# APPENDIX G

# POTENTIAL RESERVOIR SITES

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## APPENDIX G

### Potential Reservoir Sites

These potential reservoir sites for the NODOS Investigation were developed and reviewed during study team meetings, field inspections, and outreach for the NODOS Investigation for their ability to address the initial planning objectives. This Appendix generally describes the reservoir sites, and presents summary information related to their potential to create new water supplies, improve anadromous fish survival, hydropower generation and recreation effects, estimated costs, and environmental considerations. Rationale is provided for either retaining or eliminating potential reservoir sites from further development in the NODOS Investigation. Surface storage options that appear to contribute the least to the planning objectives will be dropped from further consideration in this appendix.

The four north-of-the-Delta offstream projects provide a range of potential water supply reliability benefits, but would serve similar project purposes. Since all of the projects are upstream of the Delta and adjacent to the Sacramento River, the kinds of benefits, such as supplemental yield for various uses and reduced diversions from the Sacramento River during the peak local delivery period will vary primarily in scale. Comparative project characteristics are shown on Table G-1. All of these projects have been investigated in the past. Current studies have updated and augmented these past studies as needed to allow comparative evaluation of alternatives.

**Table G-1**

**Comparative Project Statistics for the Sites, Colusa, Thomes-Newville, and Red Bank Projects**

| Project Feature | Sites | Colusa | Small Thomes-Newville | Large Thomes-Newville | Red Bank | |
|---|---|---|---|---|---|---|
| | | | | | Dippingvat | Schoenfield |
| Storage (acre-feet) | | | | | | |
| Gross | 1,800,000 | 3,000,000 | 1,900,000 | 3,000,000 | 104,000 | 250,000 |
| Dead | 40,000 | 100,000 | 50,000 | 50,000 | | |
| Drainage Area (square miles) | 85 | 115 | 63 | 63 | 132 | 39 |
| Reservoir Surface Area (acres) | 14,000 | 28,000 | 14,500 | 17,000 | 1,270 | 2,770 |
| Dam Height/Volume (feet/1,000yd$^3$) | | | | | | |
| Sites | 290/3,800 | 290/3,800 | | | | |
| Golden Gate | 310/10,600 | 310/10,600 | | | | |
| Prohibition | | 230/11,300 | | | | |
| Owens | | 260/11,700 | | | | |
| Hunters | | 260/24,700 | | | | |
| Logan | | 270/30,600 | | | | |
| Newville | | | 325/16,000 | 400/33,000 | | |
| Burrows Gap (largest saddle) | | | 75/600 | 150/2,000 | | |
| Schoenfield (RCC) | | | | | | 300/467 |
| Dippingvat (RCC) | | | | | 250/367 | |

**Table G-1**
**(Continued)**

| Project Feature | Sites | Colusa | Small Thomes-Newville | Large Thomes-Newville | Red Bank | |
|---|---|---|---|---|---|---|
| | | | | | Dippingvat | Schoenfield |
| Lanyan (RCC) | | | | | 75/19 | |
| Bluedoor (RCC) | | | | | 115/55 | |
| Saddle Dams (Number/Height) | 9/130 | 7/140 | None | 4/75 | | 4/85 |
| Reservoir Elevation (feet) | | | | | | |
| Normal | 520 | 520 | 905 | 980 | 1,205 | 1,017 |
| Minimum | 320 | 320 | 685 | 685 | 1,103 | 830 |
| Average Annual Natural Reservoir Inflow (acre-feet) | 15,000 | 20,000 | 20,000 | 20,000 | 96,400 | 16,000 |
| Reservoir Evaporation | | | | | | |
| Average Annual | 40,000 | 80,000 | 50,000 | 60,000 | | |
| Critical Period Total | 220,000 | 440,000 | 300,000 | 360,000 | | |
| Pumping | | | | | | |
| Static Lift from T-C Canal (feet) | 320 | 320 | 655 | 730 | | |
| Maximum | 120 | 120 | 435 | 435 | | |
| Minimum | 5 – 8 | 5 – 8 | 2 | 2 – 5 | | |
| Capacity (1,000 cfs) | | | | | | |

For Golden Gate Dam, statistics shown are for the downstream curved embankment alternative.

