase*

The EWA Project Agencies could obtain water by purchasing groundwater assets that were previously stored by the selling agency with the intent to sell a portion of those assets at a later date. This option differs from groundwater substitution in that groundwater substitution transfers would not come from water that had been previously stored. In the Upstream of Delta Region, the EWA Project Agencies may purchase previously stored groundwater from the Sacramento Groundwater Authority.

American River

The EWA Project Agencies would purchase water from the Sacramento Groundwater Authority, which would deliver water through an exchange at Folsom Lake. Agencies in the authority would exchange some of their allotment in Folsom Lake with the EWA and pump previously stored groundwater[19] within their agencies to make up for the decrease in surface water supply. Any member of the Sacramento Groundwater Authority may participate; potential participants include San Juan Water District, the City of Sacramento, Fair Oaks Water District, and Citrus Heights Water District.

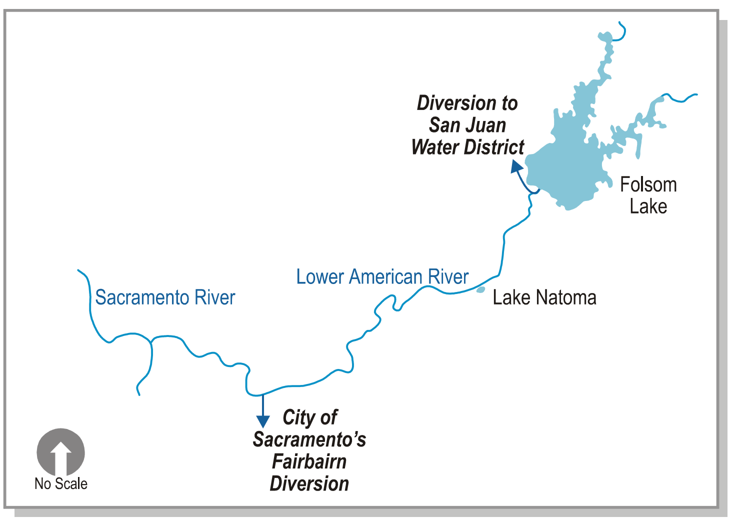

Figure 2-13
Diversion Locations for SGA Participants

San Juan Water District withdraws and treats water for itself and Fair Oaks Water District, Citrus Heights Water District, and some other SGA members directly from Folsom Lake; this water does not enter the lower American River (see Figure 2-13). SGA agencies would begin pumping groundwater and transferring surface water to the EWA once Reclamation is certain that Folsom Lake would not spill water, usually May at the earliest. The transfer could continue until mid-October, when the CVP would need to start preparing for flood control requirements and minimum flow requirements on the river. The EWA agencies would move the assets downstream through the Lower American River from June through December, depending on Delta pump availability and instream needs on the American River, as described above for stored reservoir purchase. This transfer would cause a slight increase over non-EWA conditions in Folsom Lake surface water elevations starting in May (before the Delta pumps are

[19] If the EWA agencies enter into a contract with Sacramento Groundwater Authority, the EWA agencies would verify that the water was previously stored to prevent effects to local groundwater.

available). Reservoir surface levels would return slowly to the non-EWA conditions as the water is released completely by December. Flows in the lower American River would be increased over non-EWA conditions from June through December during the transfer.

The City of Sacramento would reduce its diversions at its Fairbairn diversion point, shown on Figure 2-13. The City would not start pumping groundwater and transferring its surface water until Delta pumping capacity became available, typically starting in June. Releases from Folsom Lake would maintain the same pattern as before the transfer, but Sacramento's water would flow to the Delta instead of being diverted. This type of transfer would cause no change in Folsom Lake, but flows in the American River below Fairbairn would increase June through September.

2.4.3.2 Delta Area

The EWA Operating Principles specify methods for gaining assets in addition to those described above. These additional methods do not involve active acquisition; assets obtained by these other methods are termed "variable assets." The EWA agencies could obtain variable assets (water or pumping capacity) through changes in Delta operations.

The CALFED ROD lists the quantities of each of these assets that are expected to be available. These quantities were determined by gaming exercises that simulated project operations. During the past 2 years of EWA operation, the Project Agencies have found that some of these assets are not available on the same pattern as indicated by the CALFED ROD modeling efforts (shown in Table 2-6). The first variable asset involves acquiring (b)(2) water that has been released to meet instream flow objectives, but is diverted by the SWP because of limitations of the CVP's pumping capacity. Such flows may occur less often than the CALFED ROD predicted and less than in past years because of changes in (b)(2) water accounting imposed as a result of legal decisions (see Chapter 1 for a more detailed explanation).

Table 2-6
Acquired Variable Assets

Variable Asset Type	CALFED ROD Estimate of Quantity	Acquired EWA Water from 10/2000 - 9/2001[20]	Acquired EWA Water from 10/2001 – 9/2002
EWA share of (b)(2)/ERP Upstream Releases	40,000 acre-feet	46,079 acre-feet	3,308 acre-feet
Export Inflow Ratio Relaxation	30,000 acre-feet	1,829 acre-feet	79,306 acre-feet

Source: Pettit 2003

2.4.3.2.1 Sharing of (b)(2) and ERP Water

The SWP and the EWA would share, on a 50-50 basis, water pumped by the SWP that meets the following requirements:

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20 These numbers do not reflect conveyance losses from the pumping facilities to San Luis Reservoir. The CALFED modeling that produced the ROD estimates did not account for these losses; therefore, they are not included in the EWA numbers to provide accurate comparisons.

- Water released from storage or made available for upstream purposes under either (b)(2) or the ERP, arrives in the Delta with no further (b)(2) or ERP purposes to serve, and exceeds the export capacity of the CVP Tracy pumping plant;
- Water that the SWP and/or EWA have demand for south of the Delta; and
- Water the SWP has capacity to pump.

This type of variable asset would result in additional water for the EWA.

2.4.3.2.2 Joint Point of Diversion

The SWP can use excess capacity at its Harvey O. Banks Pumping Plant to pump water for both the CVP and the EWA, to be shared on a 50-50 basis, if the Projects meet the conditions in D-1641 (described in Section 2.3.1). The CVP water could be from either storage or the CVP's Delta water rights (to divert excess water). The EWA water could be from either non-Project water acquired Upstream from the Delta or stored or unstored water pumped under CVP or SWP water rights. If either the CVP or EWA were demand-limited,[21] the other's use of the Joint Point of Diversion would not count against its 50 percent share.

As stated in the EWA Operating Principles Agreement, use of excess capacity at Banks for the EWA and CVP would take precedence over all other non-Project pumping, except water wheeling in response to facility outages and wheeling to supply CVP contractors for whom the SWP has traditionally wheeled water. Pump usage for the EWA Operating Principles Agreement would be on an equal priority with Level 4 refuge supplies.[22]

The Project Agencies could use the Joint Point of Diversion to move EWA assets through the Delta, but the EWA agencies would still need to provide the assets to move. The Projects also have water rights to divert excess flows in the Delta, and the EWA Operating Principles Agreement allows the EWA to use these rights if excess pumping capacity and flows are available.

2.4.3.2.3 Relaxation of the Section 10 Constraint

The USACE granted permission to the SWP to relax the Section 10 constraint (of the Rivers and Harbors Act) and increase the base diversion rate by the equivalent of 500 cfs to an average of 7,180 cfs for the months of July through September, through 2002. If similar permission were obtained, this 500 cfs would be dedicated to pumping for the EWA, but the EWA agencies would still need to provide the assets to be pumped. During wet years, this conveyance capacity would likely be the only capacity

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21 A project is demand-limited if there are no contractors that want any more water than they are receiving currently and if available storage facilities and/or conveyance facilities are full.

22 The Central Valley Habitat Joint Venture defined four levels of refuge water supplies: existing firm water supply (Level 1), current average annual water deliveries (Level 2), full use of existing development (Level 3), and full habitat development, by permit (Level 4). CVPIA Section 3406(d) directed the Secretary of the Interior to provide firm water through long-term contractual agreements for Level 2 refuges.

available to the EWA. The conveyance capacity would yield approximately 50,000 to 60,000 acre-feet per year, depending on operational restrictions.

2.4.3.2.4 Relaxation of the Export/Inflow Ratio

Under the SWRCB's D-1641 and Orders 2000-10 and 2001-5, Project exports are limited at certain times of the year to a percentage of Delta inflow, usually 35 or 65 percent. This limitation is called the Export/Inflow, or E/I, ratio. Both D-1641 and the 1995 Water Quality Control Plan, consistent with the 1994 Principles for Agreement (Bay-Delta Accord), allow for these ratios to be relaxed when certain requirements are met. The EWA agencies would allow relaxation of the E/I ratio as appropriate to create EWA assets in the export service areas. By relaxing the E/I ratio, it was estimated that the EWA could export an annual average of 30,000 acre-feet, but amounts are expected to vary annually.

2.4.3.3 Export Service Area

The export service areas include the areas served by the CVP and SWP Delta pumping facilities, encompassing agricultural and urban development in the Central Valley and central and southern coasts**.**

The EWA Project Agencies could acquire assets from sources within the export service areas. The EWA agencies would not need to arrange to move these assets through the Delta. This advantage is especially important during wet years, when Delta pumping capacity for the EWA is limited because the export pumps are fully utilized to move Project water. Assets purchased in the export service areas, however, are often more expensive than other assets because potential sources in the export service areas are more limited; water agencies usually are paying for facilities needed to capture and convey the limited supplies.

2.4.3.3.1 Water Acquisition Types

The EWA Project Agencies have two potential methods for acquiring water in the export service areas, crop idling and stored groundwater purchase, as described below.

<u>Crop Idling or Crop Substitution</u>

Crop idling transfers in the export service areas also involve agricultural water users leaving their fields idle and selling their surface water allotment to the EWA. Sellers in this area normally receive water CVP and SWP that is stored in San Luis Reservoir or pumped directly out of the Delta. The EWA agencies are considering purchasing water from idled cotton fields for several reasons:

- Cotton farmers have shown a willingness to sell water to the EWA;
- Cotton is less labor-intensive than other potential crops, requiring approximately 6.6 full-time labor equivalents per 1,000 acres;
- Unlike cotton, most other crops in the region are permanent crops; and

- Most other farmers in the region raise crops that produce more profit than cotton per acre and therefore would be less willing to sell to the EWA than cotton farmers because the profit from selling water would not be attractive enough to idle land.

To minimize socioeconomic effects on local areas, the EWA agencies would not purchase water via crop idling if more than 20 percent of recent harvested cotton acreage in the county would be idled through EWA or other program water acquisitions. The EWA agencies chose this figure because of historical precedents and Water Code Section 1745.05 (b).

Policy and regulatory barriers restrict crop idling in certain areas, including those areas that receive water from the SWP. The Monterey Amendment to the SWP long-term water supply contracts allow interested SWP contractors to sell some of their allocated Table A[23] amounts to a "turn-back pool" for purchase by other interested SWP contractors or DWR (or by non-contractors if DWR does not want the water). The SWP contracts do not allow contractors to sell water for use outside their service area except through the turn-back pool.

The EWA Project Agencies may purchase water through crop idling transfers from Kern County Water Agency, if these regulatory and policy barriers are removed. The EWA agencies also could purchase water through crop idling transfers from Westlands Water District and Tulare Lake Basin Water Storage District. Any of these areas could also participate in crop substitution transfers, as described in Section 2.4.2.1.3, which are included as part of crop idling transfers because they would produce similar but lesser effects.

In the export service areas, the EWA agencies would receive crop idling water at O'Neill Forebay (adjacent to San Luis Reservoir) on the same schedule that would have otherwise been employed for water user deliveries. Operations in conjunction with San Luis Reservoir would be discussed in greater detail in the Borrowed Project Water portion of Section 2.4.3.3.2, Asset Management.

<u>Stored Groundwater Purchase</u>
Stored Groundwater Purchases in the export service areas would function in the same way as the upstream stored groundwater purchases (Section 2.4.3.1.4), in which entities would sell water to the EWA that they had previously stored in the ground. The EWA agencies could receive this water through two mechanisms:

- The selling agency could exchange its surface water allocation with the EWA and pump stored groundwater to satisfy local needs; or

23 Table A is a tool for apportioning available supply and cost obligations under the SWP contract. When the SWP was being planned, the amount of water projected to be available for delivery to the contractors was 4.2 million acre-feet (maf) per year. Table A lists by year and acre-feet the portion of the 4.2 maf deliverable to each contractor. The Table A amounts are not an indication of the SWP water delivery reliability, nor should these amounts be used to support an expectation that a certain amount of water would be delivered to a contractor in any particular time span.

- The selling agency could pump water out of its aquifer directly into a conveyance system for transfer to the EWA.

Stored groundwater is available to the EWA year-round, although the delivery would generally be during the irrigation season, usually April through September, if the water were delivered through surface water exchange.

The EWA Project Agencies may purchase stored groundwater from projects within Kern County. Several agencies have stored excess surface water in projects in the Kern County groundwater aquifer. Several projects in Kern County have stored groundwater that could be sold to the EWA:

- **Kern Water Bank:** water stored by a Joint Powers Authority consisting of local water agencies.

- **Pioneer Banking Project:** a coalition of local agencies recharges and recovers water. Kern County Water Agency could sell part of its 25 percent share of stored water to the EWA.

- **Berrenda Mesa Project:** Berrenda Mesa Water District owns this project in partnership with several other local agencies and could sell water if it chose to participate.

In addition, Semitropic Water Storage District and Arvin-Edison Water Storage District operate water storage facilities. These districts do not store their own water, but instead engage in agreements with outside parties. These external groups provide surface water for storage underground and pay a fee to the districts to store the water. The EWA Project Agencies could purchase water from the parties that store water in Semitropic or Arvin-Edison. Santa Clara Valley Water District has water in storage in Semitropic that it could sell to the EWA, and Metropolitan Water District of Southern California has water in Semitropic and Arvin-Edison.

Although water stored underground in the Export Service Area may be SWP water, CVP floodflows, or Kern River floodflows, the Kern groundwater storage projects have stored primarily SWP water, having anticipated that local water users would use it. As discussed earlier, the Monterey Agreements specify that unused SWP water should go to the turnback pool for other SWP contractors. The SWP water that was stored within Kern County did not first go to the turnback pool, creating regulatory concerns with selling that water to a non-SWP contractor. To help the EWA during its startup phase, Kern County Water Agency has sold water stored in 1995 through 1999, when SWP contractors received 100 percent allocations. DWR and other SWP contractors agreed to this stipulation before Kern County Water Agency sold the water to the EWA, but agreed that it would only apply to water sold to the EWA.

With current SWP policies, Kern projects would not be able to sell SWP water that was stored during the other years. Without additional water to recharge, it is likely that Kern County Water Agency would have less water available to sell to the EWA in upcoming years. This issue is discussed in greater depth in EWA EIS/EIR Chapter 6, Groundwater Resources, which includes a discussion of the amount of stored water from each of the different sources.

If the EWA agencies acquire stored groundwater through a transfer of the selling agency's surface water allocation, the exchange would be made at O'Neill Forebay. The EWA agencies would acquire water on the same delivery schedule that the selling agency would have had without the transfer. If the selling agencies pump groundwater directly into the California Aqueduct, the seller must work cooperatively with DWR to ensure that the groundwater meets DWR's water quality requirements.

2.4.3.3.2 Asset Management

The EWA requires facilities and operational arrangements in order to make its assets available when needed for accomplishing EWA objectives. The CALFED ROD defined several tools to manage assets, including the ability to borrow project water if needed and store it for use at a time other than when the asset was acquired. Project facilities and agencies assist the EWA by conveying, storing, and loaning water when possible.

Borrowed Project Water

Borrowing Project water is a management arrangement available to the EWA agencies, as long as the borrowed water could be repaid without affecting the current or following year's allocations to project contractors. Borrowing of project water, specifically in San Luis Reservoir, is intended to enhance the effectiveness and use of EWA assets. Borrowing could take place only when the borrowed water would not exacerbate water quality and supply problems associated with the San Luis low point[24] and if the reservoir could still meet reasonable carryover storage objectives.

The EWA agencies would use borrowed project water from the San Luis Reservoir in conjunction with upstream-from-the-Delta transfers. If the Projects are unable to convey water through the Delta because of EWA pumping reductions, the EWA agencies could borrow water from San Luis Reservoir, provide it to Project Contractors during the reduction, then repay the water to the reservoir later by moving EWA assets from upstream reservoirs when the Delta pumps are running. EWA agencies may thus at times carry a debt to the San Luis Reservoir, that would affect water elevations in the reservoir.

[24] The low point is the summertime seasonal lowest level of San Luis Reservoir. As the elevations in San Luis Reservoir approach the low point, the low point problem occurs when the volume of water in San Luis Reservoir drops to approximately 300,000 acre-feet. At 300,000 acre-feet of storage, algal blooms can cause water quality problems for urban water users that receive supplies, especially Santa Clara Valley Water District. Water quality concerns for industrial users start when the reservoir has only 300,000 acre-feet of storage, and the EWA is not allowed to cause the reservoir to reach this storage level sooner than it would without the EWA. If drawdown of the reservoir continues, CVP and SWP deliveries are no longer possible when the reservoir reaches "dead storage" at approximately 80,000 acre-feet.

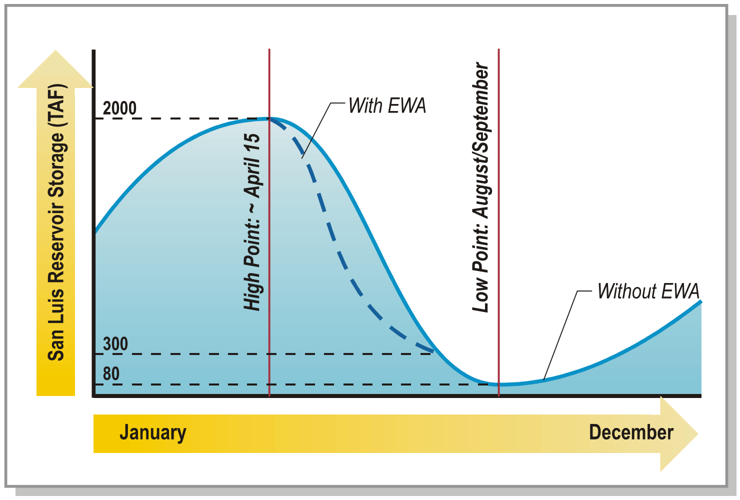

Figure 2-14
Reservoir Level Changes Due to Borrowing Water from San Luis Reservoir

Figure 2-14 illustrates a year in the San Luis Reservoir during which water is borrowed from the Projects. By borrowing water, the EWA agencies would decrease reservoir levels.

In addition to borrowing project water, as described above, the EWA agencies could also borrow project storage if space were available. Some EWA assets are available at times when they cannot immediately be used for fish actions, such as the variable assets described above. The EWA agencies could store these assets in San Luis Reservoir, but they would have the lowest priority for storage (other than water stored for non-Project entities). San Luis Reservoir fills in most years, so it is likely that the water would convert to Project water and no longer be available to the EWA.[25] Additionally, the EWA could borrow Project storage in other facilities, such as Lake Shasta, Lake Oroville, and Folsom Lake. The EWA agencies would typically use this option to store water over the winter, but this water would be the first to spill from the reservoir if the reservoir reached the flood control limits.

<u>Groundwater Storage</u>
The CALFED ROD states that the EWA agencies should purchase 200,000 acre-feet of storage (initially full) south of the Delta to provide initial assets and to store assets that have been acquired in excess of immediate needs. Groundwater storage requires the ability to percolate or inject the excess water into a groundwater basin for later extraction, or have project water that could be transferred to the EWA as a mechanism to return the water to the EWA. Having facilities for groundwater storage of EWA assets would provide the EWA the flexibility to acquire and store water throughout the year, which would allow additional flexibility in asset acquisition.

Groundwater storage is different from the acquisition method of purchasing stored groundwater because the EWA agencies would be providing the assets to be stored (after the initial purchase of the full storage area). If the EWA agencies purchased stored groundwater, it would purchase water that the sellers had previously stored in the ground.

[25] If San Luis Reservoir would have filled without the EWA, then the EWA would not be able to keep water in storage in that reservoir. EWA water would then convert to Project water.

The groundwater storage would likely be operated with 100,000 acre-feet of flexible storage that could be exercised yearly or extracted in any one year and 100,000 acre-feet of water remaining in storage as a backup supply.

Obtaining groundwater storage involves negotiating a lease agreement with an entity that operates a groundwater banking program. The agreement would require payment for use of recharge and extraction facilities, as well as charges for occupying or reserving the storage space. Assets stored in water banks are generally charged for losses upon both recharge and extraction. If the EWA agencies acquire water banking capacity, the assets would probably be charged a small percentage of loss representing basin losses. Upon extraction, similar losses would be applied.

Stored groundwater could be returned to the EWA through two mechanisms:

- The banking entity could extract the water out of the ground and into a waterway or project conveyance facility; or
- The entity could transfer its surface water allotment to the EWA and pump groundwater for local use.

The EWA agencies have not yet acquired this groundwater storage, but have acquired additional assets to account for the lack of storage. The EWA Project Agencies may acquire groundwater storage services from Kern County Water Agency, Semitropic Water Storage District, and Arvin-Edison Water Storage District. The EWA Project Agencies could also negotiate groundwater storage services with Santa Clara Valley Water District or Metropolitan Water District of Southern California, which have water storage capacity in Semitropic and Arvin-Edison Water Storage Districts.

Source Shifting

Source shifting is a tool that was developed in the CALFED ROD to help make the EWA more flexible. With source shifting, the EWA agencies would borrow scheduled water from a project contractor for a fee, returning the water at a later date. The result of this option is to delay delivery of SWP or CVP contract water.

The purpose of implementing source shifting would be to help protect the San Luis Reservoir against reaching storage volumes where the low point problem begins earlier with the EWA than it would have without the EWA. Source shifting would allow the EWA to borrow water from one or more Project contractors and use it to repay debts to the San Luis Reservoir before the low point problem has begun. The objectives of source shifting would be to prevent San Luis from reaching the point at which it could not continue to make Project deliveries (approximately 80,000 acre-feet of storage) or at which water quality creates problems for contractors (approximately 300,000 acre-feet of storage) before it would have without the EWA.

If projections show that the EWA could cause San Luis Reservoir to reach 300,000 acre-feet of storage sooner than it would have without the EWA, then the EWA agencies would implement source shifting agreements. In some years, San Luis Reservoir storage would fall below 300,000 acre-feet without the EWA. In this situation, the EWA agencies would not be responsible for source shifting to bring storage back up to 300,000 acre-feet, but would only need to implement source shifting to bring the storage back up to the without-EWA levels.

To participate in source shifting, contractors must have storage from which to draw while their deliveries are delayed. The EWA agencies could engage in source shifting agreements with Santa Clara Water District and Metropolitan Water District of Southern California. Santa Clara Water District would use surface water storage capacity within Anderson Reservoir. Metropolitan Water District is considering using surface water reservoirs (Diamond Valley Lake, Lake Mathews, Castaic Lake, and Perris Lake) and groundwater storage programs to participate. If source shifting were implemented in surface water storage facilities, it would cause the participating reservoir levels to fall earlier in the year than they would without the EWA, but the reservoir levels would return to levels that would occur without the EWA as the water is paid back (see Figure 2-15).

The EWA agencies could also create a source shifting agreement with Kern County Water Agency, which would use groundwater supplies during the delayed deliveries. Water from Kern County could be delivered by exchanging surface water deliveries or through direct groundwater pumping into the California aqueduct (as described in the Stored Groundwater Purchase section, above).

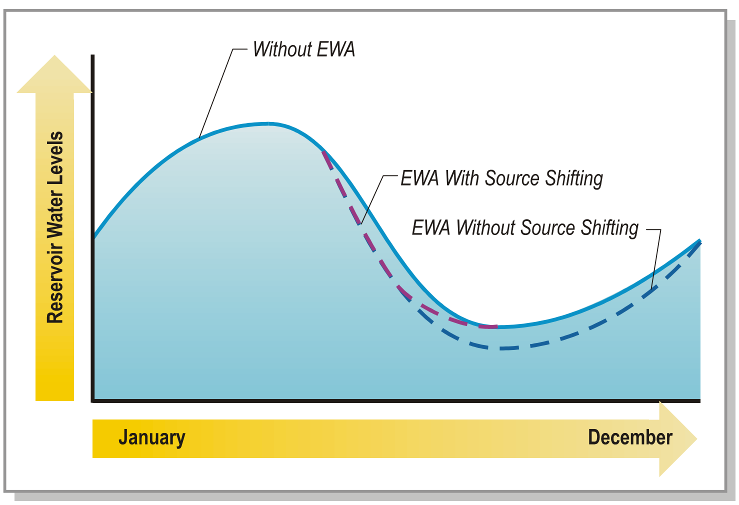

Figure 2-15
Reservoir Level Changes Due to Source Shifting

If the EWA agencies activated a source shifting agreement, the deferred surface water deliveries would be transferred to the EWA at O'Neill Forebay and could be stored in San Luis Reservoir. If the source shifting participant had a portion of its allocation stored in San Luis Reservoir, that water would be transferred to the EWA and the participant's deliveries would be reduced. After the San Luis Reservoir low point occurred, source shift water could be returned to the projects at O'Neill Forebay and then conveyed to those contractors that provided source shifting services (those that agreed to delay delivery of their contract water).

At the start of source shifting operations, water surface elevations in the reservoirs or groundwater levels would decrease relative to non-EWA conditions. The water levels would then return to non-EWA conditions as the water was paid back, which could continue into the next year. Source shifting does lower water levels temporarily, but only within existing operating parameters. The reservoirs or groundwater aquifers would not be operated outside their standard operations.

Pre-Delivery

As a permutation of source shifting, the EWA agencies could engage willing partners to receive water earlier than they would typically receive water. The EWA agencies would consider this tool if the EWA had water in storage in San Luis Reservoir during the winter that may convert to Project water as San Luis fills. To implement pre-delivery, the EWA agencies would deliver water to users in the Export Service Area that have their own storage facilities in which to store that water. The EWA would essentially be borrowing storage space from these users. This action would increase reservoir levels in surface storage facilities. The EWA Project Agencies may engage in pre-delivery with Metropolitan Water District of Southern California. In some cases, such as the Santa Clara Valley Water District's Anderson Reservoir, there may also be some risk of spill of the EWA asset that would be addressed through contract terms.

Exchanges

The EWA agencies could engage willing partners to receive water earlier than their normal delivery schedule. The EWA agencies would consider using this tool if they had remaining assets at the end of June and they did not anticipate using these assets before the end of the water year. In a dry summer period, the EWA could exchange its surplus assets with an agricultural contractor with the agreement that the contractor return the water on request in the next relatively wet year; for example, a year with SWP allocations of 70 percent or higher. The agricultural contractor would then take delivery of the EWA water from July through the end of the irrigation season instead of pumping local groundwater or drawing on other sources. The exchange would reduce groundwater pumping in the first year of the exchange, and would require the contractor to reduce dependence on contract supplies in the year of the return of the water.

Similarly, the EWA agencies could exchange surplus assets with a contractor that has available surface water storage. The contractor would take deliveries of the EWA water during the same time period instead of drawing on local surface water supplies. The exchange would result in slightly higher reservoir levels throughout the winter and until the contractor returns the water to the EWA in a relatively wet year.

Exchanges would have similar effects to other water management methods discussed in earlier sections. Exchanging water with an agricultural contractor to use in lieu of groundwater would result in the same types of effects as groundwater storage. Exchanging water with contractors that have surface water storage is similar to pre-delivery. The resource area analyses do not specifically analyze exchanges because these effects are covered as a part of the analysis of groundwater storage and pre-delivery.

2.4.4 Typical Year EWA Operations

In a typical year, the EWA would purchase 200,000-300,000 acre-feet for its annual operations. In the driest years, and when assets were carried over from the prior year, the total acquisitions could be closer to 200,000 acre-feet. In near average water years, the acquisition target would be closer to 300,000 acre-feet or even higher.

In the wetter years when operational curtailments would be expected to cost more water because the base Delta pumping rate would be higher or when the EWA ends the prior year with substantial debt, water needs for fish may be in the 400,000-600,000 acre-foot range. Initial acquisition targets may be lower in those years, and water acquisitions likely would reach the higher end of the range only if Tier 3 assets were called upon to complete the acquisition of the needed water. Tier 3 assets could be made available when Tier 2 assets were exhausted and the Management Agencies determine that jeopardy would occur due to Project operations unless additional measures were undertaken.

Table 2-7 provides an analysis of possible operational ranges of the EWA under different year types as defined by the Sacramento River Index.[26] The table is based on EWA asset acquisition priorities identified by the EWA agencies (see Section 2.4.5) and upper limits for each source category defined in Table 2-5 of this document.

Table 2-7
Estimated EWA Acquisition Patterns Keyed to SWP Allocation, Cross-Delta Capacity, and Acquisition Priorities
(Values in Thousand Acre-Feet)

Year Type	SWP Allocation	Purchase Target	Upstream from the Delta Sources				Export Service Area Sources	
			Reservoir Storage	Groundwater Substitution	Crop Idling	Groundwater Purchase	Groundwater Purchase	Crop Idling
Critical	20-40%	200-240	75-175	25-125	0-100	0-10	0-50	0-50
Dry	35-60%	210-270	75-175	25-125	0-100	0-10	0-150	50-100
Below Normal	50-80%	230-300	75-150	25-125	0-50	0-10	50-165	50-290
Above Normal	70-90%	250-300[1]	75-150	25-50	0	0	50-165	180-340
Wet	80-100%	250-300[2]	75-150	25-50	0	0	50-165	230-490

[1] In wetter years, purchases above 300 TAF may be required, depending on fish actions. Tier 3 assets may be required.
[2] In the wettest years, purchases above 300 TAF and as high as 600 TAF may be required, depending on fish actions. Tier 3 assets may be required.

The following text describes how the EWA agencies would pursue water acquisitions as the year type unfolds. In all years, the EWA agencies would begin negotiating with willing sellers in the prior summer and fall, well in advance of knowing hydrologic conditions. In some cases, multi-year agreements, most involving options, would be in place.

The EWA agencies would negotiate options both upstream from the Delta and within the export service area to be able to maximize use of cross-Delta transfer capacity in the SWP's Banks Pumping Plant, which would be minimal in wet years, but would become more available in dry years when SWP allocations to contractors would be relatively low. Cross-Delta transfer capacity also would be influenced by the amount of water transfers originating upstream from the Delta arranged by Project

[26] The Sacramento River Index classifies water years based on the unimpaired runoff from the Sacramento River system.

contractors, DWR, and the CVP. Holding option contracts would allow the agencies to maximize the purchase of less costly Upstream-from-the-Delta water when transfer capacity was available and would allow purchase of sufficient water from the export service area in wet years with limited transfer capacity.

The EWA would lose an estimated 20 percent of the water obtained from the Sacramento River and its tributaries to carriage losses in the Delta. Water obtained from the San Joaquin River basin is subject to a 10 percent conveyance loss. Each year the carriage water loss amount would be reevaluated. However, the net cost of the water from the Upstream from the Delta water after losses would be less than assets from the export service area.

2.4.4.1 Critical Year

In the driest years, the SWP would have a low water supply allocation to its contractors, probably in the range of 20 to 40 percent of requested amounts. The EWA would have significant cross-Delta transfer capacity available and would primarily seek upstream water. Stored reservoir water would be the first priority water source, followed in sequence by groundwater substitution, stored groundwater, and crop idling (rice). The priorities among source categories would remain the same in all year types.

In sequential dry and critical years, reservoir levels may be drawn down to the point that transfers of stored reservoir water to the EWA become unlikely or highly restricted. In such times, the EWA agencies would need to increase the emphasis on transfers involving groundwater substitution, groundwater purchase, and crop idling. The EWA agencies would be less likely to pursue crop idling transfers unless reservoir levels were lower than usual early in the winter.

As shown in Table 2-7, the maximum purchase target would be greatest for stored reservoir water, then groundwater substitution, groundwater purchase, and lastly crop idling, still in potentially significant amounts if reservoir water appeared limited. Stored groundwater purchase quantities would be minimal, largely due to limited availability north of the Delta.

The total purchase quantity would be relatively low in critical years, as Delta pumping would be low and operational curtailments would be less costly in terms of the pumping foregone that must be replaced by the EWA. EWA variable asset tools, however, would likely produce less water for the EWA in drier years.

2.4.4.2 Dry Year

In a dry year, SWP allocations would likely be in the 35 to 60 percent range. Cross-Delta transfer capacity available to the EWA may begin to be constrained at the upper range of these allocations, depending on runoff timing, competing transfers, and other operational factors. The EWA purchase target would be somewhat greater than in a critical year because operational curtailments would represent a larger reduction in Delta export pumping. The EWA agencies would pursue a strategy very similar to the critical year strategy, with most assets coming from the upstream from the Delta region. At higher SWP allocations, cross-Delta transfer capacity may become a constraint on the ability to move water from upstream when needed, and the EWA agencies may need to acquire water from the export service area as well.

As noted above, in sequential dry and critical years, reservoir levels may be drawn down to the point that transfers of stored reservoir water to the EWA would be unlikely or highly restricted. In such times, the EWA agencies would need to increase the emphasis on transfers involving groundwater substitution, groundwater purchase, and crop idling. Crop idling transfers would be less likely to be pursued unless reservoir levels were lower than usual early in the winter.

Acquisition target ranges would be about the same upstream from the Delta as for a critical year.

2.4.3.3 Below Normal Year

In a below normal year, the SWP allocation could range between from approximately 50 to 80 percent. In this range, the ability of the EWA to move water across the Delta would become more constrained, and at the higher allocations may become limited to the 500 cfs capacity dedicated to the EWA, or about 60,000 acre-feet, depending on runoff timing, competing transfers, and other operational factors. Purchase options play a key role in adjusting the locations where water would be purchased to match the cross-Delta transfer capacity as the SWP allocation would be established in the spring.

Because the water cost of operational curtailments would increase as SWP allocations and Delta pumping increase, the EWA's acquisition target would increase. Acquisitions can involve significant purchases from the upstream from the Delta region in the lower range of below normal year allocations, but at higher allocations the purchases would shift to the Export Service Area, where stored groundwater and crop idling play a major role. As previously stored groundwater is depleted by EWA purchases, the crop idling (cotton) source would become more important.

2.4.4.4 Above Normal Year

In an above normal year, the SWP allocation could range from approximately 70 to 90 percent. In this range, the ability of the EWA agencies to move water across the Delta may become limited to the 500 cfs of dedicated capacity, or about 60,000 acre-feet, depending on runoff timing and other operational factors. The EWA agencies would seek at least 75,000 acre-feet of stored reservoir water north of the Delta, exporting 60,000 acre-feet and providing an estimated 15,000 acre-feet (20 percent) for carriage water. If additional transfer capacity were available in that year, the EWA would seek additional water from stored reservoir supplies and groundwater substitution sources to fill the available capacity.

Water costs in some above normal years could exceed 300,000 acre-feet, possibly requiring Tier 3 purchases.

The water needed to cover operational curtailments at the Delta pumps would increase further in an above normal year, and the EWA's acquisition target would increase. The balance of needed assets would be obtained from banked groundwater and crop idling south of the Delta.

2.4.4.5 Wet Year

In the wet years, the SWP allocation would likely be at least 80 percent and in some years 100 percent. The cost of operational curtailments could become greater, especially if the wet hydrology brings fish into the vicinity of the pumps more often. Water costs in the wet years, possibly including Tier 3 purchases, could reach the upper limit selected for the Proposed Action, 600,000 acre-feet.

In the wet years, the ability of the EWA agencies to move water across the Delta may become limited to its 500 cfs dedicated capacity, or about 60,000 acre-feet. The EWA agencies would seek at least 75,000 acre-feet of stored reservoir water from the upstream from the Delta region, exporting 60,000 acre-feet and providing an estimated 15,000 acre-feet (20%) for carriage water. If additional transfer capacity were available in that year, the EWA would seek additional water from stored reservoir supplies and groundwater substitution sources to fill the available capacity.

The balance of needed water would have to be sought from the export service area, through a substantial amount of crop idling and some stored groundwater. Some of the crop idling may have to be arranged after initial planting, when the consequences of the wet hydrology and fish behavior become more completely known. Only when it is necessary to purchase Tier 3 assets would the EWA agencies actually acquire the maximum quantity of water identified in the as part of the Proposed Action.

2.4.5 Acquisition Strategy

The EWA agencies would acquire water using an acquisition strategy that meets multiple goals and objectives when acquiring water. These goals include:

- Acquire water at a unit cost that is most effective considering the benefits achieved;
- Protect assets by creating arrangements to carry over water between years;
- Continue coordination with other water purchase programs;
- Maximize the existing and future funding opportunities; and
- Improve flexibility by:
  - Expanding the types of purchases and the number of potential sellers;
  - Developing actions that continue for more than 1 year.

The sections below describe several components of the strategy that are relevant to assessing the environmental effects of the Proposed Action.

2.4.5.1 Tie Water Purchases to Hydrologic Conditions to Minimize Costs

The amount of water available for transfer is typically greater in areas upstream from the Delta than in the export service areas because more than 70 percent of runoff comes from northern California (DWR 1998). This difference is reflected in the market rates received by willing sellers in these two areas. The differences in water prices upstream from the Delta and the export service areas are greater than simply the costs of transporting water across the Delta. The differences reflect a structural difference in the water economies of these two areas.

Water from the areas upstream from the Delta is less expensive, but the EWA has limited conveyance capacity to convey water across the Delta in some hydrologic conditions. Therefore, the EWA would pursue a strategy in which it maximizes purchases from areas that are upstream from the Delta to the extent that it can convey water across the Delta.

Some water purchases in areas upstream from the Delta are generally less expensive, have fewer environmental effects, and are more flexible; therefore, the EWA Project Agencies would prioritize these types of acquisitions for purchase. The highest priority would be stored reservoir purchase, followed by groundwater substitution and stored groundwater purchase. The lowest priority would be crop idling transfers because of their increased environmental effects and decreased flexibility. In some cases (e.g. Sacramento River area idling transfers), the foregone consumptive use in April, May, and parts of June may not be effectively captured and exported by the EWA because the water must be released to meet downstream requirements, yet it cannot be pumped in the Delta.

Acquisitions in the export service area generally follow the same pattern: stored groundwater purchase is less expensive, more flexible, and has fewer environmental effects than crop idling transfers. Unfortunately, potential supplies in the export service areas are decreasing, and may not be available into the future. For purchases from the export service area, the EWA Project Agencies would prioritize stored groundwater purchases if available.

2.4.5.2 Continued Coordination with other Acquisition Programs

Other water acquisition programs would also acquire water in the same regions as the EWA, and some programs would seek to use this water to achieve similar goals. Coordination of the programs would critical to help maximize environmental benefits of these programs and avoid cumulative effects.

2.4.5.3 Set Water Purchase Targets

With a high upper limit on the purchases for the Proposed Action, the EWA would try to set water purchase targets based on Management Agencies' predictions of fish needs for different year types. Setting these purchase targets before the EWA Project Agencies negotiate acquisitions would help in purchasing enough assets to meet fish needs.

2.4.5.4 Aggressively Use Purchase Options

DWR could negotiate purchase options, in which they secure a contractual ability to call upon water to be transferred at a future date. Aggressive use of options upstream from the Delta would provide the EWA agencies flexibility to deal with changing hydrologic conditions. One concern related to options is that in many cases the call dates[27] needed by the sellers occur early in the year, before much is known about the hydrologic conditions. The EWA would seek option call dates as late into the year as possible, consistent with the needs of the sellers.

2.4.5.5 Increase Use of Multi-Year Transfers

The EWA Project Agencies could negotiate longer-term contracts with willing sellers to acquire water from the same source in multiple years. Multi-year agreements would likely decrease the cost of the water and improve flexibility by having a source that is available without additional negotiations.

2.4.6 EWA Action Effects Monitoring and Adaptive Management

The EWA agencies would implement a multifaceted monitoring program to assess the benefits and effects of EWA asset acquisition and management actions. A portion of the monitoring program would draw upon the findings of ongoing fish monitoring efforts being performed in the Delta, at the Delta pumps, Sacramento River, San Joaquin River, and tributaries. Another portion of the monitoring program would be the development of new monitoring efforts for locations where monitoring is now not occurring. The existing CALFED science review processes would continue the current evaluation of all efforts related to fish population recovery in the CALFED focus area. The data collected and reviewed through these processes would be used in an adaptive management process to suggest changes in relation to the acquisition and management of EWA assets.

Regarding terrestrial wildlife and vegetation, the EWA agencies would update species distribution maps, as introduced in Chapter 3 of the ASIP, to focus and avoid areas for rice farmland idling. The idling of rice farmland has been determined in this ASIP to be the only EWA asset acquisition and management action with potential adverse effects to terrestrial species. As part of the water acquisition and implementation strategy, the Project and Management Agencies would monitor in the field rice farmland idling patterns in relation to core wildlife areas and ensure that the conservation measures, presented in Section 2.5, are adhered to by the willing sellers.

Chapter 7 of this ASIP provides details regarding the EWA monitoring and adaptive management programs.

2.5 Conservation Measures

The CALFED MSCS, the document from which the EWA ASIP tiers, presents the basis for conservation measures developed to address CALFED actions overall, as outlined

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[27] The "call date" is the last date that the EWA could call for the water.

in the Programmatic CALFED EIS/EIR. The CALFED MSCS follows the two-tiered approach to FESA, CESA, and NCCPA compliance initiated by the CALFED Programmatic EIS/EIR and MSCS. The MSCS provides the CALFED programmatic compliance with FESA, CESA, and NCCP while this EWA ASIP provides the project-level compliance with these acts. As such, this ASIP represents the project-level biological assessment for initiating consultation with USFWS and NOAA-Fisheries under the Section 7 of the FESA and the project-level NCCPA compliance.

Many of the conservation measures introduced in the MSCS address CALFED construction and habitat improvement/conversion projects that are not components of the EWA Proposed Action. The MSCS does introduce EWA actions at the programmatic level and water transfers at a policy level. As such, the majority of the MSCS conservation measures are either too specific to other CALFED actions or too general to address specific EWA actions. The principles and expected outcomes of the MSCS conservation measures were used by a multiple agency team of biologists in the process of modifying the MSCS conservation measures to address (reduce or eliminate the effects) of EWA actions or in the development of new conservation measures not addressed in the MSCS. Included in the development of the EWA conservations measures was the assessment of the trade-offs between additional water for fish actions and water that could be used to support other environmental projects.

This section presents the EWA conservation measures developed to avoid, minimize, and compensate for effects on special-status species and NCCP communities. Included are the conservation principles the EWA measures are based on, the conservation strategy driving the development of the EWA measures, and the conservation measures put forth in this ASIP as a part of the EWA program.

2.5.1 Conservation Principles

Four documents were reviewed for principles that assure protection and improvement of species at the highest benefit based on EWA water asset and management actions. These documents are: the MSCS; CALFED Programmatic Biological Opinions and NCCP; the 1995 USFWS biological opinion for CVP/SWP operation effects on Delta smelt; and the 1993 NOAA Fisheries biological opinion for CVP/SWP operation effects on Sacramento River winter-run Chinook salmon ESU.

The Federal Endangered Species Act of 1973 as amended provides the general conservation principles used to develop conservation measures for EWA actions.

According to the ESA, conservation is "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and trans- plantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking (Endangered Species Act 1973)."

The NCCP General Process Guidelines delineate the scientifically sound principles of conservation biology used in formulating those provisions of the plan to protect, restore, or enhance the ecosystems, natural communities and habitat types within the plan area. Accepted and demonstrated principles of conservation biology for species covered have been used in formulating EWA conservation measures.

2.5.2 Conservation Strategy and Conservation Measures

The CALFED program, in particular the ERP, was developed to function as a comprehensive, long-term plan that will restore ecological health to the Bay-Delta system and improve management of water for beneficial uses. The ERP, the Strategic Plan for Ecosystem Restoration, and the MSCS were the primary documents used by CAFED agencies to outline the conservation strategy of the CALFED program with regards to species and natural communities.

The EWA Proposed Action has been developed to contribute to the recovery of at-risk native fish species inhabiting or migrating through the Bay-Delta. Therefore, the EWA actions stated in the Proposed Action description reflect an important strategy for the recovery of at-risk native fish species. For all other species potentially affected by EWA actions, the EWA conservation strategy is to avoid or minimize effects on species and natural communities. Any contributions to recovery will be incidental. The conservation measures provided in Section 2.5.3 will avoid or minimize the potential effects discussed in Chapters 4 and 6.

The MSCS contains a list of conservation goals for each species and NCCP community evaluated in the MSCS. The three alternative goals for species are recovery ("R"), contribute to recovery ("r"), and maintain ("m"). The goal of "recovery" was assigned to those species whose recovery is dependent on restoration of the Delta and Suisan Bay/Marsh ecosystems and for which CALFED could reasonably be expected to undertake all or most of the actions necessary to recover the species. Recovery is achieved when the decline of a species is arrested or reversed, threats to the species are neutralized, and the species long-term survival in nature is assured.

The goal "contribute to recovery" was assigned to species for which CALFED actions affect only a limited portion of the species range and/or have limited effects on the species. To achieve the goal of contributing to a species recovery, CALFED is expected to undertake some of the actions under its control and within its scope that are necessary to recover the species. When a species has a recovery plan, CALFED may implement both plan measures that are within the CALFED Solution Area and some measures that are outside the Solution Area. For species without a recovery plan, CALFED will need to implement specific measures that will benefit the species.

The goal "maintain" was assigned to species expected to be affected minimally by CALFED actions. For this category, CALFED will avoid, minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species. Actions may not actually contribute to the recovery of the species; however, at a minimum, they will be expected to not contribute to the need to list the species or degrade the status of a listed species. CALFED also will, to the extent practicable, improve habitat conditions for these species. These goals can be found in the species accounts in Chapter 3.

The CALFED Ecosystem Restoration Program (ERP) has adopted the CALFED MSCS goals related addressing "recovery", "contribute to recovery", and "maintain" for MSCS covered species as described above. The ERP has also adopted the MSCS conservation measures and would build upon those measures during the process of completing ERP studies and actions. The ERP's focus is on measures to enhance NCCP communities and the ERP has a goal related to the need to "enhance and/or conserve biotic communities" ("E"). A final ERP goal is to "maintain and/or enhance harvested species" ("H"), which relates to commercial/recreational use of native and non-native biological resources.

2.5.3 EWA Conservation Measures

Conservation measures that would be applied to the EWA actions for each species and NCCP habitat are described in this section. The cost of any conservation measures or additional environmental measures for EWA actions would be paid for from those funds identified for implementation of EWA.

2.5.3.1 General Conservation Measures

The conservation measures presented in this section apply to all species and NCCP habitats in general.

Conservation Measure Applicable to all Species

The EWA Project agencies will coordinate EWA water acquisition and transfer actions with Federal (Reclamation, USFWS and NOAA Fisheries), State (DWR and CDFG), other CALFED agencies, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project, the Anadromous Fish Restoration Program, the Senate Bill [SB] 1086 program, the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study, the Riparian Habitat Joint Venture, the CVPIA, the Central Valley Habitat Joint Venture, and the Grassland Bird Conservation Plan) that could affect management of evaluated species. Coordination will avoid conflicts among management objectives and will be facilitated through CALFED's water transfer program.

General Fish Species Conservation Measures

- In implementing the EWA, the EWA agencies will avoid acquisition and transfer of water that will reduce flows essential to maintaining populations of native aquatic species in the source river.

- In implementing the EWA water acquisition and transfers, the EWA agencies will not increase exports during times of the year when anadromous and estuarine fish are most vulnerable to damage or loss at project facilities or when their habitat may be adversely affected.

- In implementing the EWA, the EWA agencies will avoid acquisition and transfer of stored reservoir water quantities that will impair compliance with flow requirements and maintenance of suitable habitat conditions in the source river in subsequent years.

2.5.3.2 Federal Threatened or Endangered Species – Fish Species

Delta Smelt (T-FESA; T-CESA)

- In implementing the EWA, the EWA agencies will fully adhere to the terms and conditions in all applicable CESA and FESA biological opinions and permits for CVP and SWP operations.

- In implementing the EWA, the Project Agencies will not initiate EWA water exports in July until Management Agencies agree that Delta smelt will not be harmed.

Salmonids – General Conservation Measures - Central Valley Fall/Late-Fall Run Chinook Salmon (C-FESA; SSC-CDFG); Sacramento River Winter Run Chinook Salmon (E-FESA; E-CESA); Central Valley Spring Run Chinook Salmon (T-FESA; CT-CESA); Central Valley Steelhead (T-FESA)

- In implementing the EWA, the EWA agencies will fully adhere to the terms and conditions in all applicable CESA and FESA biological opinions and permits for CVP and SWP operations.

- In implementing the EWA, the EWA agencies will minimize flow fluctuations resulting from the release of EWA assets from project reservoirs to reduce or avoid stranding of juveniles.

- The EWA agencies will consult with the local river management teams regarding management of EWA water on those rivers.

Central Valley Fall/Late-Fall Run Chinook Salmon (C-FESA; SSC-CDFG)

- In May, the EWA agencies will evaluate Folsom Reservoir coldwater pool availability to benefit returning adult fall-run Chinook salmon prior to releasing EWA assets.

Central Valley Steelhead (T-FESA)

- In May, the EWA agencies will evaluate Folsom Reservoir coldwater pool availability to benefit over-summering juvenile steelhead prior to releasing EWA assets.

- In implementing the EWA, EWA agencies will consult with the local river management team regarding ramping considerations before and after EWA transfers to avoid downstream movement of juvenile steelhead.

2.5.3.3 Federal Threatened or Endangered Species – Terrestrial Species

Giant Garter Snake (T-FESA; T-CESA)

Within the Sacramento River valley, the giant garter snake (GGS) is highly dependent on rice fields and associated irrigation ditches. EWA actions, or cumulatively, water acquisitions, could idle up to 20 percent of flooded rice fields in each county. The following text provides the proposed approach and conservation measures to protect the GGS.

As part of the EWA consultation, the USFWS will give programmatic approval to crop idling, followed by a site-specific consultation process to ensure consistency with the programmatic approval. The programmatic consultation will include three main elements: 1) the process by which site-specific agreements will be attained; 2) the list of conservation measures (avoidance, minimization, and conservation measures) which would be used wholly or in part to minimize effects of water transfers involving fallowing or crop-shifting; and 3) a description of GGS conservation strategy in Chapter 4 of this ASIP.

USFWS EWA consultation with the Project Agencies will outline a year-by-year "site specific" process to address crop idling impacts to GGS and will put boundaries on upper limit on the amount of crop idling that may occur in any given year, considering the existing 20 percent limit. Additional measures to those presented in this EIS/EIR may be incorporated as a part of consultation based on site-specific conditions.

Each year, once it has been determined that crop idling will occur, the EWA Project Agencies will contact USFWS staff to begin informal consultation and will put together a package describing where the idling activities will take place and what proposed minimization measures will be followed. This package will include maps of the proposed idled fields. USFWS will work with the EWA Project Agencies to determine if minimization measures proposed are sufficient and if additional compensatory habitat is required.

The EWA agencies will ensure through contract terms or other requirements that the following conservation measures will be implemented:

- The EWA agencies will ensure parcels from which water is to be acquired are outside of mapped proscribed areas (see ASIP Figure 3-11), which include:

- *Refuges* – Land adjacent and within 1 mile of Sacramento, Delevan, Colusa, Sutter, and Butte Sink National Wildlife Refuge (NWR), and the Llano Seco Unit of the Sacramento River NWR, Gray Lodge Wildlife Area (WA), Upper Butte Basin WA, Yolo Bypass WA, and Gilsizer Slough CE;

- *Corridors Between Refuges* – Lands adjacent to Hunters and Logan Creeks between Sacramento River NWR and Delevan NWR; Colusa Basin Drainange Canal between Delevan NWR and Colusa NWR; Little Butte Creek between Llano Seco units of Sacramento River NWR and Upper Butte Basin WA, and Howards Slough Unit of the Upper Butte Basin WA, Butte Creek Upper Butte Basin WA, and Gray Lodge WA;

- *Waterways Serving as Corridors* – Land adjacent to Butte Creek, Colusa Basin Drainage Canal, Gilsizer Slough, land side toe drain along east side of the Sutter

Bypass, Willow Slough and Willow Slough Bypass in Yolo County, North Drainage Canal and East Drainage Canal in Natomas Basin

- *Other Core Areas* – East of SR99 and between Sutter-Sacramento County line and Elverta Road in Natomas Basin, Yolo County east of Highway 113;
- The water seller will ensure that water is maintained in irrigation and drainage canals to provide movement corridors;
- The water agency will ensure that the block size of idled rice parcels will be limited to 160 acres (includes rice fields shifting to another crop);
- The water agency will ensure that mowing along irrigation and drainage canals will be minimized and mowers will be elevated to at least 6 inches above the ground level;
- The water agency will ensure that, if canal maintenance such as dredging is required, vegetation will be maintained on at least one side; and
- The EWA agencies will maximize geographic dispersal of idled lands.

GGS conservation measures may include the following, as appropriate:

- The EWA agencies will avoid purchasing water from the same field for more than two consecutive years;
- The EWA agencies will recommend that sellers replace culverts already planned for repair or replacement with oversized culverts to facilitate better wildlife dispersal;
- The EWA agencies will recommend that sellers replace water control structures with those requiring less maintenance and less frequent replacement in order to minimize maintenance impacts (steel or wooden control boxes with pre-poured concrete boxes); and
- The water agencies may fund research or surveys.

2.5.3.4 State Special Status Species

Greater Sandhill Crane (T/FP-CESA)

Crop idling of seasonally flooded agricultural land could reduce the amount of over winter forage for migratory birds.

- Avoid or minimize actions near known wintering areas in the Butte Sink (from Chico in the north to the Sutter Buttes, and from Sacramento River in the west to Highway 99) that could adversely affect foraging and roosting habitat.

Black Tern (SSC-CDFG)

Crop idling of seasonally flooded agricultural land could reduce the amount of nesting and forage habitat during the summer rearing season.

- As part of the review process for the identification of areas acceptable for crop idling, the Management Agencies will review current species distribution/occurrence information from the Natural Diversity Database and other sources (including rookeries, breeding colonies, and concentration areas). The Management Agencies will then use the information to make decisions that will avoid EWA crop idling actions that could result in the substantial loss or degradation of suitable habitat in areas that support core populations of evaluated species that are essential to maintaining the viability and distribution of evaluated species.

- As part of contractual agreements, the willing seller will be required to maintain quantities of water in agriculture return flow ditches that maintains existing wetland habitat providing habitat to the covered species.

Western Pond Turtle (SSC-CDFG)

Ditches and drains associated with rice fields provide suitable habitat for the western pond turtle. The following conservation measures will ensure effects of crop idling actions on western pond turtle habitat are avoided or minimized.

- The willing seller will be required to maintain water levels in irrigation and drainage canals to within 6 inches of non-program conditions and do not completely dry out canals.

2.5.3.5 NCCP Communities

Non-tidal Freshwater Permanent Emergent, Natural Seasonal Wetland, and Valley/Foothill Riparian Communities

Natural and Managed Seasonal Wetlands and Riparian Communities often depend on surface water-groundwater interactions for part or all of their water supply. The following conservation measures will ensure effects on these communities from groundwater substitution actions are avoided or minimized.

- A *Well Adequacy Review.* Before groundwater substitution actions are initiated the hydrogeologic conditions of wells used to transfer EWA water will be examined to minimize the potential risk of depleting surface water sources and adversely affecting associated vegetation; and

- A *Monitoring Program.* The Project Agencies will implement a monitoring program that will provide data to determine if direct or indirect effects exist.

Valley/Foothill Riparian and Montane Riparian Communities

Riparian plant germination, establishment, growth, and distribution are driven by water availability and floodplain and channel geomorphology that conform to historical patterns. The following conservation measure will ensure effects on these communities will be avoided or minimized.

- The EWA agencies will implement a monitoring program, in cooperation with other programs, that will provide flow data and observations of habitat changes to determine if changes in flows are having a direct or indirect effect on riparian communities, particularly establishment of seedlings and survival of middle age classes.

Managed Seasonal Wetlands

Landowners with managed seasonal wetland communities often depend upon agricultural return flows for part or all of their water supply. The following conservation measure will ensure effects on this wetland community will be avoided or minimized.

- As a part of the contractual agreements, the EWA agencies will require the willing seller of water for crop idling to maintain their drainage systems at a water level that will maintain existing wetlands providing habitat to covered species. As part of monitoring program to ensure compliance with the contractual requirements, EWA agencies will periodically verify that the seller is adhering to the agreement and that no effects are occurring.

Seasonally Flooded Agricultural Lands

Conservation measures for seasonally flooded agricultural lands are provided for the giant garter snake. The primary measures applicable to seasonally flooded agricultural lands include limiting the size of idled land blocks to less than 160 acres, maintaining ditch habitat and ditch water flows, and not idling the same field more than 2 years in a row.

Anadromous Fish Community

Conservation measures for the anadromous fish community are presented in Section 2.5.3.2 for the salmonid fish species.

Estuarine Fish Species Community

Conservation measures for the estuarine fish community are presented in Section 2.5.3.2 for the delta smelt.

Chapter 3
Environmental Basis of Comparison–Special Status Species Accounts and Status in EWA Action Area

3.1 Introduction to Species Accounts

Chapter 3 presents species accounts for the species assessed in detail in this ASIP. The species addressed in this chapter are based on the screening process presented in Chapter 1, Section 1.4. In summary, the species addressed in the remaining portions of this ASIP were selected based on several considerations related to EWA asset acquisition and management actions that could affect the species or the habitat of species covered in this ASIP[1]. These considerations include:

- MSCS covered fish species that migrate upstream through the Delta to spawn in Delta tributary rivers and streams that may be affected by EWA pumping actions or alteration of Delta flows as a result of EWA pumping actions;
- MSCS covered fish species that inhabit Suisun Bay or the Delta that may be affected by EWA pumping in the Delta or reduced Delta outflows caused by EWA pumping;
- MSCS covered fish species that spawn in Delta tributary rivers and streams that may be affected by changes in the timing of stream flows (reduced flow due to water storage or increased flows when stored water is released);
- MSCS covered fish species that inhabit tributary rivers and streams whose habitat/water quality may be affected by reduced agriculture return flows due to EWA-related crop idling actions;
- MSCS covered terrestrial species whose life cycles are dependent on seasonally flooded agricultural land;
- MSCS covered species that extensively use agriculture water supply/return ditches as habitat; and
- MSCS covered species that use seasonally flooded agriculture land for a portion of their life cycle (e.g., nesting/forage during the summer, over-winter forage for winter migrants).

Not included in this ASIP are nonnative species (e.g., striped bass) or species that may occasionally visit, but are not dependent on, seasonally flooded agricultural land (e.g.,

[1] Based on the Proposed Action description provided in Chapter 2 the following EWA actions are most likely to affect covered species: 1) the pumping of EWA assets to the Export Service Area, 2) reduction in Delta outflows, 3) changes in timing of releases of water from reservoirs, and 4) crop idling involving seasonally flooded agriculture (rice).

migrants or species with broad home ranges). Terrestrial species that may be associated with lacustrine habitats (lakes, ponds, oxbows, gravel pits), such as bald eagles and osprey, are also not included because the analysis of EWA actions involving surface water purchase, storage, and release produced no adverse effect to fish populations, which can be a primary food source.

Chapter 3 presents basis of comparison descriptions at the species level. In accordance with FESA, the FESA environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in an action area, the anticipated impacts of all proposed Federal projects in an action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process. [50 CFR 402.02.] Unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultation also are part of the FESA environmental baseline, as are the Federal and other actions within the action area that may benefit listed species or critical habitat (USFWS & NMFS 1998). As a part of this environmental basis of comparison, the EWA agencies will define a baseline of population and habitat quantity and quality for listed and proposed species and designated and proposed critical habitat.

Species accounts are provided in the following order: fish (Section 3.2), birds (Section 3.3), and reptiles (Section 3.4). The species are organized by Federal, then State designation within each of these sections.

3.2 Species Accounts for Fish

3.2.1 Central Valley Fall/Late Fall-Run Chinook Salmon (*Oncorhynchus tshawytscha*)

Legal Status. The Central Valley fall-run/late-fall-run Chinook salmon is a candidate species (formerly Category 1 species) under the federal Endangered Species Act (NMFS 1999) and is listed as a California species of special concern (CDFG 2003). The Central Valley fall-run/late-fall-run Chinook salmon ESU includes all naturally spawned fall- and late-fall run populations of Chinook salmon in the Sacramento and San Joaquin basins and their tributaries, east of Carquinez Strait, California (NMFS 1999). NMFS broadly defines candidate species as those whose status is of concern, but more information is needed before they can be proposed for listing. In California, species of special concern is an informal designation used by the California Department of Fish and Game (CDFG) to identify declining and vulnerable species in the state.

NOAA Fisheries has identified distinct populations of Pacific salmon, steelhead, and sea-run trout as Evolutionarily Significant Units (ESUs). For a fish population (or group of populations) to be considered an ESU, it must be: 1) reproductively isolated from other populations; and 2) contribute substantially to the ecological and genetic diversity of the species (Waples 1991; NMFS 1991). The Central Valley fall-run/late-fall-run Chinook salmon is identified as an ESU by NOAA Fisheries.

Historical and Current Distribution and Status. Fall-run/late-fall-run Chinook salmon historically inhabited many streams of the Sacramento-San Joaquin watershed. Fish barriers (typically dams) on many streams and rivers currently limit upstream habitat. Subgroups commonly referred to include 1) San Joaquin fall-run, which includes populations in the Stanislaus, Tuolumne, and Merced Rivers; 2) populations from eastside tributaries that include the Cosumnes and Mokelumne Rivers; 3) populations from westside tributaries that include the Putah, Clear, and Cottonwood Creeks; 4) fall-run populations in the Sacramento River and its tributaries; and 5) late-fall-run populations in the Sacramento River and selected tributaries. Late-fall-run Chinook are generally the second least numerous run in the Sacramento River (after winter-run) (CDFG 1995). NMFS (1999a) summarizes long-term population trends for fall-run salmon as generally stable to increasing. However, it is unclear if these populations are self-sustaining, because at least 20 to 40 percent of the spawners are of hatchery origin (NMFS 1999). In addition, 40 to 50 percent of spawning and rearing habitats have been lost or degraded. Fall-run Chinook are currently the most numerous of the Central Valley runs (Myers *et al*. 1998). The late-fall-run Chinook salmon population in the Sacramento River appears to be stable, despite its low abundance (NMFS 1999). Reliable estimates at Red Bluff Diversion Dam (RBDD) from years prior to 1992 suggest escapement was 6,700 to 9,700 adults. Estimates made from 1992-97 are considered unreliable. In 1998, a more reliable estimate of 9,717 adults was made using carcass survey methodology. The similarity in results suggests that late-fall-run populations appear to be stable; however, there is still much uncertainty due to changes in estimation methodology (NMFS 1999). Preliminary estimates for 1999 through 2002 for carcass counts of natural spawners and fish spawned at Coleman Fish Hatchery range from approximately 7,500 to 29,300 (PFMC 2003).

Distribution in the CALFED Solution Area and EWA Action Area. Fall-run/late-fall-run Chinook salmon are found in all the ecological zones of the Central Valley except the West San Joaquin Basin Ecological Zone. Adults migrate upstream through the bay and Delta ecozones from summer through early winter, generally migrating from September through February with a peak in late December-early January. Adults are found in river and tributary ecozones generally from late summer into winter. Most young move out of tributary spawning areas in winter and spring. Young may be found in the river, Delta, and bay ecozones from winter into early summer.

Life History and Habitat Requirements. Chinook salmon require cold, freshwater streams with suitable gravel for reproduction. Despite NMFS inclusion of fall- and late-fall-run Chinook salmon in the same ESU, Moyle (2002) suggests that fundamental differences exist between the two races that warrant separate designation. Fall-run Chinook salmon are ocean-type Chinook adapted for spawning in lowland reaches of big rivers and their tributaries; juveniles have a brief rearing period (1-7 months) before emigration (Moyle 2002). Late-fall-run Chinook salmon, on the other hand, are mostly stream-type Chinook, typically entering freshwater in an immature state and holding while their gametes mature; juveniles have an extended stream residency (7 to 13 months) and attain a comparatively large size before emigration (Moyle 2002). Fall-run Chinook move upstream to freshwater from August to December, while late-fall-run Chinook move upstream from October to February (CDFG 1995). The fall-run Chinook salmon peak spawning period is October-November, whereas the late-fall-run peak spawning period is February-March (Moyle 2002). Females deposit their eggs in nests in gravel-bottom areas with relatively swift water, generally when water temperatures are less than 60°F. For maximum survival of incubating eggs and larvae, water temperatures must be between 39°F and 57°F. Incubation takes 3 to 4 months, with several weeks spent as alevins (sac-fry) (CDFG 1995). Fall-run Chinook salmon fry typically emerge December-March, and late-fall- run emerge April-June (Moyle 2002).

After emerging, many Chinook salmon fry tend to seek shallow, nearshore habitat with slow water velocities and move to progressively deeper, faster water as they grow. Many emerging fry are transported downstream into the lower rivers and the Delta, where they rear in shallow marshes and side channels. Shaded riverine aquatic habitat is important for providing cover from predators and access to food. Juvenile late-fall-run Chinook salmon typically rear in fresh water for up to a year before migrating to sea the following June-December; juvenile fall-run Chinook salmon exhibit a shorter rearing period of 1 to 7 months before emigrating January-July (Vogel and Marine 1991). Chinook salmon spend 2 to 4 years maturing in the ocean before returning to their natal streams to spawn. All Pacific adult Chinook salmon die after spawning (Moyle 2002, Beauchamp *et al*. 1983, Allen and Hassler 1986.)

Reasons for Decline. Loss and degradation of spawning and rearing habitat; alteration of streamflows; overharvest; entrainment into water diversions; blockage of migration routes; exposure to toxins; and, possibly, loss of genetic viability from interbreeding with hatchery stocks have contributed to the population decline of Central Valley fall-run/late-fall-run Chinook salmon. The human-caused factor that perhaps has had the greatest effect on the abundance of all Chinook salmon runs is loss of habitat, primarily in the rivers upstream from the Delta. Dams have presumably blocked some upstream access to habitat or impaired passage of adult fall-run and late-fall-run Chinook salmon (CDFG 1995). However, most of the historical spawning habitat for these runs has been downstream from impassable dams (Myers *et al.* 1998). Harvest rates of wild stocks are a potential contributing factor to the decline of the population; ocean harvest indices (i.e., percent of population harvested) range from 50 to 79 percent and averaged over 70 percent between 1990 and 1997 (PFMC 1998).

Designated Critical Habitat or Essential Fish Habitat. Critical habitat has not been proposed or designated. Essential fish habitat has been identified in the Pacific Coast Salmon Plan (PFMC 1997, 2000).

Conservation Efforts. The agencies implementing the CVPIA and CALFED actions are working to improve the quality of anadromous fish habitat, improving fish passage, and contributing to population recovery (AFRP 2001; CALFED 2000).

Recovery Plan and Recovery Guidance. Measures for recovery of the Sacramento late-fall-run and San Joaquin fall-run Chinook salmon populations are presented in the Anadromous Fish Recovery Plan (AFRP 2001), CDFG (1995), and the Native Fishes Recovery Plan (USFWS 1996).

Research and Monitoring Gaps. The specific habitat requirements and causes of population declines of the fall-run and late-fall-run Chinook are not well known (CDFG 1995). Research is needed to characterize the genetic makeup of all Central Valley fall-run Chinook to compare populations in the San Joaquin River to other watersheds (Myers *et al.* 1998). In addition, the amount of spatial and seasonal overlap and genetic introgression between all runs in the Sacramento River is an important topic for study (CDFG 1995).

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3.2.2 Sacramento River Winter-Run Chinook Salmon (*Oncorhynchus tshawytscha*)

Legal Status. The Sacramento River winter-run Chinook salmon ESU is listed as endangered under both the Federal (NMFS 1994) and California Endangered Species Acts (CDFG 2000, 2003). The Sacramento River winter-run Chinook salmon ESU includes populations in the Sacramento River and its tributaries in California (NMFS 1994).

NOAA Fisheries has identified distinct populations of Pacific salmon, steelhead, and sea-run trout as Evolutionarily Significant Units (ESUs). For a fish population (or group of populations) to be considered an ESU, it must be: 1) reproductively isolated from other populations and 2) contribute substantially to the ecological and genetic diversity of the species (Waples 1991; NMFS 1991).

Historical and Current Distribution and Status. Sacramento River winter-run Chinook salmon primarily spawn in the mainstem Sacramento River below Keswick Dam (NMFS 1997, CDFG 2002). Adult winter-run Chinook salmon immigration (upstream spawning migration) through the Delta and into the lower Sacramento River occurs from November through June, with peak immigration during the period extending from January through April (USFWS 1995, Myers *et al.* 1998). These salmon spawn between late-April and mid-August, with peak spawning generally from May to June (NMFS 1997, Myers *et al.* 1998). Most young move out of spawning areas in November through June. Young may be found in the Sacramento River, Delta, and Bay ecozones from winter into early summer.

The historical distribution of winter-run Chinook prior to construction of Shasta Dam included the headwaters of the McCloud, Pit, and Little Sacramento Rivers and tributaries like Hat Creek and Fall River (Myers *et al.* 1998, NMFS 1999, NMFS 2003). Since completion of Shasta Dam the Sacramento River, Battle Creek, and Calaveras River are the only habitats where winter-run Chinook have been known to occur (USFWS 1987, NMFS 1999). Fish still have access to Battle Creek through the Coleman National Fish Hatchery weir from a fish ladder that is opened during the peak of winter-run Chinook salmon migration period (Ward and Kier 1999). Currently, if a winter-run Chinook salmon population exists in Battle Creek its population size is unknown and likely very small. In addition, a winter-run to the upper Calaveras River took place between 1972 and 1984, but this population seems to have been eliminated by drought, irrigation diversions, and access blocked by the New Hogan Dam (NMFS 1997, NMFS 1999). Calaveras River winter-run Chinook salmon appear to be extirpated (NMFS 2003).

Winter-run Chinook salmon fry and juveniles generally emigrate past Red Bluff Diversion Dam (RBDD) from July through March, peaking in September and October (Hallock and Fisher 1985; USBR 1992; CDFG 2002; Vogel and Marine 1991). The abundance of juvenile salmon in the upper Sacramento River peaks during September, while the abundance of juveniles in the Delta generally peaks during December to March (CDFG 2002). The differences in peak periods of the river and Delta suggest that juvenile winter-run Chinook salmon may rear in the middle or lower Sacramento River or upper Delta prior to seaward migration. The location and extent of this middle-area rearing is unknown, but the duration of fry presence in an area may be related to the magnitude of river flows and water temperatures during the rearing period (Stevens 1989). In addition, Maslin *et al.* (1999) have found that substantial numbers of winter-run juveniles use tributaries for non-natal rearing. While small tributaries generally have insufficient flow for spawning adults, juvenile Chinook move upstream to rear, depending on the size, gradient, and quality of the tributary.

Historically, winter-run Chinook abundance during spawning was tens of thousands of adult salmon (NMFS 2003). Since 1970, winter-run salmon abundance has declined dramatically into the early 1990s, when averages returns were in the hundreds (PFMC 2003). Escapement Estimates of winter-run Chinook salmon between 1995 and 2002 ranged from approximately 600 to 7,600 adults (PFMC 2003). Some evidence suggests that the winter-run Chinook population has been growing since the 1990s, but still remain far below the proposed recovery level (NMFS 2003; PFMC 2003).

Distribution in the CALFED Solution Area and EWA Action Area. Winter-run Chinook salmon are generally found in the mainstem Sacramento River, with use of tributaries by rearing juveniles (NMFS 1997, Maslin *et al.* 1999). Winter-run Chinook salmon are found in the Sacramento River, Sacramento-San Joaquin Delta, and Suisun Marsh/North San Francisco Bay Ecological Zones. They also may rear in the lower portions of tributaries in the north Sacramento Valley (e.g., Battle Creek), Butte Basin, Feather River/Sutter Basin, American River Basin, Calaveras Creek, Cottonwood Creek, Yolo Basin, and Colusa Basin Ecological Zones (CALFED 2000).

Life History and Habitat Requirements. Winter-run Chinook salmon require freshwater streams with cold, constant summer flows and suitable gravel for reproduction (CALFED 2000). Adults move into freshwater in the winter months and delay spawning until late spring and early summer. In order to conserve energy for several months while maturing, the adults require water temperatures below a maximum of 60°F, and optimally below 56°F for maximum viability (NMFS 1993, 1997). Females deposit their eggs in nests in gravel-bottom areas with relatively swift water. For maximum survival of incubating eggs and larvae, water temperatures must be between 39°F and 57°F (CALFED 2000). After emerging, many Chinook salmon fry tend to seek shallow, nearshore habitat with slow water velocities and move to progressively deeper, faster water as they grow. Shaded riverine aquatic habitat is important for providing cover from predators and access to food. Many juvenile winter-run salmon are transported downstream into the estuary, where they forage in intertidal and shallow subtidal areas (NMFS 1997). Juveniles generally rear in freshwater for up to 5 months before migrating to sea after reaching a length of 4-6 inches (CALFED 2000). Chinook salmon spend 2-4 years maturing in the ocean before returning to their natal streams to spawn. Adult Pacific Chinook salmon die after spawning (Moyle 2002, Beauchamp *et al.* 1983, Allen and Hassler 1986).

Additional information on the life history and habitat requirements of winter-run Chinook salmon is contained in the NMFS Biological Opinion for this species, which was developed to specifically evaluate impacts to winter-run Chinook salmon associated with CVP and SWP operations (NMFS 1993).

Reasons for Decline. Loss and degradation of spawning and rearing habitat; alteration of streamflows, overharvest, high summer water temperatures, entrainment into water diversions, blockage of migration routes, predation of juveniles, exposure to toxins, and natural environmental variability have all contributed to the population decline of Sacramento River winter-run Chinook salmon (NMFS 1993, 1997, 2003; Myers *et al.* 1998; CALFED 2000, NMFS 2003). Sharp population declines of this salmon roughly correlate with increased water exports, operation of the RBDD, and unsuitable water temperatures (NMFS 1997). Habitat has been altered through the construction of dams and export facilities which can cause unsuitable water conditions for adult migration and fry development with respect to flows, temperature, pollution levels, oxygen deficiency, sedimentation, and gravel availability (NMFS 1993, 1997). Structures such as these can also block access to upstream habitat, delay migration of adults, and potentially increase predation on downstream-migrating juvenile salmon (USBR 1983). Environmental fluctuations, such as drought and strong El Nino conditions, also exacerbate these poor habitat conditions (NMFS 1997).

Commercial or recreational harvest has not been implicated as a major factor in the decline of winter-run salmon, although historical harvests of substantial levels may have contributed to declines of specific annual classes in the past (NMFS 1997).

Designated Critical Habitat or Essential Fish Habitat. In 1993, critical habitat for winter-run Chinook was designated to include the Sacramento River from Keswick Dam (River Mile [RM] 302) to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta (CALFED 2000). Also included are waters west of the Carquinez Bridge, Suisun Bay, San Pablo Bay, and San Francisco Bay north of the Oakland Bay Bridge (NMFS 1993). Essential fish habitat has been identified in the Pacific Coast Salmon Plan (PFMC 1997, 2000).

Conservation Efforts. The agencies implementing CVPIA and CALFED actions are working to improve the quality of anadromous fish habitat, fish passage, and contributing to population recovery (CDFG 2002). Recently initiated conservation actions include restoration of Battle Creek, ocean harvest reductions, screening of water diversions, remediation of Iron Mountain Mine, and improved water temperature control (NMFS 2003). The Winter-run captive Brood stock Program (WRCBP), designed as a hedge against the potential of a catastrophic cohort failure or extinction of the run in the wild, currently houses winter-run Chinook salmon at Bodega Marine Laboratory and Livingston Stone National Hatchery (CDFG 2002). In 2001 and 2002, USFWS released approximately 166,000 and 252,500, respectively, juvenile winter-run Chinook salmon brood stock progeny (CDFG 2002).

