Appendix F Groundwater Modeling Results

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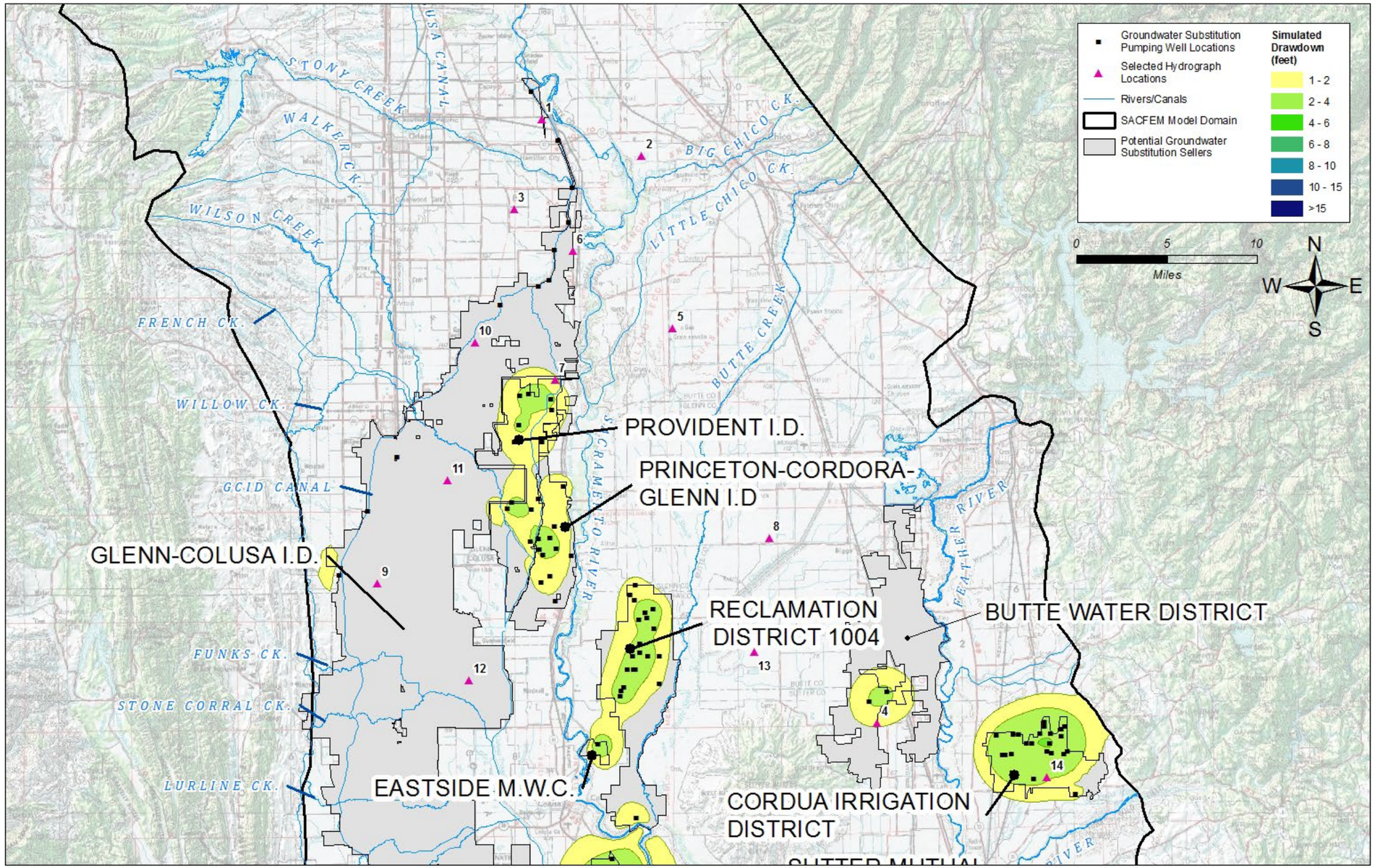

Figure F-1a.
Simulated Drawdown due to Groundwater Substitution Pumping, Aquifer Depth up to approximately 35 feet. Based on September 1976 Hydrologic Conditions

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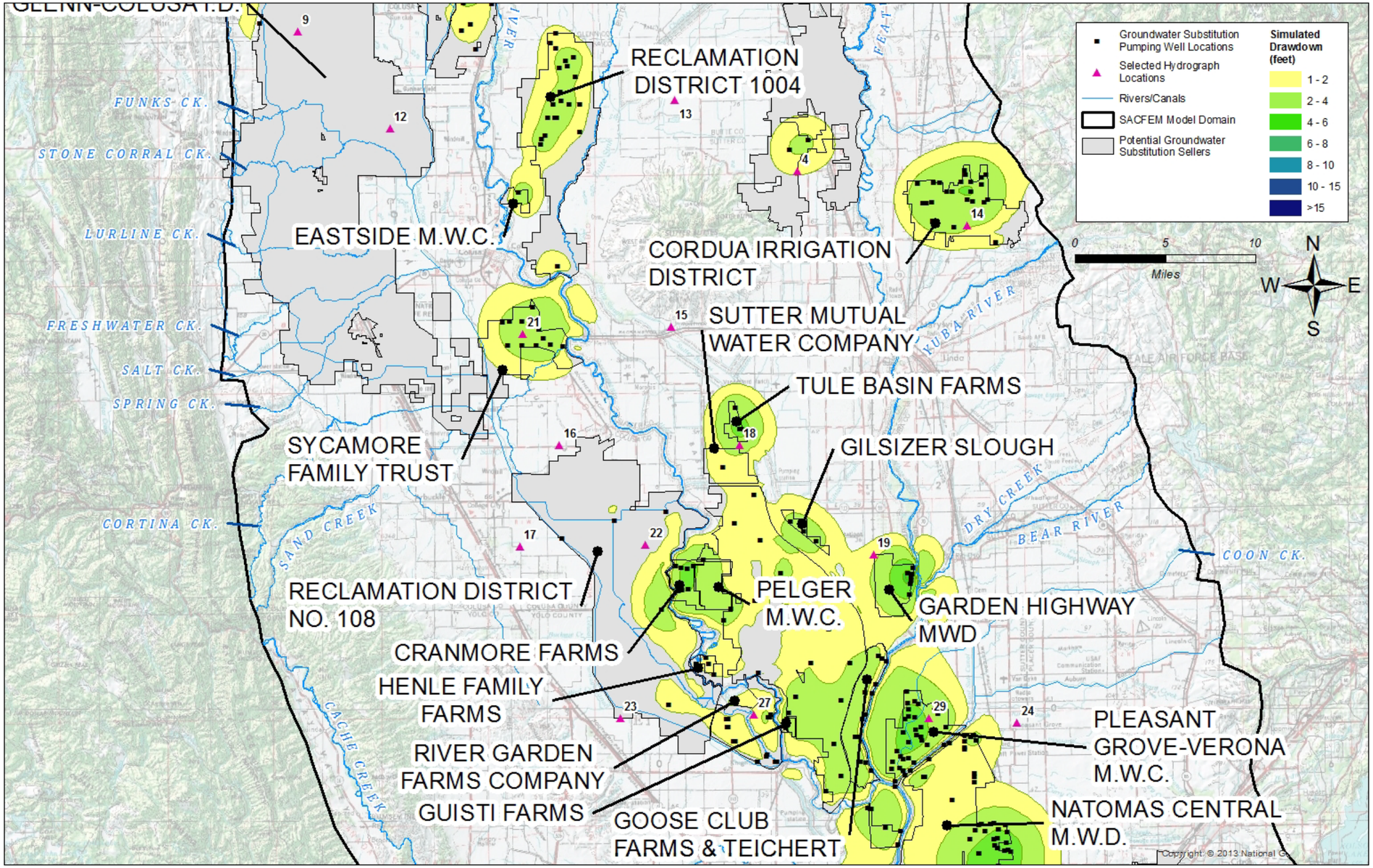

Figure F-1b.
Simulated Drawdown due to Groundwater Substitution Pumping, Aquifer Depth up to approximately 35 feet. Based on September 1976 Hydrologic Conditions

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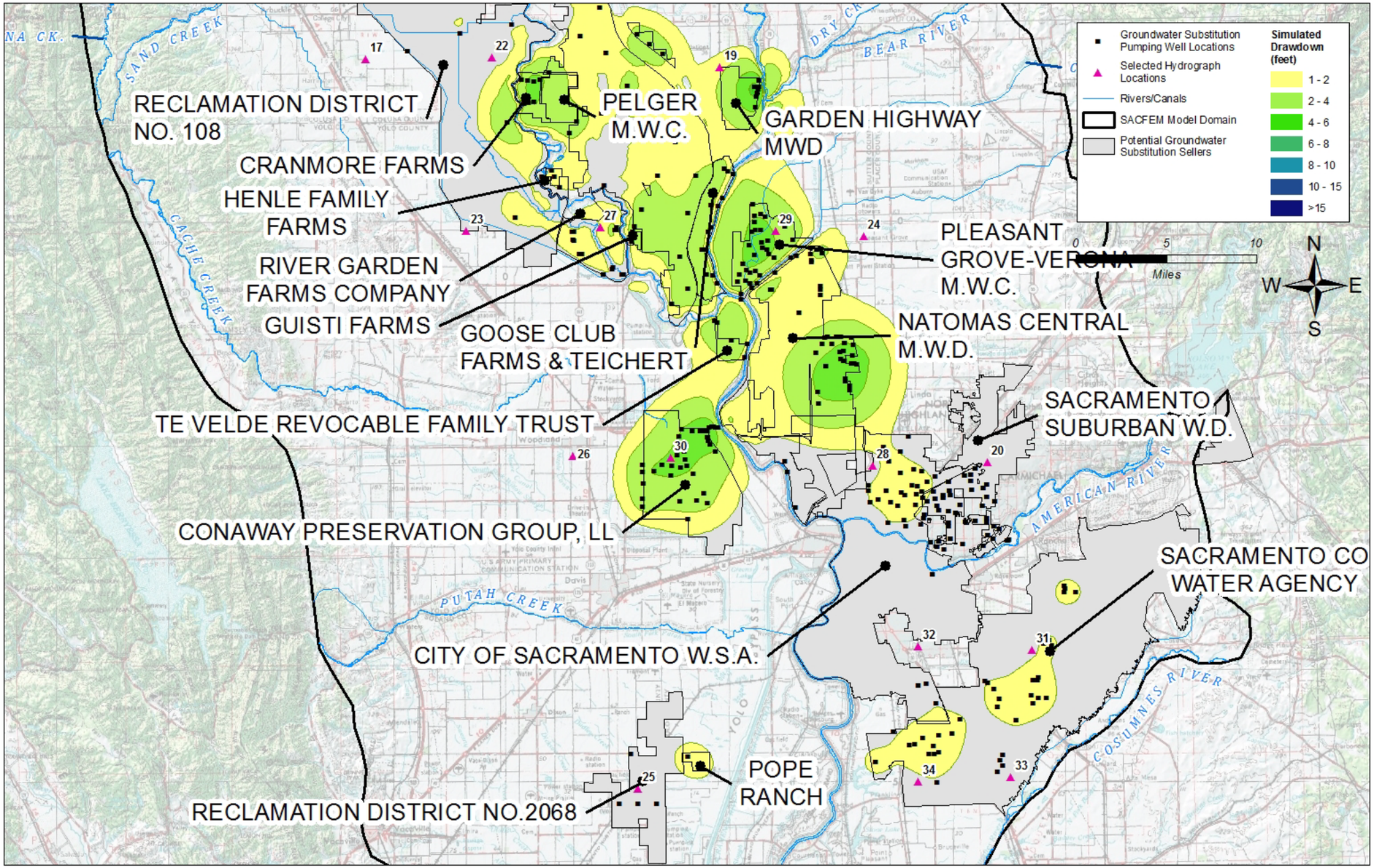

Figure F-1c.
Simulated Drawdown due to Groundwater Substitution Pumping, Aquifer Depth up to approximately 35 feet. Based on September 1976 Hydrologic Conditions

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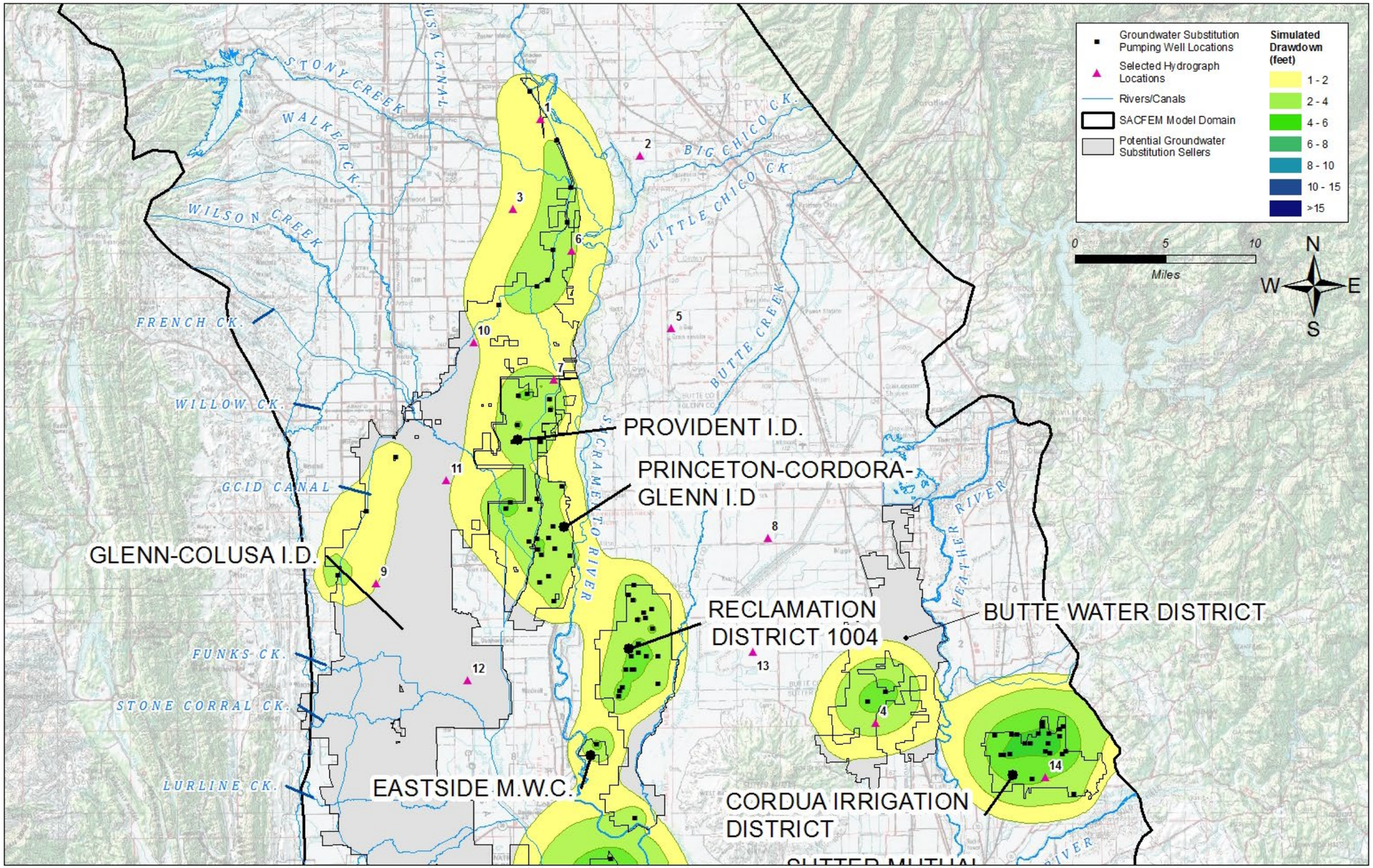

Figure F-2a.
Simulated Change in Groundwater Head due to Groundwater Substitution Pumping, Aquifer Depth of approximately 200 to 300 feet. Based on September 1976 Hydrologic Conditions

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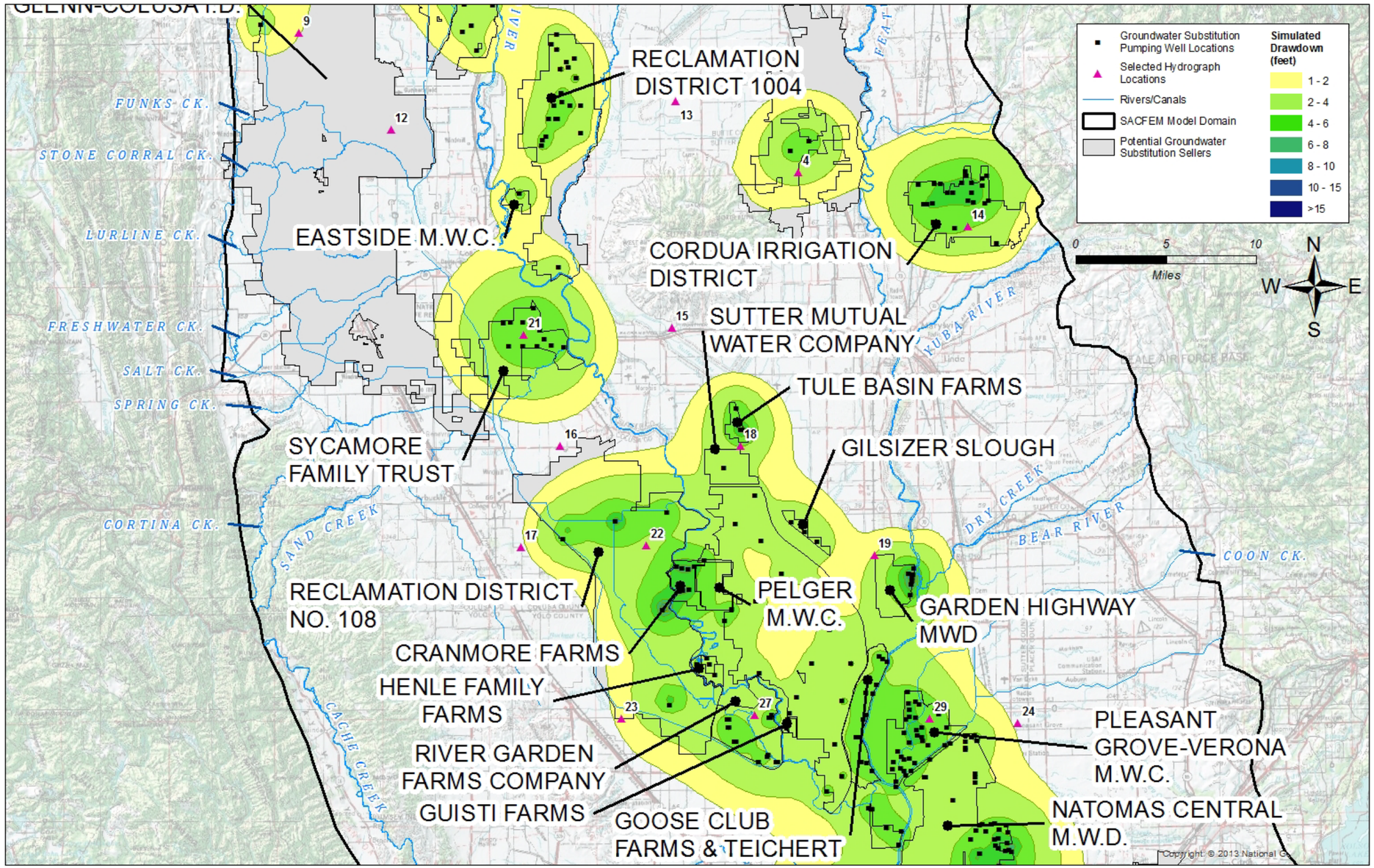

Figure F-2b.
Simulated Change in Groundwater Head due to Groundwater Substitution Pumping, Aquifer Depth of approximately 200 to 300 feet. Based on September 1976 Hydrologic Conditions

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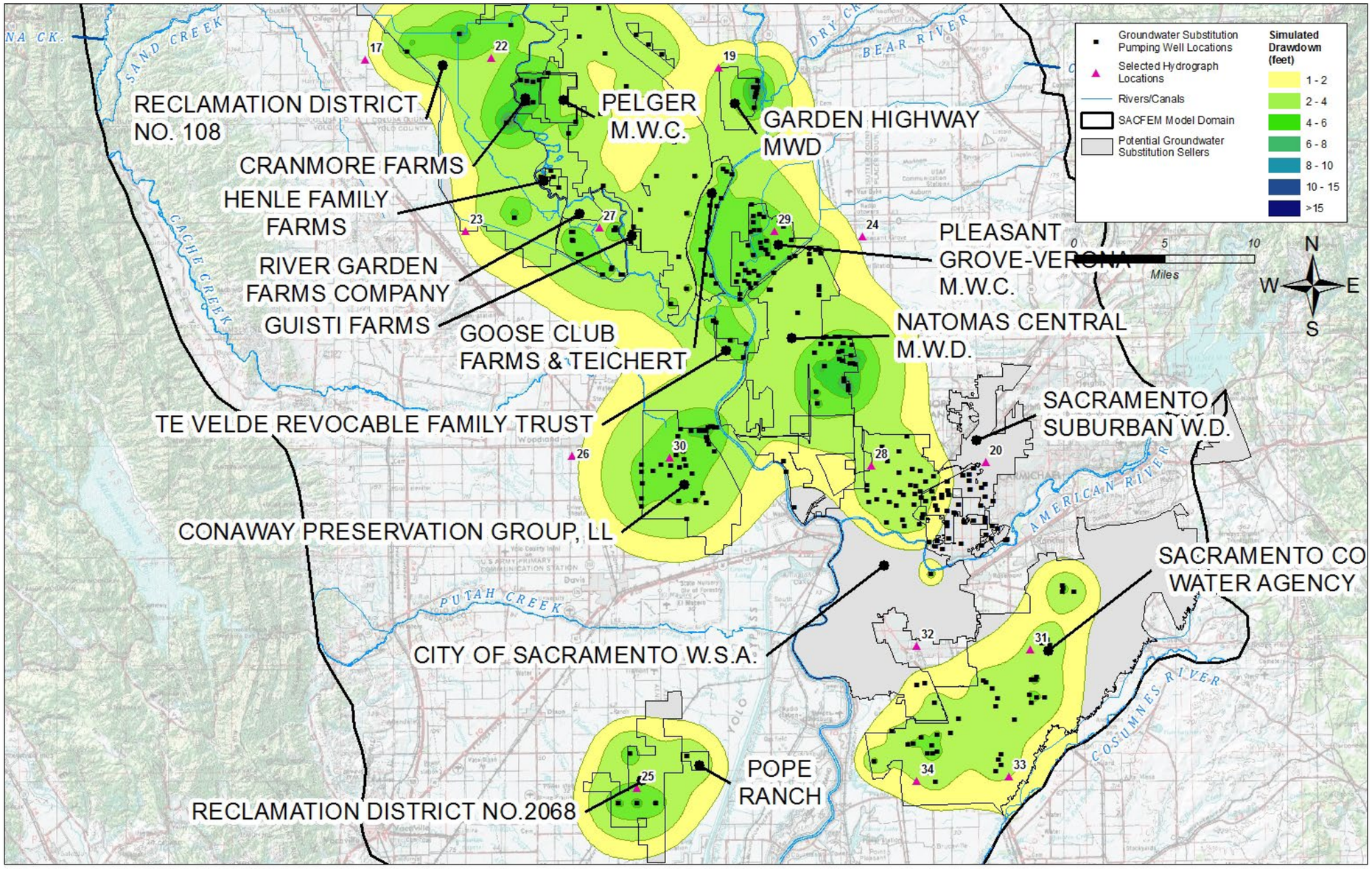

Figure F-2c.
Simulated Change in Groundwater Head due to Groundwater Substitution Pumping, Aquifer Depth of approximately 200 to 300 feet. Based on September 1976 Hydrologic Conditions

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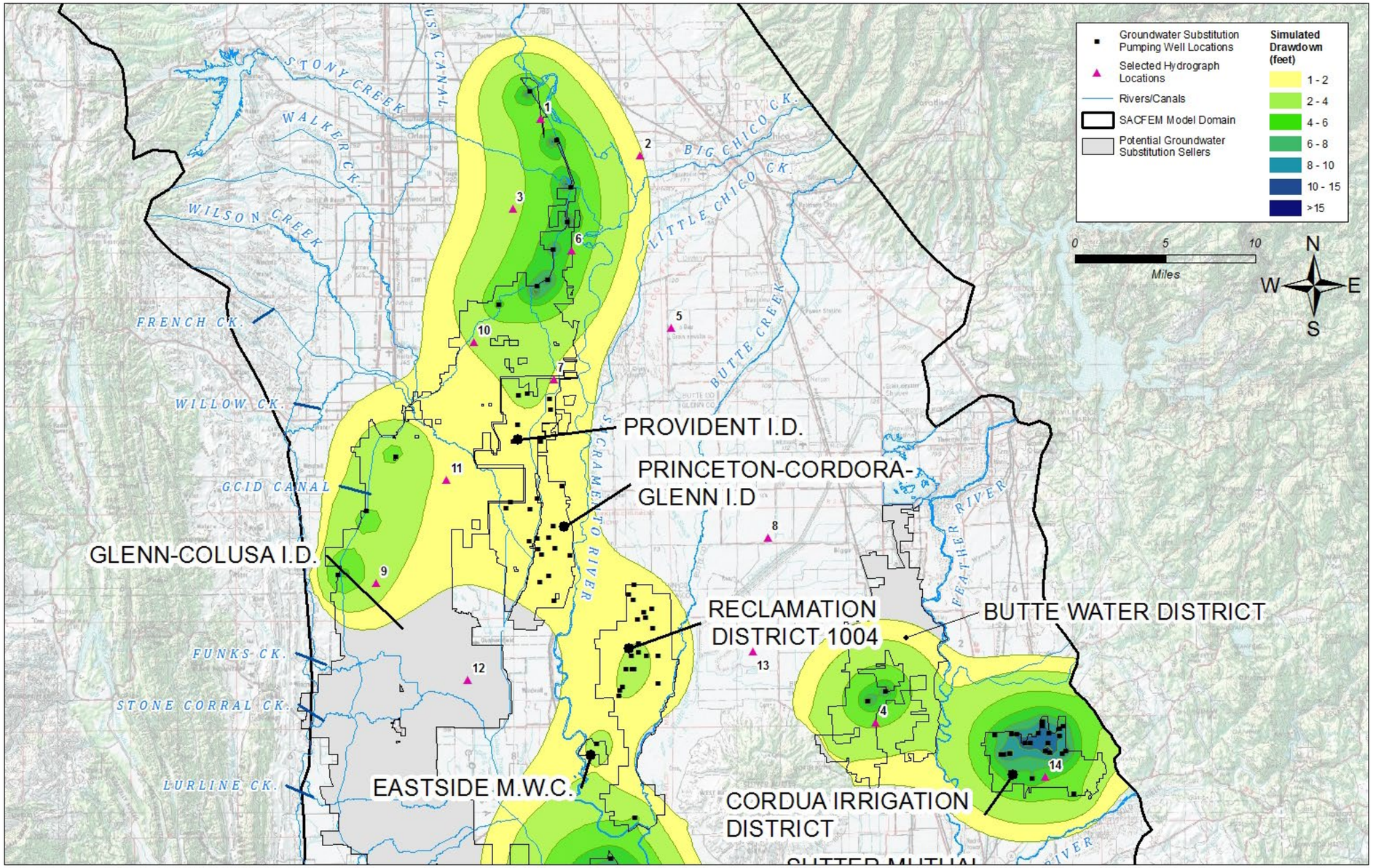

Figure F-3a.
Simulated Change in Groundwater Head due to Groundwater Substitution Pumping, Aquifer Depth of approximately 700 to 900 feet. Based on September 1976 Hydrologic Conditions

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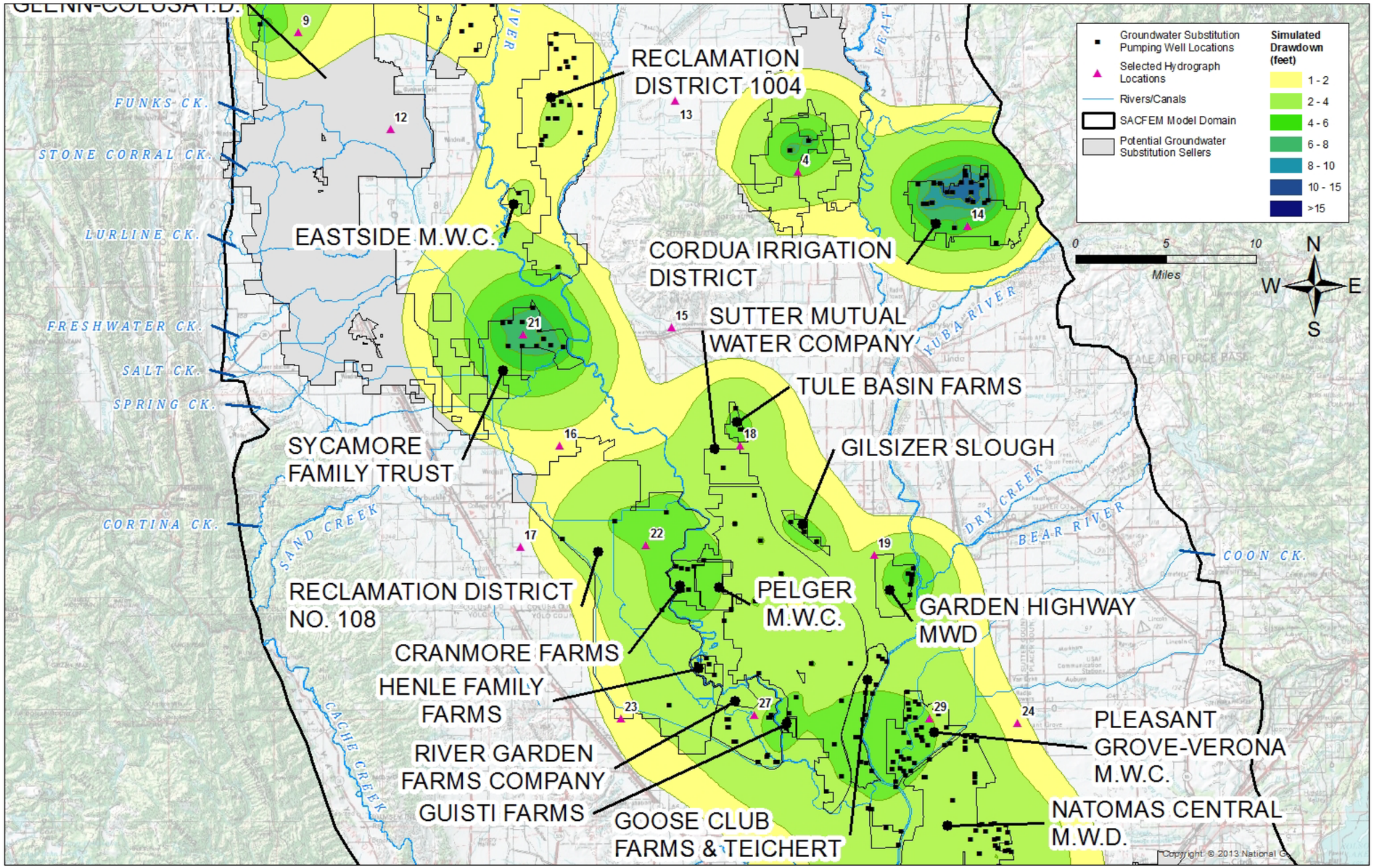

Figure F-3b.
Simulated Change in Groundwater Head due to Groundwater Substitution Pumping, Aquifer Depth of approximately 700 to 900 feet. Based on September 1976 Hydrologic Conditions

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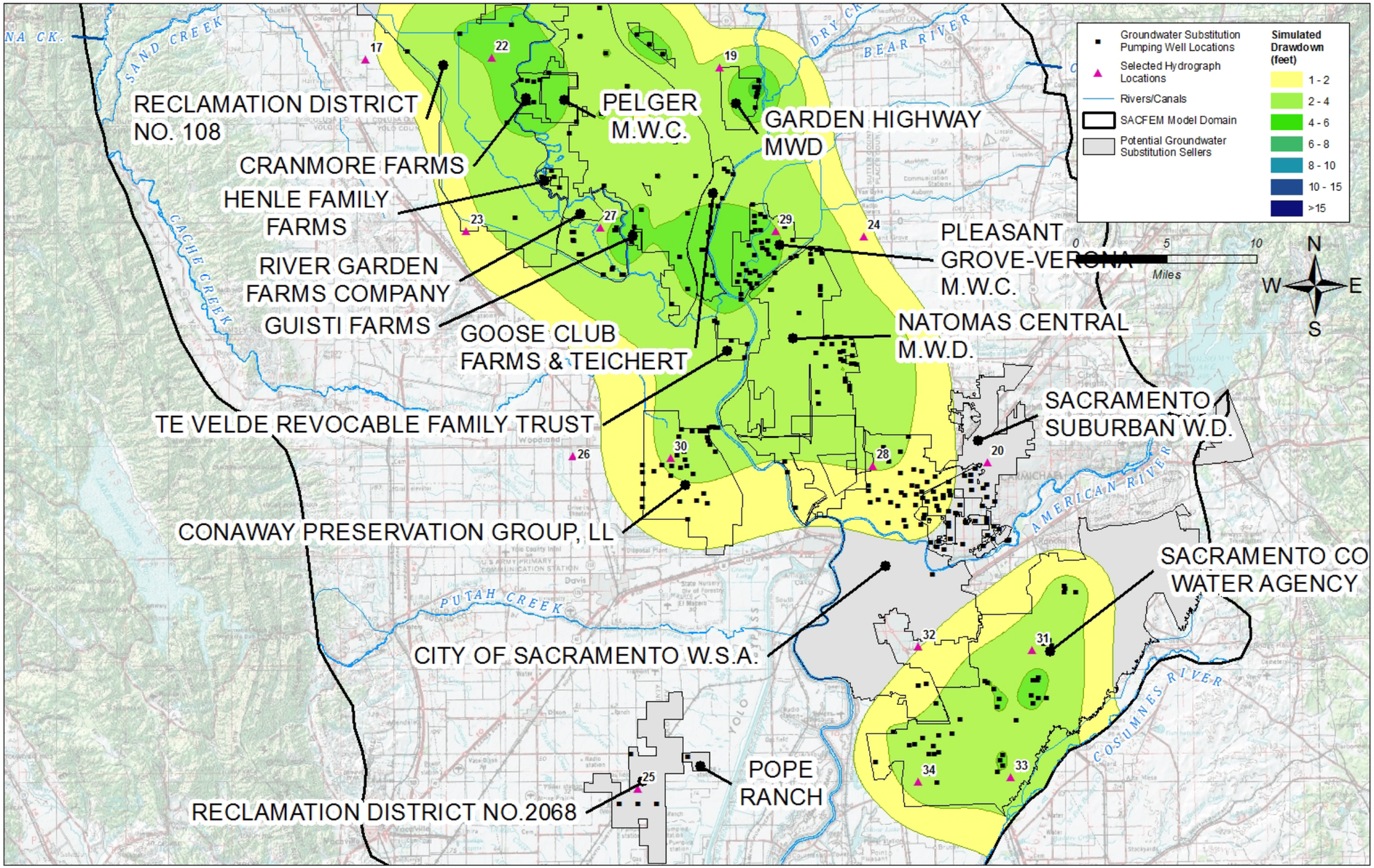

Figure F-3c.
Simulated Change in Groundwater Head due to Groundwater Substitution Pumping, Aquifer Depth of approximately 700 to 900 feet. Based on September 1976 Hydrologic Conditions

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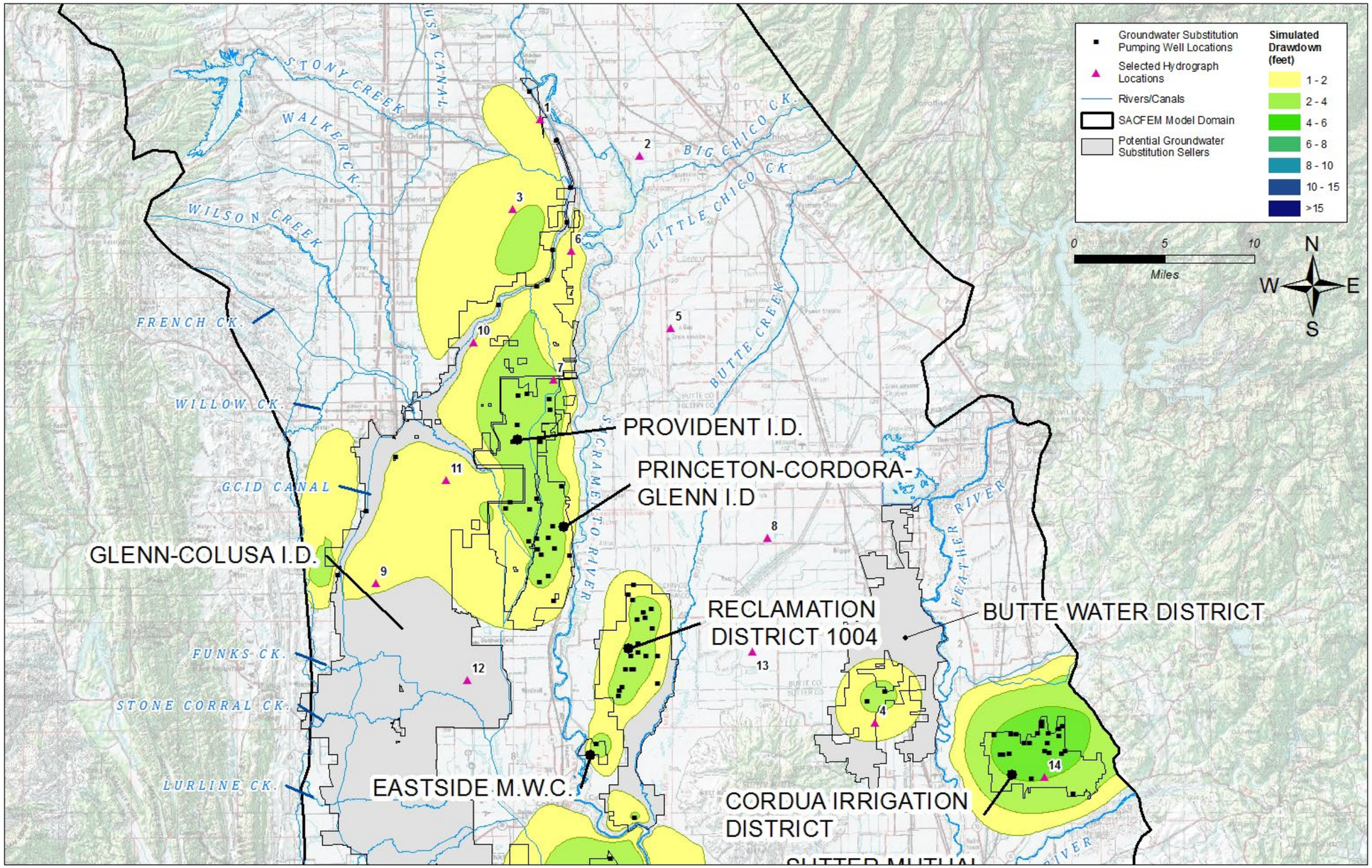

Figure F-4a.
Simulated Drawdown due to Groundwater Substitution Pumping, Aquifer Depth up to approximately 35 feet. Based on September 1990 Hydrologic Conditions

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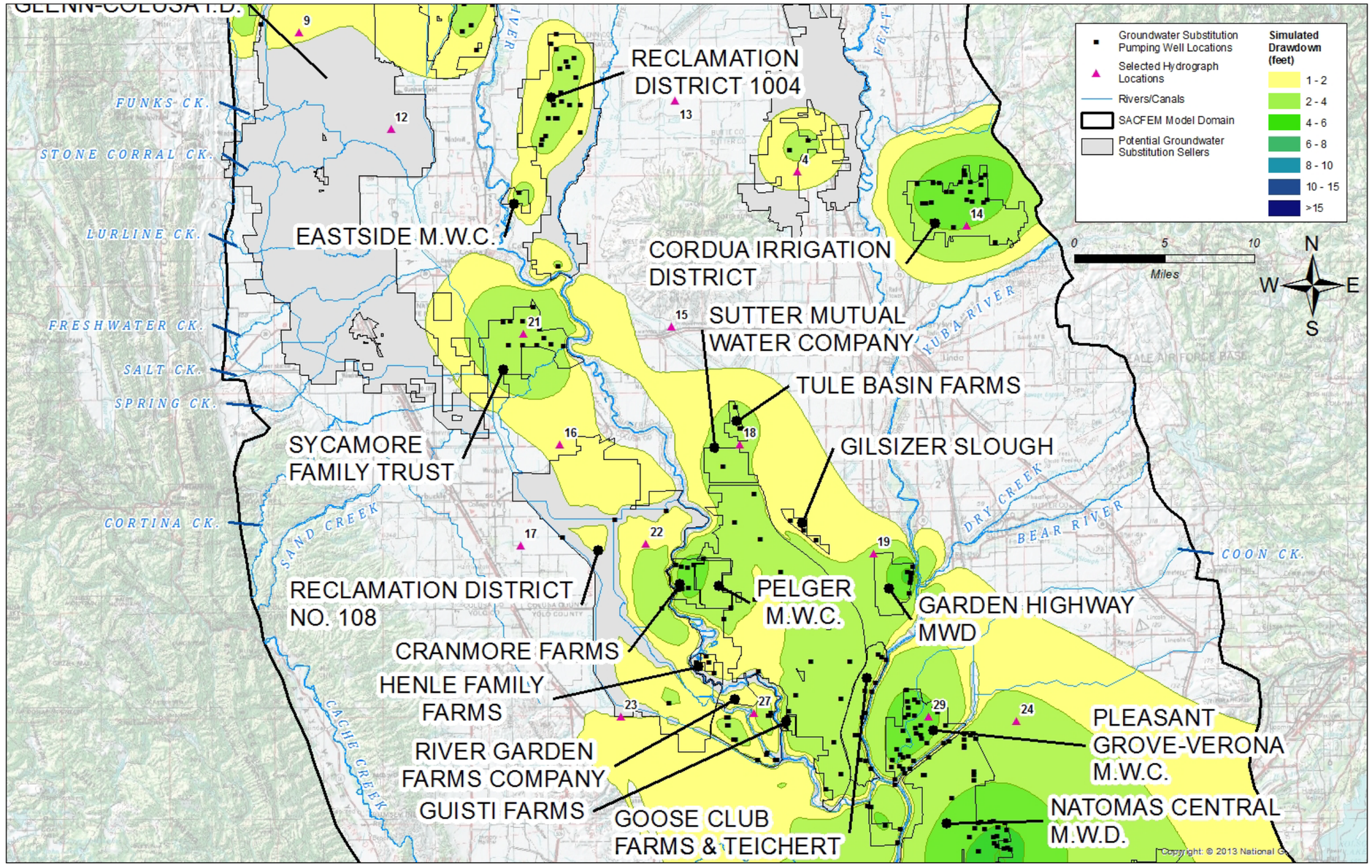

Figure F-4b.
Simulated Drawdown due to Groundwater Substitution Pumping, Aquifer Depth up to approximately 35 feet. Based on September 1990 Hydrologic Conditions

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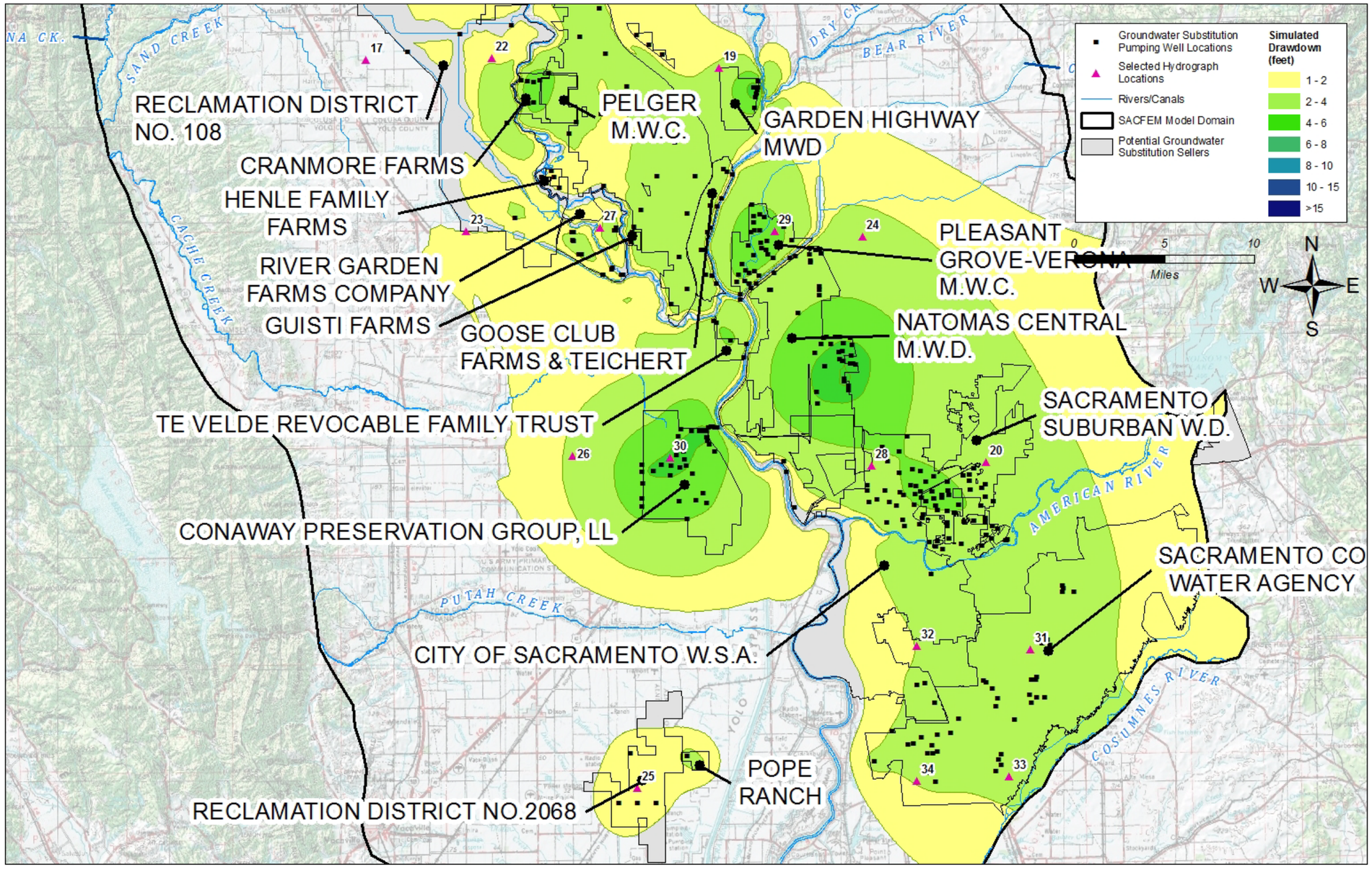

Figure F-4c.
Simulated Drawdown due to Groundwater Substitution Pumping, Aquifer Depth up to approximately 35 feet. Based on September 1990 Hydrologic Conditions