## G.1 PHYSICAL ENVIRONMENT

All four of the proposed reservoir projects are located within the Coast Range foothills along the western edge of the northern Sacramento Valley. The United States Geological Survey watersheds and subbasins containing the proposed offstream reservoirs are delineated in Figure G-1. The acreage of the watersheds or subbasins associated with the reservoirs is shown in parentheses below. The drainage area of the watersheds upstream of the dams is shown in Table G-1.

### *Sites*

The proposed Sites Reservoir is in north-central Colusa County and south-central Glenn County, approximately 10 miles due west of the community of Maxwell. The proposed reservoir inundation area includes most of Antelope Valley and the small community of Sites. As shown in Figure G-1, the reservoir is in the Funks Creek and Stone Corral Creek watersheds (59,700 acres), with the associated USGS subbasins. A mean full pool elevation of 520 feet would inundate 14,000 acres and could store a maximum of 1.8 MAF.

### *Colusa Cell*

The proposed Colusa Project would also be located in north-central Colusa County and south-central Glenn County, approximately 12 miles southwest of the community of Willows and 10 miles west of

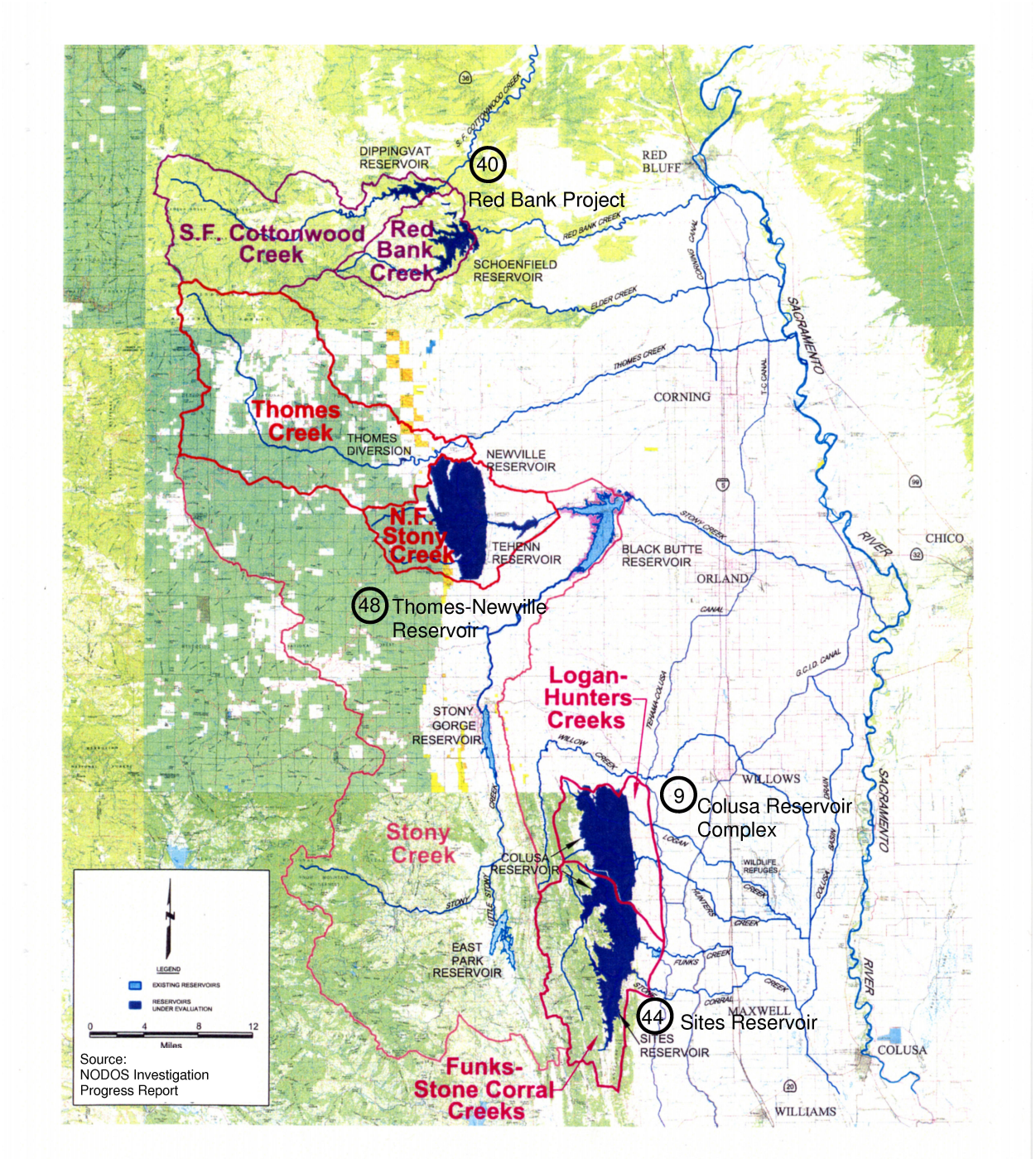


**FIGURE G-1. Delineation of Watersheds for each Reservoir Location**

Maxwell. The Colusa Cell would be due north of the proposed Sites Reservoir and could be constructed with Sites Reservoir facilities to form a single 28,000-acre reservoir (Colusa Reservoir). The inundation area of the Colusa Cell is within Logan Creek and Hunter Creek watersheds (35,000 acres), which are shown in Figure G-1, with the associated USGS subbasins. A mean full pool elevation of 520 feet would inundate about 14,000 acres within the Colusa Cell and could store an additional 1.2 MAF. The maximum storage of the Colusa Project would be 3.0 MAF.

***Thomes-Newville***

The Thomes-Newville Project would be situated within north-central Glenn County and south-central Tehama County. Newville Reservoir would be approximately 18 miles west of the City of Orland and 23 miles west-southwest of the City of Corning. As shown in Figure G-1, this proposed reservoir project would be within portions of the North Fork Stony Creek watershed (51,200 acres) and Thomes Creek watershed (123,500 acres), as well as the associated USGS subbasins. A small diversion along Thomes Creek would transfer water to Newville Reservoir in the North Fork Stony Creek watershed. Alternative reservoir sizes of 1.9 and 3.0 MAF are being evaluated, with associated normal water surface elevations of 905 and 980 feet and corresponding reservoir surface areas of 14,500 and 17,000 acres.