Recovery Plan and Recovery Guidance. The NMFS (1997) has prepared a proposed recovery plan for winter-run Chinook. The recovery goals include protecting and restoring spawning and rearing habitat; improving the survival of downstream migrants; improving adult upstream passage; reducing harvest; reducing impacts of management programs; and improving understanding of life history and habitat requirements. The delisting criteria are 1) mean annual spawning abundance of 10,000 females over 13 consecutive years; 2) a cohort replacement rate (CRR) greater than 1.0; and 3) a standard error less 25 percent of the spawning population estimate (CALFED 2000, NMFS 2003). Additional recovery guidance is presented in the Anadromous Fish Recovery Plan (AFRP 2001). Recently, NOAA Fisheries assembled a Central Valley Technical Recovery Team (TRT) in charge of developing recovery criteria for all listed ESUs in the Central Valley.

Research and Monitoring Gaps. Research into the behavior and use of juvenile winter-run Chinook in estuarine habitats would help ascertain key limiting factors for this species. For example, the effect of high water temperatures on growth and the cues for juvenile migration from the estuary are not well known (NMFS 1997). In addition, the extent and duration of juvenile salmon rearing in the middle to lower Sacramento River is not clear. Studying genetic differentiation of different Central Valley salmon runs has provided insight into the genetic status of the winter-run Chinook and development protocols for use in artificial propagation (CDFG 2002). Experimental captive rearing programs at Bodega Marine Laboratory and Livingston Stone National Fish Hatchery continue to rear winter-run Chinook salmon to maturity in captivity (CDFG 2002).

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3.2.3 Central Valley Spring-Run Chinook Salmon (*Oncorhynchus tshawytscha*)

Legal Status. The Central Valley spring-run Chinook salmon is listed as threatened under both the Federal (NMFS 1999a) and California Endangered Species Acts (CDFG 2000, 2003). The Central Valley spring-run Chinook salmon ESU includes populations in the Sacramento River and its tributaries in California (NMFS 1999a).

NOAA Fisheries has identified distinct populations of Pacific salmon, steelhead, and sea-run trout as an Evolutionarily Significant Units (ESUs). For a fish population (or group of populations) to be considered an ESU, it must 1) be reproductively isolated from other populations; and 2) contribute substantially to the ecological and genetic diversity of the species (Waples 1991; NMFS 1991).

Historical and Current Distribution and Status. Historically, the Central Valley spring-run Chinook salmon was one of the most abundant and widely distributed salmon races in the rivers and creeks of the Central Valley, including the middle and upper reaches of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud, and Pit Rivers (NMFS 1999b, NMFS 2002). Gold mining and agricultural diversions caused the first major declines in spring-run Chinook populations (Moyle *et al.* 1995). Further extirpations followed construction of major water storage and flood control reservoirs on the Sacramento and San Joaquin Rivers and their major tributaries in the 1940s and 1950s (Moyle *et al.* 1995; NMFS 1998). Spring-run Chinook salmon have been completely extirpated in the San Joaquin drainage. The only populations of spring-run salmon are currently restricted to accessible reaches in the upper Sacramento River mainstem, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (CDFG 1998; CALFED 2000a; NMFS 2002, 2003). In the 1980s, these populations reached low abundance levels (e.g., 5-year mean population sizes of 67-243 spawners), compared to historic peak abundance of 700,000 spawners (NMFS 2003). New abundance data suggest that these populations have started increasing since the 1990s, perhaps as the result of habitat improvements, reduced ocean fisheries, and a favorable terrestrial climate (NMFS 2003).

Distribution in the CALFED Solution Area and EWA Action Area. Spring-run Chinook salmon are found in the Suisun Marsh/North San Francisco Bay, Sacramento-San Joaquin Delta, Sacramento River, Feather River/Sutter Basin, Butte Basin, and North Sacramento Valley Ecological Zones (CALFED 2000a).

Life History and Habitat Requirements. Spring-run Chinook salmon require freshwater streams with cold temperatures over the summer and suitable gravel for reproduction (CALFED 2000a). Immature spring-run adults migrate into freshwater and upstream to headwaters between February and July with a peak in May to June. Adults typically hold in cold pools while maturing. These fish can reach higher elevations before the onset of high temperatures and low flows that inhibit access to these areas in the fall (Myers *et al.* 1998). Spawning occurs at the tails of holding pools between late August and early October, peaking in September (NMFS 2002). Females deposit their eggs in nests in gravel-bottom areas of relatively swift water. For maximum survival of incubating eggs and larvae, water temperatures must be between 39°F and 57°F. The length of time for eggs to develop depends largely on the water temperature; in Butte and Big Chico Creeks, emergence occurs from November through January and in the colder waters of Mill and Deer Creeks, emergence typically occurs from January through March (NMFS 2002).

After emerging, Chinook salmon fry tend to seek shallow, nearshore habitat with slow water velocities and move to progressively deeper, faster water as they grow. Spring-run juveniles may reside in freshwater habitat for 12-16 months, but many juveniles migrate to the ocean as young-of-the-year in the winter or spring within 8 months after hatching (CALFED 2000a, NMFS 2002). Riverine and estuarine habitats of the Bay and Delta are important rearing areas for these migrants. Maslin *et al.* (1999) have also found that substantial numbers of spring-run juveniles use tributaries for non-natal rearing. While small tributaries generally have insufficient flow for spawning adults, juveniles can move upstream to rear, depending on the size, gradient, and quality of the tributary. Chinook salmon spend 2-4 years maturing in the ocean before returning to their natal streams to spawn. Adult Pacific Chinook salmon die after spawning (Moyle 2002, Allen and Hassler 1986).

Reasons for Decline. Factors related to the decline of spring-run Chinook salmon include loss of habitat in river reaches blocked by dams; water development and management activities that affect water quality, timing, and quality; entrainment in water diversions; land uses that degrade aquatic and riparian habitats; over harvesting through commercial fisheries; climatic fluctuations; predation and disease; and genetic threats from the Feather River Hatchery spring-run Chinook salmon program (CDFG 1998; CALFED 2000a; NMFS 2002, 2003). The human-caused factor that has had the greatest effect on the abundance of spring-run Chinook salmon runs is loss of habitat primarily in the rivers upstream from the Delta. Major dams (e.g., Shasta, Oroville, and Friant dams) have blocked upstream access to most Chinook salmon habitat in Central Valley rivers and streams, and smaller dams with ineffective ladders also impair passage of adult spring-run (CDFG 1998). Estimates suggest that up to 95 percent of spring-run salmon spawning and rearing habitat has been lost in the Central Valley (NMFS 2003). Water diversions and reservoir operations affect streamflow, which influences the quantity, quality, and distribution of Chinook salmon spawning and rearing habitat. Water diversions also reduce survival of emigrating juvenile salmonids through direct entrainment losses in unscreened or inadequately screened diversions. The Feather River Hatchery spring Chinook program is a threat to genetic integrity of the remaining wild spring Chinook populations through possible hybridization with fall stock and high rates of straying (NMFS 2003).

Designated Critical Habitat or Essential Fish Habitat. Critical habitat for the spring-run Chinook salmon was designated on February 16, 2000 (USFWS 2000). On April 30, 2002, the U.S. District Court for the District of Columbia approved an NMFS consent decree withdrawing the February 2000 critical habitat designation for this and 18 other ESUs (NMFS 2002). Essential fish habitat has been identified in the Pacific Coast Salmon Plan (PFMC 1997, 2000).

Conservation Efforts. Agencies implementing the CVPIA and CALFED actions are working to improve the quality of anadromous fish habitat, improving fish passage, and contributing to population recovery (CDFG 2002; CALFED 2000b). Recently initiated conservation actions include habitat improvements (e.g., removal of several small dams and increases in summer flows) and reduced ocean fisheries (NMFS 2003). CDFG (1998) presents suggestions for future management of spring-run Chinook salmon.

Recovery Plan and Recovery Guidance. Measures for recovery of spring-run Chinook populations are presented in the Anadromous Fish Recovery Plan (AFRP 2001), Delta Native Fishes Recovery Plan (USFWS 1996), CDFG status reports (1998, 2001, 2002), and an interim biological opinion of the NMFS (2002). In addition, an NOAA Fishery Technical Recovery Team for spring-run Chinook will be developing an updated, long-range plan. CALFED (2000b) will also provide support to NMFS in recovery efforts following the VSP framework (McElhany *et al.* 2000), which will target restoring four key Chinook salmon population characteristics: 1) abundance; 2) productivity; 3) spatial distribution; and 4) diversity.

Research and Monitoring Gaps. Current research for spring-run Chinook is focusing on intensive studies of Butte Creek spring Chinook and genetic clarification of Feather River Hatchery fish (NMFS 2003). Myers *et al.* (1998) also point out that additional genetic information would help elucidate the status of remnant spring-run populations in Butte, Deer, and Mill Creeks and their relationship to spring-run fish from the mainstem Sacramento and Feather Rivers. Studying emigration timing, migration pathways, and juvenile abundance will help to plan habitat restoration projects (CDFG 2000). Additional areas for research include extent and effect of diseases, hatcheries as conservation, effects of mixed-stock fisheries, assessment of relative roles of different mortality factors, experimental assessment of the effects of river operations, efficacy of various habitat improvements, stock identification for management, and constant fractional marking (CDFG 1998, NMFS 2003).

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3.2.4 Central Valley Steelhead (*Oncorhynchus mykiss*)

Legal Status. The Central Valley steelhead ESU was listed as a federally threatened species on March 19, 1998 (NMFS 1998). The Central Valley steelhead ESU includes all naturally spawned populations of steelhead (and their progeny) in the Sacramento and San Joaquin Rivers and their tributaries. Also included are resident fish below historic barriers, but not those above long-standing natural barriers (NMFS 2003). Excluded are steelhead from San Francisco and San Pablo Bays and their tributaries.

NOAA Fisheries has identified distinct populations of Pacific salmon, steelhead, and sea-run trout as an Evolutionarily Significant Units (ESUs). For a fish population (or group of populations) to be considered an ESU, it must 1) be reproductively isolated from other populations and 2) contribute substantially to the ecological and genetic diversity of the species (Waples 1991, NMFS 1991).

Historical and Current Distribution and Status. Historically, the Central Valley ESU steelhead was well distributed throughout the Sacramento and San Joaquin River systems, from the upper Sacramento/Pit River systems south to the Kings and possibly Kern River systems in wet years (Yoshiyama *et al.* 1996, NMFS 2003). Because adults need to over-summer in deep pools in mid to high elevation tributaries, summer steelhead populations were probably eliminated with the construction of large-scale dams during the 1940s, 1950s, and 1960s.

The existing Central Valley steelhead ESU includes steelhead in all river reaches accessible to the Sacramento and San Joaquin Rivers and their tributaries in California (NMFS 1998). Central Valley steelhead populations are found in the Sacramento River and its tributaries, including the Feather, Yuba, and American Rivers, and many small tributaries, such as Mill, Deer, west side tributaries (including Clear, Cottonwood, Putah, Cache, Stony, Thomes, Alamo, and Ulatis Creeks), and Butte Creeks. The Cosumnes and Mokelumne Rivers also support steelhead.

In the San Joaquin River basin, the best available information suggests that the current range of steelhead is limited to reaches below major dams on the Stanislaus, Tuolumne, and Merced Rivers and to the mainstem San Joaquin River downstream from its confluence with the Merced River. Excluded are areas of the San Joaquin River upstream from the Merced River confluence and areas above specific dams identified or above longstanding, naturally impassable barriers (natural waterfalls in existence for at least several hundred years) (NMFS 2000). Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward from the Carquinez Bridge, and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge.

Currently, steelhead distribution is primarily limited by dams that block access to upstream reaches of main rivers and their tributary streams. NMFS (2003) estimated that more than 95 percent of historic spawning habitat is now inaccessible. Current abundance information suggest that Central Valley steelhead populations have declined drastically from an estimated one to two million spawners before 1850 to 40,000 spawners in the 1960s and to 3,628 spawners in the entire Central Valley (NMFS 2003). NMFS (2003) concluded that wild steelhead populations in the Central

Valley ESU area are continuing to decline and that they are currently "likely to become endangered" or "in danger of extinction" (NMFS 2003).

Distribution in the CALFED Solution Area and EWA Action Area. Central Valley steelhead are found in the Suisun Marsh/North San Francisco Bay, Sacramento-San Joaquin Delta, Yolo Basin, Sacramento River, North Sacramento Valley, west side tributaries (including Clear, Cottonwood, Putah, Cache, Stony, Thomes, Alamo, and Ulatis Creeks), Butte Basin, Feather River/Sutter Basin**,** American River Basin, Eastside Delta Tributaries, and East San Joaquin Basin Ecological Zones.

Life History and Habitat Requirements. Steelhead have a complex suite of life history traits, including the capability to be anadromous or to be a resident (called rainbow trout) (NMFS 2002a). Spawning and rearing habitat for steelhead is usually characterized by intermittent streams with clear, cool to cold, fast flowing water with a high dissolved oxygen content and abundant gravels and riffles. Preferred water depth for spawning is 6-24 inches, for fry 2-14 inches, and for parr 10-20 inches (Bovee 1978). Preferred water velocity for spawning is approximately 2 feet per second (range of 1-3.6 feet per second), although the optimal velocity depends in part on the size of the steelhead (i.e., larger steelhead will spawn in water with higher velocities) (Barnhart 1986). Steelhead use various mixtures of sand-gravel and gravel-cobble substrate for spawning, but the optimal substrate ranges from 0.2 inch to 4.0 inches in diameter (Bovee 1978, Reiser and Bjornn 1979). Optimal water temperatures for steelhead are 46-52°F for adult migration, 39-52°F for spawning, 48-52°F for incubation and emergence, 45-60°F for fry and juvenile rearing, and below 57°F for smoltification (Bovee 1978, Reiser and Bjornn 1979, Bell 1986). Steelhead rely on upstream tributary stream habitat because they require sufficient flows and habitat characteristics for spawning, rearing, and migration, such as shallow, cold riffles for spawning, deep pools with well-developed cover for rearing, and water flow year round to maintain rearing for 1 to 3 years before emigration.

Steelhead return to natal streams to spawn as 2- to 4- year-old adults. The fish migrate upstream from July through February and usually spawn between late December and March. Steelhead spawn in redds constructed by the female over a gravel and cobble substrate (Barnhart 1986). After choosing the redd site, females deposit their eggs in these redds, where they are then fertilized by the males. Adult steelhead do not necessarily die after spawning and may spawn on more than one occasion (Moyle 2002). Time of incubation and hatching varies with region, habitat, water temperature, and spawning season (USFWS 1983). Alevins emerge from the redd following yolk sac absorption and are ready to feed as fry or juveniles. Following emergence, fry live in small schools in shallow water along streambanks. As steelhead grow, they establish individual feeding territories; juveniles typically rear for 1 to 2 years (and up to four years) in streams before emigration as "smolts" (juvenile fish which can survive the transition from fresh water to salt water) (NMFS 1996). In the Sacramento River, juvenile steelhead migrate to the ocean in spring and early summer, with peak migration through the Delta in March and April (Reynolds *et al.* 1993). Steelhead may remain in the ocean from 1 to 4 years, growing rapidly as they feed in the highly productive currents along the continental shelf (Barnhart 1986).

Steelhead are primarily drift feeders and may forage in open water of estuarine subtidal and riverine tidal wetland habitats. The diet of juvenile steelhead includes emergent aquatic insects, aquatic insect larvae, snails, amphipods, opossum shrimp, and small fish (Moyle 2002). Steelhead usually do not eat when migrating upstream and often lose body weight.

Oncorhynchus mykiss (i.e., rainbow trout or steelhead) with coastal access exhibit extreme plasticity in life history expression. A continuum of migratory behaviors exists from strongly migratory to non-migratory (resident). It is not uncommon for progeny of one life history form to assume a life history strategy that differs from their parents. One study in the Deschutes River, Oregon found non-anadromous steelhead females produce steelhead progeny and steelhead females produce non-anadromous progeny (Zimmerman 2000 cited in McEwan 2001). Recent analysis of three recently spawned adult fish in the Calaveras River indicated three different life history expressions: 1) a female steelhead was the progeny of a steelhead female; 2) a non-anadromous male was the progeny of a steelhead female; and 3) a non-anadromous male was the progeny of a non-anadromous female (Titus 2000 cited in McEwan 2001).

Reasons for Decline. Factors related to the decline of Central Valley steelhead include loss of habitat in river reaches blocked by dams, degradation of habitat conditions (e.g., water temperature), entrainment in water diversions, possible introgression from hatchery fish (NMFS 2002a, 2003). Loss of habitat has the greatest effect on steelhead abundance. Major dams are the primary barriers to steelhead access to Central Valley rivers and streams. Dams at low elevations on all major tributaries block access to an estimated 95 percent of historical spawning habitat in the Central Valley (Ewan 2001). Below dams, remnant steelhead populations are affected by varying flow conditions and high summer and fall water temperature. Unscreened agricultural, municipal, and industrial diversions in the Delta and rivers cause entrainment losses of emigrating juvenile steelhead (NMFS 2002a). Steelhead populations have declined from 20,000 fish in 1969 to less than 3,000 fish in 1993 (NMFS 2003).

Over 90 percent of the adult steelhead in the Central Valley are produced in hatcheries (Reynolds *et al.* 1990). Hatchery-produced fish may substantially affect the genetic integrity of wild populations. Adult and juvenile steelhead are harvested by sport anglers within the Central Valley watershed, mostly on the American and Feather Rivers (with large steelhead hatcheries) (NMFS 2003). There is no commercial or sport fishery for steelhead in the ocean and, for unknown reasons, steelhead are rarely taken by commercial or sport salmon trollers (Skinner 1962).

Designated Critical Habitat and Essential Fish Habitat. Critical habitat for the Central Valley steelhead ESU was designated on February 16, 2000. On April 30, 2002, the U.S. District Court for the District of Columbia approved a NMFS consent decree withdrawing the February 2000 critical habitat designation for this and 18 other ESUs (NMFS 2002b).

Conservation Efforts. Agencies implementing the CVPIA actions are working to improve the quality of anadromous fish habitat, improve fish passage, and contribute to population recovery of anadromous salmonids (USFWS 2001). CALFED (2000a) has identified specific measures for steelhead recovery in the Ecosystem Restoration Program Plan, yet this plan is still in its initial stages of implementation. Recent, more restrictive, sport fishing regulations, such as those on the Yuba River, are intended to reduce adult steelhead take and incidental mortality.

Recovery Plan and Recovery Guidance. The National Marine Fisheries Service (NMFS) has formed a Central Valley Recovery Team to identify recovery requirements and prepare a recovery plan for steelhead. The Battle Creek Salmon and Steelhead Restoration Project has prepared a restoration plan to improve habitat and water flows along Battle Creek (Kier Associates 1998). CALFED (2000b) recovery criteria will follow the VSP framework (McElhany *et al.* 2000) developed by NMFS.

Research and Monitoring Gaps. NMFS (2003) noted that there are no ongoing population assessments for this species. The effect of catch-and-release mortality on wild populations and effect of trout fisheries on juvenile steelhead should be investigated (NMFS 2003). In addition, ecological conditions in the Sacramento and San Joaquin Rivers differ, and there is a potential for genetic differences \ among the different populations of these large river basins (NMFS 1997). There is also considerable uncertainty about the relationship between anadromous and non-anadromous *Oncorhynchus mykiss* forms, including the relationship with multiple subspecies of resident trout. It is likely that the abundant manmade barriers have greatly altered historical patterns of migration and anadromy (NMFS 2003). A comprehensive analysis of ecological and genetic information may help elucidate these complex issues (NMFS 1997). Steelhead have also been described spawning and rearing in seasonal habitats such as intermittent streams and streams that do not contain suitable year round habitat (McEwan 2001). McEwan (2001) suggests that further research should be done to determine the extent to which steelhead use seasonal habitats.

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3.2.5 Delta Smelt (*Hypomesus Transpacificus*)

Legal Status. The delta smelt was listed as a threatened species by the California Department of Fish and Game on December 9, 1993, and the U.S. Fish and Wildlife Service on March 5, 1993 (USFWS 1993). Delta smelt originally were classified as the same species as the pond smelt (*Hypomesus Olidus*), but Hamada (1961) and Moyle (2002, 1980) recognized the delta smelt as a distinct species (USFWS 1993). Delta smelt are the only smelt endemic to California and the only true native estuarine species found in the Sacramento-San Joaquin Estuary (known as the Delta) (Moyle and Herbold 1989, Stevens *et al.* 1990, Wang 1986).

Historical and Current Distribution and Status. Delta smelt are found mainly in the waters of the Delta and Suisun Bay, but are generally most abundant in the western Delta and eastern Suisun Bay (Honker Bay) (CALFED 2000). Their spawning distribution varies from year to year within the Delta. The species is endemic to the Sacramento-San Joaquin Estuary, and its population abundance varies substantially from year to year. Abundance has been uncharacteristically low since 1982, in large part because of the extended drought of 1987-92 and possibly to extremely wet years in 1983 and 1986 (Moyle *et al.* 1989). Population abundance has fluctuated recently from increases in some years to uncharacteristic decreases in other years (IEP 1998).

Distribution in the CALFED Solution Area and EWA Action Area. Delta smelt are confined primarily to the Delta and Suisun Marsh/San Francisco Bay Ecological Zones. They appear to move upstream from Suisun Bay into the Delta in winter and spring to spawn. After early rearing in the Delta, they tend to move downstream to low-salinity habitats in the western Delta (particularly in drier years) and Suisun Bay (in both wet and dry years). Small populations also occur in the Napa River estuary and Suisun Marsh (CALFED 2000).

Life History and Habitat Requirements. Delta smelt are a euryhaline species (species adapted to living in fresh and brackish water) that occupy estuarine areas with salinities ranging from 2-7 parts per thousand (ppt), though they can be found at salinities ranging from 0-18.4 ppt and can tolerate salinities up to 19 ppt (Moyle 2002). Delta smelt feed primarily on planktonic copepods, cladocerans and amphipods (Moyle 2002).

For a large part of their 1-year life span, delta smelt live along the freshwater edge of the mixing zone (saltwater-freshwater interface) where the salinity is approximately 2 ppt (USFWS 2002) or the area just upstream from it. This range is the principal habitat of delta smelt larvae and young juveniles (Herbold *et al.* 1992, Jassby 1993). The survival and growth of smelt larvae is best when the mixing zone occupies a large geographic area, including extensive shoal regions that provide suitable spawning substrates at depths less than 4 meters (USFWS 1993). Besides salinity, the distribution of delta smelt has also been shown to be related to prey abundance; in 1993 and 1994, delta smelt were found in Suisun Bay despite that ideal salinity conditions upstream. However, high levels of copepod *Eurytemora* were present (CDWR and USBR 1994).

Delta smelt spawn from February through May in shallow, fresh or slightly brackish water upstream from the mixing zone (Wang 1991), mostly in tidally influenced backwater sloughs and channel edgewaters where solid substrate (cattails, tules, tree roots, and submerged branches) are present for the attachment of eggs (Moyle 2002; Wang 1986, 1991; Sommer and Herbold 2000). They spawn in freshwater at temperatures from about 45-59°F (7-15 degrees Celsius) (USFWS 1993). In most years, delta smelt spawn primarily in the upper end of Suisun Bay, in Montezuma Slough, and in the northern and central Delta. In the Delta, they spawn mostly in the Sacramento River channel, central Delta, and adjacent sloughs (USFWS 1994).

Reasons for Decline. Delta smelt are considered environmentally sensitive because they live only 1 year, have a limited diet, have a low fecundity for a fish with planktonic larvae, are poor swimmers, are easily stressed, and reside primarily in the interface between saltwater and freshwater (CDFG 2000). The delta smelt has declined nearly 90 percent over the last 20 years and is primarily threatened by large freshwater exports from the Sacramento River and San Joaquin River diversions for agriculture and urban use (USFWS 1993). Other threats include drought, agricultural and industrial chemicals, introduced nonnative aquatic species, and reduction in abundance of key food organisms (USFWS 1993).

The principal concern for this species has been the diversion/reduction of freshwater into the Delta. Since 1983, the proportion of water exported from the Delta during October through March has increased (Moyle *et al.* 1992). Federal and State water diversion projects in the southern Delta export mostly Sacramento River water with some San Joaquin River water (USFWS 1993). During periods of high export pumping and low to moderate river outflows, reaches of the San Joaquin River reverse direction and flow to the pumping plants located in the southern Delta (USFWS 1993). A relationship has been found between the number of juvenile delta smelt salvaged at the State and Federal pumps and both the percent of inflow diverted and total Delta outflow (CDWR and USBR 1994). When total diversion rates are high relative to Delta outflow and the lower San Joaquin River and other channels have a net upstream (i.e., reverse or negative) flow, out-migrating larval and juvenile fish become disoriented. Mortalities occur as a result of entrainment and predation by striped bass at the various pumping plants and other water diversion sites. Delta smelt larvae require net positive riverine flows and estuarine outflows of sufficient magnitude in order to be carried downstream into the upper end of the mixing zone of the estuary instead of upstream to the pumping plants (USFWS 1993).

All size classes of delta smelt suffer near total loss when they are entrained by the pumping plants and diversions in the south Delta (USFWS 1993). Very few delta smelt are effectively salvaged at the State and Federal pumping plant screens, and the few that are transported into water project reservoirs or canals fail to reproduce. The smelt's embryonic, larval, and post-larval mortality rates also become higher as reduced western Delta flows allow increases in the salinity level and relocation of the mixing zone (USFWS 1993).

During periods of drought and increased water diversions, the mixing zone and associated smelt populations shifted farther upstream in the Delta. Prior to 1984, the mixing zone was usually located in Suisun Bay during October through March, while from April through September, the mixing zone usually was found upstream in the channels of the rivers (USFWS 1993). From 1984 to 1993, with the exception of the record flood outflows of 1986, the mixing zone had been located primarily in the river channels during the entire year because of increased water exports and diversions (USFWS 1993). When located upstream, the mixing zone becomes confined to the deep river channels; becomes smaller in total surface area; contains very few shoal areas of suitable spawning substrates; may have swifter, more turbulent water currents; and lacks high zooplankton productivity (USFWS 1993). Delta smelt reproduction is likely affected because the mixing zone is located in the main channels of the Delta, east of Suisun Bay (Moyle *et al.* 1992). In 1982, the delta smelt population declined significantly because of the shifted location of the mixing zone to the less favorable narrow, deep, and less productive channels in the lower rivers (USFWS 1993).

The delta smelt is especially vulnerable during periods of long drought. Deleterious effects of the 1987-92 droughts would have been exacerbated if additional alterations in hydrology caused by reductions of freshwater inflows to the Delta altered the timing and/or duration of water exports (USFWS 1993).

Agricultural chemicals and residues, chemicals from urban runoff, and heavy metal contaminants released from industry and mining also threaten delta smelt. Nichols *et al.* (1986) found that all major rivers in the delta smelt's historic range had been exposed to large volumes of agricultural and industrial chemicals that are applied in the California Central Valley watersheds. Toxicology studies of rice field irrigation drain water of the Colusa Basin Drainage Canal documented significant toxicity of drain water to striped bass embryos and larvae, medaka larvae, and the major food organism of the striped bass larvae and juveniles, the opossum shrimp (*Neomysis mercedis*) (USFWS 1993). Delta smelt could also be affected by run-off. Although the effects of heavy metal contaminating compounds on delta smelt larvae and their food resources are not well known, the compounds could potentially adversely affect delta smelt survival (USFWS 1993).

Several introduced species may adversely affect the delta smelt directly. There is as yet no direct evidence that suggests that disease, competition, or predation has caused delta smelt populations to decline, although these areas have not been widely studied (Moyle 2002). While not displacing delta smelt, hybridization with delta smelt may be occurring. Although the hybrids may be sterile, the attempts at interbreeding "cause the loss of viable gametes," further reducing the ability of this species to recover (Moyle 2002). Nonnative inland silversides have been known to prey on smelt larvae and may compete for similar prey such as copepods and cladocerans (Bennett 1995). An Asian clam (*Potamocorbula amurensis*), discovered in Suisun Bay in 1986, could affect the phytoplankton dynamics in the estuary by decreasing phytoplankton biomass and by directly consuming the delta smelt's primary food, *Eurytemora affinis* copepod nauplii (USFWS 1993). Additionally, the introduced striped bass may have caused an increase in predation on all size classes of the delta smelt (USFWS 1993). Three nonnative species of euryhaline copepods (*Sinocalanus doerrii, Pseudodiaptomus forbesi,* and *Pseudodiaptomus marinus*) became established in the Delta between 1978 and 1987 (Carlton *et al.* 1990), while *Eurytemora affinis* populations, the native euryhaline copepod, have declined since 1980. These introduced copepod species are more efficient at avoiding the predation of larval delta smelt and exhibit a different swimming behavior that makes them less attractive to feeding delta smelt larvae. Because of reduced food availability or feeding efficiency, weakened delta smelt larvae are more vulnerable to starvation or predation (USFWS 1993). Factors that contribute to low abundance relative to historical conditions include change in flow patterns; entrainment in diversions; contaminants; and species interactions, particularly competition and predation associated with establishment of non-native species (Stevens *et al.* 1990, Herbold *et al.* 1992). Although effects of contaminants have not been specifically described for delta smelt, pesticides have been found in the Sacramento River in recent years at concentrations potentially harmful to fish larvae (Herbold *et al.* 1992). Recent bioassays by the Central Valley Regional Water Quality Control Board indicate that water in the Sacramento River is periodically toxic to larvae of the fathead minnow, a standard U.S. Environmental Protection Agency (USEPA) test organism (Stevens *et al.* 1990).

Food availability may be an important factor affecting survival of delta smelt larvae. Abundance of rotifers and phytoplankton has declined in recent years (Obrebski *et al.* 1992). Rotifers are small and may be important to the diet of larval delta smelt (CDWR and USBR 1994) and other fish larvae (Hunter 1981).

Designated Critical Habitat. Critical habitat for the delta smelt was designated on December 19, 1994 (USFWS 1994). Critical habitat for the delta smelt is contained within Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties, California (USFWS 1994). Designated critical habitat includes all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bays), Goodyear, Suisun, Cutoff, First Mallard (Spring Branch) and Montezuma Sloughs, and the Sacramento/San Joaquin River Delta, as defined in Section 12220 of the California Water Code of 1969 (a complex of bays, dead-end sloughs, channels typically less than 4 meters deep, marshlands, etc.) as follows: bounded by a line beginning at the Carquinez Bridge, which crosses the Carquinez Strait; thence, northeasterly along the western and northern shoreline of Suisun Bay, including Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma Sloughs; thence, upstream to the intersection of Montezuma Slough with the western boundary of the Delta as delineated in Section 12220 of the State of California's Water Code of 1969; thence, following the boundary and including all contiguous water bodies contained within the statutory definition of the Delta, to its intersection with the San Joaquin River at its confluence with Suisun Bay; thence, westerly along the south shore of Suisun Bay to the Carquinez Bridge (USFWS 1994).

Critical habitat for the delta smelt includes those areas possessing the primary constituent elements essential to the conservation of the delta smelt. These primary constituent elements are the physical habitat, water, riverflow, and salinity concentrations required to maintain delta smelt habitat for 1) spawning; 2) larval and juvenile transport; 3) rearing; and 4) adult migration (USFWS 1994).

The final rule for the determination of critical habitat for the delta smelt provides details on these constituent elements (USFWS 1994). The primary constituent elements are organized by habitat conditions required for each life stage. The specific geographic areas and seasons identified for each habitat condition represent the maximum possible range of each of these conditions. Depending on the water-year type (i.e., wet, above normal, normal, below normal, dry, critically dry), each of the habitat conditions specified below requires fluctuation (within-year and between-year) in the placement of the 2 ppt isohaline (a line drawn to connect all points of equal salinity) around three historical reference points. These three historical reference points are the Sacramento-San Joaquin River confluence, the upstream limit of Suisun Bay at Chipps Island, and in the middle of Suisun Bay at Roe Island. The actual number of days that the 2 ppt isohaline is maintained at the three points varies according to water-year type. Additionally, the number of days at each reference point must simulate a level of water project development equivalent to that which historically existed in 1968. Hydrologic conditions in 1968 were such that delta smelt were abundant and anadromous and resident fisheries were relatively healthy (USFWS 1994).

Suitable habitat conditions must be maintained for recovery of the delta smelt. The naturally occurring variability found in healthy estuarine ecosystems must be preserved for the following reasons 1) temporal and spatial variability of the 2 ppt isohaline will be the most effective deterrent to further invasion of newly introduced species and continued competition by those that are already established; 2) placement of the 2 ppt isohaline in Suisun Bay will produce the high phytoplankton and zooplankton densities that characterize most healthy estuarine ecosystems; and 3) variability is needed to simulate natural processes and historical conditions (USFWS 1994).

The primary constituent elements in the Final Rule for the delta smelt (USFWS 1994) are defined as follows:

Spawning Habitat: Delta smelt adults seek shallow, fresh, or slightly brackish backwater sloughs and edge-waters for spawning. To ensure egg hatching and larval viability, spawning areas also must provide suitable water quality (low concentrations of pollutants) and substrates for egg attachment (e.g., submerged tree roots and branches and emergent vegetation). Specific areas that have been identified as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore Sloughs; the Sacramento River in the Delta; and tributaries of northern Suisun Bay. The spawning season may start as early as December and extend until July (USFWS 1994).

Larval and Juvenile Transport: To ensure that delta smelt larvae are transported from the area where they are hatched to shallow, productive rearing or nursery habitat, the

Sacramento and San Joaquin Rivers and their tributary channels must be protected from physical disturbance (e.g., sand and gravel mining, diking, dredging, and levee or bank protection and maintenance) and flow disruption (e.g., water diversions that result in entrainment and in-channel barriers or tidal gates). Adequate riverflow is necessary to transport larvae from upstream spawning areas to rearing habitat in Suisun Bay. Additionally, riverflow must be adequate to prevent interception of larval transport by the State and Federal water projects and smaller agricultural diversions in the Delta. To ensure that suitable rearing habitat is available in Suisun Bay, the 2 ppt isohaline must be located westward from the Sacramento-San Joaquin River confluence during the period when larvae or juveniles are being transported, according to the historical salinity conditions which vary according to water- year type. Reverse flows that maintain larvae upstream in deep-channel regions of low productivity and expose them to entrainment interfere with these transport requirements. Suitable water quality must be provided so that maturation is not impaired by pollutant concentrations. The specific geographic area important for larval transport is confined to waters contained within the legal boundary of the Delta, Suisun Bay, and Montezuma Slough and its tributaries. The specific season when habitat conditions identified above are important for successful larval transport varies from year to year, depending on when peak spawning occurs and on the water-year type. In the biological opinion for the delta smelt (USFWS 1995), USFWS identified where additional flows might be required in the July-August period to prevent delta smelt that were present in the south and central Delta from being entrained in the State and Federal project pumps and to avoid jeopardy to the species. The long-term biological opinion on CVP-SWP operations (USFWS 1995) identifies situations where additional flows may be required after the February through June period identified by EPA for its water quality standards to protect delta smelt in the south and central Delta.

Rearing Habitat: Maintenance of the 2 ppt isohaline according to the historical salinity conditions described above and suitable water quality (low concentrations of pollutants) within the estuary is necessary to provide delta smelt larvae and juveniles a shallow, protective, food-rich environment in which to mature to adulthood. This placement of the 2 ppt isohaline also serves to protect larval, juvenile, and adult delta smelt from entrainment in the State and Federal water projects. An area extending eastward from Carquinez Strait, including Suisun Bay, Grizzly Bay, Honker Bay, Montezuma Slough and its tributary sloughs, up the Sacramento River to its confluence with Three Mile Slough, and south along the San Joaquin River including Big Break, defines the specific geographic area critical to the maintenance of suitable rearing habitat. Three Mile Slough represents the approximate location of the most upstream extent of tidal excursion when the historical salinity conditions described above are implemented. Protection of rearing habitat conditions may be required from the beginning of February through the summer.

Adult Migration: Adult delta smelt must be provided unrestricted access to suitable spawning habitat in a period that may extend from December to July. Adequate flow and suitable water quality may need to be maintained to attract migrating adults in the Sacramento and San Joaquin River channels and their associated tributaries, including Cache and Montezuma Sloughs and their tributaries. These areas also should be protected from physical disturbance and flow disruption during migratory periods.

Conservation Efforts. The delta smelt will benefit from efforts by agencies implementing the CVPIA and CALFED actions to restore ecological health and improve water quality of the Delta (CALFED 2000).

Recovery Plan and Recovery Guidance. USFWS (1996) developed a Delta Native Fishes Recovery Plan to manage the estuary for improved native fish habitat and reduce the decline of native fish populations, including the delta smelt. Delta smelt will be considered restored when its population dynamics and distribution pattern within the estuary are similar to those that existed in the 1967-81 period (USFWS 1996). Distribution criteria include catches 1) in all zones 2 of 5 consecutive years; 2) in at least two zones in 1 of the remaining 3 years; and 3) in at least one zone, for the remaining 2 years. Abundance criteria are delta smelt numbers or catch; this catch must equal or exceed 239 for 2 out of 5 years and not fall below 84 for more than 2 years in a row (USFWS 1996).

Research or Monitoring Gaps. The California Department of Fish and Game initiated a monitoring and research program in 1992 to investigate all aspects of delta smelt biology (CDFG 2000). The results of this program are used to make informed water management decisions. The CALFED EWA Science Advisors recommend further research into artificial propagation as essential to recovery of delta smelt, as is further research on the collection, handling, transport, and release aspects of the fish salvage operation of the SWP and CVP's Delta fish protection facilities (CALFED 2002). The Interagency Ecological Program (IEP) Fish Team has identified several areas of emphasis for delta smelt, including habitat, behavior, and population impacts. Topics given high priority include 1) evaluating the quality of habitat in estuary areas; 2) conducting horizontal and vertical distribution studies; and 3) identifying impacts of predation by inland silversides and other species (IEP 2003).

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3.2.6 Sacramento Splittail (*Pogonichthys macrolepidotus*)

Legal Status. The Sacramento splittail is treated as a threatened species under the Federal Endangered Species Act. The final rule listing this species was published on February 8, 1999, but the comment period regarding this rule was reopened on January 12, 2001 (USFWS 2001), and remains open as of October 31, 2002 (USFWS 1999, 2001, 2002). This species is also listed as a California species of special concern (CDFG 2002).

Historical and Current Distribution and Status. Endemic to Central Valley lakes and rivers, adult splittail now primarily inhabit the Delta and Suisun Bay and Marsh (Moyle *et al.* 1995). The distribution of Sacramento splittail has been reduced to less than one-third of its original range (USFWS 1994). Fish surveys in the Sacramento-San Joaquin estuary indicate that splittail abundance there had declined by over 50 percent from 1980 through 1994, most likely in response to the drought of 1987-92 (Meng and Moyle 1995, Sommer *et al.* 1997). In 1995, abundance reached a record high, relative to historical conditions (Sommer *et al.* 1997). Strong year classes follow high-flow years (i.e., 1995), when portions of the estuary and river floodplains are flooded in winter and early spring. Preliminary surveys in 1998 indicated high larvae and juvenile abundance during this very wet year (CDFG 1998).

Distribution in the CALFED Solution Area and EWA Action Area. Splittail are found in all the ecological zones of the Central Valley except the West San Joaquin Basin Ecological Zone. Adults and juveniles live in the bay and Delta ecozones and migrate upstream during winter and spring. Adults are found in river ecozones generally from early winter through spring. Most young move out of upstream spawning and rearing habitat in spring and early summer.

Life History and Habitat Requirements. Splittail are estuarine fish capable of tolerating moderate levels of salinity from 10-18 ppt. Adults migrate upstream from brackish areas to spawn in freshwater. Splittail typically spawn in dead-end sloughs and slow reaches of large rivers and river floodplains over submerged vegetation. Spawning begins by late January and early February and continues through July, with most spawning from February through April (USFWS 2002). Shallow, weedy areas inundated during seasonal flooding provide habitat for adult spawning and foraging and subsequent egg development and larval and early juvenile rearing. Larvae remain in the shallow, weedy areas inshore close to the spawning sites and migrate into the deeper offshore and more riverine habitat as they mature (Wang 1986). As flooded habitat disappears, larvae and juveniles use habitat along the margins of the main river and Delta channels. Although splittail use deeper, open water as they grow, much of the population continues to use shallow (<10 feet) edge habitat as adults (Meng and Moyle 1995). Juvenile splittail are commonly found in Delta sloughs in late winter and spring and are particularly abundant in the vicinity of Montezuma Slough. As summer progresses, juvenile splittail occupy the deeper, open-water habitats of Suisun and San Pablo Bays.

Splittail are benthic foragers that feed extensively on opossum shrimp (*Neomysis mercedis*). However, detrital material typically makes up a high percentage of their stomach contents. They will feed opportunistically on earthworms, clams, insect larvae, and other invertebrates (CDFG 2002).

Reasons for Decline. The human-caused factor that has had the greatest effect on the abundance of splittail is loss and degradation of floodplain and marsh habitat (CDFG 1992). Land reclamation, flood control practices, and agricultural development have eliminated and drastically altered much of the ephemeral and perennial shallow-water habitats in the lowland areas available to spawning adults, larvae, and juveniles. An estimated 96 percent of historical wetland habitats are either unavailable to splittail or have been eliminated (USFWS 1999). Splittail abundance is positively associated with high Delta outflows during primary spawning months (March through May) (CDFG 1992, Sommer *et al.* 1997). High Delta outflows during late winter and spring correlate with increased total surface area of shallow-water habitats containing submerged vegetation (used by spawning adults), both within and upstream form the Delta. During years of low riverflow, such as the 1986-92 drought, spawning success may be greatly reduced, contributing to reduced adult abundance.

Designated Critical Habitat. None.

Conservation Efforts. The splittail will benefit from efforts by agencies implementing the CVPIA and CALFED actions to restore ecological health and improve water quality (USFWS 1999).

Recovery Plan and Recovery Guidance. USFWS (1996) developed a Delta Native Fishes Recovery Plan to manage the estuary for improved native fish habitat and reduce the decline of native fish populations, including the Sacramento splittail. The objective of the plan is to 1) create meander belts along the Sacramento River by setting levees back; 2) create and reconnect wetlands to the floodplain in the lower San Joaquin, Tuolumne, and Stanislaus Rivers; 3) restore marsh habitat in the Delta and Suisun Marsh; 4) manage bypasses for fish; and 5) remove upstream barriers to migration. Specific criteria are stated in USFWS (1996) and include meeting two out of three possible restoration criteria regarding splittail abundance over a 15-year period.

Research or Monitoring Gaps. Despite the use of several monitoring techniques for estimating splittail populations, the USFWS (2002) acknowledges significant methodological weaknesses for each method. The abundance status of the splittail could be estimated more accurately with a rigorous survey designed specifically for this species. In addition, research into the mechanisms driving splittail population declines during low outflow-high diversion years would help ascertain key limiting factors for this species. Studying the characteristics of spawning and rearing areas, especially for young-of-year splittail, would aid identification of critical habitat areas (CDFG 2002).

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3.2.7 Green Sturgeon (*Acipsenser medirostis*)

Legal Status. The green sturgeon is a State of California species of special concern (CDFG 2003). NOAA Fisheries recently (2002) completed its ESA status review for North American green sturgeon and has since concluded that listing was not warranted (NOAA 2003). Green sturgeon has been added to the candidate species list and its status will be reevaluated in 5 years.

Historical and Current Distribution and Status. The green sturgeon is the most widely distributed member of the sturgeon family Acipenseridae (NOAA 2003). In North America, green sturgeon are found in rivers from British Columbia south to the Sacramento River, California, though their ocean range is from the Bering Sea to Ensenada, Mexico (Moyle 2002). In California, historical spawning populations existed only in the Sacramento, Eel, and Klamath-Trinity river systems. A number of presumed spawning populations (Eel River, South Fork Trinity River, San Joaquin River) have been lost, and the only known spawning in California occurs in the Sacramento and Klamath Rivers (Moyle 2002; NOAA Fisheries 2002). Green sturgeon are reported to spawn in the Feather River, though this claim is not substantiated (NOAA Fisheries 2002). There is no documentation suggesting green sturgeon spawn in the San Joaquin River presently; however, spawning may have occurred prior to large-scale hydropower and irrigation development. Recent accounts of young sturgeon rearing in the San Joaquin Delta area are likely the result of immigration from the Sacramento River (NOAA Fisheries 2003).

In assessing North American green sturgeon status, NOAA Fisheries determined two distinct population segments (DPSs) exist. The northern DPS ranges from the Eel River northward; the southern DPS includes any coastal or Central Valley populations south of the Eel River, with the only known population being in the Sacramento River (NOAA Fisheries 2002). The remaining information presented will focus on the southern DPS of green sturgeon. NOAA Fisheries concluded that, based on the available information, there is no evidence suggesting that the green sturgeon population is declining in the southern DPS. Population estimates for adult green sturgeon in the San Pablo Bay area have ranged from several hundred to 2000, with a high of over 8,000 in 2001 (NOAA Fisheries 2002). These estimates are based on incidental green sturgeon catch during CDFG’s white sturgeon monitoring. However, the validity of the assumptions necessary for this estimation is questionable (Moyle 2002, NOAA Fisheries 2002). Annual juvenile abundance in the Sacramento River based on downstream migrant trapping ranges from zero to 2,068 with no apparent annual trend (NOAA Fisheries 2002).

Distribution in the CALFED Solution Area and EWA Action Area. Juvenile green sturgeon rear throughout San Francisco and San Pablo Bays, the Sacramento-San Joaquin Delta, and the Sacramento River. During spawning migrations, adult green sturgeon pass through the San Francisco Bay estuary and the Sacramento-San Joaquin Delta on their way to spawning grounds in the Sacramento River (NOAA Fisheries 2002, Moyle 2002).

Life History and Habitat Requirements. The green sturgeon is anadromous and the most marine-oriented of the Pacific coast sturgeon species (NOAA 2003). Green sturgeon are thought to spawn every 3 to 5 years, with mature males ranging from 139-199 cm FL (age 15-30 years) and mature females ranging from 157-223 cm FL (age 17-40 years) (NOAA Fisheries 2002). Green sturgeon migrate upstream between late February and late July. The spawning period is March-July, peaking mid-April to mid-June (Moyle 2002). Green sturgeon spawning takes place in deep, turbulent pools of large rivers. Preferred spawning substrate is likely large cobble, but it can range from clean sand to bedrock (Moyle 2002; NOAA Fisheries 2002). Green sturgeon larvae probably hatch at around 200 hours (at 12.7°C) after spawning and are dissimilar to other sturgeon species in that they lack a distinct swim-up or post-hatching stage (Moyle 2002, NOAA Fisheries 2002). Growth rates are optimal at temperatures of 15°C. Young sturgeon grow fast and appear to migrate to the ocean between 1-3 years at 30-66 cm TL (Moyle 2002, NOAA Fisheries 2002). They apparently remain near the estuaries at first, but then migrate considerable distances as they grow. Based on recoveries of green sturgeon tagged in the San Francisco Bay estuary, most green sturgeon migrate northward, in some cases as far as British Columbia (Moyle 2002, NOAA Fisheries 2002).

Some general information is available for green sturgeon feeding habits. Adult green sturgeon scour the Sacramento-San Joaquin Delta benthos for invertebrates, including shrimp, mollusks, amphipods, and small fish. Juvenile green sturgeon in the Sacramento River Delta are known to feed on opossum shrimp and amphipods (NOAA Fisheries 2002).

Reasons for Decline. The NMFS Biological Review Team for green sturgeon has identified several potential threats or risk factors to the southern green sturgeon DPS, including 1) harvest bycatch concerns; 2) the concentration of spawning in the Sacramento River and the apparent small population size; 3) loss of spawning habitat; 4) lack of adequate population abundance data; 5) potentially lethal water temperatures for larval green sturgeon; 6) entrainment by water projects in the Central Valley; and 7) the adverse effects of toxic materials and exotic species (NOAA Fisheries 2002).

Designated Critical Habitat or Essential Fish Habitat. Designation of critical habitat is not applicable for green sturgeon.

Conservation Efforts. Agencies implementing the CVPIA and CALFED actions are working to improve the quality of anadromous fish habitat, improving fish passage, and contributing to population recovery (CALFED 2000, AFRP 2001). The opening of the gates at the Red Bluff Diversion Dam (RBDD) primarily for winter-run Chinook salmon passage has provided a substantial increase in access to spawning habitat for green sturgeon (NOAA 2003). Other conservation measures targeted at anadromous salmonids, such as improving river thermal and flow regimes, are likely to improve conditions for green sturgeon as well.

Recovery Plan and Recovery Guidance. AFRP (2001) under authority of CVPIA states that the target production level for green sturgeon in Central Valley rivers is 2,000 fish. CALFED's (2000) goal is to achieve recovery objectives identified for green sturgeon in the recovery plan for the Sacramento-San Joaquin Delta native fishes (USFWS 1996). Green sturgeon will be considered restored when in the Sacramento-San Joaquin Delta once the median population of mature sturgeon (>1.0 m) has reached 1,000 individuals (USFWS 1996).

Research and Monitoring Gaps. NOAA Fisheries (2002) states there is a critical need to monitor population trends and identify potential risks to green sturgeon. AFRP (2001) identifies locating green sturgeon spawning sites and evaluating the availability, adequacy, and use by adult green sturgeon as a high priority.

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3.3 Species Accounts for Birds

3.3.1 Aleutian Canada Goose (*Branta canadensis* ssp. *leucopareia*)

Legal Status. The Aleutian Canada goose was removed from the list of threatened species under the Endangered Species Act on March 20, 2001, but this species is still considered as a Federal Species of Concern for 5 years after delisting (CDFG 2003). This goose is also 1) protected under the Migratory Bird Treaty Act and Convention on International Trade in Endangered Species of Wild Fauna and Flora (U.S. Fish and Wildlife Service 2001), 2) considered a California Special Animal (CDFG 2003), and 3) listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003).

Historical and Current Distribution and Status. Historically, Aleutian Canada geese wintered from British Columbia to California and northwestern Mexico (CALFED 2000). Although they occurred throughout California, the greatest concentrations were found in the Sacramento and San Joaquin Valleys (Grinnell and Miller 1944). The subspecies bred throughout the Aleutian Islands and into Russia (Springer 1977).

The present population of Aleutian Canada geese migrates along the northern California coast and winters in the Central Valley near Colusa and on scattered feeding and roosting sites along the San Joaquin River from Modesto to Los Banos (Jones & Stokes Associates and CH2M Hill 1986, Nelson et al. 1984). Fall migration usually begins in late August or early September, with birds arriving in the Central Valley between October and early November (USFWS 1980). Spring migration usually begins in mid-February and continues to early March (USFWS 1980). The population estimate in 2000 was approximately 37,000 individuals with an average annual growth rate of 20 percent (U.S. Fish and Wildlife Service 2001).

Distribution in the CALFED Solution Area and EWA Action Area. The Aleutian Canada goose is present during fall and winter in the Colusa Basin, East San Joaquin Basin, and West San Joaquin Basin Ecological Zones. During migration, it could also occur in the Butte Basin, Feather River/Sutter Basin, Yolo Basin, and Sacramento-San Joaquin Delta Ecological Zones (CALFED 2000) (Figure 3-1).

Life History and Habitat Requirements. Aleutian Canada geese breed exclusively on a small number of Aleutian islands (NatureServe Explorer 2001). This region is characterized by a polar maritime climate with high humidity, fog, rain, a small diurnal annual range of temperature, and near constant winds (NatureServe Explorer 2001). Nesting areas have been on grassy hillsides, along streams, in marshes and lagoons, and on rugged sea cliffs cut by watercourses where grasses and sedges grow in profusion (NatureServe Explorer 2001). Molting habitat is generally in the uplands. Night roosting areas include shallow pools and ponds on the islands.

Most Aleutian Canada geese that nest in the islands winter in California, primarily on agricultural lands. They arrive on the wintering grounds in mid-October (USFWS 1999). Aleutian Canada geese forage in harvested cornfields, newly planted or grazed pastures, or other agricultural fields (e.g., rice stubble and green barley). Lakes, reservoirs, ponds, and flooded fields are used for roosting and loafing (Grinnell and Miller 1944, USFWS 1982). They also roost in large marshes and stock ponds (CALFED 2000).

Aleutian Canada geese are omnivores, having a steady diet of arthropods, evergreen shrubs, roots, tubers, leaves, and stems during the breeding season. They also consume crowberries. The goslings are fed insects such as ground beetles. All their water is taken from vegetation. During the non-breeding season they feed on crops such as rice, corn, wheat, barley, oats, and lima beans. Water is taken from low-lying flooded areas.

The mating season is from May to June. Aleutian Canada geese become sexually mature around the age of 2 or 3. The incubation period is 28 days, with an average clutch of four to six eggs. Both the males and females guard the nest prior to setting, only the males after. They nest in treeless islands and areas covered with sedge, grass, and ferns with no source of freshwater.

Reasons for Decline. Predation by introduced Arctic foxes on the breeding islands is the primary reason for the population decline (Yparraguirre 1978). Predation by these foxes eliminated most breeding colonies of the Aleutian Canada goose and, by the 1930s, the subspecies was nearly extinct, with only one breeding colony on the tiny island of Buldir (USFWS 1982). Avian cholera is currently a major threat to the concentrations of Aleutian Canada geese in the Central Valley. This subspecies is particularly vulnerable to cholera outbreaks because most of the population overwinters in a small geographical area. Sport hunting has also added to the species' decline (USFWS 1982). In addition, suitable wintering habitat is disappearing due to urbanization and changing agricultural habitats, primarily in the California Central Valley. Adverse climatic conditions, such as drought, may accentuate the decline in available habitat and favor undesirable land use practices that could reduce the quality and availability of suitable habitat.

Designated Critical Habitat. None.

Conservation Efforts. Measures under the CALFED Bay-Delta Program are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. The Aleutian Canada Goose Recovery Plan implemented in 1991 outlined three primary objectives to be achieved before considering delisting the species: to maintain the wild populations at or above 7,500 individuals, to reestablish self-sustaining breeding populations of 50 pairs or more on three former breeding areas other than Buldir Island, and to identify and manage 25,000 to 35,000 acres of feeding and roosting habitat (USFWS 2001). The substantial population increase led to the delisting of this species, although the second and third objectives have not yet been achieved. Habitat acquisition and improvement continue as high-priority conservation efforts for the Aleutian goose (USFWS 2001).

Research and Monitoring Gaps. Although goose abundance has increased and this species was delisted, USFWS will continue to monitor populations.

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3.3.2 Black Tern (*Chlidonias niger*)

Legal Status. The black tern is listed as a California Species of Special Concern (CDFG 2002) and a Migratory Nongame Bird of Management Concern (USFWS 1995). This species is not listed under the California Endangered Species Act, but is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003).

Historical and Current Distribution and Status. The black tern is a common breeder throughout the northern United States and southern Canada (Dunn and Argo 1995). The black tern was also a common and even abundant summer breeder and migrant throughout much of California (Grinnell and Miller 1944). The species has declined and now breeds only in the northeast (Siskiyou, Modoc, and Lassen Counties) and Central Valley, although in much-reduced numbers (Zeiner et al. 1990). From April to early June, the black tern is a rare to common transient, uncommon to common at breeding areas and at the Salton Sea in summer, rare to common fall transient from August to mid-October, and very rare in northern California and along the southern coast between October and April (Small 1994). Although this species can be found in great numbers at the Salton Sea, it is not known to breed there (Small 1944).

Distribution in the CALFED Solution Area and EWA Action Area. This tern breeds in the Colusa Basin, Butte Basin, Feather River/Sutter Basin, and West San Joaquin Basin Ecological Zones. It also occurs as a migrant in the Yolo Basin, American River Basin, and Sacramento-San Joaquin Delta Ecological Zones (Figures 3-2 and 3-3).

Life History and Habitat Requirements. The black tern requires freshwater habitats for breeding grounds. Nesting sites are found on lakes, ponds, marshes, and agricultural fields (Grinnell and Miller 1944). During migration, this species can be common on coastal bays, river mouths, and well offshore over pelagic waters (Cogswell 1977). Nests are built on floating mats of dead vegetation among anchored vegetation or along the shore where they are built by scraping out the soil (Zeiner et al. 1990).

The black tern forages by hovering above wet meadows and fresh emergent wetlands. The tern catches insects in the air and also plucks them from water and vegetation surfaces. It eats grasshoppers, dragonflies, moths, flies, beetles, crickets, and other insects (Terres 1980). It also hovers above croplands, then drops to capture adult and larval insects from recently plowed soil. Another foraging technique is plunging to water surface for tadpoles, crayfish, small fish, and small mollusks. Young are fed insects (Cuthbert 1954). Adults drink during bathing or swoop to water to dip bill several times, particularly after swallowing prey (Dunn and Argo 1995).

Reasons for Decline. The draining of marshes and other freshwater habitats has been the main cause for this species' decline. The expansion of rice cultivation has offset this loss somewhat and has provided artificial nesting habitat (Cogswell 1977). Pesticide poisoning has also been very detrimental to the black tern (Zeiner et al. 1990).

Designated Critical Habitat. None.

Conservation Efforts. Measures under the CALFED Bay-Delta Program are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. The effects of human disturbances (e.g., marinas, campgrounds) near lakes and wetlands on black tern nesting and foraging requires further study (Beedy 1990).

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3.3.3 Black-Crowned Night Heron (*Nycticorax nycticorax*)

Legal Status. The black-crowned night heron is listed as a U.S. Bureau of Land Management sensitive species and a State Sensitive Species (CDFG 2003). This heron is not a federally listed species, nor is it a California listed species or species of special concern.

Historical and Current Distribution and Status. The black-crowned night heron breeds in Washington, southern Idaho, Saskatchewan, Michigan, and Nova Scotia south to southern South America. The black-crowned night heron winters north to Oregon, and east and south to Utah, New Mexico, Texas, lower Ohio Valley, Gulf Coast, and southern New England. In the U.S., the highest winter densities are in the vicinity of inland wildlife refuges near the California-Oregon border, along the northern California coast, in the San Joaquin Valley of California, along the lower Colorado River, near Galveston Bay in Texas, and along the coast near Jacksonville, Florida (Root 1988).

The black-crowned night heron was and is a common year-long resident throughout most of California. The heron nests in large numbers in the Central Valley, Salton Sea, and the northeastern part of the state (Zeiner et al. 1990). Birds in the northern portions of the state migrate south during winter months. Many immature black-crowned night herons migrate to the north and central coasts of California from August to March (Small 1994).

Distribution in the CALFED Solution Area and EWA Action Area. The black-crowned night heron breeds in the Butte Basin, Colusa Basin, Yolo Basin, Feather River/Sutter Basin, American River Basin, Sacramento-San Joaquin Delta, Eastside Delta Tributaries, East San Joaquin Basin, West San Joaquin Basin, and Suisun Marsh/North San Francisco Bay Ecological Zones. During winter, they also occur in the North Sacramento Valley and Cottonwood Creek Ecological Zones (Figure 3-4).

Life History and Habitat Requirements. Throughout most of California, the black-crowned night heron's breeding season is from February to July; in the northeastern portion of the State, it is from April to August. Nesting takes place in thick-foliaged trees, dense fresh or brackish emergent wetlands, or dense shrubbery or vines near aquatic feeding areas. The nests are built of twigs or various marsh plants, and the clutch size is three or four, occasionally five. The incubation period is 24 to 26 days, after which the young are cared for by both adults. The first flight attempts made by the young take place at 6 weeks of age, but they are not independent for some time after that (CDFG 1995).

The black-crowned night heron is a fairly common yearlong resident of the foothills and lowlands throughout most of California. The heron roosts during the day in dense trees or dense emergent wetland plants. The black-crowned night heron feeds primarily at night. Foraging is conducted largely along the margins of lacustrine, riverine, and fresh and saline emergent wetlands. The highly variable diet consists of fishes, crustaceans, aquatic insects, other vertebrates, amphibians, reptiles, some small mammals, and rarely a young bird. These birds hunt in shallow water, waiting motionlessly, but just as often they stalk their prey (CDFG 1995).

Reasons for Decline. Although this species is common throughout most of its range, it may have declined in some areas from the loss of marshes and other wetlands, pesticide use, human disturbance at nesting and roosting sites, and the removal of nesting and roosting trees (Airola 1980). The black-crowned night heron has been designated a "Special Animal" by California Department of Fish and Game because of its close association with a habitat that is continuing to decline in California. Additionally, any human disturbance of nesting colonies results in nest abandonment. Any project affecting the riparian corridor has the potential for affecting potential nesting and foraging sites of this species (CDFG 1995).

Designated Critical Habitat. None.

Recovery Plan and Recovery Requirements. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Black-crowned Night Heron Citations

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3.3.4 Great Blue Heron (Ardea herodias)

Legal Status. The great blue heron is listed as a California Department of Forestry sensitive species (CDFG 2003). This heron is neither a federally listed species, nor is it a California listed species or species of special concern.

Historical and Current Distribution and Status. The great blue heron is a widely distributed species with breeding and wintering ranges that stretch from Canada south to northern South America and the Galapagos Islands (NatureServe Explorer 2002). In California this species is a yearlong resident throughout the State, except for mountains above the foothills (Granholm 1990). It is fairly common in shallow estuaries and fresh and saline emergent wetlands and less common along riverine and rocky marine shores, in croplands, pastures, and high mountains (Granholm 1990). The great blue heron can also be found in salt ponds where fish are numerous from July to October (Granholm 1990). It is locally common near rookeries (scattered frequently throughout northern California and infrequently in southern California) from February to June or July (Granholm 1990). Great blue herons in California display little regular migration, simply dispersing from rookeries to outlying areas after breeding in June or July (Granholm 1990).

The great blue heron is sensitive to human disturbance near nests and probably to pesticides and herbicides in nesting and foraging areas (Granholm 1990). The great blue heron is designated a "Special Animal" because of the close association it has with habitat that is continuing to decline in California (CDFG 1995). Additionally, tree cutting, water recreation, draining of wetland habitats, building, and highway construction have all contributed to rookery abandonment (CDFG 1995).

Distribution in the CALFED Solution Area and the EWA Action Area. The great blue heron occurs in all Ecosystem Restoration Program ecological zones and throughout the EWA Action Area (Figure 3-5).

Life History and Habitat Requirements. Great blue herons use shallow estuary systems and fresh and saline emergent wetlands year round. Tall riparian-type trees are needed for perching and roosting sites (CDFG 1995). Great blue herons forage mostly for fish, but also eat small rodents, amphibians, snakes, lizards, insects, crustaceans, and occasionally small birds. Hunting techniques include standing motionless, wading slowly, probing and pecking, and then grasping prey in bill (CDFG 1995, Granholm 1990). Foraging can occur both night and day, but mostly occurs around dawn and dusk (Granholm 1990).

Great blue herons nest colonially, typically in secluded groves of tall trees near shallow-water feeding areas; however, feeding areas may be up to 10 miles distant (Granholm 1990). The breeding season is from February to June or July, with clutch sizes averaging 3-4 (Granholm 1990). Great blue heron young are often fed by parents until 11 weeks old (Granholm 1990). Breeding typically begins at 2 years (Granholm 1990).

Reasons for Decline. The great blue heron is sensitive to human disturbance near nests and probably to pesticides and herbicides in nesting and foraging areas (Granholm 1990). The great blue heron is designated a "Special Animal" because of the close association it has with habitat that is continuing to decline in California (CDFG 1995). Additionally, tree cutting, water recreation, draining of wetland habitats, building, and highway construction have all contributed to rookery abandonment (CDFG 1995).

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Research and monitoring gaps have not been identified for this species.

Great Blue Heron Citations

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3.3.5 Great Egret *(Casmerodius albus)*

Legal Status. The great egret is listed as a California Department of Forestry sensitive species and is a specified bird in Fish and Game Code Section 3505 (CDFG 2003). This egret is neither a federally listed species nor is it a California species of special concern.

Historical and Current Distribution and Status. The great egret is a widely distributed species with breeding and wintering ranges that stretch from Canada to South America (NatureServe Explorer 2002). In California, this species is a yearlong resident throughout the State, except for high mountains and deserts (Granholm 1990). Populations concentrate at nesting colonies from March to July; after breeding, these birds tend to wander widely (Granholm 1990). Seasonal movements also occur from the northeastern plateau to lowland areas from September to February.

Great egrets declined substantially at the turn of the century by plume hunting (CDFG 1995). This species is currently considered to be fairly common to common yearlong in the coastal lowlands, inland valleys, and Central Valley (Granholm 1990). However, recent water developments have negatively influenced population densities by affecting nesting environments (CDFG 1995).

Distribution in the CALFED Solution Area and EWA Action Area. The great egret occurs in all Ecosystem Restoration Program ecological zones and throughout the EWA Action Area (Figure 3-6).

Life History and Habitat Requirements. Great egrets use a wide variety of fresh, brackish, and saltwater habitats including coastal estuaries, fresh and saline emergent wetlands, ponds, slow moving rivers, mudflats, salt ponds, and irrigated croplands and pasture (Granholm 1990). These egrets feed on fishes, amphibians, snakes, snails, crustaceans, insects and small mammals (NatureServe Explorer 2002). Hunting is diurnal. The great egreat stalks slowly or waits for prey, then rapidly striks with the bill (Granholm 1990).

This species is a colonial rooster and nester and requires thick riparian stands of large trees near aquatic foraging areas relatively isolated from human activities (Granholm 1990, CDFG 1995). Great egrets construct their nests of sticks, stems, and wetland plants in large trees from 3 to 25 meters off of the ground (CDFG 1995). Nesting generally occurs from March to July with clutches averaging 3 to 5 eggs. Downy, semi-altricial young are born after 26 days incubation (CDFG 1995). Young egrets depart the nest approximately 5 to 6 weeks after hatching. Once young are independent, individual egrets tend to separate and explore other areas (Granholm 1990). The average lifespan of a great egret is approximately 23 years (Klimkiewicz 2002).

Reasons for Decline. Egrets are sensitive to human proximity and may abandon nests if they feel threatened (Granhom 1990). Other human disturbances in nesting environments, such as thinning at riparian nest sites, can reduce clutch success, decrease protection against high winds, and increase exposure to avian predators

(CDFG 1995). Other threats to egrets include pesticides, loss of suitable wetland habitat, and high winds that can destroy nests, eggs, and nestlings (Granholm 1990).

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Better information on the current abundance of this species and identification of rookeries would increase understanding of this species in the study area (CDFG 1995).

Great Egret Citations

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3.3.6 Greater Sandhill Crane *(Grus canadensis tabida)*

Legal Status. The greater sandhill crane is listed as threatened under the California Endangered Species Act and is a fully protected species under the California Fish and

Game Code (CDFG 2003). It is also listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003).

Historical and Current Distribution and Status. The greater sandhill crane breeds from southwestern British Columbia south to northern California and northern Nevada, in the Rocky Mountain region from Montana to northern Colorado, in the central plains and Great Lakes region from southern Manitoba and northern Minnesota to central Wisconsin and southern Michigan, and also southeastern Ontario. The historic breeding range included southern British Columbia, central and southern Alberta, Saskatchewan, northern Manitoba, southwestern Ontario, and Michigan, south to northeastern California, northern Nevada, Arizona, northern Utah, northwestern Colorado, Nebraska, Iowa, Illinois, Indiana, and central Ohio.

The Great Lakes population winters in Florida, the Rocky Mountain population winters along the Rio Grande in New Mexico and in northern Chihuahua, and westernmost breeding populations winter in California, including the Central and Imperial Valleys (Johnsgard 1983). Between 3,400 and 6,000 greater sandhill cranes winter in the Sacramento Valley and Sacramento-San Joaquin River Delta (Pogson and Lindstedt 1991, California Department of Fish and Game 1997, Pacific Flyway Council 1997). There are breeding populations present in the northern counties of California.

Distribution in the CALFED Solution Area and EWA Action Area. Greater sandhill cranes winter in the North Sacramento Valley, Butte Basin, Colusa Basin, Yolo Basin, Feather River/Sutter Basin, American River Basin, and Sacramento-San Joaquin Delta Ecological Zones (Figures 3-7 and 3-8).

Life History and Habitat Requirements. California populations of the greater sandhill cranes nest in extreme northern California in open areas of wet meadows that are often interspersed with emergent marsh and usually build their nests over shallow water. No nesting occurs within the EWA Action Area.

Within the EWA Action Area, favorable roost sites and an abundance of cereal grain crops characterize the winter concentration areas. Rice is the primary food source for cranes near Gray Lodge WA, Butte County, and corn is the most important food at the majority of other concentration areas in the Central Valley, particularly in the Sacramento - San Joaquin delta. Irrigated pastures are used extensively as loafing sites in some wintering areas

Greater sandhill cranes have an omnivorous diet consisting primarily of vegetable matter such as small grains; however, they will consume almost any available food. They feed in pastures, flooded grain fields, and seasonal wetlands. Toads, frogs, eggs, young birds, small rodents, invertebrates, roots, and tubers are all included in their diet. However, animal matter, except for certain invertebrates, is taken primarily opportunistically and should not be considered a major component of the diet of cranes.

Reasons for Decline. The greater sandhill crane has declined for a variety of reasons, including loss of wetlands in breeding and wintering habitats, human disturbance at nesting sites, and mower-caused mortality on the breeding grounds (Littlefield 1982, Littlefield et. al 1994, California Department of Fish and Game 1997).

A 5-year status review of the greater sandhill crane conducted by California Department of Fish and Game Wildlife Management Division Nongame Bird and Mammal Program identified the following threats to the greater sandhill crane in California: increased occurrence of flood and drought conditions, predation from increasing raven populations, powerline collision, habitat loss due to cattle grazing and crop growth, the lowering of water table which decreases stream and creek flows, disease, and parasites (Schlorff 1994).

Designated Critical Habitat. None.

Conservation Efforts. Measures under the CALFED Bay-Delta Program are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan will be completed as a provision of AB1280 and will be submitted by the California Department of Fish and Game for approval by the Fish and Game Commission (California Department of Fish and Game 2000). The CDFG did not meet the 2001 deadline for getting an approved recovery plan. A Federal Flyway Management Plan has existed since 1983 and was revised in 1997 (Pacific Flyway Council 1997). Both documents are consistent with the provisions of CESA regarding the recovery of the greater sandhill crane in California.

Research and Monitoring Gaps. The extent of disease and parasites in California nesting populations is not well known. Predator populations should also be monitored (CDFG 1994).

Greater Sandhill Crane Citations

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3.3.7 Long-Billed Curlew (*Numenius americanus*)

Legal Status. The long-billed curlew is designated as a California Species of Special Concern (CDFG 2002), a Migratory Nongame Bird of Management Concern (USFWS 1995), and a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). This species is not listed under the California Endangered Species Act, but is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003). This species is also listed on the Audubon Watchlist (CDFG 2003).

Historical and Current Distribution and Status. The long-billed curlew breeds from southern British Columbia, southern Alberta, southern Saskatchewan, southern Manitoba south to eastern Washington, northeastern California, Nevada, Utah, southern Colorado, New Mexico, and northern Texas east to southwestern Kansas. Non-breeding populations have been found in central California, southern Arizona (rarely), extreme northern Mexico, southern Texas, southern Louisiana, coastal South Carolina south to southern Mexico (Oaxaca, Veracruz, Yucatan Peninsula) and northern Gulf Coast east to Florida, irregularly to Guatemala, Honduras, Costa Rica, and Venezuela (Natureserve 2001).

In California the long-billed curlew is a migrant with two seasonal influxes: wintering visitors and summer breeders. Summer breeding populations occur in the Siskiyou, Modoc, and Lassen Counties in northeastern California. Winter transients occur along the coast, in the Central and Imperial Valleys, where their numbers are greatest (Zeiner et al. 1990). Both winter visitors and summer breeders are fairly numerous, but Grinnell and Miller (1944) had documented that numbers had declined dramatically since 1900. Small numbers of nonbreeders remain on the coast in summer, and larger numbers remain in some years in the Central Valley (Cogswell 1977, Page et al. 1979, Garrett and Dunn 1981, Swarth 1983).

Distribution in the CALFED Solution Area and EWA Action Area. During the nonbreeding season, the long-billed curlew occurs in the Butte Basin, Colusa Basin, Yolo Basin, Feather River/Sutter Basin American River Basin, Eastside Delta Tributaries, Sacramento-San Joaquin Delta, East San Joaquin Basin, West San Joaquin, and Suisun Marsh/North San Francisco Bay Ecological Zones. This species does not breed in any of the ecological zones associated with the EWA Action Area (Figure 3-9).

Life History and Habitat Requirements. Summer populations arrive in northern California in April and leave by September. Preferred breeding habitats are elevated grasslands adjacent to lakes or marshes. Nests are built on the ground, away from water, and close to cover (Zeiner et al. 1990). Winter visitors arrive in July and stay until early April. Wintering flocks favor coastal estuaries, marshes, grasslands, and croplands (Small 1994). They nest on the ground, usually in flat areas with short grass, sometimes on more irregular terrain, often near rock or other conspicuous objects (NatureServe 2001). Central Valley wintering and non-breeding summer populations utilize grassland and cropland habitat.

The long-billed curlew is a fairly opportunistic feeder. This species normally feeds on various insects (grasshoppers, beetles, caterpillars, etc.) and eats some berries. During migration they also feed on crayfishes, crabs, snails, and toads. They may obtain insect larvae by probing into loose soil (Allen 1980). Predation on nestling birds has been observed. The pick food from ground or water, probe with their bill in sand or mud in or near shallow water, and pluck berries (NatureServe 2001).

Reasons for Decline. The loss and fragmentation of marshes and coastal estuaries have contributed to the decline of the long-billed curlew. Pollution, urban runoff, and sewage discharge have contaminated many of the feeding grounds of this species.

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. More research is needed on the potential effect of mammalian predators on the long-billed curlew (NatureServe Explorer 2001).

Long-billed Curlew Citations

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3.3.8 Snowy Egret (*Egretta thula*)

Legal Status. The snowy egret is listed on the United States Bird Conservation Watch List (CDFG 2003). This species is also considered a Federal Species of Concern (formerly a species under consideration for listing), but is not listed under the California Endangered Species Act (CDFG 2003). The snowy egret is a specified bird in Fish and Game Code Section 3505 and has legal protection.

Historical and Current Distribution and Status. The snowy egret is a widely distributed species with breeding and wintering ranges that stretch from the U.S. to South America (NatureServe Explorer 2002). In California, this species is considered to be a year-round resident below 1,000 feet elevation in the southern three-fourths of the State (Bousman 2000). It is abundant in the seashore, coastal, interior, and Great Basin areas of the State and less common inland and north of Sonoma County (Bousman 2000). Snowy egrets from Central California migrate to Mexico for the first fall and winter; therafter, the egrets are generally nonmigratory. Seasonal movements tend to occur from nesting colonies and northern California areas to coastal and southern regions in the winter months (Granholm 1990). Populations along the central California coast leave for southern California coast locations from December to February; San Francisco Bay and Central Valley populations are common, year-round residents (Granholm 1990, Bousman 2000).

Before 1880, the snowy egret was considered to be locally common in the State. From the 1880s through 1920s, this egret was devastated by hunting and almost extirpated from the State. The egret has been recovering since the 1940s, and current abundance records estimate that populations in the bay area have reached carrying capacity (Bousman 2000). Data from Christmas Bird Counts (CBC) record a minimum population estimate for the bay area at 1,112 birds. While the data also show that population sizes fluctuate from year to year, populations have remained relatively stable over the past 25 years (Bousman 2000). While populations seem to have recovered, there is still concern about the availability of suitable rookery areas (CDFG 1995).