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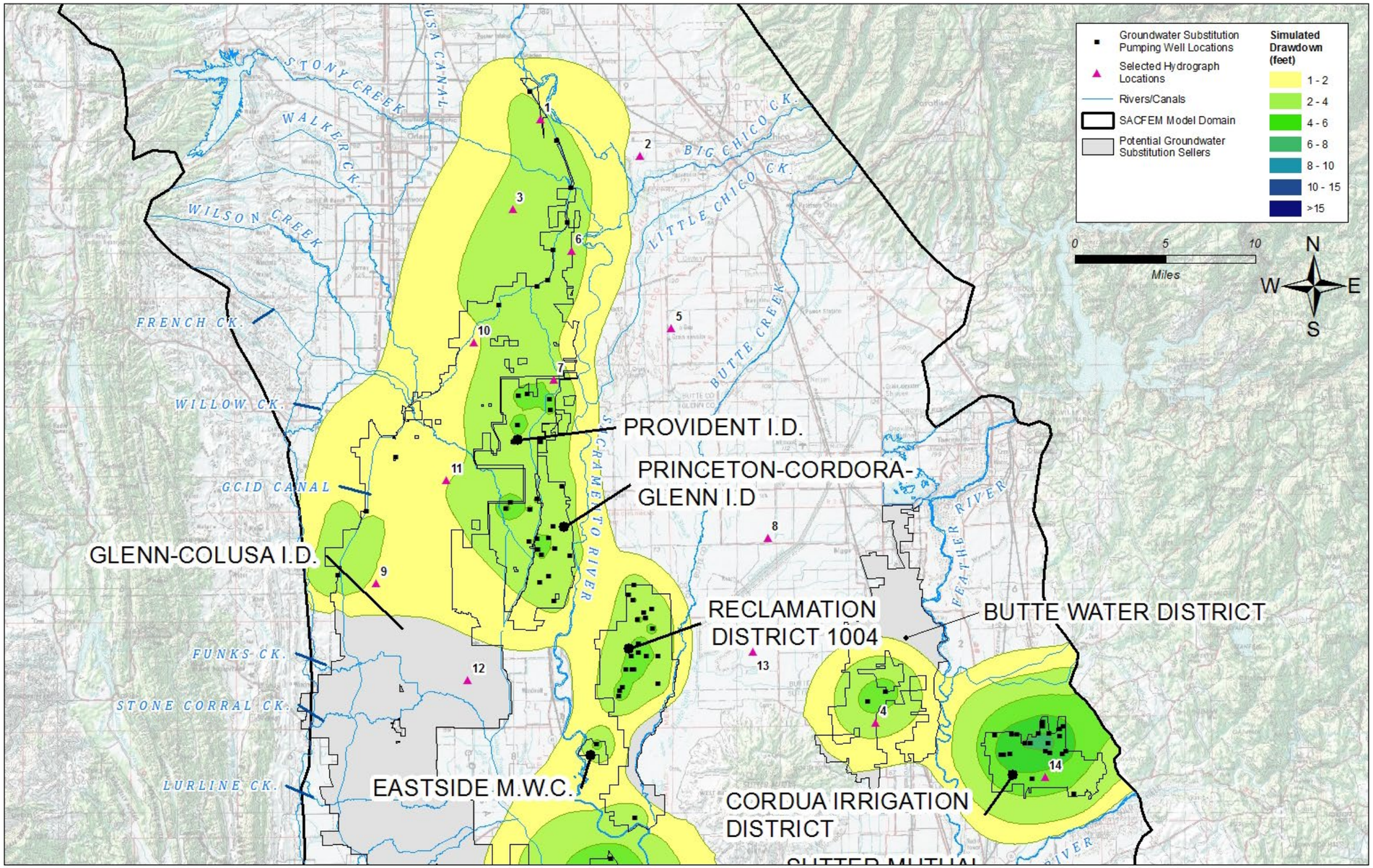

Figure F-5a.
Simulated Change in Groundwater Head due to Groundwater Substitution Pumping, Aquifer Depth of approximately 200 to 300 feet. Based on September 1990 Hydrologic Conditions

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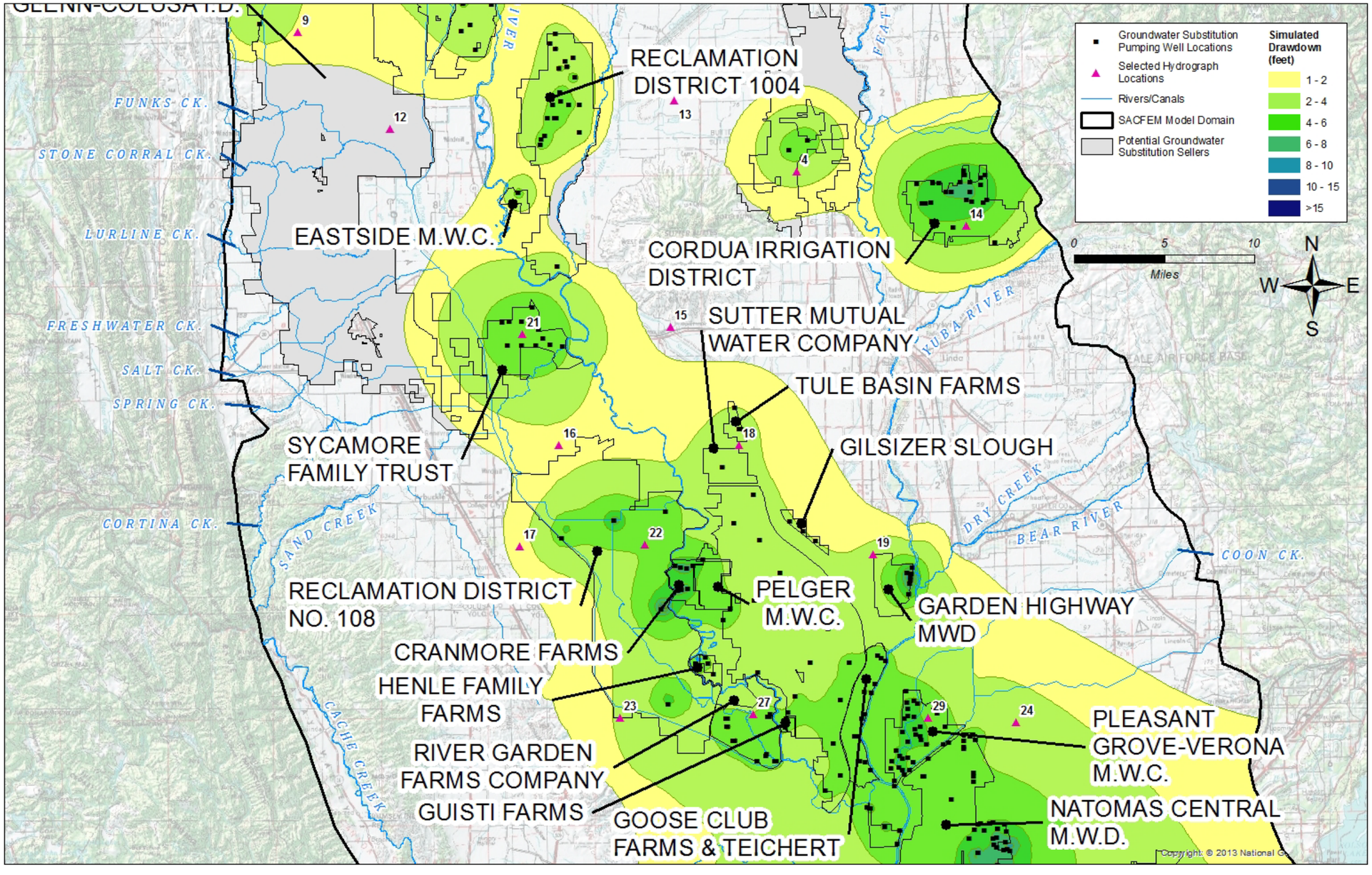

Figure F-5b.
Simulated Change in Groundwater Head due to Groundwater Substitution Pumping, Aquifer Depth of approximately 200 to 300 feet. Based on September 1990 Hydrologic Conditions

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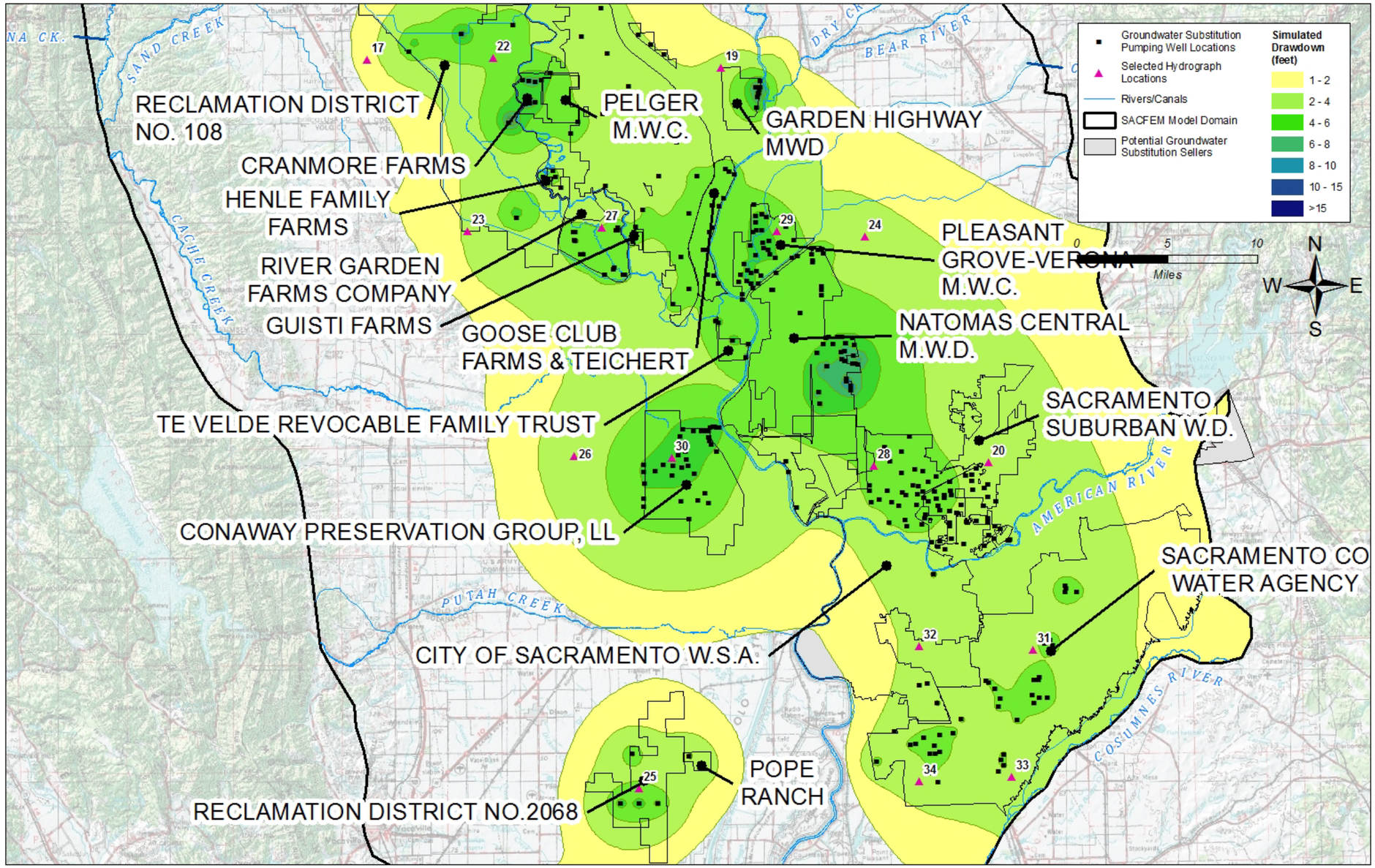

Figure F-5c.
Simulated Change in Groundwater Head due to Groundwater Substitution Pumping, Aquifer Depth of approximately 200 to 300 feet. Based on September 1990 Hydrologic Conditions

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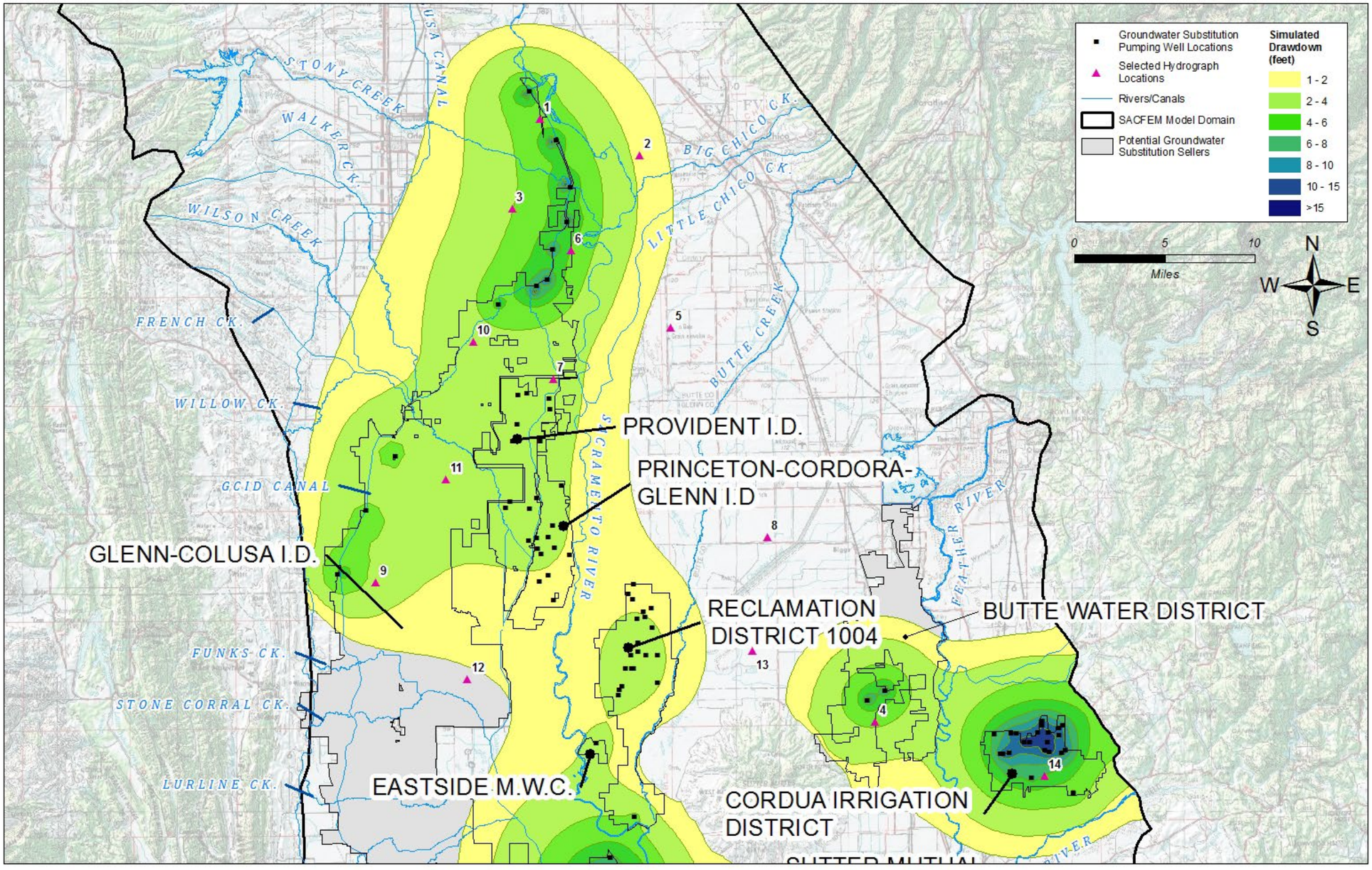

Figure F-6a.
Simulated Change in Groundwater Head due to Groundwater Substitution Pumping, Aquifer Depth of approximately 700 to 900 feet. Based on September 1990 Hydrologic Conditions

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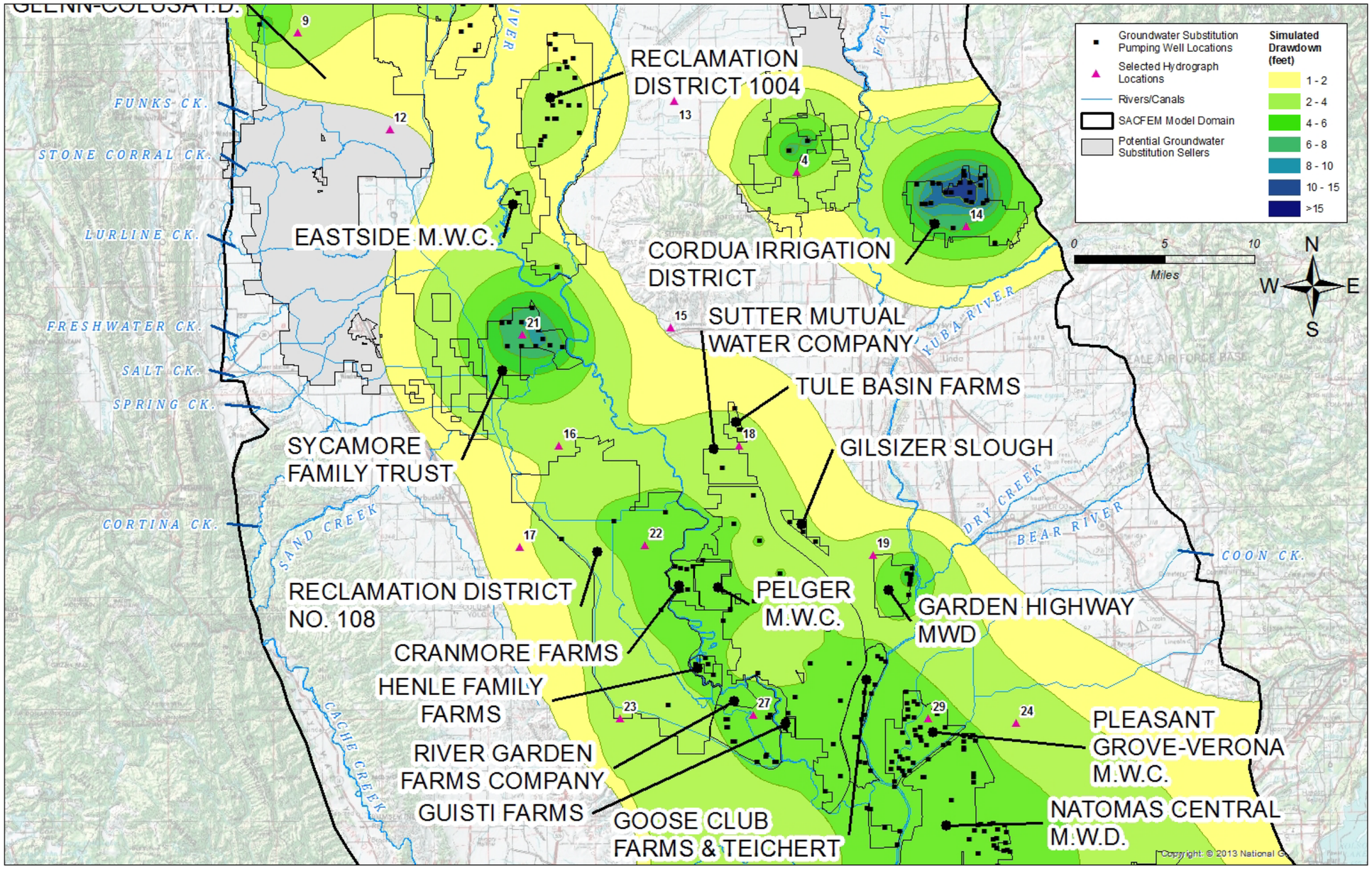

Figure F-6b.
Simulated Change in Groundwater Head due to Groundwater Substitution Pumping, Aquifer Depth of approximately 700 to 900 feet. Based on September 1990 Hydrologic Conditions

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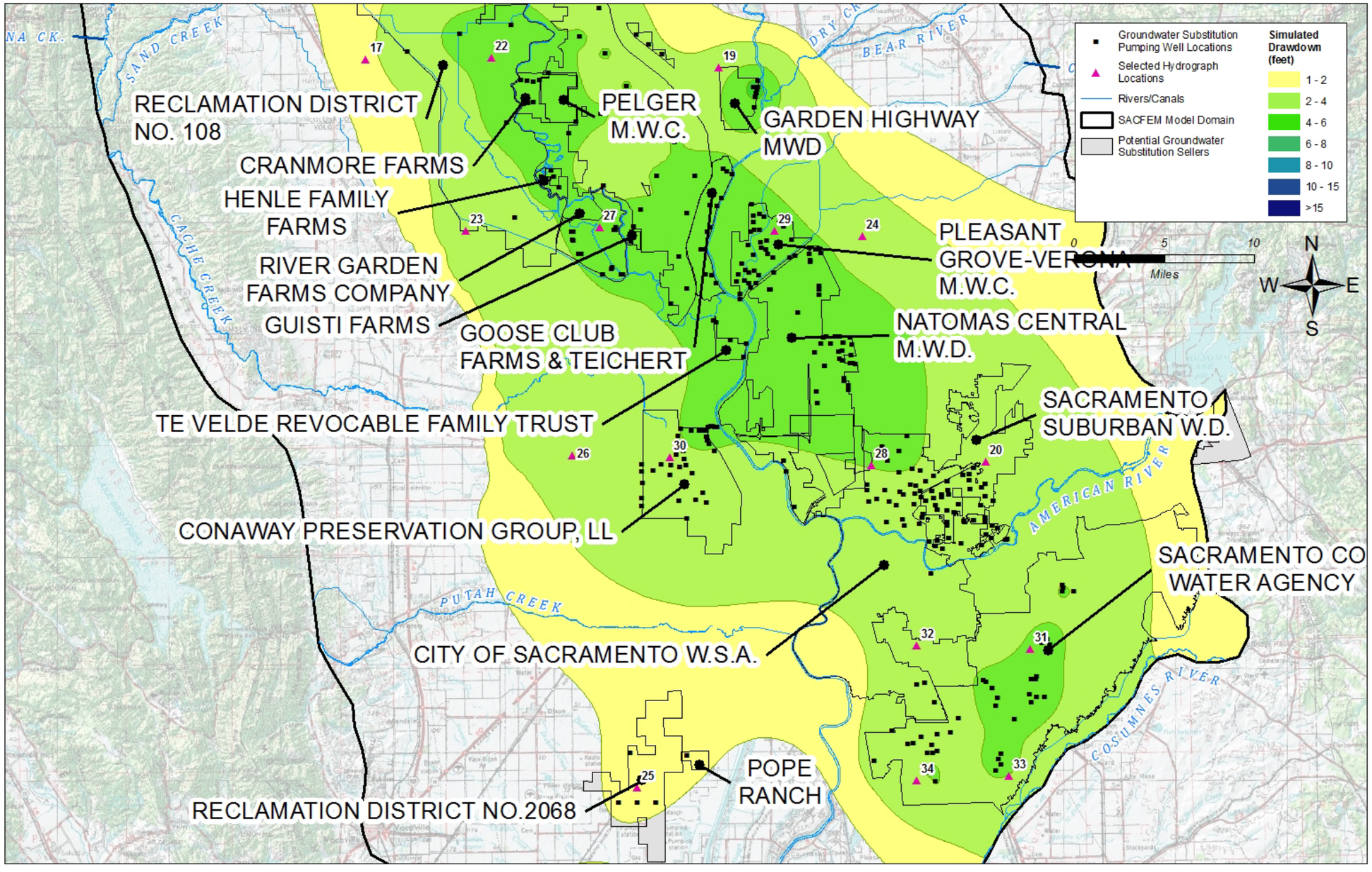

Figure F-6c.
Simulated Change in Groundwater Head due to Groundwater Substitution Pumping, Aquifer Depth of approximately 700 to 900 feet. Based on September 1990 Hydrologic Conditions

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Appendix G Natural Communities Descriptions

The list of special-status species considered for analysis was based on a search of the California Department of Fish and Wildlife [CDFW] California Natural Diversity Database (CNDDB), USFWS species lists for the counties within the area of analysis, and active HCPs in the vicinity of the area of analysis. The complete list of special-status species evaluated is provided in Tables I-1 (fish and wildlife) and I-2 (plants) contained within Appendix I of the 2014 Draft EIS/EIR. Figure 3.8-3 shows Federal national wildlife refuges (NWRs) and State wildlife management areas in the area of analysis.

G.1 Natural Communities and Agricultural Habitats in Seller Service Area

This section describes the natural communities in the Seller Service Area that could be affected by long-term water transfers. The Seller Service Area includes the Sacramento and San Joaquin rivers watershed. Although the Central Valley is dominated by agricultural land, remnant grassland, oak woodlands, riparian and wetland habitats remain (Central Valley Joint Venture 2006; Point Reyes Bird Observatory 2005).

G.1.1 Tidal Perennial Aquatic Natural Community

The tidal perennial aquatic natural community is defined as deepwater aquatic (greater than ten feet deep from mean lower low water[1]), shallow aquatic (less than or equal to ten feet deep from mean lower low water), and unvegetated intertidal (tideflats) zones of estuarine bays, river channels, and sloughs.

Tidal perennial aquatic natural community occurs in open water including sloughs and channels in the Bay Delta and bays. Deep, open water areas are largely unvegetated; beds of aquatic plants occur in shallower open-water areas. Over 50 species of fish use tidal perennial aquatic habitat at some stage of their life cycle, and many spend their entire lives within this natural community. Shorebirds, wadingbirds, waterfowl, river otters (*Lutra canadensis*), and beavers (*Castor canadensis*) are some of the terrestrial species that use this natural community.

G.1.2 Saline Emergent Wetland Natural Community

Portions of San Francisco, San Pablo, and Suisun Bays and the Delta support emergent salt-tolerant or brackish-tolerant wetland plant species, collectively considered saline emergent wetland. This natural community is typically located within the intertidal zone

[1] Mean lower low water is the average height of the lowest tide recorded at a tide station each day during the recording period.

or on lands such as diked wetlands that historically experienced tidal exchange (Reclamation and Department of Water Resources [DWR] 2004). Cordgrass (*Spartina* sp.), pickleweed (*Salicornia* sp.), bulrush (*Schoenoplectus* spp.), saltgrass *(Distichlis spicata*), arrowgrass (*Triglochin* sp.), seablite (*Suaeda* sp.), hairgrass (*Deschampsia* sp.), cattails (*Typha* spp.), common reed (*Phragmites australis*), and algae are common dominant plant species in this natural community.

Over 25 species of birds and mammals have been documented in saline emergent wetlands (CALFED 2000). Over 220 species of birds, 45 species of mammals, 16 species of amphibians and reptiles, and over 40 fish species inhabit the Suisun Marsh environs (CDFG, USFWS, Reclamation 2011). Herons, egrets, ducks, hawks, and rodents are representative wildlife that occur in saline emergent wetlands.

G.1.3 Tidal Fresh Emergent Wetland Natural Community

The tidal fresh emergent wetland natural community includes portions of the intertidal zones of the Delta that support emergent wetland plant species that are not tolerant of saline or brackish conditions. Tidal fresh emergent wetlands and brackish-water emergent marsh natural communities occur on in-stream islands and along mostly unleveed, tidally influenced waterways. Tidal emergent marsh provides habitat for many special-status species. The dominant vegetation in the tidal freshwater emergent natural community includes California bulrush (*Schoenoplectus californicus*), river bulrush (*Bolboschoenus fluviatilis*), big bulrush (*S. mucronatus*), tules (*Schoenoplectus acutus* var. *occidentalis*), 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 as well as numerous mammals, reptiles, and amphibians (CDFG 2008). Over 50 species of birds, mammals, reptiles, and amphibians use freshwater emergent wetlands in the Delta (CALFED 2000).

G.1.4 Non-tidal Fresh Emergent Wetland Natural Community

Non-tidal fresh emergent wetlands are scattered along the Sacramento River, typically in areas with slow-moving backwaters. Substantial portions of this natural community occur at the Colusa, Sutter, and Tisdale Bypasses, the Butte Sink, and at the Fremont Weir. Non-tidal fresh emergent wetland also occurs on the landward side of levees in the Delta, often in constructed waterways and ponds within agricultural lands. This natural community often occurs where soils are inundated or saturated for all or most of the growing season, such as around backwater areas.

Non-tidal fresh emergent wetland consists of permanent wetlands comprised of vegetation that is not tolerant of salt or brackish water, such as meadows (Barbour et al. 2007). These areas may be natural or managed. The dominant vegetation for this natural community includes thingrass (*Agrostis pallens*), spikerush (*Eleocharis* sp.), big leaf sedge (*Carex amplifolia*), bulrush, redroot nutgrass (*Cyperus erythrorhizos*), tules, cattails, common reed, and water grass (*Echinochloa oryzoides*).

Many wildlife species depend on non-tidal fresh emergent wetland for the entirety of their life cycles. In addition, this natural community is seasonally important to migratory species. Over 50 species of birds, mammals, reptiles, and amphibians use this natural community in the Delta (CALFED 2000). Examples of amphibians that occur within this natural community type include bullfrogs (*Rana catesbeiana*), western toads (*Bufo boreas*), and Pacific tree frogs (*Pseudacris regilla*). Birds typically found in non-tidal fresh emergent wetlands include herons, egrets, bitterns, mergansers, wood ducks (*Aix sponsa*), and yellow warblers (*Dendroica petechia*) (CDFG 2008).

G.1.5 Natural Seasonal Wetland Natural Community

The natural seasonal wetland natural community can be found scattered along the Sacramento and American Rivers, typically in areas with slow-moving backwaters. Substantial portions of these natural communities occur at the Colusa, Sutter, and Tisdale Bypasses, the Butte Sink, and at the Fremont Weir. Seasonal wetlands, including vernal pools, are interspersed with other natural communities throughout Merced County.

Natural seasonal wetlands encompass non-managed systems with natural hydrologic connections. Typically, ponded water or saturated soils are present for an extended period of time in these natural communities, supporting obligate or facultative herbaceous wetland species (Reclamation and DWR 2004). Dominant vegetation in this natural community type includes big leaf sedge, bulrush, and redroot nutgrass.

Shorebirds and waterfowl such as killdeer (*Charadrius vociferus*), western sandpiper (*Calidris mauri*), greater yellow-legs (*Tringa melanoleuca*), American coot (*Fulica americana*), American widgeon (*Anas americana*), gadwall (*Anas strepera*), mallard (*Anas platyrhynchos*), canvasback (*Aythya valisineria*), and common moorhen (*Gallinula chloropus*) utilize natural seasonal wetlands. These birds prey extensively on invertebrates in the wetlands. This natural community also supports large mammals as well as several species of reptiles and amphibians. Many special-status wildlife species are associated with natural seasonal wetlands, including vernal pool species, which have substantially declined due to impacts of various land practices (e.g., development, invasion of non-native species, flood control activities restricting water movement, and lowered groundwater levels (Barbour et al. 2007). Special-status species are discussed in greater detail in Section 3.8.1.3.3.

G.1.6 Managed Seasonal Wetland Natural Community

The managed seasonal wetland natural community occurs west of the Sacramento Deep Water Ship Channel, on the west side of the Sacramento River, between Willows and Dunnigan along the Colusa Basin Drain. Substantial portions of this natural community also occur at the Colusa, Sutter (including the Sutter Bypass Wildlife Area), Tisdale, and Yolo (including the Yolo Bypass Wildlife Area) Bypasses, at the Fremont Weir, and as a part of the Sacramento NWR Complex (six refuges totaling 38,486 acres). Privately managed wetlands occur in the Suisun Bay area, with water supplies provided by landowners' riparian or appropriative rights distributed by diversion from Delta channels and tributaries. Managed seasonal wetland natural communities on the east side of the Sacramento River generally occur along Butte Creek (Upper Butte Basin Wildlife Area) and along Angel Slough north of Butte City (Llano Seco Rancho Wildlife Area).

Managed seasonal wetland includes wetland areas that are flooded and drained by land managers in order to enhance habitat for wildlife species. Wetlands dominated by native or non-native herbaceous plants, as well as associated ditches and drains, are encompassed by this natural community type, excluding farmed croplands (California Waterfowl Association 2011).

The dominant vegetation in managed seasonal wetlands is comparable to that found in natural seasonal wetlands. Managed seasonal wetland natural communities are often managed for waterfowl such as mallards, northern pintails (*Anas acuta*), American widgeon, and Canada goose (*Branta canadensis*) and other geese. These natural communities also support a variety of wading birds and shorebirds, such as herons, egrets, terns, and gulls. Managed seasonal wetlands are of great importance to migratory waterfowl and shorebird populations during fall, winter, and spring, when bird populations in the Delta increase dramatically (USFWS 2007, California Waterfowl Association 2011). Many special-status species also utilize this natural community (CDFG 2008).

G.1.7 Lacustrine Natural Community

The lacustrine natural community consist of permanent or intermittent lakes and ponds, and may also include dammed river channels and large reservoirs (Grenfell Jr. 1988a, 1988b, 1988c,1988d). Low-lying areas historically supported this natural community, and some additional areas have been created due to dam, dike and levee construction. Dead end sloughs, forebays, and flooded islands are other examples of the lacustrine natural community that can be found throughout the Delta. The lacustrine natural communities in the Seller Service Area that would be potentially impacted by the alternatives include the following reservoirs: Shasta, Oroville, New Bullards Bar, Camp Far West, Collins, Folsom, Hell Hole, French Meadows, and McClure. Unlike lakes and ponds, the reservoirs have been designed for water supply, flood control, and/or hydroelectric power production, although not all reservoirs serve all of these functions. Reservoirs are characterized by fluctuations in water surface elevation each year.

A wide variety of birds, mammals, reptiles and amphibians use the margins of reservoirs for reproduction, food, water, and cover resources. Fish-eating terns, grebes, cormorants, herons, waterfowl, beaver, river otter, and muskrat (*Ondatra zibethicus*) are some of the resident species (CALFED 2000; CDFG 2008).

G.1.8 Valley/Foothill Riparian Natural Community

Valley/foothill riparian natural community generally occurs along river and stream corridors on the east side of the Sacramento Valley and is found in narrow bands within the upper reach of the San Joaquin River. Historically, the Merced River likely also supported this habitat type (Barbour et al. 2007). Riparian vegetation is also scattered throughout the Delta on islands, along levees, in backwater areas and sloughs, and in thin bands along river channels. This habitat type is associated with low-gradient reaches of non-tidal streams and rivers (generally below an elevation of 300 feet) and is comprised of the successional stages of woody vegetation within the active and historical floodplains and may be associated with gravel bars and bare cut banks, shady vegetated banks, and sheltered wetlands such as sloughs, side channels, and oxbow lakes

(Sacramento River Advisory Council 2001). Trees typically associated with the valley/foothill riparian natural community include willows (*Salix* spp.), Fremont cottonwood (*Populus fremontii*), valley oak (*Quercus lobata*), and western sycamore (*Platanus racemosa*) (Barbour et al. 2007). Shaded riverine aquatic, pool, riffle, run, unvegetated channel, sloughs, backwaters, overflow channels, and flood bypasses with hydrologic connection to stream and river channels are the aquatic habitats associated with the valley/foothill riparian natural community type (Barbour et al. 2007).

In California, over 225 species of birds, mammals, reptiles, and amphibians depend on riparian habitats. Cottonwood-willow riparian areas support more breeding avian species than any other comparable broad California habitat type (Sacramento River Advisory Council 2001, Stillwater Sciences 2002). Riparian habitat supports a myriad of invertebrates, such as wood-boring larvae. Woodpeckers, warblers, flycatchers, and owls are common inhabitants of this natural community, as are wintering and breeding raptors and passerines (Reclamation and San Joaquin River Group Authority 1999). Other wildlife species that use riparian habitats include western fence lizard (*Sceloporus occidentalis*), Pacific tree frog, western toad, bullfrog, western skink (*Eumeces skiltonianus*), western whiptail (*Cnemidophorus tigris*), southern alligator lizard (*Elgaria multicarinata*), racer (*Coluber constrictor*), gopher snake (*Pituophis catenifer*), king snake (*Lampropeltis* sp.), garter snake (*Thamnophis* sp.), northern Pacific rattlesnake (*Crotalus oreganus oreganus*), opossum (*Didelphis virginiana*), black-tailed jackrabbit (*Lepus californicus*), western gray squirrel (*Sciurus griseus*), ringtail (*Bassariscus astutus*), river otter, striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), beaver, mule deer (*Odocoileus hemionus*), and a number of bat species. Riparian areas serve as significant corridors for wildlife movement (Sacramento River Advisory Council 2001).

G.1.9 Montane Riparian Natural Community

The montane riparian natural community occurs in the floodplain of streams and rivers at elevations above approximately 300 feet (Reclamation and DWR 2004). Within the area of analysis, montane riparian natural community is found on the Yuba River northward from the Timbuctoo Bend, just upstream of Highway 20, as well as on the segment of American River located northeast of Folsom Reservoir. Montane riparian vegetation is dominated by black cottonwood (*Populus trichocarpa*) and Fremont cottonwood (at lower altitudes), white alder (*Alnus rhombifolia*), bigleaf maple (*Acer macrophyllum*), dogwood (*Cornus* sp.), box elder (*Acer negundo*), quaking aspen (*P. tremuloides*), western azalea (*Rhododendron* sp.), water birch (*Betula occidentalis*), and buttonbush (*Cephalanthus occidentalis*). Montane riparian natural community supports a diversity of wildlife species comparable to that of the valley/foothill riparian natural community.

G.1.10 Grassland Natural Community

Grasslands are most prevalent at the eastern and western edges of the Central Valley. Areas downstream of Lake Oroville along the Feather River and portions of the American River (Folsom Reservoir Shoreline) also contain the grassland natural community (Barbour et al. 2007). The grassland natural community occurs in many outlying areas surrounding the Delta, as well as on islands within the Delta region (Reclamation and DWR 2004). The Delta historically supported perennial grasslands associated with wetland and riparian areas, as well as in association with vernal pools at

higher elevations in drier locations. Grasslands in the Delta estuary continue to decline due to land conversion, as well as invasion by non-native annual species.

Grasslands are an upland natural community often dominated by non-native annual species including wild oats (*Avena* sp.), soft chess (*Bromus hordeaceus*), brome (*Bromus* sp.), Italian ryegrass (*Festuca perennis*), mustards (Brassicaceae), foxtail (*Alopecurus* sp.), and barley *(Hordeum* sp.). Many grassland areas within the area of analysis are in active use as rangelands. Forbs commonly observed in this natural community include filarees (*Erodium* spp.), clovers (*Trifolium* spp.), popcorn flower (*Plagiobothrys* sp.), and mullein (*Verbascum* sp.). Wildlife species of the grassland natural community include western fence lizard, garter snake, rattlesnake, black-tailed jackrabbit, California ground squirrel (*Spermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), harvest mouse (*Reithrodontomys megalotis*), California vole (*Microtus californicus*), badger (*Taxidea taxus*), and coyote (*Canis latrans*). Bird species include western meadowlark (*Sturnella neglecta*), turkey vulture (*Cathartes aura*), and American kestrel (*Falco sparverius*) (Barbour et al. 2007; CDFG 2008).

G.1.11 Inland Dune Scrub Natural Community

Inland dune scrub natural community consists of vegetated, stabilized sand dunes associated with river and estuarine systems, such as that at Antioch Dunes NWR and Brannan Island State Park. The Antioch-Oakley areas, Delta marshes, and small isolated dunes on the eastern edge of the Delta also historically supported inland dune scrub (Reclamation and DWR 2004).

This natural community is dominated by mostly sensitive species (see Appendix I of the 2014 Draft EIS/EIR), but also contains common plants such as primrose (*Camissonia* sp.), wallflower (*Erysimum* sp.), buckwheat (*Eriogonum* sp.), elegant clarkia (*Clarkia unguiculata*), California poppy (*Eschscholzia californica*), California croton (*Croton californicus*), gumplant (*Grindelia* sp.), deerweed (*Acmispon* sp.), telegraph weed (*Heterotheca grandiflora*), California matchweed (*Gutierrezia* sp.), and silver bush lupine (*Lupinus albifrons*). Common wildlife species known to occur within the inland dune scrub natural community include mink (*Mustela vison*), desert cottontail (*Sylvilagus audubonii*), beaver, muskrat, opossum, weasel (*Mustela* sp.), striped skunk, gopher (*Thomomys* sp.), gray fox (*Urocyon cinereoargenteus*), California ground squirrel, coyote, black-tailed jackrabbit, raccoon, Townsend's mole (*Scapanus townsendii*), weasel (*Mustela* sp.), red fox (*Vulpes vulpes*), California legless lizard (*Anniella pulchra*), sideblotched lizard (*Uta stansburiana*), coast horned lizard (*Phrynosoma coronatum*), San Joaquin whipsnake (*Masticophis flagellum ruddocki*), glossy snake (*Arizona elegans*), western whiptail lizard (*Cnemidophorus tigris*), and western fence lizard.

G.1.12 Upland Scrub Natural Communities

Upland scrub natural communities in the area of analysis include mixed chaparral, sage scrub, saltbush scrub, and valley sink scrub. Mixed chaparral natural community occurs on steep south-facing slopes along the Middle and Lower North Forks of the American River and portions of Folsom Reservoir also provide upland scrub natural community (Placer County Development Resources Agency 2011; California State Parks 2007). In Contra Costa County, the surroundings of Los Vaqueros Reservoir support Diablan sage

scrub, chaparral, and remnants of valley sink scrub natural community (Contra Costa Water District [WD] 2005; East Contra Costa Habitat Conservancy 2006). Common plant species observed in these natural communities include buckbrush (*Ceanothus* spp.), manzanita (*Arctostaphylos* spp.), bitter cherry (*Prunus emarginata*), oaks, poison oak (*Toxicodendron diversilobum*), coffee berry (*Frangula* sp.), California buckeye (*Aesculus californica*), toyon (*Heteromeles arbutifolia*), sugar sumac (*Rhus ovata*), chamise (*Adenostoma fasciculatum*), California saltbush (*Atriplex californica*), sagebrush (*Artemisia* sp.), and creosote bush (*Larrea tridentata*) (Barbour et al. 2007).

Upland scrub natural communities support many common wildlife species. Spotted towhee (*Pipilo maculatus*), California quail (*Callipepla californica*), California thrasher (*Toxostoma redivivum*), and red-tailed hawk (*Buteo jamaicensis*) are frequently observed in upland scrub. Common mammals occurring within this habitat include brush rabbit (*Sylvilagus bachmani*), blacktailed jackrabbit, and mule deer (CDFG 2008).

G.1.13 Seasonally Flooded Agriculture Habitat

Seasonally flooded agriculture is concentrated in the Sacramento Valley portion of the area of analysis. The central Delta also supports small grains croplands. Lands that fall within this habitat require seasonal flooding for at least one week at a time for irrigation or pest control purposes, and may include grain, rice (*Oryza* sp.), and other crops. Grain crops are typically post-harvest flooded in the winter season, which provides habitat for waterfowl and other wildlife.

Rice fields provide particularly important foraging habitat for a variety of wildlife species. Many species forage on post-harvest waste grain and other food found within the fields (Pitkin 2011; Central Valley Joint Venture 2006). Small birds and rodents that consume rice waste grain are a food source for raptors that forage in the seasonally flooded fields. Duckweed (*Lemna* sp.) and other moist soil plants, which may grow in fields where water level manipulation allows their germination, can provide high-quality food for waterfowl (California Waterfowl Association 2011). Fish are often entrained in the irrigation canals that supply water to the rice fields. Crayfish are found in the canal banks and berms of the rice fields. Other invertebrates and their larvae may be found in very shallow water, particularly during an early to midseason drawdown. Invertebrates found in these areas (e.g., bloodworms) are particularly important to shorebirds (California Waterfowl Association 2011).

Rice fields also provide resting, nesting, and breeding habitat similar to that in natural wetlands. Irrigation ditches can contain wetland vegetation such as cattails, which provide cover habitat for rails, egrets, herons, bitterns, marsh wrens (*Cistothorus palustris*), sparrows, and common yellowthroats (*Geothlypis trichas*). Rice fields provide pair, brood, and nesting habitat for birds such as mallard duck, northern pintail, and terns (Central Valley Joint Venture 2006, CDFG 2008).

G.1.14 Upland Cropland Habitat

Upland cropland areas are found throughout the Sacramento and San Joaquin valleys, as well as adjacent to most leveed waterways. This habitat is considered to include agricultural lands that are not seasonally flooded. Sacramento Valley croplands are dominated by cereal rye (*Secale cereale*), barley (*Hordeum vulgare*), wheat (*Triticum aestivum*), milo (*Sorghum* sp.), corn (*Zea mays*), dry beans, safflower (*Carthamus tinctorius*), sunflower (*Helianthus annuus*), alfalfa (*Medicago sativa*), cotton (*Gossypium* sp.), tomatoes (*Lycopersicon* sp.), lettuce (*Lactuca sativa*), Bermuda grass (*Cynodon dactylon*), Italian ryegrass, tall fescue (*Festuca arundinacea*), almonds (*Prunus dulcis*), walnuts (*Juglans* sp.), peaches (*Prunus persica*), plums (*Prunus* sp.), and grapes (*Vitis* sp.) and other fruits and vegetables. Most of these crops are annuals, planted in the spring and harvested during summer or fall. Wheat and other dryland grains are planted in the fall and harvested in the late spring, early summer. Sugar beets (*Beta vulgaris*) can also be left over winter and harvested in the spring.

Wildlife use of upland crop areas varies throughout the growing season with crop type, level of disturbance, and available cover. Upland crop fields provide important foraging habitat for a variety of wildlife species. Many species forage on crops (waste and otherwise) and other food found within the fields, such as invertebrates. Typically, various birds and rodents consume the crops and invertebrates and serve as a food source for predators. Irrigation ditches associated with upland cropland can contain wetland vegetation such as cattails, which provide cover habitat for rails, egrets, herons, bitterns, marsh wrens, sparrows, and common yellowthroats.

G.2 Natural Communities and Agricultural Habitats in Buyer Service Area

This section describes the natural communities, agricultural habitats and associated plant and wildlife species that are present in the Buyer Service Area. The Buyer Service Area includes portions of Contra Costa and Alameda Counties (Contra Costa WD, East Bay Municipal Utility District), Santa Clara County (Santa Clara Valley WD), and northern San Benito County (San Benito County WD). The Buyer Service Area also includes the area that extends south from San Joaquin County to northwestern Kings County, which contains potential buyers that are member agencies of San Luis & Delta-Mendota Water Authority.

G.2.1 Lacustrine Natural Community

The lacustrine natural community in the Buyer Service Area occurs within San Luis Reservoir on the western edge of the San Joaquin Valley.

Wildlife species that may be found within the lacustrine natural community in the Buyer Service Area include belted kingfisher (*Megaceryle alcyon*), Caspian tern (*Hydroprogne caspia*), ring-billed gull (*Larus delawarensis*), Clark's grebe (*Aechmophorus clarkii*), western grebe (*Aechmophorus occidentalis*), pied-billed grebe (*Podilymbus podiceps*), osprey (*Pandion haliaetus*), great egret (*Ardea alba*), spotted sandpiper (*Actitis macularius*), and killdeer.

G.2.2 Valley/Foothill Riparian Natural Community

This natural community occurs in the Buyer Service Area along many of the segments of the San Joaquin River from Friant Dam through the Central Valley into the Delta and is comprised primarily of mixed oak, cottonwood, and willow. Valley/foothill riparian natural community is present at San Luis Reservoir in the form of sparse mule fat and willow patches. In addition to the plant species previously mentioned in the other regions, riparian habitats south of the Delta may support Northern California black walnut, a species considered sensitive by CDFW.

Common species that may occur in this vegetation community and associated aquatic habitat within the Buyer Service Area include black phoebe (*Sayornis nigricans*), red-winged blackbird (*Agelaius phoeniceus*), Brewer's blackbird (*Euphagus cyanocephalus*), ash-throated flycatcher (*Myiarchus cinerascens*), northern rough-winged swallow (*Stelgidopteryx serripennis*), western scrub jay (*Aphelocoma californica*), black-headed grosbeak (*Pheucticus melanocephalus*), California quail, Nuttall's woodpecker (*Picoides nuttallii*), oak titmouse (*Baeolophus inornatus*), California towhee (*Pipilo crissalis*), Merriam's chipmunk (*Tamias merriami*), mule deer, coyote, black bear (*Ursus americanus*), mountain lion (*Puma concolor*), and raccoon.