***Red Bank***

The proposed Red Bank Project is in northwest Tehama County, approximately 17 miles west of the City of Red Bluff. This project would include a diversion on South Fork Cottonwood Creek at Dippingvat Reservoir, two small reservoirs in the headwaters of North Fork Red Bank Creek (Blue Door and Lanyan Reservoirs), and a larger storage reservoir on Red Bank Creek (Schoenfield Reservoir). The South Fork Cottonwood Creek watershed is relatively large (81,900 acres), while the Red Bank Creek watershed is relatively small (27,300 acres). The reservoirs, watersheds, and subbasins are shown in Figure G-1. Dippingvat Reservoir would have a normal pool elevation of 1,205 feet and an inundation area of 1,800 acres. Schoenfield Reservoir, with a normal pool elevation of 1,017 feet, would inundate 2,770 acres and have a storage capacity of 0.25 MAF.

### G.1.1 Topography

The physical topography of the watersheds draining the east side of the Coast Range toward the Sacramento Valley is diverse. The topography ranges from steep, rugged, mountainous terrain within the upper watersheds to rolling foothills in the project areas to relatively flat alluvial terrain as the watersheds enter the Sacramento Valley. Elevations range from less than 40 feet on the valley floor to over 8,000 feet along the Coast Range divide.

***Sites***

The Sites Project area is situated between the Sacramento Valley to the east and the mountainous portion of the Coast Range on the west. A relatively narrow band of steep rolling foothills, approximately 2 to 3 miles wide, separates the proposed reservoir area from the Sacramento Valley. Antelope Valley, the primary inundation area of the proposed Sites Reservoir, lies between this narrow band of foothills and the more mountainous Coast Range. This relatively narrow north-south tending valley is approximately 13 miles long and up to 2 miles wide. Elevation of the Antelope Valley floor ranges from 320 to 400 feet above mean sea level, while the foothills separating the valley from the Sacramento Valley reach a maximum elevation of 1,300 feet. Elevations along the west side of Antelope Valley increase rapidly with several peaks within 2 miles of the valley margin above 2,000 feet.