Distribution in the CALFED Solution Area and the EWA Action Area. The snowy egret occurs in all Ecosystem Restoration Program ecological zones and throughout the EWA Action Area (Figure 3-10).

Life History and Habitat Requirements. Snowy egrets use a wide variety of fresh, brackish, and saltwater habitats, including coastal estuaries, fresh and saline emergent wetlands, ponds, slow moving rivers, irrigation ditches, and wet fields (Granholm 1990). Egrets will be concentrated where suitable fish species are concentrated, such as seasonal wetlands, impoundments, and salt ponds (Bousman 2000). Egrets forage for fish, crayfish, amphibians, reptiles, worms, arthropods, small mammals, and snails in shallow water or along shores. Hunting techniques include stalking, waiting, luring, or flushing prey (Granholm 1990, CDFG 1995).

Snowy egrets nest colonially in marshy areas near brackish or saltwater areas. Nests are generally constructed of sticks in low trees about 1.5 to 3 meters from the ground; San Francisco Bay residents nest closer to the ground on Grindelia humilis, Salicornia pacifica, and Baccharis pilularis species. The main nesting requirements are protection and security from disturbance and predation and nearness to suitable wetland feeding areas (Bousman 2000). The breeding season is from late March to mid-May in central California with clutch sizes of 3 to 4; young leave the nest at 20 to 25 days (Granholm 1990). The lifespan of a snowy egret is approximately 17.5 years (Klimkiewicz 2002).

Reasons for Decline. A major threat to snowy egrets includes increased predation by burgeoning populations of nonnative red fox. One successful colony near Redwood City was abandoned for no clear reason, but researchers hypothesize that the decline may have been linked to red fox predation (Bousman 2000). In addition, populations near the Salton Sea have declined due to competition with cattle egrets (Granholm 1990). The success of egrets is likely linked to the general health of the estuary system, including secure riparian areas for nesting, adequate wetland area and prey base for foraging, and protection from direct disturbance by humans (CDFG 1995, Bousman 2000).

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species. Bousman (2000) provides management suggestions for the conservation of snowy egrets and their habitat.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. This species seems to be able to use a wide variety of habitats, but there are no quantitative data on the use of estuarine habitats for foraging. In addition, the factors behind the decline and abandonment of previously successful colonies require further study (Bousman 2000).

Snowy Egret Citations

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3.3.9 Tricolored Blackbird *(Agelaius tricolor)*

Legal Status. The tricolored blackbird is designated as a California Species of Special Concern (CDFG 2002), a Migratory Nongame Bird of Management Concern (USFWS 1995), a BLM Sensitive Species (CDFG 2003), and a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). This species is not listed under the California Endangered Species Act, but is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003). This species is also listed on the Audubon Watchlist (CDFG 2003).

Historical and Current Distribution and Status. Historically, tricolored blackbirds nested throughout much of California west of the Sierra Nevada, in coastal southern California, and in portions of northeastern California. Flocks and breeding colonies were observed in the Shasta region, Suisun Valley, and Solano County; and in or near Stockton, San Diego, Los Angeles, and Santa Barbara; Glenn, Sacramento, Butte, Colusa, Yolo, and Yuba Counties (Heermann 1853, Belding 1890, Baird 1870, Neff 1937, Orians 1961, Payne 1969). Extensive marshes that provided ample breeding habitat for tricolors in the Central Valley from overflowing river systems had been reduced by 50 percent by the mid-1980s (Frayer et al. 1989). Additionally, native perennial grasslands, which are primary foraging habitat, have been reduced by more than 99 percent in the Central Valley and surrounding foothills (Kreissman 1991).

Currently, tricolored blackbirds are found in the Sacramento Valley, San Joaquin Valley, San Francisco Bay and Delta, along the north coast and central coast, southern California, and the northeast interior of California; however, sizes of populations in many of these areas have been greatly reduced (Beedy and Hamilton 1997). In 1992, there were an estimated 250,000 adults in California (NatureServe Explorer 2001).

Distribution in the CALFED Solution Area and EWA Action Area. The tricolored blackbird nests in the American River Basin, Butte Basin, Colusa Basin, Cottonwood Creek and Yolo Basins, and the Sacramento-San Joaquin Delta, East San Joaquin Basin, Eastside Delta Tributaries, and in the Feather River/Sutter Basin Ecological Zones (Figure 3-11).

Life History and Habitat Requirements. For breeding-colony sites, tricolored blackbirds require open accessible water, a protected nesting substrate that is usually flooded or has thorny or spiny vegetation, and a foraging area that provides adequate insect prey within a few kilometers of the nesting colony (Beedy 1989, Hamilton et al. 1995). Types of vegetation in the colony area include cattails, tules, willow, blackberry, wild rose, and tall herbs. Nests are usually a few feet over, or near, freshwater and also may be hidden on ground among low vegetation. Nests are built of mud and plant materials. In addition to consuming insects, the tricolor also eats seeds and cultivated grains, such as rice and oats. It will often forage in croplands, pastures, grassy fields, flooded land, and along edges of ponds (Zeiner et al. 1990).

Tricolored blackbirds leave wintering areas in the Sacramento-San Joaquin Delta and along coastal central California in late March and early April. Its breeding season is from mid-April to late July. Breeding colonies will return to the same area year after year if the site continues to provide adequate nesting sites, water, and suitable foraging habitat (Dehaven et al. 1975).

Reasons for Decline. Decline of tricolored blackbird populations can be attributed to predation by numerous mammalian and avian species, habitat loss and alteration, poisoning to regulate the number of blackbirds preying on crops (Neff 1942), contaminants and pollution, and human disturbance (Beedy and Hamilton 1997). Habitat loss has occurred due to drainage of wetlands and conversion of former nest and roost sites to agriculture. The tricolored blackbird habitat is also possibly threatened by the growth of nonnative vegetation (Nature Serve Explorer 2001).

Designated Critical Habitat. None.

Conservation Efforts. Measures under the CALFED Bay-Delta Program are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Future research efforts could focus on developing an effective non-lethal control method for when the blackbird becomes a pest on agricultural fields (Nature Serve Explorer 2001). The current abundance of the blackbird in California is not well known and requires study.

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3.3.10 White-Faced Ibis (*Plegadis chihi*)

Legal Status. The white-faced ibis is designated as a species of special concern by the California Department of Fish and Game (CDFG 2003) and is listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003).

Historical and Current Distribution and Status. In California the white-faced ibis was once common, but, even by the 1940s, the white-faced ibis' population was declining (Grinnell and Miller 1944). By the 1970s, there were virtually no breeding white-faced ibises in California (Remsen 1978). In the 1980s, after decades of decline, the population of this species began to rebound. Since 1980, rookery sites have been recorded in Colusa, Yolo, Fresno, Kings, Siskiyou, and Modoc Counties (Natural Diversity Database 1998).

Outside of California the white-faced ibis is known to breed in eastern Oregon, southern Idaho (Taylor et al. 1989), Montana, southern North Dakota, and (formerly) southwestern Minnesota south into Mexico (to Colima, Zacatecas, State of Mexico, Veracruz), Texas, and southwestern Louisiana, southern Alabama, Florida (occasionally or formerly); also locally in South America in Bolivia, Paraguay, Uruguay, southern Brazil, northern and central Chile, and northern and central Argentina (AOU 1983). The world's largest nesting aggregation occurs probably in the marshes around the Great Salt Lake, Utah (D. Paul, in Paton et al. 1992). In non-breeding times the white-faced ibis can be found commonly from northern to southern California, Baja California, southern Texas, and Louisiana, south through lowlands to Guatemala and El Salvador, and more generally across its breeding range in South America (AOU 1983). In the United States, the highest winter densities occur near San Diego in California and on the coast of Texas and western Louisiana (Root 1988). It sometimes wanders outside its usual range and is a rare straggler to Hawaii.

Distribution in the CALFED Solution Area and EWA Action Area. The white-faced ibis nests and winters in the Yolo Basin, Colusa Basin, and West San Joaquin Basin Ecological Zones. It also winters in the Butte Basin, Feather River/Sutter Basin, American River Basin, Sacramento-San Joaquin Delta, and Suisun Marsh/North San Francisco Bay Ecological Zones (Figure 3-12).

Life History and Habitat Requirements. The white-faced ibis requires freshwater marshes and other wetlands for nesting sites and for wintering foraging grounds. The ibis forages in shallow waters, including seasonal wetlands and rice fields, or on muddy banks where it probes for invertebrates, small fish, and amphibians (Zeiner et al. 1990).

The species nests from May to July in dense freshwater marsh vegetation near foraging areas (Zeiner et al. 1990). Nests are built among tall marsh plants out of dead tules or cattails. It may also nest in very low trees (Cogswell 1977). Although white-faced ibises were formerly more common, especially in the San Joaquin Valley, some sources claim they no longer breed regularly anywhere in California (CDFG 2002). However, others believe that breeding populations can be found, and are increasing in number, in isolated areas of the Central Valley (CDFG). Clutch size usually is 3-4. Incubation lasts 21-22 days (NatureServe Explorer 2001).

The white-faced ibis is an uncommon summer resident in sections of southern California, a rare visitor in the Central Valley, and is more widespread in migration (CDFG 2002). In California, the white-faced ibis winters mainly in San Joaquin Valley and Imperial Valley, but is widely recorded as a transient. The population at Salton Sea is reduced sharply from October to March, suggesting a southward migration. It is resident in the southern part of its breeding range, and migrates in northern areas. Northern populations winter from the southern U.S. south to northern Central America (NatureServe Explorer 2001).

Reasons of Decline. The loss of freshwater marshes and other wetlands is the main reason for this species' decline. White-faced ibises are vulnerable to fluctuating water levels, which further limits the number of breeding locations (NatureServe Explorer 2001). Pesticide contamination, especially by DDT, resulted in nest failures and caused population declines in areas where suitable habitat was available (Remsen 1978).

Designated Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species. CDFG (2000) provides management recommendations for restoring white-faced ibis breeding habitat.

Recovery Plan and Recovery Guidance. A recovery plan has not been prepared, and recovery requirements have not been identified for this species.

Research and Monitoring Gaps. Habitat loss and degradation are major factors in the decline of the white-faced ibis in California. Other factors are probably involved but have not been identified (CDFG 2000).

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3.4 Species Accounts for Reptiles

3.4.1 Giant Garter Snake *(Thamnophis gigas)*

Legal Status. The giant garter snake is listed as threatened under the California and Federal Endangered Species Acts (CALFED 2000).

Historical and Current Distribution and Status. Historically, the giant garter snake was found throughout the Central Valley, from Butte County south to Kern County (CALFED 2000). However, the giant garter snake was probably absent from the northern portion of the San Joaquin Valley because the floodplain of the San Joaquin River is confined to a narrow area. Because extensive marshes are known to have once occurred in the Delta, it is possible that giant garter snakes historically occupied this area (Hansen 1986, 1988).

Today, populations of the giant garter snake are found in the Sacramento Valley and isolated portions of the San Joaquin Valley, making up 13 recognized populations representing a cluster of discrete locality records (USFWS 1993, 1999). The 13 extant populations largely coincide with historical riverine flood basins and tributary streams throughout the Central Valley (G. Hansen 1980, Brode and Hansen 1992): 1) Butte Basin, 2) Colusa Basin, 3) Sutter Basin, 4) American Basin, 5) Yolo Basin/Willow Slough, 6) Yolo Basin/Liberty Farms, 7) Sacramento Basin, 8) Badger Creek/Willow Creek, 9) Caldoni Marsh, 10) East Stockton – Diverting Canal and Duck Creek, 11) North and South Grasslands, 12) Mendota, and 13) Burrel/Lanare. Agricultural and flood control activities have extirpated the giant garter snake from the southern 1/3 of its range in the former wetlands associated with the historic Buena Vista, Tulare, and Kern lakebeds (Hansen and Brode 1980, R. Hansen 1980, CDFG 1992, G. Hansen 1986, G. Hansen 1988).

Populations in the Colusa, Butte, Sutter, and American River Basins are associated with rice production and occupy the agricultural water delivery and drainage ditches (58 FR 54053, October 20, 1993). Since April of 1995, the Biological Resources Division (BRD) of U.S. Geological Survey has further documented occurrences of giant garter snakes at the Sacramento and Colusa National Wildlife Refuges within the Colusa Basin, at Gilsizer Slough within the Sutter Basin, at the Badger Creek area of the Consumnes River Preserve within the Badger Creek-Willow Creek area, and in the Natomas Basin within the American Basin (Wylie 1999, Wylie and Cassaza 2000, Wylie et. al. 2000). These populations of giant garter snakes represent the largest extant populations.

Distribution in the CALFED Solution Area and EWA Action Area. The giant garter snake is present in the Ecological Zones of the Butte, Feather River/Sutter, Colusa, Yolo, and American River Basins; the Eastside Delta Tributaries, Sacramento-San Joaquin Delta; East San Joaquin Basin; and West San Joaquin Basin (CALFED 2000) (Figure 3-13).

Life History and Habitat Requirements. The giant garter snake is endemic to emergent wetlands in the Central Valley (CALFED 2000). The species' habitat includes marshes; sloughs; ponds; small lakes; and low-gradient waterways, such as small streams, irrigation and drainage canals, and rice fields (58 FR 54053, October 20, 1993).

Rice Fields: Ricelands, associated waterways, and adjacent uplands provide the most important agricultural habitat for the giant garter snake, particularly in the Sacramento Valley portion of their range (USFWS 1999). Gravid female garter snakes have been observed to utilize maturing rice fields and to remain in the rice fields to feed after parturition; neonate garter snakes have also been observed feeding in rice fields (Hansen pers. comm.). In current studies being conducted by the U.S.G.S. Biological Resources Division (BRD), 50 percent of radio-telemetered giant garter snakes have been observed in rice fields, especially along the edges of the fields and when the rice plants are high enough to provide sufficient cover (Glenn Wylie, pers. comm.). Giant garter snakes seasonal activity associated with rice cultivation typically occurs as follows:

Spring: Rice is planted and the fields are flooded with several inches of water. Prey species (e.g., small fish and frogs) migrate into rice fields from ditches and drains that retain water year round and where they over winter, eventually attracting giant garter snakes into the fields.

Summer: Once the rice plants are high enough to provide cover, giant garter snakes use the rice fields to feed and bear their young (see above). They will use the fields so long as there is sufficient water and quantities of prey.

Late Summer/Fall: The water is drained from the rice fields and garter snakes move off the fields to other adjacent habitats. The rice is harvested. At this time female garter snakes have just borne young and need food to regain their body weight. Prey species that were in the rice fields now concentrate in the ditches and drains where the snakes can find a ready food source.

Winter: Giant garter snakes enter a dormant period inside winter retreats (e.g., small mammal burrow). During the winter rice fields are often flooded or burned for rice straw decomposition.

Irrigation Canals/Drainage Ditches: Giant garter snakes adapt well to manmade waterways as represented by conveyance systems. In fact, irrigation canals and drainage ditches, together with their associated levees and adjacent embankments, are probably an essential component of giant garter snake habitat in the EWA Action Area. Irrigation canals provide an essential habitat component, but also create dispersal corridors allowing garter snakes to move from one area to another in search of mates, new territories, summer habitat, etc. Irrigation ditches and canals constituted 50 percent of all habitat use by giant garter snakes.

The giant garter snake requires adequate water with herbaceous, emergent vegetation for protective cover and foraging habitat (Hansen and Brode 1980). Generally quite aquatic, these garter snakes forage primarily in and along streams taking fish and amphibians and amphibian larvae Fitch 1941). Most current food may be introduced species such as carp, mosquitofish, and bullfrogs, because the native prey such as blackfish, thick-tailed chub, and red-legged frog, is no longer available (Rossman et al. 1996) (WHRS 1988-90).

Open areas and grassy banks are needed for basking. Small mammal burrows and other small crevices at higher elevations provide winter hibernation sites and refuge from floodwaters (58 FR 54053, October 20, 1993). The nature of the home range of garter snakes in California is not well known. There is likely considerable overlap in the home ranges of neighboring individuals. The garter snake is not thought to be territorial. Although this species is not well studied, other garter snakes have not been observed exhibiting behaviors suggesting territoriality (CWHR 1988-1990).

All three habitat components (cover and foraging habitat, basking areas, and protected hibernation sites) are needed. Because of their lack of basking areas and the lack of prey populations, riparian woodlands usually do not support the giant garter snake (Hansen and Brode 1980). Additionally, larger rivers generally do not support the snake because they are highly managed and channelized and do not provide suitable habitat such as emergent vegetation, slow moving waters, and adequate basking sites.

Reasons for Decline. Habitat loss to agricultural development has been the primary factor in the decline of giant garter snake populations. Small remaining populations are susceptible to predation by fish, mammals, and birds. Additional causes of mortality include vehicular traffic, agricultural practices, and maintenance of water channels.

Perhaps California's most aquatic garter snake, populations have been eliminated or decimated by the elimination of natural sloughs and marshy areas. Heavy use of pesticides is suspected as a contributing factor in the decline of this once-abundant garter snake of the Central Valley. Protection of waterfowl habitat may allow it to survive in a small portion of its original range (CWHR 1988-1990).

USFWS (1993) listed threats as habitat loss (e.g., through large-scale urbanization in the American River Basin, dewatering of habitat through water diversions, and impoundments), flooding (in rice production areas), contaminants (e.g., selenium and salinity in North and South Grassland areas), agricultural and vegetation maintenance activities (e.g., on levees and canal borders), vehicular traffic (on levees and roads along canals), livestock grazing, and introduced predators (e.g., house cats, bullfrogs, perhaps bass). See USFWS (1993) for information on threats to specific populations (NatureServe 2001).

Designated Critical Habitat. None.

Conservation Efforts. Measures under the CALFED Bay-Delta Program are designed to restore and enhance suitable habitat for this species (CALFED 2000).

Recovery Plan and Recovery Guidance. The USFWS developed a Draft Recovery Plan for the Giant Garter Snake (Federal Register 64:36033; July 2, 1999). The overall objective of this recovery plan is to delist the giant garter snake. Interim goals are twofold, to stabilize and protect existing populations and to conduct research necessary to further refine recovery criteria. The plan has five main recovery objectives that will advance efforts towards the attainment of this goal. They include 1) habitat protection; 2) public participation, outreach, and education; 3) habitat management and restoration; 4) surveying and monitoring; and 5) research.

Research or Monitoring Gaps. Research throughout the Central Valley on distribution and the biological requirements of the giant garter snake needs to continue, including the relationship between giant garter snakes and rice. Research should also be conducted on demographics, population genetics, and habitat use.

Giant Garter Snake Citations

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3.4.2 Western Pond Turtle (*Clemmys marmorata)*

Legal Status. The western pond turtle is designated as a California species of special concern by the California Department of Fish and Game (CDFG 2003) and is listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). It is identified by CALFED as a species of concern.

Historic and Current Distribution and Status. The western pond turtle is the only abundant turtle native to California (Zeiner et al. 1988). It was historically found in most Pacific slope drainages between the Oregon and Mexican borders (Jennings and Hayes 1994). The species is still found in most suitable habitats west of the Sierra-Cascade crest in California, but trends show populations to be declining (Jennings and Hayes 1994). The species is absent from desert regions except in the Mojave Desert along the Mojave River and its tributaries. The western pond turtle in found at elevations ranging from sea level to 1,830 m (6,000 ft) (California Wildlife Habitat Relationship (CWHR) System 1988-90).

Distribution in the CALFED Solution Area and EWA Action Area. The western pond turtle occurs in all Ecosystem Restoration Program ecological zones (Figure 3-14).

Life History and Habitat Requirements. The western pond turtle is generally associated with permanent or nearly permanent water in a variety of habitat types. Individuals normally associate with permanent ponds, lakes, streams, irrigation ditches, or permanent pools along intermittent streams. Hatchlings may be subject to rapid death by desiccation if exposed to hot, dry conditions (CWHR System 1988-90). The western pond turtle inhabits waters with little or no current (Behler and King 1998). The banks of inhabited waters usually have thick vegetation, but basking sites such as logs, rocks, or open banks must also be present (Zeiner et al. 1988). Turtles slip from basking sites to underwater retreats at the approach of humans or potential predators. Hibernation in colder areas is passed underwater in bottom mud (CWHR System 1988-90).

Pond turtles lay their eggs in nests in upland areas, including grasslands, woodlands, and savannas. The nest sites are typically found on a slope that is unshaded and has a high clay or silt composition (Jennings and Hayes 1994). Storer (1930) suggested that two distinct habitats may be used for oviposition. Along large slow-moving streams, eggs are deposited in nests constructed in sandy banks. Along foothill streams, females may climb hillsides, sometimes moving considerable distances to find a suitable nest site. Nussbaum et al. (1983) reports a nest in a clover field 100 m (325 ft) from water. Nests have been observed in many soil types from sandy to very hard (CWHR System 1988-90). Turtles lay their eggs from March to August, depending on local conditions, and incubation lasts from 73-80 days (Zeiner et al. 1988). Western pond turtles are omnivorous and feed on aquatic plant material, aquatic invertebrates, fishes, frogs, and even carrion (Zeiner et al. 1988).

During the spring or early summer, females move overland for up to 100 m (325 ft) to find suitable sites for egg-laying. Other long distance movements may be in response to drying of local bodies of water or other factors. The home range of the turtle is normally quite restricted (Bury 1970, 1972) except for occasional long distance movements as described above (CWHR System 1988-90).

The western pond turtle is not known to be territorial, but aggressive encounters including gesturing and physical combat (Bury and Wolfheim 1973) are common and may function to maintain spacing on basking sites and to settle disputes over preferred spots (CWHR System 1988-90).

This is the only abundant native turtle in California. Hatchlings and juveniles are preyed upon by a variety of vertebrate predators including certain fishes, bullfrogs, garter snakes, wading birds, and some mammals. Competitive interactions with other species have not been reported (CWHR System 1988-90).

Reasons for Decline. Studies showing a bias toward adults indicate that little or no recruitment is taking place. Many nesting sites are being affected during the incubation period by agricultural or livestock activities, leading to annual nesting failures (Jennings and Hayes 1994). The loss and alteration of wetlands, streams, and ponds have contributed to the species' decline.

Introductions of nonnative predators (bullfrogs and bass) probably have been detrimental. Decline is due also to alteration, loss, and fragmentation of habitat; many populations have been lost as a result of urbanization and agricultural development in the area south of central California (R. B. Bury and D. Holland, Rathbun et al. 1992, NatureServe 2001). Disease and mortality from fishing is also implicated in the decline of this species (CDFG 2000).

Designated Critical Habitat. None.

Conservation Efforts. Conservation efforts have not been identified for this species. CDFG (2000) presents important issues to consider in the protection of this species.

Recovery Plan and Recovery Guidance. A recovery plan for this species in California has not been prepared, and requirements have not yet been identified for this species. The Washington State Department of Fish and Wildlife has prepared a recovery plan for this species (Hays 1999).

Research and Monitoring Gaps. While there may be a couple hundred extant occurrences of the pond turtle in California, the viability of these populations is not known, and better information on the demography of this species is needed. (NatureServe Explorer 2001). Studying metapopulation dynamics, movement responses, and recolonizing ability would help elucidate the status and ecology of this species in California (CDFG 2000). The role of introduced predators in the decline of this species requires further study. Recovery efforts would be enhanced by developing better monitoring and management methods (NatureServe Explorer 2001).

Western Pond Turtle Citations

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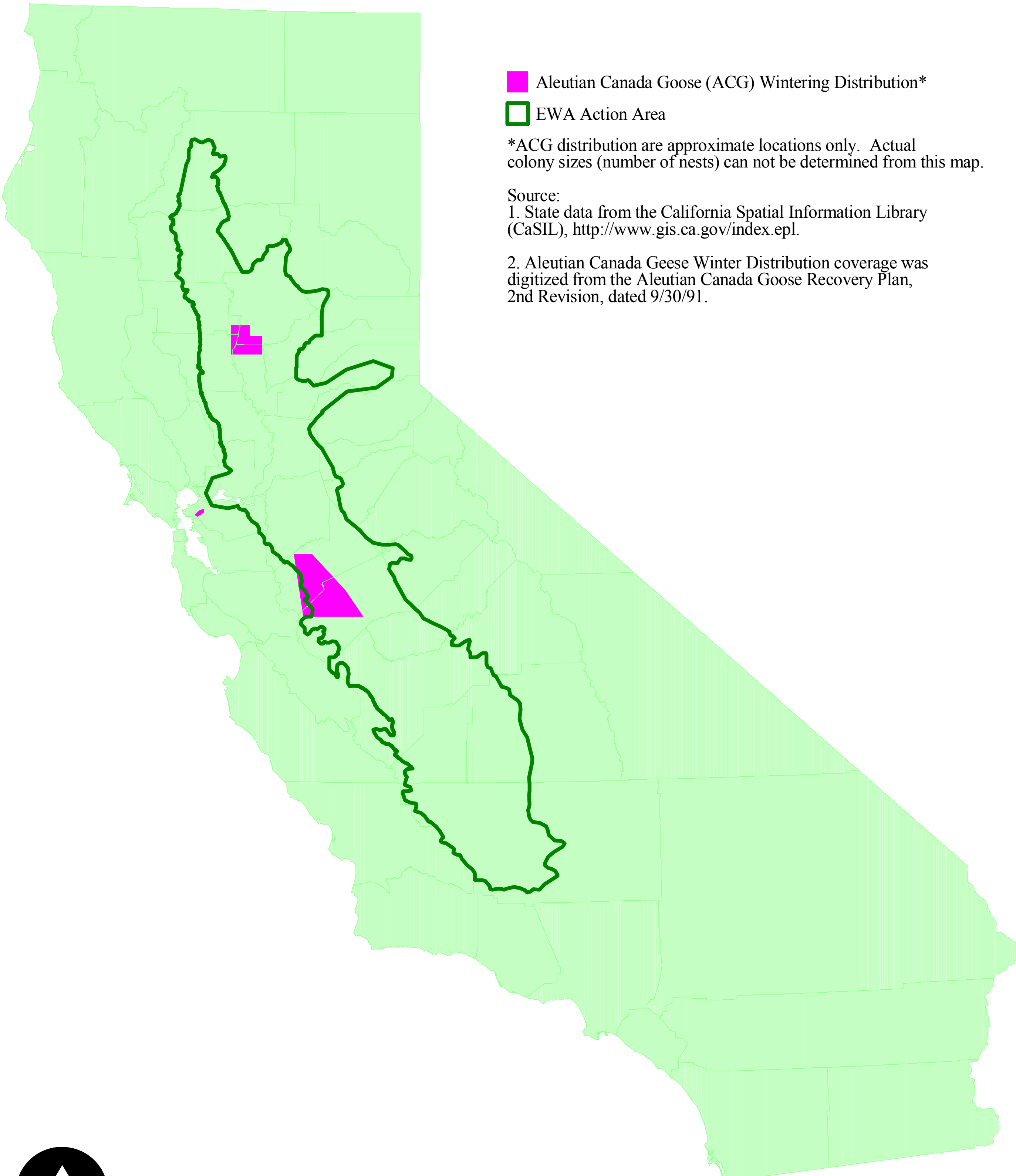
Distribution of Aleutian Canada Geese Winter



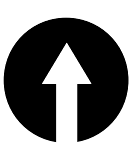


Figure 3-1
Distribution of Aleutian Canada Geese Winter

Northern California Distribution of Black Tern Nesting Colonies

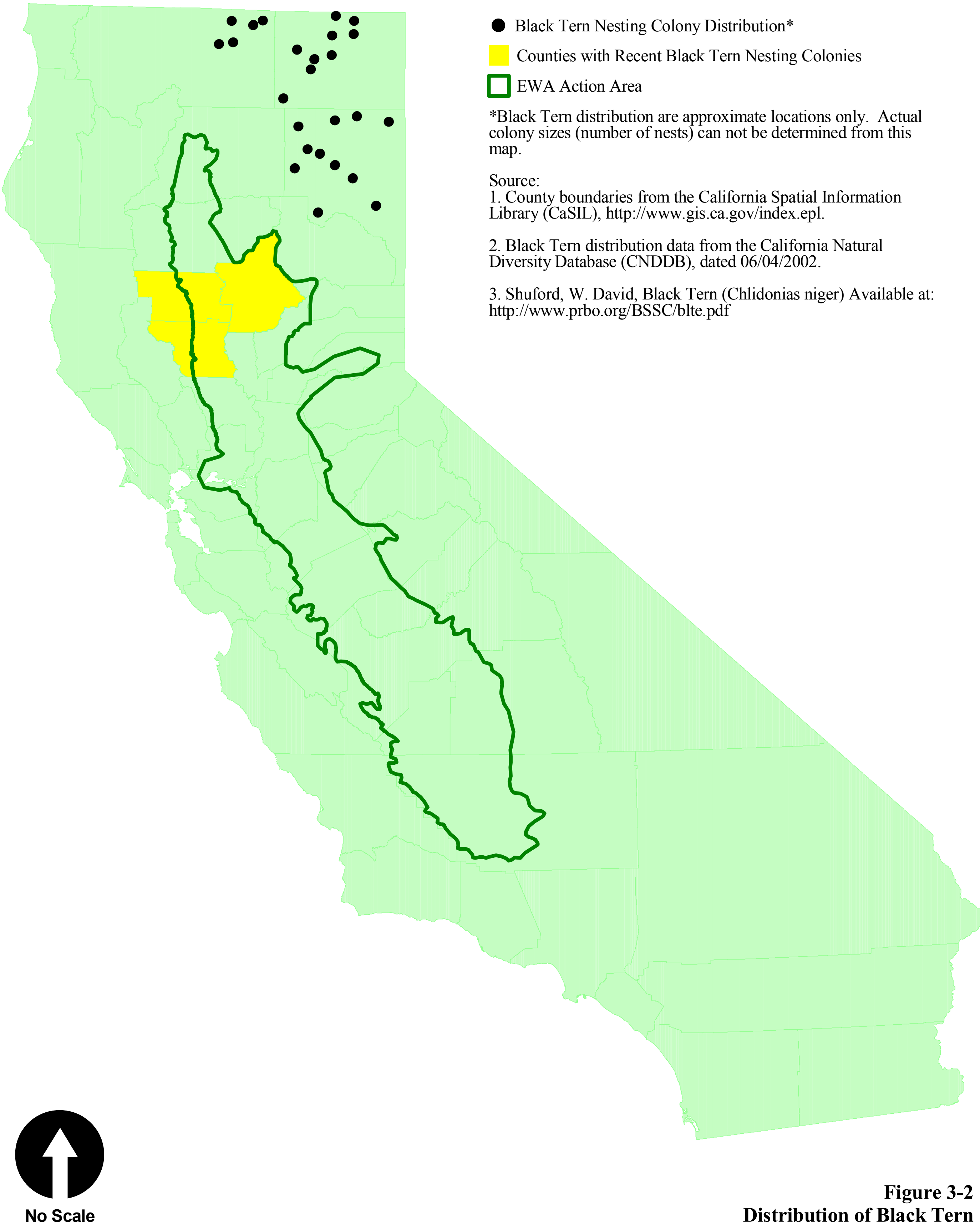


Figure 3-2
Distribution of Black Tern

Distribution of Black Tern Nesting Colonies in Potential Rice Idling Areas

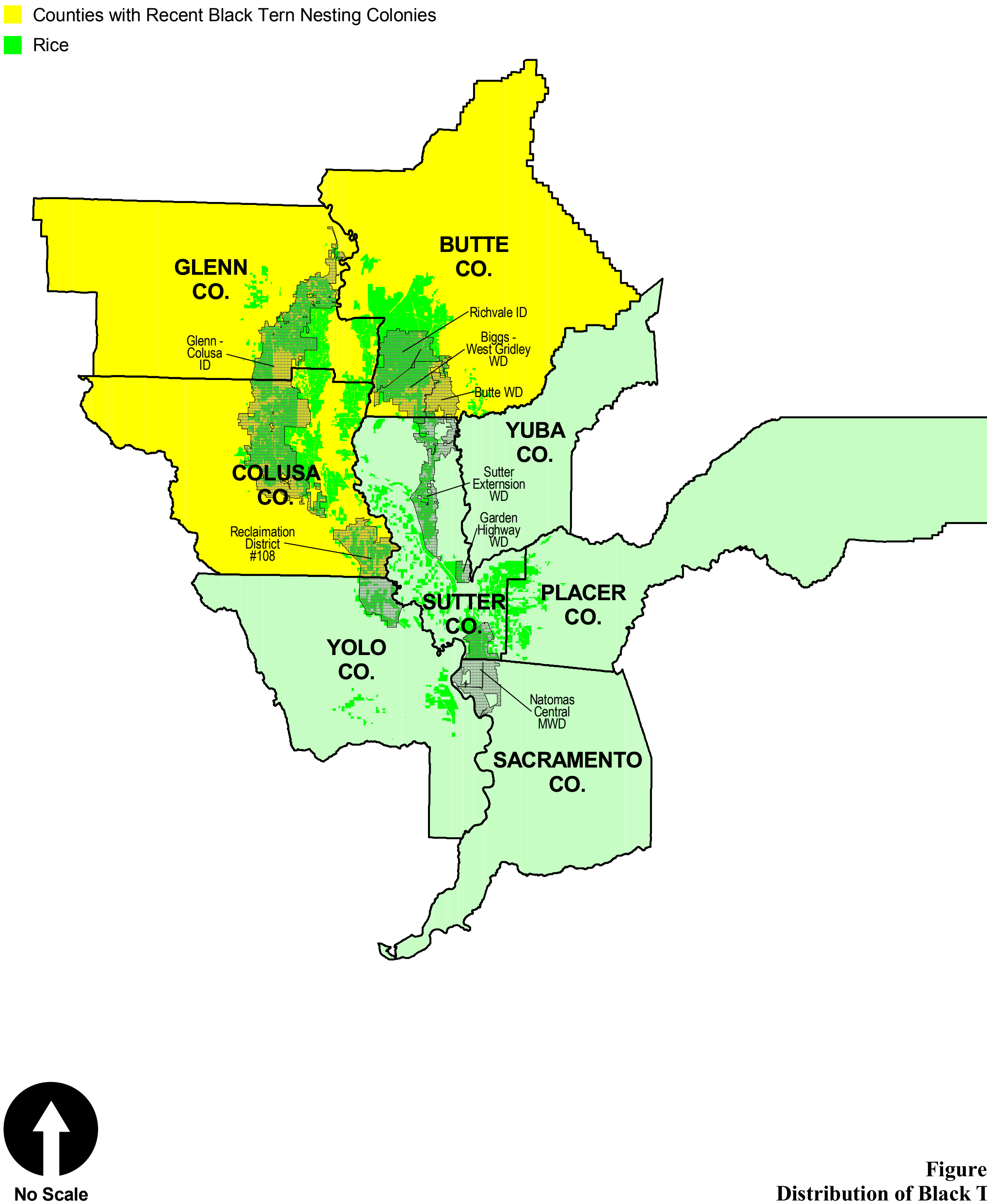


Figure 3-3
Distribution of Black Tern

Distribution of Black-crowned Night Heron Rookery

Figure 3-4
Distribution of Black-crowned Night Heron Rookery

Distribution of Great Blue Heron Rookery

Figure 3-5
Distribution of Great Blue Heron Rookery

Distribution of Great Egret Rookery

Figure 3-6
Distribution of Great Egret Rookery

Distribution of Greater Sandhill Crane

*Greater Sandhill Crane distribution are approximate locations only. Actual colony sizes (number of nests) can not be determined from this map.

Source:
1. State data from the California Spatial Information Library (CaSIL), http://www.gis.ca.gov/index.epl.

2. Greater Sandhill Crane Distribution coverage was digitized from the Aleutian Canada Goose Recovery Plan, 2nd Revision, dated 9/30/91.

Figure 3-7
Distribution of Greater Sandhill Crane

Distribution of Greater Sandhill Crane Colonies in Potential Rice Idling Areas

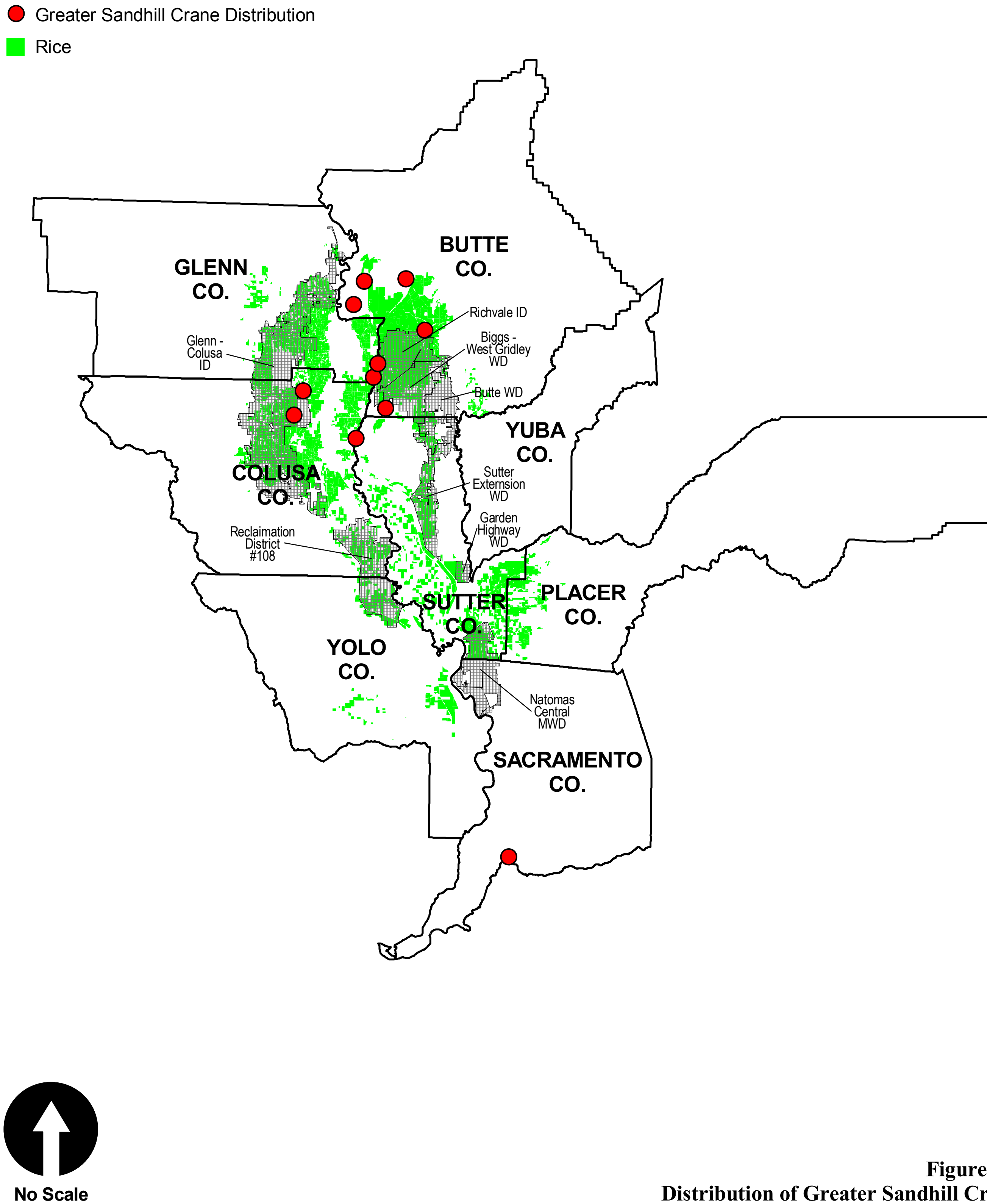


Figure 3-8
Distribution of Greater Sandhill Crane

Distribution of Long-billed Curlew

Figure 3-9
Distribution of Long-billed Curlew

Distribution of Snowy Egret

Figure 3-10
Distribution of Snowy Egret

Distribution of Tri-colored Blackbird Nesting Colonies

Figure 3-11
Distribution of Tri-colored Blackbird Nesting Colonies

Distribution of White-faced Ibis Nesting

Figure 3-12
Distribution of White-faced Ibis Nesting

Distribution of Giant Garter Snake

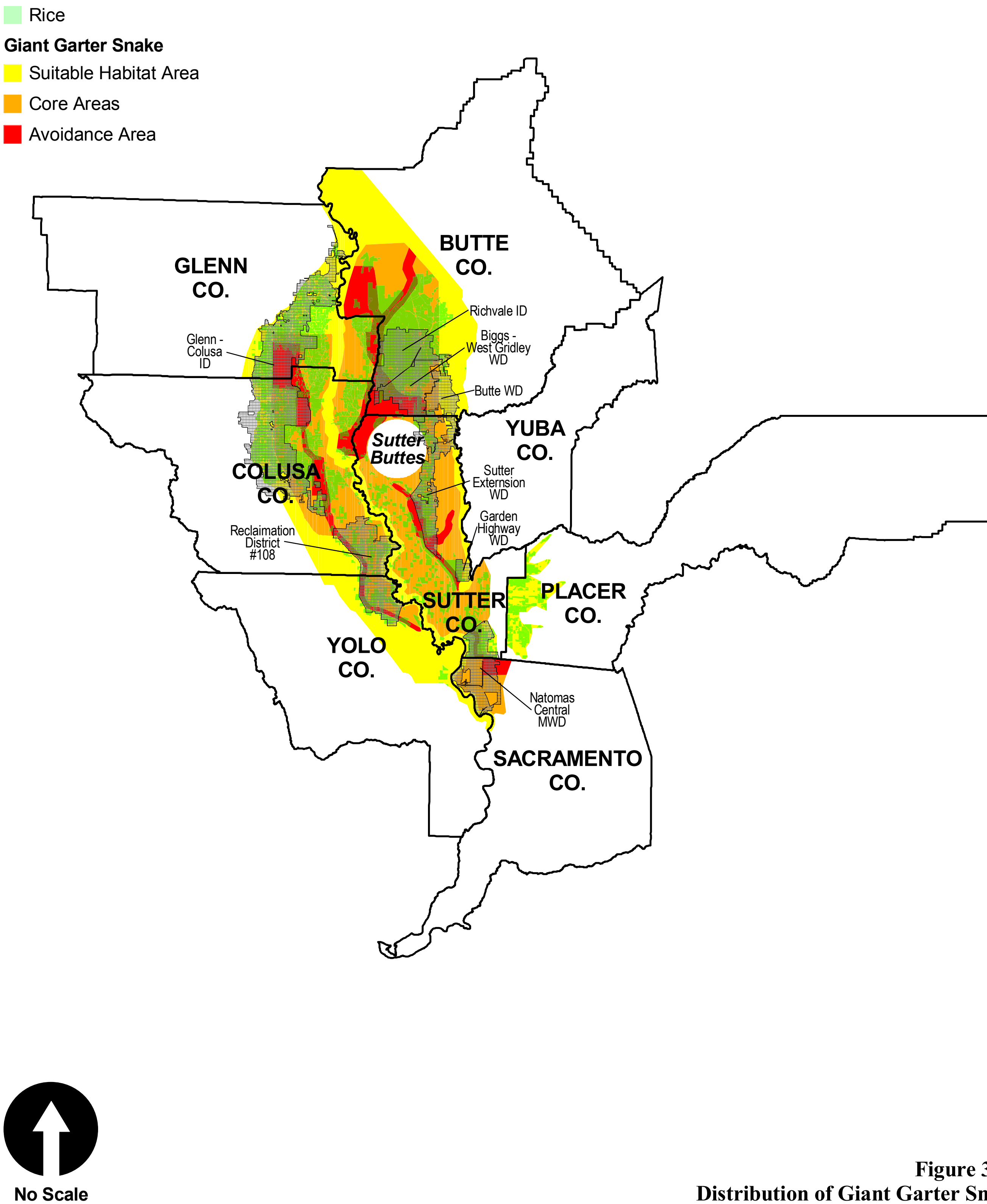


Figure 3-13
Distribution of Giant Garter Snake

Distribution of Western Pond Turtle

Figure 3-14
Distribution of Western Pond Turtle

Chapter 4
Species Assessment Methods and Impact Analyses

4.1 Introduction

This section describes the methods used to determine potential effects of the EWA Proposed Action on special-status fishery resources within the Action Area. Special-status fish species within the Action Area are comprised of those species that are Federally and state-listed species and species that are candidates for federal listing including:

- Winter-run Chinook salmon (*Oncorhynchus tshawytscha*);
- Spring-run Chinook salmon (*Oncorhynchus tshawytscha*);
- Steelhead (*Oncorhynchus mykiss*);
- Delta smelt (*Hypomesus transpacificus*);
- Sacramento splittail[1] (*Pogonichthys macrolepidotus*);
- Fall-run/late-fall-run Chinook salmon[2] (*Oncorhynchus tshawytscha*); and
- Green sturgeon[3] (*Acipenser medirostris*).

Evaluating potential effects on fishery resources within the Action Area requires an understanding of fish species' life histories and lifestage-specific environmental requirements. This information is provided for the special-status fish species listed above that occur (or potentially occur) within the Action Area in Section 9.1, Affected Environment/Existing Conditions of the EWA EIS/EIR. Ecological and status information on these species is provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP.

Fall-run/late-fall-run Chinook salmon, winter-run Chinook salmon, spring-run Chinook salmon, steelhead, delta smelt, Sacramento splittail, and green sturgeon are sensitive to changes in both river flow and water temperature throughout the year. An evaluation of effects on these special-status fish species is believed to reasonably encompass the range of potential effects upon other fish resources (hardhead, white

[1] Under a Federal District Court ruling, the splittail rule has been remanded to USFWS. Splittail continue to be treated as a listed species, however no actions that may harm water users may be taken to protect splittail (DOI 2003).
[2] The Central Valley fall-run/late-fall-run Chinook salmon is identified as one Evolutionarily Significant Unit (ESU), and is a candidate species under the federal Endangered Species Act (ESA).
[3] NOAA Fisheries recently reviewed the petition for listing green sturgeon and determined that such listing currently is not warranted, although it is still considered a candidate species.

sturgeon, longfin smelt, Pacific lamprey, river lamprey, Kern brook lamprey, Sacramento perch, San Joaquin roach) that could occur with implementation of the Proposed Action relative to the basis of comparison. Furthermore, there is not sufficient information available regarding these species to develop rigorous effect indicators and evaluation criteria similar to those developed for the special-status species listed above. Therefore, because several of the life history requirements (e.g., spawning temperature ranges) for these species are similar to or less stringent than those for Chinook salmon, the life history and species criteria (water temperature and flow) used for Chinook salmon is thought to be more conservative and will apply to these species. Brief species-specific narratives supporting this assumption are provided in Section 9.1, Affected Environment/Existing Conditions of the EWA EIR/EIS.

The analysis of effects of a particular action on a biological resource can be composed of one or more types of effects. Direct and indirect effects, interrelated and interdependent effects, and cumulative effects are defined below.

Direct and Indirect Effects. Under FESA, direct effects are those that are caused by the proposed action and occur at the time of the action. According to the USFWS and NOAA Fisheries, indirect effects*"…are caused by or result from the proposed action, are later in time, and are reasonably certain to occur, e.g., predators may follow ORV tracks into piping plover nesting habitat and destroy nests; the people moving into the housing unit may bring cats that prey on the mice left in the adjacent habitat. Indirect effects may occur outside of the area directly affected by the action"* (USFWS and NOAA Fisheries 1998).

The USFWS CALFED BO states that indirect effects of the CALFED Program, including the EWA, include the conversion of upland habitats into agricultural or urban land uses, facilitated by the availability and use of CVP/SWP water supplies, and preclusion of restoration activities for levee reconstruction and maintenance activities (USFWS 2000). However, the USFWS CALFED BO also states *"The EWA works on a principle of 'no harm' to south of Delta deliveries, which means that the EWA essentially changes the* timing *of exports but does not change the overall magnitude or timing of deliveries"* (USFWS 2000). Since the EWA would not change the overall magnitude or timing of deliveries to the export service area, the EWA would not result in the conversion of upland habitats into developed areas. Further, the EWA would not be expected to result in additional levee reconstruction or maintenance activities than would occur under the basis of comparison. Therefore, it is not anticipated that the EWA would result in indirect effects.

Interrelated and Interdependent Effects. According to FESA, interrelated and interdependent actions are defined as follows*:*

> *Effects of the action under consultation are analyzed together with the effects of other activities that are interrelated to, or interdependent with, that action. An <u>interrelated</u> activity is an activity that is part of the proposed action and depends on the proposed*

> *action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation.*[4]

According to the USFWS and NOAA Fisheries, interrelated actions are those that are part of the proposed action and depend on the proposed action for their justification - actions that would not occur "but for" the larger action of the action under consultation (proposed action) (USFWS and NOAA Fisheries 1998). Interdependent actions are those that have no significant utility apart from the action that is under consideration (USFWS and NOAA Fisheries 1998). The EWA is one of many programs established under the framework of CALFED. Further, other programs proposed separately under the CALFED Program would function independently of the EWA. However, all the programs proposed under the CALFED Program need to be implemented in order to achieve CALFED goals. The EWA Program is interrelated to the larger CALFED program, because it is part of the CALFED Program. The EWA has no independent utility apart from the larger CALFED program and is an interdependent component of the larger CALFED program. Therefore, the analysis of effects includes those resulting from other interrelated or interdependent CALFED programs, which are discussed in Section 1.4 of the EWA EIS/EIR.

The basis of comparison for this ASIP is the existing condition without the EWA Proposed Action (operating conditions of the CVP/SWP without the EWA). The No Action Alternative and Baseline Condition are termed the "basis of comparison," as referred to throughout the analysis of the EWA Proposed Action (the Flexible Purchase Alternative in the EWA EIS/EIR).

The USFWS and NOAA Fisheries have defined the different conclusions and determinations that can be reached through consultation with these agencies. These different conclusions are "*it is likely to adversely affect*," "*it is likely to jeopardize proposed species/adversely modify proposed critical habitat*," and "*it is not likely to adversely effect*" (USFWS and NOAA Fisheries 1998). "*It is likely to adversely affect*" is the appropriate conclusion if any adverse effect to listed species may occur as a direct or indirect result of the proposed action, or indirect result of the interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial. In the event the overall effect of the proposed action is beneficial to the listed species, but also is likely to cause some adverse effect, then the proposed action "*is likely to adversely affect*" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "*is likely to adversely affect*" determination should be made (USFWS and NOAA Fisheries 1998). "*It is likely to jeopardize proposed species/adversely modify proposed critical habitat*" is the appropriate conclusion when the action agency or USFWS and/or NOAA Fisheries identify situations where the proposed action is likely to jeopardize the proposed species or adversely modify critical habitat. If this conclusion is reached, conference is required (USFWS and NOAA Fisheries 1998). "*It is not likely to adversely affect*" is the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial (USFWS and NOAA Fisheries 1998).

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[4] Source: Federal Endangered Species Act (FESA) (50 CFR Section 402.02).

The effect indicators selected to evaluate the resource topics represent the potential effect issues for the resource. The anticipated change that would occur is compared against the evaluation criteria to ascertain whether the EWA Proposed Action would result in a "*no effect*," "*may affect - not likely to adversely effect*," or "*may affect - likely to adversely effect*" determination. In most instances, where a potential adverse effect may occur, environmental protection measures to reduce environmental effects to "*not likely to adversely effect*" have been identified and incorporated (see Section 2.5, Conservation Measures, of the ASIP).

The following analyses provide an evaluation of how the Proposed Action would affect the fisheries resources listed above within each of the three regions included within the Action Area (Section 4.1.1, Upstream from the Delta Region, Section 4.1.2, Delta Region, and Section 4.1.3, Export Service Area). The analyses contained herein rely extensively upon the discussion of fish species' life histories and lifestage-specific environmental requirements, the identification of effect indicators and evaluation criteria, and the detailed species-, lifestage-, river system-, and Delta-specific analyses included within the EWA EIS/EIR. In order to reduce redundancy, the detailed analyses included in the EWA EIS/EIR for the Upstream of the Delta Region are summarized in this ASIP, with specific references provided to individual sections of the EWA EIS/EIR. The analyses of potential effects with implementation of the Proposed Action on special-status fish species within each of the three regions is followed by a summary of potential effects identified for each special-status species included in the ASIP.

4.1.1 Analysis of Potential Hydrologic Effects on Special-Status Fish Species Within the Upstream from the Delta Region

For this ASIP, consideration of the species identified above in the determination of potential effects ensures compliance with federal regulatory requirements under Section 7 of the FESA, state requirements under CESA, NCCPA requirements, and EFH requirements for Anadromous Fish Habitat and Species as described in Sections 1.2.4, 1.2.5, and 1.2.6. A separate analysis of the NCCPA fish group "anadromous fish species" is not included because it would be redundant with the species-specific analysis of fish that are in this group, which is provided below.

4.1.1.1 Environmental Setting

The regional setting for the fisheries resources located within the Upstream from the Delta Region includes the Sacramento, Feather, Yuba, American, Merced and San Joaquin Rivers and associated Project reservoirs, as well as several non-Project reservoirs. These areas may be influenced by implementation of the EWA Proposed Action.

Narratives describing basin-specific conditions (e.g., species composition, distribution, time of year when the species is present in the river, and current management objectives) for each of the major river basins that are being evaluated in this region of the Action Area are provided in Section 9.1.1, Upstream from the Delta

Region, of the EWA EIR/EIS. Life histories and lifestage-specific environmental requirements for several species may differ slightly among the water bodies. Any differences are noted in the discussions of the individual water bodies. If there are not any noted differences, the species life history and environmental requirements are assumed to be identical to the general discussions in Section 9.1, Affected Environment/Existing Conditions of the EWA EIR/EIS.

4.1.1.2 Effect Assessment Methods

Extensive hydrologic, water temperature, and early lifestage salmon mortality modeling was performed to provide a quantitative basis from which to assess potential EWA-related diversion-related effects on fisheries resources and aquatic habitats within the Upstream from the Delta Region. Different methods and criterion have been employed to assess the parameters specific to each of the different types of water bodies that support fisheries and aquatic resources within this region. For instance, riverine environments primarily rely upon flow and water temperature as the criteria used to evaluate effects on anadromous and riverine fish.

Several models were used in this analysis, including CALSIM II, a Yuba River basin model, post-processing tools, reservoir temperature models, American and Sacramento water temperature models, and the lower American and Sacramento River Chinook salmon early lifestage mortality models. Appendix B of this ASIP provides a detailed discussion of the modeling process and its application to the EWA Proposed Action, including: a) the primary assumptions and model inputs used to represent hydrologic, regulatory, structural and operational conditions; and b) the simulations performed from which effects were estimated.

Modeling output provided monthly values for each year of the 72-year period of record modeled for river flows, reservoir storage and elevation, and for each year of the 69-year hydrologic simulation period modeled for river water temperatures. The period of record for water temperature modeling is shorter because it is based on records through 1990, whereas the period of record for CALSIM II extends through 1993. River water temperature output was then used in Reclamation's Chinook salmon mortality models to characterize water temperature-induced losses of early lifestages of Chinook salmon under each simulated condition. Output from the salmon mortality models provided estimates of annual (rather than monthly mean) losses of emergent fry from egg potential (all eggs brought to the river by spawning adults), which is presented in terms of survival. Diversion-related resource assessments are based on comparisons made between computer model simulations that represent the basis of comparison and the EWA Proposed Action hydrologic conditions.

The models used in this analysis are tools that have been developed for comparative planning purposes, rather than for predicting actual river conditions at specific locations and times. The 72-year and 69-year periods of record for CALSIM II and temperature modeling, respectively, provide an index of the kinds of changes that would be expected to occur with implementation of a specified set of operational conditions. Reservoir storage, river flows, water temperature, and salmon survival output for the period modeled should not be interpreted or used as definitive absolutes depicting actual river conditions that will occur in the future. Rather, output for the EWA Proposed Action can be compared to that for the basis of comparison simulation to determine:

- Whether reservoir storage or river flows and water temperature would be expected to change with implementation of the EWA Proposed Action;
- The months in which potential reservoir storage and river flow and water temperature changes could occur; and,
- A relative index of the magnitude of change that could occur during specific months of particular water year types, and whether the relative magnitude anticipated would be expected to result in effects on fish resources within the Upstream from the Delta Region.

The models used, although mathematically precise, should be viewed as having "reasonable detection limits." Establishing reasonable detection limits is useful to those using the modeling output for impact assessment purposes, and prevents making inferences: 1) beyond the capabilities of the models; and 2) beyond an ability to actually measure changes. Although data from the models are reported to the nearest 1,000 acre-feet (AF), foot in elevation, cubic foot per second (cfs), tenth of a degree Fahrenheit (°F), and tenth of a percent (%) in salmon mortality, these values were rounded when interpreting differences for a given parameter between two modeling simulations. For example, two simulations having river flows at a given location within one percent of each other were considered to be essentially equivalent. Because the models also provide reservoir storage data on a monthly time step, measurable differences in reservoir storage were evaluated similarly. Similar rounding of modeled output was performed for other output parameters in order to assure the reasonableness of the effect assessments.

In-situ temperature loggers were used to collect water temperature data for the model. These loggers typically have a precision of ±0.36ºF, yielding a potential total error of 0.72ºF (Sacramento River Temperature Modeling Project 1997). Therefore, modeled differences in temperature of 0.36ºF or less could not be consistently detected in the river by actual monitoring of water temperatures. In addition, as mentioned above, output from Reclamation's water temperature models provides a "relative index" of water temperatures under the various operational conditions modeled. Output values indicate whether the temperatures would be expected to increase, remain unchanged, or decrease, and provide insight regarding the relative magnitude of potential changes under one operational condition compared to another. Therefore, for the purposes of this effect assessment, modeled temperature changes that were within 0.3°F between modeled simulations were considered to represent no measurable change (were considered to be "essentially equivalent"). Temperature differences between modeling results of more than 0.3°F were assessed for their biological significance. This approach is considered very rigorous, because it utilizes a more conservative threshold of detection for potential water temperature changes than used in other fisheries impacts assessments. For example, USFWS and Reclamation, in the Trinity River Mainstem Fishery Restoration Draft EIS/EIR (USFWS *et al.* 1999), used a change in long-term average water temperature of 0.5°F as a threshold of significance, and the Central Valley Regional Water Quality Control Board (RWQCB) generally uses a change of 1.0°F or more as a threshold of significance.

Effect indicators such as water temperature and flows are used to evaluate if the Proposed Action will have an adverse effect on the species' habitat and range. Exceedance of monthly mean water temperatures identified by NOAA Fisheries for certain species (56ºF at Bend Bridge from April 15 through September 30 for winter-run Chinook salmon) is one such effect indicator. Changes in river flows and water temperatures during certain periods of the year have the potential to affect spawning, fry emergence, and juvenile emigration. Therefore, changes in monthly mean river flows and water temperatures during certain times of the year (during spawning, incubation, and initial rearing) are also used as effect indicators. Additional detailed information regarding the assessment methods utilized for each river system and the identification of associated significance criteria is included in Section 9.2.1.2, Riverine Fish Species Hydrologic and Water Temperature Modeling, of the EWA EIS/EIR.

4.1.1.3 Effects Analysis for Riverine Species

A detailed evaluation of direct and indirect effects of the EWA Proposed Action on special-status fish species within the Upstream from the Delta Region is provided in Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative, of the EWA EIS/EIR. The analysis of potential effects for each special-status fish species included in the ASIP is summarized in subsections 4.2 through 4.8.

4.1.2 Analysis of Potential Hydrologic Effects on Special-Status Fish Species Within the Delta Region

This section analyzes the potential effects of the EWA Proposed Action on the special-status fish species and associated aquatic resources within the Delta Region. Consideration of the special-status species identified in Section 4.1 in the determination of potential effects ensures compliance with federal regulatory requirements (ESA Section 7), State requirements under CESA, and NCCPA requirements, as described in Section 1.2, ASIP Process. According to NOAA Fisheries, there are no species requiring EFH consultation under the Magnuson-Stevens Conservation and Management Act related to the EWA Proposed Action. A separate analysis of the NCCP fish group "estuarine fish species" is not included because it would be redundant with the species-specific analysis of fish that are in this group, which is provided below.

4.1.2.1 Environmental Setting

San Francisco Bay and the Sacramento-San Joaquin Delta make up the largest estuary on the west coast (EPA 1993). The Bay-Delta estuary provides habitat for a diverse assemblage of fish and macroinvertebrates. Many of the fish and macroinvertebrate species inhabit the estuary year-round, while other species inhabit the system on a seasonal basis as a migratory corridor between upstream freshwater riverine habitat and coastal marine waters, as seasonal foraging habitat, or for reproduction and juvenile rearing. The geographic distribution of species within the estuary is determined, in part, based upon salinity gradients, which range from freshwater within the Sacramento and San Joaquin river systems to marine conditions near the Golden Gate Bridge. The abundance, distribution, and habitat use by these fish and macroinvertebrates has been monitored over a number of years through investigations conducted by CDFG, USFWS, NOAA Fisheries, DWR, and a number of other investigators. Results of these monitoring programs have shown changes in species composition and abundance within the system over the past several decades. Many of the fish and macroinvertebrate species have experienced a generally declining trend in abundance with several native species, including winter-run and spring-run Chinook salmon, steelhead, delta smelt, and Sacramento splittail, currently treated as a federally listed threatened species under FESA. Portions of the estuary have been identified as critical habitat for species such as winter-run Chinook salmon and delta smelt. A number of fish and macroinvertebrate species inhabiting the estuary also support recreational and commercial fisheries, such as fall-run Chinook salmon, Bay shrimp, Pacific herring, northern anchovy, starry flounder, striped bass, largemouth bass, and many others, and hence the estuary also has been identified as EFH for these species.

Many factors have contributed to the decline of fish species within the Delta, including changes in hydrologic patterns resulting from water project operations, loss of habitat, contaminant input, entrainment in diversions, and introduction of non-native species. The Delta is a network of channels through which water, nutrients, and aquatic food resources are moved and mixed by tidal action. Pumps and siphons divert water for Delta irrigation and municipal and industrial use or into CVP and SWP canals. River inflow, Delta Cross Channel operations, and diversions (including agricultural and municipal diversions and export pumping) affect Delta species through changes in habitat conditions (e.g., salinity intrusion), and mortality attributable to entrainment in diversions.

The majority of land in the Delta, which covers approximately 678,200 acres, is irrigated cropland (CALFED 2000). Other terrestrial habitats include *"riparian vegetation, wetlands, and other forms of 'idle land'"* (CALFED 2000). The CALFED PEIS/EIR describes the Delta aquatic environment as comprised of "…*channels, sloughs, and other open water. Under existing conditions, most of the open water is deep-channel habitat that has been modified to provide passage for ocean-going vessels as well as efficient conveyance of fresh water from the Sacramento River through the Delta. Vegetation is removed from levees, primarily to facilitate inspection, repair, and flood fighting when necessary. Although current flood protection programs may allow for properly managed vegetation, the amount of shallow water and shaded riverine habitat throughout the Delta is much lower now than it was historically, largely having been replaced by a patchwork of agricultural islands and revetted levees"* (CALFED 2000).

Seasonal and interannual variability in hydrologic conditions, including the magnitude of flows into the Bay-Delta estuary from the Sacramento and San Joaquin rivers and other tributaries and the outflow from the Delta into San Francisco Bay, have been identified as important factors affecting habitat quality and availability, and abundance for a number of fish and invertebrate species within the Bay-Delta estuary. Flows within the Bay-Delta system may affect larval and juvenile transport and dispersal, water temperatures (primarily within the upstream tributaries), dissolved oxygen concentrations (e.g., during the fall within the lower San Joaquin River), and salinity gradients within the estuary. The seasonal timing and geographic location of salinity gradients are thought to be important factors affecting habitat quality and availability for a number of species (Baxter *et al.* 1999). Operations of upstream storage impoundments, in combination with natural hydrologic conditions, affect seasonal patterns in the distribution of salinity within the system. Water project operations, for example, may result in a reduction in Delta inflows during the late winter and spring with an increase in Delta inflows, when compared to historical conditions, during the summer months. Objectives have been established for the location of salinity gradients during the late winter and spring to support estuarine habitat for a number of species (the X_2 location), in addition to other salinity criteria for municipal, agricultural, and wetland benefits. Although a number of studies have focused on the effects of variation in salinity gradients as a factor affecting estuarine habitat during the late winter and spring (Kimmerer 2002), very little information exists on the effects of increased inflows into the Delta during summer months and the resulting changes in salinity conditions (e.g., reduced salinity when compared to historical conditions) on the abundance, growth, survival, and distribution of various fish and macroinvertebrates inhabiting the Bay-Delta system.

Despite the high degree of habitat modification that has occurred in the Delta, Delta habitats are of key importance to fisheries, as illustrated by the more than 120 fish species that rely on its unique habitat characteristics for one or more of their lifestages (EPA 1993). Fish species found in the Delta include anadromous species, as well as freshwater, brackish water, and saltwater species. The Delta provides spawning and nursery habitat for more than 40 resident and anadromous fish species, including delta smelt, Sacramento splittail, American shad, and striped bass. The Delta also is a migration corridor and seasonal rearing habitat for Chinook salmon and steelhead. All anadromous fish of the Central Valley either migrate through the Delta to spawn and rear upstream or are dependent on the Delta to support some critical part of their life cycle. Delta smelt, which have been listed as threatened under both FESA and CESA, and Sacramento splittail, treated as a federally listed threatened species under FESA, reside year-round within the Delta. Species such as green sturgeon utilize the Delta as a migratory corridor, juvenile nursery, and adult foraging habitat, with spawning occurring further upstream within the mainstem Sacramento River. Longfin smelt, which have been identified as a species of special concern, inhabit the Delta estuary year-round. Other species which have been listed for protection under FESA or CESA, including winter-run and spring-run Chinook salmon and steelhead, utilize the estuary as a migratory corridor and as juvenile foraging habitat, with spawning and egg incubation occurring further upstream within the Sacramento and San Joaquin river systems.

Delta inflow and outflow are important for species residing primarily in the Delta (e.g., delta smelt and longfin smelt) (USFWS 1994), as well as juveniles of anadromous species (e.g., Chinook salmon) that rear in the Delta prior to ocean entry. Seasonal Delta inflows affect several key ecological processes, including: 1) the migration and transport of various lifestages of resident and anadromous fishes using the Delta (EPA, 1992); 2) salinity levels at various locations within the Delta as measured by the location of X_2; and 3) the Delta's primary (phytoplankton) and secondary (zooplankton) production.

A detailed description of the Delta is provided in Section 9.1.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR. Section 9.1.2 of the EWA EIS/EIR and subsequent subsections describe the aquatic habitats and fish populations within the Delta, and borrows heavily from the Interim South Delta Program (ISDP) Draft EIS/EIR (DWR and USBR 1996). It is organized into the following components: 1) a description of the Bay-Delta estuary; 2) a description of the principle hydraulic features of the Sacramento and San Joaquin rivers and the Delta that affect aquatic resources, including components of the CVP and SWP; and 3) descriptions of the status, life history, and factors affecting abundances of selected fish and invertebrate species, focusing on those species having economic importance or those identified as species of concern by the federal or state government.

4.1.2.2 Effect Assessment Methods

Delta outflow, X_2 location, E/I ratio, and frequency and magnitude of reverse flows (QWEST) have been identified as indicators of fishery habitat quality and availability within the Delta. Results of hydrologic modeling over a 15-year period of record were used to assess the potential effects of the EWA Proposed Action on habitat conditions within the Delta supporting fish and macroinvertebrates. Comparative analyses of monthly hydrologic modeling results between the basis of comparison and the EWA Proposed Action were used to assess changes in potential habitat conditions based on: 1) Delta outflow; 2) X_2 location; 3) E/I ratio; and 4) the frequency and magnitude of reverse flow (QWEST). In addition, results of hydrologic modeling were used to compare salvage at the SWP and CVP facilities for Chinook salmon, steelhead, splittail, and delta smelt under the basis of comparison and with operations under the EWA Proposed Action. Additional detailed information regarding the assessment methods utilized within the Delta and the identification of associated significance criteria is included in Section 9.1.2.3, Combined Downstream Effects of the SWP and CVP Facilities, of the EWA EIS/EIR.

The evaluation of potential effects on Delta fisheries involves two study scenarios, including: 1) the Maximum Water Purchase Scenario, and 2) the Typical Water Purchase Scenario. Although the Maximum Water Purchase Scenario represents potential worst-case effects on fish resources upstream from the Delta, the Typical Water Purchase Scenario was developed to analyze a more likely representation of potential worst-case effects within the Delta. Potential effects on fish resources within the Delta with implementation of the Proposed Action were analyzed under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario. Appendix B, Modeling Description, of this ASIP provides a more detailed discussion of the these two scenarios, the modeling process, and its application to the EWA Proposed Action, including: a) the primary assumptions and model inputs used to represent hydrologic, regulatory, structural and operational conditions; and b) the simulations performed from which effects were estimated.

Although habitat conditions within the Delta are important to fish and macroinvertebrates year-round, many of the species spawn and utilize the estuary as larval and juvenile rearing habitat and/or as a migratory corridor during the late winter and early spring. As a result, analysis of hydrologic modeling results as indicators of habitat conditions focused primarily on the seasonal period from February through June based on the life-cycle of many of the species inhabiting the system. Analyses also were conducted to identify and evaluate potential effects on habitat conditions during all months.

Calculations of salvage loss at the SWP and CVP, as a function of changes in the seasonal volume of water diverted, have also been used as an indicator of potential effects resulting from changes in water project operations. Export operations of the SWP and CVP directly affect mortality of fish within the Delta as a consequence of entrainment and associated stresses. The magnitude of direct losses resulting from export operations is a function of the magnitude of monthly water exports from each facility and the density (number per acre-foot) of fish vulnerable to entrainment at the facilities. Results of the hydrologic modeling provide estimates of the average monthly export operations for both the SWP and CVP under basis of comparison conditions and EWA operations. Extensive data are available on species-specific salvage at both the SWP and CVP facilities for use in estimating the risk of fishery losses. Average densities (number per acre-foot) were calculated monthly for both the SWP and CVP facilities for selected fish species over a range of water year conditions (e.g., wet, above normal, below normal, dry, and critical years). Data selected for use in these analyses extended over a 15-year period from 1979 to 1993. This data period was selected based on consideration of the reliability of salvage data (e.g., accurate species identification, expansion calculations, etc.) and the hydrologic model period, which extended through 1993.

SWP and CVP estimates of direct loss were calculated for the following fish species:

- Chinook salmon;
- Steelhead;
- Delta smelt; and
- Sacramento splittail.

An index of salvage was developed for purposes of evaluating the incremental effects of EWA operations on direct losses at the export facilities. The salvage index was derived using records of species-specific salvage at the SWP and CVP facilities, which was used to calculate the average monthly density (number of fish per TAF), which could then be multiplied by the calculated SWP and CVP monthly exports (in TAF) obtained from the hydrologic modeling output. The salvage index was calculated separately for the SWP and CVP export operations under both the basis of comparison and EWA operations. The resulting salvage index was then used to determine the incremental benefits (reduced salvage) and incremental impacts (increased salvage) calculated to result from EWA operations.

Average monthly salvage densities for each species were calculated from daily salvage records over the period from 1979 through 1993 (R. Brown, unpublished data; CDFG, unpublished data). Based on the daily salvage, expanded for sub-sampling effort, a daily density estimate was calculated using the actual water volume diverted at each of the two export facilities. The daily density estimates were then averaged to calculate an average monthly density. For consistency, the average monthly density of each of the individual target species was then used to calculate the salvage index for the period from January 1979 through September 1993 using hydrologic modeling results for the basis of comparison operation and operations under EWA. After calculating the monthly salvage index for each species assuming EWA operations, the basis of comparison estimate was subtracted from the monthly salvage index for each species to determine the net difference in salvage estimates (EWA operations – basis of comparison estimate = net change) that are anticipated to occur with implementation of the Proposed Action.

For purposes of evaluating potential impacts and benefits of EWA operations on fish salvage, the incremental difference in the annual salvage indices reflect the benefit (reduced salvage under EWA operations) as a negative index and an incremental adverse impact (increased salvage under EWA operations) as a positive index.

4.1.2.3 Effects Analysis for Estuarine Species

An analysis of potential effects related to implementation of the Proposed Action under the Maximum Water Purchase Scenario is presented first (Section 4.1.2.3.1), followed by an analysis of potential effects related to implementation of the Proposed Action under the Typical Water Purchase Scenario (Section 4.1.2.3.2). These analyses are identical to those provided in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR. A summary of potential effects within the Delta on each special-status species with implementation of the Proposed Action is provided in Sections 4.2 through 4.8 of this ASIP.

4.1.2.3.1 Maximum Water Purchase Scenario

<u>Delta Outflow</u>
Delta outflow provides an indicator of freshwater flow passing through the Delta and habitat conditions further downstream within San Pablo Bay and Central San Francisco Bay. Delta outflow affects salinity gradients within these downstream bays

and the geographic distribution and abundance of various fish and macroinvertebrates (Baxter *et al.* 1999).

Reductions in long-term average Delta outflow under the Maximum Water Purchase Scenario would not occur with implementation of the Proposed Action, relative to the basis of comparison, as shown in Table 4-1. Delta outflow during the period of February through June is believed to be of greatest concern for potential effects on spawning and rearing habitat and downstream transport flows for delta smelt, splittail, salmonids, and other aquatic species in the Delta. Long-term average Delta outflow would increase by approximately 2.9 to 7.7 percent during the February through June period. Monthly mean flows under the Proposed Action would be essentially equivalent to or greater than flows under the basis of comparison in all months included in the simulation [Appendix H pgs. A1-A12 of the EWA EIS/EIR]. Detectable decreases in Delta outflow would not occur with implementation of the Proposed Action under the Maximum Water Purchase Scenario, relative to the basis of comparison, in any of the 75 months simulated for the February through June period.

Table 4-1. Long-term Average Delta Outflow Under Basis of Comparison and Proposed Action (Maximum Water Purchase Scenario) Conditions

Month	Monthly Mean Flow[1] (cfs)		Difference	
	Basis of Comparison	Proposed Action	(cfs)	(%)[2]
Oct	7,494	7,494	0	0
Nov	14,729	14,729	0	0
Dec	29,135	29,762	627	2.2
Jan	35,403	36,000	597	1.7
Feb	57,924	58,824	900	1.6
Mar	53,136	54,665	1,529	2.9
Apr	29,039	30,674	1,635	5.6
May	17,995	19,372	1,377	7.7
Jun	13,767	14,792	1,025	7.4
Jul	7,915	8,354	439	5.6
Aug	4,192	4,492	300	7.2
Sep	5,574	5,884	310	5.6

[1] Based on 15 years modeled.
[2] Relative difference of the monthly long-term average.

X_2 Location

The location of the 2 ppt salinity near-bottom isohaline (X_2 location) has been identified as an indicator of estuarine habitat conditions within the Bay-Delta system. The location of X_2 within Suisun Bay during the February through June period is thought to be directly and/or indirectly related to the reproductive success and survival of the early lifestages for a number of estuarine species. Results of statistical regression analyses suggest that abundance of several estuarine species is greater during the spring when the X_2 location is within the western portion of Suisun Bay, with lower abundance correlated with those years when the X_2 location is farther to the east near the confluence between the Sacramento and San Joaquin rivers.

Under implementation of the Proposed Action under the Maximum Water Purchase Scenario, the long-term average position of X_2 would not shift upstream during any month, as shown in Table 4-2. In addition, the monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, in all of the 75 months simulated with implementation of the Proposed Action under the Maximum Water Purchase Scenario for this period [Appendix H pgs. A13-A24 of the EWA EIS/EIR].