G.2.3 Grassland Natural Community

Substantial areas of non-native grassland are present in Contra Costa, Santa Clara, and Merced Counties. This includes lands surrounding San Luis Reservoir. Non-native grasses in these locations intergrade with native species including purple needle grass (*Stipa pulchra*), beardless wild rye (*Elymus triticoides*), and onion grass (*Melica* sp.).

Killdeer, white-throated swift (*Aeronautes saxatalis*), ring-necked pheasant (*Phasianus colchicus*), American crow (*Corvus brachyrhynchos*), rufous-crown sparrow (*Aimophila ruficeps*), rock wren (*Salpinctes obsoletus*), western meadowlark, red-tailed hawk, American kestrel, common loon (*Gavia immer*), Barrow's goldeneye (*Bucephala islandica*), savannah sparrow (*Passerculus sandwichensis*), California vole, black-tailed jackrabbit, California ground squirrel, coyote, foxes, badgers, skunk, western rattlesnake, southern alligator lizard, two-striped garter snake (*Thamnophis hammondii*), California mountain kingsnake (*Lampropeltis zonata*), and western fence lizard are some of the species that would commonly be observed within grasslands in the Buyer Service Area.

G.2.4 Oak Woodland Natural Community

Scattered blue oak (*Quercus douglasii*) woodlands occur on the western shore of the San Luis Reservoir. Remnant patches are often found at the edges of agricultural lands that were converted from woodland to cultivation, and occur in larger stands leading up to the Sierra Nevada foothills. The oak woodland natural community varies with respect to the mix of hardwoods, conifers or shrubs present, and also demonstrates a range of canopy densities. Valley oak, blue oak, interior live oak (*Quercus wislizeni*), coast live oak (*Q. agrifolia*), and foothill pine (*Pinus sabiniana*) are common dominant species (Barbour et al. 2007).

Acorn woodpecker (*Melanerpes formicivorus*), northern flicker (*Colaptes auratus*), wild turkey (*Meleagris gallopavo*), oak titmouse, black-tailed jackrabbit, American crow, California quail, western fence lizard, coyote, mule deer, western bluebird (*Sialia mexicana*), white-breasted nuthatch (*Sitta carolinensis*), and American kestrel are commonly observed wildlife species in oak woodland within the Buyer Service Area (CDFG 2008).

G.2.5 Upland Cropland Habitat

Upland cropland areas are found throughout the San Joaquin Valley. Major crops in this area include alfalfa, almonds, corn, cotton, grapes, rice, and tomatoes (County of Fresno Department of Agriculture 2010; Merced County Department of Agriculture 2010; San Joaquin County 2010). These crops support common species, and may be important to common and sensitive wildlife, especially during irrigation periods. For example, cotton is known to harbor mourning doves (*Zenaida macroura*) and house mice (*Mus musculus*) and may also support species such as killdeer, American pipit (*Anthus rubescens*), and horned lark (*Eremophila alpestris*) (CDFG 2008). San Joaquin kit fox (*Vulpes macrotis mutica*), a federally endangered species, has been known to utilize croplands for forage as well (USFWS 1998). Ditches associated with intensive cropland are often chemically treated and therefore are less likely to serve as suitable habitat for wildlife species.

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Appendix H Special-Status Animals and Plants with Potential to Occur in the Area of Analysis

Table H-1.
Special-Status Animals with Potential to Occur in the Area of Analysis

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Invertebrates						
Bay checkerspot butterfly *Euphydryas editha bayensis*	T	--	Historically occurred east, west, and south of SF bay, to Mt. Diablo south to Hollister. Currently, restricted to six core areas on the west and southern edges of the SF bay - SF peninsula, San Mateo County, and Santa Clara County, Any site with appropriate habitat within historic range should be considered potentially occupied (The Xerces Society 2012)	Restricted to native grasslands on outcrops of serpentine soil. The primary host plant for this butterfly is *Plantago erecta (*Dwarf plantain*)*. Secondary host plant include *Othocarpus densiflorou*s, *O.purpurscens,* and Purple owl's clover. Prefers shallow, serpentine-derived soils.	Adult present in spring. Flight season late February to early May.	None. Occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. However, no impacts are expected to native grasslands.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Conservancy fairy shrimp *Branchinecta conservatio*	E	--	Northern two-thirds of the Central Valley. It ranges from Vina Plains of Tehama County; Sacramento NWR in Glenn County; Jepson Prairie Preserve and surrounding area east of Travis Air Force Base, Solano County; Mapes Ranch west of Modesto, Stanislaus County.	Inhabits the ephemeral water of swales and vernal pools. It is most commonly found in grass or mud bottomed swales, earth sump, or basalt flow depression pools in unplowed grasslands.	Has been collected from early December to early May.	None. Occurrences have been documented within the Seller Service Area. Suitable habitat occurs within the area of analysis. No impacts to vernal pool or other habitats occupied by this species are anticipated. The species is not likely to occur to occur in rice fields and canals due to predators (i.e. fish).
Lange's metalmark butterfly *Apodemia mormo langei*	E	--	Restricted to sand dunes along the southern bank of the Sacramento-San Joaquin River. Within Contra Costa County, it is currently found only at Antioch Sand Dunes.	Inhabits stabilized dunes along the San Joaquin river and is endemic to Antioch sand dunes, Contra Costa county. The butterfly's primary host plant is *Eriogonum nudum var. auriculatum*. It feeds on nectar of other wildflowers, as well as host plant.	Breeding season is August - September, Larvae hatch during rainy months.	None. CNDDB occurrences have been documented within the Buyer Service Area, however no impacts to sand dunes are anticipated.
Longhorn fairy shrimp *Branchinecta longiantenna*	E	--	Restricted to northern, central, and portions of southern California; populations along the eastern margin of the Central Coast Mountains from Concord, Contra Costa County south to Soda Lake in San Luis Obispo County; the Kellogg Creek watershed; the Altamont Pass area; the western and northern boundaries of Soda Lake on the Carrizo Plain; and Kesterson National Wildlife Refuge in the Central Valley.	Endemic to the eastern marring of the central coast mountains in seasonally astatic grassland vernal pools. Found in ephemeral freshwater habitats, such as vernal pools and swales.	Has been observed from late December until late April.	None. Occurrences have been documented within the Seller Service Area. Suitable habitat may occur within the area of analysis. The species is not likely to occur to occur in rice fields and canals due to predators (i.e. fish). Transfers are not expected to impact any suitable grassland vernal pools or swales.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
San Bruno elfin butterfly *Callophrys mossii bayensis*	E	--	Found in vicinity of San Bruno mountains, San Mateo County (ESSIG 2012b).	Found in coastal, mountainous areas with grassy ground cover. Colonies are located on steep, north-facing slopes within the fog belt. Larval host plant is *Sedum spathulifolium.*	Year round	None. Occurrences have been documented in the Buyer Service Area and suitable habitat is present in the area. No impacts are anticipated to mountainous areas near San Bruno. Therefore no impacts to the species are expected.
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T	--	Occurs only in the Central Valley and surrounding foothills below 3,000 feet elevation (USFWS 1980).	Dependent on elderberry shrubs (host plant) as a food source. Potential habitat consists of shrubs with stems one inch in diameter within Central Valley.	Year round for host plant and exit holes; March to June for adults	None. Occurrences have been documented within the Seller Service Area. Suitable habitat may occur within the area. However, elderberry shrubs would not be impacted by transfers, therefore no impacts are anticipated to the species.
Vernal pool fairy shrimp *Branchinecta lynchi*	T	--	Endemic to the Central Valley, Central Coast Mountains, and South Coast Mountains of California. It ranges from the Vina Plains in Tehama County, through the Central Valley, and south along the Central Coast to northern Santa Barbara County.	Endemic to the grasslands of the Central Valley, central coast mountains, and south coast mountains. Inhabits the ephemeral water of swales and vernal pools. It is most commonly found in grassed or mud bottomed swales, earth sump, or basalt flow depression pools in unplowed grasslands.	Has been collected from early December to early May.	None. Occurrences have been documented in both the Buyer and the Seller Service areas. Rice fields and canals are not likely to support this species due to the presence of predators (i.e. fish), therefore no impacts are anticipated to the species. Transfers are not expected to impact vernal pools or natural wetlands.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Vernal pool tadpole shrimp *Lepidurus packardi*	E	--	Endemic to the northern portion of the Central Valley of California. This species occurs from the Millville Plains and Stillwater Plains in Shasta County south throughout the Central Valley to Merced County.	Found in a variety of natural and artificial seasonally ponded Sacramento valley habitat types including: vernal pools, swales, ephemeral drainages, stock ponds, reservoirs, ditches, backhoe pits, and ruts caused by vehicular activities.	Has been collected from early December to early May.	None. Occurrences have been documented in both the Buyer and the Seller Service area. Suitable habitat is present in the area. Rice fields and canals are not likely to support this species due to the presence of predators (i.e. fish), therefore there is a low potential for impacts to the species. Transfers are not expected to impact vernal pools or natural wetlands. No impacts to the species are expected.
Zayante band-winged grasshopper *Trimerotropis infantilis*	E	--	Known only from Santa Cruz County. Found in local Santa Cruz mountains (the Zayanite Sand Hills ecosystem) (Santa Cruz Public Libraries 2012).	Found in isolated sandstone deposits. Inhabits mostly sand parkland habitat, but also in areas with well-developed ground cover and in sparse chaparral with grass.	Flight season from late May - Oct.	None. Occurrences have been documented in the Buyer Service Area and suitable habitat is present in the area, however, no impacts to suitable habitat are anticipated.
Amphibians						
California red-legged frog *Rana aurora draytonii*	T	SSC	Northwestern California, from Mendocino County south to northwestern Baja California. May now be extirpated in the southern Sierra Nevada; other Sierra Nevada foothill populations are small and highly localized. Nearly all current Central Valley sites are on the Coast Range slope, usually below 1,200m (3,936 ft).	Usually found in or near quiet permanent water of streams, freshwater marshes, or (less often) ponds and other quiet bodies of water; also damp woods and meadows some distance from water. Occurs in sites with dense vegetation (e.g., willows) close to water.	Year round. Little movement away from streamside habitats. Occasionally found on roads at night during winter and spring rains.	None. Suitable habitat is present within the area and occurrences of this species have been previously documented in the Buyer Service Area. Environmental Commitments would cause potential impacts to California red-legged frog to beneglegible.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
California tiger salamander *Ambystoma californiense*	T[1], E[2]	T	Found in annual grassland habitat, grassy understories of valley-foothill hardwood habitats, and uncommonly along stream courses in valley-foothill riparian habitats. Occurs from near Petaluma, Sonoma County, and east through the Central Valley to Yolo and Sacramento Counties and south to Tulare County.; and from the vicinity of San Francisco Bay south to Santa Barbara County. Occurs at elevations from 3m -1,054m (3200ft).	Lives in vacant or mammal-occupied burrows, occasionally other underground retreats, throughout most of the year, in grassland, savanna, or open woodland habitats. Lays eggs on submerged stems and leaves, usually in shallow ephemeral or semi permanent pools and ponds that fill during heavy winter rains, sometimes in permanent ponds; breeding takes place in fish free pools and ponds.	Migrates up to two km between terrestrial habitat and breeding pond. Migrations may occur from November through April.	None. Occurrences have been documented within both the Buyer and Seller Service Areas. Suitable habitat may occur within the area, but would not be impacted by transfers. This species is not expected to occur in rice fields due to predatory fish. Existing Environmental Commitments would maintain flow and temperature in streams.
Foothill yellow-legged frog *Rana boylii*	--	SSC	This species is known from the Pacific drainages from Oregon to the upper San Gabriel River, Los Angeles County, California, including the coast ranges (west pf Cascade crest) and Sierra Nevada foothills in the United States. Isolated populations in San Joaquin County on the floor of the Central Valley. Elevation range extends from near sea level to 1940m (6370ft).	This species inhabits partially shaded, rocky streams at low to moderate elevations, in areas of chaparral, open woodland, and forest. Rarely encountered far from permanent water.	Year round. Significant seasonal movements for migrations from breeding area have not been reported.	None. Occurrences have been documented within both the Buyer and Seller Service Areas. Suitable habitat is present within the area. However Transfers are not expected to impact any suitable rocky stream and woodland habitats. No impact to the species is expected.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Western spadefoot toad *Spea hammondii*	--	SSC	This species occurs in the Central Valley and bordering foothills of California and along the Coast Ranges into northwestern Baja California, Mexico. In the Coast Ranges it is found from Point Conception, Santa Barbara County, south to Mexican border. Elevation ranges from near sea level to 1,363m (4,460 ft).	Lowlands to foothills, grasslands, open chaparral, pine-oak woodlands. Prefers short grass plains, sandy or gravelly soil. It is fossorial and breeds in temporary rain pools and slow-moving streams that do not contain bullfrogs, fish, or crayfish.	Year round. Usually in underground burrows most of year, but will travel several meters on rainy nights. Movement is rarely extensive.	None. Occurrences have been documented from both the Buyer and Seller Service Areas. Suitable habitat is present in the area. Transfers would not impact suitable upland habitat types. The species is not likely to occur in rice fields due to the presence of predatory fish, bullfrogs etc. Environmental Commitments to maintain flows will protect Western spadefoot toad.
Reptiles						
Alameda whipsnake *Masticophis lateralis euryxanthus*	T	T	Seven populations (recovery units) are known from Alameda and Contra Costa Counties, including the Mt. Diablo area and other East Bay Regional Parks, south almost to the border of Alameda and Santa Clara Counties. Likely occurred historically within San Joaquin and northern Santa Clara Counties.	The species is typically found in chaparral and scrub habitats, but it will also use adjacent grassland, oak savanna and woodland habitats. It is mostly found on south-facing slopes & ravines, with rock outcrops, deep crevices or abundant rodent burrows.	Year round.	None. Occurrences have been documented within the Buyers and Sellers Service Areas. No impacts to suitable habitat for Alameda whipsnake are anticipated.
Blunt-nosed leopard lizard *Gambelia sila*	E	E	Currently known from undeveloped land within the San Joaquin Valley and the Coast Range foothills. Historically, the blunt-nosed leopard lizard ranged from the San Joaquin Valley and foothills from Stanislaus County south to northern Santa Barbara and Ventura Counties, with observations below 800m elevation.	This species is a resident of sparsely vegetated alkali and desert scrub habitats in areas of low topographic relief. The lizard seeks cover in mammal burrows, under shrubs or structures such as fence posts.	Year round. Hibernates during winter and active from late-March - July.	None. Occurrences have been documented within the Buyer Service Area and suitable habitat is present within the area of analysis. No impacts to suitable habitat for blunt-nosed leopard lizard are anticipated.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Coast horned lizard *Phrynosoma blainvillii*	--	SSC	Occurs in the Sierra Nevada foothills from Butte County to Kern County and throughout the central and southern California coast. Its elevational range extends up to 1200m (4000ft) in the Sierra Nevada foothills and up to 1800m (6000ft) in the mountains of southern California.	The species frequents a wide variety of habitats and is most commonly found in lowlands along sandy washes with scattered low bushes. It inhabits open areas for sunning, bushes for cover, patches of loose soil for burial & abundant supply of ants and other insects.	Year round.	None. Occurrences have been documented within both the Buyer and Seller Service Areas. No potential impacts to suitable habitat are anticipated.
Giant garter snake *Thamnophis gigas*	T	T	Endemic to wetlands in the Sacramento and San Joaquin Valleys from Chico, south to the Mendota Wildlife Area in Fresno County.	Marshes, sloughs, ponds, small lakes, streams and other waterways. Typically occurs in areas that provide adequate water during the active season with emergent wetland vegetation. Basking habitat consists of grassy areas or openings adjacent to aquatic habitat, and upland areas are also used for refuge from flood conditions (USFWS 2006)	Year round	High. Suitable habitat is present within the Buyer and Seller Service Areas. Suitable habitat in the Seller Service Area is intermittent based on normal variation in cropping. Direct impacts may include reduction in suitable aquatic habitat within the Seller Service Area. The greatest impact would occur during the breeding season. Conservation measures are in place to maintain aquatic habitat corridors within irrigation ditches.
San Francisco garter snake *Thamnophis sirtalis tetrataenia*	E	E	Historically occurred from north of the San Francisco-San Mateo County line south to Ano Nuevo State Reserve, west of the Santa Cruz Mountains (USFWS 2006b).	The species is found in the vicinity of freshwater marshes, ponds and slow moving streams in San Mateo county and the extreme northern Santa Cruz county. The snake prefers dense cover and water depths of at least 1ft. Upland areas near water are also very important for this species.	Year round	None. Suitable habitat may be present in a small portion of the Buyer Service Area within San Mateo County. No impacts to suitable San Francisco garter snake habitat are anticipated in association with the proposed Transfers.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
San Joaquin whipsnake *Masticophis flagellum ruddocki*	--	SSC	Known from as far north as Arbuckle, Colusa County through the San Joaquin Valley and Coast Ranges south into Kern and Santa Barbara Counties.	The species is found in open, dry habitats with little or no tree cover, generally at elevations 20 - 900m. It is also found in valley grassland and saltbush scrub in the San Joaquin valley. The snake requires mammal burrows for refuge and oviposition sites.	Year round.	None. Suitable habitat is present within the Buyer Service Area in the San Joaquin Valley. There is a very low potential that this species could occur in or adjacent to agriculture within the Buyer Service Area, but no conversion of suitable habitat would occur in association with the proposed Transfers.
Silvery legless lizard *Anniella pulchra*	--	SSC	The silvery legless lizard ranges from Antioch in Contra Costa County south through the Coast, Transverse, and Peninsular Ranges along the western edge of the Sierra Nevada Mountains. It occurs in the San Joaquin Valley and Mojave Desert down into Baja California. In the Sierra Nevada foothills it may occur at elevations up to 1,800m asl. (Contra Costa County 2006).	Sandy or loose loamy soil. May occur under sparse vegetation of beaches, chaparral, or pine-oak woodland, or near sycamores, cottonwoods, or oaks that grow on stream terraces. Often found under logs, rocks, old boards, or compacted debris of woodrat nests. Requires refugia with soil moisture during hot conditions. Agriculture and disturbed sites are not known to support the species (Contra Costa County 2006).	Year round	None. Suitable habitat is present within both the Buyer and Seller Service Areas, and previous records exist within the Buyer Service Area. Transfers are not expected to impact suitable habitat for the silvery legless lizard.
Pacific pond turtle *Actinemys marmorata*	--	SSC	Ranged from extreme western Washington and British Columbia to northern Baja California, mostly to the west of the Cascade-Sierra crest.	The western pond turtle occupies a wide variety of wetland habitats including rivers and streams (both permanent and intermittent), lakes, ponds, reservoirs, permanent and ephemeral shallow wetlands, abandoned gravel pits, stock ponds, and sewage treatment.	Year round	High. Suitable habitat occurs within the area of analysis. Pond turtles may occur in ditches, canals, rice fields, etc. Environmental Commitments would cause potential impacts to California red-legged frog to be negligible.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Birds[3]						
Alameda song sparrow *Melospiza melodia pusillula*	--	SSC	Endemic, restricted to fringes of south San Francisco Bay (east to El Cerrito, south to Alviso and west to San Francisco). Largest concentration near Dumbarton Point salt marsh, Alameda County.	The species is a resident of salt marshes. It inhabits salicornia marshes, nests low in grindelia bushes and in salicornia.	Year round, non-migratory. Breeds late-Feb to mid-August.	None. Occurrences have been documented within the Buyer Service Area. Suitable habitat may occur within the area of analysis. However, Transfers are not expected to impact any suitable habitat (i.e. salt marshes).
American peregrine falcon *Falco peregrinus anatum*	D	E, FP	Throughout California. Uncommon resident that breeds along coast north of Santa Barbara, in the Sierra Nevada, and other northern CA mountains. Migrant birds occur along the coast and the western Sierra Nevada.	Breeds in woodland, forest and coastal habitats on protected cliffs and ledges. Riparian areas and coastal and inland wetlands are important habitats yearlong especially during the non-breeding season.	Year round. Coastal migrants occur in Spring and Fall.	None. Rice fields may provide suitable foraging habitat for the species, but birds could relocate to other habitat areas in the vicinity. No nesting habitat would be affected by Transfers.
Bald eagle *Haliaeetus leucocephalus*	D	E	Throughout California. Breeding mostly in Butte, Lake, Lassen, Plumas, Shasta, Siskiyou, and Trinity counties. Winter migrant at inland waters.	Riparian areas near coasts, rivers, and lakes. Nesting generally occurs in large old-growth trees in areas with little disturbance. In flooded fields, occasionally hunts for small mammals.	Year round. Local winter movements.	None. Occurrences have been documented within both the Buyer and Seller Service Area and both areas provide suitable habitat. No impacts to suitable nesting habitat are anticipated. Rice fields represent marginal foraging habitat. Birds would be able to relocate to other suitable habitat areas in the vicinity if fields were fallowed. Environmental commitments limit the amount of land that can be fallowed in a given county.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Bank swallow *Riparia riparia*	--	T	A neotropical migrant found primarily in riparian and other lowland habitats in California west of the deserts during the spring-fall period. Breeding population in California occurs along banks of the Sacramento and Feather rivers in the northern Central Valley. Casual in southern California in winter. Other colonies along the central coast from Monterey to San Mateo counties.	Requires vertical banks and cliffs with fine-textured or sandy soils near streams, rivers, ponds, lakes, and the ocean for nesting. Feeds primarily over grassland, shrub land, savannah, and open riparian areas during breeding season and over grassland, brushland, wetlands, and cropland during migration.	March-mid-September	None. Known from both the Buyer and Seller Service Areas. No suitable nesting habitat (i.e. cliffs) would be affected. There is potential that Transfers would reduce the area of cropland habitat used for foraging during migration (wetlands and croplands) due to changes in water application. However, fallow cropland would still providing suitable foraging habitat, and birds could forage at other croplands in the vicinity. Environmental commitments limit the amount of cropland idling that would occur.
Black swift *Cypseloides niger*	--	SSC	Breeds locally in Sierra Nevada and Cascade range, San Gabriel, San Bernardino and San Jacinto Mts. Also in coastal bluffs and mountains from San Mateo County to San Luis Obispo County.	The bird breeds in small colonies on cliffs behind or adjacent to waterfalls in deep canyons and sea-bluffs above the surf. Found in moist crevice or cave on sea cliffs above the surf. Forage widely over many habitats. Avoids arid regions such as Great Basin, southern deserts and Central Valley.	Absent from October - April.	None. Occurrences have been documented within the Buyer Service Area. Suitable habitat may occur within the area of analysis. Habitat within the Buyers Service Area would not be affected, as water in excess of their CVP contract amount could not be procured, nor could this water be used to grow permanent crops. Therefore any change in habitat would fall within the normal range expected under their existing contracts.

Common Name *Scientific Name*	Federal Special Status*	State Special Status*	Distribution	Habitat Association	Seasonal Occurrence	Potential Impact
Black tern *Chlidonias niger*	--	SSC	Common spring and summer visitor to fresh emergent wetlands of California.	Uses fresh emergent wetlands, lakes, ponds, moist grasslands, and agricultural fields. In migration, some take coastal routes and forage offshore.	April-September	High. No occurrences have been documented within either the Buyer or Seller Service Areas. However, suitable habitat (i.e. rice fields) is present, and the area of analysis is within the known range for the species. Therefore it has moderate potential to occur Water transfers could reduce suitable habitat for the species within the Seller Service Area. Conservation strategies are in place that would make potential impacts to this species to negligible.
Black-crowned night heron *Nycticorax nycticorax* (rookeries)	--	--	Year round resident and common in lowlands and foothills throughout most of California, including the Salton Sea and Colorado River areas, and very common locally in large nesting colonies. Uncommon in northwestern and rare in northeastern CA in midwinter. Uncommon in winter in southern deserts.	Feeds along the margins of lacustrine, large riverine, and fresh and saline emergent habitats. Nests and roosts in dense-foliaged trees and dense emergent wetlands.	Year round. Common nesting species from April -August.	None. No occurrences of black-crowned night heron have been documented within either the Buyer or Seller Service Areas. Suitable habitat is present in the area of analysis; however, no nesting or roosting habitats would be affected.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Cackling (=Aleutian Canada) goose *Branta hutchinsii leucopareia*	D	--	The species is found in during the winter in Del Norte County, San Francisco Bay-Delta, and South Central Valley.	Forages on natural pasture or pastures that are cultivated to grain. The species occurs on lakes, reservoirs and ponds. Preferred habitats include lacustrine, fresh emergent wetlands, moist grasslands, croplands, pastures, and meadows.	Year-round in northeastern California, except when water freezes. Wintering population in California migrates north and east to northeastern California. Winters on lakes and inland prairies.	None. Occurrences have been documented within both the Buyer and Seller Service Areas. The species distribution does not overlap with the major area where fallowing would occur. Transfers are not expected to impact breeding habitat (i.e. prefers islands in lakes).
California clapper rail *Rallus longirostris obsoletus*	E	E	Common locally around San Francisco, Monterey, and Morro bay.	Found in salt-water and brackish marshes traversed by tidal sloughs. The bird is associated with abundant growths of pickle weed, but feeds on mud-bottomed sloughs.	Year round. Non-migratory in coastal wetlands. Juveniles may disperse to freshwater wetlands late summer and autumn.	None. Occurrences have been documented within the Buyer Service Area. Suitable habitat may occur within the area of analysis. However, Transfers are not expected to impact any suitable habitat (i.e. salt-water marshes).
California horned lark *Eremophila alpestris actia*	--	WL	Found on coastal regions, chiefly from Sonoma to San Diego county, but also found in the main parts of San Joaquin Valley and east to the foothills.	Prefers short-grass prairie, mountain meadows, open coastal plains, alkali flats, "bald" hills, and fallow grain fields.	Year round in California. Some movement along the coast. May leave mountains in winter.	None. Occurrences have been documented within the Buyer Service Area. Suitable habitat occurs within the area of analysis. No impacts to breeding or foraging habitat are anticipated within the Buyer Service Area.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
California least tern *Sternula antillarum browni*	E	E	Nests along the coast from San Francisco Bay south to northern Baja California. Migratory in California. Breeding colonies in Southern California near marine and estuarine shores. In SF Bay found near salt ponds and estuarine shores.	Breeds on bare or sparsely vegetated, flat substrates, sand beaches, alkali flats, landfills or paved areas. Feeds in shallow, estuarine waters.	Late April in southern California to mid-May in northern California. Winters south of California. Absent from mid-October to late April.	None. Occurrences have been documented in the Buyer Service Area. Suitable habitat may occur within the area of analysis. No impacts are expected to suitable foraging or breeding habitat (i.e. sand beaches, alkali flats).
California yellow warbler *Dendroica petechia brewsteri*	--	SSC	Throughout California. From coastal Del Norte County., east to Modoc, south along coast range to Santa Barbara and Ventura County. Also found along western slope of Sierra Nevada to Kern County.	Frequents open to medium-density woodlands and forests with a heavy brush understory in breeding season. In migration, found in a variety of sparse to dense woodland and forest habitats. Breeds in montane chaparral, ponderosa pine and mixed conifer habitats.	April-October.	None. No occurrences have been documented in the area of analysis. The species is not likely to occur in rice fields, and no suitable habitat would be impacted (i.e. dense woodland and forest habitats).
Cooper's hawk *Accipiter cooperii*	--	WL	Throughout California. Breeds in southern Sierra Nevada foothills, New York Mountains, Owens Valley and local areas in southern California.	Frequents landscapes where wooded areas occur in patches and groves- live oak, riparian deciduous, other forest habitat near water. Often uses patchy woodlands and edges with snags for perching. Dense stands with moderate crown-depths used for nesting.	Year round. Breeding resident throughout wooded portion of California.	None. Occurrences have been documented within both the Buyer and Seller Service Area. Suitable habitat occurs within the area of analysis. No potential impacts to preferred foraging or nesting habitat are anticipated.
Double-crested cormorant *Phalacrocorax pelagicus*	--	WL	Along the entire coast of California and on inland lakes, in fresh, salt and estuarine waters. Uncommon from San Luis Obispo County south and very rare to the north. Common on Colorado River reservoirs and common in the Central Valley.	Open water with offshore rocks, islands, steep cliffs, dead branches of trees, wharfs, jetties, or even transmission lines. Requires undisturbed nest-sites beside water, on islands or mainland. Uses wide rock ledges on cliffs; rugged slopes; and live or dead trees, especially tall ones. Found on inland lakes, fresh, and estuarine waters.	Year round along coastal regions. Winters inland.	None. No occurrences have been documented within the area of analysis, but the species could occur at reservoirs and inland ponds. No negative impacts to foraging or breeding habitat are expected.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Ferruginous hawk *Buteo regalis*	--	WL	Winter resident and migrant at lower elevations and open grasslands in Modoc Plateau, Central Valley, and Coast ranges. Common winter resident of grassland and agriculture areas in southwestern California. Casual in northeast in summer.	Found in open grasslands, sagebrush flats, desert scrub, low foothills and fringes of pinyon-juniper habitats.	Migratory. Present in CA from Sept. to mid-April.	None. Occurrences have been documented within both the Buyer and Seller Service Areas. Suitable habitat occurs within the area of analysis. No potential impacts to preferred habitat are anticipated.
Golden eagle *Aquila chrysaetos*	T	E	Throughout California. Uncommon permanent resident and migrant throughout California, except of Central Valley. More common in southern California.	Riparian areas near coasts, rivers, and lakes. Nesting generally occurs in large old-growth trees in areas with little disturbance. Also in foothills, mountain areas, sage-juniper flats and desert.	Year round. Mostly resident moves down slope for winter and upslope after breeding season.	None. Occurrences have been documented within both the Buyer and Seller Service Areas. Suitable habitat occurs within the area of analysis. No impacts to nesting habitat are expected.
Grasshopper sparrow *Ammodramus savannarum*	--	SSC	Uncommon and local, summer resident and breeder in foothills and lowlands west of Cascade-Sierra Nevada crest from Mendocino and Trinity counties south to San Diego County Also found in Shasta Valley, Siskiyou County, coastal southern California.	Found in dense grasslands on rolling hills, lowland plains, in valleys and on hillsides on lower mountain slopes. Favors native grasslands with a mix of grasses, forbs and scattered shrubs.	Winters chiefly in southern California, in coastal areas. Summer resident March to May, migrates south in August and September. Fall migrants occur on the Farallon Islands in late September to early October.	None. Occurrences have been documented in the Seller Service Area. Suitable habitat may occur with the area of analysis. The species' habitat (i.e. dense grassland, lowland plain areas) would not be affect by Transfers.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Great blue heron *Ardea herodias* (rookeries)	--	--	Throughout California. Most rookeries are in southern California some scattered in northern California.	Found in shallow estuaries, fresh and saline emergent wetlands, along riverine and rocky marine shores, in croplands, pastures, salt ponds, and in mountains above foothills. Nests and roosts in large trees.	Year round. Near salt ponds from July to October. Near rookeries February to June or July.	None. Rookeries have been documented within the Buyer and Seller Service Areas. No impacts to rookeries are anticipated. Idling of cropland foraging habitat would be limited by the environmental commitments, and birds could use alternative suitable foraging areas in the vicinity.
Great egret *Ardea alba* (rookeries)	--	--	Throughout California, except for high mountains and deserts.	Feeds and rests in fresh, and saline emergent wetlands, along the margins of estuaries, lakes, and slow-moving streams, on mudflats and salt ponds, and in irrigated croplands and pastures. Nests roosts in large trees.	Year round	None. Occurrences have been documented in the Seller Service Area. No impacts to rookeries are anticipated. Idling of cropland foraging habitat would be limited by the environmental commitments, and birds could use alternative suitable foraging areas in the vicinity.
Greater sandhill crane *Grus canadensis tabida*	--	T, FP	Breeds only in Siskiyou, Modoc and Lassen counties and in Sierra Valley, Plumas and Sierra counties. Winters primarily in the Sacramento and San Joaquin valleys from Tehama south to Kings Counties.	In summer, this race occurs in and near wet meadow, shallow lacustrine, and fresh emergent wetland habitats. Frequents annual and perennial grassland habitats, moist croplands with rice or corn stubble, and open, emergent wetlands. It prefers relatively treeless plains.	Migration southward is September-October and northward is March-April.	High. No occurrences have been documented within the area of analysis, but occurrences have been recorded in Butte and Sutter Counties. Suitable foraging and winter roosting habitat is present within the area of analysis (i.e. rice fields). Conservation strategies are in place for this species and birds would have other suitable nesting sites available.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Least bell's vireo *Vireo bellii pusillus*	E	E	California to northern Baja. Rare, local, summer resident below about 600m (2000ft), mostly in San Benito and Monterey counties. Present in coastal southern CA from Santa Barbara County south.	Inhabits low, dense riparian growth along water or along dry parts of intermittent streams. Typically associated with willow, cottonwood, baccharis, wild blackberry, or mesquite in desert localities.	end of March to end of August	None. Occurrences have been documented in the Buyer Service Area. Suitable habitat may occur within the area of analysis. Transfers are not expected to impact any suitable willow or dense riparian habitat, therefore no impacts to the species are anticipated.
LeConte's thrasher *Toxostoma lecontei*	--	SSC	Uncommon to rare local resident of southern California deserts from southern Mono County south to Mexican border, western and southern San Joaquin Valley. Also in Joshua tree. Formerly north to Fresno County, rare north of Kern County.	A desert resident primarily of open desert wash, desert scrub, alkali desert scrub, and desert succulent scrub habitats. Nests in dense, spiny shrub or densely branched cactus in desert wash habitat.	Year round. Non migratory.	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present in area of analysis. No impacts are anticipated to occur to suitable habitat (i.e. desert scrub).
Little willow flycatcher *Empidonax traillii brewsteri*	--	E	Migrant at lower elevations, primarily in riparian habitats throughout Sierra Nevada and Cascade Range. Not found in north coast.	Most numerous where extensive thickets of low, dense willows edge on wet meadows, ponds, or backwaters. Dense willow thicket required for nesting and roosting. Feeds in willow thickets or low perches adjacent to meadows.	Spring (mid-May to early June) and fall (mid-August to early September)	None. This species has not been documented within the area of analysis according to CNDDB. Suitable habitat may be present within the area of analysis (i.e. dense willows), but would not be impacted by Transfers.
Loggerhead shrike *Lanius ludovicianus*	--	SSC	Common resident and winter visitor in lowland and foothills throughout California. Rare on coastal slopes north of Mendocino County, occurring only in winter.	Found in broken woodlands, savannah, pinyon-juniper, Joshua tree, riparian woodlands, desert oases, scrub and washes. Prefers open country with perches for hunting, and fairly dense shrubs and brush for nesting. Rarely found in urbanized areas, but often found in open cropland.	Year round. In Great Basin, south to Inyo County, pop declines Nov.-March. Winter pop. More widespread in winter than during breeding season.	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat may be present within the area of analysis. No impacts are anticipated to breeding or foraging habitats.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Long-billed curlew *Numenius americanus*	--	WL	Along the California coast, and in the Central and Imperial valleys.	Upland short grass prairies and wet meadows are used for nesting; coastal estuaries, open grasslands, and croplands are used in winter.	Winter migrant from July-April	Low. No CNDDB occurrences have been documented within the area of analysis, but the species is known to occur within the action area during winter migration. There is potential for impacts to suitable foraging habitat (i.e. cropland), although this may be reduced by environmental commitments, which protect winter foraging habitat in Butte Sink, and other wildlife management areas downstream. Birds can relocate to other suitable habitats within the area.
Long-eared owl *Asio otus*	--	SSC	Throughout California, except for entire floor of the Central Valley and locally on the southern coast.	Frequents dense, riparian and live oak thickets near meadow edges, and nearby woodland and forest habitats. Also found in dense conifer stands at higher elevations.	Year round	None. Occurrences have been documented in the Buyer Service Area. Suitable habitat occurs within the area of analysis. Transfers are not expected to impact any suitable habitat (i.e. forest and woodland habitats).
Merlin *Falco columbarius*	--	WL	Occurs in most of the western half of California below 3,900 ft. Rare in Mojave Desert and Channel Islands.	Frequents coastlines, open grasslands, savannahs, woodlands, lakes, wetlands, edges, and early successional stages. Ranges from annual grasslands to ponderosa pine and montane hardwood-conifer habitats.	Winter migrant from September-May	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present in area of analysis. Foraging habitat may be altered, but Transfers would not decrease suitability. No negative impacts are anticipated.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Mountain plover *Charadrius montanus*	--	SSC	Found in Central Valley from Sutter and Yuba counties southward, foothill valleys west of San Joaquin Valley, Imperial Valley, plowed fields of Los Angeles and western San Bernardino County, and central Colorado river valley. Does not breed in California.	Found in short grasslands, freshly plowed fields, newly sprouting grain fields, and sod farms. Prefers grazed areas and areas with burrowing rodents.	Winter resident Sept. - March.	None. Occurrences have been documented within both the Buyer and Seller Service Area. Suitable habitat occurs within the area of analysis. Foraging habitat may be affected, but Transfers would not reduce suitability. Can relocate to other habitats within the area.
Northern harrier *Circus cyaneus*	--	SSC	Throughout lowland California, concentrated in the Central Valley and coastal valleys.	Breeds in annual grasslands and wetlands. Prefers marshes and grasslands for foraging and nesting. Also uses agricultural fields for nesting and foraging, although nests may be destroyed by agricultural activities.	Year round, nomadic	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present in area of analysis. Foraging and breeding habitat may be affected, but fallow fields would still represent suitable habitat. Birds can relocate to other habitats within the area.
Osprey *Pandion haliaetus*	--	WL	Northern California from Cascade Ranges south to Lake Tahoe, and along the coast south to Marin County.	Associated strictly with large, fish-bearing waters, primarily in ponderosa pine through mixed conifer habitats.	Year round	None. Occurrences have been documented within both the Buyer and Seller Service Area. Suitable habitat occurs within the area of analysis. Water transfers would be subject to flow requirements. Therefore no impacts to foraging area expected. No impacts to nesting sites are anticipated.
Prairie falcon *Falco mexicanus*	--	WL	Found from southeastern deserts northwest throughout Central Valley and inner Coast Ranges and Sierra Nevada. Mostly absent from northern coastal fog belt. Not found in upper elevation of Sierra Nevada.	Inhabits dry, open level or hilly terrain. Breeds on cliffs, forages far afield. Annual grassland to alpine meadows, but primarily perennial grasslands, rangeland, agricultural fields and desert scrub.	Permanent resident. Northern migrants winter in California. Upslope in summer, down slope in winter.	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present within the area of analysis. Foraging habitat (i.e. agricultural fields) may be altered, but Transfers would not reduce suitability.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Purple martin *Progne subis*	--	SSC	In south, found on the coast and interior mountain ranges. Absent from higher desert regions. In north, found on coast and inland to Modoc and Lassen counties. Absent from higher slopes of Sierra Nevada. Current breeding populations are known from western Santa Clara and Alameda counties, and western Placer County.	Inhabits woodlands, low elevation coniferous forest of Douglas-fir, ponderosa pine and Monterey pine. Uses open habitats during migration, including grassland, wet meadows, and fresh emergent wetlands.	Summer resident throughout California.	Low. CNDDB occurrences have been documented in the Seller Service Area. This species is restricted to fairly limited nesting sites with suitable cavities free of brood parasites. When wetlands are unavailable, rice fields may represent relatively high quality foraging habitat. This habitat may be slightly reduced by Transfers, but the species can relocate to other suitable habitat in the vicinity. Crop idling limitations are in place in the environmental commitments.
Saltmarsh common yellowthroat *Geothlypis trichas sinuosa*	--	SSC	Resident and summer visitor in San Francisco Bay area. Winter south along coast to San Diego county. Found in No. CA in summer months.	Found in fresh and salt water marshes. Requires thick, continuous cover to water surface for foraging and tall grasses, tulle and willows for nesting.	Year-round in southern California and San Francisco Bay, Summer resident in northern California.	None. Occurrences have been documented in the Buyer Service area and suitable habitat may be present in the area of analysis. Not known from rice fields. Water transfers would not affect suitable breeding or foraging habitat.
San Pablo song sparrow *Melospiza melodia samuelis*	--	SSC	Confined to emergent wetland along north side of San Francisco and San Pablo bay. Highest density at Petaluma River mouth.	A resident of salt marshes. The species inhabits tidal sloughs in salicornia marshes and nests in grindelia bordering slough channels.	Year round	None. Occurrences have been documented in the Buyer Service area and suitable habitat may be present in the area of analysis. However, no impacts are expected to salt water marshes.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Short-eared owl *Asio flammeus*	--	SSC	Endemic to marshes bordering the San Francisco, San Pablo Bays and Suisun Bay. Winter migrant in Central Valley, western Sierra Nevada foothills and coastline. Uncommon winter migrant in southern California. Breeding range includes: Del Norte, Humboldt, SF Bay Delta, northeastern Modoc plateau, south Lake Tahoe to Inyo County and San Joaquin valley.	Usually found in open areas with few trees, including grasslands, wet meadows, irrigated lands, saline and fresh emergent wetlands, and cleared forests. Occasionally in estuaries during breeding season. Ground nester in tall grasses, brush, ditches, and wetlands.	Year round. Migrants in CA from Sept. - April.	None. Occurrences have been documented in the Buyer Service Area. Suitable habitat occurs within the area of analysis. No impacts to breeding habitat would occur. Fallow rice fields would still represent suitable foraging habitat for the species.
Snowy egret *Egretta thula* (rookeries)	--	--	Throughout California.	Found along shores of coastal estuaries, fresh and saline emergent wetlands, ponds, slow-moving rivers, irrigation ditches, and wet fields.	Year round	None. Occurrences have been documented in the Buyer Service Area, however suitable habitat is present in both the Buyer and Seller Service area. No impacts to rookeries are anticipated. Idling of cropland foraging habitat would be limited by the environmental commitments, and birds could use alternative suitable foraging areas in the vicinity.
Suisun song sparrow *Melospiza melodia maxillaris*	--	SSC	Endemic, restrict to Suisun Marsh from Carquinez Strait east to the confluence of the Sacramento and San Joaquin rivers near Antioch. Highest numbers near Benicia State Park and Martinez shoreline.	Resident of brackish-water marshes. Inhabits cattails, tulles, sedges, and salicornia.	Year round. Non-migratory. Breeds early March to July.	None. Occurrences have been documented in the Buyer Service area and suitable habitat may be present in the area of analysis. However, no impacts are expected to brackish-water marshes.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Swainson's hawk *Buteo swainsoni*	--	T	Lower Sacramento and San Joaquin Valleys, the Klamath Basin, Northeastern plateau, Lassen County, and Mojave desert.	Nests in mature trees, including valley oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain and row crop fields.	Spring and summer resident; small wintering population in the Delta. Moves south to southern and interior CA Sept.-Oct. Moves north March-May.	None. CNDDB occurrences have been documented within both the Seller and Buyer Service Area. Suitable habitat is present within the area of analysis. Transfers may alter the composition of foraging habitat in the Buyer and Seller Service Areas, but these areas would still be suitable for the species, and additional habitats in the vicinity would be available. No impacts to breeding habitat are expected.
Tricolored blackbird *Agelaius tricolor*	--	T	A resident in California found throughout the Central Valley and in coastal districts from Sonoma County south. Found locally in northeastern California. In winter, more widespread along central coast and San Francisco Bay area.	Breeds near fresh water, preferably in emergent wetlands with tall, dense cattails or tulles, but also in thickets of willow, blackberry, wild rose, tall herbs. Feeds in grassland and cropland habitats.	Year round. Leaves northeastern CA in fall and winter.	Low. CNDDB occurrences have been documented within both the Seller and Buyer Service Area. Suitable habitat is present within the area of analysis. Foraging habitat may be affected by Transfers. Environmental commitments limit cropland idling and birds can relocate to other adjacent foraging habitats within the area.
Western burrowing owl *Athene cunicularia hypugaea*	--	SSC	Central and southern coastal habitats, Central Valley, Great Basin, and deserts. Formerly common in appropriate habitat throughout the state, excluding humid northwest coastal forests and high mountains. Present on larger offshore islands.	Open annual grasslands or perennial grasslands, deserts, and scrublands characterized by low-growing vegetation. Dependent upon burrowing mammals (especially California ground squirrel) for burrows.	Year round	None. Occurrences have been documented within both the Buyer and Seller Service Area. Suitable habitat occurs within the area of analysis. Agricultural ditches may be suitable habitat for burrowing owl burrow and nesting activity. Water transfers would not affect the suitability of habitat for burrowing owl in the area of analysis.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Western snowy plover *Charadrius alexandrinus*	T	SSC	Along the west coast states, with inland nesting taking place at the Salton Sea, Mono Lake, and at isolated sites on the shores of alkali lakes in northeastern California, in the Central Valley, and southeastern deserts.	Nests, feeds, and takes cover on sandy or gravelly beaches along the coast, on estuarine salt ponds, alkali lakes, and at the Salton Sea.	Migration is from July-March (some year round populations).	None. Occurrences have been documented in the Buyer Service Area. There is a CNDDB occurrence in Yolo County, however this species is not likely to occur in rice fields. Suitable habitat may occur within the area of analysis. However, Transfers are not expected to impact any suitable breeding or foraging habitat (i.e. sandy beaches or estuarine salt ponds).
Western yellow-billed cuckoo *Coccyzus americanus*	C,	E	Uncommon to rare summer resident in scattered locations throughout California. Breeding population along Colorado river, Sacramento and Owen Valley, along South Fork of Kern River, Santa Ana River and Amargosa River. May be present along San Luis Rey River.	Deciduous riparian thickets or forests with dense, low-level or understory foliage, and which abut on slow-moving watercourses, backwaters, or seeps. Willow almost always a dominant component of the vegetation. In Sacramento Valley, also utilizes adjacent orchards, especially of walnut. Nests in sites with some willows, dense low-level or understory foliage, high humidity, and wooded foraging spaces.	Summer migration is from June-September.	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present within the area of analysis. However, this species is not likely to occur in rice fields due to lack of suitable foraging and roosting habitat (i.e. dense riparian thickets). No impacts are anticipated.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
White-faced ibis *Plegadis chihi*	--	WL	Uncommon summer resident in sections of southern California, a rare visitor in the Central Valley, and is more widespread in migration. Uncommon to common in small pockets.	Feeds in fresh emergent wetlands, shallow lacustrine waters, muddy grounds of wet meadows, and irrigated or flooded pastures and croplands. Nests in dense, fresh emergent wetlands.	Present from April-October.	Low. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in area of analysis. Low potential impact to foraging habitat in the Seller Service Area. No potential impacts are expected to roosting habitat. Can relocate to other habitats within the area. Environmental commitments would limit acreage of allowable cropland idling.
White-tailed kite *Elanus leucurus*	--	FP	Central Valley, coastal valleys, San Francisco Bay area, and low foothills of Sierra Nevada.	Savanna, open woodlands, marshes, partially cleared lands and cultivated fields, mostly in lowland situations. Rarely found away from agricultural areas. Feeds in open grasslands, meadows, farmlands and emergent wetlands. Nests located near open foraging area and placed on top of dense oak, willow or tree stands.	Year round	None. CNDDB occurrences have been documented within both the Seller and Buyer Service Area. Suitable habitat is present within the area of analysis. Foraging habitat may be altered, but would still be suitable for the species. No potential impacts to breeding habitat are anticipated.
Yellow warbler *Dendroica petechia brewsteri*	--	SSC	Breeding range from coastal Del Norte County, east to Modoc plateau & Inyo County, south to coastal Santa Barbara and Ventura County., west to Kern County. Winters in Imperial and Colorado river valleys. Found up to 2500m (8000ft) in Sierra Nevada.	Associates with riparian habitats and prefers willows, cottonwood, aspens, sycamores, and alders. Nests in montane shrubbery in open conifer forests.	Summer resident throughout California.	None. Occurrences have been documented in the Buyer Service Area and suitable habitat is present with the area of analysis. No potential impacts are anticipated to riparian habitats.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
yellow-headed blackbird *Xanthocephalus xanthocephalus*	--	SSC	Breeds east of Cascade range and Sierra Nevada, Imperial and Colorado River valley, in Central Valley and select locations in coast range west of Central Valley. Common in winter in Imperial Valley. Found as high as 2000m (6600ft) in San Bernardino Mountains.	Associated with freshwater emergent wetlands along lakes and ponds. Nesting timed with maximum emergence of aquatic insects. Feeds on cultivated grains, in emergent vegetation, and in nearby grasslands and croplands.	Year round, in parts of Central Valley. Summer range in eastern California, and parts of Central Valley. Present April through early May, and in September.	Low. Occurrences have been documented in the Buyer Service Area and suitable habitat is present within both the Buyer and Seller Service Area. Impacts to foraging habitat are expected in the Seller Service Area, but the birds can relocate to other habitat in the area. Environmental commitments would limit the amount of cropland idling in the area of analysis.
Mammals						
Alameda Island mole *Scapanus latimanus parvus*	--	WL	Only known from Alameda Island, Alameda County.	Found in a variety of habitats, especially annual and perennial grasslands. Prefers moist, friable soils and avoids flooded soils.	Year round	None. Occurrences have been documented in the Buyer Service Area. Transfers would not impact suitable habitat.
American badger *Taxidea taxus*	--	SSC	Throughout California.	Found in dry, open stages of most shrub, forest, and herbaceous habitats with friable soils.	Year round. Permanent resident except in North Coast area.	None. Occurrences have been documented in both the Buyer and Seller Service area and suitable habitat is present within the area of analysis. Suitable habitats are not expected to be impacted.
Big free-tailed bat *Nyctinomops macrotis*	--	SSC	Rare in California. Vagrants found in San Diego County. and Alameda County (record is suspect).	Found in low-laying arid areas in Southern California and requires high cliffs or rocky outcrops for roosting sites.	Year round resident in San Diego County and Alameda County.	None. Occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. Transfers would not impact suitable arid, rocky terrain habitat.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
California wolverine *Gulo gulo*	PT	T, FP	A scarce resident of North Coast mountains and Sierra Nevada. Sightings range from Del Norte and Trinity counties. east through Siskiyou and Shasta counties., and south through Tulare County. A few possible sightings occur in the north coastal region as far south as Lake County. Habitat distribution in California is poorly known for the North Coast and northern Sierra Nevada.	In north coastal areas, has been observed in Douglas-fir and mixed conifer habitats. In the northern Sierra Nevada, have been found in mixed conifer, red fir, and lodge pole habitats, and probably use subalpine conifer, alpine dwarf-shrub, wet meadow, and montane riparian habitats. In the southern Sierra Nevada occur in red fir, mixed conifer, lodge pole, subalpine conifer, alpine dwarf-shrub, barren, and probably wet meadows, montane chaparral, and Jeffrey pine.	Year round (largely nocturnal)	None. Suitable habitat may occur within the area of analysis, however no CNDDB occurrences have been documented in the Buyer or Seller Service area. The species is not likely to occur in agriculture fields. No impacts are anticipated.
Fresno kangaroo rat *Dipodomys nitratoides exilis*	E	E	Western Fresno County. on the Alkali Sink Ecological Reserve and adjacent privately owned land.	Found in alkali sink-open grassland habitats. Prefers bare alkaline clay-based soils subject to seasonal inundation with more friable soil mounds around shrubs and grasses.	Year round. Breeds largely from March - June.	None. Occurrences have been documented in the Buyer Service Area. Suitable habitat present in the area of analysis. Transfers would not impact suitable habitat for this species (i.e. alkali sink grasslands).
Giant kangaroo rat *Dipodomys ingens*	E	E	Found along western side of San Joaquin Valley (e.g. Carrizo Plain, Panoche Valley)	Found in annual grasslands and on and marginal habitat in alkali scrub. The species requires level terrain and sandy loam soils for burrowing.	Year round	None. Occurrences have been documented in the Buyer Service Area. Suitable habitat may be present in the area of analysis. However, no impacts are expected to suitable habitat (i.e. alkali desert scrub and annual grasslands).