***Colusa Cell***

The Colusa Cell area is also between the Sacramento Valley to the east and the mountainous portion of the Coast Range on the west. In addition to the inundation area of Sites Reservoir, the proposed Colusa Reservoir would also inundate the valleys associated with both Hunter and Logan Creeks upstream of Logan Ridge. Topographic relief within the inundation area of the Colusa Cell is more varied than within Sites Reservoir and numerous islands would be created from hills greater than 520 feet elevation. The Colusa Cell inundation area would be approximately 10 miles long and 3 miles wide, with a maximum depth of 260 feet. The foothills separating the Colusa Cell from the Sacramento Valley are substantially lower in elevation than those found near Sites, with only a single peak in excess of 1,000 feet elevation. Development of this project would require construction of numerous saddle dams, as a number of areas along the eastern edge of the project are less than the normal pool elevation of 520 feet.

***Thomes-Newville***

Newville Reservoir would be located in a large circular valley surrounding the North Fork Stony Creek. Topographical relief within the inundation area of Newville Reservoir is that of gently rolling terrain ranging in elevation from 630 feet to 975 feet elevation. A single steep ridge (Rocky Ridge) separates the Newville Reservoir site from low, rolling foothill areas to the east. Rocky Ridge runs north and south with several peaks above 1,300 feet elevation. Steep, rugged mountains form the western boundary of the reservoir area, with elevations up to 3,000 feet within 2 miles of the reservoir inundation area. The currently preferred diversion on Thomes Creek would be made at a low dam in a steep, narrow, confined reach below Thomes Creek Canyon at approximately 1,035 feet above mean sea level.

***Red Bank***

The Red Bank Project area is highly dissected, rugged, mountainous terrain. The primary drainages (and associated valleys) run from west to east. Linear alluvial terraces are associated with the major drainages and stream gradients are much greater than those found in the other three proposed reservoirs. Topographical relief within the inundation area of the Red Bank Project varies from small areas of relatively flat alluvial terraces to gently rolling terrain to very steep hill slopes ranging in elevation from 780 to 1,200 feet.

### G.1.2 Climate and Water Resources

The climate of the watersheds draining into the western Sacramento Valley is typical Mediterranean (detailed descriptions are provided in Appendix B). Winters are rainy and relatively mild with only occasional freezing temperatures at the lower elevations; summers are comparatively dry and hot. The rainy season normally begins in September and continues through March or April. Rains may continue for several days at a time, but are usually gentle. Summer rains are rare, as are thunderstorms and hailstorms. Thunderstorms occur about ten days per year in the Sacramento Valley, occasionally producing high intensity rainfall of short duration. Most precipitation is associated with migrant storms that move across the area during winter. Snow is the dominant form of precipitation above 5,000-foot elevation and persists on north- and east-facing slopes into the early summer.

Streams draining the proposed Sites Reservoir, Colusa Cell, and Newville Reservoir are ephemeral with little or no flow from July through October. However, these streams tend to respond rapidly to significant rainfall events. Flash flooding with substantial overland flow has been observed. Flow recorded at the stream gage on Stone Corral Creek near Sites is representative of the flow variability in these small ephemeral streams. Annual discharge volume varied from zero in 1972, 1976, and 1977 to 39,930 AF in 1963 and averages 6,500 AF. Monthly flow volumes in excess of 15,000 AF have been documented.

The immediate area of the alternative projects has very few groundwater resources. The area is underlain by the Great Valley Sequence rocks and locally by Quaternary terrace deposits. Groundwater is found in fractures in the Great Valley Sequence and in the sands and gravels in the terrace deposits. Springs occur where the terrace deposits terminate or where water-bearing fractures encounter the surface. A number of springs also occur in the Great Valley Sequence rocks where faults create subsurface dams that cause groundwater to reach the surface. Not all fractures or faults contain groundwater. Nor do all terrace deposits have groundwater.

### G.1.3 Geology and Soils

The rocks underlying the proposed project sites are part of the Great Valley geomorphic province, which is mostly sandstone, mudstone, and conglomerate. The Great Valley geomorphic province is bounded to the west by the Coast Ranges province, to the north by the Klamath Mountains province, to the northeast by the Cascade Range province, and to the east by the Sierra Nevada province (Appendix C provides a detailed description of geology and soils).