Table 4-2. Long-term Average Delta X_2 Position Under Basis of Comparison and Proposed Action (Maximum Water Purchase Scenario) Conditions

Month	Monthly Mean Position[1] (km)		
	Basis of Comparison	Proposed Action	Difference
Oct	85.3	84.5	-0.8
Nov	83.6	83.4	-0.2
Dec	80.3	80.2	-0.1
Jan	76.9	76.6	-0.3
Feb	71.7	71.3	-0.4
Mar	66.4	66.0	-0.4
Apr	64.5	63.8	-0.7
May	67.8	67.0	-0.8
Jun	72.0	70.9	-1.1
Jul	75.9	74.7	-1.2
Aug	79.5	78.6	-0.9
Sep	84.5	83.6	-0.9

[1] Kilometers from the Golden Gate Bridge.

Export/Inflow Ratio

Exports from the SWP and CVP result in direct effects, including salvage and entrainment losses, for many fish and macroinvertebrates. Export operations also are thought to indirectly affect survival; however, indirect effects have been difficult to quantify. The ratio between exports and Delta inflow (E/I ratio) has been identified as an indicator of the vulnerability of fish and macroinvertebrates to direct and indirect effects resulting from SWP and CVP operations. The E/I ratio limits are identified in the 1995 Water Quality Control Plan, with the greatest reductions in exports relative to inflows occurring during the biologically sensitive February through June period.

The long-term average E/I ratio with implementation of the Proposed Action under the Maximum Water Purchase Scenario would decrease during all months of the February through June period, relative to the basis of comparison, as shown in Table 4-3. The monthly mean E/I ratio with implementation of the Proposed Action under the Maximum Water Purchase Scenario would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the 75 months simulated for the February through June period [Appendix H pgs. A49-A60 of the EWA EIS/EIR].

Table 4-3. Long-term Average Delta E/I Ratio Under Basis of Comparison and Proposed Action (Maximum Water Purchase Scenario) Conditions				
Month	Monthly Mean Ratio[1] (%)		Difference	
	Basis of Comparison	Proposed Action	(%)	(%)[2]
Oct	49	49	0	0
Nov	39	39	0	0
Dec	37	34	-3	-8.1
Jan	36	34	-2	-5.6
Feb	23	20	-3	-13.0
Mar	21	17	-4	-19.0
Apr	18	12	-6	-33.3
May	20	13	-7	-35.0
Jun	27	22	-5	-18.5
Jul	32	36	+4	+12.5
Aug	51	55	+4	+7.8
Sep	57	60	+3	+5.3

[1] Based on 15 years modeled.
[2] Relative difference of the monthly long-term average.

The model simulations conducted for the Proposed Action included conformance with export requirements set forth in the SWRCB Interim Water Quality Control Plan. Thus, the Delta E/I ratios under the Proposed Action and basis of comparison would not exceed the maximum export ratio as set by the SWRCB Interim Water Quality Control Plan [Appendix H pgs. A49-A60 of the EWA EIS/EIR]. However, relaxation of the E/I ratio is an EWA asset. If the Management Agencies determine that the risk to fish is relatively low, then pumping above the applicable limit for brief periods may be undertaken, with the additional water credited to the EWA. Such actions will not be taken if there is the potential to affect State or federally protected species, and will only be taken under the unanimous direction of the Management Agencies.

Reverse Flows (QWEST)

Reverse flows (also referred to as QWEST) have been identified as an indicator of the potential risk of adverse effects on planktonic fish eggs and larvae and the survival of downstream migrating juvenile Chinook salmon smolts. The potential for adverse effects associated with reverse flow is greatest during the late winter-spring period (February through June). Reverse flows occur primarily when freshwater inflow is low and export pumping is high, causing the lower San Joaquin River to change direction and flow upstream. Reversed flows are evaluated based on model simulations of the direction and magnitude of flows in the lower San Joaquin River in the vicinity of Jersey Point.

Under the basis of comparison, reverse flows would occur in 25 months out of the 75 months simulated for the February through June period (33.3 percent of the time). Reverse flows would occur less frequently with implementation of the Proposed Action under the Maximum Water Purchase Scenario, in 13 of the 75 months simulated, or 17.3 percent of the time [Appendix H pgs. A41-A45 of the EWA EIS/EIR]. Table 4-4 illustrates that the frequency of reverse flows under the Proposed

Action would be substantially reduced across all flow ranges during February through June, relative to the basis of comparison. In most months in which reverse flows would occur under the basis of comparison, flows would be positive or the magnitude of reverse flow substantially reduced under the Maximum Water Purchase Scenario [Appendix H pgs. A41-A45 of the EWA EIS/EIR].

Overall, implementation of the Proposed Action under the Maximum Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Such changes would be considered a benefit to juvenile salmonid emigration and the transport of planktonic eggs and larvae. Therefore, implementation of the Proposed Action may beneficially affect the survival of planktonic fish eggs and larvae and downstream migrating juvenile Chinook salmon smolts. In addition, changes in Delta outflows, the position of X_2, and the E/I ratios resulting from implementation of the Proposed Action under the Maximum Water Purchase Scenario are not likely to adversely affect delta smelt, splittail, steelhead, fall-, late-fall-, winter-, or spring-run Chinook salmon in the Delta.

Salvage at the SWP and CVP Export Facilities

Salvage estimates for delta smelt, Chinook salmon, steelhead, and splittail, were developed based upon historical salvage records, which exhibit variation due to interannual variability in the abundance and distribution of each species. Salvage modeling, described in Section 9.2.1.3, Estuarine Fish Species in the Delta, of the EWA EIS/EIR provides an indication of the relative effect of CVP and SWP pumping operations with implementation of the Proposed Action (Flexible Purchase Alternative) and under the basis of comparison. This section provides an analysis of potential salvage-related effects with implementation of the Proposed Action under the Maximum Water Purchase Scenario on delta smelt, Chinook salmon, steelhead, and splittail.

Delta Smelt

Under the Proposed Action (Maximum Water Purchase Scenario), a net reduction in delta smelt salvage would occur over the 15-year period of record included in the analysis, relative to the basis of comparison. Average annual salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario decrease by 135,887 delta smelt relative to the basis of comparison [Table 4-5 below].

Annual and monthly changes in delta smelt salvage estimates with implementation of the Proposed Action, relative to the basis of comparison, over the 15-year period of record included in the analysis under the Maximum Water Purchase scenario are provided in Table 4-5. Annual salvage estimates decrease in every year by 293 to 66,002 delta smelt, relative to the basis of comparison, except for one year (in 1991 there is an estimated increase of 398 delta smelt), as shown in Table 4-5. Monthly mean delta smelt salvage estimates under the Proposed Action would not change during October and November, relative to the basis of comparison. From December through July, implementation of the Proposed Action under the Maximum Water

Purchase Scenario would result in monthly mean reductions in salvage ranging from 2,358 to 61,929 delta smelt, relative to the basis of comparison. During August and September, monthly mean salvage with implementation of the Proposed Action under the Maximum Water Purchase Scenario would increase by 4,763 and 1,117 delta smelt, respectively, relative to the basis of comparison.

Table 4-4. Frequency[1] of Reverse Flows (QWEST) Over Varying Flow Ranges

Reverse Flow Range (cfs)	Basis of Comparison	Proposed Action (Maximum Water Purchase Scenario)
February		
<0	6	5
<-100	4	3
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
March		
<0	6	1
<-100	3	0
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
April		
<0	2	1
<-100	0	0
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
May		
<0	5	2
<-100	0	0
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
June		
<0	6	4
<-100	3	1
<-250	1	1
<-500	0	0
<-1000	0	0
<-2000	0	0

[1] Based on the 15-year period of record for each month.

While annual salvage estimates exhibit a decrease in 14 of the 15 years simulated with implementation of the Proposed Action under the Maximum Water Purchase Scenario, there would be isolated occurrences of increases in delta smelt salvage in 34 of the 150 months simulated for the December through September period. However, such changes would not be of sufficient magnitude to result in increases in annual delta smelt salvage in 14 of the 15 years simulated.

Table 4-5. Change in Delta Smelt Salvage at the SWP and CVP Pumps Under the Maximum Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-125	-188	-337	-1,350	-3,121	-2,440	2,463	181	15	-4,902
1980	0	0	0	-188	-348	-408	-816	-238	-9,006	915	3,314	105	-6,668
1981	0	0	-416	0	-1,128	-6,552	-1,522	-37,501	-3,836	-15,305	235	24	-66,002
1982	0	0	-63	-781	-1,257	-634	-73	-218	-36	712	414	39	-1,897
1983	0	0	-161	-862	-254	-61	-10	-8	-2,932	852	0	245	-3,191
1984	0	0	0	0	-2	-186	-50	-5,046	-1,553	761	3	9	-6,065
1985	0	0	-340	0	-30	-57	-282	-456	-7,955	63	34	50	-8,973
1986	0	0	-20	-71	-356	-241	-128	-26	-39	112	166	0	-603
1987	0	0	-22	-5	-53	-357	-3,402	-3,886	-5,925	-892	75	150	-14,319
1988	0	0	-1,337	-862	-100	0	0	-4,816	0	418	0	0	-6,697
1989	0	0	0	-44	-6	-32	-40	-366	-581	-1,884	74	31	-2,848
1990	0	0	0	-27	-80	-56	0	0	-7,656	960	2	0	-6,857
1991	0	0	0	0	0	-213	-121	-857	0	880	261	448	398
1992	0	0	0	-10	-102	-164	-20	0	0	3	0	0	-293
1993	0	0	0	-89	-59	-49	0	-5,389	-1,681	293	5	0	-6,970
Total	0	0	-2,358	-3,063	-3,964	-9,347	-7,814	-61,929	-43,642	-9,651	4,763	1,117	-135,887

As discussed in Section 4.6.4, Conservation Measures and Expected Outcomes, real-time operations would be implemented as needed to avoid pumping operations that would result in increased delta smelt salvage. Overall, based on modeling output and the efficiency of real-time adjustment of operations (real-time implementation of conservation measures) in response to abundance and distribution monitoring, implementation of the Proposed Action under the Maximum Water Purchase Scenario is not likely to adversely affect delta smelt.

Chinook Salmon

With implementation of the Proposed Action under the Maximum Water Purchase Scenario, a net reduction in Chinook salmon salvage would occur over the 15-year period of record, relative to the basis of comparison. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 1,123,826 Chinook salmon, relative to the basis of comparison [Table 4-6 below].

Annual and monthly changes in Chinook salmon salvage estimates at the CVP and SWP pumps with implementation of the Proposed Action under the Maximum Water Purchase Scenario, relative to the basis of comparison, are provided in Table 4-6. Annual salvage estimates decrease in every year by 2,529 to 320,526 Chinook salmon, relative to the basis of comparison, as shown in Table 4-6. Monthly mean Chinook salmon salvage estimates under the Proposed Action would not change in October and November, relative to the basis of comparison. From December through June, implementation of the Proposed Action would result in monthly mean decreases in salvage ranging from 7,383 to 444,219 Chinook salmon, relative to the basis of comparison. During July, August, and September, monthly mean salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase

Scenario would increase by 2,742, 286, and 555 Chinook salmon, respectively, relative to the basis of comparison.

While annual salvage estimates exhibit a decrease with implementation of the Proposed Action under the Maximum Water Purchase Scenario, there would be isolated occurrences of increases in SWP Chinook salmon salvage in 24 of the 150 months simulated for the December through September period. However, such changes would not be of sufficient magnitude to result in increases in annual salvage in any year simulated over the 15-year period of record included in the analysis. Thus, while there would be increases in Chinook salmon salvage with implementation of the Proposed Action under the Maximum Water Purchase Scenario in individual months of the simulation, annual salvage estimates for Chinook salmon would decrease, relative to the basis of comparison. Such changes are not likely to adversely affect Chinook salmon.

Table 4-6. Change in Chinook Salmon Salvage at the SWP and CVP Pumps Under the Maximum Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-586	-197	-700	-55,499	-55,646	-1,570	1,450	75	28	-112,645
1980	0	0	-466	-238	-27	-20	-86,314	-54,922	-16,405	-567	10	519	-158,431
1981	0	0	-102	0	-156	-5,630	-24,295	-15,608	-64	0	14	0	-45,839
1982	0	0	-2,161	-1,300	-3,084	-3,354	-6,557	-71,783	-15,742	32	4	0	-103,945
1983	0	0	-15,916	-3,451	-3,350	-1,593	-6,707	-19,821	-37,634	284	0	0	-88,189
1984	0	0	0	0	-6	-1,290	-45,834	-46,789	-16,714	4	133	0	-110,496
1985	0	0	-1,625	0	-362	-829	-16,828	-48,989	-10,555	29	0	2	-79,156
1986	0	0	-399	-190	-93,319	-25,239	-57,136	-86,099	-59,386	1,244	0	0	-320,526
1987	0	0	-94	-27	-78	-4,394	-16,697	-11,139	-4,062	15	2	3	-36,471
1988	0	0	-4,804	-1,015	-913	0	-1,902	-14,700	0	248	21	2	-23,062
1989	0	0	0	-118	-9	-2,071	-770	-6,591	-148	0	6	0	-9,701
1990	0	0	-51	-298	-164	-744	0	0	-1,273	1	0	0	-2,529
1991	0	0	0	0	0	-1,355	-3,919	-7,895	0	0	0	0	-13,169
1992	0	0	0	-108	-1,814	-5,750	-2,877	0	0	0	0	0	-10,547
1993	0	0	0	-51	-67	-122	-4,429	-4,236	-238	2	21	0	-9,120
Total	0	0	-25,617	-7,383	-103,545	-53,091	-329,762	-444,219	-163,792	2,742	286	555	-1,123,826

Steelhead

A net reduction in steelhead salvage would occur with implementation of the Proposed Action under the Maximum Water Purchase Scenario, relative to the basis of comparison, over the 15-year period of record included in the analysis. Average annual salvage estimates under the Maximum Water Purchase Scenario would be reduced by 28,928 steelhead, relative to the basis of comparison [Table 4-7].

Annual and monthly changes in salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario, relative to the basis of comparison, are shown in Table 4-7. Annual salvage would decrease in every year by 293 to 4,085 steelhead, relative to the basis of comparison, as shown in Table 4-7. Monthly mean steelhead salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario would not change from August through November, relative to the basis of comparison. From December through

June, implementation of the Proposed Action would result in monthly mean reductions in salvage ranging from 428 to 12,182 steelhead, relative to the basis of comparison. During July, monthly mean salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario would increase by five steelhead, relative to the basis of comparison. Such changes are not likely to adversely affect steelhead.

Table 4-7. Change in Steelhead Salvage at the SWP and CVP Pumps Under the Maximum Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-34	-93	-260	-1,425	-775	0	0	0	0	-2,588
1980	0	0	-2	-15	-48	-7	-738	-671	-55	0	0	0	-1,536
1981	0	0	-12	0	-132	-2,397	-1,452	-92	0	0	0	0	-4,085
1982	0	0	-32	-65	-130	-90	-1,790	-1,526	-373	0	0	0	-4,005
1983	0	0	-755	-40	-16	0	0	-75	0	0	0	0	-887
1984	0	0	0	0	0	-24	-261	-8	0	0	0	0	-293
1985	0	0	-2	0	-18	-145	-353	-163	0	0	0	0	-682
1986	0	0	0	-2	-144	-71	-423	-182	0	5	0	0	-815
1987	0	0	-138	-9	-12	-2,715	-546	-81	0	0	0	0	-3,500
1988	0	0	-83	-55	-189	0	-164	-170	0	0	0	0	-661
1989	0	0	0	-2	-42	-1,464	-34	-26	0	0	0	0	-1,568
1990	0	0	0	0	-383	-846	0	0	0	0	0	0	-1,230
1991	0	0	0	0	0	-1,988	-206	-31	0	0	0	0	-2,225
1992	0	0	0	-289	-1,016	-1,247	-39	0	0	0	0	0	-2,590
1993	0	0	0	-39	-588	-928	-395	-314	0	0	0	0	-2,264
Total	0	0	-1,024	-550	-2,810	-12,182	-7,826	-4,114	-428	5	0	0	-28,928

Splittail

With implementation of the Proposed Action under the Maximum Water Purchase Scenario, there would be a net reduction in splittail salvage, relative to the basis of comparison, over the 15-year period of record included in the analysis. Average annual salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario would decrease by 1,014,290 splittail, relative to the basis of comparison [Table 4-8].

Annual and monthly change in splittail salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario, relative to the basis of comparison, over the 15-year period of record included in the analysis are provided in Table 4-8. Annual salvage estimates decrease in every year by 628 to 699,086 splittail, relative to the basis of comparison, except for one year (in 1984 there is an estimated increase of 603 splittail), as shown in Table 4-8. Monthly mean splittail salvage estimates under the Proposed Action would not change in October and November, relative to the basis of comparison. From December through June, implementation of the Proposed Action would result in monthly mean reductions in salvage ranging from 1,673 to 575,902 splittail, relative to the basis of comparison. During July, August, and September, monthly mean salvage estimates with implementation of the Proposed Action under the Maximum Water Purchase Scenario would increase by 60,415, 34,596, and 2,996 splittail, respectively, relative to the basis of comparison.

While annual salvage estimates exhibit a decrease in 14 of the 15 years simulated with implementation of the Proposed Action under the Maximum Water Purchase Scenario, there would be isolated occurrences of increases in splittail salvage in 35 of the 150 months simulated for the December through September period. However, such changes would not be of sufficient magnitude to result in increases in annual splittail salvage in 14 of the 15 years simulated.

Table 4-8. Change in Splittail Salvage at the SWP and CVP Pumps Under the Maximum Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-1	-38	-398	-1,479	-9,931	-10,819	2,979	778	71	-18,838
1980	0	0	-91	-1,613	-3,254	-69	-4,310	-23,974	-66,341	46	2,198	341	-97,068
1981	0	0	-20	0	-299	-1,819	-2,823	-29,018	0	0	16	0	-33,963
1982	0	0	-73	-1,241	-3,442	-1,371	-1,274	-9,822	-23,597	13,903	20,387	166	-6,365
1983	0	0	-737	-497	-3,791	-1,437	-515	-8,712	-59,762	9,261	4,804	194	-61,192
1984	0	0	0	0	-218	-1,114	-2,807	-2,315	-3,868	8,776	1,941	208	603
1985	0	0	-138	0	-371	-677	-1,662	-700	-14,563	383	78	20	-17,630
1986	0	0	0	-10	-356	-2,094	-16,567	-368,329	-339,879	22,726	3,675	1,748	-699,086
1987	0	0	-89	-74	-268	-2,357	-642	-373	-54,289	-436	96	106	-58,326
1988	0	0	-518	-2,602	-1,315	0	-259	-1,378	0	1,178	24	47	-4,824
1989	0	0	0	-32	-83	-1,351	-104	-2,308	-670	-994	455	79	-5,008
1990	0	0	-6	-132	-757	-1,192	0	0	0	1,459	0	0	-628
1991	0	0	0	0	0	-1,337	-648	-1,329	0	459	0	0	-2,855
1992	0	0	0	-35	-642	-839	-22	0	0	0	55	0	-1,482
1993	0	0	0	-1,439	-457	-448	-1,459	-2,489	-2,114	675	89	16	-7,627
Total	0	0	-1,673	-7,675	-15,292	-16,502	-34,572	-460,681	-575,902	60,415	34,596	2,996	-1,014,290

Although there would be increases in splittail salvage with implementation of the Proposed Action under the Maximum Water Purchase Scenario in one year and in individual months of the simulation, annual splittail salvage estimates would decrease in 14 of the 15 years simulated, relative to the basis of comparison. Such changes are not likely to adversely affect splittail.

4.1.2.3.2 Typical Water Purchase Scenario

Delta Outflow

Reductions in long-term average Delta outflow under the Typical Water Purchase Scenario would not occur with implementation of the Proposed Action, relative to the basis of comparison, as shown in Table 4-9. Delta outflow during the period of February through June is believed to be of greatest concern for potential effects on spawning and rearing habitat and downstream transport flows for delta smelt, splittail, salmonids, and other aquatic species in the Delta. Long-term average Delta outflow would increase by approximately 1.3 to 6.9 percent during the February through June period. Monthly mean flows with implementation of the Proposed Action under the Typical Water Purchase Scenario would be essentially equivalent to or greater than flows under the basis of comparison in all months included in the simulation [Appendix H pgs. B1-B12 of the EWA EIS/EIR]. Detectable decreases in Delta outflow would not occur with implementation of the Proposed Action under the Typical Water Purchase Scenario, relative to the basis of comparison, in any of the 75 months simulated for the February through June period.

Table 4-9. Long-term Average Delta Outflow Under Basis of Comparison and Proposed Action (Typical Water Purchase Scenario) Conditions

Month	Monthly Mean Flow[1] (cfs)		Difference	
	Basis of Comparison	Proposed Action	(cfs)	(%)[2]
Oct	7,494	7,494	0	0
Nov	14,729	14,729	0	0
Dec	29,135	29,669	534	1.8
Jan	35,403	35,805	401	1.1
Feb	57,924	58,656	732	1.3
Mar	53,136	54,123	987	1.9
Apr	29,039	30,111	1072	3.7
May	17,995	19,082	1087	6.0
Jun	13,767	14,718	950	6.9
Jul	7,915	8,280	365	4.6
Aug	4,192	4,476	284	6.8
Sep	5,574	5,867	293	5.3

[1] Based on 15 years modeled.
[2] Relative difference of the monthly long-term average.

X_2 Location

With implementation of the Proposed Action under the Typical Water Purchase Scenario, the long-term average position of X_2 would not shift upstream during any month of the February through June period, as shown in Table 4-10. In addition, the monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, in all of the 75 months simulated with implementation of the Proposed Action under the Typical Water Purchase Scenario [Appendix H pgs. B13-B24 of the EWA EIS/EIR].

Table 4-10. Long-term Average Delta X_2 Position Under Basis of Comparison and Proposed Action (Typical Water Purchase Scenario) Conditions

Month	Monthly Mean Position[1] (km)		
	Basis of Comparison	Proposed Action	Difference
Oct	85.3	84.5	-0.8
Nov	83.6	83.4	-0.2
Dec	80.3	80.3	0
Jan	76.9	76.6	-0.3
Feb	71.7	71.5	-0.2
Mar	66.4	66.1	-0.3
Apr	64.5	64.1	-0.4
May	67.8	67.3	-0.5
Jun	72.0	71.2	-0.8
Jul	75.9	74.8	-1.1
Aug	79.5	78.7	-0.8
Sep	84.5	83.7	-0.8

[1] Kilometers from the Golden Gate Bridge.

Export/Inflow Ratio

The long-term average E/I ratio with implementation of the Proposed Action under the Typical Water Purchase Scenario would decrease during all months of the February through June period, relative to the basis of comparison, as shown in Table 4-11. The monthly mean E/I ratio with implementation of the Proposed Action under the Typical Water Purchase Scenario would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the 75 months simulated for the February through June period [Appendix H pgs. B49-B60 of the EWA EIS/EIR].

Table 4-11. Long-term Average Delta E/I Ratio Under Basis of Comparison and Proposed Action (Typical Water Purchase Scenario) Conditions

Month	Monthly Mean Ratio[1] (%)		Difference	
	Basis of Comparison	Proposed Action	(%)	(%)[2]
Oct	49	49	0	0
Nov	39	39	0	0
Dec	37	35	-2	-5.4
Jan	36	35	-1	-2.8
Feb	23	21	-2	-8.7
Mar	21	19	-2	-9.5
Apr	18	14	-4	-22.2
May	20	14	-6	-30.0
Jun	27	22	-5	-18.5
Jul	32	36	+4	+12.5
Aug	51	55	+4	+7.8
Sep	57	60	+3	+5.3

[1] Based on 15 years modeled.
[2] Relative difference of the monthly long-term average.

The model simulations conducted for the Proposed Action included conformance with export requirements set forth in the SWRCB Interim Water Quality Control Plan. Thus, the Delta E/I ratios under the Proposed Action and basis of comparison would not exceed the maximum export ratio as set by the SWRCB Interim Water Quality Control Plan [Appendix H pgs. B49-B60 of the EWA EIS/EIR]. However, relaxation of the E/I ratio is an EWA asset. If the Management Agencies determine that the risk to fish is relatively low, then pumping above the applicable limit for brief periods may be undertaken, with the additional water credited to the EWA. Such actions will not be taken if there is the potential to affect State or federally protected species, and will only be taken under the unanimous direction of the Management Agencies.

Reverse Flows (QWEST)

Under the basis of comparison, reverse flows would occur in 25 months out of the 75 months simulated for the February through June period (33.3 percent of the time). Reverse flows would occur less frequently with implementation of the Proposed Action under the Typical Water Purchase Scenario, in 16 of the 75 months simulated, or 21.3 percent of the time [Appendix H pgs. B41-B45 of the EWA EIS/EIR]. Table 4-12 illustrates that the frequency of reverse flows from February through June under the Proposed Action would be unchanged or substantially reduced across all flow ranges, relative to the basis of comparison. In most months in which reverse flows would occur under the basis of comparison, flows would be positive or the magnitude of reverse flow substantially reduced under the Typical Water Purchase Scenario [Appendix H pgs. B41-B45 of the EWA EIS/EIR].

Overall, implementation of the Proposed Action under the Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Such changes would be considered a benefit to juvenile salmonid emigration and the transport of planktonic eggs and larvae. Therefore, implementation of the Proposed Action may beneficially affect the survival of planktonic fish eggs and larvae and downstream migrating juvenile Chinook salmon smolts. In addition, changes in Delta outflows, the position of X_2, and the E/I ratios resulting from implementation of the Proposed Action under the Typical Water Purchase Scenario are not likely to adversely affect delta smelt, splittail, steelhead, fall-, late-fall-, winter-, or spring-run Chinook salmon in the Delta.

Table 4-12. Frequency[1] of Reverse Flows (QWEST) Over Varying Flow Ranges

Reverse Flow Range (cfs)	Basis of Comparison	Proposed Action (Typical Water Purchase Scenario)
February		
<0	6	6
<-100	4	3
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
March		
<0	6	3
<-100	3	1
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
April		
<0	2	1
<-100	0	0
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0
May		
<0	5	2
<-100	0	0
<-250	0	0
<-500	0	0
<-1000	0	0
<-2000	0	0

Table 4-12. Frequency[1] of Reverse Flows (QWEST) Over Varying Flow Ranges		
Reverse Flow Range (cfs)	Basis of Comparison	Proposed Action (Typical Water Purchase Scenario)
June		
<0	6	4
<-100	3	1
<-250	1	1
<-500	0	0
<-1000	0	0
<-2000	0	0
[1] Based on the 15-year period of record for each month.		

Salvage at the SWP and CVP Export Facilities

Salvage estimates for delta smelt, Chinook salmon, steelhead, and splittail, were developed based upon historical salvage records, which exhibit variation due to interannual variability in the abundance and distribution of each species. Salvage modeling, described in Section 9.2.1.3, Estuarine Fish Species in the Delta of the EWA EIS/EIR provides an indication of the relative effect of CVP and SWP pumping operations with implementation of the Proposed Action (Flexible Purchase Alternative). This section provides an analysis of potential salvage-related effects with implementation of the Proposed Action under the Typical Water Purchase Scenario on delta smelt, Chinook salmon, steelhead, and splittail.

Delta Smelt

Under the Proposed Action (Typical Water Purchase Scenario), a net reduction in delta smelt salvage would occur over the 15-year period of record included in the analysis, relative to the basis of comparison. Average annual salvage estimates with implementation of the Proposed Action under the Typical Water Purchase Scenario decrease by 93,690 delta smelt relative to the basis of comparison [Table 4-13].

Annual and monthly changes in delta smelt salvage estimates at the CVP and SWP pumps with implementation of the Proposed Action, relative to the basis of comparison, over the 15-year period of record included in the analysis under the Typical Water Purchase scenario are provided in Table 4-13. Annual salvage estimates decrease in every year by 293 to 26,355 delta smelt, relative to the basis of comparison, as shown in Table 4-13. Monthly mean delta smelt salvage estimates under the Proposed Action would not change during October and November, relative to the basis of comparison. From December through July, implementation of the Proposed Action would result in monthly mean reductions in salvage ranging from 1,533 to 41,354 delta smelt, relative to the basis of comparison. During August and September, monthly mean salvage under the Proposed Action would increase by 4,711 and 928 delta smelt, respectively, relative to the basis of comparison.

While annual salvage estimates exhibit a decrease with implementation of the Proposed Action under the Typical Water Purchase Scenario, there would be isolated occurrences of increases in delta smelt salvage in 31 of the 150 months simulated for the December through September period. However, such changes would not be of sufficient magnitude to result in increases in annual delta smelt salvage for any of the 15 years simulated. In fact, annual delta smelt salvage would decrease, relative to the basis of comparison in all 15 years simulated for the analysis.

As discussed in Section 4.6.4, Conservation Measures and Expected Outcomes, real-time operations would be implemented as needed to avoid pumping operations that would result in increased delta smelt salvage. Overall, based on modeling output and the efficiency of real-time adjustment of operations (real-time implementation of conservation measures) in response to abundance and distribution monitoring, implementation of the Proposed Action under the Typical Water Purchase Scenario is not likely to adversely affect delta smelt.

Table 4-13. Change in Delta Smelt Salvage at the SWP and CVP Pumps Under the Typical Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-42	-125	-225	-442	-1,874	-2,440	2,463	181	15	-2,489
1980	0	0	0	-188	-348	-408	-498	-127	-6,754	-8,217	3,314	105	-13,121
1981	0	0	-416	0	-1,128	-1,966	-1,036	-13,130	-3,836	-5,102	235	24	-26,355
1982	0	0	-63	-781	-1,257	-634	-73	-218	-36	712	414	39	-1,897
1983	0	0	-161	-862	-254	-61	-10	-8	-2,199	852	0	245	-2,458
1984	0	0	0	0	-2	-186	-21	-2,895	-1,165	761	3	9	-3,496
1985	0	0	-170	0	-30	-29	-255	-906	-6,524	63	34	50	-7,765
1986	0	0	-20	-71	-356	-145	-128	-18	-19	91	104	0	-561
1987	0	0	-15	0	-35	-208	-1,301	-3,886	-5,925	-19	-21	132	-11,279
1988	0	0	-668	-287	-35	0	0	-4,816	-487	290	0	0	-6,004
1989	0	0	-21	-44	-6	-32	-40	-366	-581	441	74	31	-543
1990	0	0	0	-9	-27	-28	0	-28	-7,656	136	0	0	-7,612
1991	0	0	0	0	0	-106	-121	-531	-2,708	1,240	368	277	-1,582
1992	0	0	0	-10	-102	-164	-20	0	0	3	0	0	-293
1993	0	0	0	-60	-59	-33	0	-7,318	-1,022	250	5	0	-8,237
Total	0	0	-1,533	-2,352	-3,765	-4,223	-3,945	-36,121	-41,354	-6,036	4,711	928	-93,690

Chinook Salmon

With implementation of the Proposed Action under the Typical Water Purchase Scenario, a net reduction in Chinook salmon salvage would occur over the 15-year period of record, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 895,433 Chinook salmon, relative to the basis of comparison [Table 4-14].

Annual and monthly changes in Chinook salmon salvage estimates at the CVP and SWP pumps with implementation of the Proposed Action under the Typical Water Purchase Scenario, relative to the basis of comparison, are provided in Table 4-14. Annual salvage would decrease in every year by 2,117 to 252,497 Chinook salmon, relative to the basis of comparison, as shown in Table 4-14. Monthly mean Chinook salmon salvage estimates under the Proposed Action would not change in October and November, relative to the basis of comparison. From December through June, implementation of the Proposed Action would result in monthly mean decreases in salvage ranging from 6,073 to 356,022 Chinook salmon, relative to the basis of comparison. During July, August, and September, monthly mean salvage estimates with implementation of the Proposed Action under the Typical Water Purchase Scenario would increase by 2,181, 274, and 551 Chinook salmon, respectively, relative to the basis of comparison.

While annual salvage estimates exhibit a decrease with implementation of the Proposed Action under the Typical Water Purchase Scenario, there would be isolated occurrences of increases in SWP Chinook salmon salvage in 20 of the 150 months simulated for the December through September period. However, such changes would not be of sufficient magnitude to result in increases in annual salvage in any year simulated over the 15-year period of record included in the analysis. Thus, while there would be increases in Chinook salmon salvage with implementation of the Proposed Action under the Typical Water Purchase Scenario in individual months of the simulation, annual salvage estimates for Chinook salmon would decrease, relative to the basis of comparison. Such changes are not likely to adversely affect Chinook salmon.

Table 4-14. Change in Chinook Salmon Salvage at the SWP and CVP Pumps Under the Typical Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-195	-131	-467	-31,668	-32,892	-1,570	1,450	75	28	-65,370
1980	0	0	-466	-238	-27	-20	-60,802	-35,637	-12,304	-567	10	519	-109,532
1981	0	0	-102	0	-156	-1,689	-21,608	-12,312	-64	0	14	0	-35,916
1982	0	0	-2,161	-1,300	-3,084	-3,354	-6,557	-71,783	-15,742	32	4	0	-103,945
1983	0	0	-15,916	-3,451	-3,350	-1,593	-6,707	-19,821	-28,226	284	0	0	-78,780
1984	0	0	0	0	-6	-1,290	-24,188	-29,496	-25,410	4	133	0	-80,252
1985	0	0	-812	0	-362	-415	-13,751	-56,365	-9,911	29	0	2	-81,584
1986	0	0	-399	-190	-93,319	-15,144	-57,136	-57,399	-29,693	784	0	0	-252,497
1987	0	0	-63	0	-52	-2,167	-13,631	-11,139	-4,062	-4	-1	-1	-31,120
1988	0	0	-2,402	-338	-320	0	-1,348	-14,700	-53	168	15	2	-18,978
1989	0	0	-52	-118	-9	-2,071	-770	-6,591	-148	0	6	0	-9,753
1990	0	0	-51	-99	-55	-372	0	-266	-1,273	0	0	0	-2,117
1991	0	0	0	0	0	-678	-3,919	-5,484	-500	0	0	0	-10,581
1992	0	0	0	-108	-1,814	-5,750	-2,877	0	0	0	0	0	-10,547
1993	0	0	0	-34	-67	-81	-1,957	-2,136	-205	2	18	0	-4,461
Total	0	0	-22,424	-6,073	-102,751	-35,090	-246,917	-356,022	-129,162	2,181	274	551	-895,433

Steelhead

A net reduction in steelhead salvage would occur with implementation of the Proposed Action under the Typical Water Purchase Scenario, relative to the basis of comparison, over the 15-year period of record included in the analysis. Average annual salvage estimates under the Typical Water Purchase Scenario would be reduced by 20,386 steelhead, relative to the basis of comparison [Table 4-15].

Annual and monthly changes in steelhead salvage estimates at the CVP and SWP pumps with implementation of the Proposed Action under the Typical Water Purchase Scenario, relative to the basis of comparison, are shown in Table 4-15. Annual salvage would decrease in ever year by 180 to 4,005 steelhead, relative to the basis of comparison, as shown in Table 4-15. Monthly mean steelhead salvage estimates with implementation of the Proposed Action under the Typical Water Purchase Scenario would not change from August through November, relative to the basis of comparison. From December through June, implementation of the Proposed Action would result in monthly mean reductions in salvage ranging from 414 to 7,088 steelhead, relative to the basis of comparison. During July, monthly mean salvage estimates with implementation of the Proposed Action under the Typical Water Purchase Scenario would increase by three steelhead, relative to the basis of comparison. Such changes are not likely to adversely affect steelhead.

Splittail

With implementation of the Proposed Action under the Typical Water Purchase Scenario, there would be a net reduction in splittail salvage, relative to the basis of comparison, over the 15-year period of record included in the analysis. Average annual salvage estimates with implementation of the Proposed Action under the Typical Water Purchase Scenario would decrease by 656,597 splittail, relative to the basis of comparison [Table 4-16].

Table 4-15. Change in Steelhead Salvage at the SWP and CVP Pumps Under the Typical Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				-11	-62	-173	-707	-473	0	0	0	0	-1,428
1980	0	0	-2	-15	-48	-7	-507	-458	-41	0	0	0	-1,078
1981	0	0	-12	0	-132	-719	-1,016	-24	0	0	0	0	-1,903
1982	0	0	-32	-65	-130	-90	-1,790	-1,526	-373	0	0	0	-4,005
1983	0	0	-755	-40	-16	0	0	-75	0	0	0	0	-887
1984	0	0	0	0	0	-24	-151	-5	0	0	0	0	-180
1985	0	0	-1	0	-18	-73	-220	-221	0	0	0	0	-532
1986	0	0	0	-2	-144	-43	-423	-121	0	3	0	0	-728
1987	0	0	-92	0	-8	-1,213	-302	-81	0	0	0	0	-1,695
1988	0	0	-42	-18	-103	0	-78	-170	0	0	0	0	-411
1989	0	0	-5	-2	-42	-1,464	-34	-26	0	0	0	0	-1,573
1990	0	0	0	0	-128	-423	0	-3	0	0	0	0	-554
1991	0	0	0	0	0	-994	-206	-24	0	0	0	0	-1,224
1992	0	0	0	-289	-1,016	-1,247	-39	0	0	0	0	0	-2,590
1993	0	0	0	-26	-588	-618	-165	-200	0	0	0	0	-1,597
Total	0	0	-941	-468	-2,434	-7,088	-5,636	-3,407	-414	3	0	0	-20,386

Annual and monthly change in splittail salvage estimates with implementation of the Proposed Action under the Typical Water Purchase Scenario, relative to the basis of comparison, over the 15-year period of record included in the analysis are provided in Table 4-16. Annual salvage would decrease by 75 to 409,257 splittail, relative to the basis of comparison, as shown in Table 4-16. Monthly mean splittail salvage estimates under the Proposed Action would not change in October and November, relative to the basis of comparison. From December through June, implementation of the Proposed Action would result in monthly mean reductions in salvage ranging from 1,322 to 375,810 splittail, relative to the basis of comparison. During July, August, and September, monthly mean salvage estimates with implementation of the Proposed

Action under the Typical Water Purchase Scenario would increase by 47,272, 34,061, and 2,687 splittail, respectively, relative to the basis of comparison.

While annual salvage estimates exhibit a decrease with implementation of the Proposed Action under the Typical Water Purchase Scenario for each year simulated over the 15-year period of record, there would be isolated occurrences of increases in splittail salvage in 36 of the 150 months simulated for the December through September period. However, such changes would not be of sufficient magnitude to result in increases in annual salvage in any year simulated under the Proposed Action. Thus, although there would be increases in splittail salvage with implementation of the Proposed Action under the Typical Water Purchase Scenario in individual months of the simulation, annual splittail salvage estimates would decrease, relative to the basis of comparison. Such changes are not likely to adversely affect splittail.

Table 4-16. Change in Splittail Salvage at the SWP and CVP Pumps Under the Typical Water Purchase Scenario – Proposed Action vs. Basis of Comparison

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979				0	-26	-266	-474	-4,595	-10,819	2,979	778	71	-12,351
1980	0	0	-91	-1,613	-3,254	-69	-2,861	-12,446	-49,756	-10,584	2,198	341	-78,134
1981	0	0	-20	0	-299	-546	-2,541	-8,210	0	0	16	0	-11,600
1982	0	0	-73	-1,241	-3,442	-1,371	-1,274	-9,822	-23,597	13,903	20,387	166	-6,365
1983	0	0	-737	-497	-3,791	-1,437	-515	-8,712	-44,822	9,261	4,804	194	-46,251
1984	0	0	0	0	-218	-1,114	-1,615	-1,609	-6,445	8,776	1,941	208	-75
1985	0	0	-69	0	-371	-339	-963	-1,602	-7,063	383	78	20	-9,925
1986	0	0	0	-10	-356	-1,256	-16,567	-245,553	-169,939	19,755	3,198	1,472	-409,257
1987	0	0	-60	0	-178	-1,208	-389	-373	-54,289	13	63	89	-56,332
1988	0	0	-259	-867	-666	0	-136	-1,378	-614	724	16	32	-3,147
1989	0	0	-7	-32	-83	-1,351	-104	-2,308	-670	205	455	79	-3,815
1990	0	0	-6	-44	-252	-596	0	-111	0	780	0	0	-230
1991	0	0	0	0	0	-668	-648	-825	-5,886	490	0	0	-7,539
1992	0	0	0	-35	-642	-839	-22	0	0	0	50	0	-1,487
1993	0	0	0	-959	-457	-298	-648	-6,489	-1,910	585	76	14	-10,088
Total	0	0	-1,322	-5,298	-14,036	-11,357	-28,759	-304,034	-375,810	47,272	34,061	2,687	-656,597

4.1.3 Analysis of Potential Hydrologic Effects on Special-Status Fish Species Within the Export Service Area

There are no federally or state-listed anadromous, estuarine, or riverine special-status species within the Export Service Area, therefore, an impact analysis to determine potential effects on fisheries resources was not performed for the water bodies within this area. The main channelized waterway in this region is the California Aqueduct, an artificial canal that is not managed for fishery resources. There are several non-Project reservoirs within the Export Service Area that may be affected by the EWA Proposed Action, however there are no special-status fish species associated with these reservoirs. A thorough review of all fisheries impacts, including those related to the non-Project reservoirs, is presented in Chapter 9 of the EWA EIS/EIR.

4.1.4 Analysis of Potential Effects on Terrestrial Species

The reader is also referred to Chapter 5, Effects of the Proposed Action on Vegetative NCCP Communities and Covered Species, for additional details regarding the effects to the habitats of the species presented the following subsections. The terrestrial species included in this ASIP are:

- Aleutian Canada Goose (*Branta canadensis leucopareia*)
- Black Tern (*Chlidonias niger*)
- Black-crowned Night Heron (rookery) (*Nycticorax nycticorax)*
- Great Blue Heron (rookery) (*Ardea herodias*)
- Great Egret (rookery) (*Casmerodius ablus*)
- Greater Sandhill Crane (*Grus canadensis tabida*)
- Long-billed Curlew (*Numenius americanus*)
- Snowy Egret (rookery) (*Egretta thula*)
- Tricolored Blackbird (*Agelaius tricolor*)
- White-faced Ibis (*Plegadis chihi*)
- Giant Garter Snake (*Thamnophis gigas*)
- Western Pond Turtle (*Clemmys marmorata*)

4.2 Central Valley Fall-run/Late-fall-run Chinook Salmon (*Oncorhynchus tshawytscha*)

4.2.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Central Valley fall-run/late-fall-run Chinook salmon historically inhabited the entire Sacramento-San Joaquin watershed. Fish barriers (typically dams) on many streams and rivers currently limit upstream habitat. Adults migrate upstream through the Bay and Delta ecozones from summer through early winter, with the predominant period being September and October. Adults are found in river and tributary ecozones generally from late summer into winter. Most young move out of tributary spawning areas in winter and spring. Young may be found in the river, Delta, and Bay ecozones from winter into early summer. Additional details regarding the status of Central Valley fall-run/late-fall-run Chinook salmon in the EWA Action Area are provided in Section 3.2.1, Central Valley Fall-run/Late-fall-run Chinook Salmon.

4.2.2 Effect Assessment Methods

Section 4.1.1.2, Effect Assessment Methods discusses the assessment methods for all anadromous fish. Section 4.1.2.2, Effect Assessment Methods discusses the assessment methods for all Delta estuary fish. Table 4-17 presents the effect indicators and evaluation criteria used in the analysis of potential effects on fall-run/late-fall-run Chinook salmon.

Table 4-17. Effect Indicators and Evaluation Criteria for Fall-run/Late-fall-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Sacramento River Fall-run Chinook Salmon	
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the adult immigration period (September through November).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the adult immigration period (September through November).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flows (cfs) below Keswick Dam and at Freeport for each month of the spawning, egg incubation, and initial rearing period (October through February).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the spawning, egg incubation, and initial rearing period (October through February).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile rearing and emigration period (February through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile rearing and emigration period (February through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Annual early lifestage survival.	Decrease in annual or long-term average early lifestage survival, relative to the basis of comparison, of sufficient magnitude to adversely affect initial year-class strength over the 72-year period of record.
Butte Creek Fall-run Chinook Salmon	
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the adult immigration period (late-September through October).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect adult immigation for a given month of this period.
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the juvenile emigration period (December through June).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect juvenile emigration for a given month of this period.
Lower Feather River Fall-run Chinook Salmon	
Monthly mean flow (cfs) at the mouth of the Feather River and below the Thermalito Afterbay Outlet for each month of the adult immigration period (September through November).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.

Table 4-17. Effect Indicators and Evaluation Criteria for Fall-run/Late-fall-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Monthly mean water temperature (°F) at the mouth of the Feather River and below the Thermalito Afterbay Outlet for each month of the adult immigration period (September through November).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flows (cfs) below the Thermalito Afterbay Outlet for each month of the spawning/egg incubation and initial rearing period (October through February).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) below the Fish Barrier Dam and below the Thermalito Afterbay Outlet for each month of the spawning/egg incubation and initial rearing period (October through February).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below the Thermalito Afterbay Outlet and at the mouth of the Feather River for each month of the juvenile rearing and emigration period (February through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) below the Fish Barrier Dam, below Thermalito Afterbay Outlet, and at the mouth of the Feather River for each month of the juvenile rearing and emigration period (February through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Yuba River Fall-run Chinook Salmon	
Mean daily flows (cfs) occurring at the USGS gauge (at Marysville and Smartville) for each month of the year.	Increase in flows, relative to the basis of comparison, of sufficient magnitude and rapidity to attract non-indigenous salmonids into the lower Yuba River.
Mean daily water temperatures (°F) at the USGS gauge (at Marysville and Daguerre Point Dam) for each month of the year.	Decrease in water temperatures, relative to the basis of comparison, of sufficient magnitude and contrast to Feather River water temperatures to attract non-indigenous salmonids into the lower Yuba River.
Lower American River Fall-run Chinook Salmon	
Monthly mean flow (cfs) at the mouth of the American River for each month of the adult immigration period (September through December).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at the mouth of the American River and at Freeport on the Sacramento River for each month of the adult immigration period (September through December).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flows (cfs) below Nimbus Dam and at Watt Avenue for each month of the spawning, egg incubation, and initial rearing period (October through February).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) below Nimbus Dam and at Watt Avenue for each month of the spawning, egg incubation, and initial rearing period (October through February).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) at Watt Avenue and the mouth of the American River for each month of the juvenile rearing and emigration period (February through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.

Table 4-17. Effect Indicators and Evaluation Criteria for Fall-run/Late-fall-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Monthly mean water temperature (°F) below Nimbus Dam, at Watt Avenue, at the mouth of the lower American River, and at Freeport for each month of the juvenile rearing and emigration period (February through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Annual early lifestage survival.	Decrease in annual or long-term average early lifestage survival, relative to the basis of comparison, of sufficient magnitude to adversely affect initial year-class strength over the 72-year period of record.
Merced River Fall-run Chinook Salmon	
Monthly mean flow (cfs) below Crocker-Huffman Dam and at the mouth of the Merced River for each month of the adult immigration period (October through December).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean flows (cfs) below Crocker-Huffman Dam and at the mouth of the Merced River for each month of the spawning and egg incubation period (October through December).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean flow (cfs) below Crocker-Huffman Dam and at the mouth of the Merced River for each month of the juvenile rearing and emigration period (January through June).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.
San Joaquin River Fall-run Chinook Salmon	
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the adult immigration period (October through December).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean flows (cfs) below the confluence of the Merced River and at Vernalis for each month of the spawning and egg incubation (October through January).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the juvenile rearing and emigration period (January through June).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.
Sacramento River Late-fall-run Chinook Salmon	
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the adult immigration and holding period (October through April).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the adult immigration and holding period (October through April).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flows (cfs) below Keswick Dam and at Freeport for each month of the spawning, egg incubation, and initial rearing period (December through April).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the spawning, egg incubation, and initial rearing period (December through April).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile rearing and emigration period (April through October).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.

Table 4-17. Effect Indicators and Evaluation Criteria for Fall-run/Late-fall-run Chinook Salmon	
Effect Indicators	**Evaluation Criteria**
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile rearing and emigration period (April through October).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Annual early lifestage survival.	Decrease in annual or long-term average early lifestage survival, relative to the basis of comparison, of sufficient magnitude to adversely affect initial year-class strength over the 72-year period of record.
Butte Creek Late-fall-run Chinook Salmon	
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the adult immigration period (late-December through February).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect adult immigration for a given month of this period.
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the juvenile emigration period (April through June).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect juvenile emigration for a given month of this period.
Sacramento-San Joaquin Delta Fish Resources	
Monthly mean Delta outflow (cfs) for all months of the year.	Decrease in monthly mean Delta outflow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Monthly mean location of X_2 for all months of the year.	Increase in upstream movement of the monthly mean position of X_2; relative to the basis of comparison, of sufficient magnitude (1 km) and frequency to adversely affect Delta fish resources over the 15-year period of record.
Export/Inflow (E/I) ratio during the February through June period.	Increase in the monthly mean Delta E/I ratio, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Reverse flows (QWEST) during the February through June period.	Increase in reverse flows, relative to the basis of comparison, of sufficient frequency and magnitude to result in reduced or delayed downstream transport of planktonic eggs and larvae or adverse effects on juvenile salmonid emigration.
Annual Chinook salmon CVP/SWP salvage estimates (number of individuals salvaged per year).	Increase in the annual number of Chinook salmon captured at the CVP and SWP fish salvage facilities, relative to the basis of comparison, over the 15-year period (1979 – 1993) included in these analyses.

4.2.3 Project Effects

The following discussion is a summary of potential effects related to river flow and water temperature with implementation of the EWA Proposed Action, as well as effects on long-term average annual early lifestage survival (based on water temperature effects) of fall-run and late-fall-run Chinook salmon on the Sacramento and lower American rivers. Potential effects on fall-run/late-fall-run Chinook salmon related to changes in habitat conditions and salvage at the SWP and CVP export facilities within the Sacramento-San Joaquin Delta are also summarized below.

Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative of the EWA EIR/EIS provides a detailed evaluation of effects on fall-run/late-fall-run Chinook salmon. For a detailed analysis of potential river flow and water temperature effects, refer to Section 9.2.5.1.1, Sacramento River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the Sacramento River and Impacts to Fall-run Chinook Salmon in Butte Creek; Section 9.2.5.1.2, Feather River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the Lower Feather River; Section 9.2.5.1.3, Yuba River Basin, Impacts to Yuba River Fisheries Resources; Section 9.2.5.1.4, American River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the Lower American River; and Section 9.2.5.1.5, San Joaquin River Basin, Impacts to Fall-run Chinook Salmon in the Merced River and Impacts to Fall-run Chinook Salmon and Steelhead in the San Joaquin River, of the EWA EIS/EIR.

For a detailed analysis of potential river flow and water temperature effects on late-fall-run Chinook salmon, refer to Section 9.2.5.1.1, Sacramento River Basin, Impacts to Late-fall-run Chinook Salmon in the Sacramento River and Impacts to Late-fall-run Chinook Salmon in Butte Creek, of the EWA EIS/EIR.

A detailed analysis of potential effects on Chinook salmon within the Delta is provided in Section 4.1.2.3, Effects Analysis for Estuarine Species, of this ASIP and in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR.

4.2.3.1 Fall-run Chinook Salmon

Flow

Flow reductions in the Sacramento, lower Feather, Yuba, lower American, Merced, and San Joaquin Rivers would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction of immigrating adults, spawning, egg incubation, and initial rearing, juvenile rearing, or juvenile emigration. Flow increases in the Sacramento, lower Feather, Yuba, and lower American rivers would not be of sufficient magnitude to beneficially or adversely affect attraction of immigrating adults or downstream passage of emigrating juveniles. Although flow increases in the Merced and San Joaquin rivers in the fall would beneficially affect adult immigration and the availability of spawning habitat, changes in the flow pattern may raise the potential for redd dewatering. Potential reductions of agricultural return flows in Butte Creek are expected to occur outside of the adult immigration or juvenile emigration time periods and downstream of spawning habitat, therefore neither beneficial nor adverse effects on fall-run Chinook salmon in Butte Creek are anticipated.

Water Temperature

Changes in water temperature in the Sacramento, lower Feather, Yuba, lower American, Merced, and San Joaquin Rivers would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for adult immigration, spawning, egg incubation, and initial rearing, or juvenile rearing and emigration. However, at the mouth of the Feather River, there would be one additional occurrence when mean monthly water temperatures would be above the suitable range of temperatures for juvenile rearing and emigration (65°F) with the Proposed Action, relative to the basis of comparison. At two locations in the lower American River (below Nimbus Dam and at Watt Avenue) there would be one additional occurrence each during October in which the mean monthly temperatures would be above the upper end of the suitable range of water temperatures for egg incubation (56ºF) under the Proposed Action, relative to the basis of comparison.

Annual Early Lifestage Survival

In the Sacramento River, long-term average annual early lifestage survival would be 91.2 percent under the basis of comparison and 91.1 percent with the Proposed Action. Reductions in annual early lifestage survival of 0.1 to 0.7 percent, relative to the basis of comparison, would occur in 11 of 69 years. In 8 of the 11 years, reductions in survival would be 0.1 percent, relative to the basis of comparison, and in 3 years, reductions in survival of 0.2 percent, 0.3 percent, and 0.7 percent would occur. In the lower American River, long-term average annual early lifestage survival would be 90.6 percent under the basis of comparison and 90.5 percent with the Proposed Action. Reductions in annual early lifestage survival of 0.1 to 1.4 percent relative to the basis of comparison would occur in 37 of 69 years simulated, however decreases of greater than 0.5 percent would occur in only five years.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios. The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to juvenile salmonid emigration.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect fall -run Chinook salmon in the Delta.

Salvage at the SWP/CVP Export Facilities

Annual salvage estimates exhibit a decrease in all 15 years simulated under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 1,123,826 Chinook salmon, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 895,433 Chinook salmon, relative to the basis of comparison.

Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in Chinook salmon salvage in July through September under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Such changes under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario may affect but are not likely to adversely affect Chinook salmon salvage in the Delta.

4.2.3.2 Late-fall-run Chinook Salmon

Flow

Flow reductions in the Sacramento River would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction and holding of immigrating adults, spawning, egg incubation, and initial rearing, or juvenile rearing and emigration. Flow increases in the Sacramento River would not be of sufficient magnitude to beneficially or adversely affect attraction of immigrating adults or downstream passage of emigrating juveniles. Potential reductions of agricultural return flows in Butte Creek are expected to occur outside of the adult immigration or juvenile emigration time periods and downstream of spawning habitat, therefore neither beneficial nor adverse effects on late-fall-run Chinook salmon in Butte Creek are anticipated.

Water Temperature

Changes in water temperature in the Sacramento River would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for adult immigration and holding, spawning, egg incubation, and initial rearing, or juvenile rearing and emigration.

Annual Early Lifestage Survival

No change in long-term average annual early lifestage survival in the Sacramento River would occur with the Proposed Action, relative to the basis of comparison. Substantial increases or decreases in survival would not occur in any individual year of the 69-year simulation, relative to the basis of comparison. In 67 of 69 years, there would be no difference in annual early lifestage survival between the Proposed Action and the basis of comparison. In 2 of the 69 years, a decrease in survival of 0.1 percent and increase in survival of 0.1 percent would occur, relative to the basis of comparison.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios.

The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to juvenile salmonid emigration.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect late-fall -run Chinook salmon in the Delta.

Salvage at the SWP/CVP Export Facilities
Annual salvage estimates exhibit a decrease in all 15 years simulated under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 1,123,826 Chinook salmon, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 895,433 Chinook salmon, relative to the basis of comparison.

Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in Chinook salmon salvage in July through September under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Such changes under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario may affect but are not likely to adversely affect Chinook salmon salvage in the Delta.

Therefore, EWA actions may affect, but are not likely to adversely affect Central Valley fall-/late fall-run Chinook salmon.

4.2.4 Conservation Measures

Effects of EWA actions on anadromous fish were considered adverse if pumping of EWA assets at Project facilities resulted in greater fish entrainment or death, changed the Delta flow patterns affecting fish migration patterns, or changed stream flows adversely affecting spawning and juvenile rearing. The following conservation measures would help to avoid or minimize adverse effects on fall-run/late-fall-run Chinook salmon and are included as part of the EWA Proposed Action (see Chapter 2, Description of the EWA Proposed Action):

- The EWA Project Agencies will coordinate EWA water acquisition and transfer actions with Federal (Reclamation, USFWS, and NOAA Fisheries), State (DWR and CDFG), other CALFED agencies, and regional programs (e.g., the San

Francisco Bay Ecosystem Goals Project, the Anadromous Fish Restoration Program, the Senate Bill [SB] 1086 program, the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study, the Riparian Habitat Joint Venture, the Central Valley Project Improvement Act (CVPIA), the Central Valley Habitat Joint Venture, and the Grassland Bird Conservation Plan) that could affect management of evaluated species. Coordination would avoid conflicts among management objectives and would be facilitated through CALFED's water transfer program.

- The EWA agencies will avoid acquisition and transfer of water that will reduce flows essential to maintaining populations of native aquatic species in the source river.
- EWA water acquisition and transfers will not increase exports during times of the year when anadromous and estuarine fish are most vulnerable to damage or loss at Project facilities or when their habitat may be adversely affected.
- The EWA agencies will avoid acquisition and transfer of stored reservoir water quantities that will impair compliance with flow requirements and maintenance of suitable habitat conditions in the source river in subsequent years.
- Implementing the EWA, the EWA agencies will fully adhere to the terms and conditions in all applicable CESA and FESA biological opinions and permits for CVP and SWP operations.
- The EWA agencies will minimize flow fluctuations resulting from the release of EWA assets from Project reservoirs to reduce or avoid stranding of juveniles.
- In May, the EWA agencies will evaluate Folsom Reservoir coldwater pool availability to benefit returning adult fall-run Chinook salmon prior to releasing EWA assets.
- The EWA agencies will consult with the local river management teams regarding management of EWA water on those rivers.

4.2.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on fall-run/late-fall-run Chinook salmon provided in Section 4.2.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) will contribute to the recovery of Central Valley fall-run/late-fall-run Chinook salmon.

4.3 Sacramento River Winter-run Chinook Salmon (*Oncorhynchus tshawytscha*)

4.3.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Sacramento River winter-run Chinook salmon occur only in the Sacramento River. Winter-run Chinook salmon primarily spawn in the main-stem Sacramento River between Keswick Dam (RM 302) and Red Bluff Diversion Dam (RM 243). Winter-run Chinook salmon spawn between late-April and mid-August, with peak spawning generally occurring in June. Winter-run Chinook salmon fry rearing in the upper Sacramento River exhibit peak abundance during September, with fry and juvenile emigration past Red Bluff Diversion Dam occurring from August through March (Reclamation 1992). Emigration (downstream migration) of winter-run Chinook salmon juveniles past Red Bluff Diversion Dam is believed to peak during September and October (Hallock and Fisher 1985), with abundance of juveniles in the Delta generally peaking during February, March, or April (Stevens 1989). Additional details regarding the status of Sacramento River winter-run Chinook salmon in the EWA Action Area are provided in Section 3.2.2, Sacramento River Winter-run Chinook Salmon

4.3.2 Effect Assessment Methods

Section 4.1.1.2, Effect Assessment Methods discusses the assessment methods for all anadromous fish. Section 4.1.2.2, Effect Assessment Methods discusses the assessment methods for all Delta estuary fish. Table 4-18 presents the effects indicators and evaluation criteria used in the analysis of potential effects on Sacramento River winter-run Chinook salmon.

Table 4-18. Effect Indicators and Evaluation Criteria for Sacramento River Winter-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Sacramento River Winter-run Chinook Salmon	
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the adult immigration period (December through July).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration (e.g., resulting flows <3,250 cfs), for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the adult immigration period (December through July).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.

Table 4-18. Effect Indicators and Evaluation Criteria for Sacramento River Winter-run Chinook Salmon	
Effect Indicators	**Evaluation Criteria**
Monthly mean flows (cfs) below Keswick Dam and at Freeport for each month of the spawning, egg incubation, and initial rearing period (April through August).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at Bend Bridge and Jelly's Ferry for each month of the spawning, egg incubation, and initial rearing period (April through August).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile rearing and emigration period (August through December).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting flows <3,250 cfs), for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile rearing and emigration period (August through December).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Annual early lifestage survival	Decrease in annual or long-term average early lifestage survival, relative to the basis of comparison, of sufficient magnitude to adversely affect initial year-class strength over the 72-year period of record.
Sacramento-San Joaquin Delta Fish Resources	
Monthly mean Delta outflow (cfs) for all months of the year.	Decrease in monthly mean Delta outflow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Monthly mean location of X_2 for all months of the year.	Increase in upstream movement of the monthly mean position of X_2; relative to the basis of comparison, of sufficient magnitude (1 km) and frequency to adversely affect Delta fish resources over the 15-year period of record.
Export/Inflow (E/I) ratio during the February through June period.	Increase in the monthly mean Delta E/I ratio, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Reverse flows (QWEST) during the February through June period.	Increase in reverse flows, relative to the basis of comparison, of sufficient frequency and magnitude to result in reduced or delayed downstream transport of planktonic eggs and larvae or adverse effects on juvenile salmonid emigration.
Annual Chinook salmon CVP/SWP salvage estimates (number of individuals salvaged per year).	Increase in the annual number of Chinook salmon captured at the CVP and SWP fish salvage facilities, relative to the basis of comparison, over the 15-year period (1979 – 1993) included in these analyses.

4.3.3 Project Effects

The following discussion is a summary of potential effects related to river flow and water temperature with implementation of the EWA Proposed Action, as well as effects on long-term average annual early lifestage survival (based on water temperature effects) of winter-run Chinook salmon on the Sacramento River. Potential effects on winter-run Chinook salmon related to changes in habitat conditions and salvage at the SWP and CVP export facilities within the Sacramento-San Joaquin Delta are also summarized below.

Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative of the EWA EIR/EIS provides a detailed evaluation of effects on winter-run Chinook salmon. For a detailed analysis of potential river flow and water temperature effects, refer to Section 9.2.5.1.1, Sacramento River Basin, Impacts to Winter-run Chinook Salmon in the Sacramento River, of the EWA EIS/EIR.

A detailed analysis of potential effects on Chinook salmon within the Delta is provided in Section 4.1.2.3, Effects Analysis for Estuarine Species, of this ASIP and in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR.

Flow

Flow reductions on the Sacramento River would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction of immigrating adults, maintenance of sufficient flows for spawning, egg incubation, and initial rearing, or juvenile rearing and emigration. Flow increases would not be of sufficient magnitude to beneficially or adversely affect attraction of immigrating adults or downstream passage of emigrating juveniles. Flows on the Sacramento River would not be reduced below the NOAA Fisheries Winter-run Chinook Salmon BO flow criterion more frequently with the Proposed Action, relative to the basis of comparison.

Water Temperature

Changes in water temperature in the Sacramento River would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for adult immigration and holding, spawning, egg incubation, and initial rearing, or juvenile rearing and emigration. Under the basis of comparison, Sacramento River water temperatures at Bend Bridge exceed the NOAA Fisheries Winter-run Chinook Salmon BO temperature criterion in 32 out of 276 months modeled for the April through July period. In addition, water temperatures remain below the NOAA Fisheries temperature criterion at Bend Bridge and Jelly's Ferry in 339 and 340 months, respectively, of the 345 months modeled for the August through December period, under the basis of comparison. However, Sacramento River water temperatures would not exceed the NOAA Fisheries Winter-run Chinook Salmon BO temperature criterion more frequently with the Proposed Action, relative to the basis of comparison.

Annual Early Lifestage Survival

No change in long-term average annual early lifestage survival in the Sacramento River would occur with implementation of the Proposed Action. There would be a maximum relative reduction of 0.1 percent in annual early lifestage survival in the Sacramento River in 5 of the 69 years simulated.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of

X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios. The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to juvenile salmonid emigration.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect winter-run Chinook salmon in the Delta.

Salvage at the SWP/CVP Export Facilities

Annual salvage estimates exhibit a decrease in all 15 years simulated under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 1,123,826 Chinook salmon, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 895,433 Chinook salmon, relative to the basis of comparison.

Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in Chinook salmon salvage in July through September under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Such changes under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario may affect but are not likely to adversely affect Chinook salmon salvage in the Delta.

Therefore, EWA actions may affect, but are not likely to adversely affect Sacramento River winter-run Chinook salmon.

4.3.4 Conservation Measures

Effects of EWA actions on anadromous fish were considered adverse if pumping of EWA assets at Project facilities resulted in greater fish entrainment or death, changed the Delta flow patterns affecting fish migration patterns, or changed stream flows adversely affecting spawning and juvenile rearing. The following conservation measures would help to avoid or minimize adverse effects on winter-run Chinook salmon and are included as part of the EWA Proposed Action (see Chapter 2, Description of the EWA Proposed Action):

- The EWA Project Agencies will coordinate EWA water acquisition and transfer actions with Federal (Reclamation, USFWS, and NOAA Fisheries), State (DWR and CDFG), other CALFED agencies, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project, the Anadromous Fish Restoration Program, the Senate Bill [SB] 1086 program, the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study, the Riparian Habitat Joint Venture, the Central Valley Project Improvement Act (CVPIA), the Central Valley Habitat Joint Venture, and the Grassland Bird Conservation Plan) that could affect management of evaluated species. Coordination would avoid conflicts among management objectives and would be facilitated through CALFED's water transfer program.

- The EWA agencies will avoid acquisition and transfer of water that will reduce flows essential to maintaining populations of native aquatic species in the source river.

- EWA water acquisition and transfers will not increase exports during times of the year when anadromous and estuarine fish are most vulnerable to damage or loss at project facilities or when their habitat may be adversely affected.

- The EWA agencies will avoid acquisition and transfer of stored reservoir water quantities that will impair compliance with flow requirements and maintenance of suitable habitat conditions in the source river in subsequent years.

- Implementing the EWA, the EWA agencies will fully adhere to the terms and conditions in all applicable CESA and FESA biological opinions and permits for CVP and SWP operations.

- The EWA agencies will minimize flow fluctuations resulting from the release of EWA assets from project reservoirs to reduce or avoid stranding of juveniles.

- The EWA agencies will consult with the local river management teams regarding management of EWA water on those rivers.

4.3.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on winter-run Chinook salmon provided in Section 4.3.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) will contribute to the recovery of Sacramento River winter-run Chinook salmon.

4.4 Central Valley Spring-run Chinook Salmon (*Oncorhynchus tshawytscha*)

4.4.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Historically, the Central Valley spring-run Chinook salmon was one of the most abundant and widely distributed salmon races. Extirpations followed construction of major water storage and flood control reservoirs on the Sacramento and San Joaquin Rivers and their major tributaries in the 1940s and 1950s (Moyle *et al.* 1995; 63 FR 11841, March 9, 1998). Spring-run Chinook salmon have been completely extirpated in the San Joaquin drainage. Additional details regarding the status of Central Valley spring-run Chinook salmon in the EWA Action Area are provided in Section 3.2.3, Central Valley Spring-run Chinook Salmon.

4.4.2 Effect Assessment Methods

Section 4.1.1.2, Effect Assessment Methods discusses the assessment methods for all anadromous fish. Section 4.1.2.2, Effect Assessment Methods discusses the assessment methods for all Delta estuary fish. Table 4-19 presents the effect indicators and evaluation criteria used in the analysis of potential effects on Central Valley spring-run Chinook salmon.

Table 4-19. Effect Indicators and Evaluation Criteria for Central Valley Spring-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Sacramento River Spring-run Chinook Salmon	
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the adult immigration and holding period (March through September).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the adult immigration and holding period (March through September).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flows (cfs) below Keswick Dam and at Freeport for each month of the spawning, egg incubation, and initial rearing period (August through January).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at Bend Bridge and Jelly's Ferry for each month of the spawning, egg incubation, and initial rearing period (August through January).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.

Table 4-19. Effect Indicators and Evaluation Criteria for Central Valley Spring-run Chinook Salmon

Effect Indicators	Evaluation Criteria
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile rearing and emigration period (December through April).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile rearing and emigration period (December through April).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Annual early lifestage survival	Decrease in annual or long-term average early lifestage survival, relative to the basis of comparison, of sufficient magnitude to adversely affect initial year-class strength over the 72-year period of record.
Butte Creek Spring-run Chinook Salmon	
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the adult immigration period (mid-February through July).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect adult immigation for a given month of this period.
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the juvenile emigration period (December through May).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect juvenile emigration for a given month of this period.
Lower Feather River Spring-run Chinook Salmon	
Monthly mean flow (cfs) at the mouth of the Feather River and below the Thermalito Afterbay for each month of the adult immigration and holding period (March through August).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at the mouth of the Feather River, below the Thermalito Afterbay Outlet, and in the Low Flow Channel below the Fish Barrier Dam for each month of the adult immigration and holding period (March through August).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flows (cfs) below the Thermalito Afterbay Outlet for each month of the spawning and egg incubation period (August through November.	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength, for a given month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) below the Fish Barrier Dam and the Thermalito Afterbay Outlet for each month of the spawning and egg incubation period (August through November.	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below the Thermalito Afterbay Outlet and at the mouth of the Feather River for each month of the juvenile rearing and emigration period (November through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) in the Low Flow Channel below the Fish Barrier Dam, below Thermalito Afterbay Outlet, and at the mouth of the Feather River for each month of the juvenile rearing and emigration period (November through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing and emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.

Table 4-19. Effect Indicators and Evaluation Criteria for Central Valley Spring-run Chinook Salmon	
Effect Indicators	**Evaluation Criteria**
Yuba River Spring-run Chinook Salmon	
Mean daily flows (cfs) occurring at the USGS gauge (at Marysville and Smartville) for each month of the year.	Increase in flows, relative to the basis of comparison, of sufficient magnitude and rapidity to attract non-indigenous salmonids into the lower Yuba River.
Mean daily water temperatures (°F) at the USGS gauge (at Marysville and Daguerre Point Dam) for each month of the year.	Decrease in water temperatures, relative to the basis of comparison, of sufficient magnitude and contrast to Feather River water temperatures to attract non-indigenous salmonids into the lower Yuba River.
Sacramento-San Joaquin Delta Fish Resources	
Monthly mean Delta outflow (cfs) for all months of the year.	Decrease in monthly mean Delta outflow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Monthly mean location of X_2 for all months of the year.	Increase in upstream movement of the monthly mean position of X_2; relative to the basis of comparison, of sufficient magnitude (1 km) and frequency to adversely affect Delta fish resources over the 15-year period of record.
Export/Inflow (E/I) ratio during the February through June period.	Increase in the monthly mean Delta E/I ratio, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Reverse flows (QWEST) during the February through June period.	Increase in reverse flows, relative to the basis of comparison, of sufficient frequency and magnitude to result in reduced or delayed downstream transport of planktonic eggs and larvae or adverse effects on juvenile salmonid emigration.
Annual Chinook salmon CVP/SWP salvage estimates (number of individuals salvaged per year).	Increase in the annual number of Chinook salmon captured at the CVP and SWP fish salvage facilities, relative to the basis of comparison, over the 15-year period (1979 – 1993) included in these analyses.

4.4.3 Project Effects

The following discussion is a summary of potential effects related to river flow and water temperature with implementation of the EWA Proposed Action, as well as effects on long-term average annual early lifestage survival (based on water temperature effects) of spring-run Chinook salmon on the Sacramento River. Potential effects on spring-run Chinook salmon related to changes in habitat conditions and salvage at the SWP and CVP export facilities within the Sacramento-San Joaquin Delta are also summarized below.

Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative of the EWA EIR/EIS provides a detailed evaluation of effects on Central Valley spring-run Chinook salmon. For a detailed analysis of potential river flow and water temperature effects, refer to Section 9.2.5.1.1, Sacramento River Basin, Impacts to Spring-run Chinook Salmon in the Sacramento River and Impacts to Spring-run Chinook Salmon in Butte Creek; Section 9.2.5.1.2, Feather River Basin, Impacts to Spring-run Chinook Salmon in the Feather River; and Section 9.2.5.1.3, Yuba River Basin, Impacts to Yuba River Fisheries Resources, of the EWA EIS/EIR.

A detailed analysis of potential effects on Chinook salmon within the Delta is provided in Section 4.1.2.3, Effects Analysis for Estuarine Species, of this ASIP and in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR.

Flow

Flow reductions in the Sacramento, lower Feather, and lower Yuba Rivers would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction and holding of immigrating adults, spawning, egg incubation, and initial rearing, and juvenile rearing or emigration. Flow increases would not be of sufficient magnitude to beneficially or adversely affect attraction of immigrating adults or downstream passage of emigrating juveniles. Potential reductions of agricultural return flows in Butte Creek are expected to occur outside of the adult immigration or juvenile emigration time periods and downstream of spawning habitat, therefore neither beneficial nor adverse effects on spring-run Chinook salmon in Butte Creek are anticipated.

Water Temperature

Changes in water temperature in the Sacramento, lower Feather, and lower Yuba Rivers would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for adult immigration and holding, spawning, egg incubation, and initial rearing, or juvenile rearing and emigration. However, with the Proposed Action, there would be one additional occurrence at the mouth of the Feather River in which monthly mean water temperatures would be above the suitable range of temperatures for juvenile rearing and emigration (65ºF), relative to the basis of comparison.

Annual Early Lifestage Survival

Long-term average annual early lifestage survival in the Sacramento River would be 87.5 percent under the basis of comparison and 87.4 percent with the Proposed Action. In 56 out of 69 years, there would be no difference in annual early lifestage survival between the Proposed Action and the basis of comparison. In 3 of 69 years, relative decreases in survival would range from 0.2 to 1.5 percent, relative to the basis of comparison.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios. The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to juvenile salmonid emigration.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect spring-run Chinook salmon in the Delta.

Salvage at the SWP/CVP Export Facilities

Annual salvage estimates exhibit a decrease in all 15 years simulated under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 1,123,826 Chinook salmon, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 895,433 Chinook salmon, relative to the basis of comparison.

Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in Chinook salmon salvage in July through September under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Such changes under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario may affect but are not likely to adversely affect Chinook salmon salvage in the Delta.

Therefore, EWA actions may affect, but are not likely to adversely affect Central Valley spring-run Chinook salmon.

4.4.4 Conservation Measures

Effects of EWA actions on anadromous fish were considered adverse if pumping of EWA assets at Project facilities resulted in greater fish entrainment or death, changed the Delta flow patterns affecting fish migration patterns, or changed stream flows adversely affecting spawning and juvenile rearing. The following conservation measures would help to avoid or minimize adverse effects on spring-run Chinook salmon and are included as part of the EWA Proposed Action (see Chapter 2, Description of the EWA Proposed Action):

- The EWA Project Agencies will coordinate EWA water acquisition and transfer actions with Federal (Reclamation, USFWS, and NOAA Fisheries), State (DWR and CDFG), other CALFED agencies, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project, the Anadromous Fish Restoration Program, the Senate Bill [SB] 1086 program, the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study, the Riparian Habitat Joint Venture, the Central Valley Project Improvement Act (CVPIA), the

Central Valley Habitat Joint Venture, and the Grassland Bird Conservation Plan) that could affect management of evaluated species. Coordination would avoid conflicts among management objectives and would be facilitated through CALFED's water transfer program.

- The EWA agencies will avoid acquisition and transfer of water that will reduce flows essential to maintaining populations of native aquatic species in the source river.

- EWA water acquisition and transfers will not increase exports during times of the year when anadromous and estuarine fish are most vulnerable to damage or loss at project facilities or when their habitat may be adversely affected.

- The EWA agencies will avoid acquisition and transfer of stored reservoir water quantities that will impair compliance with flow requirements and maintenance of suitable habitat conditions in the source river in subsequent years.

- Implementing the EWA, the EWA agencies will fully adhere to the terms and conditions in all applicable CESA and FESA biological opinions and permits for CVP and SWP operations.

- The EWA agencies will minimize flow fluctuations resulting from the release of EWA assets from project reservoirs to reduce or avoid stranding of juveniles.

- The EWA agencies will consult with the local river management teams regarding management of EWA water on those rivers.