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Greater western mastiff bat E*umops perotis californicus*	--	SSC	Uncommon resident in southeastern San Joaquin Valley and Coastal Ranges from Monterey County southward through southern California, from the coast eastward to the Colorado Desert.	Occurs in many open, semi-arid to arid habitats, including conifer and deciduous woodlands, coastal scrub, annual and perennial grasslands, palm oases, chaparral, desert scrub, and urban areas. Crevices in cliff faces, high buildings, trees, and tunnels are required for roosting.	Year round (nocturnal activity)	None. Occurrences have been documented in the Seller Service Area. Suitable habitat is present in the area of analysis, bur no impacts are anticipated.
Nelson's antelope squirrel *Ammospermophilus nelsoni*	--	T	Found in the western San Joaquin valley from 200-1,200 ft. elevation. Found from southern Merced County to Kern, Kings and Tulare counties. In eastern portions of San Luis Obispo and Santa Barbara counties.	Found on dry sparsely vegetated loam soils. Requires widely scattered shrubs, forbs and grasses in broken terrain with gullies and washes.	Year round.	None. Occurrences have been documented with the Buyer Service Area. Suitable habitat may occur within the area of analysis. No impacts are anticipated to suitable upland habitats.
Pacific fisher *Martes pennati (pacifica) DPS*	C	SSC	Northern California coastal ranges up to Oregon, and the Sierra Nevada's.	Found in mature, dense, coniferous or mixed coniferous hardwood forest with closed canopies.	Year round	None. Occurrences have been documented with the Seller Service Area. Suitable habitat may occur within the area of analysis. No potential impacts are anticipated to suitable habitat (i.e. mixed conifer habitats).
Pallid bat *Antrozous pallidus*	--	SC	Throughout California, except for high Sierra Nevada from Shasta to Kern counties, northwestern corner of state from Del Norte & western Siskiyou cos. To northern Mendocino County.	Found in deserts, grasslands, scrublands, woodlands and forests. Most common in open, dry habitats with rocky areas for roosting.	Year round.	None. Occurrences have been documented with the Buyer Service Area. Suitable habitat may occur within the area of analysis. No impacts would occur to suitable habitat.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Ring-tailed cat *Brassariscus astutus*	--	FP	Ringtails are found in a variety of habitats centered around the semi-arid to arid climates of the west and southwest. Little information available on distribution and relative abundance among habitats.	Occurs in various riparian habitats, and in brush stands of most forest and shrub habitats, at low to middle elevations. Uses hollow trees, logs, snags, cavities in talus and other rocky areas, and other recesses are for cover.	Year round (nocturnal)	None. No CNDDB records of this species have been documented in the area of analysis. Suitable habitat is present in the area of analysis, but the species is not likely to occur in rice fields. No potential impact to suitable habitat is expected.
Riparian brush rabbit *Sylvilagus bachmani riparius*	E	E	Isolated populations on Caswell Memorial State Park on the Stanislaus River and along an overflow channel of the San Joaquin River.	Riparian thickets	Year round	None. No CNDDB records of this species have been documented in the area of analysis. Suitable habitat is present in the area of analysis, however, no potential impacts are expected to suitable habitat (i.e. riparian thickets).
Riparian (San Joaquin Valley) woodrat *Neotoma fuscipes riparia*	E	SSC	Found along the lower portions of the San Joaquin and Stanislaus rivers in the northern San Joaquin Valley. Historical records for the riparian woodrat are distributed along the San Joaquin, Stanislaus, and Tuolumne rivers, and Corral Hollow, in San Joaquin, Stanislaus, and Merced Counties.	Most numerous where shrub cover is dense and least abundant in open areas. Dens are usually built in willow thickets with oak over story.	Year round (nocturnal activity)	None. Suitable habitat present (i.e. dense shrubs) in both the Buyer and Seller Service Areas, however no CNDDB occurrences have been documented. No potential impacts are expected.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Salt-marsh harvest mouse *Reithrodontomys raviventris*	E	E	Found in San Francisco Bay and its tributaries.	Found in saline emergent wetlands. Pickle weed is the primary habitat for the species. Requires higher grassland areas for flood escape.	Year round.	None. CNDDB occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. Transfers would not impact saline wetlands and salt marshes.
Salt-marsh wandering shrew *Sorex vagrans halicoetes*	--	SSC	Southern arm of the San Francisco Bay in San Mateo, Santa Clara, Alameda and Contra Costa counties (Bolster 1998).	Found in the salt marshes. Inhabits medium high marsh where abundant driftwood is scattered among salicornia.	Year round. Breeds February - June	None. CNDDB occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. Transfers would not impact salt marshes.
San Francisco dusky-footed woodrat *Neotoma fuscipes annectens*	--	SSC	Oregon, California and northwestern Baja California. Within California it is known from Alameda, Contra Costa, San Mateo, and Santa Clara, and Santa Cruz Counties.	Found in forest habitats of moderate canopy and moderate to dense understory. The species may prefer chaparral and redwood habitats. Nest sites include tree cavities, logs, and talus slopes (Carraway and Verts 1991; NatureServe 2011).	December - September	None. Occurrences have been documented within the Buyer Service area and suitable habitat may be present in the area of analysis. Transfers would not impact forest, chaparral and redwood habitat.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
San Joaquin kit fox *Vulpes macrotis mutica*	E	T	Found only in the Central Valley area of California. Kit foxes currently inhabit suitable habitat in the San Joaquin valley and in surrounding foothills of the Coast Ranges, Sierra Nevada, and Tehachapi Mountains; from southern Kern County north to Contra Costa, Alameda, and San Joaquin counties on the west; and near La Grange, Stanislaus County on the east.	Found in annual grasslands or grassy open stages of vegetation dominated by scattered brush, shrubs, and scrub. Build dens for cover. Some agricultural areas may support these foxes.	Year round (mostly nocturnal, but often active during daytime in cool weather)	None. Occurrences have been documented within both the Buyer and Seller Service Area. Suitable habitat is present within the area of analysis. San Joaquin kit fox have the potential to occur in inland and southern portions of the area of analysis. Changes in crop type could alter foraging habitat conditions in the Buyer Service Area, however buyers would not be allowed to buy more water than they were entitled to under their CVP contract. Transfer water would not be used to plant permanent crops, so cropping patterns would be within normal range considered under the CVP contracts and would be covered by the pertinent B.O. Conservation strategies are in place for this species.
San Pablo vole *Microtus californicus sanpabloensis*	--	SSC	Found in salt marshes of San Pablo creek on the south shore of San Pablo Bay.	Annual grassland, saline emergent wetlands, salt marsh.	Year round.	None. CNDDB occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. Transfers would not impact the wetlands and salt marshes of San Pablo Bay.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Short-nosed kangaroo rat *Dipodomys nitratoides brevinasus*	--	WL	Found in the western side of San Joaquin valley, near the mouth of Panoche Creek in western Fresno County, south to near the mouth of San Emigdio Creek, in southwestern Kern County, and to northeast of Bakersfield. Also occurs in eastern San Benito Valley and Cuyama Valley, and Santa Barbara County (Bolster 1998).	Found in grassland and desert shrub, especially a triplex. Inhabits highly alkaline soils around soda lake and prefers flat to gently sloping terrain.	Year round	None. CNDDB occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. Transfers would not impact suitable habitat for this species.
Tipton kangaroo rat *Dipodomys nitratoides nitratoides*	E	E	Found in the Tulare Lake basin of southern San Joaquin Valley, from approximately Lemoore and Hanford in Kings County to Visalia, Tipton, Delano and Bakersfield on the east.	The species is found in saltbush scrub and sink scrub communities. Requires soft friable soils. Currently limited to uncultivated ground with alkaline soils.	Year round	None. CNDDB occurrences have been documented in the Buyer Service Area and suitable habitat may be present in the area of analysis. Transfers would not impact suitable habitat for this species.
Tulare grasshopper mouse *Onychomys torridus tularensis*	--	SSC	Foothill and floor of the southern San Joaquin Valley from western Merced and eastern San Benito counties, east to Madera County, and south to foothills of Tehachapi and San Emigdio Mts. Also found on Carrizo Plains, eastern San Luis Obispo County, Cuyama Valley, parts of Kern County, Tulare Basin and Panoche Valley (Bolster 1998).	Found in hot, arid valleys and scrub deserts. Favors compact soils with sparse growth of perennial grasses.	Year round.	None. CNDDB occurrences have been documented in the Buyer Service Area. Suitable habitat is present within the area of analysis. Transfers would not impact suitable habitat for this species.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Western mastiff bat *Eumops perotis californicus*	--	SSC	Found in southeastern San Joaquin Valley and Coastal ranges from Monterey County southward through southern California and from the coast eastward to Colorado Desert.	Found in open, semi-arid habitats, including conifer and deciduous woodlands, coastal scrub, grasslands, and chaparral. Roost in crevices in cliff faces, high buildings, trees and tunnels.	Year round	None. CNDDB occurrences have been documented in the Buyer Service Area and suitable habitat is present within the area of analysis. No impacts are anticipated to feeding or roosting habitat.
Western red bat *Lasiurus blossevillii*	--	SSC	Occurs from Shasta County to Mexican border, west of Sierra Nevada/Cascade crest and deserts. Winters in western lowlands and coastal regions south of SF bay. Not found in desert areas.	Found in trees 2-40ft above ground, from sea level up through mixed conifer forests. Prefers habitat edges and mosaics with trees. Feeds over a wide variety of habitats including grasslands, scrublands and croplands.	Year round. Migrates in spring (March-May) and autumn (Sept.-Oct). Migrates between summer and winter range.	None. Occurrences have been documented in the Buyer and Seller Service Area and suitable habitat is present within the area of analysis. No impacts to roosting habitat are anticipated. Transfers could alter the configuration of foraging habitat, but would not reduce suitability.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Fish						
Sacramento River Winter-run Chinook Salmon *Oncorhynchus tshawytcha*	E	E	Occurs on the mainstem Sacramento River from Keswick Dam, Shasta County (RM 302) to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta; and in the Bay-Delta system. The area downstream of Red Bluff Diversion Dam is principally a migration corridor, although some rearing may occur during emigration.	Migrate to upstream freshwater habitat to mature and spawn. Once juveniles emerge from the gravel they seek low velocity, shallow-water areas to finish absorbing their yolk sac. Some disperse downstream when high-flow events correspond with emergence. In general, there is a shift in microhabitat use by juvenile Chinook to deeper, faster water as they grow larger. For juveniles, positive growth occurs at temperatures between 5-19 C. Temperatures greater than 24 C, even for short periods, is lethal. Salmon fry tend to move downstream, and smolts emigrate to the ocean, under conditions of increased flow, increased turbidity, and decreased temperatures.	Upstream Migration: Dec-Jul. Spawning: late Apr to early Aug Fry remain in river for five to ten months, prior to emigration. Emigration Sep.-Jan.	None. Species not present in the area of Analysis during period when transfers would occur. Potential impacts would not occur on the mainstem Sacramento River where flows are regulated by the Biological Opinions.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Central Valley Spring-run Chinook Salmon *Oncorhynchus tshawytcha*	T	T	Designated critical habitat for spring-run Chinook salmon includes San Francisco, San Pablo, and Suisun Bays, the Sacramento-San Joaquin Delta, and the Sacramento River from the Delta to Keswick Dam and the Feather River upstream to Thermalito Afterbay Dam. Spawning occurs above the valley floor in streams that have deep, cold pools where adult fish can hold over the summer before they spawn. Tributaries to the Sacramento River with independent spawning populations are Butte, Deer and Mill Creeks. Spawning may also occur on several other streams in the Area of Analysis including Thomes, Big Chico, and Antelope creeks, and the Yuba and Bear rivers. Rearing occurs in these streams and other the downstream portions of other streams tributary to the Sacramento, as well as in the Sutter and Yolo Bypasses, and in the Delta during outmigration of the young fish.	See Sacramento River winter-run Chinook salmon.	Upstream Migration and holding: Mar-Sep. Spawning: late Aug to Oct. Fry remain in river for three to 15 months, prior to emigration. Emigration Jan-Apr.	Low. Suitable habitat for over summer holding and spawning in the species primary spawning and rearing habitat is located upstream of the areas that would be affected by water transfers. Rearing habitat could potentially be affected by groundwater withdrawals in the lower sections of some streams. The sections of these waterways on the valley floor, where water transfers would occur, are typically too warm to support this species during the summer months. Potential impacts would not occur on the mainstem Sacramento River or the Feather River where the operating requirements specified in the Biological Opinions and D1641 would be met.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Fall/Late-fall Chinook Salmon *Oncorhynchus tshawytcha*	SC	SSC	Occur in the ocean from Alaska to California. Freshwater habitat use in the Central Valley occurs in the Sacramento River and all major tributaries and many minor ones, as well as in tributaries to the major tributaries to San Joaquin River, including the Merced River. In the Sacramento River, most spawning occurs between the Red Bluff Diversion Dam and Keswick Dam, although some fish spawn downstream of Red Bluff Diversion Dam. Small numbers also spawn in Battle Creek, Cottonwood Creek, Clear Creek, Mill Creek, as well as the Yuba and Bear rivers.	See Sacramento River winter-run Chinook salmon.	Fall Run: Upstream Migration: Jun-Dec. Spawning: late Sep to Dec. Fry remain in river one to seven months Emigration Dec-Mar. Late fall run: Upstream Migration: Oct-Apr. Spawning: Jan-Apr Fry remain in river seven to 13 months Emigration Dec-Mar.	Low. Operating requirements for all of the mainstem rivers would meet existing flow and temperature requirements as specified by the NMFS and USFWS BOs for the Long-term Operations of the State and Federal Water Projects and State Water Board Decision 1641. Water transfers from sellers upstream of the Delta may still result in some flow changes that would overlap spatially and temporally with the distribution of fall-run Chinook salmon emigrants, but flows would continue to meet regulatory requirements protective of this species. Transfers would not overlap the Chinook upstream migration, spawning or incubation periods.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
California Central Valley DPS Steelhead *Oncorhynchus mykiss*	T	SSC	Designated critical habitat includes all waters tributary to the San Francisco Bay from confluence of the Sacramento and San Joaquin River to the lowest impassible barrier. Within these reaches it includes all areas within the ordinary high water mark of the water body. Found in all major rivers and tributaries and may use smaller tributaries, and ephemeral tributaries when available.	Immigration from the ocean into the Delta, the Sacramento and San Joaquin River watersheds occurs when large amounts of cold water is available from winter rains. Spawning occurs in mainstem rivers and their tributaries to. The first year or two of life is spent in cool, clear, fast-flowing permanent streams and rivers where riffles predominate over pools, where there is ample cover in the form of riparian vegetation of undercut banks, and where invertebrate prey is diverse and abundant. Habitat preferences depend on fish size/age, with fry concentrating in shallow water along stream edges with low water velocities, juveniles occurring in deeper, faster water among rocks or other cover, and larger fish seeking out a wide variety of deeper habitats close to fast water. Optimal temperatures for growth are approximately 15-18 C.	Central Valley steelhead are mainly winter-run steelhead, which mature in the ocean and arrive in freshwater nearly ready to spawn. Upstream Migration: Aug-Apr. Spawning: Dec to Apr. Fry generally remain in river for one to three years. Emigration Oct-Jul.	Moderate. Uses the upper Sacramento River above Red Bluff Diversion Dam and the portions of all accessible tributaries to the Sacramento and San Joaquin Rivers with suitable temperatures for spawning and rearing. The Sacramento River below RBDD is used primarily as a migratory corridor. Water transfers from July through September, from sellers upstream of the Delta could overlap spatially and temporally with California Central Valley steelhead rearing in this region where water temperatures are suitable. Stream sections on the valley floor, where transfers could affect stream flow, are generally too warm to support rearing during the summer months, but rearing may occur above the valley floor where suitable temperatures occur. Potential impacts would not occur on the mainstem Sacramento River or the Feather River where the operating requirements specified in the Biological Opinions and D1641 would be met.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
North American Green sturgeon *Acipenser medirostris*	T	SSC	Ranges from Mexico to Alaska. The southern DPS includes spawning population in the Sacramento River, fish living in the Sacramento River, the Sacramento-San Joaquin Delta, and the San Francisco estuary. Not known to occur in the San Joaquin River. Critical habitat include: coastal marine waters from Monterey Bay to the Washington/Canada boarder; coastal bays and estuaries in California, Oregon, and Washington; fresh water rivers in the Central Valley. Proposed inland critical habitat includes Sacramento River downstream of Keswick Dam, Feather River downstream of Thermalito Dam, Yuba River downstream of Daguerre Dam, portions of Sutter and Yolo Bypasses, and the legal Delta.	Southern DPS: Adults immigrate into the Delta from the ocean to begin spawning migration into the Sacramento River. Spawning occurs in the Sacramento River (upstream of Hamilton City and downstream of Keswick Dam), both downstream and upstream of RBDD; a small number have been observed spawning in the Feather River during high flow years. Moyle (2002). Preferred spawning habitat contain large cobble in deep and cool pools with turbulent water. Water temp in spawning and egg incubation are critical; temp greater than 19C are lethal. Rear in fresh and estuarine areas for one to four years before dispersing into salt water. Occur in shallow water and move to deeper more saline areas as they mature. Emigration occurs as larvae drift downriver from freshwater spawning/rearing areas of Sacramento River watershed through the Delta to the ocean. Subadults inhabit the Delta and bays during summer months, while adults are associated with seawater and mixing zones of bays and estuaries and found in lower stretches of some rivers. Adult and juvenile green sturgeon are thought to use the same migratory routes as Chinook salmon.	Immigration: late Feb. to Jun. Spawning: March to July. After spawning, adults over-summer in deep pools of the Sacramento River from June to Nov. and emigrate to the ocean in fall and early winter and flows increase and temperatures decrease. Rearing: year-round.	Low. Potential impacts would not occur on the mainstem Sacramento River or the Feather River where the operating requirements specified in the Biological Opinions and D1641 would be met.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Delta smelt *Hypomesus transpacificus*	T	E	Endemic to Bay-Delta estuary. Primarily distributed downstream of Isleton on the Sacramento River, downstream of Mossdale on the San Joaquin River, Suisun Bay and Suisun marsh, freshwater regions of the Delta. Designated critical habitat (59 FR 65256) extends throughout Suisun Bay, the length of Goodyear, Suisun, Cutoff, first Mallard and Montezuma sloughs, and the contiguous waters of the legal Delta.	Primarily inhabit low salinity waters of estuary prior to migrating into freshwater habitats to spawn. Spawning occurs in slough and shallow edge area in the Delta and Sacramento River; spawning can occur in the Sacramento River as far upstream as Sacramento and in the Cache Slough region, the Mokelumne River system, and the San Joaquin River upstream as far as Prisoner's Point. Spawning occurs at water temperatures ranging from approximately 7C to 22C. Rearing juveniles remain in spawning areas, near or just above the X2 region of the Delta. Adult delta smelt abundance in the fall has been in the northwestern Delta in the channel of the Sacramento River. Although delta smelt tolerate a wide range of temperatures (<6C to > 25C), warm water temperatures restrict their distribution more than colder water temperatures.	Delta and Suisun Bay – year round	Low. Potential impacts would not occur in the Delta as the operating requirements specified in the Biological Opinions and D1641 would be met. Minor changes in flow could occur in the Delta as a result of water transfers, but these flows would be small. Principal rearing areas during the summer and fall are in and around Suisun Bay and in the Cache Slough region.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Longfin smelt *Spirinchus thaleichthys*	C [4]	T	Occur along the Pacific coast of North America; widespread within the Bay-Delta estuary, in the lower Sacramento River (downstream of Rio Vista), in the San Joaquin River (downstream of Medford Island). Also common in nearshore coastal marine waters.	Spawns at the transition zone between freshwater and slightly brackish water over sandy or gravel substrates at temperatures from 7 C to 14.5 C. Spawning occurs in the Sacramento River mainstem, as far upstream as Rio Vista, the San Joaquin River as far upstream as Medford Island, and in other waterways within the Delta. Hatching coincides with annual peak Delta outflows, which coincide with high turbidity. Larval smelt concentrate in near-surface, fresh and brackish waters. Distribution of larval and juvenile smelt depends on freshwater outflows from the Delta during the late-spring, eventually inhabiting the bays as well as nearshore coastal marine habitats. Longfin smelt do not occupy areas with temperatures greater than 22 C in combination with salinities greater than 26 ppt.	Spawning: November to June. Fry and juveniles have generally left the Delta by May or June.	None. Potential impacts would not occur in the Delta as the operating requirements specified in the Biological Opinions and D1641 would be met. Minor changes in flow could occur in the Delta as a result of water transfers, but these flows would be small. Longfin smelt do not occur in the Delta during the transfer period.
Hardhead	--	SSC	Hardhead are widely distributed in low to mid elevation streams in the Main Sacramento-San Joaquin river drainage as well as the Russian River drainage. Their range extends from the Ken River, in Kern County to the Pit River south of the Goose Lake drainage but are absent in the valley reaches.	Hardhead are typically found in undisturbed areas of the larger middle- and low elevation streams. Elevational range of hardhead is 10-1,450 m. Most streams in which they occur have summer temperatures in excess of 20°C.	Year-round	Low. Hardhead are largely excluded from the valley floor reaches of the streams and rivers within the Area of Analysis due to warm summer temperatures and the abundance of introduced fish.

Common Name *Scientific Name*	**Federal Special Status***	**State Special Status***	**Distribution**	**Habitat Association**	**Seasonal Occurrence**	**Potential Impact**
Sacramento splittail	--	SSC	Endemic to the lakes and rivers of the Central Valley. Current distribution generally restricted to the Delta, Suisun Bay, Suisun Marsh, the lower portions of the Napa and Petaluma rivers, and other parts of the San Francisco estuary. They may occur in the Sacramento River upstream as far as Red Bluff Diversion Dam and on the San Joaquin as far upstream as Salt Slough in wet years. They may also occur in the lower Feather and American rivers during these wetter periods. The Sutter and Yolo bypasses are important spawning areas today.	Inhabit estuarine to fresh waters. Spawning occurs primarily on inundated floodplains. Tend to be found in slow-moving sections of rivers and sloughs, and in the Delta and Suisun Marsh. YOY splittail are commonly found between Rio Vista and Chipps island indicating that juveniles prefer more riverine habitat.	Year round in the Delta, Sacramento and San Joaquin Rivers.	Low. Operating requirements for all of the mainstem rivers would meet existing flow and temperature requirements as specified by the NMFS and USFWS BOs for the Long-term Operations of the State and Federal Water Projects and State Water Board Decision 1641.

[1] Central CA DPS

[2] Santa Barbara and Sonoma Counties

[3] All bird species listed below and many other birds are protected during the nesting season under the federal Migratory Bird Treaty Act.

[4] USFWS has found that the San Francisco Bay-Delta Distinct Population Segment (DPS) of longfin smelt warrants protection under the federal Endangered Species Act, but higher priority listing actions currently preclude their listing.

*Status explanations:

F=Federal

E= listed as endangered under the federal Endangered Species Act

T= listed as threatened under the federal Endangered Species Act

PT= proposed for listing as threatened under the federal Endangered Species Act.

C = Candidate for listing under the federal Endangered Species Act

D= delisted.

S=State

E= listed as endangered under the California Endangered Species Act.

T= listed as threatened under the California Endangered Species Act.

SSC=Species of Special Concern

Table H-2.
Special-Status Plants with Potential to Occur in the Area of Analysis

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Adobe sanicle *Sanicula maritima*	-/R/ 1B.1	Alameda, Monterey, San Francisco, and San Luis Obispo Counties.	Meadows and seeps, valley and foothill grassland, chaparral, coastal prairie. Moist clay or ultramafic soils from 30-240m asl.	February - May	**None.** Adobe sanicle has been previously documented in the Buyer Service Area. Water transfer may increase the area of marginal habitat for this species in the Buyer Service Area. No negative impacts are expected.
Ahart's dwarf rush *Juncus leiospermus* var. *ahartii*	-/-/ 1B	Butte, Calaveras, Placer, Sacramento, Tehama, and Yuba Counties.	Valley and foothill grassland (mesic). May occur in disturbed areas including agricultural fields and locations with gopher digging activity (CNDDB 2012).	March-May	**Low.** Suitable grassland habitat occurs within the area of analysis and this species has been previously documented within the Seller Service Area. There is a low potential that this species would occur in managed rice fields.
Alkali milk-vetch *Astragalus tener var. tener*	-/-/ 1B.2	Central western California including Yolo County.	Subalkaline flats and areas around vernal pools.	March-June	**None.** Not likely to occur in rice fields, no suitable habitat (i.e. subalkali flats) would be affected by Transfers.
Anderson's manzanita *Arctostaphylos andersonii*	-/-/ 1B.2	Santa Clara, Santa Cruz, and San Mateo Counties.	Broadleaved upland forest, chaparral, North coast coniferous forest. Open sites in redwood forest from 180 - 800m asl.	November - May	**None.** Previously documented within the Buyer Service Area. No suitable habitat would be affected by the proposed Transfers.
Antioch Dunes evening-primrose *Oenothera deltoides* ssp. *howellii*	E/E/ 1B.1	Found only in Contra Costa and Sacramento Counties.	Occurs in inland dunes.	March-September	**None.** CNDDB records for this species have been documented within the Buyer Service Area. Not likely to occur in rice fields, and no inland dune habitat should be affected by Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Arcuate bush-mallow *Malacothamnus arcuatus*	-/-/ 1B.2	Santa Clara, Santa Cruz, and San Mateo Counties.	Chaparral within gravelly alluvium from 80 - 335m asl.	April - September	**None.** Previously observed within the Buyer Service Area. No impacts to suitable habitat are anticipated in association with the proposed Transfers.
Baker's navarretia *Navarretia leucocephala* ssp. *bakeri*	-/-/ 1B.1	Colusa, Glenn, Lake, Lassen, Mendocino, Marin, Napa, Solano, Sonoma, Sutter, Tehama, and Yolo Counties.	Cismontane woodland, meadows and seeps, vernal pools, valley and foothill grassland, lower montane coniferous forest. Vernal pools and swales, adobe or alkaline soils from 5 - 950m.	April - July	**None.** The CNDDB contains records of this species within the Seller Service Area. It is very unlikely that Baker's navarretia would establish in rice fields, given the lack of adobe or alkaline soils.
Bearded popcorn-flower *Plagiobothrys hystriculus*	-/-/ 1B.1	Napa, Solano, and Yolo Counties.	Vernal pools, valley and foothill grassland in wet sites from 10-50m. This species is only known from a few very limited occurrences at the edges of vernal pools, such as at Jepson Prairie and in the Montezuma Hills.	April - May	**None.** Previous records of bearded popcorn-flower exist within the Seller Service Area. This species is not expected to occur in rice fields. No vernal pools or grassland habitats would be affected by the proposed Transfers.
Ben Lomond buckwheat *Eriogonum nudum* var. *decurrens*	-/-/ 1B.1	Alameda, Santa Clara, and Santa Cruz Counties.	Chaparral, cismontane woodland, lower montane coniferous forest. Ponderosa pine sandhills in Santa Cruz County from 50 - 800m asl.	June - October	**None.** The CNDDB contains occurrences of this species in the Buyer Service Area. No chaparral or woodland habitats would be affected by the proposed Transfers.
Bent-flowered fiddleneck *Amsinckia lunaris*	-/-/ 1B.2	Alameda, Contra Costa, Colusa, Lake, Marin, Napa, San Benito, Santa Clara, Santa Cruz, San Mateo, Sonoma, and Yolo Counties.	Cismontane woodland, valley and foothill grassland from 50 - 500m.	March - June	**None.** Bent-flowered fiddleneck has been previously documented within the Buyer Service Area. Although suitable habitat occurs within the area of analysis, none would be affected by the proposed actions.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Big-scale balsamroot *Balsamorhiza macrolepis* var. *macrolepis*	-/-/ 1B.2	Alameda, Butte, Colusa, El Dorado, Lake, Mariposa, Napa, Placer, Santa Clara, Solano, Sonoma, Tehama, and Tuolumne Counties.	Valley and foothill grassland, cismontane woodland. Sometimes on serpentine. 35 - 1000m	March - June	**None.** This species has been previously documented within both the Buyer and Seller Service Areas. However, it is not expected to occur in rice fields due to lack of suitable habitat.
Big tarplant *Blepharizonia plumosa*	-/-/ 1B.1	Alameda, Contra Costa, San Joaquin, Solano, and Stanislaus Counties.	Valley and foothill grassland. Dry hills and plains in annual grassland. Clay to clay-loam soils, usually on slopes and often in burned areas 15 - 455m asl.	July - October	**None.** Big tarplant has been observed within the Buyer Service Area. Transfers would not affect suitable habitat for this species.
Boggs Lake hedge-hyssop *Gratiola hetersepela*	-/E/1B	Dispersed throughout the Sacramento and Central Valley. Also in Oregon.	Marshes, swamps, and vernal pools (clay).	April - August	**None.** A CNDDB occurrence has been documented within the Seller Service Area. This species may withstand some disturbances, such as cattle. However, modifications of natural hydrology by agriculture or other activities are considered a threat to the species, and Boggs Lake hedge-hyssop is not expected to occur within planted rice fields. No marsh or vernal pool habitat would be affected by the proposed Transfers.
Bolander's water-hemlock *Cicuta maculata var. bolanderi*	-/-/ 2.1	Occurs within California, Arizona, New Mexico, and Washington. In California it is found in Contra Costa, Los Angeles, Marin, Sacramento, Santa Barbara, San Luis Obispo, and Solano Counties.	Marshes, fresh or brackish water 0 - 200m asl.	July - September	**None.** Bolander's water hemlock has been previously documented within the Buyer Service Area. No marsh, fresh or brackish water habitat would be affected by the proposed Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Brandegee's clarkia *Clarkia biloba* ssp. *brandegeeae*	-/-/ 1B.2	Butte, El Dorado, Nevada, Placer, Sacramento, Sierra, and Yuba Counties.	Chaparral, cismontane woodland, often in roadcuts 295 - 885m asl.	May - July	**None.** This species has been previously recorded within the Seller Service Area. No impacts to suitable habitat are expected.
Brandegee's eriastrum *Eriastrum brandegeeae*	-/-/ 1B.2	Contra Costa, Colusa, Glenn, Lake, Santa Clara, Shasta, San Mateo, Tehama, and Trinity Counties.	Chaparral, cismontane woodland. On barren volcanic soils, often in open areas from 345 - 1000m asl.	April - August	**None.** Records of Brandegee's eriastrum exist for the Buyer Service Area. Suitable habitat would not be affected by Transfers.
Brewer's western flax *Hesperolinon breweri*	-/-/ 1B.2	Contra Costa, Napa and Solano Counties.	Chaparral, cismontane woodland, valley and foothill grassland. Often in rocky serpentine soils in serpentine chaparral and serpentine grassland from 30 - 885m asl.	May - July	**None.** Brewer's western flax has been previously observed within the Buyer Service Area. Suitable habitat would not be affected by Transfers.
Brittlescale *Atriplex depressa*	-/-/1B.2	Western Central Valley and valleys of adjacent foothills.	Alkali grassland, alkali meadow, alkali scrub, and vernal pools. Usually in alkali scalds or alkaline clay in meadows or annual grassland. Rarely associated with riparian areas, marshes, or vernal pools 1 - 320m asl.	April-October	**None.** Occurrences of this species have been documented in both the Buyer and Seller Service Areas in the CNDDB. This species is not likely to occur in rice fields due to lack of suitable habitat (i.e. alkali and vernal pools).
Butte County fritillary *Fritillaria eastwoodiae*	-/-/3.2	Butte, El Dorado, Nevada, Placer, Placer, Shasta, Tehama and Yuba Counties.	Chaparral, cismontane woodland, lower montane coniferous forest. Usually on dry slopes but also found in wet places. Soils can be serpentine, red clay, or sandy loam 40 - 1500m asl.	March - June	**None.** Butte County fritillary has been previously observed within the Seller Service Area. Rice fields do not provide suitable habitat for this species, and it is therefore not expected to be impacted by Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
California jewel-flower *Caulanthus californicus*	E/E/ 1B.1	Fresno, Kings, Kern, Santa Barbara, San Luis Obispo, and Tulare Counties.	Chenopod scrub, valley and foothill grassland, pinyon-juniper woodland. From various valley habitats in both the Central Valley and Carrizo Plain 65 - 900m asl.	February - May	**None.** CNDDB records of this species exist for the Buyer Service Area. Suitable habitat would not be affected by Transfers.
California seablite *Suaeda californica*	E/-/ 1B.1	Alameda, Contra Costa, Santa Clara, San Francisco, and San Luis Obispo Counties.	Marshes and swamps. Margins of coastal salt marshes 0 - 5m asl.	July - October	**None.** California seablite has been previously observed within the Buyer Service Area. No impacts to suitable habitat within the Buyer Service Area are expected to occur.
Caper-fruited tropidocarpum *Tropidocarpum capparideum*	-/-/ 1B.1	Alameda, Contra Costa, Fresno, Glenn, Monterey, Santa Clara, San Joaquin, and San Luis Obispo Counties.	Valley and foothill grassland in alkaline clay 0 - 455m asl.	March - April	**None.** CNDDB records exist for the Buyer Service Area. Transfers are not expected to impact suitable habitat for this species.
Carquinez goldenbush *Isocoma arguta*	-/-/ 1B.1	Occurs in Solano County.	Valley and foothill grassland. Alkaline soils, flats, lower hills. On low benches near drainages and on tops and sides of mounds in swale habitat 1 - 20m asl.	August - December	**None.** Previously documented within the Buyer Service Area. Transfers would not affect water levels in the Seller Service Area and would only increase the levels in the Buyer Service Area.
Chaparral harebell *Campanula exigua*	-/-/ 1B.2	Alameda, Contra Costa, San Benito, Santa Clara, and Stanislaus Counties.	Chaparral on rocky sites, usually on serpentine soils 300 - 1250m asl.	May - June	**None.** Chaparral harebell has been observed within the Buyer Service Area. However, Transfers are not expected to affect suitable habitat for this species.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Chaparral ragwort *Senecio aphanactis*	-/-/ 2.2	California and Baja California. Within California, the species occurs in Alameda, Contra Costa, Fresno, Los Angeles, Merced, Monterey, Orange, Riverside, Santa Barbara, Santa Clara, the Channel Islands, San Diego, San Luis Obispo, Solano and Ventura Counties.	Cismontane woodland, coastal scrub. Drying alkaline flats 20 - 575m asl.	January - April	**None.** Previous records of this species exist within the Buyer Service Area. Transfers are not expected to affect suitable habitat for chaparral ragwort.
Choris' popcorn-flower *Plagiobothrys chorisianus* var. *chorisianus*	-/-/ 1B.2	Alameda, Santa Cruz, San Francisco, and San Mateo Counties.	Chaparral, coastal scrub, coastal prairie (mesic sites) 15 - 100m asl.	March - June	**None.** Choris' popcorn flower has been documented within the Buyer Service Area. No impacts to suitable habitat are anticipated in association with the proposed Transfers.
Colusa grass *Neostapfia colusana*	T/E/1B.1	Southern Sacramento Valley, and northern San Joaquin Valley.	Vernal pools.	May-July	**None.** According to the CNDDB, this species has been previously documented in the Seller Service Area. However, this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).
Colusa layia *Layia septentrionalis*	-/-/ 1B.2	Colusa, Glenn, Lake, Mendocino, Napa, Sonoma, Sutter, Tehama, and Yolo Counties.	Chaparral, cismontane woodland, valley and foothill grassland. Scattered colonies in fields and grassy slopes in sandy or serpentine soil 145 - 1095m asl.	April - May	**None.** CNDDB records exist for the Seller Service Area. Transfers are not expected to impact suitable habitat for this species given that rice fields do not provide appropriate conditions.
Congdon's tarplant *Centromadia parryi* ssp. *congdonii*	-/-/ 1B.2	Alameda, Contra Costa, Monterey, Santa Clara, Santa Cruz, San Luis Obispo, San Mateo, and Solano Counties.	Valley and foothill grassland. Alkaline soils, sometimes described as heavy white clay 1 - 230m asl.	May - November	**None.** Although this species has been documented within the Buyer Service Area (CNDDB), no impacts to suitable habitat are expected.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Contra Costa goldfields *Lasthenia conjugens*	E/-/1B.1	San Francisco Bay Delta Regions, and scattered coastal areas.	Cismontane woodlands, playas, valley and foothill grasslands, and vernal pools. Often occurs in vernal pools, swales, and low depressions in open grassy areas 1 - 445m asl.	March-June	**None.** According to the CNDDB, this species has been previously documented within the Buyer Service Area. No impacts to suitable habitat (i.e. vernal pools, playas) are expected.
Contra Costa manzanita *Arctostaphylos manzanita* ssp. *laevigata*	-/-/1B.2	Contra Costa County.	Chaparral on rocky slopes 500 - 1100m asl.	January - April	**None.** Contra Costa manzanita has been observed within the Buyer Service Area. No impacts to suitable habitat for this species are expected.
Contra Costa wallflower *Erysimum capitatum* var. *angustatum*	E/E/1B.1	Contra Costa County	Inland dunes. Stabilized dunes of sand and clay near Antioch along the San Joaquin River 3 - 20m asl.	March - July	**None.** Records of this species exist within the Buyer Service Area. Suitable habitat would not be affected by Transfers.
Coyote ceanothus *Ceanothus ferrisiae*	E/-/1B.1	Santa Clara County	Chaparral, valley and foothill grassland, coastal scrub. Serpentine sites in the Mt. Hamilton Range 120 - 455m asl.	January - May	**None.** The CNDDB contains records of this species within the Buyer Service Area. No suitable habitat for coyote ceanothus is expected to be impacted by the proposed Transfers.
Crampton's tuctoria (Solano grass) *Tuctoria mucronata*	E/E/1B	Located only in Yolo and Solano Counties.	Valley and foothill grassland (mesic), and vernal pools.	April-August	**None.** Occurrences have been documented outside of the area of analysis. Not likely to occur in rice fields. Suitable habitat within the Seller Service Area would not be impacted by Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Delta coyote-thistle(button celery) *Eryngium racemosum*	-/E/1B	Calaveras, Contra Costa, Merced, San Joaquin, and Stanislaus Counties.	Riparian scrub and vernally mesic clay depressions.	June-October	**None.** No occurrences have been documented within the area of analysis, but the species is known from Contra Costa, Merced, San Joaquin and Stanislaus Counties. No suitable habitat would be impacted by the proposed Transfers.
Delta mudwort *Limosella subulata*	-/-/ 2.1	Contra Costa, Marin, Sacramento, San Joaquin, Solano Counties.	Riparian scrub, freshwater marsh, brackish marsh. Usually on intertidal flats and muddy banks of the Delta in marshy or scrubby riparian associations, often with Lilaeopsis masonii 0 - 3m asl. Typically occurs with other rare plant species.	May - August	**None.** Previous CNDDB records exist within the Buyer Service Area, and suitable habitat is also present within the Seller Service Area. This species is not expected to occur within rice fields given that it is sensitive to alteration of natural hydrology and other disturbances (SCWA 2007).
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	-/-/ 1B.2	Contra Costa, Napa, Sacramento, San Joaquin, Solano, Sonoma, Yolo Counties.	Coastal salt marsh. In coastal salt marsh with Distichlis, Salicornia, Frankenia, etc. from 0-3m asl.	May - September	**None.** Suitable habitat is present within the area of analysis, and CNDDB records exist for the Buyers Service Area. Transfers are not expected to impact suitable habitat for this species (i.e. coastal salt marshes).
Diablo helianthella *Helianthella castanea*	-/-/ 1B.2	Alameda, Contra Costa, Marin, San Francisco, San Mateo.	Broadleaved upland forest, chaparral, cismontane woodland, coastal scrub, riparian woodland, valley and foothill grassland. Usually in chaparral/oak woodland interface in rocky, azonal soils. Often in partial shade 25-1150m asl.	March - June	**None.** Diablo helianthella has been previously documented within the Buyer Service Area. No impacts to suitable habitat for this species are anticipated.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Diamond-petaled California poppy *Eschscholzia rhombipetala*	-/-/ 1B.1	Alameda, Contra Costa, Colusa, San Joaquin, San Luis Obispo, Stanislaus Counties.	Valley and foothill grassland. Alkaline clay slopes and flats. 0 - 975m asl.	March - April	**None.** This species has been previously documented within the Buyer Service Area. No impacts to suitable habitat are anticipated.
Dubious pea *Lathyrus sulphureus* var. *argillaceus*	-/-/ 3	Calaveras, El Dorado, Nevada, Placer, Shasta, Tehama Counties.	Cismontane woodland, lower montane coniferous forest, upper montane coniferous forest 150-305m asl.	April - May	**None.** CNDDB records of dubious pea exist within the Seller Service Area. Transfers actions would not affect suitable habitat for this species.
Dwarf downingia *Downingia pusilla*	-/-/ 2.2	Occurs in California and South America. Within California: Amador, Fresno, Merced, Napa, Placer, Sacramento, San Joaquin, Solano, Sonoma, Stanislaus, Tehama, Yuba.	Vernal pools. Many historical occurrences are extirpated. In beds of vernal pools 1 - 880m asl.	March - May	**None.** Previously observed within the Seller Service Area. Not likely to establish in rice fields, due to lack of suitable habitat (i.e., vernal pools).
Elongate copper moss *Mielichhoferia elongata*	-/-/ 2.2	Occurs in California, Colorado and Oregon. Within California, occurs in Fresno, Humboldt, Lake, Mariposa, Marin, Nevada, Placer, Plumas, Santa Cruz, Trinity, and Tulare Counties.	Cismontane woodland on very acidic, metamorphic rock or substrate, usually in higher portions in fens.	--	**None.** CNDDB records exist for the Seller Service Area. Transfers are not expected to affect suitable habitat for this species.
Ferris' milk-vetch *Astragalus tener* var. *ferrisae*	-/-/1B.1	Sacramento Valley.	Subalkaline flats and areas around vernal pools.	March-June	**None.** The species has been previously documented within the Seller Service Area. Not likely to occur in rice fields, due to lack of suitable habitat.
Fragrant fritillary *Fritillaria liliacea*	-/-/ 1B.2	Alameda, Contra Costa, Monterey, Marin, San Benito, Santa Clara, San Francisco, San Mateo, Solano, Sonoma Counties.	Cismontane woodland, valley and foothill grassland. Grassy areas from 635 - 855m asl.	February - April	**None.** Previous records exist within the Buyer Service Area. Transfers are not expected to impact suitable habitat for fragrant fritillary.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Franciscan onion *Allium peninsulare* var. *franciscanum*	-/-/ 1B.2	Mendocino, Santa Clara, San Mateo, Sonoma Counties.	Cismontane woodland, valley and foothill grassland. Clay soils, often on serpentine. Dry hillsides from 100 - 300m asl.	May - June	**None.** Previous records of franciscan onion exist for the Buyer Service Area. The proposed Transfers is not expected to impact suitable habitat for this species.
Franciscan thistle *Cirsium andrewsii*	-/-/ 1B.2	Contra Costa, Marin, San Francisco, San Mateo, Sonoma Counties.	Coastal bluff scrub, broadleaved upland forest, coastal scrub. Sometimes serpentine seeps 0 - 135m asl.	March - July	**None.** Has been observed within the Buyer Service Area. No impacts to suitable habitat for Franciscan thistle are anticipated.
Greene's tuctoria *Tuctoria greeni*	E/R/1B.1	Butte, Colusa, Fresno, Glenn, Madera, Merced, Modoc, Shasta, San Joaquin, Stanislaus, Tehama, and Tulare Counties.	Vernal pools.	May-July	**None.** There is a CNDDB occurrence within the Seller Service Area, however this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).
Hairless popcorn-flower *Plagiobothrys glaber*	-/-/ 1A	Alameda, Marin, San Benito, Santa Clara Counties.	Meadows and seeps, marshes and swamps. Coastal salt marshes and alkaline meadows 5-180m asl.	March - May	**None.** This species has been documented by CNDDB within the Buyer Service Area. Transfers are not expected to impact suitable habitat for this species within the Buyer Service Area.
Hairy Orcutt grass *Orcuttia pilosa*	E/E/1B.1	Northern Sacramento Valley, Pit River Valley; isolated populations in Lake and Sacramento counties.	Vernal pools.	May - September	**None.** Hairy Orcutt grass has previously been documented by the CNDDB in the Seller Service Area. However, this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).
Hall's bush-mallow *Malacothamnus hallii*	-/-/ 1B.2	Contra Costa, Lake, Mendocino, Merced, Santa Clara, San Mateo, Stanislaus Counties.	Chaparral. Some populations on serpentine 10 - 550m asl.	May - October	**None.** Previous records exist within the Buyer Service Area. Transfers are not expected to impact suitable habitat for Hall's bush-mallow.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Hall's tarplant *Deinandra halliana*	-/-/ 1B.1	Fresno, Monterey, San Benito, San Luis Obispo Counties.	Cismontane woodland, valley and foothill grassland, vernal pools. In grassland and not necessarily in vernal pools 200 - 1000m asl.	April - May	**None.** Hall's tarplant has been observed within the Buyer Service Area. Transfers are not expected to impact vernal pools or other suitable habitat for this species within the Buyer Service Area.
Hartweg's golden sunburst *Pseudobahia bahiifolia*	E/E/1B	Found in El Dorado, Fresno, Madera, Merced, Stanislaus, Tuolumne, and Yuba Counties.	Cismontane woodland, valley and foothill grassland, often acidic.	April - May	**None.** There are CNDDB occurrences within Yolo County outside of the area of analysis. This species is not likely to be affected by Transfers given that it is not likely to occur in rice fields.
Heartscale *Atriplex cordulata*	-/-/1B	Western Central Valley and valleys of adjacent foothills.	Alkali grasslands, alkali meadows, and alkali scrub.	May - October	**None.** CNDDB occurrences have been documented within the Seller Service Area (Butte, Colusa, Yolo, and Glenn Counties). However, this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. alkali areas).
Heckard's pepper-grass *Lepidium latipes* var**.** *heckardii*	-/-/1B	Glenn, Solano, and Yolo Counties.	Valley and foothill grassland alkaline flats.	March-May	**None.** This species has been previously documented within the Seller Service Area. However, it is not likely to occur in rice fields due to lack of suitable habitat (i.e. alkali flats).
Henderson's bent grass *Agrostis hendersonii*	- /-/ 3.2	Found in Butte, Calaveras, Merced, Placer, Shasta, and Tehama Counties. Also found in Oregon.	Vernal pools.	March- June	**None.** CNDDB records for this species occur within the Seller Service Area. Not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Hispid bird's beak *Cordylanthus mollis* ssp. *hispidus*	-/-/1B.1	Alameda, Kern, Fresno, Merced, Placer, and Solano Counties.	Meadows and seeps, playas, valley and foothill grasslands (alkali).	June-September	**None.** Previously observed within the Seller Service Area according to CNDDB records. Not likely to occur in rice fields, no suitable habitat present.
Hooked popcorn-flower *Plagiobothrys uncinatus*	-/-/ 1B.2	Monterey, San Benito, Santa Clara, San Luis Obispo, and Stanislaus Counties.	Chaparral, cismontane woodland, valley and foothill grassland, coastal bluff scrub. Sandstone outcrops and canyon sides, often in burned or disturbed areas 300 - 820m asl.	April - May	**None.** Hooked popcorn-flower has been documented within the Buyer Service Area. No impacts to suitable habitat for this species are anticipated.
Hoover's button-celery *Eryngium aristulatum* var. *hooverii*	-/-/ 1B.1	Alameda, San Benito, Santa Clara, San Diego, San Luis Obispo Counties.	Vernal pools. Alkaline depressions, vernal pools, roadside ditches and other wet places near the coast 5 - 45m asl.	July - August	**None.** This species has been documented within the Buyer Service Area. Suitable habitat for the species is present (e.g. irrigated agriculture and ditches), but no impacts to suitable habitat are expected within the Buyer Service Area.
Hoover's cryptantha *Cryptantha hooveri*	-/-/ 1A	Contra Costa, Kern, Madera, Stanislaus Counties.	Valley and foothill grassland in coarse sand up to 150m asl.	April - May	**None.** Hoover's cryptantha has been observed within the Buyer Service Area. No impacts to suitable habitat for this species are anticipated.
Hoover's eriastrum *Eriastrum hooveri*	D/-/ 4.2	Contra Costa, Kern, Madera, Stanislaus Counties.	Chenopod scrub, valley and foothill grassland, pinyon-juniper woodland. On sparsely vegetated alkaline alluvial fans, also in the Temblor Range on sandy soils 50 - 915m asl.	April - May	**None.** This species has previously been documented within the Buyer Service Area. No suitable habitat for this species would be impacted by the proposed Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Hoover's spurge *Chamaesyce hooveri*	T/-/ 1B.2	Scattered in Glenn, Butte, Colusa, Merced, Stanislaus, Tehama, and Tulare Counties.	Vernal pools.	July-September	**None.** According to the CNDDB occurrences have been documented in the Seller Service Area. However, this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).
Hospital Canyon larkspur *Delphinium californicum* ssp. *interius*	-/-/ 1B.2	Alameda, Contra Costa, Merced, Monterey, San Benito, Santa Clara, San Joaquin, and Stanislaus Counties.	Cismontane woodland, chaparral. In wet, boggy meadows, openings in chaparral and in canyons 225 - 1060m asl.	April - June	**None.** Hospital Canyon larkspur has been observed within the Buyer Service Area. There is suitable habitat for this species in the area of analysis, but the proposed actions are not expected to impact these habitat in the Buyer Service Area.
Indian valley brodiaea *Broiaea coronaria* ssp. *rosea*	-/E/1B	Scattered in Glenn, Lake, Colusa, and Tehama Counties.	Closed cone coniferous forest, chaparral, valley and foothill grasslands (serpentinite).	May-June	**None.** CNDDB occurrences have been documented outside of the area of analysis. This species is not likely to occur in rice fields due to lack of suitable habitat.
Indian Valley bush-mallow *Malacothamnus aboriginum*	-/-/ 1B.2	Alameda, Contra Costa, Merced, Monterey, San Benito, Santa Clara, San Joaquin, and Stanislaus Counties.	Cismontane woodland, chaparral. Granitic outcrops and sandy bare soil, often in disturbed soils 150 - 1700m asl.	April - June	**None.** Indian Valley bush-mallow has been observed within the Buyers Service Area. The proposed Transfers should not affect suitable habitat for this species.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Jepson's milk-vetch *Astragalus rattanii var. jepsonianus*	-/-/1B.2	Colusa, Glenn, Lake, Napa, Tehama, and Yolo Counties.	Chaparral, cismontane woodland, valley and foothill grassland, often serpentinite.	April-June	**None.** Although suitable habitat exists, no CNDDB records have been documented within the area of analysis. This species is not likely to be impacted as rice fields do not provide suitable habitat.
Keck's checkerbloom *Sidalcea keckii*	E/-/1B.1	Colusa, Fresno, Merced, Napa, Solano, Tulare, and Yolo Counties.	Cismontane woodlands, foothill and valley grasslands (serpentinite).	April-May	**None.** No CNDDB occurrences of this species are known for the area of analysis. Suitable habitat is present, but would not be impacted by the proposed Transfers.
Kellogg's horkelia *Horkelia cuneata* ssp. *sericea*	-/-/ 1B.1	Alameda, Monterey, Marin, Santa Barbara, Santa Cruz, San Francisco, San Luis Obispo, and San Mateo Counties.	Closed-cone coniferous forest, coastal scrub, chaparral. Within old dunes, coastal sandhills, openings from 10 - 200m asl.	April - September	**None.** Records of Kellog's horkelia exist in the Buyer Service Area. Transfers are not expected to affect suitable habitat for this species within the area of analysis.
Kings Mountain manzanita *Arctostaphylos regismontana*	-/-/ 1B.2	Santa Clara, Santa Cruz, and San Mateo Counties.	Broadleaved upland forest, chaparral, north coast coniferous forest. Granitic or sandstone outcrops 305 - 730m asl.	January - April	**None.** This species has been previously observed within the Buyer Service Area. Suitable habitat is presented but would not be impacted by the proposed Transfers.
Large-flowered fiddleneck *Amsinckia grandiflora*	E/E/ 1B.1	Alameda, Contra Costa, and San Joaquin Counties.	Cismontane woodland, valley and foothill grassland. Annual grassland in various soils 275 - 550m asl.	April - May	**None.** Large-flowered fiddleneck has been recorded by the CNDDB within the Buyer Service Area. No impacts would occur to suitable habitat.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Layne's ragwort *Packera layneae*	T/-/1B	Butte, El Dorado, Tuolumne, and Yuba Counties.	Chaparral and cismontane woodland, rocky and often serpentinite.	April-August	**None.** There is a CNDDB occurrence within Butte County, outside the area of analysis. Although suitable habitat is present within the area of analysis, it is not expected to be impacted by the proposed Transfers.
Legenere *Legenere limosa*	-/-/1B.1	Sacramento Valley and south of the North Coast Ranges.	Vernal pools from 1-880m asl.	April-June	**None.** Legenere has been documented within both the Buyer and Seller Service Areas. Not likely to occur in rice fields, no suitable habitat present (i.e. vernal pools).
Lesser saltscale *Atriplex minuscula*	-/-/1B	Found in Butte, Fresno, Kern, Madera, Merced, Stanislaus, and Tulare Counties.	Chenopod scrub, playas, valley and foothill grasslands (alkali and sandy).	May-October	**None.** No CNDDB records exist for the area of analysis, but it has been documented within some of the counties. Suitable habitat occurs within the Buyer Service Area, but would not be impacted by the proposed Transfers.
Lime Ridge navarretia *Navarretia gowenii*	-/-/ 1B.1	Occurs within Contra Costa and Stanislaus Counties in California.	Chaparral on calcium carbonate rich soil with high clay content, 180 - 305m asl.	May - June	**None.** Previously documented within the Buyer Service Area. No suitable habitat for Lime Ridge navarretia would be affected by the proposed Transfers.
Loma Prieta hoita *Hoita strobilina*	-/-/ 1B.1	Alameda, Contra Costa, Santa Clara, Santa Cruz Counties.	Chaparral, cismontane woodland, riparian woodland. Within serpentine at mesic sites.	May - October	**None.** CNDDB records of Loma Prieta hoita exist for the Buyer Service Area. No impacts are expected within suitable habitat for this species.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Lone buckwheat *Eriogonum apricum* var. *apricum*	E/E/1B	Found in Amador and Sacramento Counties.	Chaparral.	July-October	**None.** Although it has been documented, no CNDDB records exist within the area of analysis. This species is not likely to occur in rice fields due to lack of suitable habitat.
Lost Hills crownscale *Atriplex coronata* var. *vallicola*	-/-/ 1B.2	Fresno, Kings, Kern, Merced, and San Luis Obispo Counties.	Chenopod scrub, valley and foothill grassland, vernal pools. In powdery, alkaline soils that are vernally moist with Frankenia, Atriplex spp. And Distichlis. 0 - 605m asl.	April - August	**None.** This species has been documented within the Buyer Service Area. No impacts to suitable habitat are expected.
Lost thistle *Cirsium praeteriens*	-/-/ 1A	Little information exists on this plant. San Mateo and Santa Clara Counties. Little information exists on this species. It was collected from the Palo Alto area at the turn of the 20th century. Not observed since 1901.	0 - 100m asl.	June - July	**None.** CNDDB records of lost thistle exist for the Buyer Service Area. Very limited information is available. Based on status information it is likely to be extirpated and would therefore be unlikely to occur within an area impacted by transfers.
Maple-leaved checkerbloom *Sidalcea malachroides*	-/-/ 4.2	Occurs within California and Oregon. In California the species occurs in Del Norte, Humboldt, Mendocino, Monterey, Santa Clara, Santa Cruz, and Sonoma Counties.	Broadleafed upland forest, coastal prairie, coastal scrub, North Coast coniferous forest. Woodlands and clearings near coast, often in disturbed areas 2 - 760m asl.	March - August	**None.** This species has been previously documented within the Buyer Service Area. No impacts to areas of suitable habitat are anticipated.
Marsh checkerbloom *Sidalcea oregana* ssp. *hydrophila*	-/-/1B	Glenn, Lake, Mendocino, and Napa Counties.	Meadows and seeps, and riparian forest.	June-August	**None.** Suitable habitat present within Glenn County in the area of analysis. This species is not expected to establish in rice fields, and therefore no impacts are anticipated.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Mason's lilaeopsis *Lilaeopsis masonii*	-/R/ 1B.1	Alameda, Contra Costa, Marin, Napa, Sacramento, San Joaquin, Solano, and Yolo Counties.	Freshwater and brackish marshes, riparian scrub. Tidal zones, in muddy or silty soil formed through river deposition or river bank erosion 0 - 10m asl. Populations may be ephemeral, using freshly deposited or exposed sediments (SCWA 2007).	April - November	**None.** Previous records of this species exist within the Buyer Service Area. This species is not expected to establish within rice fields.
Merced phacelia *Phacelia ciliata var. opaca*	-/-/ 1B.2	Merced County.	Valley and foothill grassland. Adobe or clay soils of valley floors, open hills or alkaline flats 60 - 150m asl.	February - May	**None.** Merced phacelia has been documented within the Seller Service Area. Transfers are not expected to affect suitable habitat for this species.
Metcalf Canyon jewel-flower *Streptanthus albidus* ssp. *albidus*	E/-/ 1B.1	Santa Clara County.	Valley and foothill grassland. Relatively open areas in dry grassy meadows on serpentine soils 45 - 245m asl.	April - July	**None.** This species was previously observed within the Buyer Service Area according to CNDDB. No Transfers-related impacts to suitable habitat for Metcalf Canyon jewel-flower are anticipated.
Milo Baker's lupine *Lupinus milo-bakeri*	-/T/1B	Glenn and Mendocino Counties.	Cismontane woodlands, foothill and valley grasslands.	June-September	**None.** Although suitable habitat is present within the area of analysis, no CNDDB records have been documented in either the Buyer or Seller Service Areas. This species is not likely to occur in rice fields due to lack of suitable habitat.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Most beautiful jewel-flower *Streptanthus albidus* ssp. *peramoenus*	-/-/ 1B.2	Alameda, Contra Costa, Monterey, Santa Clara, and San Luis Obispo Counties.	Chaparral, valley and foothill grassland, cismontane woodland, serpentine outcrops, on ridges and slopes 120 - 730m asl.	March - October	**None.** Most beautiful jewel-flower has been previously observed within the Buyer Service Area. No Transfers-related impacts to suitable habitat for this species are expected.
Mount Day rockcress *Boechera rubicundula*	-/-/ 1B.1	Santa Clara County.	Rocky slopes in chaparral at 1200m asl.	April - May	**None.** According to CNDDB, this species was documented within the Buyer Service Area. No suitable habitat for this species would be affected by Transfers.
Mt. Diablo buckwheat *Eriogonum truncatum*	-/-/ 1B.1	Alameda, Contra Costa, and Solano Counties.	Chaparral, coastal scrub, valley and foothill grassland. Dry, exposed clay or sandy substrates 100 - 600m asl.	April - December	**None.** This species has been observed within the Buyer Service Area. No suitable habitat would be affected by Transfers.
Mt. Diablo fairy-lantern *Calochortus pulchellus*	-/-/ 1B.2	Alameda, Contra Costa, and Solano Counties.	Chaparral, cismontane woodland, riparian woodland, valley and foothill grassland on wooded and brushy slopes 200 - 800m asl.	April - June	**None.** Mt. Diablo fairy-lantern has been documented within the Buyer Service Area. No impacts to suitable habitat for this species are expected.
Mt. Diablo jewel-flower *Streptanthus hispidus*	-/-/ 1B.3	Contra Costa County.	Valley and foothill grassland, chaparral, talus or rocky outcrops 275 - 970m asl.	March - June	**None.** The Mt. Diablo jewel-flower has been documented in the Buyer Service Area. No impacts to suitable habitat area anticipated.
Mt. Diablo manzanita *Arctostaphylos auriculata*	-/-/ 1B.3	Contra Costa County.	Chaparral in canyons and on slopes. On sandstone 120 - 500m asl.	January - March	**None.** This species was previously observed within the Buyer Service Area according to CNDDB. No Transfers-related impacts to suitable habitat for Mt. Diablo phacelia are anticipated.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Mt. Diablo phacelia *Phacelia phacelioides*	-/-/ 1B.2	Contra Costa, San Benito, Santa Clara, and Stanislaus Counties.	Chaparral, cismontane woodland. Adjacent to trails, on rock outcrops and talus slopes, sometimes on serpentine 500 - 1370m asl.	April - May	**None.** Mt. Diablo phacelia has been documented within the Buyer Service Area. No impacts to suitable habitat for this species are expected.
Mt. Hamilton coreopsis *Leptosyne hamiltonii*	-/-/ 1B.2	Alameda, Santa Clara, and Stanislaus Counties.	Cismontane woodland. On steep shale talus with open southwestern exposure 530 - 1300m asl.	March - May	**None.** CNDDB records of Mt. Hamilton coreopsis exist within the Buyer Service Area. Transfers would not affect suitable habitat for this species.
Mt. Hamilton fountain thistle *Cirsium fontinale* var. *campylon*	-/-/ 1B.2	Alameda, Santa Clara, and Stanislaus Counties.	Cismontane woodland, chaparral, valley and foothill grassland. In seasonal and perennial drainages on serpentine soil 95 - 890m asl.	February - October	**None.** This species has been documented within the Buyers Service Area. No impacts to suitable habitat within the area of analysis are anticipated.
Mt. Hamilton jewel-flower *Streptanthus callistus*	-/-/ 1B.3	Santa Clara County.	Chaparral, cismontane woodland. Open talus slopes on shale with grey pine and/or black oak 600 - 790m asl.	April - May	**None.** Mt. Hamilton jewel-flower has been documented within the Buyers Service Area by CNDDB. Transfers would not impact suitable habitat for this species.
Mt. Hamilton lomatium *Lomatium observatorium*	-/-/ 1B.2	Santa Clara and Stanislaus Counties.	Cismontane woodland. Open to partially shaded openings in Pinus coulteri - Oak woodland. Sedimentary Franciscan rocks and volcanic soils 1219 - 1330m asl.	March - May	**None.** Mt. Hamilton lomatium has been documented within the Buyers Service Area by CNDDB. Transfers would not impact suitable habitat for this species.
Munz's tidy-tips *Layia munzii*	-/-/ 1B.2	Fresno, Kern, and San Luis Obispo Counties.	Chenopod scrub, valley and foothill grassland. Hillsides in white-grey alkaline clay soils with grasses and chenopod scrub associates 45 - 760m asl.	March - April	**None.** This species has been observed within the Buyer Service Area. No suitable habitat would be affected by Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Norris' beard moss *Didymodon norrisii*	-/-/ 2.2	Butte, Contra Costa, Colusa, Humboldt, Lake, Los Angeles, Madera, Monterey, Mariposa, Nevada, Plumas, San Benito, Santa Cruz, Shasta, Sierra, Sonoma, Tehama, Tulare, and Tuolumne Counties.	Cismontane woodland, lower montane coniferous forest. Moss from seasonally wet sheet drainages on exposed rock slabs or terraces that completely dry in summer.	--	**None.** Records of Norris' beard moss exist for the Buyer Service Area. Transfers would not impact suitable habitat for this species.
Northern California black walnut *Juglans hindsii*	-/-/1B	Native stands reported in Napa and Contra Costa Counties.	Riparian woodland.	April-May	**None.** Previously documented within the Buyer Service Area. Transfers would not impact suitable habitat for this species.
Oregon meconella *Meconella oregana*	-/-/ 1B.1	Occurs in California, Oregon and Washington. Within California occurs in Contra Costa and Santa Clara Counties.	Coastal prairie and coastal scrub in open, moist places 250 - 500m asl.	March - April	**None.** Oregon meconella has been observed within the Buyer Service Area. Transfers would not affect suitable habitat for this species.
Oval-leaved viburnum *Viburnum ellipticum*	-/-/2.3	Occurs in California, Oregon and Washington. Within California occurs in Contra Costa, El Dorado, Fresno, Glenn, Humboldt, Mendocino, Napa, Placer, Shasta, Sonoma and Tehama Counties.	Chaparral, cismontane woodland, and lower montane coniferous forest 215 - 1400m asl.	May - June	**None.** This species has been previously documented within the Buyer Service Area. Suitable habitat for oval-leaved viburnum is not expected to be affected by Transfers.
Pallid manzanita *Arctostaphylos pallida*	T/E/1B.1	Alameda and Contra Costa Counties.	Broadleafed upland forest, closed-cone coniferous forest, chaparral, cismontane woodland, coastal scrub. Grows on uplifted marine terraces on siliceous shale or thin chert at 185 - 465m asl. May require fire.	December - March	**None.** Pallid manzanita has been observed within the Buyer Service Area. No Transfers-related impacts to suitable habitat are anticipated.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Palmate-bracted bird's-beak *Cordylanthus palmatus*	E/E/1B.1	Found in Glenn and Colusa Counties and within the Central Valley.	Alkali meadow, alkali scrub, valley and grasslands.	May-October	**None.** CNDDB records of this species exist for the Seller Service Area. Not likely to occur in rice fields; no suitable habitat is present (i.e. alkali areas).
Panoche pepper-grass *Lepidium jaredii* ssp. *album*	-/-/ 1B.2	Fresno, San Benito, and San Luis Obispo Counties.	Valley and foothill grassland. White or grey clay lenses on steep slopes. Incidental in alluvial fans and washes. Clay and gypsum-rich soils 65 - 910m asl.	February - June	**None.** Panoche pepper-grass has previously been documented within the Buyer Service Area. The proposed Transfers would not impact suitable habitat for this species.
Peruvian dodder *Cuscuta obtusiflora* var. *glandulosa*	-/-/ 2.2	Known from California, Baja California, Sonora and Texas. Within California records exist from Butte, Los Angeles, Merced, Sacramento, San Bernardino, Sonoma and Sutter Counties.	Marshes and swamps (freshwater). Freshwater marsh 15 - 280m asl.	July - October	**None.** CNDDB records of this species exist for the Seller Service Area. Peruvian dodder is unlikely to become established within rice fields.
Pincushion navarretia *Navarretia myersii* ssp. *myersii*	-/-/1B.1	Alamdor, Calaveras, Merced, Placer, and Sacramento Counties.	Vernal pools (often acidic).	May	**None.** Previously documented in the Seller Service Area. No vernal pools would be affected by Transfers.
Pink creamsacs *Castilleja rubicundula* ssp. *rubicundula*	-/-/ 1B.2	Butte, Contra Costa, Colusa, Glenn, Lake, Napa, Plumas, San Benito, Santa Clara, and Shasta Counties.	Chaparral, meadows and seeps, valley and foothill grassland. Openings in chaparral or grasslands. On serpentine 20 - 900m asl.	April - June	**None.** Pink creamsacs has been previously documented within the Buyer Service Area. No impacts to suitable habitat for this species are anticipated.
Point Reyes bird's-beak *Chloropyron maritimum* ssp. *palustre*	-/-/ 1B.2	California and Oregon. Within California it occurs in Alameda, Humboldt, Marin, Santa Clara, San Francisco, San Mateo, and Sonoma Counties.	Coastal salt marsh, usually in coastal salt marsh with Salicornia, Distichlis, Jaumea, Spartina, etc. 0 - 15m.	June - October	**None.** CNDDB records of this species exist for the Buyer Service Area. Suitable habitat for this species is not expected to be affected by Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Presidio clarkia *Clarkia franciscana*	E/E/1B.1	Alameda and San Francisco Counties	Coastal scrub, valley and foothill grassland. Serpentine outcrops in grassland or scrub 20 - 335m.	May - July	**None.** Presidio clarkia has been previously observed within the Buyer Service Area. Suitable habitat exists in the area of analysis, but would not be affected by the proposed Transfers.
Recurved larkspur *Delphinium recurvatum*	-/-/1B	Disbursed throughout the Sacramento and Central Valley.	Chenopod scrub, cismontane, valley and foothill grasslands (alkali).	March-June	**None.** According to the CNDDB this species has been previously recorded in the Buyer Service Area. Suitable habitat exists (i.e. alkali areas) in the area of analysis, but would not be affected by the proposed Transfers.
Red Bluff dwarf rush *Juncus leiospermus* var. *leiospermus*	-/-/1B.1	Butte, Placer, Shasta, and Tehama Counties.	Chaparral, valley and foothill grassland, cismontane woodlands, vernal pools. Vernally mesic sites. Sometimes on edges of vernal pools 30 - 1020m asl. The species has also been documented within intermittent drainages and in areas with pocket gopher and ground squirrel activity (BRCP 2011).	March - May	**Low.** Red Bluff dwarf rush has been previously documented within the Seller Service Area. Given that the species has some tolerance for disturbance, is a low potential for red bluff dwarf rush to establish within rice fields, which may represent marginal habitat.
Red Hills soaproot *Chlorogalum grandiflorum*	-/-/1B.2	Amador, Butte, Calaveras, El Dorado, Placer and Tuolumne Counties.	Cismontane woodland, chaparral, lower montane coniferous forest. Occurs frequently on serpentine or gabbro, but also on non-ultramafic substrates, often on historically disturbed sites.	May - June	**None.** CNDDB records of this species exist within the Seller Service Area. This species is not expected to occur within rice fields due to lack of suitable habitat (i.e., serpentine areas).

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Red mountain catchfly *Silene campanulata* ssp. *campanulata*	-/E/1B	Found in Colusa, Glenn, Mendocino, Shasta, Tehama, and Trinity Counties.	Chaparral and lower montane coniferous forest, usually sepentinite and rocky.	April-July	**None.** There is a CNDDB occurrences in the vicinity, within counties in the area of analysis. However, this species is not likely to occur in rice fields due to lack of suitable habitat.
Robust spineflower *Chorizanthe robusta* var. *robusta*	E/-/1B.1	Alameda, Monterey, Marin, Santa Clara, Santa Cruz, San Francisco, and San Mateo Counties.	Cismontane woodland, coastal dunes, coastal scrub. Sandy terraces and bluffs or in loose sand 3 - 120m asl.	April - September	**None.** Robust spineflower has been documented within the Buyer Service Area. Transfers are not expected to affect suitable habitat for this species.
Rock sanicle *Sanicula saxatilis*	-/-/ 1B.2	Contra Costa and Santa Clara Counties.	Broadleafed upland forest, chaparral, valley and foothill grassland. Bedrock outcrops and talus slopes in chaparral or oak woodland habitat 625 - 1215m asl.	April - May	**None.** CNDDB records of this species exist within the Buyer Service Area. Suitable habitat for rock sanicle is not expected to be affected by Transfers.
Round-leaved filaree *California macrophylla*	-/-/1B.1	California, Baja California, Oregon.	Cismontane woodland, valley and foothill grassland. Clay soils 15 - 1200m asl.	March - May	**None.** Round-leaved filaree has been previously documented within both the Buyer and Seller Service Areas. No Transfers-related impacts to suitable habitat for the species are anticipated.
Sacramento Orcutt grass *Orcuttia viscida*	E/E/1B.1	Valley grasslands and freshwater wetlands.	Vernal pools.	May-June	**None.** CNDDB records of this species exist for the Seller Service Area. Sacramento Orcutt grass is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Saline clover *Trifolium hydrophilum*	-/-/ 1B.2	California's Central coast and Bay Area.	Marshes and swamps, valley and foothill grassland, vernal pools. Mesic, alkaline sites 0 - 300m asl.	April - June	**Low.** Records of saline clover exist within both the Buyer and Seller Service Areas. Rice fields may represent marginally suitable habitat for this species. There is a low potential for impacts within the Seller Service Area (Colusa, Solano, and Yolo Counties).
San Benito pentachaeta *Pentachaeta exilis* ssp. *aeolica*	-/-/ 1B.2	Monterey, San Benito, and Santa Clara Counties.	Cismontane woodland, valley and foothill grassland. Grassy areas from 635 - 855m asl.	March - May	**None.** This species has previously been documented within the Buyer Service Area. No suitable habitat for this species would be impacted by the proposed Transfers.
San Francisco Bay spineflower *Chorizanthe cuspidata* var. *cuspidata*	-/-/ 1B.2	Alameda, Marin, San Francisco, San Mateo, and Sonoma Counties.	Coastal bluff scrub, coastal dunes, coastal prairie, coastal scrub. Sandy soil on terraces and slopes 5 - 550m asl.	April - August	**None.** San Francisco Bay spineflower has been observed within the Buyer Service Area. No impacts to suitable habitat for this species are anticipated in association with the proposed Transfers.
San Francisco collinsia *Collinsia multicolor*	-/-/ 1B.2	Monterey, Marin, Santa Clara, Santa Cruz, San Francisco, and San Mateo Counties.	Closed-cone coniferous forest, coastal scrub. On decomposed shale (mudstone) mixed with humus 30 - 250m asl.	March - May	**None.** This species has been documented within the Buyer Service Area. No impacts to suitable habitat are expected.
San Francisco popcorn-flower *Plagiobothrys diffusus*	-/E/1B.1	Alameda, Santa Cruz, San Francisco, and San Mateo Counties.	Valley and foothill grassland, coastal prairie. Historically known from grassy slopes with marine influence 60 - 485m asl.	March - June	**None.** San Francisco popcorn-flower has been observed within the Buyer Service Area. No impacts to suitable habitat for this species are anticipated in association with the proposed Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
San Joaquin spearscale *Atriplex joaquiniana*	-/-/1B.2	Western Central Valley and valleys of adjacent foothills.	Alkali grasslands, and alkali scrub.	April-September	**None.** Has been previously documented within both the Buyer and Seller Service Areas. Not likely to occur in rice fields, no suitable habitat present (i.e. alkali areas).
San Joaquin woollythreads *Monolopia congdonii*	E/-/1B.2	Fresno, Kings, Kern, Santa Barbara, San Benito, San Luis Obispo, and Tulare Counties.	Chenopod scrub and valley and foothill grassland. Alkaline or loamy plains, sandy soils 60 - 800m asl.	February - May	**None.** San Joaquin woollythreads was previously documented within the Buyer Service Area. No impacts to suitable habitat are anticipated.
Sanford's arrowhead *Sagittaria sanfordii*	-/-/1B	Central Valley.	Freshwater marshes, shallow streams, and ditches.	May-August	**Moderate.** Sanford's arrowhead has been previously documented within the Seller Service Area. Not likely to establish in rice fields, but ditches represent suitable habitat. There is a moderate potential that this species would be affected by the proposed Transfers.
Santa Clara red ribbons *Clarkia concinna ssp. automixa*	-/-/ 4.3	Alameda and Santa Clara Counties.	Cismontane woodland, chaparral on slopes and near drainages 90-970m asl.	April - July	**None.** CNDDB records for this species exist for the Buyer Service Area. No suitable habitat for this species should be affected by Transfers.
Santa Clara Valley dudleya *Dudleya abramsii* ssp. *setchellii*	E/-/ 1B.1	Santa Clara County.	Valley and foothill grassland, cismontane woodland. On rocky serpentine outcrops and on rocks within grassland or woodland 80 - 335m asl.	April - October	**None.** Santa Clara Valley dudleya has been previously documented within the Buyer Service Area. Suitable habitat for this species would not be impacted by the proposed Transfers.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Santa Cruz tarplant, *Holocarpha macradenia*	T/E/1B.1	Alameda, Contra Costa, Monterey, Marin, Santa Cruz, and Solano Counties.	Coastal prairie, valley and foothill grassland. Light, sandy soil or sandy clay, often with non-natives 10 - 260masl.	June - October	**None.** Santa Cruz tarplant has been observed within the Buyer Service Area, according to CNDDB records. No impacts to suitable habitat are anticipated.
Santa Cruz Mountains beardtongue *Penstemon rattanii* var. *kleei*	-/-/ 1B.2	Santa Clara and Santa Cruz Counties	Chaparral, lower montane coniferous forest. Sandy shale slopes, sometimes in the transition between forest and chaparral 400 - 1100m asl.	May - June	**None.** This species has been observed within the Buyer Service Area. No suitable habitat would be affected by Transfers.
Santa Cruz Mountains pussypaws *Calyptridium parryi* var. *hesseae*	-/-/ 1B.1	Monterey, Santa Clara, Santa Cruz, San Luis Obispo, and Stanislaus Counties.	Chaparral, cismontane woodland, sandy or gravelly openings 305 - 1530m asl.	May - August	**None.** CNDDB records of Santa Cruz Mountains pussypaws exist for the Buyer Service Area. Suitable habitat for this species is not expected to be affected by Transfers.
Santa Cruz tarplant, *Holocarpha macradenia*	T/E/1B.1	Alameda, Contra Costa, Monterey, Marin, Santa Cruz, and Solano Counties.	Coastal prairie, valley and foothill grassland. Light, sandy soil or sandy clay, often with non-natives 10 - 260masl.	June - October	**None.** Santa Cruz tarplant has been observed within the Buyer Service Area, according to CNDDB records. No impacts to suitable habitat are anticipated.
Scadden Flat checkerbloom *Sidalcea stipularis*	-/E/ 1B.1	Nevada County. Known from two occurrences near Grass Valley.	Marshes and swamps. Typical habitat includes montane marshes fed by springs 700 - 740m asl.	July - August	**None.** This species has been previously documented within the Seller Service Area. It is not likely to establish in rice fields due to lack of suitable habitat (i.e. montane marsh).
Sharsmith's harebell *Campanula sharsmithiae*	-/-/ 1B.2	Santa Clara and Stanislaus Counties.	Chaparral. Serpentine barrens 480 - 1820m asl.	April - June	**None.** Sharsmith's harebell has been observed within the Buyer Service Area. No impacts to suitable habitat for this species are expected.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Sharsmith's onion *Allium sharsmithiae*	-/-/ 1B.3	Alameda, Santa Clara, and Stanislaus Counties.	Cismontane woodland. Rocky, serpentine slopes 400 - 1200m asl.	March - May	**None.** CNDDB records for this species occur within the Buyer Service Area. Suitable habitat for this species should not be impacted by the proposed Transfers.
Sheldon's sedge *Carex sheldonii*	-/-/2.2	Occurs in California, Idaho, Nevada, Oregon, Utah and Washington. Within California the species occurs in Lassen, Modoc, Placer, and Plumas Counties.	Lower montane coniferous forest, marshes and swamps, riparian scrub. Mesic sites along creeks and in wet meadows 1065 - 1755m asl.	May - August	**None.** Sheldon's sedge has been observed within the Seller Service Area. Although rice fields may provide the appropriate moisture conditions, this species occurs at very high elevations and is therefore not expected to be impacted by the proposed Transfers.
Shining navarretia *Navarretia nigelliformis* ssp. *radians*	-/-/1B.2	Alameda, Contra Costa, Fresno, Merced, Monterey, San Benito, San Joaquin, and San Luis Obispo Counties.	Cismontane woodland, valley and foothill grassland, and vernal pools 200 - 1000m asl. Known from grassland, and may not necessarily occur in vernal pools.	April - July	**None.** Previous CNDDB records of shining navarettia exist for the Seller Service Area. This species is unlikely to establish within rice fields due to lack of suitable habitat (i.e., vernal pools and native grassland).
Sierra blue grass *Poa sierrae*	-/-/1B.3	Butte, Madera, Nevada, Placer, Plumas, Shasta Counties.	Lower montane coniferous forest. Shady, moist, rocky slopes often in canyons 365 - 1160m asl.	April - June	**None.** This species has been documented within the Seller Service Area. This species is not likely to be impacted, given that it requires shaded rocky slope habitat not provided in rice fields.
Showy golden madia *Madia radiata*	-/-/1B.1	Contra Costa, Fresno, Kings, Kern, Monterey, Santa Barbara, San Benito, Santa Clara, San Joaquin, San Luis Obispo, and Stanislaus Counties.	Valley and foothill grassland, cismontane woodland, chenopod scrub. Mostly on adobe clay in grassland or among shrubs 25 - 1125m asl.	March - May	**None.** Showy golden madia has been observed within the Buyer Service Area. No project impacts to suitable habitat for this species are anticipated.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Slender Orcutt grass *Orcuttia tenuis*	T/E/1B.1	Northern Sacramento Valley, Pit River Valley; isolated populations in Lake and Sacramento Counties.	Vernal pools.	May-October	**None.** The CNDDB contains records of slender Orcutt grass in the Seller Service Area. However, this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).
Slender-leaved pondweed *Stuckenia filiformis*	-/-/ 2.2	Occurs in California, Arizona, Nevada, Oregon, and Washington.	Marshes and swamps. Shallow, clear water of lakes and drainage channels 15 - 2310m asl.	May - July	**None.** Slender-leaved pondweed has been previously documented within the Buyer Service Area. It is not expected to occur within rice fields in the Seller Service Area given the lack of suitable natural lake and stream habitat.
Slender silver moss *Anomobryum julaceum*	-/-/ 2.2	California and Oregon. Within California it occurs in Butte, Contra Costa, Humboldt, Los Angeles, Mariposa, Santa Barbara, Santa Cruz, Shasta, and Sonoma Counties.	Broadleafed upland forest, lower montane coniferous forest, north coast coniferous forest. Grows on damp rocks and soil in acidic substrates and on roadcuts 100 - 1000m asl.	--	**None.** CNDDB records of slender silver moss exist for the Buyer Service Area. Suitable habitat for this species is not expected to be affected by Transfers.
Smooth lessingia *Lessingia micradenia var. glabrata*	-/-/ 1B.2	Santa Clara County.	Chaparral. Serpentine often on roadsides 120 - 485m asl.	July - November	**None.** This species has been previously documented within the Buyer Service Area. No impacts to chaparral or serpentine areas are anticipated.
Soft bird's beak *Cordylanthus mollis* ssp. *mollis*	E/R/1B.2	Located in Contra Costa, Marin, Napa, Sacramento, Solano, and Sonoma Counties.	Coastal salt marshes and swamps.	July-November	**None.** CNDDB occurrences exist for the Buyer Service Area, however this species is not likely to be affect by Transfers due to lack of suitable habitat (i.e. coastal salt marshes).

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Stinkbells *Fritillaria agrestis*	-/-/ 4.2	Occurs in Central and Northern California, including Alameda, Contra Costa, Fresno, Kern, Mendocino, Merced, Monterey, Mariposa, Placer, Sacramento, Santa Barbara, San Benito, Santa Clara, Santa Cruz, San Luis Obispo, San Mateo, Stanislaus, Tuolumne, Ventura, and Yuba Counties.	Cismontane woodland, chaparral, valley and foothill grassland. Sometimes on serpentine, mostly in non-native grassland or in grassy openings in clay soil 95 - 890m asl.	March - June	**None.** This species has been documented within both the Buyer and the Seller Service Areas. No impacts to suitable habitat for stinkbells are anticipated.
Succulent owl's clover *Castilleja campestris* ssp. *succulenta*	T/E/1B.2	Fresno, Madera, Merced, Mariposa, San Joaquin, and Stanislaus Counties.	Vernal pools.	April-May	**None.** Succulent owl's clover has been documented in the Seller Service Area, however this species is not likely to occur in rice fields due to lack of suitable habitat (i.e. vernal pools).
Suisun Marsh aster *Symphyotrichum lentum*	-/-/ 1B.2	Contra Costa, Napa, Sacramento, San Joaquin, Solano, and Yolo Counties.	Saline and freshwater marshes and swamps. Most often seen along sloughs with Phragmites, Scirpus, blackberry, Typha, etc. at 0-3m asl.	May - November	**None.** This species has been previously documented within both the Buyer and Seller Service Areas. This species is not expected to occur within rice fields given its sensitivity to habitat alteration and agricultural amendments. Environmental commitments would require that downstream flows are maintained, such that no impacts are anticipated in the natural habitats for the species.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Talus fritillary *Fritillaria falcata*	-/-/ 1B.2	Alameda, Monterey, San Benito, Santa Clara, and Stanislaus Counties.	Chaparral, cismontane woodland, lower montane coniferous forest. On shale, granite, or serpentine talus 300 - 1525m asl.	March - May	**None.** Talus fritillary has been observed within the Buyer Service Area. Suitable habitat for this species is not expected to be affected.
Temblor buckwheat *Eriogonum temblorense*	-/-/ 1B.2	Fresno, Kern, Monterey, and San Luis Obispo Counties.	Valley and foothill grassland. Barren clay or sandstone substrates 300 - 1000m asl.	April - September	**None.** Records of temblor buckwheat exist within the Buyer Service Area. Transfers are not expected to impact any suitable habitat for this species.
Tiburon buckwheat *Eriogonum luteolum var. caninum*	-/-/ 1B.2	Alameda, Contra Costa, Marin, Sonoma Counties.	Chaparral, valley and foothill grassland, cismontane woodland, coastal prairie. Serpentine soils on sandy to gravelly sites 0 - 700m asl.	May - September	**None.** Has been observed within the Buyer Service Area. No impacts to suitable habitat for Tiburon buckwheat are expected.
Tiburon paintbrush *Castilleja affinis* ssp. *neglecta*	E/T/ 1B.2	Marin, Napa, and Santa Clara Counties.	Valley and foothill grassland. Rocky serpentine sites 75 - 400m asl.	April - June	**None.** CNDDB records of Tiburon paintbrush exist within the Buyer Service Area. Transfers are not expected to impact suitable habitat for this species.
Tracy's eriastrum *Eriastrum tracyi*	-/R/ 1B.2	Colusa, Fresno, Glenn, Kern, Santa Clara, Shasta, Stanislaus, Tehama, Trinity, and Tulare Counties.	Chaparral, cismontane woodland. Gravelly shale or clay, often in open areas 315 - 760m asl.	June - July	**None.** Previously documented within the Buyer Service Area. No impacts to suitable habitat for this species are expected.
Vernal pool smallscale *Atriplex persistens*	-/-/ 1B.2	Colusa, Glenn, Madera, Merced, Solano, Stanislaus, and Tulare Counties.	Vernal pools. Alkaline vernal pools 10 - 115m asl.	June - October	**None.** Vernal pool smallscale has been documented within the Seller Service Area. This species is not likely to establish within rice fields given the lack of vernal pool and alkaline habitat.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Western leatherwood *Dirca occidentalis*	-/-/ 1B.2	Alameda, Contra Costa, Marin, Santa Clara, San Mateo, and Sonoma Counties.	Broadleafed upland forest, chaparral, closed-cone coniferous forest, cismontane woodland, north coast coniferous forest, riparian forest, riparian woodland. On mesic sites on brushy slopes 30-550m asl within mixed evergreen and foothill woodland communities.	January - April	**None.** CNDDB records of this species exist within the Buyer Service Area. Suitable habitat for western leatherwood is not expected to be affected by Transfers.
White-flowered rein orchid *Piperia candida*	-/-/ 1B.2	California, Oregon, Washington. Within California the species occurs in Del Norte, Humboldt, Mendocino, Santa Clara, Santa Cruz, Siskiyou, San Mateo, Sonoma, and Trinity Counties.	North coast coniferous forest, lower montane coniferous forest, broad leafed upland forest. Coast ranges from Santa Cruz County North on serpentine. Forest duff, mossy banks, rock outcrops and muskeg 0 - 1200m asl.	March - September	**None.** White-flowered rein orchid has been documented within the Buyer Service Area. However, no impacts to suitable habitat for this species are anticipated in the Buyer Service Area.
Woodland woollythreads *Monolopia gracilens*	-/-/ 1B.2	Alameda, Contra Costa, Monterey, Santa Clara, Santa Cruz, San Luis Obispo, and San Mateo Counties.	Chaparral, valley and foothill grassland (serpentine), cismontane woodland, broad leafed upland forests, north coast coniferous forest. Grassy sites in openings, sandy to rocky soils. Often seen on serpentine after burns but may have only a weak affinity to serpentine.	February - July	**None.** Has been observed within the Buyer Service Area. No impacts to suitable habitat for woodland woolly threads are anticipated.
Woolly rose-mallow *Hibiscus lasiocarpos* var. *occidentalis*	-/-/ 1B.2	Butte, Contra Costa, Colusa, Glenn, Sacramento, San Joaquin, Solano, Sutter, and Yolo Counties.	Marshes and swamps (freshwater). Moist, freshwater-soaked river banks and low peat islands in sloughs. Known from the Delta watershed 0 - 150m asl.	June - September	**None.** Previously observed in the Buyer Service Area. Not likely to establish in rice fields given the lack of suitable habitat (marsh and swamp). This species is sensitive to habitat disturbance and agricultural amendments.

Common Name *Scientific name*	**Special Status* (F/S/RPR)**	**Distribution**	**Habitat Association**	**Blooming Period**	**Potential Impact**
Wright's trichocoronis *Trichocoronis wrightii* var. *wrightii*	-/-/ 2.1	Colusa, Merced, Riverside, San Joaquin, and Sutter Counties.	Marshes and swamps, riparian forest, meadows and seeps, vernal pools. Mud flats of vernal lakes, drying river beds and alkali meadows 5 - 435m asl.	May - September	**Low.** According to the CNDDB, this species has previously been recorded in the Seller Service Area. Rice fields are not expected to support this species given the lack of suitable natural habitats.

RPR=California Rare Plant Rank
1B= Rare, threatened, or endangered in California and elsewhere
2= Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere
3= Plants about which we need more information - A review list
*Status explanations:
F=Federal
E= listed as endangered under the federal Endangered Species Act
T= listed as threatened under the federal Endangered Species Act
S=State
E=Endangered
T=Threatened
R=Rare
SSC=Species of Special Concern

Wildlife and plant species addressed in the area of analysis have been selected through the following process. First, all species identified in database records searches went through an evaluation to identify what are considered "special-status species" in relationship to the federal ESA and CESA compliance. For the purpose of this assessment, "special-status species" are those species that meet one or more of the following criteria:

- Species that are listed or proposed for listing as threatened or endangered under ESA (50 Code of Federal Regulations [CFR] 17.11 [listed animals]; 50 CFR 17.12 [listed plants]; and various notices in the Federal Register [FR]).
- Species that are candidates for possible future listing as threatened or endangered under ESA (75 FR 69222, November 10, 2010).
- Species that are listed or proposed for listing by the State of California as threatened or endangered under CESA (14 California Code of Regulations [CCR] 670.5).
- Species that meet the definitions of rare or endangered under the California Environmental Quality Act (CEQA) (State CEQA Guidelines Section 15380).
- Plants listed as rare under the CNPPA (CDFW Commission 1900 et seq.).
- Plants listed by California Native Plant Society (CNPS) as plants about which more information is needed to determine their status and plants of limited distribution, which may be included as special-status species on the basis of local significance or recent biological information.
- Animals listed as California Species of Special Concern (SSC) to the CDFW (Shuford and Gardali 2008 [birds]; Williams 1986 [mammals]; and Jennings and Hayes 1994 [amphibians and reptiles]).
- Animals that are fully protected in California (CDFW Commission 3511 [birds], 4700 [mammals], 5050 [amphibians and reptiles], and 5515 [fish]).
- Birds of Conservation Concern (USWFS 2008).