4.4.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on spring-run Chinook salmon provided in Section 4.4.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) will contribute to the recovery of Central Valley spring-run Chinook salmon.

4.5 Central Valley Steelhead (*Oncorhynchus mykiss*)

4.5.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Historically, the Central Valley ESU steelhead was well distributed throughout the Sacramento and San Joaquin river systems: from the upper Sacramento/Pit river systems south to the Kings and possibly Kern River systems in wet years (Yoshiyama *et al*. 1996). Currently, steelhead distribution is primarily limited by dams that block access to upstream reaches of main rivers and their tributary streams. The existing Central Valley steelhead ESU includes steelhead in all river reaches accessible to the Sacramento and San Joaquin Rivers and their tributaries in California (Federal Register 2000). Additional details regarding the status of Central Valley steelhead in the EWA Action Area are provided in Section 3.2.4, Central Valley Steelhead.

4.5.2 Effect Assessment Methods

Section 4.1.1.2, Effect Assessment Methods discusses the assessment methods for all anadromous fish. Section 4.1.2.2, Effect Assessment Methods discusses the assessment methods for all Delta estuary fish. Table 4-20 presents the effect indicators and evaluation criteria used in the analysis of potential effects on Central Valley steelhead.

Table 4-20. Effect Indicators and Evaluation Criteria for Central Valley Steelhead

Effects Indicators	Evaluation Criteria
Sacramento River Central Valley Steelhead	
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the adult immigration period (September through March).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and at Freeport for each month of the adult immigration period (September through March).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the spawning and egg incubation period (December through March),	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport in the Sacramento River for each month of the spawning and egg incubation period (December through March),	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F) for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile over-summer rearing period not covered in the fall-run Chinook salmon juvenile rearing analysis (July through September).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength and juvenile rearing for a given month of this period over the 72-year period of record.

Table 4-20. Effect Indicators and Evaluation Criteria for Central Valley Steelhead

Effects Indicators	Evaluation Criteria
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile over-summer rearing period not covered in the fall-run Chinook salmon juvenile rearing analysis (July through September).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial adverse affects to juvenile rearing (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile fall/winter rearing period (October through January).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength and juvenile rearing for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile fall/winter rearing period (October through January).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial adverse affects to juvenile rearing for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Keswick Dam and at Freeport for each month of the juvenile rearing and emigration period (February through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency, to adversely affect juvenile emigration for a given month of this period over the 72-year period of record.
Monthly water mean temperature (°F) at Bend Bridge, Jelly's Ferry, and Freeport for each month of the juvenile rearing and emigration period (February through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Annual early lifestage survival, based on LSALMON2 output for late-fall-run Chinook salmon.	Decrease in annual or long-term average early lifestage survival, relative to the basis of comparison, of sufficient magnitude to adversely affect long-term initial year-class strength over the 72-year period of record.
Butte Creek Central Valley Steelhead	
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the adult immigration period (late-fall through winter).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect adult immigation for a given month of this period.
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the juvenile rearing period (year-round).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect juvenile rearing for a given month of this period.
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the juvenile emigration period (September through June).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect juvenile emigration for a given month of this period.
Lower Feather River Central Valley Steelhead	
Monthly mean flow (cfs) below the Thermalito Afterbay Outlet and at the mouth of the Feather River for each month of the adult immigration period (September through January).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) below the below the Thermalito Afterbay Outlet and at the mouth of the Feather River for each month of the adult immigration period (September through January).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration, for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Thermalito Afterbay Outlet for the spawning and egg incubation period (December through April).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength for a given month of this period over the 72-year period of record.

Table 4-20. Effect Indicators and Evaluation Criteria for Central Valley Steelhead	
Effects Indicators	**Evaluation Criteria**
Monthly mean water temperature (°F) below the Fish Barrier Dam, and below Thermalito Afterbay for each month of the spawning and egg incubation period (December through April).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Thermalito Afterbay Outlet and at the mouth of the Feather River for the juvenile over-summer rearing period (July through September).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing, for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) below the Fish Barrier Dam, below Thermalito Afterbay, and at the mouth of the Feather River for each month of the juvenile over-summer rearing period (July through September).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial adverse affects to juvenile rearing (e.g., resulting temperatures >65°F), for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Thermalito Afterbay Outlet and at the mouth of the Feather River for the juvenile fall/winter rearing period (October through January).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) below the Fish Barrier Dam, below Thermalito Afterbay, and at the mouth of the Feather River for each month of the juvenile fall/winter rearing period (October through January).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial adverse affects to juvenile rearing for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Thermalito Afterbay Outlet and at the mouth of the Feather River for each month of the juvenile rearing and emigration period (February through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency, to adversely affect juvenile emigration, for a given month of this period over the 72-year period of record.
Monthly water mean temperature (°F) below Thermalito Afterbay Outlet and at the mouth of the Feather River for each month of the juvenile rearing and emigration period (February through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile emigration (e.g., resulting temperatures >65°F), for a given month of this period over the 69-year period of record.
Yuba River Central Valley Steelhead	
Mean daily flows (cfs) occurring at the USGS gauge (at Marysville and Smartville) for each month of the year.	Increase in flows, relative to the basis of comparison, of sufficient magnitude and rapidity to attract non-indigenous salmonids into the lower Yuba River.
Mean daily water temperatures (°F) at the USGS gauge (at Marysville and Daguerre Point Dam) for each month of the year.	Decrease in water temperatures, relative to the basis of comparison, of sufficient magnitude and contrast to Feather River water temperatures to attract non-indigenous salmonids into the lower Yuba River.
Lower American River Central Valley Steelhead	
Monthly mean flow (cfs) at the mouth of the American River for each month of the adult immigration period (December through March).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) at the mouth of the American River and at Freeport on the Sacramento River for each month of the adult immigration period (December through March).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) below Nimbus Dam and at Watt Avenue for each month of the spawning and egg incubation period (December through April.	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength for a given month of this period over the 72-year period of record.

Table 4-20. Effect Indicators and Evaluation Criteria for Central Valley Steelhead

Effects Indicators	Evaluation Criteria
Monthly mean water temperature (°F) below Nimbus Dam and at Watt Avenue for each month of the spawning and egg incubation period (December through April.	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial egg and alevin loss (e.g., resulting temperatures >56°F for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) at Watt Avenue for each month of the juvenile over-summer rearing period (July through September).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) below Nimbus Dam and at Watt Avenue for each month of the juvenile over-summer rearing period (July through September).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial adverse affects to juvenile rearing (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) at Watt Avenue for the juvenile fall/winter rearing period (October through January)	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing for a given month of this period over the 72-year period of record.
Monthly mean water temperature (°F) below Nimbus Dam and at Watt Avenue for each month of the juvenile fall/winter rearing period (October through January).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to result in substantial adverse affects to juvenile rearing for a given month of this period over the 69-year period of record.
Monthly mean flow (cfs) at Watt Avenue, the mouth of the American River and at Freeport for each month of the juvenile rearing and emigration period (February through June).	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency, to adversely affect juvenile emigration for a given month of this period over the 72-year period of record.
Monthly water mean temperature (°F) at Watt Avenue, at the mouth of the American River, and at Freeport for each month of the juvenile rearing and emigration period (February through June).	Increase in monthly mean water temperature, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile emigration (e.g., resulting temperatures >65°F) for a given month of this period over the 69-year period of record.
San Joaquin River Central Valley Steelhead	
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the adult immigration period (November through January).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect adult immigration for a given month of this period over the 72-year period of record.
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the spawning and egg incubation period (November through January).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength for a given month of this period over the 72-year period of record.
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the juvenile over-summer rearing period (July through September).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing for a given month of this period over the 72-year period of record.
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis during the juvenile fall/winter rearing period (October through December).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect juvenile rearing for a given month of this period over the 72-year period of record.
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the juvenile emigration period (November through May).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency, to adversely affect juvenile emigration for a given month of this period over the 72-year period of record.
Sacramento-San Joaquin Delta Fish Resources	
Monthly mean Delta outflow (cfs) for all months of the year.	Decrease in monthly mean Delta outflow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.

Table 4-20. Effect Indicators and Evaluation Criteria for Central Valley Steelhead

Effects Indicators	Evaluation Criteria
Monthly mean location of X_2 for all months of the year.	Increase in upstream movement of the monthly mean position of X_2; relative to the basis of comparison, of sufficient magnitude (1 km) and frequency to adversely affect Delta fish resources over the 15-year period of record.
Export/Inflow (E/I) ratio during the February through June period.	Increase in the monthly mean Delta E/I ratio, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Reverse flows (QWEST) during the February through June period.	Increase in reverse flows, relative to the basis of comparison, of sufficient frequency and magnitude to result in reduced or delayed downstream transport of planktonic eggs and larvae or adverse effects on juvenile salmonid emigration.
Annual Chinook salmon CVP/SWP salvage estimates (number of individuals salvaged per year).	Increase in the annual number of Chinook salmon captured at the CVP and SWP fish salvage facilities, relative to the basis of comparison, over the 15-year period (1979 – 1993) included in these analyses.

4.5.3 Project Effects

The following discussion is a summary of potential effects related to river flow and water temperature with implementation of the EWA Proposed Action, as well as effects on long-term average annual early lifestage survival (based on water temperature effects) of steelhead on the Sacramento River. Potential effects on steelhead related to changes in habitat conditions and salvage at the SWP and CVP export facilities within the Sacramento-San Joaquin Delta are also summarized below.

Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative of the EWA EIR/EIS provides a detailed evaluation of effects on Central Valley steelhead. For a detailed analysis of potential river flow and water temperature effects, refer to Section 9.2.5.1.1, Sacramento River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the Sacramento River and Impacts to Steelhead in Butte Creek; Section 9.2.5.1.2, Feather River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the Lower Feather River; Section 9.2.5.1.3, Yuba River Basin, Impacts to Yuba River Fisheries Resources; Section 9.2.5.1.4, American River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the Lower American River; and Section 9.2.5.1.5, San Joaquin River Basin, Impacts to Fall-run Chinook Salmon and Steelhead in the San Joaquin River, of the EWA EIS/EIR.

A detailed analysis of potential effects on steelhead within the Delta is provided in Section 4.1.2.3, Effects Analysis for Estuarine Species, of this ASIP and in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR.

Flow

Flow reductions in the Sacramento, lower Feather, Yuba, lower American, and San Joaquin Rivers would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction of immigrating adults, spawning, egg incubation, and initial rearing, juvenile over-summer and fall/winter rearing, or juvenile emigration.

Flow increases would not be of sufficient magnitude to beneficially affect attraction of immigrating adults or downstream passage of emigrating juveniles. Potential reductions of agricultural return flows in Butte Creek would occur outside the adult immigration or juvenile emigration time periods and downstream of spawning habitat, therefore neither beneficial nor adverse effects on steelhead in Butte Creek are anticipated.

Water Temperature

Changes in water temperature in the Sacramento, lower Feather, Yuba, lower American, and San Joaquin Rivers would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for spawning, incubation, and initial rearing, or juvenile rearing and emigration. However, at the mouth of the Feather River, there would be one additional occurrence when mean monthly water temperatures would be above the suitable range of temperatures for juvenile rearing and emigration (65ºF) with the Proposed Action, relative to the basis of comparison. In addition, in October there would be one additional occurrence in the lower American River below Nimbus Dam and one additional occurrence in the lower American River at Watt Avenue in which water temperatures would be above the upper end of the suitable range of temperature for egg incubation (56ºF), relative to the basis of comparison.

Annual Early Lifestage Survival

Based on the late-fall run Chinook salmon survival analysis for the Sacramento River, there would be no change in long-term average annual early lifestage survival in the Sacramento River with the Proposed Action, relative to the basis of comparison. Substantial increases or decreases in survival would not occur in any individual year of the 69-year simulation. In 67 of 69 years, there would be no difference in annual early lifestage survival between the Proposed Action and the basis of comparison. In 2 of the 69 years, there would be a decrease in survival of 0.1 percent and an increase in survival of 0.1 percent, relative to the basis of comparison.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios. The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to juvenile salmonid emigration.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect steelhead in the Delta.

Salvage at the SWP/CVP Export Facilities

Annual steelhead salvage estimates exhibit a decrease in all 15 years simulated under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 28,928 steelhead, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 20,386 steelhead, relative to the basis of comparison.

Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in steelhead salvage in July under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Such changes under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario may affect but are not likely to substantially alter steelhead salvage patterns in the Delta.

Therefore, EWA actions may affect, but are not likely to adversely affect steelhead.

4.5.4 Conservation Measures

Effects of EWA actions on steelhead were considered adverse if pumping of EWA assets at Project facilities resulted in greater fish entrainment or death, changed the Delta flow patterns affecting fish migration patterns, or changed stream flows adversely affecting spawning and juvenile rearing. The following conservation measures would help to avoid or minimize adverse effects on Central Valley steelhead and are included as part of the EWA Proposed Action (see Chapter 2, Description of the EWA Proposed Action):

- The EWA Project Agencies will coordinate EWA water acquisition and transfer actions with Federal (Reclamation, USFWS, and NOAA Fisheries), State (DWR and CDFG), other CALFED agencies, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project, the Anadromous Fish Restoration Program, the Senate Bill [SB] 1086 program, the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study, the Riparian Habitat Joint Venture, the Central Valley Project Improvement Act (CVPIA), the Central Valley Habitat Joint Venture, and the Grassland Bird Conservation Plan) that could affect management of evaluated species. Coordination would avoid conflicts among management objectives and would be facilitated through CALFED's water transfer program.

- The EWA agencies will avoid acquisition and transfer of water that will reduce flows essential to maintaining populations of native aquatic species in the source river.

- EWA water acquisition and transfers will not increase exports during times of the year when anadromous and estuarine fish are most vulnerable to damage or loss at project facilities or when their habitat may be adversely affected.

- The EWA agencies will avoid acquisition and transfer of stored reservoir water quantities that will impair compliance with flow requirements and maintenance of suitable habitat conditions in the source river in subsequent years.

- Implementing the EWA, the EWA agencies will fully adhere to the terms and conditions in all applicable CESA and FESA biological opinions and permits for CVP and SWP operations.

- The EWA agencies will minimize flow fluctuations resulting from the release of EWA assets from project reservoirs to reduce or avoid stranding of juveniles.

- In May, the EWA agencies will evaluate Folsom Reservoir coldwater pool availability to benefit over-summering juvenile steelhead prior to releasing EWA assets.

- The EWA agencies will consult with the local river management teams regarding flow ramping rates before and after EWA transfers to avoid downstream movement of juvenile steelhead.

4.5.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on steelhead provided in Section 4.5.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) will contribute to the recovery of Central Valley steelhead.

4.6 Delta Smelt (*Hypomesus transpacificus*)

4.6.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Delta smelt are found mainly in the waters of the Delta and Suisun Bay, but are generally most abundant in the western Delta and eastern Suisun Bay (Honker Bay) and commonly use Montezuma Slough. Their spawning distribution varies from year to year within the Delta. The species is endemic to the Sacramento-San Joaquin estuary and its population abundance varies substantially from year to year. Abundance has been uncharacteristically low since 1982, in large part because of the extended drought of 1987-1992 and possibly to extremely wet years in 1983 and 1986 (Moyle *et al.* 1989). Population abundance has fluctuated recently from increases in some years to uncharacteristic decreases in other years (Interagency Ecological Program 1998). Additional details regarding the status of delta smelt in the EWA Action Area are provided in Section 3.2.5, Delta Smelt.

4.6.2 Effect Assessment Methods

Section 4.1.1.2, Effect Assessment Methods discusses the assessment methods for all anadromous fish. Section 4.1.2.2, Effect Assessment Methods discusses the assessment methods for all Delta estuary fish. Table 4-21 presents the effect indicators and evaluation criteria used in the analysis of potential effects on delta smelt.

Table 4-21. Effect Indicators and Evaluation Criteria for Delta Smelt

Effect Indicator	Evaluation Criteria
San Joaquin River	
Monthly mean flow (cfs) at Vernalis for each month of the spawning period (January through June).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength and juvenile rearing for a given month of this period over the 72-year period of record
Sacramento-San Joaquin Delta Fish Resources	
Monthly mean Delta outflow (cfs) for all months of the year.	Decrease in monthly mean Delta outflow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Monthly mean location of X_2 for all months of the year.	Increase in upstream movement of the monthly mean position of X_2; relative to the basis of comparison, of sufficient magnitude (1 km) and frequency to adversely affect Delta fish resources over the 15-year period of record.
Export/Inflow (E/I) ratio during the February through June period.	Increase in the monthly mean Delta E/I ratio, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Reverse flows (QWEST) during the February through June period.	Increase in reverse flows, relative to the basis of comparison, of sufficient frequency and magnitude to result in reduced or delayed downstream transport of planktonic eggs and larvae or adverse effects on juvenile salmonid emigration.
Annual delta smelt CVP/SWP salvage estimates (number of individuals salvaged per year).	Increase in the annual number of delta smelt captured at the CVP and SWP fish salvage facilities, relative to the basis of comparison, over the 15-year period (1979 – 1993) included in these analyses.

4.6.3 Project Effects

The following discussion is a summary of potential effects related to river flow and water temperature with implementation of the EWA Proposed Action. Potential effects on delta smelt related to changes in habitat conditions and salvage at the SWP and CVP export facilities within the Sacramento-San Joaquin Delta are also summarized below.

Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative of the EWA EIR/EIS provides a detailed evaluation of effects on delta smelt. For a detailed analysis of potential river flow and temperature related effects, refer to Section 9.2.5.1.5, San Joaquin River Basin, Impacts to Delta Smelt in the San Joaquin River, of the EWA EIS/EIR.

A detailed analysis of potential effects on delta smelt within the Delta is provided in Section 4.1.2.3, Effects Analysis for Estuarine Species, of this ASIP and in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR.

Flow

Changes in San Joaquin River flows are not expected during the spawning period with the Proposed Action, relative to the basis of comparison, therefore beneficial or adverse affects on delta smelt spawning and initial rearing are not anticipated.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios. The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to the transport of planktonic larvae.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect delta smelt in the Delta.

Salvage at the SWP/CVP Export Facilities

Annual salvage estimates exhibit a decrease in 14 of the 15 years simulated under the Maximum Water Purchase Scenario, with an overall estimated decrease of 135,887 delta smelt. Under the Typical Water Purchase Scenario, annual salvage estimates exhibit a decrease in all 15 years, with an overall estimated decrease of 93,690 delta smelt. Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in delta smelt salvage in July through September under both the Maximum Water Purchase and Typical Water Purchase Scenarios. Overall, based on modeling output and the efficiency of real-time adjustment of operations (real-time implementation of conservation measures) in response to abundance and distribution monitoring, implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario may affect but is not likely to adversely affect delta smelt salvage in the Delta.

Therefore, EWA actions may affect, but are not likely to adversely affect Delta smelt.

4.6.4 Conservation Measures

The following conservation measures are included as part of the EWA Proposed Action (see Chapter 2, Description of the EWA Proposed Action) and would ensure that potential adverse effects on delta smelt are avoided or minimized:

- The EWA Project Agencies will coordinate EWA water acquisition and transfer actions with Federal (Reclamation, USFWS, and NOAA Fisheries), State (DWR and CDFG), other CALFED agencies, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project, the Anadromous Fish Restoration Program, the Senate Bill [SB] 1086 program, the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study, the Riparian Habitat Joint Venture, the Central Valley Project Improvement Act (CVPIA), the Central Valley Habitat Joint Venture, and the Grassland Bird Conservation Plan) that could affect management of evaluated species. Coordination would avoid conflicts among management objectives and would be facilitated through CALFED's water transfer program.

- The EWA agencies will avoid acquisition and transfer of water that will reduce flows essential to maintaining populations of native aquatic species in the source river.

- EWA water acquisition and transfers will not increase exports during times of the year when anadromous and estuarine fish are most vulnerable to damage or loss at project facilities or when their habitat may be adversely affected.

- The EWA agencies will avoid acquisition and transfer of stored reservoir water quantities that will impair compliance with flow requirements and maintenance of suitable habitat conditions in the source river in subsequent years.

- Implementing the EWA, the EWA agencies will fully adhere to the terms and conditions in all applicable CESA and FESA biological opinions and permits for CVP and SWP operations.

- The Project Agencies will not initiate EWA water exports in July until EWA Management Agencies agree that delta smelt will not be harmed.

4.6.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on delta smelt provided in Section 4.6.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) will contribute to the recovery of delta smelt.

4.7 Sacramento Splittail (*Pogonichthys macrolepidotus*)

4.7.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Endemic to Central Valley lakes and rivers, adult splittail now primarily inhabit the Delta and Suisun Bay and Marsh (Moyle *et al.* 1995). The species' distribution has been reduced to less than one-third of its original range (59 FR 862, January 6, 1994). Fish surveys in the Sacramento-San Joaquin estuary indicate that splittail abundance there had declined by over 50% from 1980 through 1994, most likely in response to the drought of 1987-1992 (Meng and Moyle 1995, Sommer *et al.* 1997). In 1995, abundance reached a record high, relative to historical conditions (Sommer *et al.* 1997). Strong year classes follow high flow years (1995), when portions of the estuary and river floodplains are flooded in winter and early spring. Preliminary surveys in 1998 indicated high larvae and juvenile abundance during this very wet year (California Department of Fish and Game 1998). Additional details regarding the status of Sacramento splittail in the EWA Action Area are provided in Section 3.2.6, Sacramento Splittail.

4.7.2 Effect Assessment Methods

Section 4.1.1.2, Effect Assessment Methods discusses the assessment methods for all anadromous fish. Section 4.1.2.2, Effect Assessment Methods discusses the assessment methods for all Delta estuary fish. Table 4-22 presents the effect indicators and evaluation criteria used in the analysis of potential effects on Sacramento splittail.

Table 4-22. Effect Indicators and Evaluation Criteria for Sacramento Splittail

Effects Indicators	Evaluation Criteria
Sacramento River Splittail	
Monthly mean flows (cfs) at Freeport and below Keswick during each month of the February through May spawning period.	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect potential splittail habitat availability for each month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at Freeport, Bend Bridge, Jelly's Ferry, and the mouth during each month of the February through May spawning period.	Substantial increase in the frequency, relative to the basis of comparison, in which monthly mean water temperatures exceed the reported upper temperature range for splittail spawning (68°F) for a given month of this period over the 69-year period of record.
Butte Creek Sacramento Splittail	
Agricultural return flows downstream of the Western Canal (Butte Creek) Siphon during the spawning period (February through April).	Decreases in flows, relative to the basis of comparison, of sufficient frequency and magnitude to adversely affect spawning habitat availability for a given month of this period.
Lower Feather River Sacramento Splittail	
Monthly mean flows (cfs) at the mouth of the Feather River for each month of the February through May spawning period.	Decrease in monthly mean flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect potential splittail habitat availability for each month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at the mouth of the Feather River for each month of the February through May spawning period.	Substantial increase in the frequency, relative to the basis of comparison, in which monthly mean water temperatures exceed the reported upper temperature range for splittail spawning (68°F) for a given month of this period over the 69-year period of record.
Lower American River Sacramento Splittail	
Monthly mean acreage of flooded riparian habitat at Watt Avenue during each month of the February through May spawning period.	Decrease in monthly mean quantity of inundated riparian habitat, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect potential splittail habitat availability for each month of this period over the 72-year period of record.
Monthly mean water temperatures (°F) at Watt Avenue and the mouth of the lower American River during each month of the February through May spawning period.	Substantial increase in the frequency, relative to the basis of comparison, in which monthly mean water temperatures exceed the reported upper temperature range for splittail spawning (68°F) for a given month of this period over the 69-year period of record.
San Joaquin River Sacramento Splittail	
Monthly mean flow (cfs) below the confluence of the Merced River and at Vernalis for each month of the spawning period (February through May).	Decrease in monthly mean flow (> 25%), relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect initial year-class strength and juvenile rearing for a given month of this period over the 72-year period of record.
Sacramento-San Joaquin Delta Fish Resources	
Monthly mean Delta outflow (cfs) for all months of the year.	Decrease in monthly mean Delta outflow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.

Table 4-22. Effect Indicators and Evaluation Criteria for Sacramento Splittail

Effects Indicators	Evaluation Criteria
Monthly mean location of X_2 for all months of the year.	Increase in upstream movement of the monthly mean position of X_2; relative to the basis of comparison, of sufficient magnitude (1 km) and frequency to adversely affect Delta fish resources over the 15-year period of record.
Export/Inflow (E/I) ratio during the February through June period.	Increase in the monthly mean Delta E/I ratio, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect Delta fishery resources over the 15-year period of record.
Reverse flows (QWEST) during the February through June period.	Increase in reverse flows, relative to the basis of comparison, of sufficient frequency and magnitude to result in reduced or delayed downstream transport of planktonic eggs and larvae or adverse effects on juvenile salmonid emigration.
Annual splittail CVP/SWP salvage estimates (number of individuals salvaged per year).	Increase in the annual number of splittail captured at the CVP and SWP fish salvage facilities, relative to the basis of comparison, over the 15-year period (1979 – 1993) included in these analyses.

4.7.3 Project Effects

The following discussion is a summary of potential effects related to river flow and water temperature with implementation of the EWA Proposed Action. Potential effects on Sacramento splittail related to changes in habitat conditions and salvage at the SWP and CVP export facilities within the Sacramento-San Joaquin Delta are also summarized below.

Section 9.2.5, Environmental Consequences/Environmental Impacts of the Flexible Purchase Alternative of the EWA EIR/EIS provides a detailed evaluation of effects on Sacramento splittail. For a detailed analysis of potential river flow and water temperature effects, refer to Section 9.2.5.1.1, Sacramento River Basin, Impacts to Sacramento Splittail in the Sacramento River and Impacts to Sacramento Splittail in Butte Creek; Section 9.2.5.1.2, Feather River Basin, Impacts to Sacramento Splittail in the Feather River; Section 9.2.5.1.4, American River Basin, Impacts to Sacramento Splittail in the lower American River; and Section 9.2.5.1.5, San Joaquin River Basin, Impacts to Sacramento Splittail in the San Joaquin River, of the EWA EIS/EIR.

A detailed analysis of potential effects on Sacramento splittail within the Delta is provided in Section 4.1.2.3, Effects Analysis for Estuarine Species, of this ASIP and in Section 9.2.5.2, Sacramento-San Joaquin Delta Region, of the EWA EIS/EIR.

Flow

Changes in flows on the Sacramento, lower Feather, lower American, and San Joaquin Rivers would not be of sufficient frequency or magnitude to adversely affect the availability of inundated habitat for spawning. Potential reductions of agricultural return flows in Butte Creek are expected to occur after the cessation of splittail spawning, therefore neither beneficial nor adverse effects on splittail spawning in Butte Creek are anticipated.

Water Temperature

Changes in water temperature on the Sacramento, lower Feather, lower American, and San Joaquin Rivers would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for spawning (68ºF). However, there would be one additional occurrence of temperatures above the preferred spawning temperature at the mouth of the Feather River with the Proposed Action, compared to the basis of comparison.

Delta Habitat Conditions

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum Water Purchase and Typical Water Purchase Scenarios. The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum Water Purchase and Typical Water Purchase Scenarios (except during brief periods when the Management Agencies determine the risk to fish is low and elect to allow pumping above the E/I ratio to gain water for the EWA). Implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be considered a benefit to the transport of planktonic larvae.

Therefore, the habitat conditions resulting from implementation of the Proposed Action under both the Maximum Water Purchase Scenario and Typical Water Purchase Scenario are not likely to adversely affect splittail in the Delta.

Salvage at the SWP/CVP Export Facilities

Annual salvage estimates exhibit a decrease in 14 of the 15 years simulated under the Maximum Water Purchase Scenario, with an overall estimated decrease of 1,014,290 splittail. Under the Typical Water Purchase Scenario, annual salvage estimates exhibit a decrease in all 15 years, with an overall estimated decrease of 656,597 splittail. Although annual salvage estimates decrease in all but one year, there would be isolated occurrences of monthly increases in delta smelt salvage in July through September under both the Maximum Water Purchase and Typical Water Purchase Scenarios.

Although there would be increases in splittail salvage with implementation of the Proposed Action under the Maximum Water Purchase Scenario in one year and in individual months of the simulation, such changes under both the Maximum Water Purchase Scenario and the Typical Water Purchase Scenario may affect but are not likely to adversely affect splittail salvage in the Delta.

Therefore, EWA actions may affect, but are not likely to adversely affect Sacramento splittail.

4.7.4 Conservation Measures

Effects of EWA actions on Sacramento splittail were considered adverse if pumping of EWA assets at Project facilities resulted in greater fish entrainment or death. The following conservation measures are included as part of the EWA Proposed Action (see Chapter 2, Description of the EWA Proposed Action) and would ensure that potential adverse effects on Sacramento splittail are avoided or minimized:

- The EWA Project Agencies will coordinate EWA water acquisition and transfer actions with Federal (Reclamation, USFWS, and NOAA Fisheries), State (DWR and CDFG), other CALFED agencies, and regional programs (e.g., the San Francisco Bay Ecosystem Goals Project, the Anadromous Fish Restoration Program, the Senate Bill [SB] 1086 program, the U.S. Army Corps of Engineers' [USACE's] Sacramento and San Joaquin Basin Comprehensive Study, the Riparian Habitat Joint Venture, the Central Valley Project Improvement Act (CVPIA), the Central Valley Habitat Joint Venture, and the Grassland Bird Conservation Plan) that could affect management of evaluated species. Coordination would avoid conflicts among management objectives and would be facilitated through CALFED's water transfer program.

- The EWA agencies will avoid acquisition and transfer of water that will reduce flows essential to maintaining populations of native aquatic species in the source river.

- EWA water acquisition and transfers will not increase exports during times of the year when anadromous and estuarine fish are most vulnerable to damage or loss at project facilities or when their habitat may be adversely affected.

- The EWA agencies will avoid acquisition and transfer of stored reservoir water quantities that will impair compliance with flow requirements and maintenance of suitable habitat conditions in the source river in subsequent years.

4.7.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on splittail provided in Section 4.7.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) will contribute to the recovery of Sacramento splittail.

4.8 Green Sturgeon (*Acipenser medirostris*)

4.8.1 Status in the Action Area

The following is a summary of the more detailed discussion provided in Chapter 3, Environmental Baseline – Special-Status Species Accounts and Status in Action Area, of this ASIP. Green sturgeon is an anadromous species, migrating from the ocean to freshwater to spawn. Adults of this species tend to be more marine-oriented than the more common white sturgeon. Nevertheless, spawning populations have been identified in the Sacramento River (Beak Consultants 1993), and most spawning is believed to occur in the upper reaches of the Sacramento River as far north as Red Bluff (Moyle *et al.* 1992; 1995). Adults begin their inland migration in late-February (Moyle *et al.* 1995), and enter the Sacramento River between February and late-July (CDFG 2001). Spawning activities occur from March through July, with peak activity believed to occur between April and June (Moyle *et al.* 1995). In the Sacramento River, green sturgeon presumably spawn at temperatures ranging from 46°F to 57°F (Beak Consultants 1993). Small numbers of juvenile green sturgeon have been captured and identified each year from 1993 through 1996 in the Sacramento River at the Hamilton City Pumping Plant (RM 206) (Brown, pers. comm. 1996). Lower American River (Gerstung 1977) fish surveys conducted by the CDFG have not collected green sturgeon (Snider, pers. comm. 1997). Although a green sturgeon sport fishery exists on the lower Feather River, the extent to which green sturgeon use of the Feather River is still to be determined. Green sturgeon larvae are occasionally captured in salmon outmigrant traps, suggesting the lower Feather River may be a spawning area (Moyle 2002). However, NOAA Fisheries (2002) reports that green sturgeon spawning in the Feather River is unsubstantiated. Additional details regarding the status of green sturgeon in the EWA Action Area are provided in Section 3.2.7, Green Sturgeon.

4.8.2 Effect Assessment Methods

There is not sufficient information available regarding green sturgeon to develop rigorous effect indicators and evaluation criteria similar to those developed for the other special-status species included in this ASIP. Therefore, because several of the life history requirements (e.g., spawning temperature ranges) for green sturgeon are similar to or less stringent than the physiochemical and biological requirements of Chinook salmon, the life history and species criteria (water temperature and flow) used for Chinook salmon is thought to be more conservative and will apply to the analysis for green sturgeon.

4.8.3 Project Effects

As discussed above in Section 4.8.2, Effect Assessment Methods, the analysis of potential effects on Chinook salmon is considered a conservative estimate of potential effects on green sturgeon. The analysis of potential effects on Chinook salmon with implementation of the Proposed Action is provided in Sections 4.2.3, 4.3.3, and 4.4.3, Project Effects.

EWA actions may affect, but are not likely to adversely affect green sturgeon.

4.8.4 Conservation Measures

Riverine conditions (water temperature) suitable for the various life history stages of Chinook salmon are also suitable for green sturgeon, thus conservation measures targeting Chinook salmon are anticipated to also benefit green sturgeon.

4.8.5 Contribution to Recovery

The EWA Program has been developed to contribute to the recovery of at-risk native fish species. The EWA agencies have established operating tools that allow them to meet protection objectives for at-risk fish species within the Sacramento and San Joaquin Rivers and their tributaries and the Delta, including: 1) reducing export pumping, 2) closing the Delta Cross Channel gates, 3) increasing instream flows, and 4) augmenting Delta outflow. The EWA agencies use their acquired assets, in addition to actions specified in the regulatory baseline fishery protection, and implement actions to protect at-risk fish under various conditions throughout the year. Each tool, its timing, the protection it provides and why, and how each action is undertaken is described in Section 2.4.2, Actions to Protect Fish and Benefit the Environment, of this ASIP.

The analysis of potential effects on Chinook salmon provided in Sections 4.2.3, 4.3.3, and 4.4.3, Project Effects, demonstrates that implementation of the EWA Proposed Action (including the above conservation measures) may contribute to the recovery of green sturgeon.

4.9 Aleutian Canada Goose (*Branta canadensis leucopareia*)

4.9.1 Status in the Action Area

The Aleutian Canada goose was removed from the list of threatened species under the Endangered Species Act on March 20, 2001, but this species is still considered as a Federal Species of Concern for five years after delisting (CDFG 2003). This goose is also 1) protected under the Migratory Bird Treaty Act and Convention on International Trade in Endangered Species of Wild Fauna and Flora (U.S. Fish and Wildlife Service 2001), 2) considered a California Special Animal (CDFG 2003), and 3) listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003).

The present population of Aleutian Canada geese migrates along the northern California coast and winters in the Central Valley near Colusa and on scattered feeding and roosting sites along the San Joaquin River from Modesto to Los Banos (Jones & Stokes Associates and CH2M Hill 1986, Nelson et al. 1984). Fall migration usually begins in late August or early September, with birds arriving in the Central

Valley between October and early November (U.S. Fish and Wildlife Service 1980). Spring migration usually begins in mid-February and continues to early March (U.S. Fish and Wildlife Service 1980). The current population estimate is approximately 24,000 individuals (63 FR 68:17,350-17,352). Figure 3-1 depicts the distribution of Aleutian Canada geese in California over the winter. According to the Final Rule delisting the goose, the lands used by Aleutian Canada geese during the fall/winter period near Colusa, California, are primarily privately owned farms and Reclamation District land, as well as the Butte Sink National Wildlife Refuge (66 FR 54: 15,643-15656). The goose also overwinters near Cresent City and in the northern San Joaquin Valley.

Most Aleutian Canada geese that nest in the islands winter in California, primarily on agricultural lands. They arrive on the wintering grounds in mid-October (USFWS, 1999). Aleutian Canada geese forage in harvested cornfields, newly planted or grazed pastures, or other agricultural fields (e.g., rice stubble and green barley). Lakes, reservoirs, ponds, and flooded fields are used for roosting and loafing (Grinnell and Miller 1944, U.S. Fish and Wildlife Service 1982). They also roost in large marshes and stock ponds.

Aleutian Canada geese are omnivores, having a steady diet of arthropods, evergreen shrubs, roots, tubers, leaves, and stems during the breeding season. They also consume crowberries. The goslings are fed insects such as ground beetles. All their water is taken from vegetation. During the non-breeding season they feed on crops such as rice, corn, wheat, barley, oats, and lima beans. Water is taken from low-lying flooded areas.

4.9.2 Effect Assessment Methods

The only habitat used by the Aleutian Canada goose affected by EWA actions (crop idling) is seasonally flooded agriculture. (For the EWA program seasonally flooded agriculture is equated with rice.) The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the Aleutian Canada Goose. Table 4-23 provides the relationship of the Aleutian Canada goose with rice lands and the rice production cycle. The primary concern is the loss of wastegrain forage for the goose.

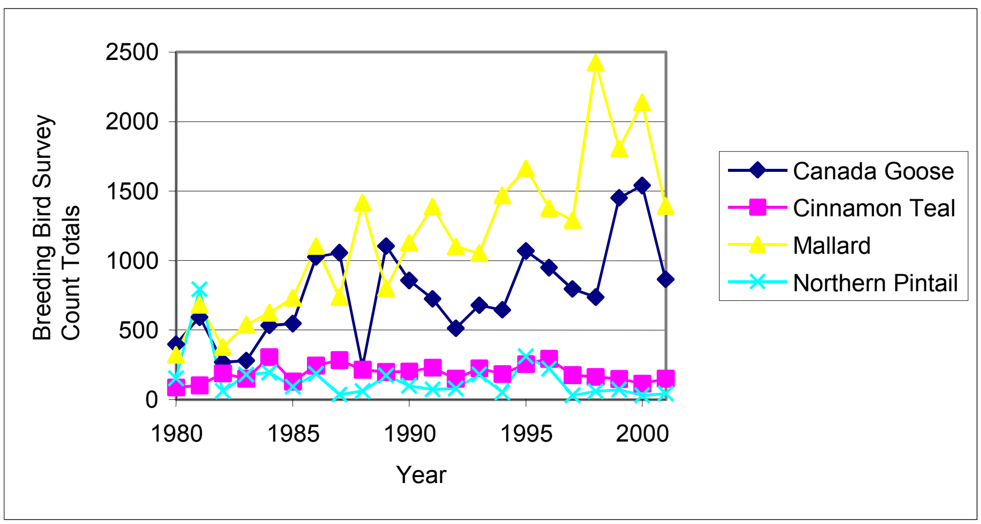
4.9.3 Project Effects

Aleutian Canada Goose Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing winter forage and habitat for this recovering species. The Aleutian Canada goose is a winter visitor to the Central Valley. The primary cause of its population decline was the introduction of foxes to its breeding islands in Alaska. A recovery plan (USFWS 1991a) has been put in place to address the threat predators pose to its breeding habitat. The concern for its winter use in California is to ensure the survival of the over wintering populations as measure of addressing the species overall recovery.

Like many migratory waterfowl, the Aleutian Canada goose forages on waste grain on agricultural fields in the Colusa Basin. This includes flooded rice land and rice land stubble. In addition to waste grains, the birds also consume insects and vegetative matter.

The concern for SFA idling is a reduced winter food supply for the Aleutian Canada goose (31 million pounds out of 157 million pounds within the 6 counties altogether or 20%). However, the analysis of waterfowl population trends for the Central Valley (Figure 4-1) shows no correlation between the amount of waste grain and waterfowl numbers. It appears that waste grain is not a limiting factor for controlling waterfowl populations and therefore the reductions of winter forage resulting from EWA crop idling would have a less-than-significant effect on the species. No environmental measure for the Aleutian Canada goose related to reduction in winter forage is proposed.

Crop idling actions taken by EWA agencies may affect but are not likely to adversely affect the goose.



Source: Sauer, J. R., et. al..

Figure 4-1
Breeding Bird Survey Results 1980-2001

Table 4-23
Relationship of Covered Species Associated to Rice Land Crop Cycles

Annual Cycles	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Rice Fields Status	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded or draining in Sacramento Valley)*	Generally draining and drying in preparation for planting*	Generally flooded*	Generally flooded*	Flooded	Flooded	Draining and harvesting	Draining and harvesting	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)
Giant Garter Snake	Snakes are dormant.	Snakes are dormant.	Snakes emerge. Riceland provides canals with emergent vegetation for cover and for locating mates.	Snakes emerge. Riceland provides canals with emergent vegetation for cover and for locating mates.	Snakes remain close to their denning areas.	Snakes move throughout flooded rice land habitat. Rice land provides warm shallow open waters with aquatic prey for foraging.	Snakes move throughout flooded rice land habitat and start birthing. Rice land provides emergent vegetation for birthing and juvenile dispersion cover.	Snakes move throughout flooded rice land habitat and continue birthing. Rice land provides emergent vegetation for birthing and juvenile dispersion cover.	Snakes complete birthing and leave rice land area to concentrate in drainage ditches and irrigation canals. Rice land provides concentrated prey within canals	Snakes are concentrating in drainage ditches and irrigation canals. Rice land provides drainage pools of concentrated prey for pre-dormancy gorging.	Snakes are dormant.	Snakes are dormant.
Tricolored Blackbird	Birds winter in pastureland and other habitat. Some flocks use shallow open waters for foraging on aquatic insects and plants if fields are flooded and barren fields for foraging on waste grain.	Birds winter in pastureland and other habitat. Some flocks use shallow open waters for foraging on aquatic insects and plants if fields are flooded and barren fields for foraging on waste grain.	Birds initiate breeding in habitats adjacent to rice lands. Some foraging may continue in residual flooded fields/inactive fields on aquatic insects and waste grain.	Birds are breeding in habitats adjacent to rice lands. Rice lands in planting stage typically provide no significant resource.	Birds are breeding in habitats adjacent to rice lands. Rice land resources include shallow open waters for foraging on aquatic insects and emergent plants.	Birds are breeding in habitats adjacent to rice lands. Rice land resources include shallow open waters for foraging on aquatic insects and emergent plants.	Birds are breeding in habitats adjacent to rice lands. Rice land resources include shallow open waters for foraging on aquatic insects and emergent plants.	Birds are breeding in habitats adjacent to rice lands. Rice land resources include shallow open waters for foraging on aquatic insects and emergent plants.	Birds finish breeding and are dispersing to a variety of habitats. Waste grain becomes available for foraging.	Birds finish breeding and are dispersing to a variety of habitats. Waste grain becomes available for foraging.	Birds winter in pastureland and other habitat. Some flocks use shallow open waters for foraging on aquatic insects and plants if fields are flooded and barren fields for foraging on waste grain.	Birds winter in pastureland and other habitat. Some flocks use shallow open waters for foraging on aquatic insects and plants if fields are flooded and barren fields for foraging on waste grain.

Table 4-23
Relationship of Covered Species Associated to Rice Land Crop Cycles

Annual Cycles	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice Fields Status	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded or draining in Sacramento Valley)*	Generally draining and drying in preparation for planting*	Generally flooded*	Generally flooded*	Flooded	Flooded	Draining and harvesting	Draining and harvesting	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)
Greater Sandhill Crane	Crane is wintering. Rice land resources include dry and barren rice fields with rice stubble for foraging/cranes avoid flooded fields.	Crane is wintering. Rice land resources include dry and barren rice fields with rice stubble for foraging.	Crane migrates to breeding habitat in Northern California.	Crane breeds in Northern California.	Crane breeds in Northern California.	Crane breeds in Northern California.	Crane breeds in Northern California.	Crane breeds in Northern California.	Crane breeds in Northern California.	Crane begins returning to winter habitat, typically to the same location each year.	Crane is wintering. Rice land resources include dry and barren rice fields with rice stubble for foraging.	Crane is wintering. Rice land resources include dry and barren rice fields with rice stubble for foraging.
Great and Snowy Egrets and Heron	Egrets are wintering. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are wintering. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are wintering. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are breeding in rookeries. Rice lands during planting typically provide no significant resource.	Egrets are breeding in rookeries. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are breeding in rookeries. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are breeding in rookeries. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are breeding in rookeries. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are breeding in rookeries. Rice lands during harvesting typically provide no significant resource.	Egrets are wintering. Rice lands during harvesting typically provide no significant resource.	Egrets are wintering. Rice land resources include shallow open waters for foraging on small fish and invertebrates.	Egrets are wintering. Rice land resources include shallow open waters for foraging on small fish and invertebrates.

Table 4-23
Relationship of Covered Species Associated to Rice Land Crop Cycles

Annual Cycles	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice Fields Status	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded or draining in Sacramento Valley)*	Generally draining and drying in preparation for planting*	Generally flooded*	Generally flooded*	Flooded	Flooded	Draining and harvesting	Draining and harvesting	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)
White-faced Ibis	Ibis is wintering. Rice land resources include shallow open waters for foraging on aquatic insects and invertebrates if fields are winter-flooded and barren fields for foraging on terrestrial or aquatic insects and invertebrates if fields are inactive.	Ibis is wintering. Rice land resources include shallow open waters for foraging on aquatic insects and invertebrates if fields are winter-flooded and barren fields for foraging on terrestrial or aquatic insects and invertebrates if fields are inactive.	Ibis is wintering. Rice land resources include shallow open waters for foraging on aquatic insects and invertebrates if fields are winter-flooded and barren fields for foraging on terrestrial or aquatic insects and invertebrates if fields are inactive.	Ibis is migratory and is breeding mostly in areas apart from rice lands.	Ibis is migratory and is breeding mostly in areas apart from rice lands.	Ibis is migratory and is breeding mostly in areas apart from rice lands.	Ibis is migratory and is breeding mostly in areas apart from rice lands.	Ibis is migratory and is breeding mostly in areas apart from rice lands.	Ibis is migrating. Rice lands during harvesting typically provide no significant resource.	Ibis is wintering. Rice lands during harvesting typically provide no significant resource.	Ibis is wintering. Rice land resources include shallow open waters for foraging on aquatic insects and invertebrates if fields are winter-flooded and barren fields for foraging on terrestrial or aquatic insects and invertebrates if fields are inactive.	Ibis is wintering. Rice land resources include shallow open waters for foraging on aquatic insects and invertebrates if fields are winter-flooded and barren fields for foraging on terrestrial or aquatic insects and invertebrates if fields are inactive.
Long-billed Curlew	Curlew is wintering. Rice land resources for the curlew include shallow open waters for foraging on invertebrates.	Curlew is wintering. Rice land resources for the curlew include shallow open waters for foraging on invertebrates.	Curlew is wintering. Rice land resources for the curlew include shallow open waters for foraging on invertebrates.	Curlew moves to breeding areas with elevated grasslands.	Curlew breeds in elevated grasslands.	Curlew breeds in elevated grasslands.	Curlew breeds in elevated grasslands.	Curlew breeds in elevated grasslands.	Curlew breeds in elevated grasslands.	Curlew returns. Rice lands during harvesting typically provide no significant resource.	Curlew is wintering. Rice land resources include shallow open waters for foraging on invertebrates.	Curlew is wintering. Rice land resources include shallow open waters for foraging on invertebrates.

Table 4-23
Relationship of Covered Species Associated to Rice Land Crop Cycles

Annual Cycles	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice Fields Status	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded or draining in Sacramento Valley)*	Generally draining and drying in preparation for planting*	Generally flooded*	Generally flooded*	Flooded	Flooded	Draining and harvesting	Draining and harvesting	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)
Black Tern	Tern over winters in South America	Tern over winters in South America	Tern over winters in South America	Terns begin to return to California and initiate breeding in habitats other than rice land. Rice land during planting typically provides no significant resource.	Tern is breeding and can start using flooded rice land for foraging on insects and invertebrates.	Tern is breeding and is using flooded rice land emergent vegetation for nesting and for foraging on insects and invertebrates.	Tern is breeding and is using flooded rice land emergent vegetation for nesting and for foraging on insects and invertebrates.	Tern ends breeding. Rice land resources include shallow open waters and emergent vegetation for foraging on insects and invertebrates.	Terns begin to disperse from riceland	Tern migrates to South America	Tern over winters in South America	Tern over winters in South America
Black-crowned Night Heron	Heron is wintering. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates if fields are flooded.	Herons initiate breeding in trees possibly near rice land. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates if fields are flooded.	Heron is breeding. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates if fields are flooded.	Heron is breeding. Rice lands during planting typically provide no significant resource.	Heron is breeding. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates.	Heron is breeding. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates.	Heron completes breeding. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates.	Heron is roosting in trees more remote from rice land. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates.	Heron is roosting. Rice lands during harvesting typically provide no significant resource to Herons	Heron is roosting. Rice lands during harvesting typically provide no significant resource to Herons	Heron is wintering. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates if fields are flooded.	Heron is wintering. Rice land resources include shallow open waters for foraging on aquatic insects, small fish, and invertebrates if fields are flooded.

Table 4-23
Relationship of Covered Species Associated to Rice Land Crop Cycles

Annual Cycles	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rice Fields Status	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded or draining in Sacramento Valley)*	Generally draining and drying in preparation for planting*	Generally flooded*	Generally flooded*	Flooded	Flooded	Draining and harvesting	Draining and harvesting	Inactive (40% flooded in Sacramento Valley)	Inactive (40% flooded in Sacramento Valley)
Western Pond Turtle	Turtles are dormant.	Turtles are dormant.	Turtles become active. Rice land resources include emergent vegetation in canals and drainage ditches for cover and for foraging on aquatic plants and invertebrates and dikes for basking.	Turtles are active. Rice land resources include emergent vegetation in canals and drainage ditches for cover and for foraging on aquatic plants and invertebrates and dikes for basking.	Female turtles begin moving to upland nest sites. Rice land resources include emergent and wet irrigation canals and drainage ditches for cover and for foraging on aquatic plants and invertebrates and dikes for basking.	Female turtles move to upland nest sites. Rice land resources include emergent vegetation in canals and fields for cover and for foraging and dikes for basking.	Female turtles complete nesting. Rice land resources include emergent vegetation in canals and fields for cover and for foraging and dikes for basking.	Turtles are active in fields and canals. Juveniles begin to hatch but remain at the nests, usually until March	Turtles are active. Turtles move into drainages and canals with emergent vegetation and cover and for foraging on aquatic plants and invertebrates.	Turtles are active. Remain in drainages and canals with emergent vegetation until hibernation. Canals have concentrated prey to prepare for hibernation.	Turtles are dormant.	Turtles are dormant.

* The determination of when field preparation initiates is dependent on the last significant rainfall. If rainfall ends in March, field prep can start in April, if rain extends into May, field preparation may wait until early June.

4.9.4 Conservation Measures

Conservation measures are not proposed for the Aleutian Canada goose because this species is not likely to be adversely affected.

4.9.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. These goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The Aleutian Canada goose has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measure listed above will further ensure the potential for effects discussed in Section 4.9.3 are avoided.

4.10 Black Tern (*Chlidonias niger*)

4.10.1 Status in the Action Area

The black tern is listed as a California Species of Special Concern (CDFG 2002) and a Migratory Nongame Bird of Management Concern (USFWS 1995). This species is not listed under the California Endangered Species Act, but is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003).

The black tern was a common and even abundant summer breeder and migrant throughout much of California (Grinnell and Miller 1944). The species has declined and now breeds only in the northeast (Siskiyou, Modoc, and Lassen Counties) and Central Valley, although in much-reduced numbers (Zeiner et al. 1990). The black tern requires freshwater habitats for breeding grounds. Nesting sites are found on lakes, ponds, marshes, and agricultural fields (Grinnell and Miller 1944). During migration, this species can be common on coastal bays, river mouths, and well offshore over pelagic waters (Cogswell 1977). Nests are built on floating mats of dead vegetation among anchored vegetation or along the shore where they are built by scraping out the soil (Zeiner et al. 1990). Figure 3-2 depicts the current nesting distribution of the black tern in California.

The black tern forages by hovering above wet meadows and fresh emergent wetlands; catching insects in the air or plucking them from water and vegetation surfaces. It eats grasshoppers, dragonflies, moths, flies, beetles, crickets, and other insects (Terres 1980). It also hovers above croplands, then drops to capture adult and larval insects from recently plowed soil. Another foraging technique is plunging to water surface for tadpoles, crayfish, small fish, and small mollusks. Young are fed insects (Cuthbert 1954). Adults drink during bathing or swoop to water to dip bill several times, particularly after swallowing prey (Dunn and Argo 1995).

4.10.2 Effect Assessment Methods

The only habitat used by the black tern affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the black tern. Table 4-23provides the relationship of the black tern with rice lands and the rice production cycle. The primary concern is the loss of nesting and foraging habitat when rice crops are idled.

4.10.3 Project Effects

Black Tern Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing breeding habitat and summer habitat for this Covered Species. The black tern was once a common spring and summer visitor to the emergent wetlands of the Central Valley, but its numbers have declined due to habitat losses. Although restricted to freshwater habitats for breeding, it migrates to bays, rivers, and pelagic waters the remainder of the year. SFA habitat has partially replaced the lost emergent vegetation breeding habitat for this species. The rice production cycle coincides with the tern's seasonal behavior in two ways: 1) fields are flooded during the tern's Central Valley breeding season, and 2) fields are dry when the birds have migrated to other aquatic habitats.

The black tern forages by hovering above wet meadows and emergent wetlands, catching insects in the air and diving into the water to capture tadpoles, crayfish, small fish, and mollusks. It nests in loose mats of dead vegetation on the ground or anchored to other vegetation. In rice fields, the tern can also nest on dikes that separate the fields.

Because this species uses SFA for nesting and forage, a reduction of rice habitat could be detrimental to local populations. As an environmental measure, idling of rice habitat known to support colonies of black terns should be avoided. The EWA agencies will review maps of areas proposed for EWA water acquisition crop idling for the presence of the nearest colony. Fields supporting colonies will not be idled.

Crop idling actions may affect but are likely to adversely affect black tern populations with the implementation of the following conservation measures.

4.10.4 Conservation Measures

Crop idling of seasonally flooded agricultural land could reduce the amount of nesting and forage habitat during the summer rearing season.

- As part of the review process for the identification of areas acceptable for crop idling, the Management Agencies will review current species distribution/occurrence information from the Natural Diversity Database and other sources (including rookeries, breeding colonies, and concentration areas). The Management Agencies will then use the information to make decisions that will avoid EWA crop idling actions that could result in the substantial loss or degradation of suitable habitat in areas that support core populations of evaluated species that are essential to maintaining the viability and distribution of evaluated species.

- As part of contractual agreements, the willing seller will be required to maintain quantities of water in agriculture return flow ditches that maintains existing wetland habitat providing habitat to the covered species.

4.10.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into CALFED, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The black tern has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measure listed above will further ensure the potential for effects discussed in Section 4.10.3 are avoided or minimized.

4.11 Black-crowned Night Heron (*Nycticorax nycticorax*)

4.11.1 Status in the Action Area

The black-crowned night heron is listed as a U.S. Bureau of Land Management sensitive species (CDFG 2003). This heron is not a federally listed species, nor is it a California listed species or species of special concern.

The black-crowned night heron is a fairly common yearlong resident of the foothills and lowlands throughout most of California. Figure 3-3 depicts the distribution of black-crowned night heron rookeries. The heron roosts during the day in dense trees or dense emergent wetland plants. The black-crowned night heron feeds primarily at night. Foraging is conducted largely along the margins of lacustrine, riverine, and fresh and saline emergent wetlands. The highly variable diet consists of fishes, crustaceans, aquatic insects, other vertebrates, amphibians, reptiles, some small mammals, and rarely a young bird. These birds hunt in shallow water waiting motionlessly, but just as often they stalk their prey (CDFG 1995).

4.11.2 Effect Assessment Methods

The only habitat used by the black-crowned night heron affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the black-crowned night heron. Table 4-23 provides the relationship of the black-crowned night heron with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat such as irrigation canals near rookery areas when rice crops are idled.

4.11.3 Project Effects

Black-Crowned Night Heron Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley affecting roosting habit and reducing forage for this Covered Species. The black-crowned night heron is a fairly common, yearlong resident of lowlands and foothills in California. It nests and roosts in dense tree foliage. Nesting roosts are typically near water, but non-breeding roosts can be some distance from water. Unlike other herons, the black-crowned night heron feeds primarily at night. It has a highly variable diet consisting of fish, crustaceans, aquatic insects, and other invertebrates, amphibians, and small mammals. There are reports of black-crowned night herons raiding bird colonies, including terns and tricolored black birds.

SFA habitat is just one of the many habitats used by the black-crowned night heron. These birds commonly fly up to three miles from their roosts to their feeding areas. Although idling of rice fields may reduce some forage available to the heron, the heron has no particular affinity to this habitat. The only effect would be to those herons, which have incorporated rice into their foraging routine. If insufficient forage is present within idled rice fields, the black-crowned night heron has the ability to forage elsewhere. The heron's roosting sites are not dependent on rice farmland practices and will not be affected by crop idling actions.

The EWA program may effect but is not likely to adversely affect the black-crowned night heron.

4.11.4 Conservation Measures

Conservation measures are not proposed for the black-crowned night heron because this species is not likely to be adversely affected.

4.11.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The black-crowned night heron has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.11.3.

4.12 Great Blue Heron (*Ardea herodias*)

4.12.1 Status in the Action Area

The great blue heron is listed as a California Department of Forestry sensitive species (CDFG 2003). This heron is not a federally listed species, nor is it a California listed species or species of special concern.

Figure 3-4 depicts the distribution of great blue heron rookeries. Great blue herons use shallow estuary systems and fresh and saline emergent wetlands year round. Tall riparian-type trees are needed for perching and roosting sites (CDFG 1995). Great blue herons forage mostly for fish, but also eat small rodents, amphibians, snakes, lizards, insects, crustaceans, and occasionally small birds. Hunting techniques include standing motionless, wading slowly, probing and pecking, and then grasping prey in bill (CDFG

1995, Granholm 1990). Foraging can occur both night and day, but mostly occurs around dawn and dusk (Granholm 1990).

4.12.2 Effect Assessment Methods

The only habitat used by the great blue heron affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the great blue heron. Table 4-23 provides the relationship of the great blue heron with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat near rookery areas when rice crops are idled.

4.12.3 Project Effects

Great Blue Heron, Great Egret, Snowy Egret Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley affecting roosting habit and reducing forage for these Covered Species. These three species are included in one assessment because of coinciding roosting and feeding habits. In the Central Valley, all three species roost communally in trees in riparian areas, and feed commonly in shallow water, along shorelines, irrigation ditches, and other water bodies that contain fish, amphibians, insects, crustaceans, small mammals, and similar prey items. The species will readily abandon nesting attempts if disturbed. Destruction of riparian habitat and roosting trees is therefore a major concern for all of these species.

These species typically “commute” daily from their overnight roosting sites to their feeding areas. All species typically travel from one to five miles from the roosting site to the feeding locations. For seasonally flooded agricultural land (rice farmland), these species utilize both the rice fields and associated irrigation ditches. In relation to the rice cycle (Section 10.1.1.14), the flooded fields during the summer and the irrigation ditches during the fall provide ample aquatic and insect prey. The dry fields during fall and spring, and partially flooded fields during the winter provide for some insect prey. None of the species rely on waste grain (except for the insect populations the grain may support) and thus absence of waste grain is not a concern for the species as it is for other avian species.

Idling of rice farmland for a season has the potential to reduce some summer and fall forage for egrets and herons that roost within 5 miles of the idling action. Because the birds will travel long distances to forage and because environmental measures for the giant garter snake will provide for the maintenance of aquatic habitat in rice growing areas, the only effect on these species is a potential change in forage patterns from idled fields to fields with abundant prey. Idling of rice farmland will not affect roosting sites; there is less human activity because no farming is occurring. Therefore, effects would be less than significant and no environmental measures are proposed.

The EWA program may affect but is not likely to adversely affect the great blue heron.

4.12.4 Conservation Measures

Conservation measures are not proposed for the great blue heron because this species is not likely to be adversely affected.

4.12.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The great blue heron has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.12.3.

4.13 Great Egret (*Casmerodius albus*)

4.13.1 Status in the Action Area

The great egret is listed as a California Department of Forestry sensitive species (CDFG 2003). This egret is not a federally listed species, nor is it a California species of special concern.

Figure 3-5 depicts the distribution of great egret rookeries. Great egrets use a wide variety of fresh, brackish, and saltwater habitats including coastal estuaries, fresh and saline emergent wetlands, ponds, slow moving rivers, mudflats, salt ponds, and irrigated croplands and pasture (Granholm 1990). These egrets feed on fishes, amphibians, snakes, snails, crustaceans, insects and small mammals (NatureServe Explorer 2002). This species is a colonial rooster and nester and requires thick riparian stands of large trees near aquatic foraging areas and relatively isolated from human activities (Granholm 1990, CDFG 1995).

4.13.2 Effect Assessment Methods

The only habitat used by the great egret affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the great egret. Table 4-23 provides the relationship of the great egret with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat near rookery areas when rice crops are idled.

4.13.3 Project Effects

Great Blue Heron, Great Egret, Snowy Egret Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley affecting roosting habit and reducing forage for these Covered Species. These three species are included in one assessment because of coinciding roosting and feeding habits. In the Central Valley, all three species roost communally in trees in riparian areas, and feed commonly in shallow water, along shorelines, irrigation ditches, and other water bodies that contain fish, amphibians, insects, crustaceans, small mammals, and similar prey items. The species will readily abandon nesting attempts if disturbed. Destruction of riparian habitat and roosting trees is therefore a major concern for all of these species.

These species typically "commute" daily from their overnight roosting sites to their feeding areas. All species typically travel from one to five miles from the roosting site to the feeding locations. For seasonally flooded agricultural land (rice farmland), these species utilize both the rice fields and associated irrigation ditches. In relation to the rice cycle (Section 10.1.1.14), the flooded fields during the summer and the irrigation ditches during the fall provide ample aquatic and insect prey. The dry fields during fall and spring, and partially flooded fields during the winter provide for some insect prey. None of the species rely on waste grain (except for the insect populations the grain may support) and thus absence of waste grain is not a concern for the species as it is for other avian species.

Idling of rice farmland for a season has the potential to reduce some summer and fall forage for egrets and herons that roost within 5 miles of the idling action. Because the birds will travel long distances to forage and because environmental measures for the giant garter snake will provide for the maintenance of aquatic habitat in rice growing areas, the only effect on these species is a potential change in forage patterns from idled fields to fields with abundant prey. Idling of rice farmland will not affect roosting sites; there is less human activity because no farming is occurring. Therefore, effects would be less than significant and no environmental measures are proposed.

The EWA program may affect but is not likely to adversely affect the great egret.

4.13.4 Conservation Measures

Conservation measures are not proposed for the great egret because this species is not likely to be adversely affected.

4.13.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The great egret has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.13.3.

4.14 Greater Sandhill Crane (*Grus canadensis tabida*)

4.14.1 Status in the Action Area

The greater sandhill crane is listed as threatened under the California Endangered Species Act and is a fully protected species under the California Fish and Game Code

(CDFG 2003). It is also listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003).

In California the greater sandhill crane breeds in the northeastern portion of the state. Between 3,400 and 6,000 greater sandhill cranes winter in the Sacramento Valley and Sacramento-San Joaquin River Delta (Pogson and Lindstedt 1991, California Department of Fish and Game 1997, Pacific Flyway Council 1997). Figure 3-6 depicts the distribution of greater sandhill crane habitat. Greater sandhill crane can be located in the Ash Creek, Shasta Valley, Butte Valley, Gray Lodge, Honey Lake, and Los Banos Wildlife Areas; the Woodbridge Ecological Reserve; the Merced, Modoc, Sacramento, and Tule Lake/Lower Klamath and Pixely National Wildlife Refuges; the Carrizo Plain National Area and Consumnes River Preserve; and other lands adjacent to these areas. Greater sandhill cranes nest in open areas of wet meadows that are often interspersed with emergent marsh and usually build their nests over shallow water. Favorable roost sites and an abundance of cereal grain crops characterize winter concentration areas. Rice is the primary food source for cranes near Gray Lodge WA, Butte County, and corn is the most important food at the majority of other concentration areas in the Central Valley particularly in the Sacramento - San Joaquin delta. Irrigated pastures are used extensively as loafing sites in some wintering areas. Greater sandhill cranes have an omnivorous diet consisting primarily of vegetable matter such as small grains; however, they will consume almost any available food. They feed in pastures, flooded grain fields, and seasonal wetlands. Toads, frogs, eggs, young birds, small rodents, invertebrates, roots, and tubers are all included in their diet. However, animal matter, except for certain invertebrates, is taken primarily opportunistically and should not be considered a major component of the diet of cranes.

4.14.2 Effect Assessment Methods

The only habitat used by the greater sandhill crane affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the crane. Table 4-23 provides the relationship of the greater sandhill crane with rice lands and the rice production cycle. The primary concern is the loss of winter foraging habitat in the Butte Basin when rice crops are idled.

4.14.3 Project Effects

Greater Sandhill Crane Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley thereby reducing winter forage for this Covered Species. The Central Valley Population of the sandhill crane is one of five populations in North America (Littlefield et al. 1994). It is comprised of 6000-6800 individuals, among which 3400 breed in the southern segment of its range, which includes northeast California, outside of the EWA action area. The entire population winters in the Central Valley (Littlefield and Thompson 1979), and from 1983-1984, 95percent wintered from Sacramento Valley south to the Bay-Delta (Pogson and Lindstedt 1991).

The greater sandhill crane uses harvested rice fields in the Sacramento Valley for wintering habitat and forage from October to February (Littlefield 1993). It also uses grain fields in the Delta. The time period that cranes over winter also corresponds to the time when rice land is being harvested (October) and then becomes inactive. The greater sandhill crane prefers rice stubble that has not been flooded to decompose the vegetative materials. Burning or flooding to manage harvested rice stubble has contributed to the reduction of portions of the crane's wintering habitat (Littlefield 1993).

The greater sandhill crane typically returns to the same location each year to winter. Crop idling of seasonally flooded agricultural land used for rice production in the areas to which the cranes return will affect their wintering distribution patterns due to reduced forage on the idled fields. Although the cranes will disperse from their core areas as winter food resources diminish, crop idling could affect this change earlier. Avoiding crop idling in the core areas could minimize this effect to crane populations.

Crop idling actions may affect but are not likely to adversely affect greater sandhill crane populations with implementation of the following conservation measure.

4.14.4 Conservation Measures

Crop idling of seasonally flooded agricultural land could reduce the amount of over winter forage for migratory birds.

- Avoid or minimize actions near known wintering areas in the Butte Sink (from Chico in the north to the Sutter Buttes, and from Sacramento River in the west to Highway 99) that could adversely affect foraging and roosting habitat.

4.14.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The greater sandhill crane has been designated an "r" or "contribute to recovery" species. For this designation, the CALFED agencies will make specific contributions towards the recovery of the species (CALFED MSCS 2000).

4.15 Long-billed Curlew (*Numenius americanus*)

4.15.1 Status in the Action Area

The long-billed curlew is designated as a California Species of Special Concern (CDFG 2002), a Migratory Nongame Bird of Management Concern (USFWS 1995), and a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). This species is not listed under the California Endangered Species Act, but is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003). This species is also listed on the Audubon Watchlist (CDFG 2003).

The long-billed curlew's California summer breeding populations occur in Siskiyou, Modoc, and Lassen Counties in northeastern California. Non-breeding populations have been found along the coast and in the Central and Imperial Valleys. Figure 3-7 depicts the distribution of long-billed curlew habitat. Preferred breeding habitats are elevated grasslands adjacent to lakes or marshes. Central valley wintering and non-breeding summer populations utilize grassland and cropland habitat. This species normally feeds on various insects (grasshoppers, beetles, caterpillars, etc.) and eats some berries. During migration they also feed on crayfishes, crabs, snails, and toads.

4.15.2 Effect Assessment Methods

The only habitat used by the long-billed curlew affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the curlew.
Table 4-23 provides the relationship of the long-billed curlew with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat when rice crops are idled.

4.15.3 Project Effects

Long-billed Curlew Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing winter forage for this Covered Species. The long-billed curlew is a common winter visitor to the Central Valley where it forages on upland herbaceous plants and croplands. Some non-breeding individuals remain in the Central Valley during the summer. Breeding habitat is located in upland prairie grassland habitat outside of the EWA action area. Winter migrants can arrive as early as June and most leave the valley by April. The primary food prey items of the curlew in the Central Valley are estuarine fish, insects, worms, spiders, crayfish, snails, and small crustaceans. Curlews "display no consistent season-specific food item preferences or limitations" (NRCS 2000). Therefore, during the winter curlews would take advantage of flooded or dry rice fields as long as adequate prey is available. The idling of seasonally flooded agricultural land would reduce some insect forage areas for the species (assuming the idled cropland produces less insects), but curlews would respond by looking for forage in other habitats. This effect is considered less than significant and no environmental measure is proposed for this species.

Therefore, EWA actions may affect but are not likely to adversely affect the long-billed curlew.

4.15.4 Conservation Measures

Conservation measures are not proposed for the long-billed curlew because this species is not likely to be adversely affected.

4.15.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The long-billed curlew has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measure listed above will further avoid or minimize the potential effects discussed in Section 4.15.3.

4.16 Snowy Egret (*Egretta thula*)

4.16.1 Status in the Action Area

The Snowy egret is listed on the United States Bird Conservation Watch List (CDFG 2003). This species is also considered a Federal Species of Concern (formerly a species under consideration for listing), but is not listed under the California Endangered Species Act (CDFG 2003).

In California, this species is considered to be a year-round resident below 1,000 feet elevation in the southern three-fourths of the state (Bousman 2000). It is abundant in the seashore, coastal, interior, and Great Basin areas of the state and less common inland and north of Sonoma County (Bousman 2000). Figure 3-12 depicts the distribution of snowy egret rookeries. Snowy egrets use a wide variety of fresh, brackish, and saltwater habitats including coastal estuaries, fresh and saline emergent wetlands, ponds, slow moving rivers, irrigation ditches and wet fields (Granholm 1990). Egrets forage for fish, crayfish, amphibians, reptiles, worms, arthropods, small mammals, and snails in shallow water or along shores.

4.16.2 Effect Assessment Methods

The only habitat used by the snowy egret affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the snowy egret. Table 4-23 provides the relationship of the snowy egret with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat near rookery areas when rice crops are idled.

4.16.3 Project Effects

Great Blue Heron, Great Egret, Snowy Egret Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley affecting roosting habit and reducing forage for these Covered Species. These three species are included in one assessment because of coinciding roosting and feeding habits. In the Central Valley, all three species roost communally in trees in riparian areas, and feed commonly in shallow water, along shorelines, irrigation ditches, and other water bodies that contain fish, amphibians, insects, crustaceans, small mammals, and similar prey items. The species will readily abandon nesting attempts if disturbed. Destruction of riparian habitat and roosting trees is therefore a major concern for all of these species.

These species typically "commute" daily from their overnight roosting sites to their feeding areas. All species typically travel from one to five miles from the roosting site to the feeding locations. For seasonally flooded agricultural land (rice farmland), these species utilize both the rice fields and associated irrigation ditches. In relation to the rice cycle (Section 10.1.1.14), the flooded fields during the summer and the irrigation ditches during the fall provide ample aquatic and insect prey. The dry fields during fall and spring, and partially flooded fields during the winter provide for some insect prey. None of the species rely on waste grain (except for the insect populations the grain may support) and thus absence of waste grain is not a concern for the species as it is for other avian species.

Idling of rice farmland for a season has the potential to reduce some summer and fall forage for egrets and herons that roost within 5 miles of the idling action. Because the birds will travel long distances to forage and because environmental measures for the giant garter snake will provide for the maintenance of aquatic habitat in rice growing areas, the only effect on these species is a potential change in forage patterns from idled fields to fields with abundant prey. Idling of rice farmland will not affect roosting sites; there is less human activity because no farming is occurring. Therefore, effects would be less than significant and no environmental measures are proposed.

The EWA program may affect but is not likely to adversely affect the snowy egret.

4.16.4 Conservation Measures

Conservation measures are not proposed for the snowy egret because this species is not likely to be adversely affected.

4.16.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The snowy egret has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.16.3.

4.17 Tricolored Blackbird (*Agelaius tricolor*)

4.17.1 Status in the Action Area

The tricolored blackbird is designated as a California Species of Special Concern (CDFG 2002), a Migratory Nongame Bird of Management Concern (USFWS 1995), a BLM Sensitive Species (CDFG 2003), and a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). This species is not listed under the California Endangered Species Act, but is considered a Federal Species of Concern (formerly a species under consideration for listing) (CDFG 2003). This species is also listed on the Audubon Watchlist (CDFG 2003).

Historically, tricolored blackbirds nested throughout much of California west of the Sierra Nevada, in coastal southern California, and in portions of northeastern California.

Flocks and breeding colonies were observed in the Shasta region, Suisun Valley, Solano County; near Stockton, San Diego, Los Angeles, Santa Barbara, Glenn County, Sacramento County, Butte County, Colusa County, Yolo County, and Yuba County (Heermann 1853, Belding 1890, Baird 1870, Neff 1937, Orians 1961, Payne 1969). Figure 3-9 depicts the distribution of tricolored blackbird nesting colonies. Extensive marshes that provided ample breeding habitat for tricolors in the Central Valley from overflowing river systems had been reduced by 50 percent by the mid-1980s (Frayer et al. 1989). Additionally, native perennial grasslands, which are primary foraging habitat, have been reduced by more than 99 percent in the Central Valley and surrounding foothills (Kreissman 1991). For breeding-colony sites, tricolored blackbirds require open accessible water, a protected nesting substrate that is usually flooded or has thorny or spiny vegetation, and a foraging area that provides adequate insect prey within a few kilometers of the nesting colony (Beedy 1989, Hamilton et al. 1995). In addition to consuming insects, the tricolored blackbird also eats seeds and cultivated grains, such as rice and oats. It will often forage in croplands, pastures, grassy fields, flooded land, and along edges of ponds (Zeiner et al. 1990).

Tricolored blackbirds leave wintering areas in the Sacramento-San Joaquin Delta and along coastal central California in late March and early April. Its breeding season is from mid-April to late July. Breeding colonies will return to the same area year after year if the site continues to provide adequate nesting sites, water, and suitable foraging habitat (Dehaven et al. 1975).

4.17.2 Effect Assessment Methods

The only habitat used by the tricolored blackbird affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the blackbird. Table 4-23 provides the relationship of the tricolored blackbird with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat near nesting areas when rice crops are idled.

4.17.3 Project Effects

Tricolored Blackbird Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing summer forage and breeding colonies for this Covered Species. The tricolored blackbird is an inhabitant of the Sacramento-San Joaquin Delta and central coast of California in the winter and typically migrates to breeding locations near open freshwater in Sacramento County and throughout the San Joaquin Valley in the spring (Dehaven et al. 1975). In addition to insects and seeds, the tricolored blackbird forages on cultivated grains such as rice on croplands and flooded fields, and waste grain rice following the harvest (Zeiner et al. 1990). One study showed that rice constituted up to 38 percent of the annual diet of tricolored blackbirds (Crase and DeHaven 1978), but most reports indicate that insects can make up to 90 percent of their diets in the summer shifting to 88 percent vegetative matter in the winter.

Tricolored blackbirds generally breed from March to July, but have been observed breeding in the Sacramento Valley in October and December. In some years there may be up to three attempts at breeding, particularly if a colony is disturbed during an earlier attempt. Although the primary cause for the overall decline in tricolored blackbird populations is due to loss of wetland habitat to agriculture and urban development, the current threat to the population is predation by mammalian and avian predators and the destruction/disturbance of breeding colonies. Tricolored blackbirds can breed in large colonies, with over 100,000 birds being reported for some colonies.

Tricolored blackbirds have three basic requirements for selecting breeding colony sites (Beedy and Hamilton, 1997): 1) open accessible water; 2) protected nesting substrate, usually either flooded or thorny or spiny vegetation; and 3) suitable foraging space providing adequate insect prey within a few kilometers of the nesting colony. Rice fields can provide two of the three requirements (water and insects), but the adjacent vegetation is usually not sufficiently shrubby and the emergent rice plants are not tall and strong enough to support nests, at least during the time when initial nesting is being attempted. Colonies have been rarely observed in rice fields (USFWS 1999), but can use emergent vegetation in canals associated with rice fields. The rice agriculture cycle provides insect forage in the flooded fields during the summer and waste grain forage over winter.