The selection process resulted in an initial list of 257 special-status plant and wildlife species. Tables I-1 and I-2 provide information on all 257 special-status species known from, or with potential to occur in the area of analysis, including common and scientific name, listing status (Federal, State, Global Rank, and/or State Rank), suitable habitat characteristics, distribution in California, and potential for occurrence in the area of analysis.

Not all of these species have the potential to be affected by long-term water transfers. Many of the 257 species are not expected to occur in the natural communities and agricultural habitats that would be affected by the action alternatives (e.g., riverine, riparian, natural and managed wetlands, rice fields, and irrigation/drainage channels). Consequently, the action alternatives have the potential to affect only a limited number of these special-status species.

For each plant and wildlife species that could be affected by the Proposed Action in Table I-3, the likelihood that water transfers would affect the species is assigned a category in the last column and the rationale for that categorization is provided. Those species in Tables I-1 and I-2 which are known to occur in the area of analysis, but would not be affected by the action alternatives are not addressed further in this analysis. Based on these considerations, the initial list of species potentially present was reduced to 14 species that could be affected. These 14 species are listed in Table I-3 along with HCP/NCCPs that are adopted or in preparation which cover the species and may have additional requirements for species conservation within their plan areas. Special-status plants and terrestrial wildlife species potentially affected by the action alternatives are discussed below. Potentially affected special-status fish species are discussed separately in Section 3.7 of this document.

Table H-3.
Potentially Affected Special-Status Plant and Wildlife Species in the Area of Analysis

				Conservation Plan Coverage[2]										
	Status	Species	Status[1]	BRCP	BDCP	ECCC HCP/NCCP	NB HCP	PCCP	SJMSCP	SCV HCP/NCCP	SMSHCP	SSHCP	YNHP	YS NCCP/HCP
Plants	California Rare Plant Rank	Ahart's dwarf rush	RPR 1B.2	X				X				X		X
		Sanford's arrowhead	RPR 1B.2						X					
		Red Bluff dwarf rush	RPR 1B.1	X				X	X					
		Saline clover	RPR 1B.2											
Wildlife	State or Federally Listed	Giant garter snake	FT, ST	X	X	X	X	X	X		X	X	X	X
		San Joaquin kit fox	FE, ST		X	X			X	X				
		Greater sandhill crane	ST, FP	X	X				X			X		X
	Species of Special Concern	Black tern	SSC/WL											
		Long-billed curlew	SSC						X					
		Pacific pond turtle	SSC		X	X	X		X	X		X	X	X
		Purple martin	SSC										X	

				Conservation Plan Coverage[2]										
	Status	**Species**	**Status[1]**	**BRCP**	**BDCP**	**ECCC HCP/NCCP**	**NB HCP**	**PCCP**	**SJMSCP**	**SCV HCP/NCCP**	**SMSHCP**	**SSHCP**	**YNHP**	**YS NCCP/HCP**
		Tricolored blackbird	ST	X	X	X	X	X	X	X	X	X	X	X
		White-faced ibis	WL				X		X					
		Yellow-headed blackbird	SSC											

[1] Status:
FE-federally listed endangered
FP-fully protected under California Fish and Game Code
FT-federally listed threatened
RPR 1B.1-California Rare Plant Rank 1B.1 = Plants rare, threatened, or endangered in California and elsewhere. Seriously threatened in California (over 80 percent of occurrences threatened / high degree and immediacy of threat)
RPR 1B.2-California Rare Plant Rank 1B.1 = Plants rare, threatened, or endangered in California and elsewhere. Fairly threatened in California (20 to 80 percent occurrences threatened / moderate degree and immediacy of threat)
ST-state-listed threatened
SSC-California Species of Special Concern
WL- species that were previously designated as SSC but no longer merit SSC status or which do not meet SSC criteria but for which there is concern and a need for additional information to clarify status.

[2] Conservation plan
BDCP – Bay-Delta Conservation Plan (under development)
BRCP – Butte Regional Conservation Plan (under development)
ECCCHCP/NCCP – East Contra Costa County HCP/NCCP (adopted)
NBHCP – Natomas Basin HCP (adopted)
PCCP – Placer County Conservation Plan (under development)
SCVHCP/NCCP – Santa Clara Valley HCP/NCCP (adopted)
SJMSCP – San Joaquin County Multi-Species Habitat Conservation and Open Space Plan (adopted)
SMSHCP-Solano Multispecies HCP (under development)
SSHCP – South Sacramento HCP (under development)
YNHP – Yolo Natural Heritage Program (under development)
YSNCCP/HCP – Yuba-Sutter NCCP/HCP (under development)

H.1 Special-Status Plants

H.1.1 Ahart's Dwarf Rush

Ahart's dwarf rush (*Juncus leiospermus* var. *ahartii*) is a California Rare Plant Rank (RPR) 1B.2 species known from Butte, Calaveras, Placer, Sacramento, Tehama, and Yuba counties, and previous observations exist within the Seller Service Area. This species has generally been documented at mesic locations within valley and foothill grassland between 30 and 229 meters above mean sea level (amsl). It may also occur in disturbed areas including agricultural fields and locations with gopher digging activity. Ahart's dwarf rush typically blooms between March and May. Development is the major threat to this species.

H.1.2 Sanford's Arrowhead

Sanford's arrowhead (*Sagittaria sanfordii*) is a California RPR 1B.2 perennial rhizomatous herb found in the Central Valley in freshwater marsh, shallow stream areas, and ditches between zero and 650 meters amsl. Previous observations exist within the Seller Service Area. Sanford's arrowhead typically blooms between May and August.

Threats to Sanford's arrowhead include grazing, development, recreational activities, non-native plants, road widening, and alteration of channels.

H.1.3 Red Bluff Dwarf Rush

Red Bluff dwarf rush (*Juncus leiospermus* var. *leiospermus*) is a California RPR 1B.1 species that occurs within Butte, Placer, Shasta, and Tehama counties. Red Bluff dwarf rush is known from vernally mesic sites in chaparral, valley and foothill grassland, cismontane woodlands, and vernal pools from 30 to 1,020 meters amsl. It may also be found in intermittent drainages and areas of pocket gopher and ground squirrel activity (Butte County Association of Governments 2011). The typical bloom period for Red Bluff dwarf rush is March through May. Suitable habitat for this species occurs within the area of analysis and occurrences have been documented within the Seller Service Area.

Some of the recognized threats to Red Bluff dwarf rush include: development, grazing, vehicles, industrial forestry, and agricultural activities.

H.1.4 Saline Clover

Saline clover (*Trifolium hydrophilum*) is a California RPR 1B.2 species known from California's central coast and Bay Area. Previous observations exist within both the Buyer and Seller Service Areas. This species has generally been documented in marshes and swamps, valley and foothill grassland, and vernal pool habitats from zero to 300 meters amsl. It is often found in mesic or alkaline areas. Saline clover blooms from April through June.

The status of many saline clover populations is not known. Development, trampling, road construction, and vehicles are considered some of the major threats to the species.

H.2 Special-Status Wildlife

H.2.1 Giant Garter Snake

Giant garter snake (*Thamnophis gigas*) is listed as threatened under both the ESA and CESA (58 FR 54053). A Revised Draft Recovery Plan for giant garter snake was completed in 2015, but no critical habitat has been designated for this species (U.S. Fish and Wildlife Service 2015). One of the largest garter snakes, the giant garter snake reaches up to 64 inches in length, with females generally slightly longer and heavier than males (Hansen 1980).

Giant garter snake historically occupied wetlands throughout the Sacramento and San Joaquin Valleys, as far north as Chico, and as far south as Buena Vista Lake, near Bakersfield (Hansen and Brode 1980). The current known distribution of giant garter snakes is patchy, extending from near Chico, Butte County, south to Mendota Wildlife Area, Fresno County. Giant garter snakes are not known from the northern portion of the San Joaquin Valley north to the eastern fringe of the Sacramento-San Joaquin River Delta, where the floodplain of the San Joaquin River is limited to a relatively narrow trough (Hansen and Brode 1980, Federal Register 58:54053–-54066). Numerous observations of giant garter snake have been documented within the Sacramento Valley portion of the Seller Service Area. Records also exist within the Buyer Service Area, including near Mendota, in the Central Valley (CNDDB 2018; Halstead et al. 2014).

Giant garter snakes typically breed in March and April and live young are born from late July to early September (Halstead et. al. 2015). The giant garter snake inhabits marshes, sloughs, ponds, small lakes, low gradient streams, agricultural wetlands (including irrigation canals and rice fields), and adjacent uplands. Essential habitat components consist of 1) freshwater aquatic habitat with protective emergent vegetation cover where snakes can forage; 2) upland habitat near the aquatic habitat that can be used for thermoregulation and summer shelter (i.e., burrows), and 3) upland refugia outside flood waters that can serve as winter hibernacula (U.S. Fish and Wildlife Service 2015).

Ideal giant garter snake aquatic habitat exhibits the following characteristics.

- Water present from March through November.
- Slow moving or static water flow with mud substrate.
- Presence of emergent and bankside vegetation that provides cover from predators and may serve in thermoregulation.
- Absence of a continuous canopy of riparian vegetation.
- Available prey in the form of small amphibians and small fish.
- Thermoregulation (basking) sites with supportive vegetation such as folded tule clumps immediately adjacent to escape cover.
- Absence of large predatory fish.
- Absence of recurrent flooding, or, where flooding is probable, the presence of upland refugia.

Another key requirement of the giant garter snake includes maintenance of connectivity between habitats. Giant garter snakes rely on canals and ditches as movement corridors. These corridors provide important habitat, and are used during daily movement within a home range.

Giant garter snake typically forage and shelter within cattail, bulrush, or other emergent herbaceous wetland vegetation, using grassy banks and openings at the water's edge for basking. Rice fields in particular may be important nursery and feeding habitat, providing prey that are absent from other permanent aquatic areas (USFWS 1999). Wintering habitat consists of higher elevation upland areas with vegetation, burrows or other underground refugia (Hansen 1988). Studies of marked snakes indicated that individuals typically move about 0.25 to 0.5 miles per day. Individuals have been documented to move five to eight miles over the course of a few days. Giant garter snake home range size is highly variable, with an average size of about 0.1 square miles (USFWS 2010). During the winter months, when the snakes are inactive, small mammal burrows and other soil or rock crevices may be used for hibernation, and also provide refuge from hot conditions during the snake's active season (Hansen and Brode 1993; USFWS 1999). Giant garter snake have been documented using burrows as much as 165 feet from marsh edges to shelter from heat during the active season, and up to 820 feet away during the winter (Wylie et al. 2000).

H.2.1.1 Use of Rice Lands

The following information on use of rice lands by giant garter snake was obtained from a Biological Assessment report (U.S. Bureau of Reclamation 2018) prepared for the Proposed Action as part Reclamation's Section 7 consultation with U.S. Fish and Wildlife Service.

Recent studies have been and are currently being conducted to gather information on the distribution and occurrence of giant garter snake in rice lands. Studies conducted by CDFW and USGS have documented giant garter snake in portions of the rice-producing regions of the Sacramento Valley, particularly the Colusa Basin. USGS has conducted trapping surveys of giant garter snake at the Sacramento National Wildlife Refuge Complex, and giant garter snake were observed at each of the national wildlife refuges in the region (Colusa, Delevan, and Sacramento). It is likely that giant garter snake occur outside of refuge lands in the adjacent rice production areas.

Recent work by USGS has utilized landscape-level information on habitat attributes such as canopy cover, distance to rice fields, and canal density, to model the current likely locations of suitable giant garter snake habitat in the Sacramento Valley. This work resulted in a habitat suitability dataset for the Sacramento Valley. Based on survey data collected from 1996 to 2005, the habitat suitability dataset predicts that 83 percent of giant garter snake occurrences will be in the top 50 percent of suitable habitat (i.e., rice production within historic marsh wetland areas) (Halstead et al. 2010). Another landscape-level analysis completed by USGS looked at whether historic or contemporary conditions were better predictors of giant garter snake occurrence in areas of rice agriculture. The conclusion from this research is that proximity to historic habitat, such as historic areas of tule marsh, is the most important variable for predicting occurrence of giant garter snake in the Sacramento Valley (Halstead et al. 2014). This information was used to generate maps of giant garter snake priority habitat for participating water agency lands within the Sacramento Valley. The goal of the mapping effort was to identify areas of "priority habitat" where environmental commitments could be focused. These maps were used in the 2014 water

transfer consultation to ensure that adequate water was available for "priority suitable habitat with a high likelihood of giant garter snake occurrence". Subsequently, Reclamation has assigned those environmental commitments (maintaining adequate water in drains and canals) to all rice-lands participating in this program through crop idling/shifting. This all-inclusive approach is reasonable partially because the location of all giant garter snake within the action area is not known. The assumption is that there is potential for giant garter snake in all areas participating in idling/shifting transfers. The Priority Habitat Mapping by USGS is not scheduled for annual updating, but may be updated when sufficient data is accumulated to provide a relevant updates.

More recent research involving occupancy of giant garter snake did not support the hypothesis that historic tule marsh is the most important variable for predicting occupancy (Hanson 2017). The results of this later study suggest, "canal density, the proportion of adjacent rice agriculture and wetlands, and underlying soils appear to be stronger drivers" for giant garter snake occupancy.

Regardless of the importance of historic tule marsh or underlying soils on current giant garter snake occupancy, the loss of tule marsh habitat has resulted in rice cultivation lands becoming important giant garter snake habitat. This is particularly true of the associated canals and their banks, which are used for both spring and summer active behavior and winter hibernation. USGS research involving radio-telemetry of female giant garter snake showed that "litter, emergent vegetation, terrestrial vegetation, and submerged vegetation microhabitats were positively selected, and rock and rice were avoided" (Halstead 2016). However, the discussion of that research paper also pointed out that "The response of individual giant gartersnakes to rice was highly variable, with some individuals remaining in canals for the entire active season, others selecting rice and venturing into it, and still others remaining in restored wetlands where no rice was available to them."

A study published in 2017 looked at the response of giant garter snake to water availability in the Sacramento Valley at both the site and individual levels. While the study determined that rice cultivation is important to giant garter snake, it showed that the giant garter snake were strongly associated with the water conveyance canals and made "little use of rice fields themselves" (Reyes 2017). The study also showed that maintaining canals without neighboring rice cultivation led to a decrease in giant garter snake survival rates.

Giant garter snake seasonal activity associated with rice cultivation occurs in the following progression:

- **Spring**: Rice is planted and the fields are flooded with several inches of water. Rice fields that contain prey species such as small fish or frogs may attract giant garter snake. However, the lack of emergent vegetative cover in the rice fields may preclude foraging during this period.

- **Summer:** While the rice grows, giant garter snake continue to use related water infrastructure, drains, canals, and to a lesser extent, rice fields as long as their prey and vegetative cover is present in sufficient densities. As the rice crop matures and provides

emergent vegetative cover (starting in late June), giant garter snake are more likely to utilize the fields for foraging.

- **Late Summer/Fall**: Once rice is mature (starting in late August)) the water is drained from the rice fields and giant garter snake likely reduce foraging activities in the fields. Rice is harvested at this time and female giant garter snake have just borne young and need food to regain their body weight. In August and September, the snakes can get a good supply of food from the rice lands because prey animals are concentrated in the rice drains. The dry-down of the rice fields in fall is thought to be important because prey, which have been proliferating, are concentrated in the drains and remaining pockets of standing water in the fields where snakes can gorge prior to the period of winter inactivity.

- **Winter:** giant garter snake is dormant in the winter while rice fields are either fallow or being prepared for planting in the spring.

Valcarcel (2011) studied giant garter snake spatial ecology in agricultural and constructed wetlands. He found that home ranges in agricultural habitat were 80 percent smaller and had less variation among individuals than home ranges in constructed wetlands. Snakes in agricultural habitat had greater and more uniform home range overlap. In both agricultural and constructed wetlands, vegetation patch edges were used more often than interior locations, and temperature can greatly influence movement. The research recommended further investigation of giant garter snake dispersal movements and habitat connectivity in agricultural areas.

H.2.2 San Joaquin Kit Fox

San Joaquin kit fox is federally-listed as endangered under the ESA (USFWS 1967) and state-listed as threatened under CESA (Swick 1971). No critical habitat has yet been designated for the species.

San Joaquin kit foxes occur in some areas of suitable habitat on the floor of the San Joaquin Valley and in the surrounding foothills of the Coast Ranges, Sierra Nevada, and Tehachapi Mountains from Kern County north to Contra Costa, Alameda, and San Joaquin Counties (USFWS 1998). Since 1998, the population structure has become more fragmented, with some resident satellite populations having been locally extirpated, and frequented by dispersing kit foxes rather than resident animals (USFWS 2010:15). The largest extant populations of kit fox are in Kern County (Elk Hills and Buena Vista Valley) and San Luis Obispo County in the Carrizo Plain Natural Area (USFWS 1998). Natural habitats for San Joaquin kit fox include alkali sink, alkali flat, and grasslands. San Joaquin kit foxes may use agricultural lands such as row crops, orchards, and vineyards to a limited extent but kit foxes are unable to occupy farmland on a long-term basis (USFWS 2010:19–21.) San Joaquin kit foxes usually prefer areas with loose-textured soils suitable for den excavation (Orloff et al. 1986:62) but are found on virtually every soil type (USFWS 1998:129). Where soils make digging difficult, kit foxes may enlarge or modify burrows built by other animals, particularly those of California ground squirrels (Orloff et al. 1986:63; USFWS 1998:127). Structures such as culverts, abandoned pipelines, and well casings may also be used as den sites (USFWS 1998:127).

San Joaquin kit fox are active throughout the year and are generally active during twilight. The kit fox's home range may vary from less than 2.6 square kilometers (km^2) to 31 km^2 (Morrell 1972; Zoellick et al. 2002, Spiegel and Bradbury 1992; White and Ralls 1993). The breeding season begins during September and October when adult females begin to clean and enlarge natal or pupping dens. Mating and conception occur between late December and March, and litters of two to six pups are born between late February and late March (USFWS 1998:126).

Growth of agricultural and urban areas is cited as the primarily threat to San Joaquin kitfox. Land conversion displaces populations, may reduce preferred prey abundance, prohibits movement throughout the landscape, and may also result in direct or indirect mortality of kit foxes (Constable et al. 2009; USFWS 1998). Intensive grazing, use of pesticides and rodenticides, and predation by coyote and red fox are other notable stressors on San Joaquin kit fox populations (Bell et al. 1994; USFWS 1998).

H.2.3 Greater Sandhill Crane

The Central Valley population of greater sandhill crane (*Grus canadensis tabida)* is a state-listed threatened and fully protected species. This species uses a variety of habitats including non-tidal fresh emergent wetland, natural seasonal wetland, and managed seasonal wetland. They will also utilize upland habitats such as grassland and upland crop areas. As a result of the loss of a large proportion of wetlands in the Sacramento Valley, greater sandhill cranes are increasingly associated with managed seasonal wetland environments and seasonally flooded agriculture, particularly rice fields.

Formerly a common breeder in California, the species now breeds only in Siskiyou, Modoc, Lassen, Sierra Valley, Plumas and Sierra counties (Zeiner et al. 1988); during the summer, the birds are found near wet meadows, shallow lacustrine and fresh emergent wetland habitats. Greater sandhill crane is known to winter in the Sacramento and San Joaquin valleys, within the Butte Sink (from Chico in the north to the Sutter Buttes in the south and from Sacramento River in the west to Highway 99 in the east), where birds forage in annual and perennial grassland habitats, moist croplands with rice and corn stubble, and emergent wetlands. Cranes migrate to the Central Valley between September and November and depart between March and May (Reclamation and DWR 2004); however, the California breeding population winters chiefly in the Central Valley (Zeiner et al. 1988). Sandhill cranes mate for life and have high site fidelity; the pair will return to the same territory each year (USFWS 1987).

Food, cover, and nesting requirements for greater sandhill cranes are closely associated with water in the form of some type of wetland. The loss and degradation to riverine and wetland ecosystems is an important threat to sandhill crane populations. For the migratory populations, this is of greatest concern in foraging and wintering areas (USGS 2006). Additional threats include development pressures and human disturbance when nesting.

H.2.4 Black Tern

The black tern (*Chlidonias niger*) is designated as a California SCS. Within California, black terns typically occur as migrants and summer residents between mid-April and mid-October (Shuford and Gardali 2008) where they breed in flooded rice fields and freshwater marshes, including lakes and ponds with marsh edges (Shuford et al. 2001). In the Central Valley, black terns nest on small dirt mound-islands in rice fields (Shuford et al. 2001) and are known to build

nests on masses of dead floating vegetation, or on mounds within marsh habitat (Shuford and Gardali 2008). The species may also nest on dikes or levees (Reclamation and DWR 2004). The remainder of the year, the terns migrate to bays, rivers, and pelagic waters (Reclamation and DWR 2004).

The black tern was once a common visitor to emergent wetlands of the Central Valley, but its numbers have declined due to habitat losses, especially the widespread loss of freshwater marshes. In California, the terns have been known to breed in the Central Valley, Klamath Basin, and the Modoc Plateau (Shuford et al. 2001). Due to lack of suitable freshwater habitat in most NWRs and State Wildlife Areas during the summer, black tern breeding sites in the Sacramento Valley are primarily flooded rice fields (Technology Associates 2009a). In 2001, Shuford et al. reported that rice fields supported 90 percent of the Central Valley breeding population. Surveys in the late 1990s found breeding black terns to be widespread in Sacramento Valley rice fields, with the largest concentration in the northern Colusa Basin. This species only has two known regular breeding locations in the San Joaquin Valley, in rice fields in Merced and Fresno counties (Shuford and Gardali 2008).

Black terns are considered to be an area-dependent species with specific breeding and foraging requirements. Because black terns have a limited distribution and are dependent upon flooded rice fields for breeding, conversion of rice fields to other crops, or to dry land rice, pose a threat to the migrant population (Technology Associates 2009a). Additional threats to the species include water management of rice fields (i.e. rapid lowering of water exposes nests to predators) and effects from exposure to pesticides (Technology Associates 2009a).

H.2.5 Pacific Pond Turtle

The Pacific pond turtle (*Actinemys marmorata*) is the only native box turtle widely distributed in the western United States, occurring from Baja California north into the State of Washington. Historically, the turtle once inhabited the vast permanent and seasonal wetlands of the Central Valley. Pacific pond turtle is considered a SSC by CDFW and its status is currently under review by USFWS.

Pacific pond turtle is associated with nontidal fresh emergent wetland, managed seasonal wetland, valley/foothill riparian, and lacustrine habitats. They may also utilize upland habitats including grassland and scrub (Holland 1994). 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. Irrigation ditches, drains, and rice fields provide suitable habitat for Pacific pond turtle foraging, with basking areas on adjacent levees. The turtles are active during the spring, summer, and fall when rice preparation, growing, and harvesting are performed, respectively.

The draining of wetlands for agriculture and urban development has greatly reduced this species' habitat. Other causes of population decline include increased predation and collecting by humans. Poor reproductive success due to predation and nest destruction also hamper the turtle's recovery. Reduced vegetative cover, such as in heavily maintained ditches, may increase predation on females and juveniles moving between aquatic habitats and nest sites between May and October (Holland 1988).

The CNDDB reports several occurrences spread throughout the area of analysis in Sacramento, San Joaquin, and Contra Costa counties.

H.2.6 Purple Martin

Purple martin (*Progne subis*) is a passerine bird species and is considered by the CDFW to be a SSC. Purple martin occurs in eastern North America, west to the Pacific Coast and south into Central Mexico. In the arid west, its distribution is concentrated in the southern Rocky Mountains and the Sonoran Desert (Shuford and Gardali 2008). In California, purple martins are summer residents, typically observed between mid-March and mid-August (Shuford and Gardali 2008). They have been documented in forest and woodland areas, generally at lower elevations, and the most robust populations are known from conifer forests on the north coast and the foothills of the Sierra Nevada Mountains. Only a small breeding population occurs in the Central Valley.

Purple martins prefer breeding areas with numerous nesting cavities and locally sparse canopy cover. They require access to open foraging areas that support their insect prey, particularly wetlands or other water bodies. Purple martins may nest as single pairs or in larger groups.

Non-native European starlings (*Sturnus vulgaris*) compete with purple martins for nest sites. Additional threats include loss of suitable nesting sites due to habitat conversion by human activity or events such as stand-replacing fires (Shuford and Gardali 2008).

H.2.7 Long-Billed Curlew

The long-billed curlew (*Numenius americanus*) is designated as a CDFW Watch List species and a Bird of Conservation Concern by the USFWS (USFWS 2008). The long-billed curlew is a migratory bird that breeds east of the Cascade Mountains, including northeastern California, through the western Great Plains (Zeiner et al. 1988). It winters from Central and Imperial Valleys, coastal California to southwestern United States. and is found as a winter migrant in the San Joaquin Valley.

Long-billed curlews are found in grasslands, meadows, pastures, and fallow agricultural fields, as well as tidal flats, beaches, and salt marshes in winter. The most highly preferred habitat is natural marshes, grassland, irrigated pasture, and alfalfa fields (San Joaquin County Multi-Species Habitat Conservation and Open Space Plan 2000) and preferred winter habitat includes large coastal estuaries, upland herbaceous areas, and croplands (Zeiner et al. 1988). A small number of nonbreeders remain in coastal habitat in summer and a larger number of birds remain in some years in the Central Valley (Zeiner et al. 1988). In California, long-billed curlew nest on elevated interior grasslands and wet meadows, usually adjacent to bodies of water, such as lakes or marshes (Zeiner et al. 1988).

The conversion of natural lands to agriculture has greatly diminished available forage for wintering birds (Zeiner et al. 1988); wintering habitat in California wetlands has declined by 90 percent (Dugger and Dugger 2002). Continuing threats to long-billed curlews include habitat loss owing both to development and projected effects of climate change and effects of pesticide spraying indirectly reducing the birds' prey items (Dugger and Dugger 2002). The species has previously been proposed as a candidate for Federal Endangered status.

H.2.8 Tricolored Blackbird

The tricolored blackbird (*Agelaius tricolor*) is a medium-sized passerine bird, which is very similar in appearance to red-winged blackbird (*Agelaius phoeniceus*). The species is listed as threatened under CESA and designated as a Bird of Conservation Concern by the USFWS (USFWS 2008). The species forms the largest colonies of any North American passerine bird, often with tens of thousands of breeding pairs (Beedy and Hamilton 1999).

Nearly all tricolored blackbird populations occur within California. While no major changes in their overall geographic distribution have been noted, large gaps in the occupied range now exist due to loss of habitat (e.g., Kings, San Joaquin, Riverside, and San Bernardino counties) and populations have significantly declined (Kyle and Kelsey 2011). Most individuals are year-round residents in the Central Valley, although some birds overwinter elsewhere, including in the Sacramento-San Joaquin Delta (Beedy 2008).

This species typically breeds in areas with access to open water and protected nesting sites, often including flooded, thorny, or spiny vegetation. Historically, tricolored blackbirds nested in freshwater marsh habitat in vegetation including tules, cattails, willows, thistles or nettles. Nests may also be concentrated in grain fields, giant reed (*Arundo donax*), and riparian scrubland and forest areas (DeHaven et al. 1975; Kyle and Kelsey 2011). Birds may forage as much as eight miles from nest sites (Beedy and Hamilton 1999) in areas that support insect prey. Pasturelands, alfalfa and rice crops, dairies, grassland, and shrubland habitats may be used in lieu of natural flooded habitat (Beedy and Hamilton 1999).

Tricolored blackbird colonies are sensitive to habitat loss, predation, and human activities. When water is withdrawn from marshes, nests become more susceptible to predation, such as by coyotes (*Canis latrans*) (Technology Associates 2009b). Chemical application in agricultural areas may reduce survivorship and disturbance associated with urbanization, including noise, pet and human presence, may result in nest abandonment (Beedy and Hamilton 1999).

H.2.9 White-Faced Ibis

White-faced ibis (*Plegadis chihi*) is considered a Species of Concern by USFWS and an SCC by CDFW. Historically, the ibis was a locally common summer resident in California and its breeding distribution was centered in the San Joaquin Valley. Currently, the species occurs in California as an uncommon, localized breeder and summer resident. It is a mobile species and shifts in range usually coincide with changing water levels and water quality. The ibis is found in shallow, emergent wetlands with high quality fresh and brackish water. Muddy grounds of wet meadows, irrigated or flooded pastures, flooded pond edges and shallow lacustrine water, and wet cropland such as rice fields are suitable foraging habitat. Ibises typically prefer large emergent wetlands with islands of dense emergent vegetation for nesting (CDFG 2008).

White-faced ibis is a colonial breeder and builds shallow nests in thick emergent vegetation such as tule and cattail, in shrubs, or in low trees (Ryder and Manry 1994). It breeds in scattered locations in the San Joaquin Valley and has established breeding colonies in the Sacramento Valley. Significant breeding colonies have been reported in the Mendota Wildlife Area and the Colusa NWR (Natomas Basin HCP 2003). The species winters primarily in the San Joaquin and Imperial Valleys with a concentrated wintering population near Los Banos in Merced County (Zeiner et al. 1990a).

Populations of white-faced ibis have declined in California and stopped breeding regularly as a result of loss or deterioration of extensive marshes in the Central Valley, which are required for nesting. Elsewhere in its range, pesticides have caused decline in numbers (Zenier 1988).

H.2.10 Yellow-Headed Blackbird

The yellow-headed blackbird (*Xanthocephalus xanthocephalus*) is a small to medium-sized passerine which is a California SSC. This species winters in the western United States; in California it has been documented east of the Cascade Range and Sierra Nevada Mountains, within the Imperial, Colorado River, and Central Valleys, as well as localized areas of the Coast Range west of the Central Valley (Twedt *et al*. 1991). It is fairly common in winter in the Imperial Valley, but its distribution is concentrated mainly in the western portion of the valley (CDFG 2008).

Yellow-headed blackbirds forage along emergent wetland and moist, open areas near croplands and grasslands, in addition to muddy shores of lacustrine habitat (CDFG 2008). They mainly feed on seeds and cultivated grains, although aquatic insects may make up a large part of their diet during the breeding season (Twedt et al. 1991; Twedt and Crawford 1995). Rice fields near freshwater marshes often support breeding colonies (Twedt and Crawford 1995).

In California, yellow-headed blackbirds are found year-round, but breed and winter in different locations and habitat. Water levels are a very important factor in reproduction success. This species breeds in fresh emergent wetland with dense vegetation (e.g. cattails and tules) and deep water, generally along lake and pond borders (Picman et al. 1993). They only breed where large insects are abundant and nesting is timed with maximum emergence of aquatic insect prey (Zeiner et al. 1990).

Throughout its range, the primary threat to the yellow-headed blackbird is the conversion of wetlands to croplands and urban land uses. The species' population has declined in California as a result of habitat loss and competitive exclusion from great-tailed grackles (*Quiscalus mexicanus*), as well as other mammalian and avian predators. Agricultural pesticides and herbicides have also negatively affected the species (Technology Associates 2009b).

H.2.11 Other Migratory Birds

Managed wetlands and flooded agriculture within the Seller's Service Area provide critical nesting and wintering habitat for millions of migratory birds, particularly waterfowl that migrate to the Sacramento Valley. These open water habitats and associated vegetation provide food, cover, and resting sites for migrating birds. The Sacramento Valley is considered the most important wintering site for migratory birds on the Pacific Flyway, supporting nearly 50 percent of wintering shorebirds and over 60 percent of wintering waterfowl using the Pacific Flyway. Flooded agriculture within the Sacramento Valley accounts for approximately 57 percent of food resources available to waterfowl (Petrie and Petrick 2010). Although these species are not considered special-status wildlife species, they are protected under the Migratory Bird Treaty Act.

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Appendix I Tables Summarizing the Screening Evaluation and Average Monthly Flows using the Groundwater Model for Smaller Streams

Table I-1.
Screening Evaluation Results for Smaller Streams in the Sacramento River Watershed for Detailed Vegetation and Wildlife Impact Analysis for the Proposed Action

Waterway	>1 cfs reduction?	>10% reduction?	Data Source
Deer Creek (Tehama County)	N	-	N/A
Antelope Creek	N	-	N/A
Paynes Creek	N	-	N/A
Seven Mile Creek	N	-	N/A
Elder Creek	N	-	N/A
Mill Creek (Tehama County)	N	-	N/A
Thomes Creek	N	-	N/A
Mill Creek (tributary to Thomes Creek)	N	-	N/A
Stony Creek	Y	Y	USGS Gage 11388000; Water Years 1976-2003
Butte Creek	Y	N	USGS Gage #11390000; Water Years 1976-2003
Cache Creek	Y	Y	USGS Gage #11452500; Water Years 1975-2013
Eastside/Cross Canal	Y	U	N/A
Auburn Ravine	N	-	N/A
Coon Creek	Y	Y	Bergfeld personal communication 2014
Dry Creek (tributary to Bear River)	Y	U	N/A
Honcut Creek	N	-	N/A
South Fork Honcut Creek	Y	U	N/A
North Fork Honcut Creek	Y	U	N/A
Colusa Basin Drain	Y	N	DWR Gage # WDL A02976; Water Years 1976-2003
Lower Sycamore Slough	Y	U	N/A
Upper Sycamore Slough	N	-	N/A
Wilkins Slough Canal	Y	U	N/A
Sand Creek	Y	U	N/A
Cortina Creek	Y	U	N/A
Lurline Creek	Y	U	N/A
Stone Corral Creek	N	Y	USGS Gage #11390672; Water Years 1976-2003

Waterway	>1 cfs reduction?	>10% reduction?	Data Source
Funks Creek	N	-	N/A
Freshwater Creek	N	-	N/A
Putah Creek	Y	N	USGS Gage # 11454000; Water Years 1976-2003
Big Chico Creek	N	-	N/A
Little Chico Creek	Y	Y	DWR Gage # WDL A04280; Water Years 1976-1996
Salt Creek	Y	U	N/A
Willow Creek (nr Williams)	Y	U	N/A
South Fork Willow Creek	N	Y	USGS Gage #11390655; Water Years 1976-2003
French Creek	N	-	N/A
Spring Valley Creek	N	-	N/A
Walker Creek (Willow Creek tributary)	N	-	N/A
North Fork Walker Creek	N	-	N/A
Wilson Creek	N	-	N/A

Y = Yes; N = No; U = Unknown
Note: Darkened rows indicate that a detailed effects analysis was not conducted because both criteria were not met.

Table I-2.
Average Monthly Flow in Cache Creek Under the No Action/No Project Using Historical Data and the Proposed Action using the Groundwater Model and Reduction in Flow due to the Proposed Action[1]

Month	No Action/ No Project[1]	Proposed Action	Reduction	Percent Reduction
	Flow (cfs)			
Jan	1,255.2	1,251.2	4.1	0.3
Feb	1,625.1	1,621.8	3.4	0.2
Mar	1,706.0	1,702.6	3.4	0.2
Apr	801.8	800.0	1.8	0.2
May	157.2	155.6	1.6	1.0
Jun	34.4	33.1	1.3	3.9
Jul	18.4	17.4	1.0	5.6
Aug	16.8	15.8	1.1	6.3
Sep	16.0	14.9	1.0	6.5
Oct	16.8	15.8	1.0	5.7
Nov	72.5	71.3	1.2	1.7
Dec	444.8	442.7	2.1	0.5

[1] USGS data, streamflow gage for Cache Creek near Yolo, gage #11452500 (1975-2013). Groundwater model data (1976-2003).

Table I-3.
Average Monthly Flow by Water Year Type in Cache Creek Under the No Action/No Project Using Historical Data and the Proposed Action using the Groundwater Model and Reduction in Flow due to the Proposed Action[1]

Month	WYT	No Action/ No Project[1]	Proposed Action	Reduction	Percent Reduction
			Flows (cfs)		
Jan	W	2,677.3	2,673.7	3.8	0.1
	AN	1,604.0	1,595.3	8.7	0.5
	BN	634.7	630.4	4.3	0.7
	D	312.5	310.1	2.4	0.8
	C	231.5	228.7	2.8	1.2
Feb	W	3,713.8	3,711.6	2.3	0.1
	AN	1,945.8	1,941.6	4.1	0.2
	BN	1,014.2	1,009.7	4.5	0.4
	D	193.1	191.1	2.0	1.0
	C	168.2	162.9	5.3	3.2
Mar	W	4,159.3	4,157.3	2.1	0.0
	AN	1,758.1	1,754.7	3.5	0.2
	BN	805.1	802.7	2.4	0.3
	D	225.5	223.5	2.0	0.9
	C	103.1	96.6	6.5	6.3
Apr	W	2,170.1	2,168.2	1.9	0.1
	AN	589.7	586.5	3.2	0.5
	BN	337.0	334.9	2.1	0.6
	D	28.2	26.4	1.7	6.2
	C	11.0	10.4	0.7	6.1
May	W	367.2	365.3	1.9	0.5
	AN	219.3	216.5	2.8	1.3
	BN	60.9	60.1	0.8	1.3
	D	15.1	13.8	1.6	10.3
	C	3.8	3.2	0.4	11.5
Jun	W	86.6	84.8	1.8	2.1
	AN	33.4	30.9	2.5	7.4
	BN	6.5	5.3	1.2	18.9
	D	7.9	6.8	1.1	13.5
	C	0.6	0.5	0.2	27.9
Jul	W	43.0	41.2	1.8	4.1
	AN	18.1	16.9	1.2	6.4
	BN	7.6	6.4	1.2	15.8
	D	6.4	5.5	0.9	13.5
	C	0.6	0.4	0.1	21.5
Aug	W	41.1	39.4	1.7	4.1
	AN	13.8	12.6	1.2	8.4
	BN	3.2	2.8	0.4	13.0
	D	7.1	5.8	1.3	18.2
	C	0.5	0.4	0.1	18.0

Month	WYT	No Action/ No Project[1]	Proposed Action	Reduction	Percent Reduction
			Flows (cfs)		
Sep	W	37.6	35.9	1.7	4.6
	AN	16.2	14.6	1.7	10.2
	BN	1.3	1.3	0.0	0.0
	D	6.9	6.2	0.7	10.6
	C	0.9	0.8	0.1	13.4
Oct	W	29.9	28.4	1.5	5.0
	AN	16.5	15.9	0.5	3.3
	BN	2.0	2.0	0.0	0.0
	D	17.5	16.8	0.7	4.1
	C	4.0	3.1	0.9	22.8
Nov	W	197.1	195.1	2.0	1.0
	AN	11.0	10.6	0.4	3.8
	BN	7.3	7.3	0.0	0.0
	D	39.2	37.5	1.7	4.5
	C	2.0	1.4	0.6	30.5
Dec	W	963.4	961.6	1.8	0.2
	AN	399.6	396.8	2.8	0.7
	BN	170.7	170.7	0.0	0.0
	D	276.9	274.1	2.7	1.0
	C	26.8	25.1	1.8	6.7

[1] USGS data, stream gage Cache Creek near Yolo, gage #11452500 (1975-2013). Groundwater model data (1976-2003).

Table I-4.
Average Monthly Flow in Stony Creek Under the No Action/No Project Using Historical Data and the Proposed Action using the Groundwater Model and Reduction in Flow due to the Proposed Action

Month	No Action/ No Project[1]	Proposed Action	Reduction	Percent Reduction
		Flow (cfs)		
Jan	1403.0	1401.9	1.1	0.1
Feb	1556.6	1555.6	1.0	0.1
Mar	891.2	890.2	0.9	0.1
Apr	168.5	167.6	0.9	0.5
May	207.1	206.5	0.7	0.3
Jun	74.5	73.8	0.7	0.9
Jul	31.0	30.3	0.6	2.0
Aug	40.9	40.3	0.6	1.5
Sep	40.5	40.0	0.5	1.2
Oct	58.8	57.2	1.6	2.7
Nov	112.8	111.7	1.1	1.0
Dec	562.4	561.4	1.0	0.2

[1] USGS data, streamflow gage for Stony Creek below Black Butte Dam, gage #11388000 (1976-2003). Groundwater model data (1976-2003).

Table I-5.
Average Monthly Flow by Water Year Type in Stony Creek Under the No Action/No Project Using Historical Data and the Proposed Action using the Groundwater Model and Reduction in Flow due to the Proposed Action[1]

Month	WYT	No Action/ No Project[1]	Proposed Action Flows (cfs)	Reduction	Percent Reduction
Jan	W	2662.6	2661.9	0.7	0.0
	AN	1841.4	1839.9	1.6	-0.1
	BN	53.8	53.1	0.6	-1.2
	D	439.9	438.9	1.0	-0.2
	C	488.7	487.1	1.6	-0.3
Feb	W	3660.6	3659.9	0.7	0.0
	AN	1905.4	1904.5	0.9	0.0
	BN	105.0	104.3	0.6	0.6
	D	104.6	103.7	0.9	0.9
	C	54.2	52.8	1.5	2.7
Mar	W	2176.3	2175.6	0.7	0.0
	AN	698.9	698.1	0.8	0.1
	BN	158.0	157.4	0.6	0.4
	D	228.6	227.8	0.9	0.4
	C	48.9	47.4	1.4	2.9
Apr	W	335.7	335.1	0.6	0.2
	AN	173.0	172.3	0.8	0.5
	BN	84.7	84.1	0.6	0.7
	D	66.7	65.8	0.9	1.4
	C	49.6	48.3	1.4	2.8
May	W	449.9	449.3	0.6	0.1
	AN	201.7	201.2	0.5	0.3
	BN	55.1	54.5	0.5	1.0
	D	101.7	100.8	1.0	0.9
	C	10.8	10.2	0.6	5.6
Jun	W	177.7	177.1	0.6	0.3
	AN	47.2	46.7	0.5	1.1
	BN	30.0	29.5	0.5	1.7
	D	24.4	23.3	1.1	4.3
	C	10.5	9.9	0.5	5.0
Jul	W	47.9	47.4	0.6	1.2
	AN	46.1	45.6	0.5	1.1
	BN	26.5	26.0	0.5	1.9
	D	17.0	16.2	0.8	5.0
	C	10.9	10.3	0.5	4.9
Aug	W	80.0	79.5	0.6	0.7
	AN	47.6	47.1	0.5	1.1
	BN	23.4	22.9	0.5	2.0
	D	15.3	14.3	1.0	6.2
	C	10.2	9.6	0.5	5.4

Month	WYT	No Action/ No Project[1]	Proposed Action	Reduction	Percent Reduction
			Flows (cfs)		
Sep	W	64.7	64.2	0.5	0.8
	AN	66.5	66.0	0.6	0.8
	BN	13.0	12.5	0.5	3.5
	D	16.8	16.0	0.8	5.0
	C	14.9	14.8	0.1	0.9
Oct	W	108.2	107.4	0.7	0.7
	AN	44.2	43.1	1.1	2.6
	BN	27.1	26.4	0.7	2.7
	D	32.2	30.8	1.4	4.5
	C	33.0	29.7	3.3	10.0
Nov	W	255.8	255.1	0.7	0.3
	AN	35.3	34.5	0.8	2.2
	BN	36.7	36.0	0.7	1.9
	D	54.1	53.0	1.1	2.1
	C	45.6	43.5	2.0	4.5
Dec	W	1234.8	1234.1	0.7	0.1
	AN	367.6	366.9	0.6	0.2
	BN	53.8	52.9	0.7	1.2
	D	363.0	362.0	1.0	0.3
	C	80.7	78.9	1.8	2.2

[1] USGS data, streamflow gage for Stony Creek below Black Butte Dam, gage #11388000 (1976-2003). Groundwater model data (1976-2003).

Appendix J Climate Change Technical Appendix

J.1 Introduction and Overview

This modeling appendix provides a description of assumptions, methods and modeling of the effects of future uncertainties in climate conditions on the Central Valley Project (CVP), State Water Project (SWP), and on water transfers. In keeping with the U.S. Department of the Interior, Bureau of Reclamation's (Reclamation) policy to use the best available science to inform decision making, quantitative methods and modeling tools were used whenever possible. Reclamation has actively pursued analysis and understanding of the potential effects of uncertainties related to climate change and socioeconomic conditions through several recent studies. Studies include the Sacramento and San Joaquin Basins Climate Impact Assessment (Reclamation, 2014a), Central Valley Project Integrated Resource Plan (Reclamation, 2014b), and the Sacramento and San Joaquin Rivers Basin Study (Reclamation, 2016a). This modeling appendix relies upon information and technical analyses developed under those studies, including modeling results that quantify the effects of future uncertainties in socioeconomic and climate change conditions. Modeling performed as part of the Sacramento and San Joaquin Rivers Basin Study (Basins Study) was analyzed in the development of this modeling appendix. Model results from the Basins Study are summarized to illustrate the potential effects of climate change on the CVP and SWP. Model results also were used to quantify the potential effects of future uncertainties related to climate change on the long-term water transfers.

This appendix is organized as follows:

- Section 2 of this appendix presents information on a summary of global climate projections and relevant research on climate change implications for California water resources, particularly those for the Central Valley of California.
- Section 3 provides an overview of the scenarios analyzed in the Basins Study that are relied upon for this analysis.
- Section 4 is a summary of changes in water transfer supply and demand under a range of future climate projections analyzed in the Basins Study.
- Section 5 lists the references used in preparation of this appendix.

J.2 Climate Change Research and Anticipated Effects on Central Valley of California

This section provides a summary of global climate projections and relevant research on climate change implications for California water resources, including a summary of key findings on the sensitivity of California water resources to climate changes, particularly those for the Central Valley of California.

J.2.1 Historical Climate

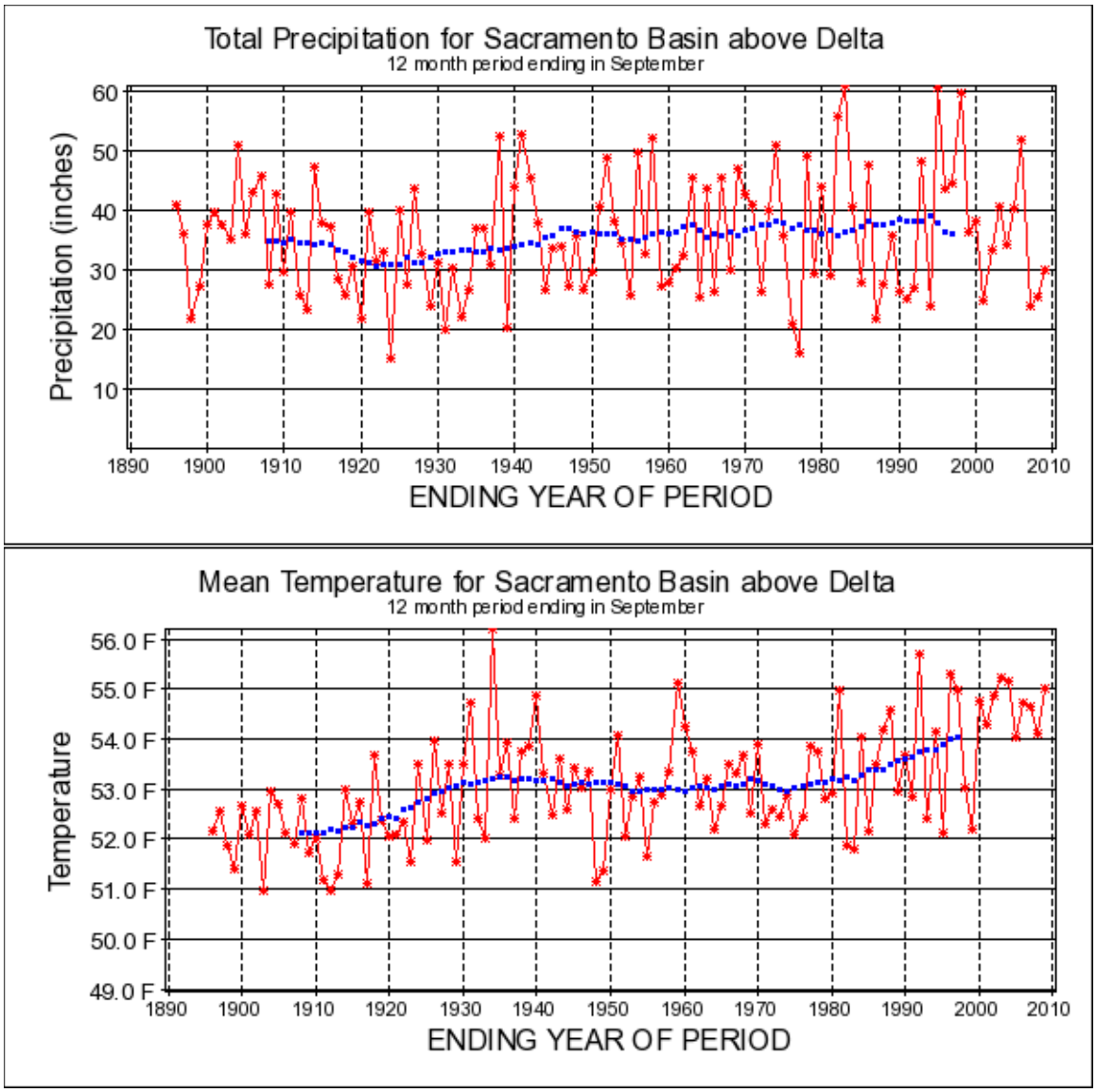
The historical climate of the Central Valley is characterized by hot and dry summers and cool and damp winters. Over the course of the 20th century, warming has been prevalent over the Sacramento and San Joaquin River basins. Basin average mean-annual temperature has increased by approximately 2°F during the course of the 20th century for just the Sacramento River basin north of the Delta (Figure J-1) or the San Joaquin River basin south of the Delta (Figure J-2).

Warming has not occurred steadily throughout the 20th century. Increases in air temperatures occurred primarily during the early part of the 20th century between 1910 and 1935. Subsequently, renewed warming began again in the mid-1970s and appears to be continuing at present, as shown for the Sacramento River basin in Figure J-1. Similar results are apparent for the San Joaquin River basin (Figure J-2) and have been reported in other studies.

In the Sacramento basin, the warming trend also has been accompanied by a gradual trend starting in the 1930s toward increasing precipitation (Figure J-1, top panel). However, a similar precipitation trend is not evident in the San Joaquin basin (Figure J-2, bottom panel). Other studies have shown similar results. Regonda et al. (2005) reported increased winter precipitation trends from 1950 to 1999 at many Western United States locations, including several in California's Sierra Nevada; but a consistent region-wide trend was not apparent. The variability of annual precipitation appears to have increased in the latter part of the 20th century, as can be seen by comparing the range of differences in high and low values of the solid red line in Figure J-1 and Figure J-2. These extremes in wet and dry years have been especially frequent since the mid-1970s in both the Sacramento and San Joaquin basins.

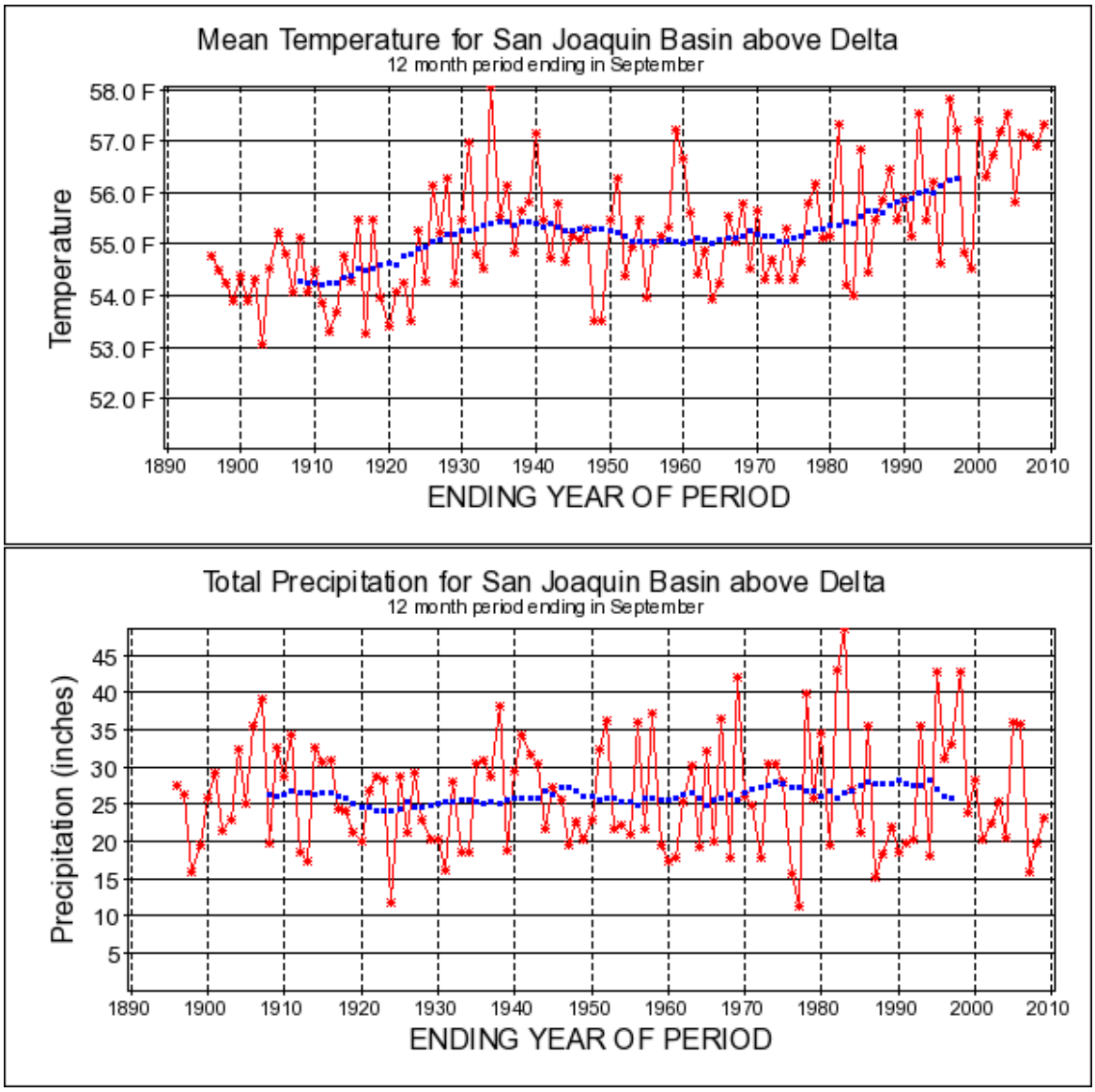
J.2.2 Historical Hydrology

Streamflow in the Sacramento River and San Joaquin River basins has historically varied considerably from year to year. Runoff can also vary geographically; during any particular year, some portions of the basin may experience relatively greater runoff than other areas. On a monthly to seasonal basis, runoff is generally greater during the winter to early summer months, with winter runoff generally originating from rainfall-runoff events and spring to early summer runoff generally supported by snowmelt from the Cascade Mountains and Sierra Nevada.



Source: Western Climate Mapping Initiative (WestMap) available at: http://www.cefa.dri.edu/ Westmap/. Red line indicates annual time series for the given geographic region. Blue line indicates 25-year moving annual mean values, where each value is plotted on the center year of its respective 25-year period. WestMap data are derived from the PRISM climate mapping system (Daly et al. 1994; Gibson et al. 2002).

Figure J-1.
Observed Annual (red) and Moving-Mean Annual (blue) Temperature and Precipitation, Averaged over the Sacramento River Basin



Source: Western Climate Mapping Initiative (WestMap) available at: http://www.cefa.dri.edu/ Westmap/. Red line indicates annual time series for the given geographic region. Blue line indicates 25-year moving annual mean values, where each value is plotted on the center year of its respective 25-year period. WestMap data are derived from the PRISM climate mapping system (Daly et al. 1994; Gibson et al. 2002).

Figure J-2.
Observed Annual (red) and Moving-Mean Annual (blue) Temperature and Precipitation, Averaged Over the San Joaquin River Basin

Historical changes in climate have resulted in several important effects on Sacramento and San Joaquin basin hydrology. Although annual precipitation may have slightly increased or remained relatively unchanged, corresponding increases in mean annual runoff in the Sacramento and San Joaquin rivers did not occur (Dettinger and Cayan 1995). However, a shift in the seasonal timing of runoff has been observed. In the Sacramento River Basin, a decrease of about 10 percent in the fraction of total runoff occurring from April through July has been observed over the course of the 20th century

(Roos 1991). Similar results were obtained from analyses of the combined basin runoffs for both the Sacramento and San Joaquin basins by Dettinger and Cayan (1995).

Increases in winter runoff have been observed. Analysis of data for 18 Sierra Nevada river basins found earlier runoff trends (Peterson et al. 2008). Of the potential climatic factors that could produce such changes, analyses indicated increasing spring temperatures rather than increased winter precipitation was the primary cause of the observed trends (Cayan 2001). Studies by these researchers and others showed the magnitude of the decreases in April through July runoff was correlated with the altitude of the basin watershed. High altitude basins like the San Joaquin exhibited less decrease in spring runoff than lower elevation watersheds such as the Sacramento. However, it is noted that the appearance of runoff trends in the basins depends on location and period of record being assessed. For example, runoff trends were evaluated for the Basins Study during the last half of the 20th century; and although similar trends were found, they were found to be statistically weak.[1]

Other studies of the magnitude of spring snowpack changes during the 20th century found that snowpack as measured by April 1 Snow Water Equivalent (SWE) showed a decreasing trend in the latter half of the 20th century (Mote 2005). Coincident with these trends, reduced snowpack and snowfall ratios were indicated by analyses of SWE measurements made from 1948 through 2001 at 173 Western United States stations (Knowles et al. 2007). Regonda et al. (2005) reported decreasing spring SWE trends in 50 percent of Western United States locations evaluated.

Changes discussed in the previous paragraphs over regional drainages such as the Sacramento and San Joaquin River basins are sensitive to the uncertainties of station measurements, the periods of analyses, and analyzed locations. For the entire Western United States, observed trends of temperature, precipitation, snowpack, and streamflow might be partially explained by anthropogenic influences on climate (e.g., Barnett et al. 2008; Pierce et al. 2008; Bonfils et al. 2008; Hidalgo et al. 2009; and Das et al. 2009). However, it remains difficult to attribute observed changes in hydroclimate to historical human influences or anthropogenic forcings. This is particularly the case for trends in precipitation (Hoerling et al. 2010) and for trends in basin-scale conditions rather than at the larger Western United States scale (Hidalgo et al. 2009).

Sea level change is also an important factor in assessing the effect of climate on California's water resources because of its effect on water quality in the Sacramento-San Joaquin Delta. Higher mean sea levels (msl) are associated with increasing salinity in the Delta, which influences the suitability of its water for agricultural, urban, and environmental uses. The global rate of msl change was estimated by IPCC (2007) to be 1.8 +/- 0.5 millimeters (mm)/year (0.07 +/- 0.02 inches per year (in/year)) from 1961–

[1] Trend significance was assessed using statistical testing during the period from 1951 through 1999 applied to historical simulated runoff results under observed historical weather conditions (Reclamation 2011). Trends were computed and assessed for four Missouri basin locations, focusing on annual and April–July runoff. In all cases, computed trends were judged to not be statistically significant with 95 percent confidence.

2003 and 3.1 +/- 0.7 mm/year (0.12+/0.03 in/year) during 1993–2003. During the 20th century, msl at Golden Gate Bridge in San Francisco Bay has risen by an average of 2 mm/year (0.08 in/year) (Anderson et al. 2008). These rates of sea level rise appear to be accelerating based on tidal gauges and remote sensing measurements (Church and White 2006; Beckley et al. 2007).

J.3 Technical Approach and Modeling

The modeling approach and analysis tools for the Basins Study were developed as part of the CVP Integrated Resource Plan (Reclamation 2014a) and the Sacramento and San Joaquin Basin's Climate Risk Assessment Report (Reclamation 2014b) and further improved for the Basins Study. During these studies, Reclamation evaluated future uncertainties related to climate and socioeconomic changes. Uncertainties in future climates primarily surround changes in temperature and precipitation. Changes in both temperature and precipitation then drive changes in runoff, snowpack, and sea level rise assumptions that can affect water supplies and the operations of the CVP/SWP system. Additionally, changes in temperature and precipitation can also affect water needs for agriculture, urban, and the environment.

The following provides a brief overview of the significant body of work performed in support of the CVP Integrated Resource Plan and the Basins Study. Detailed information is available in those plans and technical appendices to those plans. The purpose of this overview is to provide a high-level background on the assumptions included in the Basins Study modeling that was relied upon for the long-term water transfer analysis.

J.3.1 Description of Ensemble Climate Scenarios

A total of five representative climate futures were developed for use in the Basins Study using results from recent global climate model (GCM) simulations (IPCC 2013) that had been further refined for use in climate studies such as the Basins Study. These are usually referred to as "ensemble" scenarios as they are assembled from an ensemble group of climate projections. By using only five representative future climates, it was possible to efficiently assess the impacts of a range of potential climate futures without having to perform an excessive number of simulations.

The representative climate futures were created by combining together multiple individual GCM projections that occur within defined representative climate categories. Future projections of temperature show a consistent trend of warming, but the magnitude of the warming can vary. Future projections of precipitation are less consistent with some GCMs showing future increases in precipitation while others show a decrease in precipitation. The combination of these two variables and the range of future projections create a range of future conditions that are grouped into five different climate categories. A representative scenario is then selected from each category. The representative climate scenarios are shown conceptually in Figure J-3.

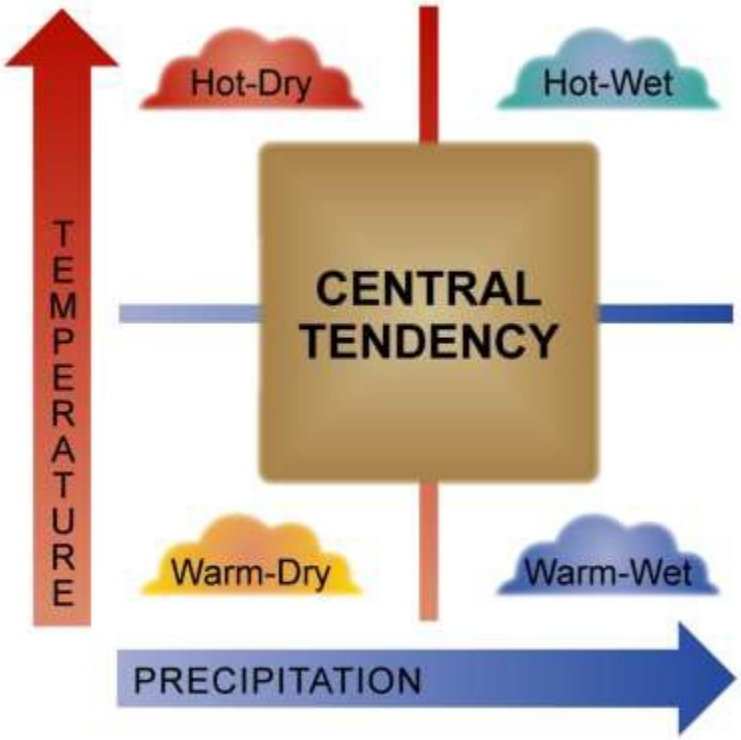


Figure J-3.
Conceptual Representation of Ensemble Climate Scenarios to Relate the Concept of Developing a Wide Range of Ensemble Projections (Reclamation 2016a)

Representative scenarios illustrated in Figure J-3 are described as:

- Central Tendency (CEN) scenario is in the middle of the range of all the projected temperatures and precipitations. It consists of a large number of projections and can be viewed as a better, though not certain, estimate of what the future climate may be.

- Warm-Dry (WD) scenario consists of a small number of projections that are not as warm as the central tendency but are significantly drier.

- Warm-Wet (WW) scenario consists of a small number of projections that are not as warm as the central tendency but are significantly wetter

- Hot-Dry (HD) scenario consists of a small number of projections that are significantly warmer and drier than the central tendency.

- Hot-Wet (HW) scenario consists of a small number of projections that are significantly hotter and wetter than the central tendency projection.

Both the Basins Study and this analysis for water transfers focus effort on evaluation of three of the five scenarios. The Central Tendency, Warm-Wet, and Hot-Dry scenarios are used to evaluate a relatively wide range of potential future climate conditions, particularly future conditions related to water supply and the operations of the CVP and SWP.

J.3.2 Socioeconomic Scenarios and Future Demands for Water

As population increases, municipal, commercial, and industrial water demands tend to increase. These demands are dynamic and depend on a variety of factors, such as urban development and land use density. Agricultural demand is also influenced by socioeconomic trends but to a lesser degree. The Basins Study evaluated three different socioeconomic scenarios to describe how water demands might evolve with changing populations and land use. These scenarios vary based on the expected future population growth and urban density and include Expansive Growth, Current Trends, and Slow Growth scenarios. This analysis focuses only on the Current Trends scenario, in part because this analysis is primarily addressing uncertainty related to future climate conditions.

Future water demands depend upon changes in population and land use as well as climate changes. As urban population increases, adjacent agricultural land is often incorporated into urban areas, thus reducing the agricultural land area to varying degrees. Consequently, with fewer acres of future irrigated lands, projected agricultural water demands tend to decline over time. Correspondingly, future urban demands may be anticipated to increase with increasing populations. The agricultural and urban demands and growth vary by regions.

Additionally, modeling performed for the Basins Study includes changes in demand through time, as opposed to a fixed level of demand analyzed over a range of hydrologic conditions. Demands in the first decades of the analysis are similar to current levels of demand, while demands closer to the end of analysis period in 2099 are different due to both socioeconomic and climate driven changes expected by the end of the century.

Agricultural water demands are affected by climate, population, and land use as well as other factors such as the types of crops and agricultural water management practices. The crop types, acreages, and changes in irrigated land area are based on the scenarios developed from the DWR analysis in the California Water Plan (DWR 2014). Under assumptions used in the Current Trends socioeconomic scenario for population growth and land changes, agricultural land in the Central Valley is projected to gradually decline from 6.5 million acres in 2012 to 5.8 million acres in 2040 and 5.4 million acres by 2099. Even though irrigated acreages were simulated as declining, the amount of contracted water supply available to the CVP/SWP contractors was not reduced. Details regarding the crop types, irrigated acreages, growing seasons, and other parameters used in the agricultural demands assessment are provided in technical reports to the Basins Study.

If there were no climate change, then the projected average annual agricultural demands for water in the Central Valley would decline from estimates of current demands of approximately 21.7 million acre-feet to 19.1 million acre-feet by 2070 – 2099 (see No

Climate Change [No CC] in Table J-1). This decline reflects a decrease in irrigated crop acreage. Changes in climate—especially increased carbon dioxide levels and temperature increases that exceed crop water stress thresholds, create additional changes in agricultural demand. This result occurs because the hotter climate scenarios have higher temperatures as well as higher levels of carbon dioxide. These changes do not become significant until the latter part of the 21st century and are therefore less significant for the analysis of water transfers over the next several years. Table J-1 shows the average annual agricultural water demands for the Central Valley for the Current Trends socioeconomic scenario.

Urban demands are an important portion of Reclamation's water deliveries. Urban demands now account for about one-twelfth of the water use in the Central Valley. Urban demands are driven largely by population and therefore tend to change steadily over time based on the assumed level of population, municipal, commercial, and industrial growth associated with each of the socioeconomic scenarios. Table J-1 shows the average annual urban water demands for the Central Valley for the Current Trends socioeconomic scenario.

Table J-1.
Average Annual Water Demands under the No CC Scenario Compared with Ensemble Climate Scenarios in the Current Trends Socioeconomic Scenario in Thousand Acre-Feet/Year

Demand	Period	No CC	Hot-Dry	Warm-Wet	Central Tend.
Agricultural	2015-2039	21,722	22,456	21,416	21,946
	2040-2069	20,135	20,211	19,373	19,990
	2070-2099	19,081	15,864	17,905	17,695
	2015-2099	**20,230**	**19,337**	**19,456**	**19,756**
Urban	2015-2039	2,152	2,211	2,153	2,178
	2040-2069	2,920	3,036	2,933	2,986
	2070-2099	3,701	3,851	3,705	3,769
	2015-2099	**2,970**	**3,081**	**2,976**	**3,025**

J.3.3 Future Sea Level Rise

Transient sea level changes were also included in the analysis of climate change scenarios. The amount of sea level rise was based on National Research Council (NRC) median projection for sea level rise, The NRC report suggested that by 2100, sea levels could rise by about 90 centimeters (cm), with a projected range between 42 cm through 166 (NRC 2012).

J.3.4 No Climate Change Scenario

In order to understand the uncertainties related to future climate and socioeconomic changes it is necessary to compare results that include future projections with historical climate conditions. Therefore, a No Climate Change (No CC) scenario was developed that "projected" historical climate conditions into the future climate period. In the No CC

scenario, total Central Valley demands change temporally in responses to changes in population and land use.

J.3.5 Modeling Tools

Several different modeling tools were used in the Basins Study to analyze uncertainties in future climate and socioeconomic trends. The Water Evaluation and Planning model of the Central Valley (WEAP-CV) hydrology model was used to simulate water supply and demands for multiple scenarios to address critical uncertainties related to climate and socioeconomic changes. Results from WEAP-CV were used as inputs to the CalLite-CV model to simulate how the CVP, SWP, and other water management systems operate to meet urban, agriculture, and environmental needs. Results from the CalLite-CV model were used to understand and quantify the potential changes in CVP and SWP operations as a result of climate change and assess how those changes may affect long-term water transfers. The following sections provide additional details on WEAP-CV and CalLite-CV. Additional details on these tools is available in technical appendices to the Basins Study.

WEAP-CV is a planning model of the Central Valley, developed on the WEAP modeling platform. Water supply is primarily driven by climatic variables such as precipitation and temperature. Precipitation directly affects water supplies whereas temperature influences water supply through water evaporation and crop evapotranspiration. Demands are influenced by socioeconomic conditions such as population, commercial and industrial growth, and land-use changes. WEAP-CV is capable of simulating both water supply and demand changes under the different climate change scenarios and socioeconomic conditions.

WEAP-CV includes rainfall-runoff modules used to develop climate-based watershed runoff for the main watersheds of the Bay-Delta, the Sacramento River, San Joaquin River, and Tulare Lake hydrologic regions. One of the key components of the model is the dynamic calculation of crop water requirements under various climate change scenarios. Each climate change scenario is analyzed using a transient approach in which the climate and socioeconomic factors gradually change as the simulation progresses through time.

Results from WEAP-CV model are input to the CalLite-CV model. CalLite-CV simulates CVP and SWP operations, delivery allocation decisions, Delta salinity, river flows, and reservoir levels based on hydrologic inputs from WEAP-CV. CalLite-CV is developed on the GoldSim modeling platform and has the ability to rapidly simulate system operations and to incorporate changes with relative ease, making it suitable for analysis of multiple climatic and socioeconomic scenarios. Results from the CalLite-CV model were used in the Basins Study to understand water supply and demand, and as inputs to other tools for evaluating impacts on water temperature, hydropower, greenhouse gas emissions, and economics.

J.4 Effects of Climate Change on CVP/SWP Operations

This analysis focuses on three climate change scenarios: 1) Central Tendency 2) Warm-Wet, and 3) Hot-Dry. These climate change scenarios are based on the Current Trends scenario of socio-economic development. These three climate change scenarios were selected out of the five scenarios as they represent a relatively wide range of potential future climate conditions, particularly future conditions related to water supply and the operations of the CVP and SWP.

While the remainder of the analysis focuses on only three climate change scenarios, Figure J-4 and Figure J-5 illustrate the range of runoff for all five ensemble climate scenarios to illustrate how the Central Tendency, Warm-Wet, and Hot-Dry scenarios compare with the Warm-Dry and Hot-Wet scenarios.

Figure J-4 compares the average annual runoff in the Sacramento River basin under the different climate change scenarios with the No Climate Change scenario (No CC) for water year 2015 through 2099. Average annual runoff in the Sacramento River basin varies from nearly 18 million acre-feet under the Hot-Dry scenario to 27 million acre-feet under the Hot-Wet scenario. Average annual runoff in the Sacramento River system under both Warm-Dry and Hot-Dry scenarios is nearly the same, and shows a decrease of approximately 4 million acre-feet compared to the No CC scenario. Similarly, average annual runoff under both Hot-Wet and Warm-Wet scenarios is nearly the same, and shows an increase of approximately 5 million acre-feet from the No CC scenario. The average annual runoff in the Sacramento River system under the Central Tendency scenario is similar in volume to the No CC scenario, though there are changes in the monthly timing of runoff.

Figure J-5 presents average annual runoff in the San Joaquin River basin. Relative changes in runoff between scenarios in the San Joaquin basin are similar to those seen in the Sacramento basin. The Hot-Dry scenario has the lowest runoff at just less than 5 million acre-feet, a reduction of approximately 1.2 million acre-feet compared to the No CC scenario. The Warm-Wet scenario shows the highest runoff of over 8 million acre-feet, an increase of approximately 2 million acre-feet from the No CC scenario. Runoff under the Central Tendency scenario is again similar in volume to the No CC scenario with an average of approximately 6.2 million acre-feet annually.

Tables J-2, J-3, and J-4 summarize key results of CVP and SWP operations from the CalLite-CV model for the three climate change scenarios as compared against the No CC scenario. Each table provides the average monthly results for one of the three climate projections, the No CC scenario, and the change from the No CC scenario.

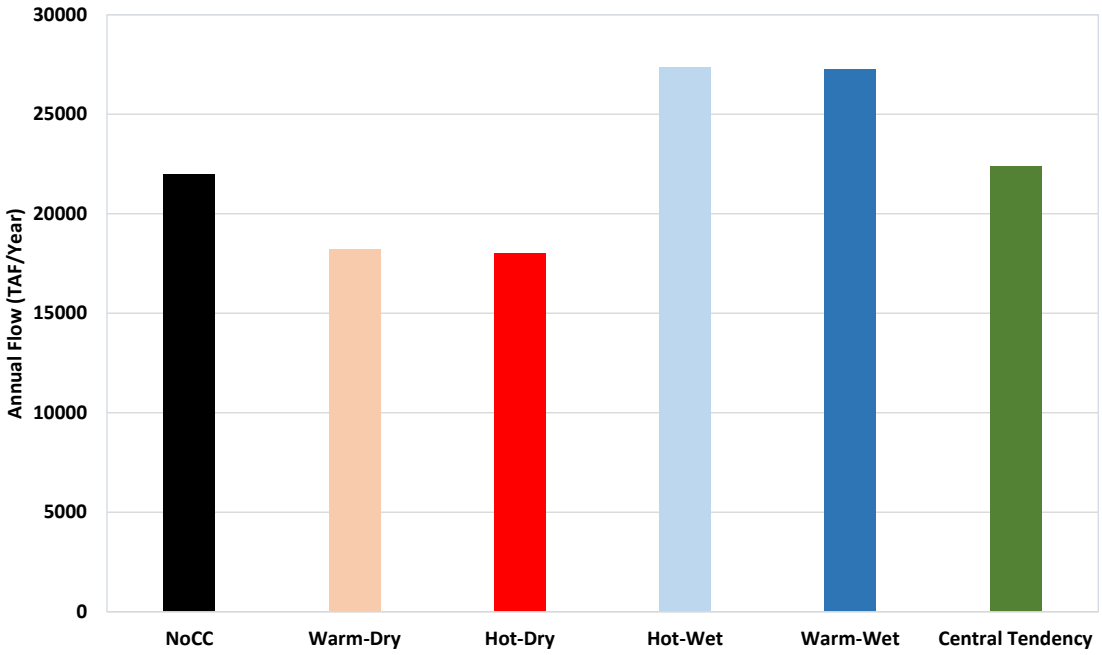


Figure J-4.
Average Annual Runoff in the Sacramento River System under different climate change projections and Current Trend Scenario (Reclamation 2016b)

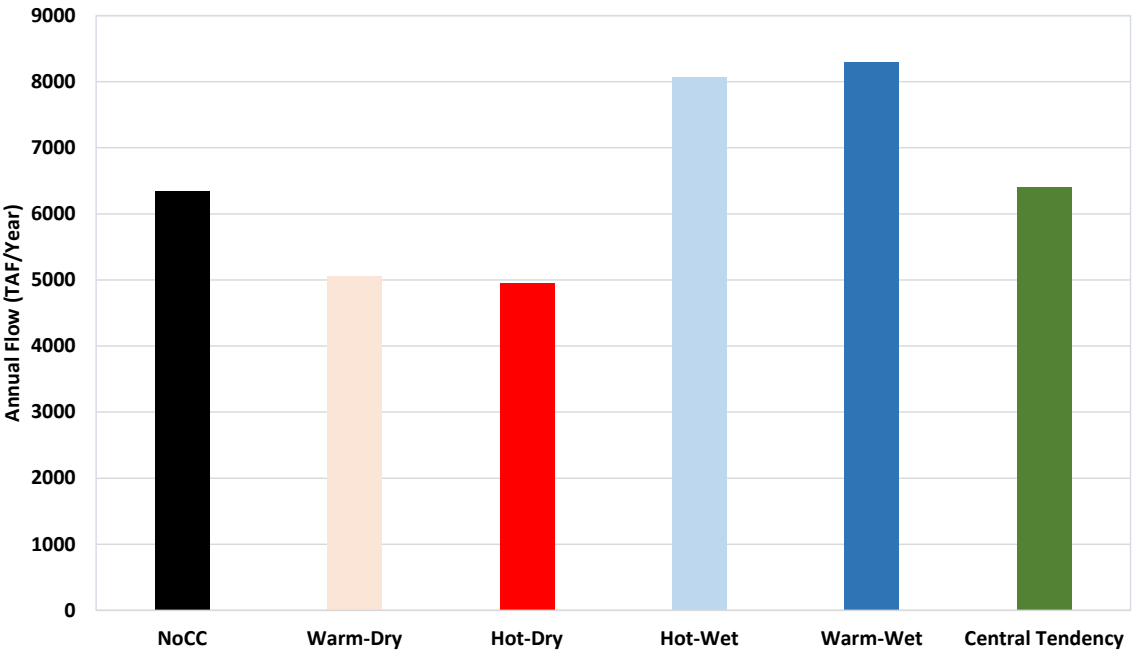


Figure J-5.
Average Annual Runoff in the San Joaquin River System under different climate change projections and Current Trend Scenario (Reclamation 2016b)

Table J-2.
Comparison of Average Monthly Values of CVP/SWP Operations between Central Tendency and No CC Scenarios

No CC Scenario	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	11282	23296	45282	50666	48877	37851	22265	11413	7197	4443	4473	5812
Jones Pumping Plant (cfs)	3582	3961	3170	3047	2804	1516	1241	3004	3789	3445	3862	2728
Banks Pumping Plant (cfs)	6064	4340	4169	4509	4884	1641	1232	3149	4857	3410	3566	6187
Sac. River at Hood (cfs)	15957	24143	34614	37660	40112	29534	18696	16073	16592	10873	9414	11191
Sac. River at Keswick (cfs)	4253	5719	8609	11307	12962	9225	7731	13585	12971	9580	5520	5422
Sac. River at NCP (cfs)	6488	11903	19266	22307	21325	13407	7030	6650	6668	4799	4648	5299
Feather River blw. Thermalito (cfs)	2656	3267	5680	6810	8474	6024	4341	4416	6943	3903	1477	2864
American River at Nimbus (cfs)	2765	3226	5518	5315	5378	4708	3525	3696	2462	1838	1485	1480
American River at H.St (cfs)	2494	2970	5272	5082	5151	4469	3252	3375	2101	1470	1135	1167
SJ River at Vernalis (cfs)	2557	2724	5231	6569	7482	8957	6822	4440	2930	2692	2553	2720
Shasta Storage (TAF)	2269	2368	2604	2956	3227	3369	3427	3442	2994	2567	2326	2313
Folsom Storage (TAF)	426	407	440	469	495	589	675	749	642	536	471	449
Oroville Storage (TAF)	1461	1531	1700	1949	2114	2267	2379	2401	2127	1716	1498	1504
CVP San Luis Storage (TAF)	273	395	570	689	769	821	768	630	491	346	247	274
SWP San Luis Storage (TAF)	439	619	701	813	863	908	789	587	449	388	270	255
Central Tendency	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Delta Outflow (cfs)	11702	27528	55280	58777	50419	36170	19017	9811	8461	4869	4416	6906
Jones Pumping Plant (cfs)	3301	3910	3355	3011	2720	1508	1116	2928	3514	3078	3633	2418
Banks Pumping Plant (cfs)	5987	4578	4441	4874	5062	1754	1095	3018	4809	2829	3543	5159
Sac. River at Hood (cfs)	15944	26374	37505	39268	40111	27651	16605	15093	18073	10431	9297	10952
Sac. River at Keswick (cfs)	4080	6031	9585	11924	12581	8790	8726	14235	13896	9187	5462	5146
Sac. River at NCP (cfs)	6279	13124	21639	23885	20672	12758	7843	7455	7865	4697	4538	4961
Feather River blw. Thermalito (cfs)	3004	3717	7341	8097	8913	5616	3731	4254	7199	3707	1671	2999
American River at Nimbus (cfs)	2685	4119	7450	6171	5307	3692	2392	2913	2718	1708	1394	1457
American River at H.St (cfs)	2411	3860	7201	5934	5076	3448	2113	2587	2352	1336	1041	1146
SJ River at Vernalis (cfs)	2585	2912	7143	8983	9013	9698	5839	3345	2321	2394	2370	2688
Shasta Storage (TAF)	2068	2173	2478	2878	3164	3301	3366	3300	2805	2322	2108	2096
Folsom Storage (TAF)	376	383	439	476	501	592	645	647	542	440	395	388
Oroville Storage (TAF)	1340	1407	1633	1945	2165	2300	2382	2346	2039	1585	1386	1384
CVP San Luis Storage (TAF)	273	381	558	694	779	831	785	652	527	382	267	285
SWP San Luis Storage (TAF)	363	548	653	785	850	905	795	591	445	385	239	226
Change from No CC Scenario	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Delta Outflow (cfs)	420	4231	9997	8111	1543	-1681	-3247	-1601	1264	426	-58	1093
Jones Pumping Plant (cfs)	-281	-50	185	-36	-84	-8	-125	-76	-276	-367	-229	-311
Banks Pumping Plant (cfs)	-77	238	272	365	178	113	-136	-131	-48	-580	-23	-1027
Sac. River at Hood (cfs)	-13	2231	2891	1607	-1	-1883	-2092	-980	1481	-442	-117	-239
Sac. River at Keswick (cfs)	-173	312	976	617	-381	-435	995	650	925	-393	-57	-276
Sac. River at NCP (cfs)	-209	1221	2372	1578	-653	-649	814	805	1197	-103	-110	-338
Feather River blw. Thermalito (cfs)	348	450	1661	1287	439	-409	-610	-161	256	-196	194	134
American River at Nimbus (cfs)	-80	893	1932	856	-71	-1016	-1133	-784	256	-130	-92	-24
American River at H.St (cfs)	-82	890	1928	852	-75	-1021	-1139	-787	251	-133	-94	-21
SJ River at Vernalis (cfs)	28	188	1912	2414	1531	741	-983	-1096	-609	-298	-184	-32
Shasta Storage (TAF)	-200	-195	-126	-78	-63	-69	-61	-141	-189	-245	-218	-217
Folsom Storage (TAF)	-50	-24	0	8	6	2	-30	-102	-100	-96	-76	-61
Oroville Storage (TAF)	-121	-124	-68	-4	52	33	3	-54	-88	-131	-112	-120
CVP San Luis Storage (TAF)	0	-14	-13	5	10	10	18	22	37	36	20	11
SWP San Luis Storage (TAF)	-76	-71	-48	-29	-13	-3	6	4	-4	-2	-31	-28

Table J-3.
Comparison of Average Monthly Values of CVP/SWP Operations between Hot-Dry and No CC Scenarios

No CC Scenario	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	11282	23296	45282	50666	48877	37851	22265	11413	7197	4443	4473	5812
Jones Pumping Plant (cfs)	3582	3961	3170	3047	2804	1516	1241	3004	3789	3445	3862	2728
Banks Pumping Plant (cfs)	6064	4340	4169	4509	4884	1641	1232	3149	4857	3410	3566	6187
Sac. River at Hood (cfs)	15957	24143	34614	37660	40112	29534	18696	16073	16592	10873	9414	11191
Sac. River at Keswick (cfs)	4253	5719	8609	11307	12962	9225	7731	13585	12971	9580	5520	5422
Sac. River at NCP (cfs)	6488	11903	19266	22307	21325	13407	7030	6650	6668	4799	4648	5299
Feather River blw. Thermalito (cfs)	2656	3267	5680	6810	8474	6024	4341	4416	6943	3903	1477	2864
American River at Nimbus (cfs)	2765	3226	5518	5315	5378	4708	3525	3696	2462	1838	1485	1480
American River at H.St (cfs)	2494	2970	5272	5082	5151	4469	3252	3375	2101	1470	1135	1167
SJ River at Vernalis (cfs)	2557	2724	5231	6569	7482	8957	6822	4440	2930	2692	2553	2720
Shasta Storage (TAF)	2269	2368	2604	2956	3227	3369	3427	3442	2994	2567	2326	2313
Folsom Storage (TAF)	426	407	440	469	495	589	675	749	642	536	471	449
Oroville Storage (TAF)	1461	1531	1700	1949	2114	2267	2379	2401	2127	1716	1498	1504
CVP San Luis Storage (TAF)	273	395	570	689	769	821	768	630	491	346	247	274
SWP San Luis Storage (TAF)	439	619	701	813	863	908	789	587	449	388	270	255
Hot-Dry Scenario	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Delta Outflow (cfs)	8991	18400	36288	39622	36099	27594	16321	9536	9414	4759	5129	7605
Jones Pumping Plant (cfs)	2328	3245	2936	2646	2409	1448	1136	2326	2510	2002	2446	1669
Banks Pumping Plant (cfs)	4513	4160	3846	4153	4172	1682	1132	2358	3570	1764	2270	3470
Sac. River at Hood (cfs)	12207	20437	29857	32318	31449	22504	15441	14537	17042	8591	8206	9810
Sac. River at Keswick (cfs)	3994	3871	5690	7582	9044	7246	9308	14108	13666	8222	5092	5225
Sac. River at NCP (cfs)	5010	8605	14533	16494	15174	10108	7867	7377	7967	4233	3950	4506
Feather River blw. Thermalito (cfs)	2617	3037	4190	5593	6576	4576	3479	4024	6363	2930	1749	3120
American River at Nimbus (cfs)	1769	3089	5436	4855	4275	3113	2322	3279	2798	1277	1109	1132
American River at H.St (cfs)	1498	2830	5187	4617	4041	2865	2041	2947	2437	933	779	835
SJ River at Vernalis (cfs)	2042	2082	4179	5352	5763	7125	4617	2624	2090	1991	1996	2322
Shasta Storage (TAF)	1310	1372	1634	2083	2439	2658	2719	2556	2022	1529	1355	1351
Folsom Storage (TAF)	235	258	346	415	466	552	592	560	404	273	244	244
Oroville Storage (TAF)	1011	1053	1226	1552	1764	1938	2006	1925	1625	1223	1076	1075
CVP San Luis Storage (TAF)	270	334	484	617	705	758	736	645	553	433	316	299
SWP San Luis Storage (TAF)	243	380	499	673	790	863	785	617	454	353	193	159
Change from No CC Scenario	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Delta Outflow (cfs)	-2291	-4897	-8994	-11044	-12778	-10258	-5944	-1877	2216	316	656	1792
Jones Pumping Plant (cfs)	-1254	-715	-234	-402	-395	-68	-105	-678	-1279	-1442	-1416	-1060
Banks Pumping Plant (cfs)	-1552	-180	-323	-356	-713	41	-99	-792	-1287	-1646	-1296	-2716
Sac. River at Hood (cfs)	-3749	-3706	-4758	-5342	-8662	-7029	-3255	-1536	449	-2282	-1208	-1382
Sac. River at Keswick (cfs)	-259	-1848	-2919	-3725	-3918	-1980	1578	523	695	-1358	-428	-197
Sac. River at NCP (cfs)	-1478	-3298	-4734	-5813	-6151	-3299	837	727	1299	-566	-698	-793
Feather River blw. Thermalito (cfs)	-40	-230	-1490	-1217	-1898	-1448	-862	-391	-580	-974	272	256
American River at Nimbus (cfs)	-996	-137	-81	-461	-1103	-1595	-1203	-418	336	-561	-376	-348
American River at H.St (cfs)	-996	-140	-86	-466	-1110	-1604	-1211	-428	336	-537	-356	-332
SJ River at Vernalis (cfs)	-515	-642	-1052	-1217	-1718	-1832	-2205	-1816	-840	-701	-557	-398
Shasta Storage (TAF)	-959	-996	-970	-874	-788	-711	-709	-886	-972	-1038	-971	-962
Folsom Storage (TAF)	-191	-149	-94	-53	-29	-37	-82	-189	-238	-263	-227	-204
Oroville Storage (TAF)	-450	-478	-474	-397	-349	-329	-373	-476	-502	-493	-422	-429
CVP San Luis Storage (TAF)	-3	-60	-86	-72	-64	-63	-32	15	62	87	69	24
SWP San Luis Storage (TAF)	-196	-239	-202	-140	-73	-45	-3	30	5	-35	-78	-95

Table J-4.
Comparison of Average Monthly Values of CVP/SWP Operations between Warm-Wet and No CC Scenarios

No CC Scenario	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Delta Outflow (cfs)	11282	23296	45282	50666	48877	37851	22265	11413	7197	4443	4473	5812
Jones Pumping Plant (cfs)	3582	3961	3170	3047	2804	1516	1241	3004	3789	3445	3862	2728
Banks Pumping Plant (cfs)	6064	4340	4169	4509	4884	1641	1232	3149	4857	3410	3566	6187
Sac. River at Hood (cfs)	15957	24143	34614	37660	40112	29534	18696	16073	16592	10873	9414	11191
Sac. River at Keswick (cfs)	4253	5719	8609	11307	12962	9225	7731	13585	12971	9580	5520	5422
Sac. River at NCP (cfs)	6488	11903	19266	22307	21325	13407	7030	6650	6668	4799	4648	5299
Feather River blw. Thermalito (cfs)	2656	3267	5680	6810	8474	6024	4341	4416	6943	3903	1477	2864
American River at Nimbus (cfs)	2765	3226	5518	5315	5378	4708	3525	3696	2462	1838	1485	1480
American River at H.St (cfs)	2494	2970	5272	5082	5151	4469	3252	3375	2101	1470	1135	1167
SJ River at Vernalis (cfs)	2557	2724	5231	6569	7482	8957	6822	4440	2930	2692	2553	2720
Shasta Storage (TAF)	2269	2368	2604	2956	3227	3369	3427	3442	2994	2567	2326	2313
Folsom Storage (TAF)	426	407	440	469	495	589	675	749	642	536	471	449
Oroville Storage (TAF)	1461	1531	1700	1949	2114	2267	2379	2401	2127	1716	1498	1504
CVP San Luis Storage (TAF)	273	395	570	689	769	821	768	630	491	346	247	274
SWP San Luis Storage (TAF)	439	619	701	813	863	908	789	587	449	388	270	255
Warm-Wet Scenario	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Delta Outflow (cfs)	17037	41762	81242	80532	70668	48340	25308	11774	8008	4474	5137	8256
Jones Pumping Plant (cfs)	4055	4205	3494	3557	3098	1699	1229	3348	4237	4014	4230	3443
Banks Pumping Plant (cfs)	6314	5045	4809	5701	6012	1908	1209	3492	5593	4306	4235	5850
Sac. River at Hood (cfs)	20761	34033	45503	45936	48517	34446	20009	16263	17953	11479	10526	13275
Sac. River at Keswick (cfs)	5544	9237	13852	15143	15381	10669	8139	13895	13516	9342	6005	5800
Sac. River at NCP (cfs)	8757	18115	29202	29751	26652	16313	8429	7521	7605	5055	5472	6269
Feather River blw. Thermalito (cfs)	3338	5289	11860	11671	11345	6924	4382	4273	6936	3873	1487	3315
American River at Nimbus (cfs)	3877	6419	9478	7589	6578	4671	3022	3146	2638	1955	1602	1823
American River at H.St (cfs)	3596	6154	9224	7348	6345	4426	2738	2812	2264	1573	1243	1501
SJ River at Vernalis (cfs)	3136	4787	11700	14652	14218	13212	8097	4782	3131	3026	2872	3169
Shasta Storage (TAF)	2636	2733	2952	3248	3479	3650	3735	3802	3373	2915	2694	2670
Folsom Storage (TAF)	492	465	490	509	519	612	691	729	646	574	526	514
Oroville Storage (TAF)	1741	1822	2037	2279	2423	2560	2680	2700	2430	2004	1797	1812
CVP San Luis Storage (TAF)	262	405	586	708	800	856	795	628	466	296	196	227
SWP San Luis Storage (TAF)	463	639	737	830	879	938	806	583	440	413	317	314
Change from No CC Scenario	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Delta Outflow (cfs)	5755	18465	35960	29866	21791	10488	3043	361	811	31	664	2444
Jones Pumping Plant (cfs)	473	244	324	510	294	183	-12	344	447	569	368	715
Banks Pumping Plant (cfs)	250	705	640	1192	1128	267	-23	342	736	897	669	-336
Sac. River at Hood (cfs)	4804	9891	10889	8275	8406	4912	1313	190	1360	606	1112	2084
Sac. River at Keswick (cfs)	1290	3518	5243	3836	2419	1444	408	310	546	-238	485	378
Sac. River at NCP (cfs)	2269	6212	9935	7444	5327	2907	1399	871	937	256	824	970
Feather River blw. Thermalito (cfs)	681	2023	6180	4860	2871	900	41	-142	-8	-31	10	451
American River at Nimbus (cfs)	1113	3193	3960	2273	1200	-37	-503	-550	177	117	117	343
American River at H.St (cfs)	1102	3184	3952	2266	1195	-43	-514	-562	163	103	108	334
SJ River at Vernalis (cfs)	579	2062	6469	8083	6736	4255	1275	341	201	335	319	449
Shasta Storage (TAF)	367	365	348	292	252	280	307	361	379	347	368	357
Folsom Storage (TAF)	65	57	50	40	24	23	16	-20	4	37	55	65
Oroville Storage (TAF)	280	291	337	330	309	293	300	299	304	288	299	308
CVP San Luis Storage (TAF)	-11	10	15	19	31	35	27	-2	-25	-49	-50	-48
SWP San Luis Storage (TAF)	24	20	36	17	15	30	17	-3	-9	26	47	59

Table J-2 compares average monthly results for the Central Tendency scenario as compared to the No CC scenario. Under the Central Tendency scenario, Delta outflow is higher by approximately 1.2 million acre-feet per year than under the No CC scenario. The majority of the increase in Delta outflow occurs from November through January, in part due to the shift in the timing of runoff in the Central Tendency scenario. During the months of March, April, May, and August, Delta outflow is reduced under the Central Tendency scenario. Total Delta exports decrease by nearly 150 thousand acre-feet under

the Central Tendency scenario as compared to the No CC scenario. In some months, the river flows are greater and in other months they are lower under Central Tendency as compared to the No CC scenario. River flows in the Sacramento basin show consistent average monthly increases from November through January. Average monthly flow of the San Joaquin River at Vernalis increases from November through March. Overall, on an average annual basis, Sacramento River flows and San Joaquin River flows increase by approximately 300 cfs under Central Tendency scenario as compared to the No CC scenario. Combined North-of-Delta (NOD) upstream reservoir carryover storage at the end-of-September under the Central Tendency scenario is lower by nearly 400 thousand acre-feet as compared to the No CC scenario.