Tricolored black birds do not necessarily return to the same location each year to breed and can vary location between season or within a season. Because the birds have specific breeding habitat requirements and there are limited areas available for breeding, colonies are typically found in the general vicinity of the previous years colony, if the same site is not being used.

The primary concern for the tricolored blackbird's association with rice fields is the use of the habitat as a source of insects and waste grain forage. The birds are highly mobile and fly up to 3 miles from the colony site to forage. During the winter, the birds are more nomadic and move from pastureland and dairy farms to feed, primarily on vegetative matter. The idling of rice fields could affect the behavior of the birds related to foraging distribution patterns. Because environmental measures for the giant garter snake will prevent large blocks of land from being fallowed and will require maintenance of ditch habitat, any effect on foraging behavior is considered less than significant for the tricolored blackbird.

Therefore, EWA actions may affect but are not likely to adversely affect the tricolored blackbird.

4.17.4 Conservation Measures

Conservation measures are not proposed for the tricolored blackbird because this species is not likely to be adversely affected.

4.17.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The tricolored blackbird has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.17.3.

4.18 White-faced Ibis (*Plegadis chihi*)

4.18.1 Status in the Action Area

The white-faced ibis is designated as a species of special concern by the California Department of Fish and Game (CDFG 2003) and is listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003).

In California the white-faced ibis was once common but, even by the 1940s, the white-faced ibis' population was declining (Grinnell and Miller 1944). By the 1970s, there were virtually no breeding white-faced ibises in California (Remsen 1978). In the 1980s, after decades of decline, the population of this species began to rebound. Figure 3-8 depicts the distribution of white-faced ibis rookeries. Key areas of wintering white-faced ibis in the Central Valley (1990-1996) include the Delevan-Colusa Butte Sink area, northwestern Yuba County (District 10), the Yolo Bypass, Grasslands Complex, and Mendota Wildlife Area (Shuford and Hickey 1996).

The white-faced ibis requires freshwater marshes and other wetlands for nesting sites and for wintering foraging grounds. The ibis forages in shallow waters, including seasonal wetlands and rice fields, or on muddy banks where it probes for invertebrates, small fish, and amphibians (Zeiner et al. 1990).

4.18.2 Effect Assessment Methods

The only habitat used by the white-faced ibis affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the ibis. Table 4-23 provides the relationship of the white-faced ibis with rice lands and the rice production cycle. The primary concern is the loss of foraging habitat near rookery areas when rice crops are idled.

4.18.3 Project Effects

White-faced Ibis Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing winter forage for this Covered Species. The white-faced ibis is primarily a winter migrant to the Central Valley. The largest breeding colonies are in Utah, Nevada, and Oregon. Key areas for wintering include the Delevan-Colusa Butte Sink, northwestern Yuba County, the Yolo Bypass, Grasslands Wetlands Complex, and Mendota Wildlife Area. There are reports of breeding colonies in the Central Valley, particularly within the Mendota Wildlife Area and Colusa National Wildlife Area. Within the Central Valley, the species occupies a variety of aquatic and wetland habitats, including rice fields that provide abundant prey (Remsen 1978). The ibis can breed from April to September (USFWS 1999).

Primary cause for the decline in numbers of this species is the drainage of wetlands and destruction of nesting habitat. SFA habitat is one of the many habitat types used by the species, and the species has no particularly affinity to rice fields compared to other wetland habitats.

The diet of the ibis consists of insects, small fish, and miscellaneous invertebrates (Granholm 1991). It feeds in flooded (less than 20 cm water depth) (USFWS 1999; RMI, 1997) or inactive fields that contain its prey items. Surveys of the Sacramento Valley found 66 percent of the ibis concentrated in agricultural fields. In one study up to 53 percent of the foraging ibis were observed in rice stubble (Shuford et. al. 1996).

The white-faced ibis is well adapted to changes in environmental conditions such as drought and flooding; therefore, use of specific areas can vary greatly from year to year depending on habitat conditions (Granholm 1991). The species interaction with the rice crop cycle includes using flooded land in the summer for foraging of prey, and dry or flooded rice fields in the winter, also for prey. Because the species is adaptive and responds to changes in environmental conditions, the effect dude idling of flooded rice fields is considered to be less than significant. No environmental measure is proposed for the species.

Therefore, EWA actions may affect but are not likely to adversely affect the white-faced ibis.

4.18.4 Conservation Measures

Conservation measures are not proposed for the white-faced ibis because this species is not likely to be adversely affected.

4.18.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The white-faced ibis has been designated an "m" or "maintain" species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.18.3.

4.19 Giant Garter Snake (*Thamnophis gigas*)

4.19.1 Status in the Action Area

The giant garter snake is listed as a threatened species under both the federal Endangered Species Act and the California Endangered Species Act (CALFED 2000).

The giant garter snake historically ranged throughout the Central Valley, but is currently extirpated from the southern 1/3 of its historic habitat. Figure 3-10 depicts the current distribution of giant garter snake population areas in the 6 counties that are identified for potential rice idling actions. During the winter (the snake's dormant season) and at night it typically inhabits upland, small mammal burrows and other soil crevices. Daytime and active season (early spring through mid-fall) habitats include aquatic sites, emergent vegetation, and grassy banks along agricultural wetlands, irrigation and drainage canals, sloughs, ponds, small lakes, and low gradient streams. The GGS feeds on fish, amphibians, and amphibian larvae. The decline of the GGS is attributable to habitat loss through flood control and agricultural activities. The final rule listing the giant garter snake as threatened determined that designating critical habitat was not prudent.

4.19.2 Effect Assessment Methods

The effect assessment methods described for Seasonally Flooded Agriculture in Section 6.15 are used here to assess effects on the Giant Garter Snake. Table 4-23 provides the relationship of the giant garter snake with rice lands and the rice production cycle. In addition, to the conservation measures described in Section 6.15.4, the maximum amount of crop idling that would take place annually would not be more than 20% of the rice acreage in any given county or any individual district. USFWS will prepare a programmatic biological opinion on the effects on the giant garter snake of EWA water acquisitions that include rice idling. The programmatic biological opinion will outline expected conservation measures and a streamlined process for review of proposals to idle rice or shift rice to other crops. Proposals to idle rice fields or shift rice to other crops each year would be subject to formal ESA Section 7 consultation with the USFWS to determine effects to the giant garter snake. This formal consultation would begin when the EWA agencies submit a package from a willing seller describing the location of the rice fields proposed for idling and which giant garter snake conservation measures would be followed, and request that the proposal be appended to the programmatic biological opinion. This package will include maps and a legal description of the fields. The USFWS will then review the proposals and append it to the programmatic consultation if the conservation measures and effects of the action are consistent with the programmatic biological opinion. If the USFWS determines that the proposal is not consistent with the programmatic, or additional effects not previously analyzed may occur, then additional compensatory giant garter snake mitigation may be required, consistent with the REA and the giant garter snake Recovery Plan. Further section 7 consultation may be required if additional effects not considered in the programmatic consultation are identified. Compensatory mitigation for certain crop idling actions might include the acquisition, restoration, and preservation of additional giant garter snake habitat. Prior to submittal of a final package, EWA agencies may consult informally under ESA section 7 to get a preliminary effects determination and further refine project descriptions and proposed conservation measures.

4.19.3 Project Effects

Giant Garter Snake Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing replacement wetland habitat that this Covered Species uses year *around thereby jeopardizing population numbers.* Giant garter snakes' reliance on rice fields and agricultural drainage is due to a lack of viable alternative habitats. Most of its historic wetland habitat has been lost (USFWS 1999). Riparian woodlands do not provide the basking areas the snake requires to warm to activity levels (Hansen and Brode 1980), nor do they provide the pools of concentrated prey such as carp, mosquitofish, and bullfrogs (Rossman et al. 1996) the species relies upon for food. Open river environments make the giant garter snake susceptible to predation by non-native species such as bass and leveed rivers do not provide the snake with grassy banks for basking or elevated areas for hibernation (58 FR 54053, Oct 20, 1993).

Rice fields provide all necessary elements of the giant garter snake habitat. This includes irrigation canals and flooded fields that provide forage and escape, emergent vegetation for cover, and upland areas along canals for basking and dens. Populations of giant garter snakes in the Colusa, Butte, Sutter, and American River Basins are mostly associated with rice field habitats and their connecting irrigation and drainage canals (58 FR 54053, October 20, 1993). Current studies are finding up to 50 percent of observed individuals in rice field habitats (USFWS 1999).

The rice agriculture cycle, as described in Section 10.1.1.14, coincides closely with the habitat requirements of the giant garter snake. The snake hibernates over winter in dens near the fields and thus land management practices that do not involve reconstruction of drainage channels will not affect the snake. (The Rice Council has provided guidance to rice growers in relation to protecting the snake.) When the snake emerges from its burrow in March and April, water is only in the drainage ditches. This helps concentrate prey and facilitates the mating process. After field preparation, the fields are flooded increasing the forage habitat for the snake. When flooded, rice field habitat provides warm shallow open waters of prey for foraging (Hansen 1980, Brode and Hansen 1992, Hansen and Brode 1993). Once the rice plant emerges, the rice field provides cover from predators.

In July to early September, the female snakes give birth. Rice fields continue to provide food and cover for the snake population. Finally, in the fall when the fields are drained, the snake's prey species are concentrated in the drainage ditches. The snakes move into the adjacent drainages that, as long as the vegetation cover is retained, provide the necessary habitat and forage to prepare the snake for hibernation. The concentration of prey in the canals is a benefit to the snakes inhabiting rice farmland. In the fall, the snakes return to burrows and cracks in the upland area to hibernate. Snakes are generally dormant from November to February (USFWS 1999).

In September, juveniles make extensive use of the pools of concentrated prey that are associated with the temporally coinciding rice field drainage areas. Prey concentrations in drainage pools provide pre-dormancy gorging opportunities for giant garter snakes.

Predation of giant garter snakes is limited to the habitat corridors such as irrigation and drainage ditches. Irrigation ditches provide both mobility and extensive cover for the snake (USFWS 1999). Removal of vegetation can expose snakes to predators, thereby considerably diminishing this particular habitat benefit. The loss of a food source and critical habitat as a result of EWA crop idling actions would have a significant adverse effect on the giant garter snake populations associated with SFA habitat.

Crop idling actions may affect but are not likely to adversely affect giant garter snake populations with implementation of the following conservation measures.

4.19.4 Conservation Measures

Within the Sacramento River valley, the giant garter snake (GGS) is highly dependent on rice fields and associated irrigation ditches. EWA actions, or cumulatively, water acquisitions, could idle up to 20 percent of flooded rice fields in each county. The following text provides the proposed approach and conservation measures to protect the GGS.

As part of the EWA consultation, the USFWS will give programmatic approval to crop idling, followed by a site-specific consultation process to ensure consistency with the programmatic approval. The programmatic consultation will include three main elements: 1) the process by which site-specific agreements will be attained; 2) the list of conservation measures (avoidance, minimization, and conservation measures) which would be used wholly or in part to minimize effects of water transfers involving fallowing or crop-shifting; and 3) a description of GGS conservation strategy in Chapter 4 of this ASIP.

USFWS EWA consultation with the Project Agencies will outline a year-by-year "site specific" process to address crop idling impacts to GGS and will put boundaries on upper limit on the amount of crop idling that may occur in any given year, considering the existing 20 percent limit. Additional measures to those presented in this EIS/EIR may be incorporated as a part of consultation based on site-specific conditions.

Each year, once it has been determined that crop idling will occur, the EWA Project Agencies will contact USFWS staff to begin informal consultation and will put together a package describing where the idling activities will take place and what proposed minimization measures will be followed. This package will include maps of the proposed idled fields. USFWS will work with the EWA Project Agencies to determine if minimization measures proposed are sufficient and if additional compensatory habitat is required.

The EWA agencies will ensure through contract terms or other requirements that the following conservation measures will be implemented:

- The EWA agencies will ensure parcels from which water is to be acquired are outside of mapped proscribed areas (see ASIP Figure 3-11), which include:
    - *Refuges* – Land adjacent and within 1 mile of Sacramento, Delevan, Colusa, Sutter, and Butte Sink National Wildlife Refuge (NWR), and the Llano Seco Unit of the Sacramento River NWR, Gray Lodge Wildlife Area (WA), Upper Butte Basin WA, Yolo Bypass WA, and Gilsizer Slough CE;

- *Corridors Between Refuges* – Lands adjacent to Hunters and Logan Creeks between Sacramento River NWR and Delevan NWR; Colusa Basin Drainange Canal between Delevan NWR and Colusa NWR; Little Butte Creek between Llano Seco units of Sacramento River NWR and Upper Butte Basin WA, and Howards Slough Unit of the Upper Butte Basin WA, Butte Creek Upper Butte Basin WA, and Gray Lodge WA;

- *Waterways Serving as Corridors* – Land adjacent to Butte Creek, Colusa Basin Drainage Canal, Gilsizer Slough, land side toe drain along east side of the Sutter Bypass, Willow Slough and Willow Slough Bypass in Yolo County, North Drainage Canal and East Drainage Canal in Natomas Basin

- *Other Core Areas* – East of SR99 and between Sutter-Sacramento County line and Elverta Road in Natomas Basin, Yolo County east of Highway 113;

- The water seller will ensure that water is maintained in irrigation and drainage canals to provide movement corridors;

- The water agency will ensure that the block size of idled rice parcels will be limited to 160 acres (includes rice fields shifting to another crop);

- The water agency will ensure that mowing along irrigation and drainage canals will be minimized and mowers will be elevated to at least 6 inches above the ground level;

- The water agency will ensure that, if canal maintenance such as dredging is required, vegetation will be maintained on at least one side; and

- The EWA agencies will maximize geographic dispersal of idled lands.

GGS conservation measures may include the following, as appropriate:

- The EWA agencies will avoid purchasing water from the same field for more than two consecutive years;

- The EWA agencies will recommend that sellers replace culverts already planned for repair or replacement with oversized culverts to facilitate better wildlife dispersal;

- The EWA agencies will recommend that sellers replace water control structures with those requiring less maintenance and less frequent replacement in order to minimize maintenance impacts (steel or wooden control boxes with pre-poured concrete boxes); and

- The water agencies may fund research or surveys.

4.19.5 Contribution to Recovery

The giant garter snake is designated an "r" species in the Ecosystem Restoration Program ("ERP") Plan and Multi-species Conservation Strategy ("MSCS"). This means that CALFED will make specific contributions toward the recovery of the species by undertaking some of the actions under its control and within its scope that are necessary to recover the species. The Stage 1 expectation for the giant garter snake is described in the ERP Volume 1:

> *Stage 1 Expectation for the Giant Garter Snake*
>
> *Existing natural habitats that have available water all year will have been maintained, and key habitats in agricultural area identified for special management. Sites for freshwater marsh restoration will have been identified and a restoration program established.*

The ERP includes targets and programmatic actions (specific implementation measures) to maintain, enhance or restore aquatic, wetland, riparian, and upland habitats in the ERP Focus Area in order to help in the recovery of the giant garter snake by increasing habitat quality and area. The ERP also includes conservation measures that provide additional detail to ERP actions that would help achieve giant garter snake habitat or population targets and improve our scientific understanding of the species. The USFWS also has a draft recovery plan for the giant garter snake, which is in the last phase of the approval process that will culminate in the release of the final recovery plan.

CALFED has made commitments to conduct essential studies to fill gaps in our scientific knowledge about the giant garter snake's ecological requirements and to conduct surveys to provide the information needed to ensure that recovery objectives for the species are achieved. The ROD identifies certain MSCS-ERP milestones that need to be achieved during Stage 1 of CALFED Program implementation that consist, in part, of ERP targets, actions, and science objectives that will provide conservation benefits for the giant garter snake. These milestones were developed to ensure that best –available scientific information would be developed by CALFED and used to guide restoration and recovery strategies for the giant garter snake using the adaptive management process described in the ERP Strategic Plan for Ecosystem Restoration. The MSCS-ERP milestones were also developed to ensure that the ERP would be implemented in a manner and to an extent sufficient to sustain programmatic FESA, CESA, and NCCPA compliance for all CALFED Program elements. The ERP implementation priorities, strategies, actions and milestones for Stage 1 that will provide conservation benefits for the giant garter snake include:

- Protection, enhancement and restoration of habitat that will include mosaics of seasonal wetlands, fresh emergent wetlands, riparian habitat, and adjacent uplands;
- Management of suitable habitat areas adjacent to known populations to encourage the natural expansion of the species;
- Development of wildlife friendly agricultural programs and practices;
- Improvements to agricultural infrastructure (e.g. ditches, drains and canals) to improve habitat values associated with agricultural lands and to reduce stressors to giant garter snake populations;

- Development and implementation of a monitoring and assessment program;
- Range wide surveys for the giant garter snake.

Implementation of the ERP giant garter snake strategy described in this section is essential to the successful implementation of the EWA program. The MSCS describes CALFED's intention to link CALFED actions for purposes of implementation, as part of the ASIP process. If actions are linked in this manner USFWS, NMFS, and DFG can review the actions and their effects on the covered species and make their determinations under FESA, CESA, and NCCPA for the linked actions based on their overall beneficial and detrimental impacts to the covered species, rather than assessing the impacts of each action individually. This approach allows implementing entities to further simplify the compliance process for CALFED actions that are compatible or complementary from a biological standpoint. **This is not to say that the ERP actions will be used to avoid, minimize, and compensate for any adverse effects of the EWA program—each CALFED action, including the EWA program, must avoid, minimize, and compensate for its adverse environmental effects.** However, in determining whether the EWA program will jeopardize the continued existence or modify critical habitat of any listed species, USFWS, NMFS, and DFG can consider together the beneficial effects of the ERP strategy for the giant garter snake and the potential adverse effects on fish and wildlife of the EWA program with its conservation measures. DFG would also consider the combined effects of the ERP giant garter snake strategy and the EWA program when it determines whether the linked actions together provide adequately for the conservation and management of State-covered species.

The following section describes the key program objectives that will guide the development of a giant garter snake conservation strategy that will build upon the foundation of the USFWS Recovery Plan for the Giant Garter Snake; Ecosystem Restoration Program Plan; the Draft Stage 1 Implementation Plan; and MSCS-ERP milestones for the species. The conservation strategy will identify specific research objectives including population surveys and experimental analyses of population responses to varying cropping patterns. It will include the identification of priority areas for habitat protection, enhancement and restoration, consistent with the Stage 1 expectations for the species. The strategy will also include "wildlife friendly" agricultural and water management practices to reduce giant garter snake population stressors. From this strategy, proposals will be developed and will conform to all of the standards established by CALFED for the proposal review and selection process. Implementation of this strategy will begin with the submission of proposals to implement the highest priority actions at the earliest possible opportunity. An outline of the giant garter snake conservation strategy is provided in Section 4.19.6 below.

The programmatic consultation process for the giant garter snake, as described in Section 4.19.2 above, will require the USFWS and DFG to review "site-specific" rice idling proposals and evaluate whether implementation of a proposed action, in conjunction with conservation measures described in Section 4.19.4, will continue to provide the required level of protection to the species. The USFWS and DFG, which are both EWA and ERP Implementing Agencies, will also assess rice idling proposals within the context of progress being made toward implementing the giant garter snake conservation strategy and under certain circumstances may require additional conservation measures.

4.19.6 Conservation Strategy for the Giant Garter Snake

Recovery strategy

The recovery strategy outlined in the Draft Giant Garter Snake Recovery Plan includes: 1) habitat protection and restoration; 2) research to refine recovery goals (species distribution and status, reserve design, genetics, life history, use of corridors, effects of contaminants, and population and management response monitoring); and 3) actions to reduce or eliminate threats (stressors), including developing management practices for agricultural and water management operations.

Science objectives

Specific research objectives include conducting inventory and surveys, developing additional techniques to expand research capabilities, investigating optimal habitat and reserve design, and examining effects of cropping patterns and agricultural practices on the giant garter snake. Other research objectives that may be met as part of these studies include gathering life history data necessary to conduct population viability analyses and archiving tissue for genetic and contaminants analyses.

Inventory and surveys: No systematic range-wide surveys have been conducted for the giant garter snake and data for many populations is 10-15 years old (if not older). Inventory and survey needs include: mapping to identify suitable habitats; determining the species status, particularly in the Delta and the San Joaquin Valley; and defining the species distribution in rice-growing areas east of the Feather River and in western Placer County.

Development of new research techniques: Giant garter snakes are difficult to study because of their wariness, cryptic coloration, and inaccessibility of their wetland habitats. Techniques for trapping in uplands and within wetlands interiors (as opposed to wetland margins) are needed to better examine habitat use by the giant garter snake. Techniques for use of external radios that can be used on smaller individuals are also needed to examine effects of management activities on a broader range of size/age classes.

Habitat and reserve design: Although basic habitat components are known, optimal habitat conditions necessary to support viable populations of giant garter snakes have not been defined. Monitoring giant garter snake response to restoration efforts, and examining the effects of varying habitat restoration designs are needed to further define optimal habitat conditions that should be incorporated into restoration plans and management plans.

Effects of cropping patterns on the giant garter snake: The draft recovery plan recommends maintaining rice agriculture to contribute to recovery, but no model exists for optimal conditions to maintain giant garter snake populations in a rice landscape. Evaluating the response of giant garter snakes to varying cropping patterns that may occur as a part of normal agricultural practices will be essential to developing strategies to protect agricultural lands consistent with the needs of the giant garter snake.

Habitat protection, enhancement and restoration objectives

Priority areas for habitat protection and restoration in the Sacramento Valley include areas within the rice growing regions of the Colusa, Butte, Sutter, and American basins that currently lack native or restored wetland habitats. These areas include the southern portion of the Colusa Basin, the Butte Basin east of Butte Creek, the Sutter Basin, and the American Basin north of the Natomas Cross Canal. Habitat protection and restoration in these priority areas will provide core habitat areas to buffer giant garter snakes from the effects of market- or drought-driven fluctuations in rice production. We expect models for habitat restoration and cropping patterns to be tested and adaptively managed as part of habitat protection and restoration in these areas.

Reduction of stressors

A main component of giant garter snake recovery is threat (stressor) reduction. This includes developing management practices for agricultural and water management operations that: (1) minimize risk of injury to giant garter snakes; (2) minimize habitat disturbance; and (3) allow establishment and/or maintenance of habitat for the giant garter snake. An additional component of stressor reduction includes improvements to agricultural and water management structures that improve giant garter snake and wildlife passage and reduce maintenance needs.

Research on other threats that affect giant garter snakes within otherwise suitable habitat, such as non-native predators, contaminants and pesticide/herbicide use, and parasitism, are also expected to further define management actions necessary to remove or ameliorate threats (stressors) and maintain giant garter snake populations.

Implementation

Steps in implementation of the ERP giant garter snake strategy will include: 1) selecting sites for monitoring and adaptive management of restoration designs and agricultural treatments, and developing habitat mapping to identify sites for survey efforts; 2) establishing baseline conditions of sites, designing restorations and/or agricultural treatments, and beginning distributional and status surveys based on habitat mapping results; 3) build restoration and implement agricultural treatments and start monitoring efforts, and continue surveys; and 4) continue monitoring giant garter snake responses and habitat conditions.

4.20 Western Pond Turtle (*Clemmys marmorata*)

4.20.1 Status in the Action Area

The western pond turtle is designated as a California species of special concern by the California Department of Fish and Game (CDFG 2003) and is listed as a Sacramento Fish and Wildlife Office Species of Concern (Sacramento Fish and Wildlife Office 2003). It is identified by CALFED as a species of concern.

The western pond turtle is common to uncommon throughout California, west of the Sierra-Cascade crest. Figure 3-11 depicts the distribution of western pond turtles. Today the western pond turtle remains in 90 percent of its historic range, but at greatly reduced numbers (USFWS 1999). It inhabits aquatic areas with plentiful hiding and basking sites. A permanent water source is necessary to avoid desiccation, especially for hatchlings. Underwater bottom mud or upland habitat is used for hibernation in colder areas. Upland habitat is used for aestivation and reproduction. The turtle seeks aquatic plant material, beetles, aquatic invertebrates, fishes, and frogs for a food source. Loss of upland nesting habitat through human disturbance is a potential source for the turtles' decline.

4.20.2 Effect Assessment Methods

The only habitat used by the western pond turtle affected by EWA actions (crop idling) is seasonally flooded agriculture. The results of the effect assessment for seasonally flooded agriculture (Section 6.15) are used here to assess effects on the turtle. Table 4-23 provides the relationship of the western pond turtle with rice lands and the rice production cycle. The primary concern is the loss of habitat by drying up irrigation and drainage canals.

4.20.3 Project Effects

Western Pond Turtle Effects Statement: Crop idling would reduce the SFA acreage in the Sacramento Valley reducing habitat for this Covered Species. The western pond turtle is the only native box turtle widely distributed in the western United States. Historically, the turtle once inhabited the vast permanent and seasonal wetlands of the Central Valley. The draining of wetlands for agriculture and urban development has greatly reduced this species' habitat. The western pond turtle is found in brackish permanent to intermittent aquatic habitats, including marshes, rivers, ponds, streams, and vernal pools. In the Central Valley it is also found in man-made habitats such as irrigation ditches, reservoirs, and ponds. Its preferred habitat is slow moving or quiet water, with emergent vegetation and undercuts for refuge. Protected, grassy uplands with a clay/silt soil are the preferred nesting sites. Because irrigation ditches typically are maintained, they generally do not include all required habitat elements for the turtle, particularly nesting habitat.

In addition to the loss of aquatic habitat, other causes of population decline include increased predation and collecting by man. Poor reproductive success due to predation and nest destruction is also hampering the turtle's recovery.

Females move upland from aquatic habitat to lay from 1 to 13 eggs. Eggs are laid May through July and juveniles hatch during August to October. Juveniles generally stay at the next site over winter. Movement of females from aquatic habitat to the nest and back, and juveniles from the nest, exposes the turtles to predation, particularly in agricultural areas where vegetation cover is controlled.

The diet of the western pond turtle is comprised primarily of small invertebrates, but adults do consume some vegetative matter. In seasonally flooded agricultural habitat, irrigation ditches and flooded rice land can contain required habitat elements for box turtles. The turtles can forage in the aquatic habitat and bask on adjacent levees. The turtles are active during the spring, summer, and fall when rice preparation, growing, and harvesting is performed, respectively.

Because the western pond turtle can utilize irrigation ditches and rice fields as habitat, any action that dries up the habitat and forces the turtle to migrate to new areas, also exposes the turtle to increased predation. Further reduction of turtle population would be considered significant if it resulted from idling of seasonally flooded agricultural land.

Crop idling actions may affect but are not likely to adversely affect western pond turtle populations with implementation of the following conservation measure.

4.20.4 Conservation Measures

Ditches and drains associated with rice fields provide suitable habitat for the western pond turtle. The following conservation measures would ensure effects of crop idling actions on western pond turtle habitat are avoided or minimized.

- The willing seller will be required to maintain water levels in irrigation and drainage canals to within 6 inches of non-program conditions and do not completely dry out canals.

4.20.5 Contribution to Recovery

The MSCS outlines species conservation goals that have been incorporated into the CALFED plan, hence the EWA program. The goals generally are intended to enable USFWS, NOAA Fisheries, and CDFG to make necessary findings and determinations under FESA, CESA, and NCCPA (CALFED MSCS 2000). The western pond turtle has been designated an “m” or “maintain” species. For this designation, the CALFED agencies will avoid minimize, and compensate for any adverse effects to the species commensurate with the level of effect on the species (CALFED MSCS 2000). The conservation measures listed above will avoid or minimize the potential effects discussed in Section 4.20.3.

Chapter 5
Environmental Basis of Comparison – NCCP Community Descriptions

5.1 Introduction to NCCP Community Descriptions

The following descriptions of NCCP communities are taken directly from the MSCS. Proposed Ecosystem Restoration Program goals (CALFED NCCP Community goals) for each community type are included with the descriptions. Each habitat description also includes a discussion on the relationship between EWA and the NCCP community goal. This discussion describes effects of EWA asset acquisition and management actions on each habitat. A detailed environmental consequences analysis can be found in Chapter 6.

The MSCS identifies 18 terrestrial habitat types, also termed NCCP habitats, and two fish communities based on commonly recognized features. A review of the EWA Proposed Action and associated conservation measures that 13 of the 18 NCCP habitats to be potentially affected by an EWA action. The Grassland, Upland Scrub, Valley/Foothill Woodland and Forest, Montane Woodland and Forest, and Inland Dune Scrub NCCP habitats will not be affected by EWA actions and are not addressed in this ASIP (See Chapter 1, Section 1.5)

A total of 20 natural communities were analyzed on a broad, programmatic basis in the MSCS – 18 habitats and two ecologically based fish groups. The term "NCCP communities" refers to both habitats and fish groups. The MSCS assigned a conservation goal to each NCCP community. The goals for the NCCP communities were developed within the ERP and the Strategic Plan for Ecosystem Restoration. Goals for NCCP habitats not addressed by the ERP were predicated on the fisheries and aquatic ecosystems and vegetation and wildlife strategies in the CALFED Programmatic EIS/EIR.

Table 5-1 provides a crosswalk of the NCCP habitat types included in this ASIP to other commonly used community and habitat classification systems. The ability to translate NCCP habitat type designations into other designations is necessary to provide a common understanding among ASIP users of what communities are encompassed in each NCCP habitat. The crosswalk provides the basis for using existing community and habitat distribution maps and geographic information systems (GISs) of the action area to analyze effects of the Proposed Action in development of this ASIP. The text that follows presents a description of the NCCP communities addressed in this ASIP and their relationship within the EWA Action Area.

Table 5-1 Crosswalk of MSCS NCCP Habitat Types to Other Community and Habitat Classification Systems

MSCS NCCP Habitat Type	Equivalent Community or Habitat Type Under Other Classification Systems				
	Ecosystem Restoration Program	Wildlife Habitat Relationships [(a)]	Terrestrial Natural Communities of California [(b)]	National Wetland Inventory [(c)]	Department of Water Resources [(d)]
Tidal perennial aquatic	Tidal perennial aquatic, Delta sloughs, and midchannel islands and shoals	Estuarine	None	Estuarine (aquatic subtypes only)	Water surface
Valley riverine aquatic	Riparian and riverine aquatic	Riverine	None	Riverine (aquatic subtypes only)	Water surface
Montane riverine aquatic	Riparian and riverine aquatic	Riverine	None	Riverine (aquatic subtypes only)	Water surface
Lacustrine	Nontidal perennial aquatic	Lacustrine	None	Lacustrine (aquatic subtypes only)	Water surface
Saline emergent	Saline emergent wetland	Saline emergent wetland	Coastal saltmarsh (52100) and coastal brackish marsh (52200)	Estuarine/emergent	Riparian vegetation: marshlands
Tidal freshwater emergent	Fresh emergent wetland, Delta sloughs, and midchannel islands and shoals	Fresh emergent wetland	Coastal and valley freshwater marsh (52410)	Palustrine/emergent/tidal	Riparian vegetation: marshlands
Nontidal freshwater permanent emergent	Fresh emergent wetland	Fresh emergent wetland and wet meadow	Freshwater marsh (52400), alkali marsh (52300), and meadow and seep (45000)	Palustrine/emergent/nontidal/ permanent; lacustrine/emergent/permanent; riverine/emergent/permanent	Riparian vegetation: marshlands; riparian vegetation: natural high-water table
Natural seasonal wetland	Seasonal wetlands	Fresh emergent wetland	Vernal pool (44000), vernal marsh (52500) and alkali playa (46000)	Palustrine/emergent/nontidal/ seasonal	None
Managed seasonal wetland	Seasonal wetlands	Fresh emergent wetland	Vernal marsh (52500)	Palustrine/emergent/nontidal/ seasonal/artificial	Riparian vegetation: duck marsh
Valley/foothill riparian	Riparian and riverine aquatic	Valley foothill riparian	Great Valley riparian forest (61400), sycamore alluvial woodland (62100) and Great Valley riparian scrub (63400)	Estuarine/scrub-shrub, estuarine/ forested, palustrine/scrub-shrub, and palustrine/forested	Riparian vegetation: trees and shrubs.
Montane riparian	Riparian and riverine aquatic	Montane riparian	Montane riparian forest (61500) and montane riparian scrub (63500)	Estuarine/scrub-shrub, estuarine/ forested, palustrine/scrub-shrub, and palustrine/forested	Riparian vegetation: trees and shrubs.
Grassland	Perennial grassland	Annual grassland and perennial grassland	Valley and foothill grassland (42000)	Upland	Native vegetation: grassland
Inland dune scrub	Inland dune scrub	None	Stabilized interior dunes (23100)	Upland	None

Table 5-1 Crosswalk of MSCS NCCP Habitat Types to Other Community and Habitat Classification Systems

MSCS NCCP Habitat Type	**Equivalent Community or Habitat Type Under Other Classification Systems**				
	Ecosystem Restoration Program	**Wildlife Habitat Relationships [(a)]**	**Terrestrial Natural Communities of California [(b)]**	**National Wetland Inventory [(c)]**	**Department of Water Resources [(d)]**
Upland scrub	None	Montane chaparral, mixed chaparral, chamise-redshank chaparral, and alkali desert scrub	Great valley chenopod scrub (36200), chaparral (37000), and Diablan sage scrub (32600)	Upland	Native vegetation: light brush, medium brush, and heavy brush
Valley/foothill woodland and forest	None	Valley oak woodland, blue oak woodland, and blue oak-foothill pine	Cismontane woodland (71000), interior live oak forest (81330)	Upland	Native vegetation: brush and timber
Montane woodland and forest	None	Sierran mixed conifer, Douglas-fir, ponderosa pine, aspen, montane hardwood conifer, and montane hardwood	Broadleaved upland forest (81000), upland Douglas fir forest (82420), and Sierran coniferous forest (84200)	Upland	None
Upland cropland	Agricultural lands	Cropland, pasture, and orchard-vineyard	None	Upland	Grain and hay crops, field crops, truck and berry crops, pasture, and idle
Seasonally flooded agriculture	Agricultural lands	Cropland	None	Palustrine/framed	Grain and hay crops, field crops, and rice

Notes: In many cases, the MSCS NCCP habitats do not directly crosswalk to other classifications. NCCP habitats may encompass several habitats from other classifications or only a portion of a habitat from another classification. Habitats from other classifications may encompass several NCCP habitats.

(a) Mayer, K.E. and W.F. Laundenslayer (eds). 1988. A guide to wildlife habitats of California. California Department of Forestry and Fire Protection. Sacramento, CA.
(b) Holland, R.F. 1986. Preliminary description of the terrestrial communities of California. California Department of Fish and Game. Sacramento, CA. Numbers in parentheses are Natural Diversity Database element codes corresponding to each community type.
(c) Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service. Washington, D.C.
(d) California Department of Water Resources. 1993. Land cover mapping program. Sacramento, CA.

5.2 Tidal Perennial Aquatic

Description: Tidal perennial aquatic (TPA) habitat is defined as deepwater aquatic (greater than 3 meters deep from mean low tide), shallow aquatic (less than or equal to 3 meters deep from mean low tide), and unvegetated intertidal (i.e., tideflats) zones of estuarine bays, river channels, and sloughs (MSCS 2000).

Historical and Current Distribution and Status: There has been substantial loss of historic shallow tidal waters, mainly as a result of reclamation and channel dredging and scouring. Many animal and plant species, identified as threatened or endangered under the California and federal endangered species acts (ESAs), rely on tidal perennial aquatic habitat during some portion of their life cycle. Many leveed lands in the Bay and Delta have subsided and are too low to support shallow tidal perennial aquatic habitat. The greatest subsidence has occurred in the Central and West Delta Ecological Management Unit. All major habitat types in the Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay have been reduced to a small fraction of the area they once occupied, resulting in a large number of at-risk plant and animal species and an increased susceptibility of the remaining areas to irreversible degradation (e.g., invasion by non-native species) (ERPP 2000, pages 114 – 116).

The functions of the Delta sloughs have been degraded severely over the years. Urban and industrial development has moved into areas adjacent to sloughs, destroying historic riparian habitat. Invasion and spread of non-native plant species, such as water hyacinth, reduced water quality, and reduced freshwater outflows have also historically contributed to degradation. Existing natural sloughs require protection and habitat improvement (ERPP 2000, page 125).

Midchannel islands and shoals have been shrinking or disappearing from progressive erosion of the remaining habitat. Major factors contributing to the loss of midchannel islands and shoals are gradual erosion from channels conveying water across the Delta to South Delta pumping plants, boat wakes, and dredging within the Delta or on adjacent waters. The Delta formerly supported broad expanses of tule marshes, riparian forests, and shallow-water habitats. Today, intensive agricultural production on levee-bounded islands has replaced most of these habitats (ERPP 2000, page 128).

Relationship to EWA Action Area: Tidal perennial aquatic habitat can be found in the Delta and Suisun Bay.

CALFED NCCP Community Goal: The CALFED NCCP community goal is to restore 9,000 acres of tidal perennial aquatic habitat and approximately 150–330 miles (900–1,700 acres) of tidal sloughs within CALFED's Delta and Bay Regions. Additionally the goal is to avoid, minimize, and compensate for all CALFED effects on tidal perennial aquatic habitat.

5.3 Valley Riverine Aquatic

Description: Valley riverine aquatic (VRA) habitat includes the water column of flowing streams and rivers in low-gradient channel reaches below an elevation of approximately 300 feet that are not tidally influenced. Additionally, VRA includes associated shaded riverine aquatic (SRA), pool, riffle, run, and unvegetated channel substrate (including seasonally exposed channel bed) habitat features, and sloughs, backwaters, overflow channels, and flood bypasses hydrologically connected to stream and river channels (MSCS 2000). The dominant vegetation of valley riverine aquatic habitat includes plankton, water moss, algae, and duckweed. Aquatic species include riffle insects such as the nymphs of caddisflies, mayflies, alferflies, and stoneflies; pool insects such as dragonflies, damselflies, and water striders; and mollusks, crustaceans, diving beetles, water boatmen. Avian species associated with VRA habitat include waterfowl, wading birds, shorebirds, and raptors such as gulls, terns, osprey, bald eagles, herons, kingfisher, swallows, swifts, and flycatchers. Mammal species associated with VRA include river otter, muskrat, and beaver.

Historical and Current Distribution and Status: Historically, the Central Valley floor had approximately 922,000 acres of riparian vegetation supported by a watershed of more than 40,000 square miles. Today, approximately 100,000 acres of riparian forest remain. About half of this riparian habitat is in a highly degraded condition, representing a decline of 90 percent. The Sacramento River once supported 500,000 acres of riparian forest; it now supports 10,000 - 15,000 acres, or just 2 - 3 percent of historic levels. From about 1850 to the turn of the century, most of the forest was destroyed for fuel as a result of the Gold Rush and river navigation, and by large-scale agricultural clearing (ERPP 2000, page 152).

Additional clearing in early and mid 1900s coincided with the aftermath of flood control reservoir and levee projects. These projects allowed ongoing clearing of floodplain riparian stands for orchards, crops, flood bypasses, levee construction, and urban areas. Similar patterns occurred along the San Joaquin River, which was also greatly affected when major portions of the river were dried up following construction of Friant Dam and other large reservoirs in the San Joaquin Basin. Resulting major changes in river flow conditions and sediment deposits triggered channel instability, and downcutting of rivers and streams that caused additional riparian and riverine habitat loss and fragmentation (ERPP 2000, page 152).

The condition of riverine aquatic and nearshore habitats is not well documented for most of Central Valley and Delta estuaries, rivers, and streams. The condition of these habitats has been degraded by channel straightening; channel incising; channel dredging and clearing; instream gravel mining; riparian zone grazing; flow modifications; removal and fragmentation of shoreline riparian vegetation; and the loss of sediment, bedload, and woody debris from watershed sources upstream of dams (ERPP 2000, page 152).

Relationship to EWA Action Area: This habitat occurs below 300 ft amsl for all areas described in this section. Valley Riverine Aquatic habitat on the Sacramento River extends from approximately the legal limits of the Delta (Sacramento River at the I Street bridge) to the vicinity of Red Bluff, California. VRA habitat on the Feather River extends from the juncture of the Sacramento and Feather Rivers up to Oroville.

VRA habitat on the Yuba River extends from the juncture of the Sacramento and Yuba Rivers up to approximately Timbuctoo Bend. VRA habitat on the American River extends from the juncture of the Sacramento and American Rivers to Folsom Lake. VRA habitat on the Merced River extends from the juncture of the Merced and San Joaquin Rivers to Merced Falls. VRA habitat on the San Joaquin River in the EWA Action Area extends from the juncture of the Merced and San Joaquin Rivers to the Delta. Delta waterways that are classified as VRA include the Sacramento, San Joaquin, Consumnes, Mokelumne, and Calaveras rivers and other sloughs, streams, and ephemeral creeks. Major waterways with VRA in Suisun Bay and Marsh area include Suisun, Montezuma, and Nurse sloughs.

CALFED NCCP Community Goal: The CALFED NCCP goal is to 1) substantially increase SRA instream habitats; 2) improve flows for anadromous and other native fishes; 3) improve stream temperatures; and 4) improve anadromous fish passage and rearing along the Sacramento and San Joaquin Rivers and their tributaries. Additionally the goal is to avoid, minimize, and compensate for all CALFED effects on valley riverine aquatic habitat. CALFED will reach its goals for valley riverine and montane riverine aquatic habitats by restoring approximately 10,550–11,800 acres of riparian habitat along 235 miles of channels, and by protecting and enhancing approximately 18,000–26,000 acres of stream channel meander corridors. Some riverine aquatic habitat will be restored and enhanced on montane streams, but most will occur on valley streams.

5.4 Montane Riverine Aquatic

Description: Montane riverine aquatic (MRA) habitat includes the water column of flowing streams and rivers above an elevation of approximately 300 feet. Additionally, MRA includes associated SRA, pool, riffle, run, and unvegetated channel substrate (including seasonally exposed channel bed) habitat features, and sloughs, backwaters, and overflow channels hydrologically connected to stream and river channels (MSCS 2000). The vegetation and wildlife associated with montane riverine aquatic habitat is similar to valley riverine aquatic habitat species.

Historical and Current Distribution and Status: Montane riverine habitats are found statewide usually between 300 and 8,000 feet. Mountain ranges with montane riverine habitat include the Klamath, Coast, Cascade, Sierra Nevada, Penninsular, and Transverse.

Relationship to EWA Action Area: This habitat occurs above 300ft amsl for all areas described in this section. MRA habitat on the Sacramento River extends from Red Bluff, CA to Lake Shasta. MRA habitat on the Feather River extends between Oroville, CA and Lake Oroville, and then continues from Lake Oroville to Little Grass Valley Reservoir. MRA habitat can also be found along Lost Creek from its juncture with the Feather River to Sly Creek Reservoir. MRA habitat on the Yuba River in the EWA Action Area extends from approximately Timbuctoo Bend to New Bullards Bar Reservoir. MRA habitat on the American River in the EWA Action Area extends from approximately Folsom Lake to French Meadows Reservoir. MRA habitat on the

Merced River in the EWA Action Area extends from Merced Falls, CA through Lake McSwain to Lake McClure.

CALFED NCCP Community Goal: As with VRA, the goal is to 1) increase the extent of SRA and instream habitats; 2) improve flows for anadromous and other native fishes; 3) improve stream temperatures; and 4) improve anadromous fish passage and rearing along tributaries of the Sacramento and San Joaquin Rivers and the North Bay. Additionally the goal is to avoid, minimize, and compensate for all CALFED effects on MRA habitat. CALFED will reach its goals for montane riverine and valley riverine aquatic habitat by restoring approximately 10,550–11,800 acres of riparian habitat along 235 miles of channels, and protecting and enhancing approximately 18,000–26,000 acres of stream channel meander corridors. Some riverine aquatic habitat will be restored and enhanced on montane streams, but most will occur on valley streams.

5.5 Lacustrine

Description: Lacustrine habitat is defined as portions of permanent bodies of water that do not support emergent vegetation and that are not subject to tidal exchange, including lakes, ponds, oxbows, gravel pits, and flooded islands (MSCS 2000). Plankton, water willies, duckweed, pondweed, and smartweeds are the dominant vegetation for openwater lacustrine habitats. When water levels are low, exposed shorelines (drawdown zones) are a common feature of lacustrine habitats, and include rocky, sandy, or silty substrates. Aside from ruderal species, these areas are usually devoid of vegetation because of the inundation/desiccation cycle associated with fluctuating reservoir water levels. Lacustrine habitats are used by a wide variety of birds, mammals, reptiles, and amphibians for reproduction, food, water, and cover.

Historical and Current Distribution and Status: Nontidal perennial aquatic habitat in the Bay-Delta estuary is present in certain low-elevation areas. Historically, most wetlands in the Bay-Delta estuary were tidal. Nontidal perennial aquatic habitats were largely nonexistent. Some historical nontidal perennial habitat was created naturally. Shifts in river alignments occasionally isolated oxbow lakes, and drainage divide ponds in Bay area tidal wetlands were subjected to limited tidal action. Most of the remaining nontidal perennial aquatic habitat areas were established by constructing dikes and levees. Isolating these areas allowed their conversion for other uses, primarily agricultural. Perennial aquatic habitats on converted lands are primarily located in large agricultural drains, small farm ponds, industrial ponds, ponds managed for waterfowl and other wildlife, and Delta island blowout ponds (created by levee failures that scour island interiors deeply enough to maintain permanent water through seepage) (ERPP 2000, page 119).

Existing nontidal open-water areas generally have poor wildlife value. Nontidal perennial aquatic habitats have insufficient shoreline cover for nesting and protection from predators. Adjacent lands are relatively barren (e.g., farmed fields and land next to industrial ponds) and lack cover needed by nesting waterfowl and other species that require adjacent open-water and upland habitats. A notable exception is the unreclaimed blowout ponds, around which native vegetation has been allowed to establish (e.g., ponds on Webb Tract) (ERPP 2000, page 119).

All major habitat types in the Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay have been reduced to a small fraction of the area they once occupied, resulting in a large number of at-risk plant and animal species and an increased susceptibility of the remaining areas to irreversible degradation (e.g., invasion by non-native species) (ERPP 2000, page 116).

The major lacustrine habitats associated with the EWA Action Area are the man-made water storage reservoirs. These are water bodies within rivers that are controlled by dam structures. Seasonal operations of the reservoirs for water supply storage/release and power production cause wide variations in surface water elevation and nonvegetated shoreline vegetation. In the Export Service Area there are a number of off-stream reservoirs with primary purpose of water supply storage and release for agriculture and municipal uses.

Relationship to the EWA Action Area: Lacustrine habitat along the Sacramento River includes Lake Shasta and Keswick Reservoir. In addition, historical meandering by the Sacramento River has created remnant oxbow and floodplain lakes within the Action Area. Lacustrine habitat along the Feather River includes Little Grass Valley and Sly Creek Reservoirs, Lake Oroville, and the Thermalito Afterbay. Lacustrine habitat along the Yuba River includes New Bullards Bar Reservoir and Englebright Lake. Lacustrine habitat along the American River begins with French Meadows and Hell Hole Reservoirs and includes Folsom Lake and Lake Natoma. Lacustrine habitat along the Merced and San Joaquin Rivers within the Action Area includes Lakes McClure and McSwain. Lacustrine habitats such as dead end sloughs, forebays, and flooded islands can be found in the Delta. Lacustrine habitat within the Export Service Area includes San Luis Reservoir, Anderson Reservoir, Castaic Lake, Silverwood Lake, Lake Perris, Lake Mathews, and Diamond Valley Lake.

CALFED NCCP Community Goal: The goal is to restore 1,600 acres of lacustrine habitat adjacent to existing and restored wetlands in the CALFED Bay Region. Additionally the goal is to avoid, minimize, and compensate for loss of lacustrine habitat where evaluated species are affected by CALFED actions.

5.6 Saline Emergent

Description: Saline emergent (SE) habitat includes the portions of Suisun Bays and the Delta that support emergent wetland plant species that are tolerant of saline or brackish conditions within the intertidal zone or on lands that historically were subject to tidal exchange (i.e., diked wetlands) (MSCS 2000). The dominant vegetation for saline emergent habitats include cordgrass, pickleweed, and bulrush, glasswort, saltwort, saltgrass, arrowgrass, seablite, hairgrass, cattail, and algae. Remnants of developed saline emergent habitats are present along the shores of Suisun Bay and in the western Delta. Some wildlife species that use saline emergent habitats include ducks, herons, egrets, and hawks.

Historical and Current Distribution and Status: Saline emergent wetlands were once continuous from San Francisco Bay into the western Delta. Saline emergent habitat also is found in low-elevation areas of the Central Valley where salts have accumulated and groundwater is near the surface. Most remnant tidal saline emergent wetlands are narrow bands along the margins of San Pablo Bay and Suisun Marsh and Bay. Extensive relict tidal marshes are associated with Cutoff Slough and eastern Hill Slough flank the Potrero Hills in the north-central Suisun Marsh and are especially unique in that there is a wetland continuum from tidal sloughs through low, middle, and high marsh zones and into adjacent uplands which are rich with associated vernal pools (ERPP 2000, page 133).

Land use changes over the past century have reduced the amount of saline emergent wetland habitat and fragmented what was once nearly contiguous habitat. In particular, diking of historic wetlands has substantially reduced the amount of tidally influenced saline emergent wetlands. Large areas of nontidal wetlands that were created largely by diking for reclamation are present in the Suisun Marsh and Bay areas (ERPP 2000, page 133).

Water management in California's Central Valley reduced saltwater flowing into the Delta. Before the development of California's water storage/conveyance systems, saltwater intruded far into the upper Delta during summer months. This saltwater intrusion created a seasonally wide range of salinity over a large portion of the estuary. Reservoir operations and other water management practices have reduced saltwater intrusion into the Delta by retaining water during winter and releasing water during summer. Consequently, the area that can support brackish wetlands has been reduced, and the area that can support fresh emergent wetlands has increased. Complex water control systems are now required in Suisun Marsh to preserve the largest single area of saline emergent wetland habitat in California (ERPP 2000, page 133).

Since the turn of the century, an estimated 70,000 acres of saline emergent wetland have been lost in the Suisun Marsh and Bay and the west Delta. The primary factor causing this loss has been wetland conversion to agricultural and other land uses (ERPP 2000, page 134).

Relationship to the EWA Action Area: Saline emergent habitat can be found in Suisun Bay and western portions of the Delta, often as narrow bands along the margins of waterways.

CALFED NCCP Community Goal: The goal is to restore 7,500–12,000 acres and enhance 6,200 acres of saline emergent habitat, and restore habitat along 35–70 miles (215–425 acres) of restored tidal sloughs in the CALFED Bay Region. Additionally the goal is to avoid, minimize, and compensate for all CALFED effects on saline emergent habitat.

5.7 Tidal Freshwater Emergent

Description: Tidal freshwater emergent habitat includes portions of the intertidal zones of the Delta that support emergent wetland plant species that are not tolerant of saline or brackish conditions (MSCS 2000). The dominant vegetation for tidal freshwater emergent habitat includes California, river, and big bulrush, tules, cattails, and common reed. Freshwater emergent wetlands are among the most productive wildlife habitats in California. They provide food, cover, and water for more than 160 species of birds and numerous mammals, reptiles, and amphibians (Kramer 2003).

Historical and Current Distribution and Status: Over the past 150 years, more than 300,000 acres of fresh emergent wetlands have been lost in the Sacramento-San Joaquin Delta Ecological Management Zone. Less than 15,000 acres remain (ERPP 2000, page 140).

Prior to the mid-1800s, extensive areas of fresh emergent habitat occurred throughout the Central Valley, particularly in the Delta. A complex network of rivers, sloughs, and channels connected low islands and basins that supported a diverse and dense variety of freshwater emergent vegetation. This freshwater emergent vegetation supported a diversity of fish and wildlife species and ecological functions (ERPP 2000, page 140).

Vast areas of the Sacramento-San Joaquin Valley were commonly flooded in winter by a slow-moving blanket of silt-laden water. Flood control activities and land settlements in the late 1800s and early 1900s led to the development of leveed Delta islands. Levees and other land uses led to the loss of fresh emergent wetlands in the Delta. Loss of wetlands has substantially reduced habitat for wetland wildlife species in the Bay-Delta system. Fresh emergent wetland losses have also substantially reduced the area available for the biological conversion of nutrients in the Delta. The Delta contains insufficient wetland area to provide adequate levels of nutrient transformation, which results in lower quality water in San Francisco Bay (ERPP 2000, page 140).

Central Valley wetlands have experienced over a 95 percent reduction from historic extent. Isolating wetlands from tidal flows and removing Delta island fresh emergent wetlands changed the ecological processes that support wetlands. Loss of these tidal flow to islands has reduced habitat for native species of fish, plants, and wildlife; reduced water quality; and decreased the area available for floodwater dispersion and suspended silt deposition (ERPP 2000, page 141).

High water velocities in confined Delta channels continue to erode remaining fresh emergent wetland at a greater rate than habitat formation. Continued erosion reduces the amount of fresh emergent habitat and changes the elevation of the land. Elevation affects the types of plant species that can grow depending on a species' ability to tolerate flooding. Flood protection and levee maintenance continue to impair wetland vegetation and prevent the natural reestablishment of fresh emergent wetlands in some locations (ERPP 2000, page 141).

Wind, boat-wake waves, and high water velocities in confined channels actively erode the soil needed to support remnant fresh emergent wetlands. Continued erosion of existing habitat, such as midchannel islands and levees and levee berms, is currently the primary cause of habitat loss in the Delta (ERPP 2000, page 141).

The functions of the Delta sloughs have been degraded severely over the years. Urban and industrial development has moved into areas adjacent to sloughs, destroying historic riparian habitat. Invasion and spread of non-native plant species, such as water hyacinth, reduced water quality, and reduced freshwater outflows have also historically contributed to degradation. Existing natural sloughs require protection and habitat improvement (ERPP 2000, page 125).

Midchannel islands and shoals have been shrinking or disappearing from progressive erosion of the remaining habitat. Major factors contributing to the loss of midchannel islands and shoals are gradual erosion from channels conveying water across the Delta to South Delta pumping plants, boat wakes, and dredging within the Delta or on adjacent waters. The Delta formerly supported broad expanses of tule marshes, riparian forests, and shallow-water habitats. Today, intensive agricultural production on levee-bounded islands has replaced most of these habitats (ERPP 2000, page 128).

Relationship to the EWA Action Area: Tidal freshwater emergent habitat occurs in the Delta along island levees, channel islands, and shorelines (ERPP 2000).

CALFED NCCP Community Goal: The goal is to increase the extent of tidal freshwater emergent habitat by 30,200–45,800 acres in the CALFED Delta Region through restoration, restore habitat along 115–260 miles (700–1,275 acres) of restored tidal sloughs, and enhance habitat by controlling non-native plants. Additionally the goal is to avoid, minimize, and compensate for all CALFED effects on tidal freshwater emergent habitat.

5.8 Nontidal Freshwater Permanent Emergent

Description: Nontidal freshwater permanent emergent (NFPE) includes permanent (natural and managed) wetlands, including meadows, dominated by wetland plant species that are not tolerant of saline or brackish conditions (MSCS 2000). Vegetation and wildlife for nontidal freshwater permanent emergent habitats are essentially the same as for tidal freshwater emergent habitats.

Historical and Current Distribution and Status: Over the past 150 years, more than 300,000 acres of fresh emergent wetlands have been lost in the Sacramento-San Joaquin Delta Ecological Management Zone. Less than 15,000 acres remain (ERPP 2000, page 140).

Prior to the mid-1800s, extensive areas of fresh emergent habitat occurred throughout the Central Valley, particularly in the Delta. A complex network of rivers, sloughs, and channels connected low islands and basins that supported a diverse and dense variety of freshwater emergent vegetation. This freshwater emergent vegetation supported a diversity of fish and wildlife species and ecological functions (ERPP 2000, page 140).

Vast areas of the Sacramento-San Joaquin Valley were commonly flooded in winter by a slow-moving blanket of silt-laden water. Flood control activities and land settlements in the late 1800s and early 1900s led to the development of leveed Delta islands. Levees and other land uses led to the loss of fresh emergent wetlands in the Delta. Loss of wetlands has substantially reduced habitat for wetland wildlife species in the Bay-Delta system. Fresh emergent wetland losses have also substantially reduced the area available for the biological conversion of nutrients in the Delta. The Delta contains insufficient wetland area to provide adequate levels of nutrient transformation, which results in lower quality water in San Francisco Bay (ERPP 2000, page 140).

Central Valley wetlands have experienced over a 95 percent reduction from historic extent. Isolating wetlands from tidal flows and removing Delta island fresh emergent wetlands changed the ecological processes that support wetlands. Loss of these tidal flow to islands has reduced habitat for native species of fish, plants, and wildlife; reduced water quality; and decreased the area available for floodwater dispersion and suspended silt deposition (ERPP 2000, page 141).

High water velocities in confined Delta channels continue to erode remaining fresh emergent wetland at a greater rate than habitat formation. Continued erosion reduces the amount of fresh emergent habitat changes the elevation of the land. Elevation affects the types of plant species that can grow depending on a species' ability to tolerate flooding. Flood protection and levee maintenance continue to impair wetland vegetation and prevent the natural reestablishment of fresh emergent wetlands in some locations (ERPP 2000, page 141).

Wind, boat-wake waves, and high water velocities in confined channels actively erode the soil needed to support remnant fresh emergent wetlands. Continued erosion of existing habitat, such as midchannel islands and levees and levee berms, is currently the primary cause of habitat loss in the Delta (ERPP 2000, p. 141).

Relationship to the EWA Action Area: NFPE habitat occurs throughout the Delta in areas where soils are inundated or saturated for all or most of the growing season, such as landward sides of levees, constructed waterways, and ponds. NFPE also occurs on Delta islands in low-lying areas among crop and pasture land.

CALFED NCCP Community Goal: The goal is to restore 19,600 acres of nontidal freshwater permanent emergent habitat in the CALFED Delta Region, including 2,600 acres of open-water areas within restored wetlands. Avoid, minimize, and compensate for all CALFED effects on nontidal freshwater permanent emergent habitat.

5.9 Natural Seasonal Wetland

Description: Natural seasonal wetland habitat includes vernal pools and other nonmanaged seasonal wetlands with natural hydrologic conditions that are dominated by herbaceous vegetation and that annually pond surface water or maintain saturated soils at the ground surface for enough of the year to support facultative or obligate wetland plant species. Alkaline and saline seasonal wetlands that were not historically part of a tidal regime are included in natural seasonal wetlands (MSCS 2000). Dominant natural seasonal wetland vegetation includes big leaf sedge, bulrush, and redroot nutgrass. Examples of special-status plant species associated with natural seasonal wetland habitats include Alkali milk-vetch, Crampton's tuctoria, Colusa grass, Bogg's lake hedge-hyssop, legenere, Hoover's spurge, Butte County meadowfoam, Greene's tuctoria, slender orcutt grass, hairy orcutt grass. Examples of special-status animal species associated with natural seasonal wetland include American peregrine falcon, California gull, greater sandhill crane, long-billed curlew, northern harrier, short-eared owl, Swainson's hawk, tricolored blackbird, white-tailed kite, giant garter snake, California red-legged frog, California tiger salamander, western spadefoot toad, conservancy fairy shrimp, Delta green ground beetle, longhorn fairy shrimp, mid-valley fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp.

Historical and Current Distribution and Status: Historically, seasonal wetlands occurred throughout the Central Valley. The extent and quality of seasonal wetlands has declined because of cumulative effects of many factors, including:

- modification of natural geomorphology such as ground leveling for agriculture and development,
- adverse effects of overgrazing,
- contamination from herbicides,
- establishment of non-native species that have an adverse effect on native wetland plants and wildlife,
- flood control and water supply infrastructure that reduces overbank flooding and floodplain size, and
- reduction of the natural underground water table that supported wetlands (ERPP 2000, pages 146, 147).

Existing wetland regulations have been in effect for several years in an attempt to prevent the further loss of seasonal wetlands. The protected status of wetlands has resulted in an extensive permitting process for construction in wetland areas. Mitigation measures have been developed to offset loss of existing wetlands as a result of construction activities. These efforts have slowed the rate of wetland loss in many areas. Large-scale efforts in areas such as the Suisun Marsh, Grasslands

Resource Conservation District, Yolo Bypass, and Butte Sink have been successful in maintaining and restoring seasonal wetlands (ERPP 2000, page 147).

Relationship to the EWA Action Area: Natural seasonal wetland habitat may be found throughout the Sacramento and San Joaquin valleys. This includes areas where EWA actions involve groundwater substitution, groundwater purchase, and crop idling.

CALFED NCCP Community Goal: Protect, enhance, or restore 100 acres of vernal pools and 500–1,000 acres of surrounding native upland buffer habitat in the CALFED Bay Region. Avoid, minimize, and compensate for all CALFED effects on natural seasonal wetland habitat.

5.10 Managed Seasonal Wetland

Description: Managed seasonal wetland habitat includes wetlands dominated by native or non-native herbaceous plants, excluding croplands farmed for profit (e.g., rice), that land managers flood and drain during specific periods to enhance habitat values for specific wildlife species. Ditches and drains associated with managed seasonal wetlands are included in this habitat type (MSCS 2000). Vegetation and wildlife species associated with managed seasonal wetland habitats are similar to those associated with natural seasonal wetland habitats, with the exception of vernal pool species.

Historical and Current Distribution and Status: Historically, managed seasonal wetlands did not occur in the Sacramento and San Joaquin valleys. All managed seasonal wetlands now are a result of agricultural practices and the management of water flows for wildlife (waterfowl gun clubs and wildlife refuges). The extent and quality of managed seasonal wetlands varies based on the practices that create and maintain this type of habitat.

Relationship to the EWA Action Area: Managed seasonal wetlands are either private lands managed primarily for waterfowl or state and federal wildlife areas/refuges. These wetlands occur throughout the Central Valley; however, they are concentrated in the following areas:

- along the Sacramento and its flood byways;
- along the Feather River
- in the Butte Sink;
- throughout the Delta and Suisun Marsh;
- in the Los Banos and Mendota vicinity; and
- scattered throughout the Tulare basin.

CALFED NCCP Community Goal: The goal is to restore 29,000–29,500 acres of managed seasonal wetland habitat in the CALFED Delta and Bay Regions and enhance approximately 308,125 acres of habitat in all CALFED regions. Additionally the goal is to avoid, minimize, and compensate for loss of managed seasonal wetland habitat where evaluated species are affected by CALFED actions.

5.11 Valley/Foothill Riparian

Description: Valley/foothill riparian habitat includes all successional stages of woody vegetation, within the active and historical floodplains of low-gradient reaches of streams and rivers generally below an elevation of 300 feet (MSCS 2000). Valley/Foothill Riparian habitat is dominated by a cottonwood, sycamore, alder, ash, and valley oak tree overstory and a blackberry, poison oak, and wild grape understory. In California over 225 species of birds, mammals, reptiles, and amphibians depend on riparian habitats, and cottonwood-willow riparian areas support more breeding avian species than any other comparable broad California habitat type (Merced River Corridor Restoration Plan 2002 and Sacramento River Advisory Council 2001).

Historical and Current Distribution and Status: Historically, the Central Valley floor had approximately 922,000 acres of riparian vegetation supported by a watershed of more than 40,000 square miles. Today, approximately 100,000 acres of riparian forest remain. About half of this riparian habitat is in a highly degraded condition, representing a decline of 90 percent. The Sacramento River once supported 500,000 acres of riparian forest; it now supports 10,000 - 15,000 acres, or just 2 - 3 percent of historic levels. From about 1850 to the turn of the century, most of the forest was destroyed for fuel as a result of the Gold Rush and river navigation, and by large-scale agricultural clearing (ERPP 2000, page 152).

Additional clearing in early and mid 1900s coincided with the aftermath of flood control reservoir and levee projects. These projects allowed ongoing clearing of floodplain riparian stands for orchards, crops, flood bypasses, levee construction, and urban areas. Similar patterns occurred along the San Joaquin River, which was also greatly affected when major portions of the river were dried up following construction of Friant Dam and other large reservoirs in the San Joaquin Basin. Resulting major changes in river flow conditions and sediment deposits triggered channel instability, and downcutting of rivers and streams that caused additional riparian and riverine habitat loss and fragmentation (ERPP 2000, page 152).

The condition of riverine aquatic and nearshore habitats is not well documented for most of Central Valley and Delta estuaries, rivers, and streams. The condition of these habitats has been degraded by channel straightening; channel incising; channel dredging and clearing; instream gravel mining; riparian zone grazing; flow modifications; removal and fragmentation of shoreline riparian vegetation; and the loss of sediment, bedload, and woody debris from watershed sources upstream of dams (ERPP 2000, page 152).

Relationship to EWA Action Area: Valley/foothill riparian habitat includes the approximate 0.1 to 1 mile width of woody vegetation adjacent to riverine habitats below 300 feet msl. For the EWA Action Area this habitat is scattered along: 1) the Sacramento River from approximately the legal limits of the Delta (Sacramento River at the I Street bridge) to the vicinity of Red Bluff, California; 2) the Feather River from the juncture of the Sacramento and Feather Rivers up to Oroville, CA; 3) the Yuba River from the juncture of the Sacramento and Yuba Rivers up to approximately Timbuctoo Bend; 4) the American River from the juncture of the Sacramento and American Rivers to Folsom Lake; 5) the Merced River from the juncture of the Merced and San Joaquin Rivers to Merced Falls, CA; 6) the San Joaquin River from the juncture of the Merced and San Joaquin Rivers to the Delta; and 7) Delta waterways such as the Sacramento, San Joaquin, Consumnes, Mokelumne, and Calaveras rivers and other sloughs, streams, and ephemeral creeks.

CALFED NCCP Community Goal: The goal is to: 1) restore approximately 1,200 acres of riparian habitat in the CALFED Delta Region, 200–300 acres in the CALFED Bay Region, 3,650 acres in the CALFED Sacramento River Region, and 5,450–5,950 acres in the CALFED San Joaquin River Region; 2) protect and enhance 500 acres of existing riparian habitat in the CALFED Delta Region; and 3) enhance and restore riparian habitat associated with restoration of 18,000–26,000 acres of stream channel meander corridors in the CALFED Sacramento and San Joaquin River Regions. Additionally the goal is to avoid, minimize, and compensate for all CALFED effects on valley/foothill riparian habitat.

5.12 Montane Riparian

Description: Montane riparian habitat includes all successional stages of woody vegetation, such as willow, black cottonwood, white alder, birch, and dogwood, within the active floodplains of moderate-to-high-gradient reaches of streams and rivers generally above an elevation of 300 feet (MSCS 2000). Montane Riparian habitat vegetation is dominated by cottonwood (black and Fremont [at lower altitudes]), white alder, big leaf maple, dogwood, box elder, quaking aspen, wild azalea, water birch, and buttonwillow trees. As with valley/foothill riparian habitat, numerous wildlife species depend on montane riparian habitat.

Historical and Current Distribution and Status: Montane riparian habitats are found in the Klamath, Coast, and Cascade ranges and in the Sierra Nevada south to about Kern and northern Santa Barbara usually below 8,000 feet. Montane riparian habitat also occurs in the Peninsular and Transverse ranges of southern California from about southern Santa Barbara to San Diego counties.

Relationship to EWA Action Area: Montane riparian habitat includes the approximate 0.1 to 1 mile width of woody vegetation adjacent to riverine habitats above 300 feet msl. For the EWA Action Area this habitat is scattered along: 1) the Sacramento River from Red Bluff, CA to Lake Shasta; 2) the Feather River between Oroville, CA and Lake Oroville, and then from Lake Oroville to Little Grass Valley Reservoir; 3) Lost Creek from its juncture with the Feather River to Sly Creek

Reservoir; 4) the Yuba River from approximately Timbuctoo Bend to New Bullards Bar Reservoir; 5) the American River from approximately Folsom Lake to French Meadows Reservoir; 6) the Merced River from Merced Falls, CA through Lake McSwain to Lake McClure.

CALFED NCCP Community Goal: The goal is to increase the extent and connectivity of montane riparian habitat on tributary steams in the CALFED Sacramento, San Joaquin, and Bay Regions, and to avoid, minimize, and compensate for all CALFED effects on montane riparian habitat.

5.13 Upland Cropland

Description: Upland cropland habitat includes agricultural lands farmed for grain field, truck, and other crops for profit that are not seasonally flooded (MSCS 2000). Upland cropland vegetation is dominated by cereal rye, barley, wheat, corn, dry beans, safflower, alfalfa, cotton, tomatoes, lettuce, Bermuda grass, ryegrass, tall fescue, almonds, walnuts, peaches, plums, and grapes. Wildlife use of these areas varies throughout the growing season with crop type, level of disturbance, and available cover. Orchard and vineyard typically support resident species, such as scrub jay, northern mockingbird, yeloo-billed magpie, American crow, and northern flicker. During the winter orchard habitats provide foraging habitat and roostin sites for many songbirds species including the white-crowned sparrow, dark-eyed junco, golden-crowned sparrow, lesser goldfinch, and yellow-rumped warbler. Species associated with field and row crops include the red-winged blackbird, European starling, western meadowlark, California vole, black-tailed jackrabbit, western harvest mouse, Botta’s pocket gopher, raccoon, striped skunk, and Virginia opossum. Croplands provide foraging habitat for many raptors including the northern harrier, red-tailed hawk, and white-tailed kite. Cotton crops are of limited value to wildlife.

Historical and Current Distribution and Status: Prior to settlement of the valleys by Europeans, there was no agricultural practice in the valley other than the gathering of native vegetation. Following extensive native habitats loss in the Central Valley to agricultural and urban lands, some wildlife species have adapted to the artificial wetland and upland environments created by some agricultural practices. Once adapted, species became dependent on these agricultural areas to sustain their populations (ERPP 2000, page 176).

California agriculture thrives on the coasts, mountains, deserts and valleys of the Golden State. All but one of the state's 58 counties reports agricultural production (CFBF 2003).

The Central Valley contains the largest irrigated agricultural area west of the Rocky Mountains. This alluvial plain extends nearly 450 miles from the Klamath/Cascades in the north to the Tehachapis in the south and between the Coast Range and the Sierra Nevada. This region has nearly half of the state's farmland, two-thirds of the cropland and almost 75 percent of the irrigated land. A number of U.S. crops are grown exclusively in the region, including almonds, figs, kiwifruit, nectarines, olives, persimmons, pistachios, prunes, raisins and walnuts (CFBF 2003).

The Sacramento Valley, with its cooler winters and higher rainfall, produces small grain crops and seasonal grazing on its non-irrigated acreage. Rice is the predominant irrigated crop in the areas of relatively impervious soils. Fruit and nut crops are produced on deeper, better-drained and more fertile soils. The region also has row crops such as tomatoes, beans, corn, milo and sunflowers. The foothills of the Sacramento Valley support seasonal grazing of cattle and sheep (CFBF 2003).

The southern portion of the great Central Valley - the San Joaquin Valley - is the most extensive and productive agricultural region in the state. A third of the state's farms and farmland are in this valley. Nearly half of the cropland and more than half of the irrigated acreage in California lie in this region. A variety of crops is grown in the San Joaquin Valley, including deciduous tree fruits and nuts, grapes and citrus, in addition to cotton, alfalfa and a broad spectrum of vegetable and other field crops. Dairy farming is important throughout the region. Poultry enterprises thrive on the valley floor. Beef cattle and sheep production is carried on in the foothills on irrigated pasture (CFBF 2003).

The Central Coast consists of a number of highly productive valleys lying between predominately north-south mountain ridges of the Coast Range. The region features a diverse mix of agriculture including premium winegrapes, dairies, orchard crops, strawberries and vegetables (CFBF 2003).

The state's North Coast and Mountain regions feature fewer farms in number but they tend to be larger in size per acre than other regions. The area comprises slightly more than a third of the state's total land area, but less than 1 million acres are cropped because of the topography and climate. The area is suited to timber production and livestock, such as cattle and sheep. Hay, irrigated pasture and rangeland covers privately owned land and leased public land (CFBF 2003).

The southern California region is also an important agricultural region. Farms in the region tend to be smaller in size on the average than other parts of the state, but the average value of farm products sold per acre and per farm exceeds many other regions. Crops such as avocados, citrus, vegetables and flowers grow along the South Coast in the moderate climate and breezes from the Pacific Ocean. Alfalfa, cotton, citrus, dates, small grains and winter vegetables thrive in the hotter interior valleys of Coachella and Imperial where the farms are generally larger in size compared to the coastal regions. Irrigation is critical for crop production in the interior valleys (CFBF 2003).

Agricultural lands are located throughout the Central Valley. These lands comprise many different types of agricultural land uses ranging from non-irrigated grazing land to drip-irrigated vineyard. The types of crops grown on any particular parcel are usually dictated by soil type, topography, and availability of water. Intensively managed agricultural lands or croplands are located on flat or slightly rolling terrain.

Flat cropland is usually the product of extensive surveying and laser land-leveling activities. Flat croplands provide more efficient use of water, less soil erosion, and higher crop yields. A variety of fragmented habitats that support various resident and migratory wildlife species are closely associated with these agricultural lands and includes naturally occurring wetland types (creeks, vernal pools, and gullies) (ERPP 2000, page 176).

Agricultural lands being managed for certain crops and following certain agricultural practices create wetland-like benefits for certain wildlife. These lands can provide significant habitat for some wildlife species. Crop type and cultivation practices determine the quality of habitats. Lands where wheat and corn have been harvested, particularly if they have been shallowly flooded after harvest, also support large populations of wintering waterfowl and the State-listed greater sandhill crane (ERPP 2000, page 176).

Relationship to EWA Action Area: Upland cropland habitat includes land farmed for cotton in the San Joaquin Valley.

CALFED NCCP Community Goal: The CALFED NCCP goal is to manage the upland cropland portion of 353,933–388,933 acres of agricultural lands to enhance wildlife habitat values, and to avoid, minimize, and compensate for loss of upland cropland habitat where evaluated species are affected by CALFED actions.

5.14 Seasonally Flooded Agricultural Lands

Description: Seasonally flooded agricultural land habitat includes agricultural lands farmed for grain, rice, field, truck, and other crops for profit that require seasonal flooding for at least 1 week at a time as a management practice (e.g., for pest control and irrigation) or are purposely flooded seasonally to enhance habitat values for specific wildlife species (e.g., ducks for duck clubs). Agricultural ditches and drains associated with maintaining seasonally flooded agricultural land are included in this habitat type (MSCS 2000).

Rice fields (seasonally flooded agriculture) provide important habitat for a variety of Covered Species (see Table 5-2). Many species forage on more than 350 pounds per acre of post-harvest waste grain and more than 250 pounds per acre of other food found within the fields such as duckweed, fish, and crayfish (Wrysinski, 2002 and CH2MHill, 1996). Rice can also provide resting and nesting habitat similar to natural wetlands, which is particularly important to waterfowl migrating along the Pacific Flyway (60 percent of waterbirds using the Pacific Flyway winter in the Sacramento Valley and 95 percent of historical Central Valley wetlands have been destroyed [Ducks Unlimited, Inc. 1996]). Other species dependent upon rice fields for all or part of their lifecycle include the threatened giant garter snake, various rodents feeding on waste grain, and raptors foraging for these rodents. In addition, irrigation ditches can contain wetland vegetation such as cattails, which provide habitat for rails, egrets, herons, bitterns, marsh wrens, sparrows, and common yellowthroats.

Covered Species associated with rice (Seasonally Flooded Agricultural Lands [SFA]) are provided in Table 5-2. Species associations were determined based on the 1997 report, *Special Status Wildlife Species Use of Rice Cultivation Lands in California's Central Valley* (RMI 1997), and the Draft CALFED Technical Report, *Affected Environment - Supplement to Vegetation and Wildlife* (CALFED 1998).