Table J-3 summarizes similar results for the Hot-Dry scenario. This scenario is the driest scenario in terms of water supply with the greatest reduction in Delta exports and Delta outflows relative to the No CC scenario. Delta outflows decrease by nearly 3 million acre-feet per year and Delta exports decrease by 1.2 million acre-feet per year as compared to the No CC scenario. Decrease in exports could result in increased potential for transfers to SLDMWA under Hot-Dry scenario. Reductions in average monthly Delta outflows occur from October through May, with the highest reduction in February. Under the Hot-Dry scenario, river flows and reservoir storages are consistently lower when compared to the No CC scenario. On an average annual basis, Sacramento River flows at Hood decrease by nearly 3,500 cfs as compared to the No CC scenario. Average annual flow in the San Joaquin River at Vernalis is reduced by nearly 1,100 cfs under the Hot-Dry scenario. Combined carryover storage (end of September) in Shasta, Folsom, and Oroville is reduced by nearly 1.6 million acre-feet under the Hot-Dry scenario. San Luis reservoir carryover storage is reduced by approximately 70 thousand acre-feet under the Hot-Dry scenario as compared to the No CC scenario, though the reduction occurs only in the SWP portion of San Luis Reservoir while the CVP portion has higher average carryover storage.

Table J-4 presents results for the Warm-Wet scenario as compared against the No CC scenario. The Warm-Wet scenario is the wettest scenario with increased reservoir storage, river flows, and Delta exports. Delta outflow increases by an average of nearly 7.8 million acre-feet per year and exports increase by nearly 660 thousand acre-feet per year. It is noted that Delta exports under the Warm-Wet scenario increase by only a fraction of the increase in Delta outflow indicating increases in Delta inflow occur primarily during periods when only a small fraction can be diverted under existing regulatory requirements and with existing infrastructure. River flows are higher in most months in the Sacramento basin. On an average annual basis, Sacramento River flow at Hood is nearly 4,500 cfs higher under Warm-Wet scenario as compare to the No CC scenario. San Joaquin River flow at Vernalis is higher in all months, with average annual flows higher by nearly 2,600 cfs under the Warm-Wet scenario. San Luis Reservoir storage does not change significantly under the Warm-Wet scenario, in part due to the relatively modest increase in Delta exports.

J.4.1 Transient Change

To help understand how climate change will vary temporally in the future, Figure J-6 is presented which shows the annual mean temperature and precipitation changes for California and Nevada derived from the central quadrant (Central Tendency climate scenario). Projected changes for the future periods 2011-2040 (2025 centering), 2041-2070 (2055 centering), and 2070-2099 (2084 centering) are compared to the historical climatological period of 1981-2010. Changes in climate are less dramatic in the first 30 years with substantial warming expected to occur by 2050 and more severe effects by the end of the 21st century.

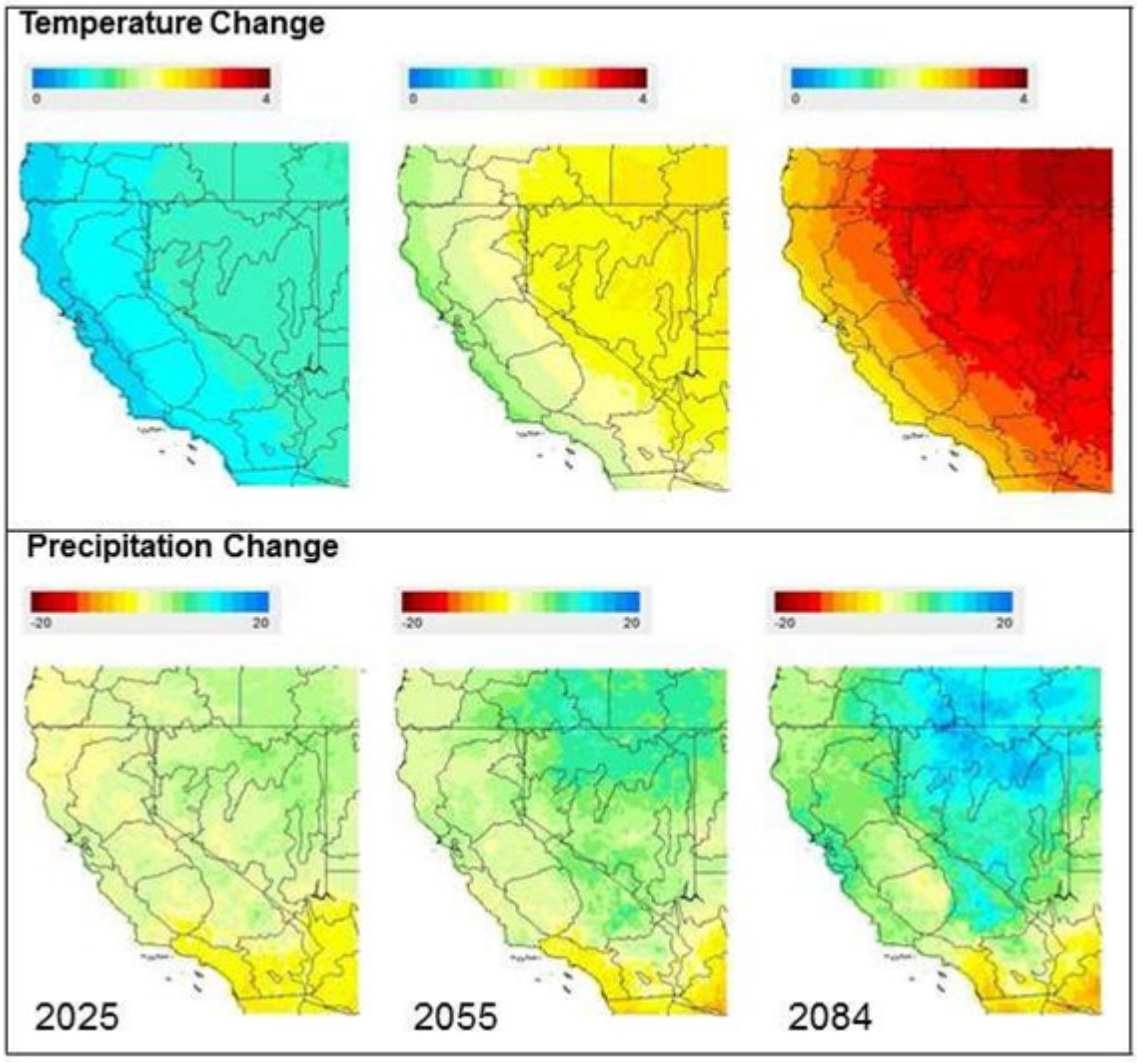


Figure J-6.
Projected changes in annual mean temperature and precipitation for 2011-2040 (2025), 2041-2070 (2055) and 2070-2099 (2084).

To illustrate how the transient change in climate and may affect CVP/SWP operations, reservoir carryover storage and Delta exports were analyzed over the three different future periods. Figures J-7 through J-9 show changes in north of Delta CVP/SWP reservoir carryover storage from the CalLite-CV model under the three future periods of 2025, 2055 and 2084. These figures generally show an increased range of potential carryover storage (greater differences between Warm-Wet and Hot-Dry scenario results) at the end of the 21st century (Figure J-9) as compared to the first 30 years (Figure J-7).

Figures J-10 through J-12 show similar effects of this transient change of climate on Delta exports based on results from CalLite-CV models. The range or the difference in Delta exports between the extreme climate change scenarios are greater with time and are more pronounced at the end of the 21st century than the beginning.

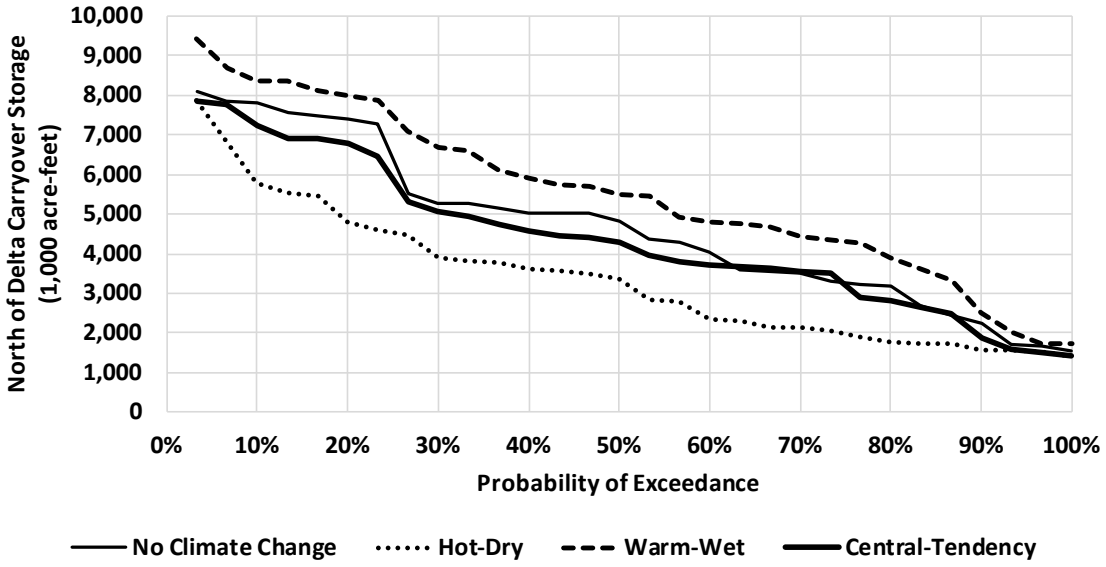


Figure J-7.
North of Delta Carryover Storage (Trinity, Folsom, Shasta and Oroville) (2015-2044)

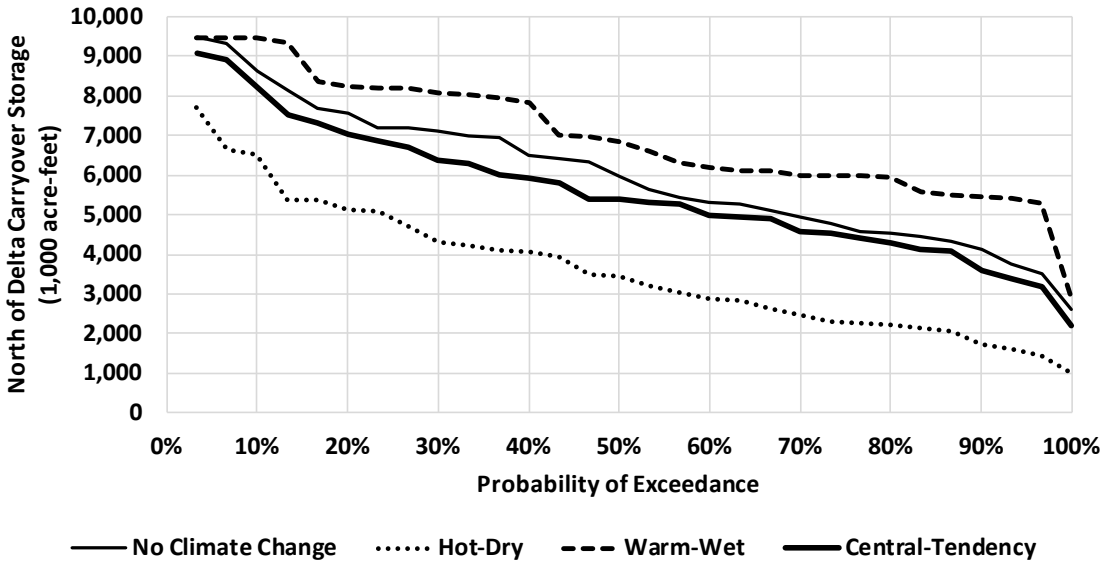


Figure J-8.
North of Delta Carryover Storage (Trinity, Folsom, Shasta and Oroville)
(2045-2074)

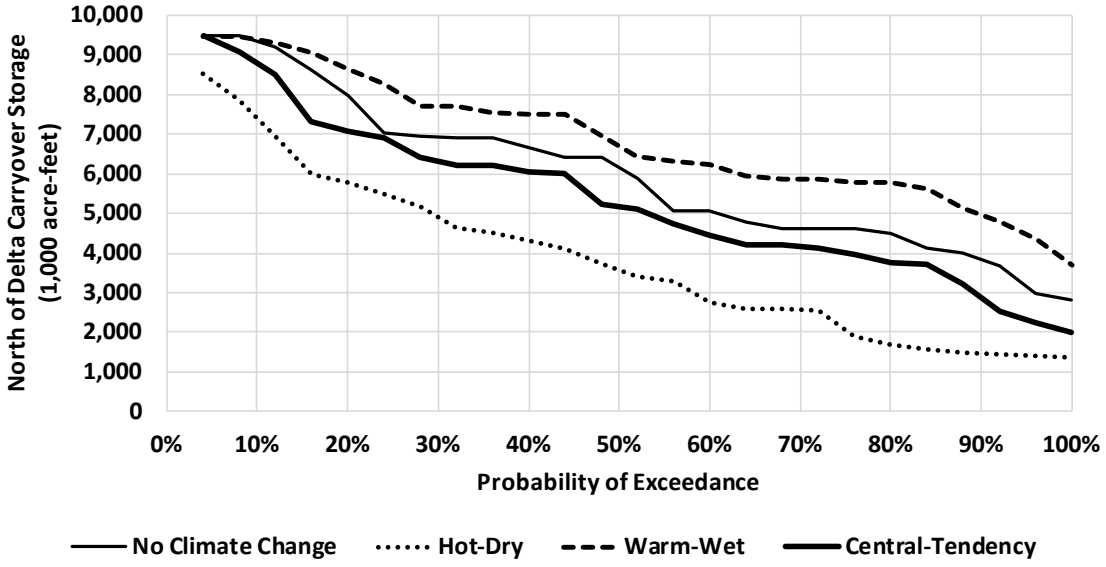


Figure J-9.
North of Delta Carryover Storage (Trinity, Folsom, Shasta and Oroville)
(2075-2099)

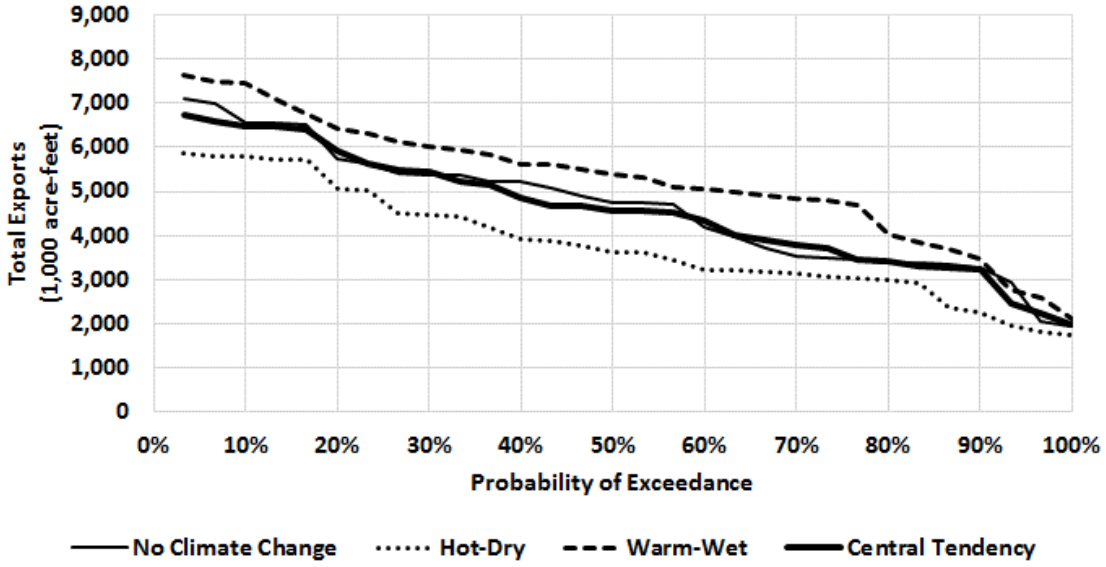


Figure J-10.
Annual Exports (Jones and Banks) (2011-2044)

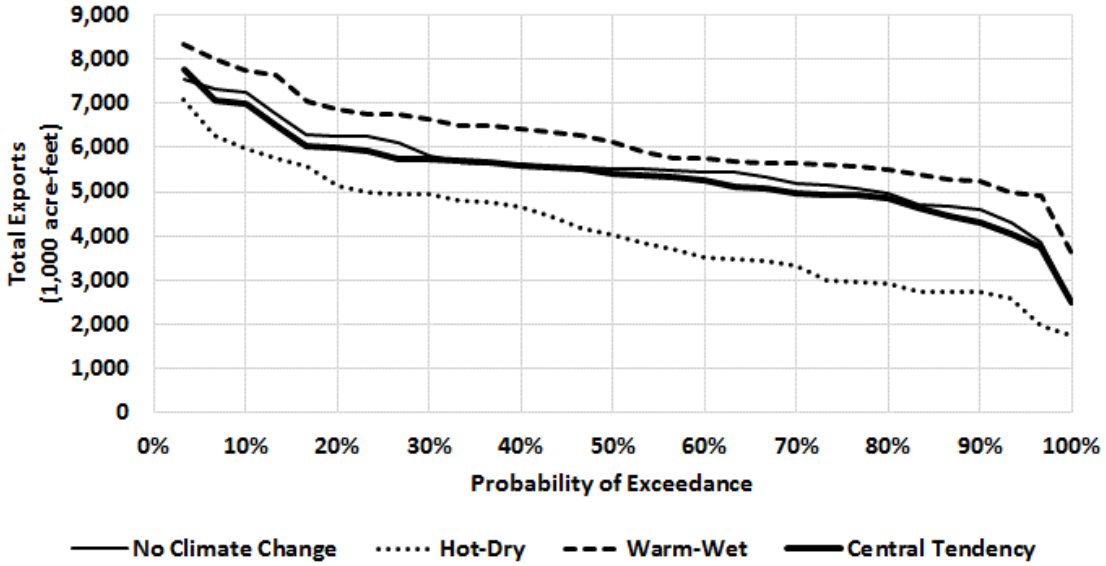


Figure J-11.
Annual Exports (Jones and Banks) (2045-2074)

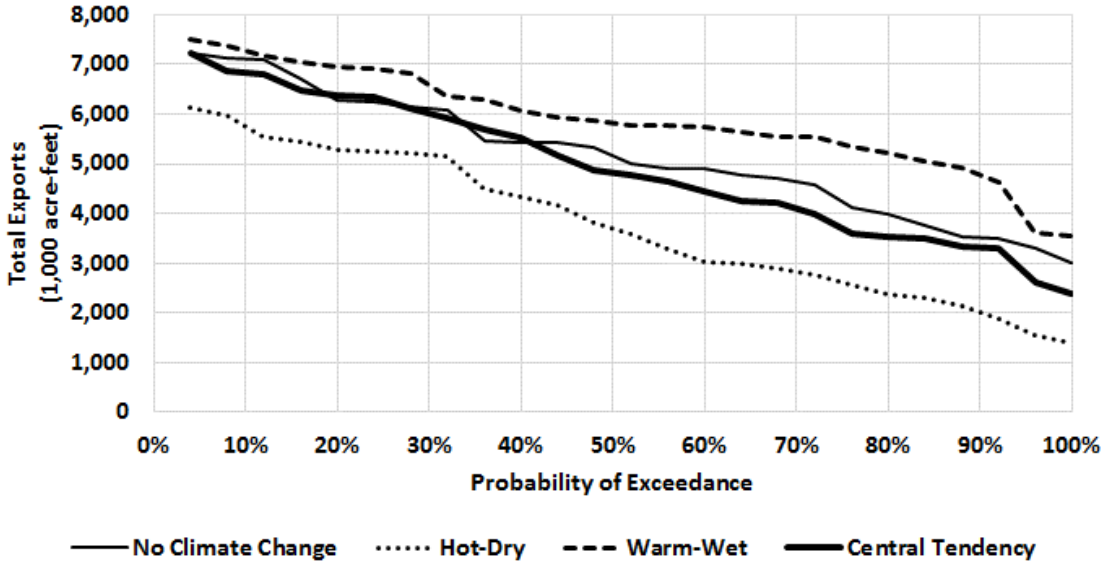


Figure J-12.
Annual Exports (Jones and Banks) (2075-2099)

J.5 Effects on Long-Term Water Transfers

J.5.1 Methods and Assumptions

This section summarizes the methods used in the assessment of climate change effects on long-term water transfers. This climate change analysis relies upon information and technical analyses developed as part of the Basins Study. CalLite-CV model results from the Basins Study were used to quantify the potential effects of future uncertainties related to climate change on water transfers. In addition to the effects of climate change on transfers, an additional assumption was made to limit the annual volume of demand for transfer water to 250,000 acre-feet. This assumption reduces the total volume of transfers that would occur from the volumes analyzed for the 2014 Draft EIS/EIR.

As stated earlier, this climate change analysis focuses on three of the five scenarios, the Central Tendency, Warm-Wet, and Hot-Dry scenarios to evaluate the effects on long-term water transfer supply and demand. The following section presents a detailed description of the methods applied in developing the transfer demands and supply under the climate change scenarios using model results from the Basins Study.

J.5.2 Transfer Demand

San Luis & Delta-Mendota Water Authority (SLDMWA) demand for transfer water was assumed to be equal to estimated available Delta export capacity and was calculated by post-processing Basins Study CalLite-CV results. This is the same assumption and approached used in the 2014 Draft EIS/EIR when available Delta export capacity was calculated by post-processing CalSim II results. Demand for transfer water from East Bay Municipal Utility District (EBMUD) and Contra Costa Water District (CCWD) were assumed to be the same as analyzed in the 2014 Draft EIS/EIR. For the 2014 Draft

EIS/EIR, EBMUD and CCWD performed independent modeling to assess their transfer demand under the current conditions without climate change. EBMUD and CCWD did not perform additional modeling of their respective systems with climate change.

J.5.3 Transfer Supply

Water is made available for transfer by one of four different methods: reservoir release of stored water, water conservation, groundwater substitution, and crop idling. The following sections describe methods used to estimate the available transfer supply for the climate change assessment for each transfer supplier.

J.5.4 Reservoir Release

Several different sellers that proposed to make water available through reservoir release were analyzed in the EIS/EIR. The following sections describe assumptions for the climate change analysis for each seller.

Estimates of stored water available from Merced Irrigation District (MID) were based on end-of-October Lake McClure storage results from CalLite-CV models. It was assumed MID would make water available when simulated end-of-October storage exceeded 300 thousand acre-feet, and may make water available at lower carryover storage levels depending on prior year transfers.

Stored water releases from Browns Valley Irrigation District (BVID), South Sutter Water District (SSWD), and Nevada Irrigation District (NID) were based on simulated inflow into New Bullards Bar Reservoir on the Yuba River from CalLite-CV models. Each of these districts receives water supply from the Yuba River and adjacent watersheds such as Dry Creek (BVID) and the Bear River (NID and SSWD). Yuba River flow was used as a surrogate for the available transfer supply from these three districts.

Available transfer supply from Placer County Water Agency (PCWA) was estimated using monthly inputs of inflows into Folsom Lake from the CalLite-CV models. It was assumed PCWA would make more water available for transfers when there is less water available in the American River Basin, similar to analysis in the EIS/EIR and their agreement under the Water Forum. Simulated inflow to Folsom was assumed to be a surrogate for unimpaired March through November runoff at Folsom.

J.5.5 Conserved Water

Conserved water from BVID is available in all years under current conditions and with climate change.

J.5.6 Groundwater Substitution

Groundwater substitution supply was dependent on available surface water supply to some sellers participating in groundwater substitution transfers. These sellers identified that during years when they experience a reduced surface water supply, it would subsequently limit groundwater substitution transfers.

Water shortage years varied for different sellers. Sacramento River Settlement Contractors have shortages in CVP supplies during Shasta Critical years. In this climate change assessment, Shasta Critical years under the different climate change scenarios were determined based on CalLite-CV model inputs of hydrologic indices. Similar logic was used in the computation of years when Feather River Settlement Contractors' Feather River supplies would be curtailed based on CalLite-CV model hydrologic indices.

Groundwater substitution supplies from Yuba River contractors were based on simulated end-of-September storage in New Bullards Bar reservoir as a surrogate for when Yuba River surface water supplies may be limited.

CalLite-CV model inputs of Folsom Lake inflow were used to determine transfer water supply from Sacramento Suburban Water District under the different climate change scenarios. It was assumed that Sacramento Suburban Water District would only make groundwater substitution transfers in years when they have available surface water supplies. These years are generally when the March through November inflow to Folsom Lake exceeds 1.6 million acre-feet.

J.5.7 Crop Idling Supply

Assumptions for available crop idling transfer supply were based on similar triggers as groundwater substitution transfers to determine the volume of transfer supply. Crop idling sellers include some Sacramento and Feather river settlement contractors whose identified volumes of crop idling transfers based on their contract criteria. Other sellers propose to make the same volume of water available in all years and were analyzed with this assumption for the climate change assessment.

J.6 Results

This section presents results from climate change analysis along with EIS/EIR modeling results adjusted to reflect the 250 thousand acre-feet annual limit on total water transfer demands.

J.6.1 EIS/EIR

Figures J-13 and J-14 show the water transfer demand and supply based on EIS/EIR modeling results. Based on the modeling performed for EIS/EIR, water transfer occurs during 13 years out of 34 years (38 percent) with an annual average transfer demand of 75 thousand acre-feet and an annual average transfer supply of 88 thousand acre-feet. Nearly 80 percent of the transfer demand comes from SLDMWA. Nearly 70 percent of the total water transfer demands are met by groundwater substitution followed by stored water release, which provides nearly 16 percent of the total demand for transfer.

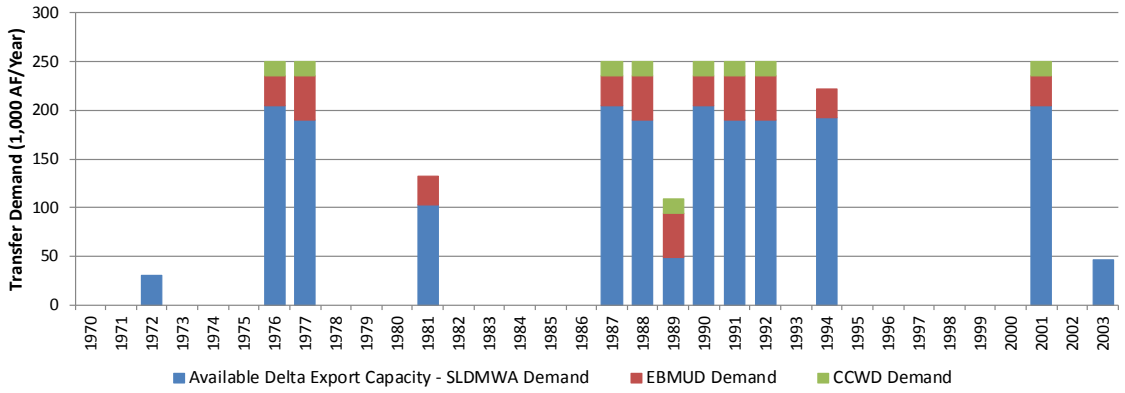


Figure J-13.
Annual Demand for Transfer Water by CVP Buyers (EIS/EIR)

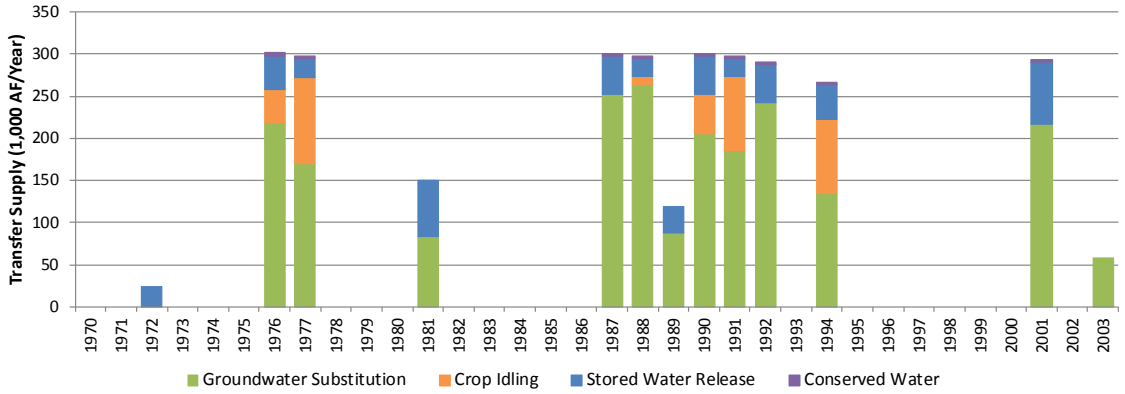


Figure J-14.
Annual Available Water Transfer Supply (EIS/EIR)

J.6.2 Basins Study with No Climate Change Scenario

Figures J-15 and J-16 show the water transfer demand and supply based on CalLite-CV modeling results from the No Climate Change scenario from the Basins Study. Water transfers under the No Climate Change scenario occurs for 15 years out of 34 years (44 percent) with an average transfer demand of 61 thousand acre-feet/year and an average transfer supply of 71 thousand acre-feet/year. Even though this scenario does not include any climate change assumptions and contains assumptions like the EIS/EIR, the results are different between the two scenarios. EIS/EIR results are based on CalSim II whereas this scenario uses CalLite-CV. The No Climate Change scenario results show a slightly greater frequency of water transfers as compared to the EIS/EIR which may be due to differences in CVP/SWP operations between CalLite-CV and CalSim II and other foundational differences in these models.

The climate change results from CalLite-CV models present a high-level summary of climate change effects and the results must be understood in light of the different

assumptions built in the post-processing method. This climate change assessment using CalLite-CV model results is similar to the EIS/EIR, which was based on CalSim II modeling, but not exactly the same. Therefore, results of the climate change analyses based on CalLite-CV, and results in the EIS/EIR based on CalSim II, should not be compared. Results from the CalLite-CV model are not directly comparable with CalSim II results due to differences in the models. CalSim II is a more detailed model than CalLite-CV and includes fewer simplifying assumptions. CalSim II results were more thoroughly reviewed and validated as compared to CalLite-CV modeling which was performed at a higher level to understand more generalized potential effects of climate change on CVP/SWP operations.

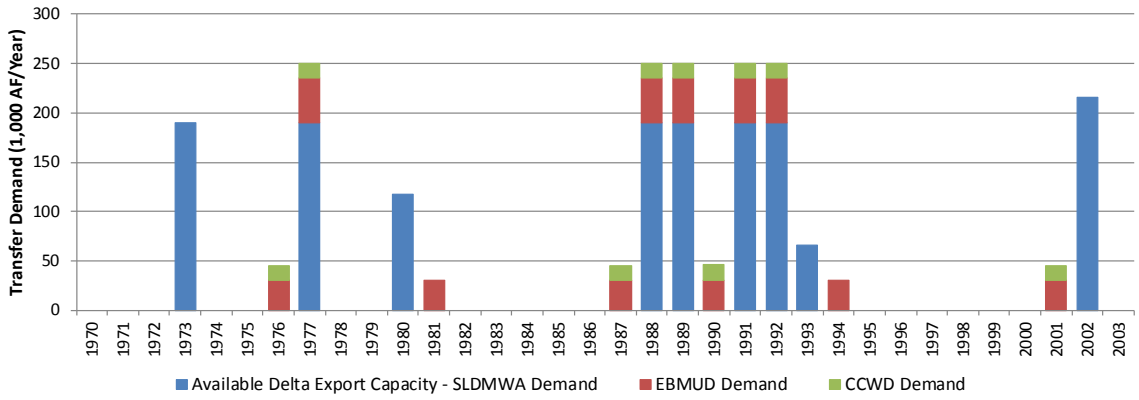


Figure J-15.
Annual Demand for Transfer Water by CVP Buyers (No Climate Change)

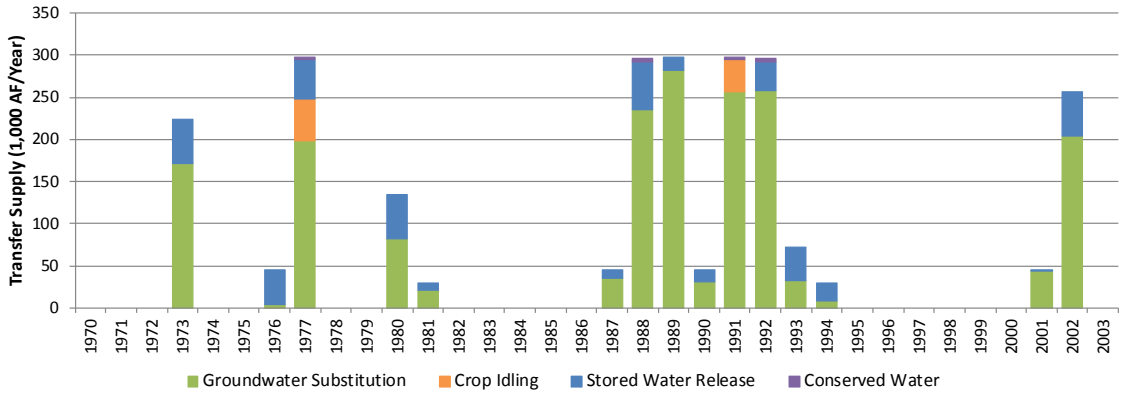


Figure J-16.
Annual Available Water Transfer Supply (No Climate Change)

J.6.3 Hot-Dry Scenario

The Hot-Dry scenario has the lowest total water supply among the scenarios (see Figures J-4 and J-5) and thus the lowest CVP and SWP water supply allocations to water users. Lower allocations to South of Delta water users means higher availability of export capacity in the Delta to transfer water which is demonstrated in Figure J-17. Figure J-17

shows 22 years when water transfers could occur under this climate change scenario with average water transfer demand of 121 thousand acre-feet/year and average water transfer supply of 144 thousand acre-feet/year, the highest among the climate change scenarios.

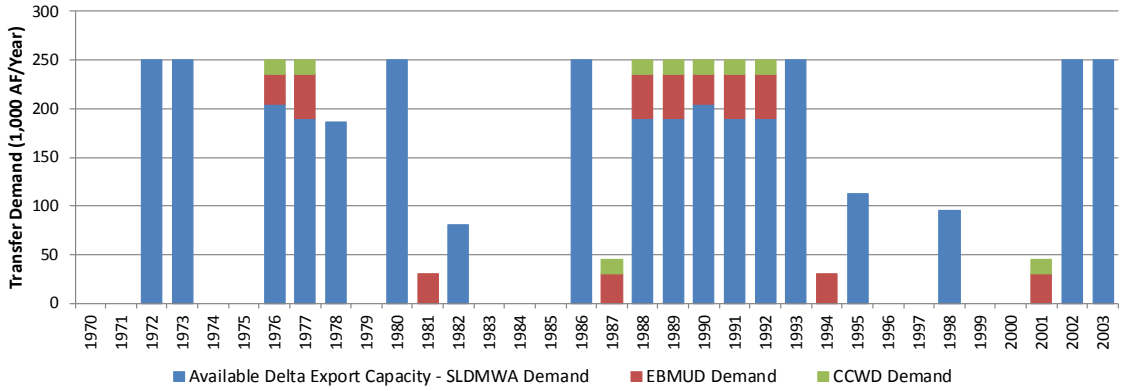


Figure J-17.
Annual Demand for Transfer Water by CVP Buyers (Hot-Dry)

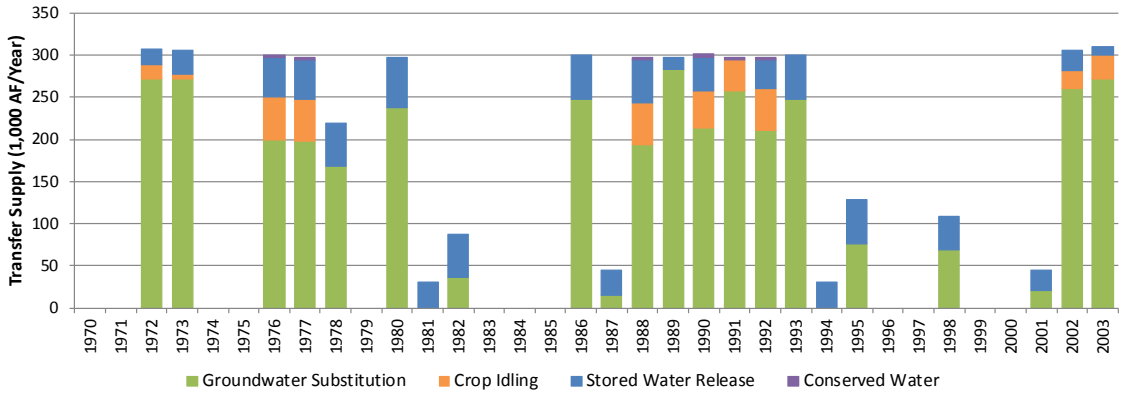


Figure J-18.
Annual Available Water Transfer Supply (Hot-Dry)

J.6.4 Warm-Wet Scenario

The Warm-Wet scenario is the wettest scenario evaluated with the largest water supply, CVP/SWP allocations, and highest Delta exports of CVP/SWP supplies. Figure J-19 and J-20 show how the transfer demand and supply are lowest in this scenario, primarily driven by unavailability of export capacity in the Delta. Figure J-19 shows 12 years when transfers could occur under this climate change scenario with average water transfer demand of 24 thousand acre-feet/year and average water transfer supply at 26 thousand acre-feet/year, the lowest among the scenarios.

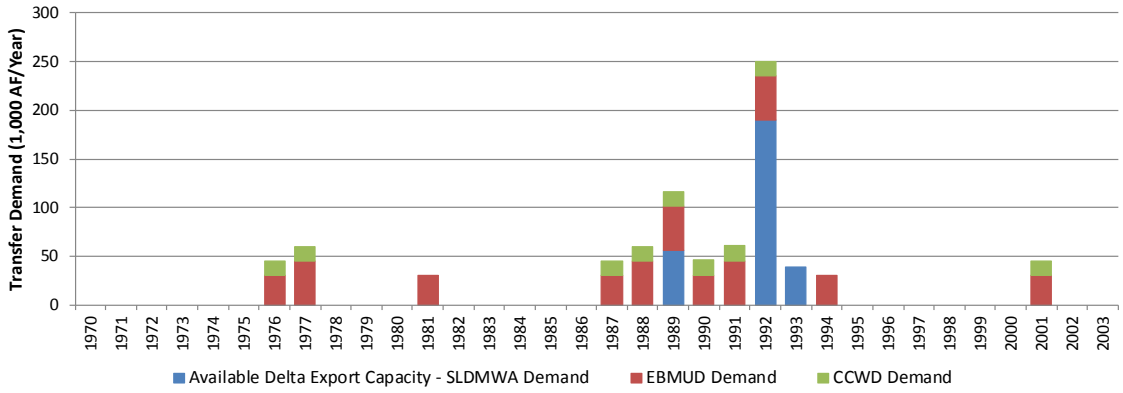


Figure J-19.
Annual Demand for Transfer Water by CVP Buyers (Warm-Wet)

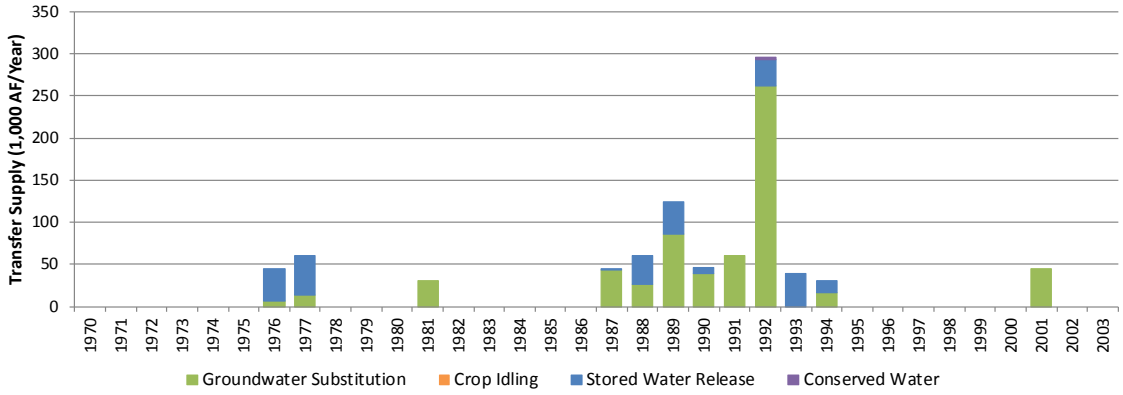


Figure J-20.
Annual Available Water Transfer Supply (Warm-Wet)

J.6.5 Central Tendency Scenario

Figures J-21 and J-22 present water transfer demand and supply under the Central Tendency climate change scenario. Results indicate the average annual demand and supply are nearly identical to EIS/EIR results, but the frequency of transfers are greater compared to the EIS/EIR.

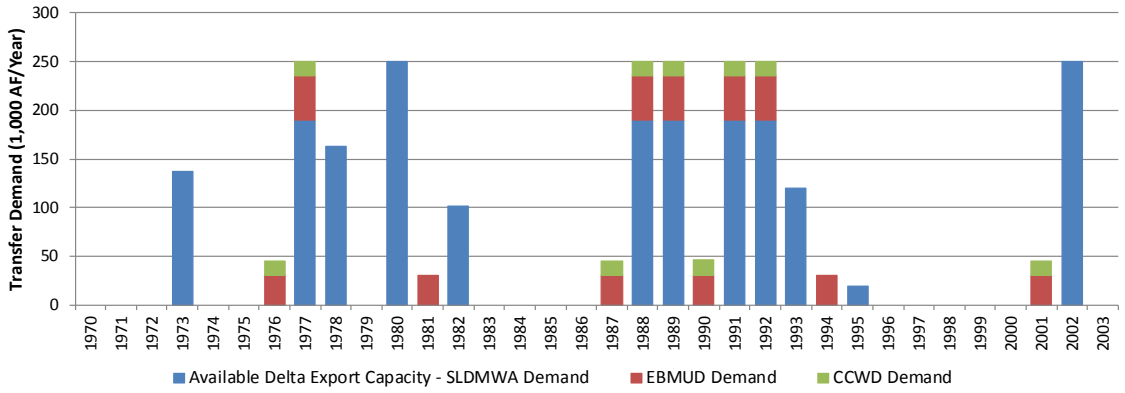


Figure J-21.
Annual Demand for Transfer Water by CVP Buyers (Central Tendency)

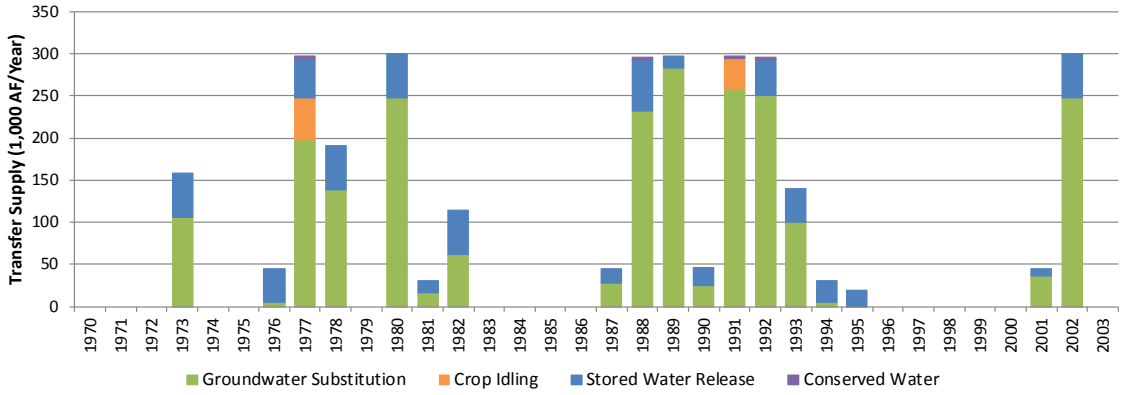


Figure J-22.
Annual Available Water Transfer Supply (Central Tendency)

Table J-5 provides a summary of the annual average transfer demand, supply, and the number of years when transfers may occur within the 34-year period of analysis. Results summarized in Table J-5 show climate change may create considerable variability in the annual average volume of transfers that may occur. The Hot-Dry climate changed condition results in the highest demand and frequency for transfers, while the Warm-Wet condition has the lowest demand and frequency.

Table J-5.
Summary of Transfer Demand, Supply, and Frequency for Assumptions on Maximum Annual Demand and Climate Change

	Annual Average Demand(1,000 acre-feet)	Annual Average Transfer Supply (1,000 acre-feet)	Years with Potential Transfers
EIS/EIR[1]	75	88	13
No Climate Change	61	71	15
Hot-Dry	121	144	22
Warm-Wet	24	26	12
Central Tendency	75	87	18

[1] Water transfer demands limited to 250 thousand acre-feet/year and thus different from results presented in EIR/EIS

Climate change assessment results show there are adequate transfer supplies available from the four different methods analyzed for making water available for transfer (groundwater substitution, crop idling, stored water release, and conserved water). Annual average transfer supply exceeds demand in all scenarios to account for the additional water needed to convey transfers across the Delta, for those transfers exported from the Delta.

J.6.6 Results Interpretation

The following points should be considered in the interpretation of the reported results of climate change effects on water transfers.

- Modeling completed for the Basins Study included predicted climate change over the course of the next century, including increased effects of climate change through time, i.e. the effects of climate change are more pronounced at the end of the century than at the beginning.

- Modeling performed for the Basins Study estimated the effects of climate change by perturbing the historical hydrology. Historical hydrology covered the period from water year (WY) 1926 through 2010 with 1926 historical hydrology representing the first year of simulation, 2015.

- Analysis conducted for the EIS/EIR was based on the historical hydrology for the period of WY 1970 through 2003. This period was selected because it represented the period of overlapping simulation for the SACFEM2013 and CalSim II models and covered a period of the historical hydrology that included the range of hydrology that might be expected over the period of the project.

- For this analysis, a consistent 34-year period of the historical hydrology (WY 1970 through 2003) was selected to be consistent with the EIS/EIR, and climate changed hydrology for the same historical period. This results in an analysis of mid to late-century climate change effects being imposed on the historical, WY 1970 through 2003 period as this period translates to WY 2059 through 2092 in modeling performed for the Basins Study. Therefore, the effects of climate change illustrated in these results is more than what the Basins Study would

indicate should be expected over the next decade. In this way the effects of climate change on transfers is likely overstated.

- Annual average demand for transfer water was estimated based on post-processing of Basins Study CalLite-CV results to estimate available Delta export capacity as a surrogate for SLDMWA demand for transfer water.

- Demand for transfer water from EBMUD and CCWD with climate change were assumed to be the same as analyzed in the EIS/EIR. These demands for transfer water were based on independent modeling conducted by EBMUD and CCWD.

- The estimates of available export capacity from CalLite-CV modeling results are coarse as compared to CalSim II and thus require interpretation of results. The available export capacity and the transfer demands vary under the climate change scenarios depending on CVP and SWP allocations and several other discretionary operating criteria used to operate the CVP and the SWP. Allocations and discretionary operating criteria in Basins Study CalLite-CV models also are coarse.

- Basins Study models are not exact predictions of how Reclamation and DWR may operate the CVP/SWP in the future, particularly a future where the effects of climate change may result in significant differences in the available water supply. Basins Study models have not been refined to include operational and regulatory adaptation that may occur because of changes in demands, water supply, and the timing of runoff within different basins.

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