Historical and Current Distribution and Status: Seasonally flooded agriculture practices originated during the last century with the great expansion in the amount of flooded land for rice production during the last 50 years. For the EWA Action Area, seasonally flooded agricultural land is primarily in the Sacramento Valley.

Relationship to EWA Action Area: Seasonally flooded agricultural land includes rice lands in the Sacramento Valley, agricultural land where groundwater substitution and purchase occur, and ditches and drains that provide irrigation water to croplands and channel return flows from idled cropland. Currently the EWA Agencies are considering idling up to 55,100 acres of rice crop in 6 counties (Glenn, Colusa, Butte, Sutter, Placer, and Yolo). These counties typically harvest about 496,820 acres of rice (USDA 1997).

CALFED NCCP Community Goal: Manage the seasonally flooded agricultural land portion of 353,933–388,933 acres of agricultural lands to enhance wildlife habitat values. Avoid, minimize, and compensate for loss of seasonally flooded agricultural land habitat where evaluated species are affected by CALFED actions.

5.15 NCCP Fish Groups

The EWA ASIP also includes the anadromous and estuarine species fish groups described in the MSCS. These fish groups are discussed separately because an evaluation of NCCP habitats, which is based on vegetation, land use, and geography, does not adequately address these groups. This section identifies the species comprising each group and their associated NCCP habitats, including non-estuarine NCCP aquatic habitats that are periodically used by some estuarine fish species. Fishes included in NCCP fish groups are those that:

- Will be most affected by CALFED water storage, conveyance, and water operations actions;
- Depend on the Bay-Delta ecosystem; and
- Are subject to established USFWS, NMFS, and CDFG recovery goals.

Table 5-2. Covered Species Associated with Rice Fields[1]		
Species	**Scientific Name**	**Status[2]**
Amphibians		
Western Spadefoot	*Scaphiopus hammondii*	CSC
Reptiles		
Western Pond Turtle	*Clemmys marmorata*	CSC
Giant Garter Snake*	*Thamnophis gigas*	FT, ST
Birds		
Double-crested Cormorant	*Phalacrocorax auritus*	CSC
American Bittern*	*Botaurus lentiginosus*	FSC
Great Egret	*Casmerodius albus*	CSC
Snowy Egret	*Egretta thula*	CSC
White-faced Ibis	*Plegadis chihi*	CSC
Aleutian Canada Goose	*Branta canadensis leucopareia*	De-listed
White-tailed Kite	*Elanus leucurus*	FSC, FP
Bald Eagle	*Haliaeetus leucocephalus*	FT, PR, SE, FP
Northern Harrier*	*Circus cyaneus*	CSC
Swainson's Hawk	*Buteo swainsoni*	ST
Ferruginous Hawk	*Buteo regalis*	CSC
Golden Eagle	*Aquila chrysaetos*	PR, CSC, FP
Merlin	*Falco columbaris*	CSC
Peregrine Falcon	*Falco peregrinus*	SE, FP
Prairie Falcon	*Falco mexicanus*	CSC
Greater Sandhill Crane	*Grus canadensis tabida*	ST, FP
Mountain Plover	*Charadrius montanus*	PT, FSC, CSC
Long-billed Curlew	*Numenius americanus*	CSC
Black Tern*	*Chlidonias niger*	CSC
Burrowing Owl*	*Speotyto cunicularia*	CSC
Long-eared Owl	*Asio otus*	CSC
Short-eared Owl*	*Asio flammeus*	CSC
Bank Swallow	*Riparia riparia*	ST
Bewick's Wren	*Thryomanes bewickii*	FSC
Loggerhead Shrike	*Lanius ludovicianus*	CSC
Lark Sparrow	*Chondestes grammacus*	FSC
Tricolored Blackbird*	*Agelaius tricolor*	CSC
California Gull	*Larus californicus*	CSC

[1]*Special Status Wildlife Species Use of Rice Cultivation Lands in California's Central Valley*, Rice Management Institute, 1997 and *Affected Environment – Supplement to Vegetation and Wildlife*, Draft CALFED Technical Report, 1998.

[2] Status Codes
FE = Listed as Endangered under FESA
FT = Listed as Threatened under FESA
PT = Proposed for listing as Threatened under FESA
FSC = Federal species of management concern
PR = Protected under the Bald and Golden Eagle Protection Act
SE = Listed as Endangered under CESA
ST = Listed as Threatened under CESA
FP = Fully protected under California Fish and Game Code
CSC = California Department of Fish and Game "species of special concern"
* = Species breeds or is in some manner dependent on rice cultural habitats for successful reproduction.

5.15.1 Anadromous Fish Group

Description: The anadromous fish group includes tidal perennial aquatic, valley riverine aquatic, montane riverine aquatic, saline emergent, and tidal freshwater emergent aquatic habitats. Fish species of concern associated with these habitats include Sacramento River winter-run Chinook salmon, Central Valley fall-run/late-fall-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley and Central California Coast steelhead evolutionarily significant units (ESUs); and green sturgeon (MSCS 2000).

Historical and Current Distribution and Status: Please refer to Chapter 3, Sections 3.2.1 through 3.2.4 for a description of the historical and current distribution of the fish species being addressed as part of the anadromous fish group.

Relationship to EWA Action Area: The anadromous fish group is found in Suisun Bay, the Delta, the Sacramento and San Joaquin Rivers, and their primary tributaries the Feather, Yuba, American, and Merced Rivers.

CALFED NCCP Community Goals: The goal is to substantially improve anadromous fish species habitat and restore and maintain Chinook salmon and steelhead populations to levels that ensure the long-term viability of individual runs and species.

5.15.2 Estuarine Fish Group

Description: The estuarine fish group includes tidal perennial aquatic, valley riverine aquatic, saline emergent, and tidal freshwater emergent aquatic habitats. Fish species of concern associated with these habitats include tidewater goby, delta smelt, longfin smelt, Sacramento splittail, and Sacramento perch (MSCS 2000).

Historical and Current Distribution and Status: Please refer to Chapter 3, Section 3.2.5 and 3.2.7 for a description of the historical and current distribution of the fish species being addressed as part of the estuarine fish group.

Relationship to EWA Action Area: The estuarine fish group is found in Suisun Bay, the Delta, the Sacramento and San Joaquin Rivers, and their primary tributaries the Feather, Yuba, American, and Merced Rivers.

CALFED NCCP Community Goals: The goal is to substantially improve estuarine fish species habitat and restore and maintain populations of evaluated species of estuarine fish species to levels that ensure their long-term viability.

Chapter 6
Effects of the Proposed Action on NCCP Communities inside the Action Area

6.1 Introduction

This chapter assesses effects on NCCP communities caused by implementation of the Proposed Action. The Proposed Action contains asset acquisition and management actions that include pre-delivery, source shifting, purchasing stored reservoir water, using groundwater substitution and/or storage, purchasing stored groundwater, and crop idling. These actions may affect the following variables: 1) the timing of water releases, 2) river flows, 3) reservoir levels, or 4) water table levels. Effects to plant communities may include changes in water availability, alteration of species composition, and removal, conversion, or fragmentation of communities.

Chapter 5 describes the 15 NCCP communities evaluated in this ASIP. This ASIP does not evaluate in detail inland dune scrub, grassland, valley/foothill woodland and forest, montane woodland and forest, and upland scrub habitats because EWA actions will not affect these habitats. Chapter 4 provides analyses of the effects of EWA actions on fish species based on changes in stream flow, Delta pumping actions, and Delta outflow. This chapter evaluates fish species and their riverine and Delta habitats based on their NCCP fish groups (anadromous fish species and estuarine fish species) designations. Therefore, this ASIP provides for an assessment of effects on these fish groups based upon species-specific analyses and analyses of associated NCCP habitats.

6.2 Determining the Likelihood that EWA Actions would Affect NCCP Habitats

The MSCS provided a programmatic evaluation of CALFED's effects on the evaluated NCCP habitats and similar criteria will be used in this ASIP to determine the EWA-specific effects on these habitats. EWA actions were considered likely to affect evaluated habitats adversely or beneficially if the quality of the habitat to support populations of species is changed or should populations of a species critical for the viability of the habitat be present in the area where actions could be implemented and:

- Implementing one or more actions may affect or could result in take of the species; or
- Implementing the actions would increase or decrease the extent or quality of habitat potentially occupied by the species.

6.3 Tidal Perennial Aquatic

Tidal perennial aquatic (TPA) habitat is defined as deepwater aquatic (greater than 3 meters deep from mean low low tide), shallow aquatic (less than or equal to 3 meters deep from mean low low tide), and unvegetated intertidal (tideflats) zones of estuarine bays, river channels, and sloughs (MSCS 2000).

Open water in the Delta Region includes sloughs and channels in the Delta, flooded islands, ponds, and bays. Deep open-water areas are largely unvegetated; beds of aquatic plants occasionally occur in shallower open-water areas. Open water provides resting and foraging habitat for water birds.

6.3.1 Status in the Action Area

The Tidal Perennial Aquatic community occurs in the western Delta area and Suisun Bay. There has been substantial loss of historic shallow tidal waters, mainly as a result of reclamation and channel dredging and scouring. Many animal and plant species, identified as threatened or endangered under the California and federal Endangered Species Acts, rely on tidal perennial aquatic habitat during some portion of their life cycle. Many leveed lands in the Bay and Delta have subsided and are too low to support shallow tidal perennial aquatic habitat. The greatest subsidence has occurred in the Central and West Delta Ecological Management Unit. All major habitat types in the Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay have been reduced to a small fraction of the area they once occupied, resulting in a large number of at-risk plant and animal species and an increased susceptibility of the remaining areas to irreversible degradation (e.g., invasion by non-native species) (ERPP 2000).

The functions of the Delta sloughs have been degraded severely over the years. Urban and industrial development has moved into areas adjacent to sloughs, destroying historic riparian habitat. Invasion and spread of non-native plant species, such as water hyacinth, reduced water quality, and reduced freshwater outflows have also historically contributed to degradation. Existing natural sloughs require protection and habitat improvement (ERPP 2000).

Midchannel islands and shoals have been shrinking or disappearing from progressive erosion of the remaining habitat. Major factors contributing to the loss of midchannel islands and shoals are gradual erosion from channels conveying water across the Delta to South Delta pumping plants, boat wakes, and dredging within the Delta or on adjacent waters. The Delta formerly supported broad expanses of tule marshes, riparian forests, and shallow-water habitats. Today, intensive agricultural production on levee-bounded islands has replaced most of these habitats (ERPP 2000).

6.3.2 Effect Assessment Methods

Table 6-1 provides a summary of effect indicators (parameters) and evaluation criteria developed to assess potential adverse effects on the tidal perennial aquatic community and associated covered species that may result from implementation of EWA actions in the Delta. Potential effects on covered fish species associated with this community considered to be adverse if adverse effects were identified for the community. Chapter 4 presents the overall assessment methodology for fish species in the Delta.

Table 6-1. Effect Indicators and Evaluation Criteria for Tidal-Perennial Aquatic Community

Tidal Perennial Aquatic Assessment Criteria	
Effect Indicator	Evaluation Criteria
Monthly mean flows (cfs) from March through October.	Decrease in flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect the growth, maintenance, and reproductive capacity of vegetation in the lower Sacramento River and Delta for any month of this period over the 72-year period of record.
Position of X_2.	Upstream shift in the position of X_2, relative to the basis of comparison of sufficient magnitude (greater than 1 km) and frequency to adversely affect the growth, maintenance, and reproductive capacity of vegetation of the Delta for any month of this period over the 72-year period of record.

6.3.3 Project Effects

The following text contains an analysis of potential direct and indirect effects to Delta NCCP communities, including Tidal Perennial Aquatic, Saline Emergent, and Tidal Freshwater Emergent habitats and associated covered species.

EWA acquisitions via groundwater substitution, crop idling, stored reservoir water purchase, stored groundwater purchase, and source shifting change the timing of Delta pumping operations, and have the potential to result in changes to Delta inflows and associated parameters. Potential changes in lower Sacramento River flows can result in changes in the position of X_2. Under the proposed action, long-term average flows in the lower Sacramento River at Freeport would be similar relative to the basis of comparison. Under the proposed action, the long-term average position of X_2 would be maintained through the use of carriage water releases and other EWA asset directed releases controlling X_2, relative to the basis of comparison.

In summary, changes to Delta inflows would not be of sufficient magnitude and frequency to significantly alter existing riparian and wetland habitat dependent of the Delta. Therefore, the proposed action is not likely to adversely affect Delta riparian and wetland vegetation.

6.3.4 Conservation Measures

Because there are no adverse effects on tidal perennial aquatic habitat from EWA actions, no conservation measures are necessary.

6.3.5 Contribution to Recovery

The EWA program is not expected to contribute to the recovery of tidal perennial aquatic habitat or associated Covered Species.

6.4 Valley Riverine Aquatic

Valley riverine aquatic (VRA) habitat includes the water column of flowing streams and rivers in low-gradient channel reaches below an elevation of approximately 300 feet that are not tidally influenced. Additionally, VRA includes associated shaded riverine aquatic (SRA), pool, riffle, run, and unvegetated channel substrate (including seasonally exposed channel bed) habitat features, and sloughs, backwaters, overflow channels, and flood bypasses hydrologically connected to stream and river channels (MSCS 2000). The dominant vegetation of VRA habitat includes plankton, water moss, algae, and duckweed. Aquatic species include riffle insects such as the nymphs of caddisflies, mayflies, alderflies, and stoneflies; pool insects such as dragonflies, damselflies, and water striders; and mollusks, crustaceans, diving beetles, water boatmen. Avian species associated with VRA habitat include waterfowl, wading birds, shorebirds, and raptors such as gulls, terns, osprey, bald eagles, herons, kingfisher, swallows, swifts, and flycatchers. Mammal species associated with VRA include river otter, muskrat, and beaver.

6.4.1 Status in the Action Area

The VRA habitat includes the streams and the adjacent riparian corridors (providing shaded riverine aquatic habitat). This habitat has been in decline because of agricultural and flood control practices, particularly during the last century.

6.4.2 Effect Assessment Methods

EWA asset acquisition and management actions were considered significant should reductions or increases in stream flows alter stream bank stability, including erosion of stream banks, or should decreases in stream or groundwater water sources supporting aquatic vegetation be interrupted causing the death of riparian vegetation. Reductions in stream flows that alter the quality of habitat (e.g., water temperature) are also considered significant.

6.4.3 Project Effects

This section analyzes the EWA water acquisition and management effects on aquatic habitat within the valley reach of each river system in the Upstream from the Delta Region. Effects would be considered significant should 1) decreases in river flows or reservoir levels reduce the water source for riparian vegetation, thereby decreasing its extent; 2) decreases in stream flow do not allow for temporary flooding of adjacent floodplain thereby inhibiting germination and growth of seedlings; 3) decreases in river flows strand populations of wildlife species (e.g., tadpoles) increasing their loss through predation; 4) increases in stream flow cause erosion of stream banks resulting in a loss of shaded riverine habitat; 5) increases in stream flows flush populations (non-volitional movement) of wildlife from protected areas or wash seedlings of riparian vegetation away from stream banks/shallow areas causing a loss in recruitment vegetation; or 6) increases and timing of flows are such that natural geomorphic processes such as point bar formation do not occur and establishment of seedlings in adversely affected.

The timing and amount of EWA water releases, will, in general, decrease mean flow peaks in early spring and increase summer water levels available for plants. Peak spring flows typically clear the river channel of debris and unclog sediments, depositing them downstream creating point bars and nutrient rich floodplains essential for early successional plant germination. Decreasing summer water levels ensure that pioneer seedlings are able to match growth with increasingly unavailable water supplies and out compete non-pioneer species for resources. Currently, river regulation in the Central Valley has created artificially stable hydrological conditions and EWA actions would further exacerbate this trend. Affects to riparian habitat include the loss of point bars and other substrates for seed germination and increased water supply availability during the summer allowing non-pioneer species to compete for resources once only available to pioneer species.

Another consequence of altered hydrological conditions is the presence of amphibian species in river mainstems where they were previously confined to tributaries. Dams, particularly those created for power generation have often reduced flows to such a degree that newly created slow moving water habitats attract frogs such as the foothill yellow-legged frog (FYLF). These frogs lay eggs March through May, and the tadpoles metamorphose three to four months later. Frogs at this stage are highly vulnerable to non-volitional movements because of increased flows. However, a search of the CNDDB and current literature did not reveal any occurrences of species such as the FYLF in the mainstems of the rivers being affected by EWA actions.

The following sections provide detailed timing and flow rate discussions for each river and associated EWA actions. The effects on riparian habitats adjacent to each river and associated wildlife are the same as those just discussed, the only difference being the magnitude of the effect. The conservation measure outlined in Section 6.4.4 will ensure that effects on riparian habitat are avoided or minimized.

Sacramento River

EWA acquisition of Sacramento River contractor water via groundwater substitution and crop idling would change Sacramento River flows downstream from Lake Shasta in April through September. EWA acquisition of up to 120,000 acre-feet of water via groundwater substitution and up to 158,000 acre-feet from crop idling would increase Sacramento River flows by 240 cfs between Lake Shasta and the point of diversion in July. Flows in this reach would decrease 133 cfs and 111 cfs in August and September, respectively. Downstream from the diversion point, flows would increase by 289 cfs, 372 cfs, 429 cfs, 1,940 cfs, 777 cfs, and 157 cfs in April through September, respectively.

This represents a 1 to 11 percent increase in flow and is not considered significant to cause adverse effects.

<u>Feather River</u>
EWA acquisition of Feather River contractor water via groundwater substitution, crop idling, and stored reservoir water would change Feather River flows downstream of Oroville Reservoir from July through September relative to the basis of comparison. Under the Flexible Purchase Alternative, crop idling and groundwater substitution transfers would not affect flow in the lower Feather River from April through June (the hold-back period) because this water would typically have been released from the Thermalito Afterbay directly to the water agencies. Crop idling and groundwater substitution transfers would act in conjunction with Oroville-Wyandotte ID stored reservoir water transfers to increase flows in the lower Feather River from July through September. Long-term average flows in the lower Feather River below Oroville Dam during the March through October growing season would increase 2105 cfs (from 5, 896 cfs to 6,497 cfs) in July, increase 850 cfs (from 4,434 cfs to 4,515 cfs) in August, and increase 149 cfs (from 1,600 cfs to 1,421 cfs) in September compared to the basis of comparison. These changes represent a 36 percent increase in July, a 19 percent increase in August, and a 9 percent increase in September. EWA agencies would monitor the releases to ensure that adverse effects do not occur, and institute changes to quantities of water released through adaptive management processes to avoid or minimize any adverse effect.

<u>Yuba River</u>
EWA acquisition of Yuba County WA water via groundwater substitution would decrease Yuba River flows from the power facility discharge upstream from Englebright Dam to the users' diversion points, typically at Englebright and Daguerre Point Dams, from April to June. Yuba River flows would decrease at most by 239 cfs in late spring as farmers use groundwater for irrigation instead of surface water from New Bullards Bar Reservoir. (A total of 12 to 19 percent reduction in April through June compared to the median flow under the basis of comparison.) EWA agencies would monitor the releases to ensure that adverse effects do not occur, and institute changes to quantities of water released through adaptive management processes to avoid or minimize any adverse effect.

EWA acquisition of Yuba County WA water via stored reservoir water and groundwater substitution would increase Yuba River flows from July through September. EWA agencies acquisition of Yuba County WA stored reservoir water and Yuba River contractor water via groundwater substitution would increase Yuba River flows, downstream of Englebright Dam, from July to September relative to the basis of comparison. Flows would increase at most by 1,005 cfs in July through September, approximately 60 percent above the basis of comparison. While this increase would be a noticeable change, releases would be operated to maintain relatively constant flows during this time period in accordance with existing Yuba County WA operations to protect fish and the environment. This increase in flow would have the potential to increase non-volitional movement of aquatic wildlife that cannot find quieter water to remain in during periods of increase. However, species such as the California red-legged frog and foothill yellow-legged frog are not known to inhabit this reach of the Yuba River. These effects cannot be quantified, but may be considered significant adverse effects if the EWA-related water releases are maintained at significantly higher flows for long periods of time. EWA agencies would monitor the releases to ensure that adverse effects do not occur, and institute changes to quantities of water released through adaptive management processes to avoid or minimize any adverse effect.

American River

EWA acquisition of Placer County WA stored reservoir water would decrease flows in the American River compared to the basis of comparison while the reservoir refills during winter months. During the rainy season after December, Placer County WA would refill its reservoirs, which would decrease the flow that travels downstream of French Meadows, and Hell Hole Reservoirs. These decreases would occur during the winter rainy season, and would not likely have an effect on flow downstream of Folsom Lake.

EWA acquisition of Sacramento Groundwater Authority water via groundwater substitution and Placer County WA stored reservoir water under the Flexible Purchase Alternative would increase flows in the Lower American River compared to basis of comparison from June to December. American River flows would increase from June through December because of increased releases from Folsom Lake because of Sacramento Groundwater Authority groundwater purchase transfers and Placer County WA stored reservoir water. The change in flow is not predicted to adversely affect stream habitat.

Merced and San Joaquin Rivers

EWA acquisition of Merced ID water via groundwater substitution would increase Merced River fall flows relative to the basis of comparison. EWA agency acquisition of Merced ID water via groundwater substitution would increase Merced River flows by a maximum of 210 cfs (from 231 to 441 cfs; 52 percent above the median) below Crocker-Huffman Dam in the fall relative to the basis of comparison as the water is released from Lake McClure. EWA agencies would monitor the releases to ensure that adverse effects do not occur, and institute changes to quantities of water released through adaptive management processes to avoid or minimize any adverse effect.

6.4.4 Conservation Measures

Riverine communities often depend on surface water-groundwater interactions for part or all of their water supply. The following environmental measures would ensure effects on these communities from groundwater substitution actions are avoided or minimized.

- **A Well Adequacy Review.** Before groundwater substitution actions the hydrogeologic conditions of wells used to transfer EWA water will be examined to minimize the potential risk of depleting surface water sources and adversely affecting associated vegetation; and

- **A Monitoring Program.** The Project Agencies will implement a monitoring program that will provide data to determine if direct or indirect effects exist.

6.4.5 Contribution to Recovery

The EWA program would not contribute to the recovery of valley riverine aquatic habitats or associated Covered Species.

6.5 Montane Riverine Aquatic

The Montane Riverine Aquatic Community reflects the water column of flowing streams and rivers above an elevation of approximately 300 feet. This includes associated SRA, pool, riffle, run, and unvegetated channel substrate habitat features, and sloughs, backwaters, and overflow channels hydrologically connected to stream and river channels. Seasonal changes in flows could potentially affect this habitat type. The MSCS conservation goal is to substantially increase extent and quality of the habitat.

6.5.1 Status in the Action Area

The montane riverine aquatic habitat includes the streams and the adjacent riparian corridors (providing shaded riverine aquatic habitat). This habitat has been in decline because of dams, mining, and forestry practices, particularly during the last century.

6.5.2 Effect Assessment Methods

EWA asset acquisition and management actions were considered significant should reductions or increases in stream flows alter stream bank stability, including erosion of stream banks, or should decreases in stream or groundwater water sources supporting aquatic vegetation be interrupted causing the death of riparian vegetation. Reductions in stream flows that alter the quality of habitat (e.g., water temperature) are also considered significant.

6.5.3 Project Effects

The EWA program could affect Montane Riverine Aquatic habitats that are on the same rivers as the Valley Riverine Aquatic habitats, but at higher elevations. Several of the following sections include abbreviated discussions from the Valley Riverine Aquatic habitat evaluation.

<u>Sacramento River</u>
Montane Riverine Aquatic habitat within the EWA action area on the Sacramento River occurs between approximately Red Bluff, CA and Lake Shasta.

EWA acquisition of Sacramento River contractor water via groundwater substitution and crop idling under the Flexible Purchase Alternative would change Sacramento River flows from June through September. The flow changes would be the same as those described in Section 6.4.3 for Valley Riverine Aquatic habitat. The numbers represent a 1 to 11 percent increase in flow. No adverse effect to habitat is predicted due to the low changes in flow.

<u>Feather River</u>
EWA acquisition of Oroville-Wyandotte ID stored reservoir water would increase Feather River flows below Sly Creek and Little Grass Valley Reservoirs to Lake Oroville in November and December. The water released from Little Grass Valley and Sly Creek Reservoirs into Lake Oroville would get diverted through Woodleaf and Forbestown tunnels to run through the corresponding power generation facilities and end up in Ponderosa Reservoir. Transfer water spills from Ponderosa Reservoir directly into Lake Oroville. Because the water transferred from Little Grass Valley and Sly Creek Reservoirs into Lake Oroville would almost entirely bypass the Feather River, there would be no effects on vegetation and wildlife.

EWA acquisition of Oroville-Wyandotte ID stored reservoir water could decrease flows in the South Fork of the Feather River during the winter. Oroville-Wyandotte ID would deliver stored reservoir water for the EWA agencies from October through December, and store it in Lake Oroville until it could be transferred through the Delta during the following summer. During the rainy season after December, Oroville-Wyandotte ID would refill its reservoirs, which would decrease the flow that travels downstream of Sly Creek and Little Grass Valley Reservoirs. The effect is not considered significant because it does not occur during the growing season for vegetation along the river.

<u>Yuba River</u>
Montane Riverine Aquatic habitat occurs on the Yuba River between approximately Timbuctoo Bend and New Bullards Bar Reservoir.

EWA acquisition of Yuba County WA water via stored reservoir water and groundwater substitution would decrease Yuba River flows downstream of New Bullards Bar Reservoir from April to June and increase flows from July through September. The flow changes would be the same as those described in Section 6.4.3 for Valley Riverine Aquatic habitat. The only stretch of the river that includes Montane Riverine Aquatic habitat is from Englebright Dam downstream to Timbuctoo Bend (between Englebright and Daguerre Point Dams). The increases from July through September would noticeably change river flows. The Yuba County WA would operate the system to maintain relatively constant flows during this time period in accordance with existing Yuba County WA operations to protect fish and the environment.

<u>American River</u>
EWA acquisition of Placer County WA stored reservoir water from French Meadows and Hell Hole Reservoirs would increase flows in the Middle Fork of the American River compared to

the basis of comparison downstream from Oxbow Power House to Folsom Lake from June to October. At a maximum, releases would increase flows from June through August relative to the basis of comparison. Median flows downstream from Oxbow Power House (where the reservoirs' power facilities release water into the river) on the Middle Fork are 790, 793, and 776 cfs during June, July, and August, respectively. EWA agencies would monitor the releases to ensure that adverse effects do not occur, and institute changes to quantities of water released through adaptive management processes to avoid or minimize any adverse effect.

EWA acquisition of Placer County WA stored reservoir water would decrease flows in the Middle Fork of the American River compared to the basis of comparison while the reservoir refills during winter months. During the rainy season after December, Placer County WA would refill its reservoirs, which would decrease the flow that travels downstream of Oxbow Power House. These decreases would occur during the winter rainy season, and would likely not substantially decrease flows in the river.

EWA acquisition of Placer County WA stored reservoir water would decrease flows in the Middle Fork of the American River compared to the basis of comparison while the reservoir refills during winter months. During the rainy season after December, Placer County WA would refill its reservoirs, which would decrease the flow that travels downstream of French Meadows, and Hell Hole Reservoirs.

Merced River
Montane Riverine Aquatic habitat occurs on the Merced River between approximately Merced Falls and Lake McClure.

EWA acquisition of Merced ID water via groundwater substitution would decrease Merced River summer flows and increase Merced River fall flows relative to the basis of comparison. Merced ID would hold the EWA transfer water in Lake McClure until the fall, when it would release the water downstream. This pattern would decrease flows downstream of New Exchequer Dam in the summer by a maximum of 70 cfs, but only for the short distance between New Exchequer Dam and Lake McSwain (the typical diversion point). EWA agency acquisition of Merced ID water via groundwater substitution would increase Merced River flows in fall relative to the basis of comparison as the water is released from Lake McClure. EWA agencies would monitor the releases to ensure that adverse effects do not occur, and institute changes to quantities of water released through adaptive management processes to avoid or minimize any adverse effect.

6.5.4 Conservation Measures

The conservation measure listed in Section 6.4.4 also applies to montane riverine aquatic habitat.

6.5.5 Contribution to Recovery

The EWA program would not contribute to the recovery of montane riverine aquatic habitats or associated Covered Species.

6.6 Lacustrine

Lacustrine habitat includes portions of permanent bodies of water that do not support emergent vegetation and that are not subject to tidal exchange, including lakes, ponds, oxbows, gravel pits, and flooded islands (MSCS 2000). Plankton, water willies, duckweed, pondweed, and smartweeds are the dominant vegetation for openwater lacustrine habitats. The majority of the lacustrine communities with the EWA Action Area are man-made reservoirs operated primarily for water supply management and energy production. For most of the reservoirs, water levels vary widely between the winter refill and summer usage seasons. When water levels are low, exposed shorelines (drawdown zones) are a common feature of lacustrine habitats, and include rocky, sandy, or silty substrates. Aside from ruderal species, these areas are usually devoid of vegetation because of the inundation/dessication cycle associated with fluctuating reservoir water levels. A wide variety of birds, mammals, reptiles, and amphibians use lacustrine habitats for reproduction, food, water, and cover.

6.6.1 Status in the Action Area

This ASIP assesses lacustrine communities that the EWA could affect; including the man-made lakes and reservoirs used to acquire or store EWA water assets. Within the Sacramento and San Joaquin River watersheds (that is, upstream of the Delta), the ASIP considered the following on-stream facilities:

- Lake Shasta (Sacramento River);
- Lake Oroville (Feather River);
- Little Grass Valley Reservoir (South Fork Feather River);
- Sly Creek Reservoir (Lost Creek/South Fork Feather River);
- New Bullards Bar Reservoir (North Fork Yuba River);
- French Meadows Reservoir (Middle Fork American River);
- Hell Hole Reservoir (Rubicon River/Middle Fork American River);
- Folsom Lake (American River);
- Lake McClure (Merced River); and
- Lake McSwain (Merced River).

Within the Export Service Area, the following off-stream facilities that may be involved in EWA asset storage or management actions are addressed in this ASIP:

- San Luis Reservoir (Central Valley);
- Andersen Reservoir (Santa Clara Valley);
- Castaic Lake (southern California);
- Lake Perris (southern California);
- Lake Mathews (southern California); and
- Diamond Valley Lake (southern California).

Historically, these reservoirs did not exist. Since the construction of reservoirs for flood protection and water storage, the acreage of artificial lacustrine habitat has increased dramatically, while the acreage of natural lacustrine environments has decreased due agriculture and urbanization. Although the current political climate may make it difficult for new reservoirs, there are plans for expansion of existing reservoirs and possibly new off-river storage facilities that could increase the acreage of lacustrine habitat in the future.

6.6.2 Effect Assessment Methods

Two EWA asset acquisition and management actions raise concerns for effects to lacustrine habitats. First, groundwater substitution that lowered the groundwater table could affect natural lacustrine habitat created by a high groundwater table. Because, the EWA agencies will use a well adequacy review, prior to groundwater substitution actions, that precludes the use of wells with a surface water interaction as a mitigation measure, groundwater to surface water effects are not addressed in this section.

Second, the other concern for EWA actions is the alteration of reservoir levels causing effects to the lacustrine community. Fluctuations in reservoirs levels, in response to day-to-day operations and changes in runoff patterns, can potentially affect vegetation that has been established at or near the water surface and within the drawdown zone. Vegetation that periodically grows within the drawdown zone or near the waters' edge is commonly inundated and lost during prolonged periods of high storage. Alternatively, plants that establish above the waters' edge during periods of high storage may be lost during periods of reduced reservoir storage or drought. Consequently, the vegetation that develops within the drawdown zone of these reservoirs is characterized by weedy, annual plant species, which do not provide high quality wildlife habitat. No Covered Species are known to be associated with vegetation of the drawdown zone of potentially affected reservoirs. Therefore, potential alterations in the timing and magnitude of reservoir drawdown would not likely affect Covered Species.

CVP and SWP Reservoirs (Shasta, Oroville, and Folsom Reservoirs)
The analysis of potential effects on lacustrine habitat associated with CVP and SWP reservoirs utilized the hydrologic modeling results. Appendix B, the Modeling Description, provides a discussion of the hydrologic modeling process and its application to the EWA program analysis, including 1) the primary assumptions and model inputs that represent hydrologic, regulatory, structural and operational conditions; and 2) the model simulations that helped derive effects.

Upstream of Delta Non-Project Reservoirs
Several non-Project reservoirs upstream of the Delta (Little Grass Valley, Sly Creek, New Bullards Bar, French Meadows, Hell Hole, Lake McClure) could sell water to the EWA agencies. Because the CVP and SWP do not manage these non-Project reservoirs, the CALSIM II hydrologic modeling simulations do not reflect these reservoir operations. Appendix B, the Modeling Description, describes the alternative methodology used to calculate changes in monthly operations based on historic water storage data. The effects analysis compares the changes in storage and elevation to the surrounding vegetation to determine if the reservoir changes would affect the lacustrine community.

6.6.3 Project Effects

Comparing EWA actions to the basis of comparison determines project effects. Reservoirs fluctuate seasonally in response to use and hydrology; therefore, this normal fluctuation creates the basis of comparison. EWA actions further modify these fluctuations, sometimes accentuating changes and other times attenuating changes in reservoir levels. Any change in reservoir level that could reduce the extent of riparian vegetation along the shore of the reservoir or populations of species inhabiting the shoreline environment would be significant. Chapter 9 presents the analyses of effects to fish populations inhabiting reservoir being used to store and manage EWA assets.

Sacramento River
EWA acquisition of Sacramento River contractor water via groundwater substitution and crop idling would change the timing of releases from Lake Shasta. Lake Shasta would hold back at most 68,900 acre-feet that would have been released under the basis of comparison. The lake level would decline faster in July and August compared to the basis of comparison; however, end of month elevation in September would be the same as the basis of comparison because of reduced releases during September (EWA EIS/EIR Figure 14-5). Lake Shasta elevation would be 1.1 feet lower in July, 0.5 of a foot lower in August, and equal to the basis of comparison in September. These small changes of less than 0.5 inches per day would not be enough to affect the lacustrine habitat within the lake or surrounding the lake perimeter. The water source for riparian vegetation will not be affected and the upland scrub vegetation surrounding the reservoir does not rely on the reservoir for its water source. Therefore, the change in Lake Shasta water surface elevation is not likely to adversely affect lacustrine habitat used by Covered Species or other wildlife, particularly as wildlife movement corridors or nurseries along the water edge.

Feather River

EWA acquisition of Oroville-Wyandotte ID stored reservoir water would decrease surface water elevations from October until refill for Sly Creek and Little Grass Valley Reservoirs. Little Grass Valley and Sly Creek Reservoirs could release a combined maximum of 15,000 acre-feet of water from October to December (a maximum of 12,000 acre-feet from Little Grass Valley and a maximum of 5,000 acre-feet from Sly Creek Reservoir). Reservoir levels within Little Grass Valley would decrease approximately 12 feet because of the maximum potential release. Reservoir levels within Sly Creek Reservoir would decrease approximately 17 feet because of the maximum potential release. These reductions would not affect shoreline vegetation because this vegetation is not dependent upon reservoir levels for water (the shore-line vegetation is not riparian, it is associated with upland scrub that is not dependent on saturated soil for water). In addition, Sly Creek and Little Grass Valley reservoir water levels fluctuate seasonally and annually; therefore, the drawdown zone is vegetated primarily with non-native herbaceous plants and scattered willow shrubs that do not form a contiguous riparian community and would not be affected by decreases in reservoir levels caused by EWA actions (CALFED 1998). Therefore, the EWA agencies' acquisition of Oroville-Wyandotte ID stored reservoir water is not likely to adversely affect lacustrine habitat of Sly Creek and Little Grass Valley reservoirs used by Covered Species or other wildlife, particularly as wildlife movement corridors or nurseries.

EWA acquisition of Feather River contractor water via crop idling and groundwater substitution would increase the surface water elevation April to June and decrease the surface water elevation in July and August in Lake Oroville compared to the basis of comparison. EWA agencies would acquire 110,000 acre-feet through groundwater substitution and 126,550 acre-feet through crop idling. During April through June, Lake Oroville would hold back water that would have been released under the basis of comparison. By the end of June, the surface water elevation in the reservoir would be, at most, two feet higher than under basis of comparison (EWA EIS/EIR Figure 14-8). Increased releases in July and August as the stored EWA water is released for cross-Delta transfer would cause the lake level to decline faster compared to basis of comparison; however, reduced releases in September would allow end of month elevation in September to be the same as basis of comparison. The increase water surface elevation would result in increased flooding of shoreline habitat. The increased level would come slowly (less than an inch per day) so that wildlife would not be affected and riparian vegetation are accustomed to flooding and will not be adversely affected. Therefore, the change in Lake Oroville water surface elevation is not likely to adversely affect lacustrine habitat used by Covered Species or other wildlife, particularly as wildlife movement corridors or nurseries along the shoreline.

Yuba River

EWA acquisition of Yuba County Water Agency stored reservoir water would decrease surface water elevations July to refill at New Bullards Bar Reservoir. EWA agencies would acquire up to 100,000 acre-feet by the end of September. The release of this water would decrease reservoir surface water levels by approximately 24 feet. This reduction would not affect shoreline vegetation because this vegetation is not dependent upon reservoir levels for water (the shore-line vegetation is not riparian, it is associated with upland scrub that is not dependent on saturated soil for water). In addition, New Bullards Bar Reservoir water levels fluctuate seasonally and annually; therefore, the drawdown zone is vegetated primarily with non-native herbaceous plants and scattered willow shrubs that do not form a contiguous riparian community and would not be affected by decreases in water levels caused by EWA actions (CALFED 1998). Therefore, the EWA agency acquisition of Yuba County Water Agency water is not likely to adversely affect lacustrine habitat of New Bullards Bar Reservoir used by Covered Species or other wildlife, particularly as wildlife movement corridors or nurseries along the shoreline.

The EWA agencies and Yuba County WA could agree to transfer water under a multi-year contract. If full refill occurred, which it has for 85 percent of the past transfers, effects on vegetation and wildlife for subsequent years would be the same as described above. If full refill did not occur, Yuba County WA would consider selling less water the following year.

<u>American River</u>
EWA acquisition of Placer County Water Agency stored reservoir water would decrease surface water elevations June to refill at Hell Hole and/or French Meadows Reservoirs. Hell Hole Reservoir and French Meadows Reservoir would release a combined maximum of 20,000 acre-feet of water. The amount released from each reservoir would be at the discretion of Placer County Water Agency; however, this analysis assumes that releases would be in proportion to the sizes of the reservoirs (61 percent from Hell Hole, the remainder from French Meadows). Releases of reservoir water from French Meadows and Hell Hole could begin as early as June and end as late as October. For the purposes of this analysis, releases were assumed to take place between July and September. Using these assumptions, French Meadows would release 7,800 acre-feet, decreasing water surface levels by approximately eight feet. Hell Hole would release 12,200 acre-feet decreasing water surface levels by 14 feet. These reductions would not affect shoreline vegetation because this vegetation is not dependent upon reservoir levels for water. In addition, French Meadows and Hell Hole Reservoir water levels fluctuate seasonally and annually; therefore, the drawdown zones are vegetated primarily with non-native herbaceous plants and scattered willow shrubs that do not form a contiguous riparian community and would not be affected by decreases in reservoir levels caused by EWA actions (CALFED 1998). Therefore, the EWA agency acquisition of stored reservoir water and the decrease in surface water elevations at French Meadows and Hell Hole Reservoirs is not likely to adversely affect lacustrine habitat used by Covered Species or other wildlife, particularly as wildlife movement corridors or nurseries along the shoreline.

EWA acquisition of Sacramento Groundwater Authority's water via stored groundwater purchase and Placer County WA's water via stored reservoir water would change surface water elevations in Folsom Lake. During July and August, the surface water elevation at Folsom Lake would be 0.8 of a foot lower than the basis of comparison. The lake level would decline faster in July and August compared to the basis of comparison; however, end of month elevation in September would be the same as the basis of comparison because of reduced releases during September (EWA EIS/EIR Figure 14-12). Therefore, the change in Folsom Lake surface water elevations is not likely to adversely affect lacustrine habitat used by Covered Species or other wildlife, particularly as wildlife movement corridors or nurseries.

<u>Merced River</u>
EWA acquisition of Merced ID water via groundwater substitution would increase the water surface elevation in Lake McClure compared to the basis of comparison. EWA agencies could acquire 25,000 acre-feet through groundwater substitution. During April through September, Lake McClure would hold back water that would have been released under the basis of comparison. By the end of September, the surface water elevation in the reservoir would be, at most, three feet higher than under basis of comparison (EWA EIS/EIR Figure 14-13). This increase would occur slowly over the six-month period, less than 0.5 inches per day. The increase would not flood sensitive habitats or nesting areas. Therefore, the change in Lake McClure surface water elevations is not likely to adversely affect lacustrine habitat used by Covered Species or other wildlife, particularly as wildlife movement corridors or nurseries along the shoreline.

Source shifting of Anderson Reservoir would decrease the summer water surface elevation of the reservoirs. EWA agencies could acquire up to 20,000 acre-feet of source shifting capability via agreements with Santa Clara Valley Water District (WD). Source shifting would delay the water amounts that the SWP delivers to the Santa Clara Valley WD, which would cause the Santa Clara Valley WD to draw upon other sources of water in the interim period. The Santa Clara Valley WD would typically draw water from storage within Anderson Reservoir or temporarily reduce diversions to groundwater storage facilities. The water amounts drawn from each source would be at the discretion of Santa Clara Valley WD, but it would operate each facility within normal operating parameters. The levels of Anderson Reservoir currently vary widely year-to-year as part of normal Santa Clara Valley WD operations and EWA source shifting would occur within normal Santa Clara Valley WD operational parameters. Source shifting would not have adverse effects on lacustrine habitat at Anderson Reservoir.

EWA management of Santa Clara Valley WD water via predelivery could increase the surface water elevation in Anderson Reservoir in the months prior to the high point[1] in San Luis Reservoir. With the EWA, water would be transferred from San Luis Reservoir to Anderson Reservoir or groundwater storage facilities prior to the high point in San Luis Reservoir. Although the amount of water within Anderson Reservoir would increase compared to the basis of comparison, it would not exceed the existing drawdown zone (for flood control reasons) and inundate established shoreline habitats. Therefore, the effect on vegetation and wildlife would be less than significant.

Borrowing project water from San Luis Reservoir would decrease surface water elevations. Under basis of comparison, surface water elevations in San Luis Reservoir would begin to decrease in mid-April. At approximately 300,000 acre-feet, the "low-point problem" at San Luis Reservoir occurs, whereby warm-season algae growth and decreasing summer levels can affect the quality of the reservoir water. EWA actions would be managed to prevent contributing to or aggravating the low point problem. (See Figure 2-13, Section 2.4.2.3.2.) Therefore, the effect of borrowing project water on lacustrine habitat would be less than significant.

Source shifting by DWR at Metropolitan WD reservoirs would decrease the summer surface water elevation of the targeted reservoirs. Metropolitan WD has many options for source shifting. These options include:

- **Lake Mathews, Lake Perris, Castaic Lake, and Diamond Valley Lake.** Metropolitan WD could delay delivery of SWP water and instead draw its supplies from these storage facilities; accepting the SWP water deliveries at a later date.
- **Semitropic and Arvin Edison.** During wet years, Metropolitan WD could reduce deliveries when they would have otherwise SWP delivered water to storage. Metropolitan WD could then deliver SWP water to Semitropic and Arvin Edison for storage at a later date.
- **Hayfield (upstream aqueduct groundwater storage on the Colorado River).** Metropolitan WD could delay delivery of Colorado River water to Hayfield; the water would be delivered at a later date.
- **Change blend.** Metropolitan WD generally maximizes water sources and quality by blending Colorado River and SWP water 50:50. Metropolitan WD could change the blend to provide water for source shifting.

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1 High point is the value at which storage has peaked annually. In San Luis Reservoir, high point occurs approximately in mid-April.

Lake Mathews
Because the vegetation surrounding Lake Mathews is not dependent upon reservoir water levels changes to water surface elevations is not likely to adversely affect lacustrine habtiat.

Lake Perris and Castaic Lake
Metropolitan WD has rights to flexible storage in Castaic Lake and Lake Perris allowing the agency to borrow water from the lakes for up to 5 years, subject to DWR approval. The flexible storage in Castaic Lake is 153,940 acre-feet and 65,000 acre–feet in Lake Perris. Metropolitan WD gained these rights as part of the Monterey Amendments[2], signed in 1995, and has exercised the right several times, including in 2001 as part of the source shifting agreement in that year. The amount of water that could be source shifted under the EWA would fall within the recent operating parameters of both Castaic Lake and Lake Perris.

Diamond Valley Lake
Because the vegetation surrounding Lake Mathews is not dependent upon reservoir water levels, changes to water surface elevations is not likely to adversely affect lacustrine habitat.

Metropolitan WD management of EWA water provided as predelivery could increase the surface water elevation in Diamond Valley Lake, Lake Mathews, and other Metropolitan WD storage facilities. If Metropolitan WD were to accept predelivery water and use it to repay its flexible storage debt in Castaic Lake or Lake Perris, predelivery could affect the surface water elevations in those lakes as well. With the EWA, water could be transferred to Metropolitan WD at any of its turnouts and then to storage in Diamond Valley Lake, Lake Mathews, or other Metropolitan WD storage facilities, or used to repay flexible storage in Castaic Lake or Lake Perris. Although the amount of water within these facilities would increase compared to the basis of comparison, water surface elevations would not exceed the existing drawdown zone (for flood control reasons) and inundate shoreline habitats. Therefore, the proposed action is not likely to adversely affect lacustrine habitat.

6.6.4 Conservation Measures

There are no conservation measures proposed for the Lacustrine Habitat Community. EWA actions are not likely to cause adverse effects on lacustrine habitats for the reservoirs and no conservation measures are necessary.

6.6.5 Contribution to Recovery

The EWA program would not contribute to the recovery of lacustrine habitats or associated Covered Species.

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2 The Monterey Agreement, signed in 1994 by DWR and SWP water contractors, addresses water supply reliability problems, provides greater flexibility in water operations, and provides greater financial stability for SWP contractors.

6.7 Saline Emergent

Saline emergent (SE) habitat includes the portions of Suisun Bays and the Delta that support emergent wetland plant species that are tolerant of saline or brackish conditions within the intertidal zone or on lands that historically were subject to tidal exchange (diked wetlands) (MSCS 2000). The dominant vegetation for saline emergent habitats include cordgrass, pickleweed, and bulrush, glasswort, saltwort, saltgrass, arrowgrass, seablite, hairgrass, cattail, and algae. Wildlife species that use saline emergent habitats include ducks, herons, egrets, and hawks.

6.7.1 Status in the Action Area

Saline emergent wetlands were once continuous from San Francisco Bay into the western Delta. Saline emergent habitat also is found in low-elevation areas of the Central Valley where salts have accumulated and groundwater is near the surface. Most remnant tidal saline emergent wetlands are narrow bands along the margins of San Pablo Bay and Suisun Marsh and Bay. Extensive relict tidal marshes are associated with Cutoff Slough and eastern Hill Slough flank the Potrero Hills in the north-central Suisun Marsh and are especially unique in that there is a wetland continuum from tidal sloughs through low, middle, and high marsh zones and into adjacent uplands which are rich with associated vernal pools (ERPP 2000, page 133).

Land use changes over the past century have reduced the amount of saline emergent wetland habitat and fragmented what was once nearly contiguous habitat.
In particular, diking of historic wetlands has substantially reduced the amount of tidally influenced saline emergent wetlands. Large areas of nontidal wetlands that were created largely by diking for reclamation are present in the Suisun Marsh and Bay areas (ERPP 2000, page 133).

6.7.2 Effect Assessment Methods

To assess effects to Delta habitats and associated Covered Species, long-term average flows in the Sacramento River at Freeport were evaluated under the proposed action during the March through October growing season and compared to those under the ESA environmental baseline (CCOMWP 1999). The frequency and magnitude of differences in monthly mean flows also were evaluated. In addition, fluctuations in water salinity were assessed by evaluating monthly mean values for X_2 position under the proposed action and compared to X_2 positions under the ESA environmental basis of comparison. If Delta habitats are affected by flow reductions and shifts in X_2 position, then a finding of the potential effects to covered species dependent on these habitats also was determined.

Table 6-2 provides a summary of effect indicators (parameters) and evaluation criteria developed for use in assessing potential adverse effects on the tidal perennial aquatic community and associated covered species that may result from implementation of EWA actions in the Delta. Potential effects on covered fish species associated with this community considered to be adverse if adverse effects were identified for the community. Chapter 4 presents the overall assessment methodology for fish species in the Delta.

Table 6-2. Effect Indicators and Evaluation Criteria for Saline Emergent Community

Saline Emergent Assessment Criteria	
Effect Indicator	Evaluation Criteria
Monthly mean flows (cfs) from March through October.	Decrease in flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect the growth, maintenance, and reproductive capacity of vegetation in the lower Sacramento River and Delta for any month of this period over the 72-year period of record.
Position of X_2.	Upstream shift in the position of X_2, relative to the basis of comparison of sufficient magnitude (greater than 1 km) and frequency to adversely affect the growth, maintenance, and reproductive capacity of vegetation of the Delta for any month of this period over the 72-year period of record.

6.7.3 Project Effects

The following text contains an analysis of potential direct and indirect effects to Delta NCCP communities, including Tidal Perennial Aquatic, Saline Emergent, and Tidal Freshwater Emergent habitats and associated covered species.

EWA acquisitions via groundwater substitution, crop idling, stored reservoir water purchase, stored groundwater purchase, and source shifting change the timing of Delta pumping operations, and have the potential to result in changes to Delta inflows and associated parameters. Potential changes in lower Sacramento River flows can result in changes in the position of X_2. Under the proposed action, long-term average flows in the lower Sacramento River at Freeport would be similar relative to the basis of comparison. Under the proposed action, the long-term average position of X_2 would be maintained through the use of carriage water releases and other EWA asset directed releases controlling X_2, relative to the basis of comparison.

In summary, changes to Delta inflows would not be of sufficient magnitude and frequency to significantly alter existing riparian and wetland habitat dependent of the Delta. Therefore, the proposed action is not likely to adversely affect saline emergent habitat. Under the proposed action, long-term average flows in the lower Sacramento River at Freeport would be similar relative to the basis of comparison. Under the proposed action, the long-term average position of X_2 would be maintained through the use of carriage water releases and other EWA asset directed releases controlling X_2, relative to the basis of comparison.

In summary, changes to Delta inflows would not be of sufficient magnitude and frequency to significantly alter existing riparian and wetland habitat dependent of the Delta. Therefore, the proposed action is not likely to adversely affect covered species associated with riparian and wetland habitats of the Delta.

6.7.4 Conservation Measures

Because there are no adverse effects on saline emergent habitat from EWA actions, no conservation measures are necessary.

6.7.5 Contribution to Recovery

The EWA program is not expected to contribute to the recovery of saline emergent habitat or associated Covered Species.

6.8 Tidal Freshwater Emergent

Tidal freshwater emergent habitat includes portions of the intertidal zones of the Delta that support emergent wetland plant species that are not tolerant of saline or brackish conditions (MSCS 2000). The dominant vegetation for tidal freshwater emergent habitat includes big leaf sedge, bulrush, redroot nutgrass, tules, cattails, common reed, and water grass. The following rivers have developed tidal freshwater emergent habitats. Freshwater emergent wetlands are among the most productive wildlife habitats in California. They provide food, cover, and water for more than 160 species of birds and numerous mammals, reptiles, and amphibians (Kramer 2003).

6.8.1 Status in the Action Area

The functions of the Delta sloughs have been degraded severely over the years. Urban and industrial development has moved into areas adjacent to sloughs, destroying historic riparian habitat. Invasion and spread of non-native plant species, such as water hyacinth, reduced water quality, and reduced freshwater outflows have also historically contributed to degradation. Existing natural sloughs require protection and habitat improvement (ERPP 2000).

Midchannel islands and shoals have been shrinking or disappearing from progressive erosion of the remaining habitat. Major factors contributing to the loss of midchannel islands and shoals are gradual erosion from channels conveying water across the Delta to South Delta pumping plants, boat wakes, and dredging within the Delta or on adjacent waters. The Delta formerly supported broad expanses of tule marshes, riparian forests, and shallow-water habitats. Today, intensive agricultural production on levee-bounded islands has replaced most of these habitats (ERPP 2000).

6.8.2 Effect Assessment Methods

To assess effects to Delta habitats and associated Covered Species, long-term average flows in the Sacramento River at Freeport were evaluated under the proposed action during the March through October growing season and compared to those under the ESA environmental baseline (CCOMWP 1999). The frequency and magnitude of differences in monthly mean flows also were evaluated. In addition, fluctuations in water salinity were assessed by evaluating monthly mean values for X_2 position under the proposed action and compared to X_2 positions under the ESA environmental basis of comparison. If Delta habitats are affected by flow reductions and shifts in X_2

position, then a finding of the potential effects to covered species dependent on these habitats also was determined.

Table 6-3 provides a summary of effect indicators (parameters) and evaluation criteria developed for use in assessing potential adverse effects on the tidal perennial aquatic community and associated covered species that may result from implementation of EWA actions in the Delta. Potential effects on covered fish species associated with this community considered to be adverse if adverse effects were identified for the community. Chapter 4 presents the overall assessment methodology for fish species in the Delta.

Table 6-3. Effect Indicators and Evaluation Criteria for Tidal Freshwater Emergent Community

Tidal Freshwater Emergent Assessment Criteria	
Effect Indicator	Evaluation Criteria
Monthly mean flows (cfs) from March through October.	Decrease in flow, relative to the basis of comparison, of sufficient magnitude and frequency to adversely affect the growth, maintenance, and reproductive capacity of vegetation in the lower Sacramento River and Delta for any month of this period over the 72-year period of record.
Position of X_2.	Upstream shift in the position of X_2, relative to the basis of comparison of sufficient magnitude (greater than 1 km) and frequency to adversely affect the growth, maintenance, and reproductive capacity of vegetation of the Delta for any month of this period over the 72-year period of record.

6.8.3 Project Effects

The following text contains an analysis of potential direct and indirect effects to Delta NCCP communities, including Tidal Perennial Aquatic, Saline Emergent, and Tidal Freshwater Emergent habitats and associated covered species.

EWA acquisitions via groundwater substitution, crop idling, stored reservoir water purchase, stored groundwater purchase, and source shifting change the timing of Delta pumping operations, and have the potential to result in changes to Delta inflows and associated parameters. Potential changes in lower Sacramento River flows can result in changes in the position of X_2. Under the proposed action, long-term average flows in the lower Sacramento River at Freeport would be similar relative to the basis of comparison. Under the proposed action, the long-term average position of X_2 would be maintained through the use of carriage water releases and other EWA asset directed releases controlling X_2, relative to the basis of comparison.

In summary, changes to Delta inflows would not be of sufficient magnitude and frequency to significantly alter existing riparian and wetland habitat dependent of the Delta. Therefore, the proposed action is not likely to adversely affect tidal freshwater emergent habitat. Under the proposed action, long-term average flows in the lower Sacramento River at Freeport would be similar relative to the basis of comparison. Under the proposed action, the long-term average position of X_2 would be maintained through the use of carriage water releases and other EWA asset directed releases controlling X_2, relative to the basis of comparison.

In summary, changes to Delta inflows would not be of sufficient magnitude and frequency to significantly alter existing riparian and wetland habitat dependent of the Delta. Therefore, the proposed action is not likely to adversely affect covered species associated with riparian and wetland habitats of the Delta.

6.8.4 Conservation Measures

Because there are no adverse effects on tidal freshwater permanent emergent habitat from EWA actions, no conservation measures are necessary.

6.8.5 Contribution to Recovery

The EWA program is not expected to contribute to the recovery of tidal freshwater permanent habitat or associated Covered Species.

6.9 Nontidal Freshwater Permanent Emergent

Nontidal freshwater permanent emergent (NFPE) includes permanent (natural and managed) wetlands, including meadows, dominated by wetland plant species that are not tolerant of saline or brackish conditions (MSCS 2000). Vegetation and wildlife for nontidal freshwater permanent emergent habitats are essentially the same as for tidal freshwater emergent habitats. Freshwater emergent wetlands are among the most productive wildlife habitats in California. They provide food, cover, and water for more than 160 species of birds and numerous mammals, reptiles, and amphibians (Kramer 2003).

6.9.1 Status in the Action Area

Over the past 150 years, more than 300,000 acres of fresh emergent wetlands have been lost in the Sacramento-San Joaquin Delta Ecological Management Zone. Less than 15,000 acres remain (ERPP 2000, page 140). Prior to the mid-1800s, extensive areas of fresh emergent habitat occurred throughout the Central Valley, particularly in the Delta. A complex network of rivers, sloughs, and channels connected low islands and basins that supported a diverse and dense variety of freshwater emergent vegetation. This freshwater emergent vegetation supported a diversity of fish and wildlife species and ecological functions (ERPP 2000, page 140).

Vast areas of the Sacramento-San Joaquin Valley were commonly flooded in winter by a slow-moving blanket of silt-laden water. Flood control activities and land settlements in the late 1800s and early 1900s led to the development of leveed Delta islands. Levees and other land uses led to the loss of fresh emergent wetlands in the Delta. Loss of wetlands has substantially reduced habitat for wetland wildlife species in the Bay-Delta system. Fresh emergent wetland losses have also substantially reduced the area available for the biological conversion of nutrients in the Delta. The Delta contains insufficient wetland area to provide adequate levels of nutrient transformation, which results in lower quality water in San Francisco Bay (ERPP 2000, page 140).

6.9.2 Effect Assessment Methods

The methods of assessing effects to the Nontidal Freshwater Permanent Emergent habitat are the same as for the Tidal Freshwater Emergent (Section 6.8.2) with the following exception. Some Nontidal Freshwater Permanent Emergent habitat may be the result of an elevated groundwater table. The lowering of the water table as part of groundwater substitution could affect this habitat. A well adequacy review to preclude groundwater to surface water interactions will occur prior to all groundwater actions to prevent this effect.

6.9.3 Project Effects

No adverse effects are predicted for this habitat within the Delta based on the analyses provided in Section 6.8.3. The well adequacy review will prevent adverse effects to the habitat within the Sacramento and San Joaquin valleys.

6.9.4 Conservation Measures

Wetlands often depend on surface water-groundwater interactions for part or all of their water supply. The following environmental measures would ensure effects on these communities from groundwater substitution actions are avoided or minimized.

- **A Well Adequacy Review.** Before groundwater substitution actions the hydrogeologic conditions of wells used to transfer EWA water will be examined to minimize the potential risk of depleting surface water sources and adversely affecting associated vegetation; and

- **A Monitoring Program.** The Project Agencies will implement a monitoring program that will provide data to determine if direct or indirect effects exist.

6.9.5 Contribution to Recovery

The EWA program is not expected to contribute to the recovery of nontidal freshwater permanent habitat or associated Covered Species.

6.10 Natural Seasonal Wetland

Natural seasonal wetland habitat includes vernal pools and other nonmanaged seasonal wetlands with natural hydrologic conditions that are dominated by herbaceous vegetation and that annually pond surface water or maintain saturated soils at the ground surface for enough of the year to support facultative or obligate wetland plant species. Alkaline and saline seasonal wetlands that were not historically part of a tidal regime are included in natural seasonal wetlands (MSCS 2000). Dominant natural seasonal wetland vegetation includes big leaf sedge, bulrush, and redroot nutgrass. Examples of special-status plant species associated with natural seasonal wetland habitats include Alkali milk-vetch, Crampton's tuctoria, Colusa grass, Bogg's lake hedge-hyssop, legenere, Hoover's spurge, Butte County meadowfoam, Greene's tuctoria, slender orcutt grass, hairy orcutt grass.

6.10.1 Status in the Action Area

Historically, seasonal wetlands occurred throughout the Central Valley. The extent and quality of seasonal wetlands has declined because of cumulative effects of many factors involving agriculture and urban developments, lowering of groundwater tables, land reclamation, and flood control projects. Existing wetland regulations have been in effect for several years in an attempt to prevent the further loss of seasonal wetlands. The protected status of wetlands has resulted in an extensive permitting process for construction in wetland areas. Mitigation measures have been developed to offset loss of existing wetlands as a result of construction activities. These efforts have slowed the rate of wetland loss in many areas. Large-scale efforts in areas such as the Suisun Marsh, Grasslands Resource Conservation District, Yolo Bypass, and Butte Sink have been successful in maintaining and restoring seasonal wetlands (ERPP 2000, page 147).

6.10.2 Effect Assessment Methods

Due to the strong groundwater/surface water interaction that create Natural Seasonal Wetlands, any EWA groundwater substitution action that lowered the groundwater table would be considered to have significant adverse effects on this community. The specific locations in the Sacramento and San Joaquin valleys where groundwater substitution and groundwater purchase could occur are not currently identified and can vary year to year based on EWA water acquisition strategies. Therefore, the effect of the EWA water acquisitions can only be assessed in a qualitative sense. The concern for the two acquisition strategies is that under groundwater pumping (either substitution or purchase) where there is direct connection between groundwater and surface water, that groundwater pumping would affect the hydrology (lower the groundwater table) thereby drying up the natural wetland. As a conservation measure, the EWA agencies will revue all groundwater substitution and acquisition proposals to ensure that there is no direct groundwater to surface water connection for any pumping action. The conservation measure includes a mitigation response (e.g., cease pumping or provide alternative surface water source) should the condition arise that a direct groundwater to surface water interaction has occurred.

6.10.3 Project Effects

EWA acquisition of water via groundwater substitution transfers in the Upstream from the Delta Region could lower groundwater levels. As a part of groundwater substitution transfers, the willing sellers would use groundwater to irrigate crops and decrease use of surface water. Pumping additional groundwater would decrease groundwater levels in the vicinity of the sellers' pumps. Some areas of Natural Seasonal Wetland habitat have groundwater as a source of water, and decreasing groundwater levels could reduce the water base for these habitats.

Chapter 6 of the EWA EIS/EIR, Groundwater Resources, analyzes in detail how groundwater substitution transfers could affect groundwater levels and surrounding beneficial users, including the environment. The section concludes that these effects could be potentially significant, and requires several measures. These measures would require monitoring to identify if any effects are occurring, and implementation of additional measures by the seller if any effects should occur. The additional mitigation steps could be cessation of pumping or use of a replacement water source for the affected area. Because the mitigation involves monitoring and the effect may only be determined after the drying of a habitat is observed, groundwater substitution has the potential for an adverse effect on natural seasonal wetlands. The degree of that effect will be dependent on how soon the effect is noted and the response by the willing seller to mitigate that effect. Implementation of conservation measures in Section 6.10.4 will reduce this effect to a less-than-significant level.

6.10.4 Conservation Measures

The conservation measure listed in Section 6.9.4 also applies to Natural Seasonal Wetlands.

6.10.5 Contribution to Recovery

The EWA program is not expected to contribute to the recovery of natural seasonal wetland habitat or associated Covered Species.

6.11 Managed Seasonal Wetland

Managed seasonal wetland habitat includes wetlands dominated by native or non-native herbaceous plants, excluding croplands farmed for profit (e.g., corn and rice), that land managers flood and drain during specific periods to enhance habitat values for specific wildlife species. Ditches and drains associated with managed seasonal wetlands are included in this habitat type (MSCS 2000). Vegetation and wildlife species associated with managed seasonal wetland habitats are similar to those associated with natural seasonal wetland habitats, with the exception of vernal pool species.

6.11.1 Status in the Action Area

Historically, managed seasonal wetlands did not occur in the Sacramento and San Joaquin valleys. All managed seasonal wetlands now are a result of agricultural practices and the management of water flows for wildlife (waterfowl gun clubs and wildlife refuges). The extent and quality of managed seasonal wetlands varies based on the practices that create and maintain this type of habitat. For the EWA Action Area, this habitat includes all agricultural ditches that support wetland species and return flows used by land managers to support wetlands. The action area includes all locations where crop idling and groundwater substitution can occur in the Sacramento and San Joaquin valleys.

6.11.2 Effect Assessment Methods

The EWA agencies have not identified the specific locations in the Sacramento and San Joaquin valleys where crop idling and groundwater substitution transfers could occur because they can vary year to year based on the location of willing sellers and EWA water acquisition strategies. Therefore, the following section assesses the effect of the EWA water acquisitions in a qualitative sense.

To determine if groundwater substitution transfers affect water in ditches, the analysis qualitatively examines the process that water agencies would use to sell water to the EWA to determine if this process could decrease the water available to managed seasonal wetlands. For crop idling, return flows may decrease if water farmers idle lands that are upstream of managed seasonal wetlands. The analysis qualitatively examines the likelihood that crop idling would reduce flows within agricultural ditches, and compares the locations of ditches with decreased flows to wetlands that receive water from the same sources.

6.11.3 Project Effects

Two EWA water acquisition actions could have adverse effects (dry up) managed seasonal wetlands. These include groundwater substitution and crop idling. Both actions could result in less water in agriculture supply and return flow ditches, potentially resulting in the drying up of managed seasonal wetlands. The specific locations of where EWA agencies would acquire water through groundwater substitution or crop idling are not known. Therefore, this effect can only be addressed in a qualitative sense. Conservation measures (below) would be used as part of water acquisitions to prevent loss of managed seasonal wetlands.

6.11.3.1 Groundwater Substitution Transfers in the Sacramento Valley

Groundwater substitution transfers would decrease flows in agricultural delivery ditches. When water agencies agree to sell water to the EWA agencies through groundwater substitution transfers, the agencies help to identify willing sellers within each area. The sellers then forgo their surface water supplies and substitute groundwater. This change results in less diversion into the agricultural delivery system, which could affect species within the delivery ditches. This decrease is likely to adversely affect the species and vegetation that depend on this flow. The conservation measures in Section 6.11.4 would minimize these effects on species.

6.11.3.2 Crop Idling Transfers

The effects of crop idling transfers on managed seasonal wetlands depend on the location of the transfers. The following section is divided by river system to fully explain these potential effects.

Sacramento River

EWA acquisition of water via crop idling would reduce the water supply for managed seasonal wetlands that rely on return flows from fields that would be idled. Glenn, Colusa, and Yolo Counties could idle up to 47,980 acres. The EWA would purchase approximately 3.3 acre-feet per acre (the amount of water consumed by the crop); however, under the basis of comparison, water agencies divert additional water from the Sacramento River to account for system losses. System losses include conveyance losses (evaporation or percolation within the conveyance system), riparian evapotranspiration (water used by vegetation along the conveyance system), and on-farm losses (deep percolation to groundwater or tailwater runoff). The amount of water diverted varies depending on the amount of system losses.

If farmers idled their crops, their water agency would reduce diversions by the 3.3 acre-feet per acre plus the additional amount that goes to on-farm losses. Of this additional amount that is applied to fields in the basis of comparison, a portion percolates into the groundwater aquifer below and a portion runs off the field back into the conveyance system. This "tailwater" that runs back into the conveyance system could then be used again by managed wetlands downstream on the conveyance system. If farmers idled land, tailwater would no longer be available to downstream users, either other farmers or managed wetlands.

Few managed seasonal wetlands exist downstream of the water agencies that may sell water to the EWA via crop idling. These wetlands, however, have the potential to be adversely affected by the reduction in return flows. The conservation measures in Section 6.11.4 would reduce effects to managed seasonal wetlands.

Feather River

EWA acquisition of water via crop idling would reduce the water supply for managed seasonal wetlands that rely on the return flows from fields that would be idled. Butte and Sutter Counties could idle up to 38, 340 acres. As described above for the Sacramento River, idling these fields would reduce tailwater, which could reduce supplies to downstream wetlands. Several of the agencies within Butte and Sutter Counties discharge return flows from the irrigation systems into Butte Creek, which provides water for several managed seasonal wetlands. The reduction in return flows has the potential to adversely affect these managed seasonal wetlands. The conservation measures in Section 6.9.4 would reduce effects to managed seasonal wetlands.

American River

EWA acquisition of water via crop idling would reduce the water supply for managed seasonal wetlands that rely on return flows from fields that would be idled. Placer County could idle up to 3,280 acres. As described above for the Sacramento River, idling these fields would reduce tailwater, which could reduce supplies to downstream wetlands. The reduction in return flows has the potential to adversely affect managed seasonal wetlands. The conservation measures in Section 6.9.4 would reduce effects to managed seasonal wetlands.

6.11.4 Conservation Measures

The conservation measure listed in Section 6.9.4 also applies to Natural Seasonal Wetlands. Additionally, landowners with managed seasonal wetland communities often depend upon agricultural return flows for part or all of their water supply. The following environmental measure would ensure effects on this wetland community would be avoided or minimized.

- As a part of the contractual agreements, the EWA agencies will require the willing seller of water for crop idling to maintain their drainage systems at a water level that would maintain existing wetlands providing habitat to covered species. As part of monitoring program to ensure compliance with the contractual requirements, EWA agencies will periodically verify that the seller is adhering to the agreement and that no effects are occurring.

6.11.5 Contribution to Recovery

The EWA program would not contribute to the recovery of managed seasonal wetland habitats or associated Covered Species.

6.12 Valley/Foothill Riparian

Valley/foothill riparian habitat includes all successional stages of woody vegetation within the active and historical floodplains of low-gradient reaches of streams and rivers generally below an elevation of 300 feet (MSCS 2000). Valley/Foothill Riparian habitat is dominated by a cottonwood, sycamore, alder, ash, and valley oak tree overstory and a blackberry, poison oak, and wild grape understory. In California over 225 species of birds, mammals, reptiles, and amphibians depend on riparian habitats, and cottonwood-willow riparian areas support more breeding avian species than any other comparable broad California habitat type (Merced River Corridor Restoration Plan 2002 and Sacramento River Advisory Council 2001).

6.12.1 Status in the Action Area

Historically, the Central Valley floor had approximately 922,000 acres of riparian vegetation supported by a watershed of more than 40,000 square miles. Today, approximately 100,000 acres of riparian forest remain. About half of this riparian habitat is in a highly degraded condition, representing a decline of 90 percent. The Sacramento River once supported 500,000 acres of riparian forest; it now supports 10,000 - 15,000 acres, or just 2 - 3 percent of historic levels. From about 1850 to the turn of the century, most of the forest was destroyed for fuel as a result of the Gold Rush and river navigation, and by large-scale agricultural clearing (ERPP 2000, page 152).

Additional clearing in early and mid 1900s coincided with the aftermath of flood control reservoir and levee projects. These projects allowed ongoing clearing of floodplain riparian stands for orchards, crops, flood bypasses, levee construction, and urban areas. Similar patterns occurred along the San Joaquin River, which was also greatly affected when major portions of the river were dried up following construction of Friant Dam and other large reservoirs in the San Joaquin Basin. Resulting major changes in river flow conditions and sediment deposits triggered channel instability, and downcutting of rivers and streams that caused additional riparian and riverine habitat loss and fragmentation (ERPP 2000, page 152).

6.12.2 Effect Assessment Methods

The effect assessment methods for this community are the same as for Valley Riverine Aquatic (Section 6.4.2)

6.12.3 Project Effects

The project effects conclusions for this community are the same as for Valley Riverine Aquatic (Section 6.4.3) EWA actions may be likely to affect, but with the incorporation of the conservation measure in 6.12.4, are not likely to adversely affect Valley Riparian habitat.

6.12.4 Conservation Measures

The conservation measure proposed for Valley Riverine Aquatic habitat (Section 6.4.4) will also apply to Valley/Foothill Riparian.

6.12.5 Contribution to Recovery

The EWA program is not expected to contribute to the recovery of Valley/Foothill Riparian habitat or associated Covered Species.

6.13 Montane Riparian

Montane riparian habitat includes all successional stages of woody vegetation within the active floodplains of moderate-to-high-gradient reaches of streams and rivers generally above an elevation of 300 feet (MSCS 2000). Montane Riparian habitat vegetation is dominated by cottonwood (black and Fremont [at lower altitudes]), white alder, big leaf maple, dogwood, box elder, quaking aspen, wild azalea, water birch, and buttonwillow trees. As with valley/foothill riparian habitat, numerous wildlife species depend on montane riparian habitat.

6.13.1 Status in the Action Area

Montane riparian habitats are found in the Klamath, Coast, and Cascade ranges and in the Sierra Nevada south to about Kern and northern Santa Barbara usually below 8,000 feet. Montane riparian habitat also occurs in the Peninsular and Transverse ranges of southern California from about southern Santa Barbara to San Diego counties. This habitat has been in decline because of dams, mining, and forestry practices, particularly during the last century.

6.13.2 Effect Assessment Methods

The effect assessment methods for this community are the same as for Montane Riverine Aquatic (Section 6.5.2)

6.13.3 Project Effects

The project effects conclusions for this community are the same as for Montane Riverine Aquatic (Section 6.5.3)

6.13.4 Conservation Measures

The conservation measure proposed for Valley Riverine Aquatic habitat (Section 6.4.4) will also apply to Montane Riparian.

6.13.5 Contribution to Recovery

The EWA program is not expected to contribute to the recovery of Montane Riparian habitat or associated Covered Species.

6.14 Upland Cropland

Upland cropland habitat includes agricultural lands farmed for grain field, truck, and other crops for profit that are not seasonally flooded (MSCS 2000). Upland cropland vegetation is dominated by cereal rye, barley, wheat, corn, dry beans, safflower, alfalfa, cotton, tomatoes, lettuce, Bermuda grass, ryegrass, tall fescue, almonds, walnuts, peaches, plums, and grapes. Wildlife use of these areas varies throughout the growing season with crop type, level of disturbance, and available cover. Orchard and vineyard typically support resident species, such as scrub jay, northern mockingbird, yellow-billed magpie, American crow, and northern flicker. During the winter orchard habitats provide foraging habitat and roosting sites for many songbirds species including the white-crowned sparrow, dark-eyed junco, golden-crowned sparrow, lesser goldfinch, and yellow-rumped warbler. Species associated with field and row crops include the red-winged blackbird, European starling, western meadowlark, California vole, black-tailed jackrabbit, western harvest mouse, Botta's pocket gopher, raccoon, striped skunk, and Virginia opossum. Croplands provide foraging habitat for many raptors including the northern harrier, red-tailed hawk, and white-tailed kite. Cotton crops are of limited value to wildlife.

6.14.1 Status in the Action Area

Prior to settlement of the valleys by Europeans, there was no agricultural practice in the valley other than the gathering of native vegetation. Following extensive native habitats loss in the Central Valley to agricultural and urban lands, some wildlife species have adapted to the artificial wetland and upland environments created by some agricultural practices. Once adapted, species became dependent on these agricultural areas to sustain their populations (ERPP 2000, page 176).

6.14.2 Effect Assessment Methods

The effect assessment methods for this community were based on the relative value of a particular crop as wildlife habitat and forage. The EWA agencies propose to purchase water that would have been used to irrigate cotton farmland. This would idle the land resulting in bare fields. Neither the cotton land nor bare field would provide for significant wildlife habitat. Dust suppression plans may involve the use of a substitute crop providing some wildlife value. However, the growing of substitute crops will not be an EWA water acquisition requirement and is thus not factored into the effects analysis. However, given that cotton land provides extremely marginal habitat and forage, no assessment of this habitat was performed.

6.14.3 Project Effects

Given that cotton land provides extremely marginal habitat and forage to wildlife, no adverse effects due to crop idling are predicted.

6.14.4 Conservation Measures

No conservation measures are proposed for this community.

6.14.5 Contribution to Recovery

The EWA program is not expected to contribute to the recovery of Upland Cropland.

6.15 Seasonally Flooded Agricultural Land

Seasonally flooded agricultural (SFA) land habitat includes agricultural lands farmed for profit with grain, rice, field, truck, and other crops that require seasonal flooding for at least 1 week at a time as a management practice (e.g., for pest control and irrigation) or are purposely flooded seasonally to enhance habitat values for specific wildlife species (e.g., ducks for duck clubs). Agricultural ditches and drains associated with maintaining seasonally flooded agricultural land are included in this habitat type (MSCS 2000).

EWA actions include crop idling of rice and cotton. For the purposes of the EWA ASIP, SFA consists of rice land, which landowners flood during the summer months to grow rice as a crop. The farmers then drain the fields in the fall to harvest the rice. Farmers reflood some fields during the winter to decompose the rice stubble and then drain them again in the spring so they can be prepared for growing rice. A number of bird species use the flooded fields for resting (cover), forage, and nesting in the summer and as winter forage and resting habitat for migrating birds. Flooded rice fields also comprise an important habitat for the threatened giant garter snake.

6.15.1 Status in the Action Area

For the EWA Action Area, the EWA agencies may purchase water from crop idling of rice fields in the Sacramento Valley (Butte, Colusa, Glenn, Placer, Sutter, and Yolo counties). These counties typically harvest a total of 496,820 acres of rice (USDA, 1997), although farmers would idle only a fraction of this acreage for EWA actions. Historically these areas would most likely have been permanent and seasonal wetlands. Since the cultivation of rice in the Sacramento Valley began, the current acreage of rice grown and harvested fluctuates, but remains relatively high.

6.15.2 Effect Assessment Methods

Potential effects on Covered Species associated with SFA were determined based on an analysis of changes in the amount of habitat and forage provided by rice fields within each county having water agencies that potentially would sell water to EWA agencies.

6.15.2.1 Changes in Habitat Availability

This SFA effects analysis addresses water acquisitions that would result in the maximum potential quantities available from crop idling. The SFA effect analysis includes the following steps:

- Derivation of the acquisition quantity for each county by the evapotranspiration of applied water[3] to determine the amount of idled acreage required to obtain the acquisition amount;
- Comparing the total acreage required for EWA crop idling to the amount in the rice land in the 1997 Agricultural Census data to obtain the change in rice acreage per county; and
- Calculating the absolute and relative change in rice habitat availability using the changes in rice acreage numbers.

The analysis presents change in rice habitat availability both as an absolute quantity (number of acres) and relative value (percent of rice acreage).

6.15.2.2 Changes in Forage Availability

Waste grain remaining after rice harvest serves as a food resource for wildlife species, including the Covered Species associated with rice fields identified in Table 5-2. Consequently, changes in the amount of rice acreage would change the availability of forage for Covered Species associated with rice fields. Each acre of rice provides approximately 300 to 350 pounds per acre (lbs/ac) of waste grain (Brouder and Hill 1995). Although newer technologies used for harvesting generate less waste grain per acre, this analysis uses 350 lbs/acre to provide a conservative estimate for the amount of waste grain lost due to rice idling (Brouder and Hill 1995). This analysis presents the total amount of waste grain lost due to rice idling for each county, and expressed as an absolute quantity (lbs) and relative value (percent of forage provided by rice in the county).

Rice fields also provide approximately 250 lbs/ac of other food (not waste rice grain), which is comprised primarily of invertebrates (Brouder and Hill 1995). This analysis assumed that some plant species (weeds and other plant species that could colonize

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3 The Evapotranspiration of Applied Water (ETAW) represents the amount of applied water that is used by the crop for evapotranspiration. This number is defined in Section 2, Program Description, and is approximately 3.3 acre-feet per acre for rice.

idled fields) and invertebrates would still be available in idled fields, and that crop idling would not substantially reduce this food source. Accordingly, potential effects on other food available to wildlife species were considered to be insignificant and are not further analyzed in this section.

6.15.2.3 Habitat Fragmentation

A decrease in the availability of SFA under the EWA program has the potential to contribute to fragmentation and isolation of wetland habitats within an individual county on a temporary basis. Because the EWA is a program, and the specific fields where idling will occur cannot be predicted and will change from year to year, the degree of fragmentation within a county cannot be quantified. In addition, EWA program crop idling actions are dependent upon hydrologic year type and more than likely will not occur every year. Consequently, this section does not include an analysis of habitat fragmentation and isolation. Potential temporary fragmentation and isolation effects, however, will be avoided through crop idling conservation measures. Specifically, the EWA agencies will minimize crop idling in adjacent fields within each county.

6.15.3 Project Effects

Crop idling would reduce the rice acreage in the Sacramento Valley. Table 6-4 displays seasonally flooded agriculture (SFA) acreage and waste grain reduction for the maximum acreage of crop idling anticipated for all counties where idling action could occur for the EWA program. These numbers reflect the maximum water transfers (for all water programs acquiring water through crop idling) based on the project limitation of 20% maximum crop acreage idled per county. Idling this acreage would reduce the extent of habitat available to those Covered Species dependent upon SFA for some portion of their lifecycle (identified with an * in Table 5-2), which is likely to adversely affect those species. Section 6.15.4 proposes conservation measures to help minimize any adverse effects to Covered Species.

Table 6-4 also displays the reduction in the availability of waste grain as forage to wildlife by county and total for all crop idling actions (depending on agricultural practices). This amount represents a potentially adverse effect to those Covered Species dependent upon waste grain for a large portion of their forage (identified with an * in Table 5-2). Conservation measures proposed in Section 6.14.4 help to minimize any adverse effects to Covered Species.

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[4] The Evapotranspiration of Applied Water (ETAW) represents the amount of applied water that is used by the crop for evapotranspiration. This number is defined in Section 2, Program Description, and is approximately 3.3 acre-feet per acre for rice.

Table 6-4. Seasonally Flooded Agriculture Acreage and Waste Grain Reductions in Each County Based on Crop Idling Maximum Purchases under the Proposed Action

	Rice Acreage (97 Ag Census) (AC)	Idled Acreage (AC)	Percent Rice Acreage (%)	Waste Grain per Acre (lbs)	Total Waste Grain (million lbs)	Waste Grain Loss (million lbs)	Percent Waste Grain Loss (%)	Total Acre-Feet of Water Available for EWA Fish Actions (TAF)	Potential Square Miles Idled
Butte	95,120	19,000	20%	350	33.3	6.6	20%	62.7	30
Colusa	132,338	26,460	20%	350	46.3	9.2	20%	87.3	41
Glenn	83,777	16,750	20%	350	29.3	5.7	20%	55.2	26
Placer	16,379	3,280	20%	350	5.7	1.1	20%	10.8	5
Sutter	96,722	19,340	20%	350	33.9	6.8	20%	63.8	30
Yolo	23,822	4,770	20%	350	8.3	1.7	20%	15.7	7
Total	448,158	89,608	20%	350	156.9	31.1	20	295.7	140

Associated with the idling of SFA is the potential loss of water within adjacent irrigation and return ditches in all 6 counties. EWA water would not enter water agencies' distribution systems because it is no longer being delivered to the agricultural users, and unused flows from the fields would not return to the delivery system. These changes have the potential to reduce flow in these ditches, thereby reducing the value of habitat provided. Some irrigation ditches provide forage, resting, and nesting habitat and serve as migration corridors. Devaluing or losing this habitat could affect giant garter snakes, herons, egrets, western pond turtles, etc. This decrease to water in agricultural ditches is potentially an adverse effect to these Covered Species. Conservation measures proposed in Section 6.2.4 help to minimize any adverse effects to Covered Species.

Associated with the idling of SFA is the potential for fragmentation of seasonally flooded agriculture land habitat. Assuming the maximum acreage is fallowed (20% of rice within each county), a total of 140 square miles of formerly flooded land would be dry in all 6 counties over the late spring, summer, and early fall months. This effect would be significant if it occurred as one contiguous block of SFA. The idled land would have the potential to interfere with wildlife migration and the dispersal of individuals within a metapopulation (hence a loss of genetic diversity). The inability of a snake to migrate to more suitable habitat would potentially be an adverse effect to this Covered Species, especially those populations that are succumbing to other population pressures. Conservation measures proposed in Section 6.2.4 help to minimize any adverse effects to Covered Species.

6.15.4 Conservation Measures

Conservation measures for seasonally flooded agricultural lands are provided for the giant garter snake.

6.15.5 Contribution to Recovery

EWA crop idling of rice land actions are considered to be temporary. Conservation measures will minimize effects on this habitat during the temporary EWA agency water acquisition actions. EWA water acquisition and management actions will not lead to the recovery of species inhabiting seasonally flooded agriculture habitat.

6.16 Anadromous Fish Species Community

The Anadromous fish species addressed in this ASIP are the Sacramento River winter-run Chinook salmon, Central Valley fall-/late-fall-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and Central California Coast steelhead evolutionary significant units (ESUs); and green sturgeon. Associated habitat types for these species are tidal perennial aquatic, valley riverine aquatic, montane riverine aquatic, lacustrine, saline emergent, and tidal freshwater emergent. Seasonal changes in flows and changes in reservoir water surface elevations could potentially affect these fish species. The MSCS conservation goal is to substantially increase extent and quality of populations and habitat.

For the purposes of this ASIP, the anadromous fish community is essentially the fish species addressed in Chapter 4. The reader is referred to that chapter for a discussion on the effect assessment methodology, effects, and conservation measures related to the fish species.

6.17 Estuarine Fish Species Community

Estuarine fish species addressed in this ASIP are the tidewater goby, Delta smelt, longfin smelt, Sacramento splittail, and Sacramento perch. Associated habitat types for these species are tidal perennial aquatic, valley riverine aquatic, lacustrine, saline emergent, and tidal freshwater emergent. Seasonal changes in flows could potentially affect these fish species. The MSCS conservation goal is to substantially increase extent and quality of populations and habitat.

For the purposes of this ASIP, the estuarine fish community is essentially the fish species addressed in Chapter 4. The reader is referred to that chapter for a discussion on the effect assessment methodology, effects, and conservation measures related to the fish species.

Chapter 7
Monitoring, Adaptive Management, and other Disclosures

7.1 Monitoring Program

The EWA program involves acquiring assets through stored reservoir water purchase, groundwater substitution, stored groundwater purchase, and crop idling actions. EWA agencies will manage the assets to maximize benefits to at-risk native fish species, but asset management can change river flows and Delta outflows, and also the amount of seasonal wetlands within agricultural areas. The manner in which EWA agencies apply, acquire, and manage assets will be monitored to ensure that EWA fish benefit objectives are being met while minimizing or avoiding adverse effects to other species and their habitats due to EWA actions. The monitoring program will include both compliance and effectiveness monitoring. Data collected and reviewed under EWA monitoring efforts will be used to support adaptive management decisions that could change how some assets are managed should the overall goals of the EWA program related to fish species, habitats, and terrestrial species not be met. EWA agencies will document compliance with FESA, CESA, and NCCP in the BO's and NCCP Determination prior to implementation of the EWA Proposed Action.

The EWA agencies will complete a Monitoring Plan before implementation of 2004 water purchases. An EWAT Monitoring Subteam will be responsible for implementation of the Monitoring Plan.

7.1.1 Responsibilities

Agency Responsibilities

The responsibilities of each agency may include data collection, analysis, interpretation, findings, and recommendations for changing EWA water asset acquisition and management strategies. The EWA agencies will establish the EWAT Monitoring Subteam who will manage the EWA Monitoring Plan.

EWA agencies will be responsible for including conservation measures in the water purchase contracts with willing sellers as outlined in this document so that the sellers would know their responsibilities in the water transfer action.

Monitoring for compliance with the conservation measures will also be the responsibility of the EWA agencies. The EWA agencies will confirm through field visits and aerial photography that the land idled as part of a fallowing contract action is consistent with the purchase contract. EWA agencies will verify in the field that the willing seller is adhering to conservation measures for maintenance of irrigation ditch habitat and adequate return ditch flows. EWA agencies will seek appropriate remedies if water agencies fail to meet their contractual obligations.

Water Agency/Willing Seller Responsibilities

Water agencies and/or willing sellers may participate in monitoring efforts related to asset management actions involving their facilities or land within their districts. The EWA Monitoring Plan will address the responsibilities and involvement of these parties related to overall EWA monitoring efforts.

7.1.2 Monitoring Plan Development

The initial steps of the monitoring plan development will be the identification of specific data requirements for effects and compliance determination, the identification of existing data collection programs that can provide the data, and the development of new monitoring efforts for locations where monitoring is not currently occurring.

The monitoring plan will address data collection, analysis, and implementation activities necessary to demonstrate EWA effects on aquatic and terrestrial resources. Upon completion of the assessment of existing programs and the identification of new monitoring efforts, the EWA agencies will complete a Monitoring Plan that will include, at least, the following sections:

- Data requirements and the actions necessary to satisfy those data requirements;
- Data assessment methods;
- Compliance and performance measures;
- Monitoring strategy;
- Implementation process and schedule;
- Responsibilities of the EWA agencies and the water agency/willing seller;
- Reporting requirements; and
- Monitoring Plan review and adaptive management processes.

7.1.3 Monitoring Plan Implementation

The EWAT Monitoring Subteam will be responsible for ensuring that all aspects of the Monitoring Plan are implemented.

The EWAT Monitoring Subteam will review and assess monitoring data as necessary to evaluate EWA action effects. The EWAT Monitoring Subteam will assess each proposed EWA action relative to Baseline conditions in making recommendations to the EWAT for any change in asset acquisition and management strategies.

7.1.4 EWA Monitoring Program Review

The EWA monitoring program will be subject to an annual review by peers with knowledge of the Bay-Delta system and its tributaries. This can be accomplished through the CALFED Science Program. The purpose of the review would be to allow for independent evaluation of EWA monitoring efforts that would also allow for the development of independent recommendations regarding future EWA asset management actions. The EWAT Monitoring Subteam will be responsible for incorporating suggested changes into the monitoring studies as provided by the independent review.

7.2 Adaptive Management

The August 28, 2000, CALFED Bay-Delta Program PEIS/EIR and ROD described an EWA as a 4-year program that could be extended by written agreement of the participating agencies. The CALFED science panel will be one of the entities responsible for reviewing the EWA program at the end of the four years. In addition to this review, the CALFED program includes annual conferences and symposia for analyses of population trends and recovery. It is expected that the scientific reviews of EWA actions and effects will provide recommendations for changes both to the EWA and for the ongoing monitoring efforts related to the EWA. Therefore, the expected decision to continue EWA in 2007 would also include the recommended changes.

The EWA agencies, in consultation with other CALFED agencies, may need to amend or modify the Monitoring Plan as information is developed on actions, implementation, and biological monitoring and research. The following elements may change during the four-year life of the EWA Program:

- The EWA program description;
- Implementation status of other CALFED agency actions;
- Species status relative to goals, or other biological information that results from research and monitoring (including new listings and delistings);
- Species found to be affected by CALFED agency actions;
- Exceedance of incidental take allowed in biological opinions; and
- Prescriptions for achieving "R" and "r" species goals.

Changes in these elements may result in reinitiation of consultation on the EWA Program. Conservation measures do not necessarily have to be modified when new information becomes available, but USFWS, NOAA Fisheries, and CDFG, in consultation with the EWA agencies, may do so when necessary and appropriate. If necessary, conservation measures could be amended to include additional avoidance, minimization, and compensation or restoration measures, species or habitat monitoring, or completion of research needed to meet species goals.

7.3 Funding

This document assumes that during the period reviewed (2004-2007), the EWA agencies' water acquisitions and monitoring plan will be funded by the State and federal governments, however, funding is contingent upon the appropriation of funds. The initial acquisition of assets for the EWA actions is being made by federal and State agencies (Reclamation and DWR). In future years it is anticipated that acquisitions of assets may involve participation of third parties.

7.4 Assurances to Landowners

At a minimum, the following assurances will be included in the cooperating landowner commitments:

- Land Use Classification – EWA agencies will not implement EWA actions or associated conservation measures that will change the land use classification of any land where EWA actions may occur.

- Monitoring – Monitoring and site-specific surveys will be carried out in cooperation with the water agency and local landowner.

Additional landowner assurances may be included in each individual cooperating landowner commitment, depending upon site-specific requirements.

7.5 Assessment of Cumulative Effects

The impact analysis performed for the Proposed Action (the Flexible Purchase Alternative) was based on the maximum quantity of water that any agency, including the EWA agencies, could acquire upstream of the Delta via either surface water purchase, crop idling, groundwater substitution, or groundwater purchase. This limitation represents the maximum quantity of water that is likely to be moved through the Delta in any one year. The water acquisition strategy of the EWA agencies is to employ the conservation measures stated in this ASIP and to assess water acquisition efforts of other agencies before committing to water purchases for the current year. Through the use of the conservation measures and water acquisition program assessments, the EWA agencies would avoid any cumulative effect by not making water acquisitions that lead to a significant adverse effect.

The Draft EWA EIS/EIR contains descriptions of the other water acquisition programs and CALFED agency actions included in the cumulative effects analysis. The EWA agencies will work together in a collaborative process to review the water acquisition plans for all water transfer programs to ensure that there are no cumulative effects on MSCS covered fish and terrestrial species or their habitats.

7.6 Other Alternatives Evaluated

The CALFED ROD for the PEIS/EIR identified the EWA as one element of the CALFED Bay-Delta Program. The CALFED Program's primary objective is to restore the Bay-Delta ecosystem and improve water quality and reliability for the state's water users. Developing the alternatives for the CALFED PEIS/EIR involved a lengthy and inclusive public process that identified problems, objectives, actions, strategies, and alternatives, and culminated in a preferred alternative. The process identified 50 categories of actions that would resolve Bay-Delta problems and achieve Program objectives. The categories were drawn from existing literature; participation from CALFED agencies and the Bay Delta Advisory Council; and numerous workshops with stakeholders and the general public. The CALFED ROD for the PEIS/EIR included the EWA as one element in the preferred alternative.

The element of the CALFED ROD that the EWA program is intended to address is the protection and recovery of at-risk native fish species in the Delta through the use of a water acquisition and management strategy that includes no uncompensated water cost to the CVP and SWP water contractors. The strategy involves EWA agencies acquiring water (EWA assets) that can be use to replace project water whose deliveries were curtailed when Delta pumping was reduced to protect fish species. Acquiring of water assets also allows EWA agencies to initiate additional beneficial fish actions without interrupting water supplies.

DWR implemented the EWA in 2001 in accordance with the CALFED ROD and Operating Principles. Reclamation joined in with EWA asset acquisitions in 2002. Because the PEIS/EIR did not address EWA actions fully, an EIS/EIR on the EWA actions – tiered from the PEIS/EIR - was deemed necessary. The preparation of the EWA EIS/EIR allows for reevaluation of actions described in the ROD and of other potential alternatives to the actions described in the ROD.

In addition to the No Action/No Project Alternative, the EWA Draft EIS/EIR evaluates two action alternatives. The first action alternative is a "strict" interpretation of the ROD that could limit the quantities of water EWA agencies could acquire and the second is a "flexible" interpretation of the ROD that could allow greater acquisition and management quantities and potentially more fish benefits. The "strict" interpretation of the ROD has been termed the "Fixed Purchase Alternative" and the "flexible" interpretation the "Flexible Purchase Alternative". Each alternative employs a different acquisition strategy with the Flexible Purchase Alternative allowing for the purchase of greater quantities of water to address fish protection and recovery needs.

As part of development of the alternative details, other actions were assessed in relation to their ability to meet the purpose and need of the EWA program. The development of alternatives presented in the Draft EIS/EIR was an iterative and collaborative process involving representatives from Reclamation, DWR, USFWS, NOAA Fisheries, CDFG, and other CALFED agencies. This interagency team worked together to interpret the CALFED ROD definition of the EWA while fully considering a range of possible EWA alternatives. The purpose and need statement contained in the Draft EWA EIS/EIR formed the basis for the determination and evaluation of alternatives. Because none of the other alternatives could be immediately implemented to address the EWA purpose and need, only the fixed and flexible purchase EWA strategies were subject to detailed effects analyses in the EIS/EIR. Because the EWA agencies have identified the flexible purchase alternative as the preferred alternative, this ASIP addresses the flexible purchase alternative as the proposed action.

Chapter 8
Changed Circumstances

Water transfers such as those being anticipated and implemented for EWA water acquisitions are relatively new concepts for California's overall water management strategies. Reclamation, DWR, and other California water agencies (agriculture and municipal) continue to assess and refine transfer mechanisms and policies necessary to address numerous environmental and social issues related to the transfers. It is expected that as the EWA water transfer program continues to mature over the next 4 years, project implementation will identify effects (adverse and beneficial) currently not anticipated. These effects could adversely affect covered species or their NCCP habitats necessitating changes to the EWA water acquisition/management strategies included in the Proposed Action. At present the magnitude and nature of such changes is not readily predictable due to the lack of long-term data related to transfer programs.

Species and habitat responses to water asset management actions will be documented through monitoring and adaptive management activities (see Section 7). This documentation will allow USFWS, NOAA Fisheries, and CDFG, in consultation with other CALFED agencies, to determine whether NCCP community and covered species goals and prescriptions should be modified. If a given species or suite of species responds well to EWA asset management actions, priority of management activities may be shifted to other species or habitats, and/or species or habitat prescriptions may be subject to modification.

Chapter 9
Effects Determination Conclusion

9.1. Species

The purpose of this ASIP is to review the proposed Environmental Water Account in sufficient detail to determine to what extent the Proposed Action may affect any threatened, endangered, proposed, or sensitive species within the project area. This section summarizes the environmental setting, analysis, and effects determination presented in Chapters 3 and 4.

9.1.1 Summary of Effects

9.1.1.1 Federal Covered Species

The Proposed Action may affect but is not likely to adversely affect seven federally listed species through direct and indirect effects (see Table 9-1).

The Bay-Delta and its tributaries provide habitat for several special-status anadromous and estuarine fish species. Effect indicators such as water temperature and flows were used to evaluate if the Proposed Action would have an adverse effect on the species' habitat and range. Changes in river flows and water temperatures during certain periods of the year could potentially affect spawning, fry emergence, and juvenile emigration. Delta outflow, X_2 location, E:I ratio, and frequency and magnitude of reverse flows (QWEST) are indicators of fishery habitat quality and availability within the Delta. Habitat conditions within the Delta are important to fish and macroinvertebrates year-round, as many of the species spawn and utilize the estuary as larval and juvenile rearing habitat and/or as a migratory corridor.

Central Valley Fall-run/Late-fall-run Chinook Salmon

Flow reductions in the Sacramento, lower Feather, Yuba, lower American, Merced, and San Joaquin Rivers would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction of immigrating adults, spawning, egg incubation, and initial rearing, juvenile rearing, or juvenile emigration. Flow increases in the Sacramento, lower Feather, Yuba, and lower American Rivers would not be of sufficient magnitude to beneficially or adversely affect attraction of immigrating adults or downstream passage of emigrating juveniles. Although flow increases in the Merced and San Joaquin Rivers in the fall would beneficially affect adult immigration and the availability of spawning habitat, changes in the flow pattern may raise the potential for redd dewatering. Potential reductions of agricultural return flows in Butte Creek would occur outside of the adult immigration or juvenile emigration time periods and downstream of spawning habitat, therefore neither beneficial nor adverse effects on fall-run Chinook salmon in Butte Creek are anticipated.

Changes in water temperature in the Sacramento, lower Feather, Yuba, lower American, Merced, and San Joaquin Rivers would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for adult immigration, spawning, egg incubation, and initial rearing, or juvenile rearing and emigration. However, there would be isolated occurrences when monthly mean water temperatures could be above the suitable range of temperatures for juvenile rearing and emigration (65˚F) with the Proposed Action, relative to the basis of comparison.

In the Sacramento River, long-term average annual early lifestage survival of Central Valley fall-run Chinook salmon would be 91.2 percent under the basis of comparison and 91.1 percent with the Proposed Action. In the lower American River, long-term average annual early lifestage survival of fall-run Chinook salmon would be 90.6 percent under the basis of comparison and 90.5 percent with the Proposed Action. No change in Central Valley late-fall-run Chinook salmon long-term average annual early lifestage survival in the Sacramento River would occur with the Proposed Action, relative to the basis of comparison.

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift, relative to the basis of comparison, under both the Maximum and Typical Water Purchase Scenarios. The monthly mean E/I ratio would be identical to or less than (a reduced proportion of exports, relative to inflow) the E/I ratio under the basis of comparison in all of the months simulated for the February through June period, under both the Maximum and Typical Water Purchase Scenarios. (The relaxation of the E/I ratio is a discretionary action, taken as appropriate.) Implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenario would provide a benefit to reverse flows, relative to the basis of comparison, by decreasing the frequency of reverse flows and reducing the magnitude when reverse flows would still occur. Overall, such changes would be a benefit to juvenile salmonid emigration and the transport of planktonic eggs and larvae.

Annual salvage estimates exhibit a decrease in all 15 years simulated under both the Maximum and Typical Water Purchase Scenarios. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 1,123,826 Chinook salmon, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 895,433 Chinook salmon, relative to the basis of comparison. Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in Chinook salmon salvage in July through September under both the Maximum and Typical Water Purchase Scenarios. Therefore, EWA action may affect, but are not likely to adversely affect fall-run/late-fall-run Chinook salmon.

Sacramento River Winter-run Chinook Salmon

Flow reductions on the Sacramento River would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction of immigrating adults, maintenance of sufficient flows for spawning, egg incubation, and initial rearing, or juvenile rearing and emigration. Flow increases would not be of sufficient magnitude to beneficially or adversely affect attraction of immigrating adults or downstream passage of emigrating juveniles. Flows on the Sacramento River would not be reduced below the NOAA Fisheries winter-run Chinook Salmon BO flow criterion more frequently with the Proposed Action, relative to the basis of comparison.

Changes in water temperature in the Sacramento River would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for adult immigration and holding, spawning, egg incubation, and initial rearing, or juvenile rearing and emigration. Sacramento River water temperatures would not exceed the NOAA Fisheries winter-run Chinook Salmon BO temperature criterion more frequently with the Proposed Action, relative to the basis of comparison.

No change in long-term average annual early lifestage survival in the Sacramento River would occur with implementation of the Proposed Action.

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift and the monthly mean E/I ratio would be identical to or less, relative to the basis of comparison, under both the Maximum and Typical Water Purchase Scenarios. Implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios would decrease the frequency and magnitude of reverse flows, relative to the basis of comparison. Overall, such changes would be considered a benefit to juvenile salmonid emigration and the transport of planktonic eggs and larvae.

Annual salvage estimates exhibit a decrease in all 15 years simulated under both the Maximum and Typical Water Purchase Scenarios. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 1,123,826 Chinook salmon, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 895,433 Chinook salmon, relative to the basis of comparison. Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in Chinook salmon salvage under both the Maximum and Typical Water Purchase Scenarios. Therefore, EWA action may affect, but are not likely to adversely affect winter-run Chinook salmon.

Central Valley Spring-run Chinook Salmon

Flow reductions and increases in the Sacramento, lower Feather, and lower Yuba Rivers would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction and holding of immigrating adults, spawning, egg incubation, and initial rearing, and juvenile rearing or emigration. Potential reductions of agricultural return flows in Butte Creek would occur outside of the adult immigration or juvenile emigration time periods and downstream of spawning habitat, therefore neither beneficial nor adverse effects on spring-run Chinook salmon in Butte Creek are anticipated.

Changes in water temperature in the Sacramento, lower Feather, and lower Yuba Rivers would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for adult immigration and holding, spawning, egg incubation, and initial rearing, or juvenile rearing and emigration.

Long-term average annual early lifestage survival in the Sacramento River would be 87.5 percent under the basis of comparison and 87.4 percent with the Proposed Action.

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift and the monthly mean E/I ratio would be identical to or less, relative to the basis of comparison, under both the Maximum and Typical Water Purchase Scenarios. Implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios would decrease the frequency and magnitude of reverse flows, relative to the basis of comparison. Overall, such changes are likely to benefit juvenile salmonid emigration and the transport of planktonic eggs and larvae.

Annual salvage estimates would decrease in all 15 years simulated under both the Maximum and Typical Water Purchase Scenarios. Average annual salvage estimates under the Maximum Water Purchase Scenario would decrease by 1,123,826 Chinook salmon, relative to the basis of comparison. Average annual salvage estimates under the Typical Water Purchase Scenario would decrease by 895,433 Chinook salmon, relative to the basis of comparison. Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in Chinook salmon salvage in July through September under both the Maximum and Typical Water Purchase Scenarios.

Therefore, EWA action may affect, but are not likely to adversely affect spring-run Chinook salmon.

Central Valley Steelhead

Flow reductions and increases in the Sacramento, lower Feather, Yuba, lower American, and San Joaquin Rivers would not be of sufficient frequency or magnitude to beneficially or adversely affect attraction of immigrating adults, spawning, egg incubation, and initial rearing, juvenile over-summer and fall/winter rearing, or juvenile emigration. Potential reductions of agricultural return flows in Butte Creek would occur outside the adult immigration or juvenile emigration time periods and downstream of spawning habitat, therefore neither beneficial nor adverse effects on steelhead in Butte Creek are anticipated.

Changes in water temperature in the Sacramento, lower Feather, Yuba, lower American, and San Joaquin Rivers would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for spawning, incubation, and initial rearing, or juvenile rearing and emigration. However, there would be isolated occurrences when mean monthly water temperatures would be above the suitable range of temperatures for juvenile rearing and emigration (65ºF) and egg incubation (56ºF) with the Proposed Action, relative to the basis of comparison.

Based on the late-fall run Chinook salmon survival analysis for the Sacramento River, there would be no change in long-term average annual early lifestage survival in the Sacramento River with the Proposed Action, relative to the basis of comparison.

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift and the monthly mean E/I ratio would be identical to or less, relative to the basis of comparison, under both the Maximum and Typical Water Purchase Scenarios. Implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios would decrease the frequency and magnitude of reverse flows, relative to the basis of comparison. Overall, such changes are likely to benefit juvenile salmonid emigration and the transport of planktonic eggs and larvae.

Annual steelhead salvage estimates exhibit a decrease in all 15 years simulated under both the Maximum and Typical Water Purchase Scenarios. Average annual salvage estimates would decrease by 28,928 and 20,386 steelhead under the Maximum and Typical Water Purchase Scenarios, respectively, relative to the basis of comparison. Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in steelhead salvage in July under both the Maximum and Typical Water Purchase Scenarios.

Therefore, EWA action may affect, but are not likely to adversely affect Central Valley steelhead.

Delta Smelt

Changes in San Joaquin River flows would not occur during the spawning period with the Proposed Action, relative to the basis of comparison, therefore there would be no beneficial or adverse affects on delta smelt spawning and initial rearing.

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift and the monthly mean E/I ratio would be identical to or less, relative to the basis of comparison, under both the Maximum and Typical Water Purchase Scenarios. Implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios would provide a benefit to reverse flows, by decreasing the frequency and magnitude of reverse flows, relative to the basis of comparison. Overall, such changes would be likely to benefit juvenile salmonid emigration and the transport of planktonic eggs and larvae.

Annual salvage estimates exhibit a decrease in 14 of the 15 years simulated under the Maximum Water Purchase Scenario, with an overall estimated decrease of 135,887 delta smelt. Under the Typical Water Purchase Scenario, annual salvage estimates exhibit a decrease in all 15 years, with an overall estimated decrease of 93,690 delta smelt. Although annual salvage estimates decrease, there would be isolated occurrences of monthly increases in delta smelt salvage in July through September under both the Maximum and Typical Water Purchase Scenarios.

Therefore, EWA action may affect, but are not likely to adversely affect Delta smelt.

Sacramento Splittail

Changes in flows on the Sacramento, lower Feather, lower American, and San Joaquin Rivers would not be of sufficient frequency or magnitude to adversely affect the availability of inundated habitat for spawning. Potential reductions of agricultural return flows in Butte Creek would occur after the cessation of splittail spawning, therefore neither beneficial nor adverse effects on splittail spawning in Butte Creek are anticipated.

Changes in water temperature on the Sacramento, lower Feather, lower American, and San Joaquin Rivers would not be of sufficient frequency or magnitude to result in water temperatures above the upper end of the suitable range of temperatures required for spawning (68ºF).

With implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios, long-term average Delta outflow would increase, relative to the basis of comparison, and monthly mean flows would be essentially equivalent to or greater than flows under the basis of comparison. The monthly mean position of X_2 would move downstream or would not shift and the monthly mean E/I ratio would be identical to or less, relative to the basis of comparison, under both the Maximum and Typical Water Purchase Scenarios. Implementation of the Proposed Action under both the Maximum and Typical Water Purchase Scenarios would decrease the frequency and magnitude of reverse flows, relative to the basis of comparison. Overall, such changes would be likely to benefit juvenile salmonid emigration and the transport of planktonic eggs and larvae.

Annual salvage estimates exhibit a decrease in 14 of the 15 years simulated under the Maximum Water Purchase Scenario, with an overall estimated decrease of 1,014,290 splittail. Under the Typical Water Purchase Scenario, annual salvage estimates exhibit a decrease in all 15 years, with an overall estimated decrease of 656,597 splittail. Although annual salvage estimates decrease in all but one year, there would be isolated occurrences of monthly increases in delta smelt salvage in July through September under both the Maximum and Typical Water Purchase Scenarios.

Therefore, EWA action may affect, but are not likely to adversely affect Sacramento splittail.

Aleutian Canada Goose

During the winter, the Aleutian Canada goose forages on post-harvest wastegrain, among other items, in the Sacramento Valley. The EWA proposed action would reduce the overall amount of rice wastegrain forage available in the Sacramento Valley by 31 million pounds (Chapter 10 Section 10.2.6.1.7). However, because the goose's diet consists of a wide variety of marsh vegetation, algae, grass and sedge seeds, grain, berries, insects, and other terrestrial invertebrates (McCullough 2000) and the fact that these food sources are readily available throughout the wintering range of the goose, the loss of rice wastegrain is not considered an adverse affect. Crop idling actions taken by EWA agencies may affect but are not likely to adversely affect the Aleutian Canada goose.

Giant Garter Snake

In some portions of the Sacramento Valley, the giant garter snake is highly dependent upon rice fields for the majority of its habitat requirements. Idling of rice croplands would temporarily reduce the amount of resting, feeding, escape cover, and migratory habitat available to the giant garter snake in the Sacramento Valley. Conservation measures (Section 4.19.4) were developed to help avoid or minimize effects to the giant garter snake and include annual appendages to the EWA biological opinion for rice idling activities. The USFWS and CDFG will also assess rice idling proposals within the context of progress being made toward implementing the ERP giant garter snake conservation strategy. With these measures, crop idling actions may affect but are not likely to adversely affect giant garter snake populations.

9.1.1.2 State Covered Species

Direct and indirect effects of the Proposed Action may affect but are not likely to adversely affect the 16 State species covered in this document (see Table 9-1). Several of these state listed species such as the Chinook salmon are already discussed above in Section 9.1.1.1.

Green Sturgeon

The analysis of potential effects on Chinook salmon is considered a conservative (high) estimate of potential effects on green sturgeon. Because EWA actions may affect, but are not likely to adversely affect Chinook salmon, EWA actions may affect, but are not likely to adversely affect green sturgeon.

Black Tern

The black tern uses rice fields, primarily in Glenn and Colusa Counties in the Action Area for both nesting and foraging. Idling of rice crops would temporarily reduce the amount of this habitat available to the black tern during the summer breeding season. This may affect both nesting and foraging for the black tern. Conservation measures (Section 4.10.4) will help to avoid or minimize effects from the loss of nesting and foraging habitat on black terns. The EWA program may affect but is not likely to adversely affect the black tern.

Black-crowned Night Heron

The black-crowned night heron forages along irrigation canals and other waterways associated with rice crops throughout the Sacramento Valley. The acquisition of water from crop idling would potentially dry up irrigation and drainage ditches associated with rice crops. The lack of foraging habitat, particularly near rookeries during the breeding season, could potentially affect black-crowned night heron breeding efforts. However, conservation measures developed for the giant garter snake such as maintaining ditch aquatic habitat and minimizing the block size for idled riceland (Section 4.19.4) will avoid or minimize effects from the loss of foraging habitat on black-crowned night herons by keeping a prey base available and within a reasonable flight distance even during idling actions. The EWA program may affect but is not likely to adversely affect the black-crowned night heron.

Great Blue Heron

The great blue heron forages along irrigation canals and other waterways associated with rice crops throughout the Sacramento Valley. The acquisition of water from crop idling would potentially dry up irrigation and drainage ditches associated with rice crops. The lack of foraging habitat, particularly near rookeries during the breeding season, could potentially affect great blue herons. However, conservation measures developed for the giant garter snake such as maintaining ditch aquatic habitat and minimizing the block size for idled riceland (Section 4.19.4) will avoid or minimize effects from the loss of foraging habitat on great blue herons by keeping a prey base available and within a reasonable flight distance even during idling actions. The EWA program may affect but is not likely to adversely affect the great blue heron.

Great Egret

The great egret has similar life history requirements as the great blue heron. As such the great egret would be affected by EWA actions in the same manner. Conservation measures developed for the giant garter snake such as maintaining ditch aquatic habitat and minimizing the block size for idled riceland (Section 4.19.4) will avoid or minimize effects from the loss of foraging habitat on great egrets by keeping a prey base available and within a reasonable flight distance even during idling actions. The EWA program may affect but is not likely to adversely affect the great egret.

Greater Sandhill Crane
During the winter, the greater sandhill crane forages on waste grain remaining in fields following the harvesting of the rice crop, particularly in the Butte Basin. EWA actions would acquire water from idled rice croplands over the summer. The following winter, because of the lack of a rice crop, there would be no post-harvest rice waste grain on idled rice fields. This would reduce the overall amount of waste grain forage available in the Sacramento Valley. In the Butte Basin area the greater sandhill crane is often dependent on rice waste grain. Conservation measures have been developed to avoid or minimize the effects of this loss of forage on the greater sandhill crane. The Proposed Action may affect, but is not likely to adversely affect the crane.

Long-billed Curlew
The Long-billed Curlew uses rice fields to forage for invertebrates during the winter. EWA would acquire water from idled rice croplands in the summer, temporarily reducing the overall amount of rice cropland available in the Sacramento Valley. The following winter, rice farmers would more than likely refrain from flooding their fields because of the lack of rice stubble to decompose. However, winter rains often provide sufficient water to promote the growth of invertebrates in croplands. Therefore, EWA actions may affect but are not likely to adversely affect the long-billed curlew.

Snowy Egret
The snowy egret has similar life history requirements as the great blue heron and great egret and would be affected by EWA actions in the same manner. Conservation measures such as maintaining ditch aquatic habitat and minimizing the block size for idled riceland (Section 4.19.4) developed for the giant garter snake will avoid or minimize effects from the loss of foraging habitat on snowy egrets by keeping a prey base available and within a reasonable flight distance even during idling actions. Therefore, EWA actions may affect but are not likely to adversely affect the snowy egret.

Tricolored Blackbird
The tricolored blackbird forages on rice grain along with insects, and often breeds in areas adjacent to rice fields. EWA acquisition of water through crop idling actions would temporarily reduce the amount of rice and insects available for blackbirds during its summer nesting season. The EWA proposed action would reduce the overall amount of forage habitat available in the Sacramento Valley. However, tricolored blackbirds often move from location to location and can relocate during the nesting season trying to take advantage of optimal habitat conditions. Also, conservation measures developed for the giant garters snake (Section 4.19.4) will help to avoid or minimize effects on tricolored blackbird foraging habitat. Therefore, EWA actions may affect but are not likely to adversely affect the tricolored blackbird.

White-faced Ibis

The white-faced ibis uses rice fields to forage for invertebrates during the winter. EWA would acquire water from idled rice croplands in the summer, temporarily reducing the overall amount of rice cropland available in the Sacramento Valley. The following winter, rice farmers would more than likely refrain from flooding their fields because of the lack of rice stubble to decompose. However, winter rains often provide sufficient water to promote the growth of invertebrates in croplands and the seller would be encouraged to continue flooding idled rice fields during the winter. Therefore, EWA actions may affect but are not likely to adversely affect the white-faced ibis.

Western Pond Turtle

The western pond turtle uses irrigation and drainage ditches adjacent to rice fields for resting and foraging habitat. The idling of rice croplands would mean the loss of irrigation and agricultural return flows within these ditches possibly adversely affecting the western pond turtle. Conservation measures (Section 4.20.4) were developed to ensure that the Proposed Action, although it may be likely to affect, would not adversely affect the western pond turtle.

Table 9-1: Direct and Indirect Effects Analysis of Special-Status Species Within the Action Area.

			Effects Analysis				
			Species				**Critical Habitat/EFH**
Common Name	**Scientific Name**	**Status**	**No Effect**	**May Affect, Not Likely to Adversely Affect**	**May Affect, Likely to Adversely Affect**	**Beneficial Effect**	**May Adversely Modify**
Central Valley Fall/Late-Fall Run Chinook Salmon	*Oncorhynchus tshawytscha*	C, CSC		X			
Sacramento River Winter Run Chinook Salmon	*Oncorhynchus tshawytscha*	E, CE		X			
Central Valley Spring-Run Chinook Salmon	*Oncorhynchus tshawytscha*	T, CT		X			
Central Valley Steelhead	*Oncorhynchus mykiss*	T		X			
Delta Smelt	*Hypomesus transpacificus*	T, CT		X			
Sacramento Splittail	*Pogonichthys macrolepidotus*	T, CT		X			
Green Sturgeon	*Acipsenser medirostis*	CSC		X			

Table 9-1: Direct and Indirect Effects Analysis of Special-Status Species Within the Action Area.

			Effects Analysis				
			Species				Critical Habitat/EFH
Common Name	Scientific Name	Status	No Effect	May Affect, Not Likely to Adversely Affect	May Affect, Likely to Adversely Affect	Beneficial Effect	May Adversely Modify
Aleutian Canada Goose	*Branta canadensis leucopareia*	Delisted		X			
Black Tern	*Chlidonias niger*	CSC		X			
Black-crowned Night Heron	*Nycticorax nycticorax*	CS		X			
Great Blue Heron	*Ardea herodias*	CS		X			
Great Egret	*Casmerodius albus*	CS		X			
Greater Sandhill Crane	*Grus canadensis tabida*	CT/FP		X			
Long-billed Curlew	*Numenius americanus*	CSC		X			
Snowy Egret	*Egretta thula*	CS		X			
Tricolored Blackbird	*Agelaius tricolor*	CSC		X			
White-faced Ibis	*Plegadis chihi*	CSC		X			
Giant Garter Snake	*Thamnophis gigas*	T, CT		X			
Western Pond Turtle	*Clemmys marmorata*	CSC		X			

C= candidate species
CSC = California species of Special Concern
E= Endangered Species
CE = California Endangered Species
T = Threatened Species
CT = California Threatened Species
FP = California fully protected species
CS = California Sensitive Species

9.2 NCCP Communities

This section summarizes the environmental setting, analysis, and effects determination presented in Chapters 5 and 6.

NCCP communities that may be affected by EWA actions include Valley/Foothill Riverine, Montane Riverine, Valley/Foothill Riparian, Montane Riparian, Nontidal Freshwater Permanent Emergent Natural Seasonal Wetland, Managed Seasonal Wetland, and Seasonally Flooded Agriculture. Effects include the change in timing and amount of river flows, potentially altering riverine aquatic habitat and exacerbating effects caused by human-induced hydrologic changes on riparian habitats. Effects also include the potential loss of water sources for wetland habitats through crop idling and groundwater substitution actions, and the loss of seasonally flooded agriculture habitat through crop idling. Affecting these communities may affect several special-status species; therefore, conservation measures have been developed and are outlined in Section 2.5.3.5 to avoid or minimize effects on these communities and their associated special-status species.

Chapter 10
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Environmental Water Account

VOLUME III

Draft Environmental Impact Statement Environmental Impact Report

Appendix J - Action Specific Implementation Plan

July 2003

VOLUME III

Environmental Water Account

Draft Environmental Impact Statement
Environmental Impact Report
Appendix J
Action Specific Implementation Plan

NOAA Fisheries
National Marine Fisheries Service

July 2003

Environmental Water Account ASIP
GLOSSARY OF TECHNICAL TERMS

Term	Definition
acre-foot (AF)	The volume of water that would cover 1 acre to a depth of 1 foot, or 325,851 gallons of water. On average, 1 acre-foot could supply one to two households with water for a year. A flow of 1 cubic foot per second for a day is approximately 2 acre-feet.
action	A structure, operating criteria, program, regulation, policy, or restoration activity that is intended to address a problem or resolve a conflict in the Bay-Delta system.
action area	All areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. [50 CFR 402.02(d)]
adequately conserved	To use, and the use of, conservation methods and procedures that are adequate to protect and perpetuate a species of fish, plant, or wildlife within the Focus Area, taking into consideration the whole of CALFED, including the direct and indirect effects of CALFED actions.
alternative	A collection of actions or action categories assembled to provide a comprehensive solution to problems in the Bay-Delta system.
anadromous fish	Fish that spend a part of their life cycle in the sea and return to freshwater streams to spawn.
applicant	Any person (an individual, corporation, partnership, trust, association or any other private entity; or any officer, employee, agent, department, or instrumentality of the Federal Government, of any State, municipality, or political subdivision of a State, or of any foreign government; any State, municipality, or political subdivision of a State; or any other entity subject to the jurisdiction of the United States) [ESA 3(12) who requires formal approval or authorization from a Federal agency as a prerequisite to conducting the action. [50 CFR 402.02].
(b)(2) water	Statutory mandate to manage the water dedicated to fish and wildlife purposes pursuant to Section 3406 (b)(2) of the Central Valley Project Improvement Act.

Term	Definition
Basis of Comparison	For the purposes of this ASIP, the "Basis of Comparison" is the Baseline (as defined below) contrasted with the EWA Proposed Action.
Baseline	For the purposes of this ASIP, the Baseline reflects the existing without EWA environmental and regulatory conditions of the Bay-Delta region, particularly in relation to the existing actions taken to protect fish species.
Bay-Delta	The San Francisco Bay/Sacramento-San Joaquin Delta estuary.
best management practices	A water conservation measure that the California Urban Water Conservation Council agrees to implement among member agencies. The term is also used in reference to water quality standards and watershed management activities.
biological opinion	A written statement setting forth the opinion of the U.S. Fish and Wildlife Service or the National Marine Fisheries Service as to whether or not a federal action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat. See 16 USCA 1536(b).
CALFED Bay-Delta Program	A consortium of 15 State and federal agencies with management or regulatory responsibilities in the Bay-Delta.
CALFED Program Phases	See Phase I, Phase II, Phase III
candidate species	Any species being considered by the U.S. Secretary of the Interior or Secretary of Commerce for listing as an endangered or a threatened species, but not yet the subject of a proposed rule (see 50 CFR 424.02), or any species accepted as a candidate species by the California Fish and Game Commission pursuant to Fish and Game Code Section 2074.2.
Central Valley Project (CVP)	A federally operated water management and conveyance system that provides water to agricultural, urban, and industrial users in California. The Central Valley Project was originally authorized by legislation in 1937.
Central Valley Project Improvement Act (CVPIA)	Public Law 102-575, Title 34, 106-Stat. 4600. Federal legislation, signed into law on October 30, 1992, that governs the federal Central Valley Project. The Central Valley Project Improvement Act puts fish and wildlife on an equal footing with agricultural, municipal, industrial, and hydropower water users.

Term	Definition
California Endangered Species Act (CESA)	California legislation that prohibits the “take” of plant and animal species designated by the California Fish and Game Commission as either endangered or threatened. Take includes hunting, — pursuing, catching, capturing, killing, or attempting such activity. CESA provides the California Department of Fish and Game (CDFG) with administrative responsibilities over the plant and wildlife species listed under the State act as threatened or endangered. CESA also provides CDFG with the authority to permit the take of State-listed species under certain circumstances. See Fish and Game Code 2050—2116.
California Environmental Quality Act (CEQA)	California legislation that requires State, regional, and local agencies to prepare environmental impact assessments -of proposed projects with significant environmental effects and to circulate these documents to other agencies and the public for comment before making decisions. CEQA requires the lead agency to make findings for all significant impacts identified in the environmental impact report (EIR). The lead agency must adopt all mitigation to reduce environmental impacts to a less-than-significant level unless the mitigation is infeasible or unavailable and there are overriding considerations that require the project to be approved. See Public Res. Code 21001.1, 21002, 21080; Guidelines 15002(c).
carriage water	Additional flows released during export periods to ensure maintenance of water quality standards and assist with maintaining natural outflow patterns in Delta channels. For instance, a portion of transfer water released from upstream of the Delta intended for export from south Delta would be used for Delta outflow.
channel islands	Natural, unleveed land masses within Delta channels that are typically good sources of habitat.
conservation measures	Actions to benefit or promote the recovery of listed species that are included by the Federal agency as an integral part of the proposed action. These actions will be taken by the Federal agency or applicant, and serve to minimize or compensate for, project effects on the species under review. These may include actions taken prior to the initiation of consultation, or actions which the Federal agency or applicant have committed to complete in a biological assessment or similar document.
conservation recommendations	U.S. Fish & Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) non-binding suggestions resulting from formal or informal consultation that: 1) identify discretionary measures a Federal agency can take to minimize or avoid the adverse effects of a proposed action on listed or proposed species, or designated or proposed critical habitat; 2) identify studies, monitoring, or research to develop new information on listed or proposed species, or designated or proposed critical habitat; and 3) include suggestions on how an action agency can assist species conservation as part of their action in furtherance of their authorities under section 7(a)(1) of the Act. [50 CFR 402.02]

Term	Definition
conserve, conserving, conservation	To use, and the use of, all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to the federal and California Endangered Species Acts are no longer necessary. These methods and procedures include, but are not limited to, all activities associated with scientific resources management, such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressure within a given ecosystem cannot be in the otherwise relieved, may include regulated taking.
"contribute to recovery"	Also referred to as 'r', a goal assigned to evaluated species where CALFED actions affect only a limited portion of the species range and/or CALFED actions have limited effects on the species. The goal of contributing to a species' recovery means that CALFED will undertake the actions under its control and within its Multi-Species Conservation Strategy Problem Area and scope that are necessary to recover the species.
conveyance	A pipeline, canal, natural channel, or other similar facility that transports water from one location to another.
covered species	At a programmatic level, species selected from the evaluated species that would be adequately conserved (State requirement for State-covered species) and for which programmatic CALFED actions would not cause jeopardy and/or adversely affect designated critical habitat (federal requirement for federally covered species).
critical habitat	Designation for federally listed species. Consists of: 1) the specific areas within the geographical area occupied by the species at the time it is listed in accordance with the provisions of Section 4 of the federal Endangered Species Act (FESA) (16 USCA 1533), on which are found those physical or biological features (constituent elements) that (a) are essential to- the conservation of the species and (b) may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of Section 4 of FESA (16 USCA 1533), upon a determination by the Secretary that such areas are essential for the conservation of the species. (16 USCA 1 532(5)(A)). Critical habitat may be established for those species now listed as threatened or endangered species for which no critical habitat has heretofore been established. Except in those circumstances determined by either the Secretary of the Interior or the Secretary of Commerce, critical habitat shall not include the entire geographical area, which can be occupied by the threatened or endangered species. Designated critical habitats are described in 50 CFR 17 and 50 CFR 226.
crop idling	Allowing previously irrigated agricultural land to temporarily lie idle (fallowing) for a variety of purposes for a period of time.

Term	Definition
cumulative impact	Those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation. [50CFR 402.02(d)]
Delta Cross Channel	Existing gated structure and channel connecting the Sacramento River at Walnut Grove to Snodgrass Slough and thence to the North Fork Mokelumne River. The facility was constructed as part of the Central Valley Project to control movement of Sacramento River water into the central Delta and to the south-Delta export pumps. Operating criteria currently require the gates to be - closed for specific periods to keep downstream-migrating fish in the Sacramento River and to prevent flooding of the central Delta.
Delta inflow	The combined water flow entering the Delta at a given time from the Sacramento River, San Joaquin River, and other tributaries.
Delta islands	Islands in the Sacramento-San Joaquin Delta protected by levees. Delta islands provide space for numerous functions including agriculture, communities, and important infrastructure such as transmission lines, pipelines, and roadways.
Delta outflow	The net amount of water (not including tidal flows) at a given time flowing out of the Delta towards the San Francisco Bay. The Delta outflow equals Delta inflow minus the water used within the Delta and the exports from the Delta.
direct mortality	The direct loss of fish associated with facilities (Forebay, fish screens, and salvage facilities) for the south Delta export pumps. This direct mortality is a portion of the total fish mortality resulting from operation of the export pumps (see indirect mortality).
diversions	The action of taking water out of a river system or changing the flow of water in a system for use in another location.
ecosystem	A recognizable, relatively homogeneous unit that includes organisms, their environment, and all the interactions among them.
ecosystem restoration	A term sometimes used to imply the process of recreating the structural and functional configurations of an ecosystem to that present at some agreed to time in the past. Because the structure and function of many elements of the Bay-Delta ecosystem have been severely disrupted and cannot be feasibly restored to a specified historic condition, within the context of CALFED, ecosystem restoration is more realistically defined as the process by which resource managers ensure that the capacity of the ecosystem to provide ecological outcomes valued by society is maintained, enhanced, or restored.

Term	Definition
effect indicator	Measure or parameter that is used to record environmental conditions
effects of the action	The direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. These effects are considered along with the environmental baseline and the predicted cumulative effects to determine the overall effects to the species for purposes of preparing a biological opinion on the proposed action. [50 CFR 402.02] The environmental baseline covers past and present impacts of all Federal actions within the action area. This includes the effects of existing Federal projects that have not yet come in their section 7 consultation.
emergent	A plant rooted in shallow water that has most of its vegetative growth above water.
endangered species (CESA)	Any species listed as endangered under the California Endangered Species Act. Endangered species are native California species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that has been determined by the California Fish and Game Commission to be in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease. See California Fish and Game Code Section 2062.
endangered species (FESA)	Any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary of Interior or the Secretary of Commerce to constitute a pest whose protection under the provisions of this Act would present an overwhelming and overriding risk to man (Endangered Species Act of 1973) Any species listed as endangered under the federal Endangered Species Act or the California Endangered species are any species (including subspecies or qualifying distinct population segment) which is in danger of extinction throughout all or a significant portion of its range See 16USCA 1532(6).
endemic species	A native species or subspecies confined naturally to a particular, and usually restricted, area or region.
entrainment	The process of drawing fish into diversions along with water, resulting in the loss of such fish.
environmental baseline	The past and present impacts of all Federal, State, or private actions and other human activities in an action area, the anticipated impacts of all proposed Federal projects in an action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process. [50 CFR 402.02]

Term	Definition
environmental impact report (EIR)	A detailed written report, required by the California Environmental Quality Act, analyzing the environmental impacts of a proposed action, adverse effects that cannot be avoided, alternative courses of action, and cumulative impacts.
environmental impact statement (EIS)	A detailed written statement, required by Section 1 02(2)(c) of the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance of long-term productivity, and any irreversible and irretrievable commitment of resources.
Environmental Water Account (EWA)	A method of accounting for the water and financial assets that can be managed to provide additional protections for fishery resources beyond prescriptive standards.
Environmental Water Account (EWA) Agencies	The Management Agencies, including the U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and the California Department of Fish and Game (CDFG), as well as the two Project Agencies, the U.S. Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR).
Environmental Water Account (EWA) assets	Alternative sources of project water supply, which will be used to augment streamflows and Delta outflows, to modify exports that provide fishery benefits, and to replace the regular project water supply interrupted by changes in project operations. The replacement water will compensate for reductions in deliveries relative to existing facilities, project operations, and the regulatory baseline that result from EWA actions. EWA assets are managed by USFWS, NMFS, and DFG in coordination with the CALFED Operations Group.
ephemeral stream	A stream that flows seasonally.
Essential Fish Habitat	EFH is defined in the Magnuson-Stevens Fishery Conservation and Management Act as "…those waters and substrate necessary to fish for spawning, breeding, feeding or growth and maturity…" NMFS regulations further define "waters" to include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" to include sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" to mean habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" to cover a species' full life cycle.
estuary	A water passage where ocean water mixes with river water.
estuarine fish	Fish that spend a part of their life cycle in an estuary.

Term	Definition
evaluated species	A species within the Multi-Species Conservation Strategy Focus Area that is listed under federal law as threatened or endangered or California listed as rare, threatened, endangered, or fully protected; could become federally or California listed as threatened or endangered under California or federal law during the term of CALFED implementation and could be adversely affected by CALFED actions; or could be adversely affected by CALFED actions within a substantial portion of the species' range or important habitat.
evaluation criteria	The standard of measure with which to assess potential adverse effects
export	Water diversion from the Delta used for purposed outside the Delta.
export:inflow ratio (E:I ratio)	This requirement presently limits Delta exports by the State and federal water projects to a percentage of Delta inflow. In July though January, 65% of inflow can be exported. During February through June, months most critical to fisheries, the allowable E:I ratio is reduced to 35% to help diminish reverse flows and the resulting entrainment of fish caused by south Delta export operations.
Facultative species	Not limited to a specific condition; having the ability to live under varying conditions, such as in wetland and upland habitats.
Federal Endangered Species Act (FESA)	Federal legislation that requires federal agencies, in consultation with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), to ensure that their actions do not jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of these species. FESA recognizes the value to the nation of species in danger of or threatened with extinction. The act requires federal agencies to conserve these species and their habitats and ranges to the extent practicable. Section 4 of FESA (16 USCA 1533) provides a listing process for species considered "endangered" (in danger of becoming extinct) or "threatened" (threatened to become endangered). The Secretary of Commerce, acting through NMFS, is involved for projects that may affect marine or anadromous fish species listed under FESA. All other species listed under FESA are under USFWS jurisdiction. Section 7 of FESA (16 USCA *l536(a)(2))* requires all federal agencies, in consultation with the Secretaries of the Interior and Commerce (acting through USFWS and NMFS, respectively), to ensure that their actions do not jeopardize the continued existence of species listed as endangered or threatened and protected or result in the destruction or adverse modification of the critical habitat of these species. Section 9 of FESA (16 USCA *1538)* prohibits take of a listed species. Section 9 (16 USCA *1538)* compliance is applicable if the proposed action would result in the take of any listed threatened (if not subject to special rule) or endangered fish or wildlife species and such take is not authorized in a biological opinion issued by USFWS or NMFS. Section 10 of FESA (16 USCA *1539)* authorizes the conditions for USFWS or NMFS to issue a permit for incidental take of a listed species when there is no other federal agency involved. See I6USC 1531 *et seq*.

Term	Definition
federally covered species	Federally listed and proposed species identified by USFWS and NMFS in the programmatic biological opinions for which programmatic CALFED actions would not cause jeopardy and/or adversely affect designated critical habitat.
fish entrainment	The incidental capture and loss of fish during water diversion.
fish group	Federally listed and proposed species identified by USFWS and NMFS in the programmatic biological opinions for which programmatic CALFED actions would not cause jeopardy and/or adversely affect designated critical habitat. A classification that is based on ecological behavior of the included fish species. Two fish groups are evaluated in the Multi-Species Conservation Strategy: anadromous fish and estuarine fish.
fish salvage	The process of screening fish at the south Delta export facilities and physically transporting them by truck to release in other parts of the Delta. This generally results in higher fish mortality than a more conventional fish screen where screened fish simply return to the river and continue downstream. Fish salvage is required at the existing export facilities since there is no flow continuing downstream to carry the fish away.
fish screens	Physical structures placed at water diversion facilities to keep fish from getting pulled into the facility and dying there.
Focus Area	The legally defined Delta, Suisun Bay and Marsh, the Sacramento and San Joaquin Rivers and their tributaries downstream of major dams, and the potential locations of conveyance and water storage facilities.
groundwater banking	Storing water in the ground for use to meet demand during dry years. In-lieu groundwater banking replaces groundwater used by users with surface water to build up and save underground water supplies for use during drought conditions.
habitat conservation plan	A comprehensive planning document pursuant to Section 10 of the federal Endangered Species Act (16 USCA 1 539(a)(2)(A)) that is a mandatory component of an incidental take permit issued pursuant to Section 10 (16 USCA 1539(a)(l)(B)).
habitat enhancement, enhance habitat	To improve degraded habitat. Management actions that enhance habitat do not result in increasing the extent of habitat area.
habitat protection, protect habitat	To maintain the existing extent and quality of habitat.
habitat restoration, restore habitat	To create habitat. Management actions that restore habitat result in increasing the extent of habitat area.

Term	Definition
incidental take	"Take" that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.
incidental take statement	When an action results in an incidental take, USFWS and NMFS prepare an incidental take statement. The statement includes the amount of extent of anticipated take due to the action, reasonable and prudent measures to minimize the take, and terms and conditions that must be observed when implementing those measures.
incidental take permit	Federal exception to Section 9 of the federal Endangered Species Act (FESA) (16 USCA *1538);* a permit issued pursuant to Section 10 of FESA (16 USCA *1539(a)(l)(B)).*
indirect mortality	The indirect fish losses from operating the Delta Cross Channel and south Delta export pumps. For example, fish diverted from the Sacramento River into the central and south Delta experience higher mortality through increased stress, small agricultural water diversions, poor water quality, predation, reduced shallow water habitat for fry, higher water temperatures, and higher residence time. This indirect mortality is a portion of the total fish mortality resulting from operation of the export pumps (see direct mortality).
invertebrate	An animal that lacks a backbone or spinal column.
jeopardy	appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species [50 CFR 402.02]
listed species (FESA)	Species, including subspecies, of fish, wildlife, or plants federally listed at 50 CFR 17.11 and 50 CFR 17.12 as either endangered or threatened, or listed at 14 CCR 670.2 and 14 CCR *670.5* as threatened or endangered.
listed species (CESA)	Species or subspecies declared as threatened or endangered by the California Fish and Game Commission in 14 CCR *670.5.*
"maintain"	Also known as 'm', a type of CALFED goal assigned to species expected to be minimally affected by CALFED actions. The MSCS requires that CALFED actions' adverse effects on species in this category be avoided, minimized, or compensated for. The avoidance, minimization, and compensation measures for these species may not contribute to their recovery, but would ensure that CALFED actions do not degrade the status of the species or contribute to the need to list the species. CALFED is also expected, where practicable, to take advantage of opportunities to improve conditions for these species.

Term	Definition
Management Agencies	The U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and the California Department of Fish and Game (CDFG). The Management Agencies have primary responsibility for exercising biological judgment to determine which State Water Project (SWP) and/or Central Valley Project (CVP) operational changes would be beneficial to the Bay-Delta ecosystem or the long-term survival of fish species, including those listed under CESA and FESA.
may affect	The appropriate conclusion when a proposed action may pose **any** effects on listed species or designated critical habitat. When the Federal agency proposing the action determines that a "may affect" situation exists, then they must either initiate formal consultation or seek written concurrence from USFWS and NMFS that the action "is not likely to adversely affect listed species.
mitigation	To moderate, reduce, alleviate the impacts of a proposed activity; includes in order: (a) avoiding the impact by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time *by* preservation and maintenance operations during the life of the action; and (e) compensating for the impact by replacing or providing substitute resources or environments.
National Environmental Policy Act	Federal legislation establishing the national policy that environmental impacts will be evaluated as an integral part of any major federal action. Requires the preparation of an environmental impact statement for all major federal actions significantly affecting the quality of the human environment.
Natural Community Conservation Plan	A plan prepared pursuant to the Natural Community Conservation Planning Act that identifies and provides for the regional or area wide protection and perpetuation of natural wildlife diversity, while allowing compatible and appropriate development and growth.
Natural Community Conservation Planning Act	A California law providing for regional or area wide planning for natural wildlife diversity and compatible and appropriate development and growth. (See Fish and Game Code 2800 *et seq*.)
NCCP community	Refers to both habitats and fish groups addressed in the Multi-Species Conservation Strategy (MSCS). The MSCS provides the information for a programmatic Natural Community Conservation Plan (NCCP) for 20 natural communities, encompassing 18 habitat types and two ecologically based fish groups.
NCCP community goals	CALFED goals developed by the Multi-Species Conservation Strategy team and Ecosystem Restoration Program staff for Natural Community Conservation Plan (NCCP) communities.

Term	Definition
NCCP community prescriptions	Multi-Species Conservation Strategy (MSCS) targets that describe the future expected changes in extent and condition of MSCS Natural Community Conservation Plan (NCCP) communities with full implementation of CALFED. If NCCP community prescriptions are achieved, CALFED goals for NCCP communities will have been met.
NCCP habitat	Broad habitat categories, each of which includes a number of habitat or vegetation types recognized in frequently used classification systems. The Multi-Species Conservation Strategy includes an evaluation of 18 Natural Community Conservation Plan (NCCP) terrestrial and 2 fish group habitats.
non-native species	Also called introduced species or exotic species; refers to plants and animals that originate elsewhere and are brought into a new area, where they may dominate the local species or in some way negatively impact the environment for native species.
not likely to adversely affect	The appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: 1) be able to meaningfully measure, detect, or evaluate insignificant effects; or 2) expect discountable effects to occur.
obligate species	A species limited to -a restricted environment, such as a wetland.
perennial plant	A plant that grows for more than one season; it overwinters in a dormant condition and resumes growth the following season.
Phase I	First phase of CALFED. During Phase I, begun in May 1995, when the problems of the Bay-Delta were defined and work began on developing a range of alternatives to solve them. Phase I was completed by CALFED in August 1996.
Phase II	Second phase of CALFED. During Phase II, which ended when the Final Programmatic Environmental Impact Statement/ Environmental Impact Report was issued in July 2000, CALFED developed a Preferred Program Alternative, conducted comprehensive programmatic environmental review, and developed the implementation plan focusing on the first 7 years (Stage 1) following the Record of Decision.
Phase III	Third and final phase of CALFED. During Phase III, implementation of the Preferred Program Alternative will begin. Implementation will continue in stages over many years. This phase will include any necessary studies and site-specific environmental review and permitting.
practicable	Capable of being put into practice, done, or accomplished using reasonable means and costs.

Term	Definition
Projects	A shortened and combined form of the Central Valley Project and State Water Project. See the definitions for the Central Valley Project (CVP) and State Water Project (SWP).
Project Agencies	The U.S. Bureau of Reclamation (Reclamation) and the California Department of Water Resources (CDWR).
Raptor	A bird species in the order Falconiformes such as hawks, eagles, kites, and falcons, and in the order Strigiformes (owls).
reasonable and prudent measures	Actions either the Assistant Administrator for Fisheries for the National Oceanic and Atmospheric Administration, the Fish and Wildlife Service Regional Director, or their respective authorized representative, believes necessary or appropriate to minimize the impacts, i.e., amount of extent, of incidental take
"recovery" (CALFED goal)	Also referred to as 'R', a goal assigned to evaluated species whose recovery is dependent on restoration of the Delta and Suisun Bay/Marsh ecosystems and for which CALFED could reasonably be expected to undertake all or most of the actions necessary to recover the species. The term "recover" means that the decline of a species is arrested or reversed and threats to the species are neutralized and that the species' long-term survival in nature is therefore assured.
recovery (federal Endangered Species Act)	The process by which the decline of an endangered or threatened species is arrested or reversed, and threats to survival are neutralized, so that long-term survival in nature can be ensured.
riparian	The strip of land adjacent to a natural watercourse such as a river or stream. Often supports vegetation that provides important wildlife habitat values when a complex forest structure is present and important fish habitat values when vegetation grows large enough to overhang the bank.
riverine habitat	Habitat within or alongside a river or channel.
Section 7	Section of the federal Endangered Species Act (16 USCA 1536) dealing with the requirement that federal agencies consult with the U.S. Fish and Wildlife Service or National Marine Fisheries Service to ensure that any action authorized, funded, or carried out by a federal agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of designated critical habitat of such species.
Section 9	Section of the federal Endangered Species Act (16 USCA 1538) that defines prohibited acts, including the "take" of any listed species without specific authorization of the U.S. Fish and Wildlife Service or National Marine Fisheries Service.
Section 10	Section of the federal Endangered Species Act (FESA) (16 USCA *1539)* that defines exceptions to acts prohibited by Section 9 of FESA (16 USCA 1538) for nonfederal entities (e.g., states, local governments, private individuals).

Term	Definition
sensitive species	Listed species, species that are candidates for listing, and other species that have been designated as species of special concern by federal or State agencies or scientific organizations (see “special-status species”).
service area	All of the areas that receive water from a particular water project.
smolt	A young salmon that has assumed the silvery color of the adult and is ready to migrate to the sea.
special-status species	Species that are in at least one of the following categories: federally listed as threatened or endangered under the federal Endangered Species Act (FESA); proposed for federal listing under FESA; federal candidates under FESA; California listed as threatened or endangered under the California Endangered Species Act (CESA); California candidates under CESA; plants listed as rare under the California Native Plant Protection Act; California fully protected species or specified birds under various sections of the California Fish and Game Codes; California species of special concern; California Native Plant Society List 1A, 1B, 2, or 3 species; or other native species of concern to CALFED.
species	Includes any subspecies of fish, wildlife, or plants, and any distinct population segment of any vertebrate fish or wildlife that interbreeds when mature.. The California Endangered Species Act also includes any native species or subspecies of bird, mammal, fish, amphibian, reptile, or plant.
species goal	CALFED goals developed by the Multi-Species Conservation Strategy Team and the Ecosystem Restoration Program staff for the evaluated species, termed “recovery”, “contribute to recovery”, and “maintain”.
species of concern	Species evaluated in the Multi-Species Conservation Strategy that could be affected by actions and are not federally listed as threatened or endangered under the federal Endangered Species Act (FESA); proposed for federal listing under FESA; federal candidates under FESA; California listed as threatened or endangered under the California Endangered Species Act (CESA); California candidates under CESA; plants listed as rare under the California Native Plant Protection Act; California fully protected species or specified birds under various sections of the California Fish and Game Codes; California species of special concern; or California Native Plant Society List 1A, 1B, 2, or 3 species.
species prescriptions	Multi-Species Conservation Strategy targets that describe the future expected changes in evaluated species’ habitats and populations with full implementation of CALFED. If evaluated species prescriptions are achieved, CALFED goals for evaluated species will have been met.
stage	The height of the water surface above an arbitrarily established elevation.

Term	Definition
Stage 1	The first 7 years of CALFED implementation following the Record of Decision on the CALFED Programmatic Environmental Impact Statement/Environmental Impact Report.
State-covered species	Evaluated species identified by CDFG in the programmatic NCCP determination that would be adequately conserved with the implementation of programmatic CALFED actions and conservation measures.
State Water Project	A California State water conveyance system that pumps water from the Delta for agricultural, urban domestic, and industrial purposes. The State Water Project was authorized by legislation in 1951.
subsidence	The reduction in land elevation due to the compaction of soil, oxidation of organic soils, removal of underground fluids, or other mechanisms.
take	Under the federal Endangered Species Act (FESA), "To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" regard to federally listed, endangered species of wildlife (16 USCA 1532~19]). "Harm" is further defined as an act "which actually kills or take injures". Harm *may* include "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or shelter" (50 CFR 17.3). Under the California Fish and Game Code, take is defined as "to hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill" (California Fish and Game Code Section 86).
terrestrial species	Types of species of animals and plants that live on or grow from the land.
threatened species (CESA)	Any species listed as threatened under the California Endangered Species Act.. Threatened species are native California species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that have been determined by the California Fish and Game Commission, although not presently threatened with extinction, to be likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts. See California Fish and Game Code Section 2067.
threatened species (FESA)	Any species listed as threatened under the federal Endangered Species Act (FESA). Threatened species are any which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (see 16 USCA 1532(19)).
turbidity	A cloudy appearance that results when excessive silt or other substances are in the water.
vernal pool	Seasonally ponded landscape depressions in which water accumulates because of limitations to subsurface drainage and which support a distinct association of plants and animals.

Term	Definition
water transfers	Voluntary water transactions conducted under State law and in keeping with federal regulations.
Watershed Program Area	The area that encompasses the watersheds of the CALFED Solution Area, but focuses on the watersheds of the San Joaquin and Sacramento Rivers, primarily those areas above major dams, and a portion of the upper Trinity River watershed.
X_2	The location (measured in kilometers upstream from the Golden Gate Bridge) of 2 parts per thousand total dissolved solids. The length of time X_2 must be positioned at set locations in the estuary in each month is determined by a formula that considers the previous month's inflow to the Delta and a "Level of Development" factor, denoted by a particular year. X_2 is currently used as the primary indicator in managing Delta outlflows. The X_2 indicator is also used to reflect a variety of biological consequences related to the magnitude of fresh water flowing downstream through the estuary and the upstream flow of salt water in the lower portion of the estuary. The outflow that determines the location of X_2 also affects both the downstream transport of some organisms and the upstream movement of others and affects the overall water operations of the CVP and SWP.

ENVIRONMENTAL WATER ACCOUNT

Draft Environmental Impact Statement
Environmental Impact Report

Volume III
Action Specific Implementation Plan

JULY 2003

State Clearinghouse #1996032083

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Acronyms

AF ... acre-feet
AFRP ... Anadromous Fish Recovery Plan
ASIP ... Action Specific Implementation Plan
BA ... Biological Assessment
BMPs ... Best Management Practices
BO ... Biological Opinion
BRD ... Biological Resource Division
CALFED ... CALFED Bay-Delta Program
CCAs ... Candidate Conservation Agreements
CDFG ... California Department of Fish and Game
CDWR ... California Department of Water Resources
CESA ... California Endangered Species Act
CEQA ... California Environmental Quality Act
CFR ... Code of Federal Regulations
cfs ... cubic feet per second
CMARP ... Comprehensive Monitoring, Assessment, and Research Program (defunct)
CNPS ... California Native Plant Society
CRR ... Cohort Replacement Rate
CSC ... California species of special concern
CVP ... Central Valley Project
CVPIA ... Central Valley Project Improvement Act
CWA ... Clean Water Act
CWHR ... California Wildlife Habitat Relationship
DCC ... Delta Cross Channel
DFG ... California Department of Fish and Game
EFH ... essential fish habitat
EIS/EIR ... Environmental Impact Statement/Environmental Impact Report
ERP ... Ecosystem Restoration Program
ESA ... Endangered Species Act
ESUs ... Evolutionarily Significant Units
EWA ... Environmental Water Account
EWP ... Environmental Water Program
FERC ... Federal Energy Regulatory Commission
FESA ... Federal Endangered Species Act
FWS ... US Fish and Wildlife Service
Gap GIS ... California Gap Analysis land-cover GIS database
GIS ... Geographic Information System
ha ... Hectare
HCP ... Habitat Conservation Plan
IA ... Implementing Agreement
IEP ... Interagency Ecological Program
ISDP ... Interim South Delta Program

ISI .... Integrated Storage Investigation
Metropolitan WD .... Metropolitan (Los Angeles) Water District
MSCS .... Multi-Species Conservation Strategy
NEPA .... National Environmental Policy Act
NMFS .... National Marine Fisheries Service
NCCP .... Natural Community Conservation Plan
NCCPA .... Natural Community Conservation Planning Act
NOAA .... National Oceanic and Atmospheric Agency
NOD .... Notice of Determination
PFMC .... Pacific Coast Salmon Plan
PG&E .... Pacific Gas & Electric Company
Reclamation .... U.S. Bureau of Reclamation
RBDD .... Red Bluff Diversion Dam
rm .... river mile
ROD .... Record of Decision
SB .... Senate Bill
SJRA .... San Joaquin River Agreement
SRA .... Shaded Riverine Aquatic
SWP .... State Water Project
SWRCB .... State Water Resources Control Board
TOC .... Total Organic Carbon
USACE .... U.S. Army Corps of Engineers
USBR .... U.S. Bureau of Reclamation
USEPA .... U.S. Environmental Protection Agency
USFWS .... U.S. Fish and Wildlife Service
VAMP .... Vernalis Adaptive Management Plan
VSP .... Viable Salmonid Populations
Wetlands GIS .... California Central Valley Wetlands and Riparian GIS
WMS .... Water Management Strategy
WQCP .... Water Quality Control Plan
YCWA .... Yuba County Water Agency
YCTWG .... Yuba County Technical Working Group