### G.1.4 Air Quality

Air Pollution Control Districts has been established for Colusa, Glenn and Tehama Counties. Each county monitors similar contaminants, including ozone and particulate matter. Detailed site-specific air quality information is not available. Colusa County is a non-attainment area for both particulates (PM10) and ozone under both State and federal criteria. Tehama County is considered a moderate non-attainment area for both ozone and particulates (PM10) under the California Clean Air Act. However, levels of both contaminates are within federal criteria. Glenn County air quality meets both State and federal air quality standards for ozone and PM10.

## G.2 BIOLOGICAL RESOURCES

The following subsections summarize biological resources, such as vegetation, fish, and wildlife, found in the proposed project areas.

### G.2.1 Vegetation

The watersheds of Sacramento Valley west-side streams contain a variety of vegetative communities (botanical surveys are summarized in Appendix D). These include white fir, Klamath mixed conifer, Douglas fir, ponderosa pine, closed-cone pine-cypress, montane hardwood conifer, montane hardwood, blue oak woodland, valley oak woodland, blue oak foothill pine, montane riparian, valley foothill riparian, montane chaparral, mixed chaparral, chamise-redshank chaparral, annual grassland, and cropland.

Vegetation within the four proposed project locations is varied due to the influence of local soils, geology, microclimate, hydrology, aspect, and elevation, as well as other physical and biological factors. All four project sites contain at least some annual grassland habitat. This upland plant community of herbaceous annual grasses and herbs is characteristically composed of many non-native species and a limited number of native species. Species composition is highly variable among stands and throughout the growing season. Vernal pools and swales within the annual grassland community support unique assemblages of native wetland plant species.

Chaparral communities occur at or near each of the proposed project locations in varying amounts. These stands frequently occur in a continuous canopy with little or no understory. Other shrub and tree species, including poison oak and manzanita, form a mosaic in some chaparral stands.

Riparian vegetation is associated with both intermittent and permanent streams. Common riparian overstory species include Fremont's cottonwood, willow, and Mexican elderberry.

Two types of oak woodland were identified within the four proposed project locations: valley oak woodland and blue oak woodland. Valley oak woodlands are found along the major tributaries and valley bottoms in the reservoir sites. This vegetative community may include other native tree and shrub species. Blue oak woodland occurs at or near each of the proposed project. Blue oak is the dominant or sole canopy species in these woodlands. An annual grassland understory is common and a shrub layer comprised of manzanita and wedgeleaf ceanothus can occur. Blue oak woodlands primarily occur on moderately rocky to well-drained slopes. Limited amounts of wetlands occur within the proposed project areas.

Foothill pine woodland is the most common vegetative community (61 percent) within the Red Bank Project area. This woodland is dominated by foothill pine and frequently contains a well-developed blue oak understory. The foothill pine community is most common on well-drained uplands.

Annual grasslands (89 percent of the surface area) dominate the proposed Sites Reservoir. Blue oak woodland occurs around the fringe of the reservoir area. Approximately 923 acres (7 percent of the surface area) of blue oak woodland are present within the project area. Relatively small amounts of chaparral, riparian, wetlands, cultivated grain, and non-vegetated areas comprise the remaining 4 percent of the inundation area. As elevation increases above the western edge of the reservoir boundary, the foothill pine community becomes dominant with large chamise chaparral stands present on shallow soils and southern exposures.

Ninety-nine percent of the Colusa Cell area is dominated by an annual grasslands community. The remaining one percent of the land area is divided between blue oak woodland, riparian, emergent wetlands, and non-vegetated areas. No chaparral, blue oak/gray pine woodland, or cultivated grain is present within the project area. As elevation increases above the western edge of the reservoir boundary, the blue oak savanna community becomes dominant.

The Newville Reservoir area is dominated (85 percent) by annual grasslands. Oak woodland comprises an additional 11 percent of the inundation area. A limited amount of chaparral, emergent wetland, and riparian habitat were also mapped within Newville Reservoir. No foothill pine or cultivated grain was mapped within the reservoir footprint.

Foothill pine woodland comprises 61 percent of the Red Bank Project area. Oak woodland habitat was identified and mapped in about 20 percent of the area. Annual grasslands are present on about 12 percent. Limited amounts of chaparral, riparian, and wetlands are also present.

### G.2.2 Fish and Wildlife Resources

Following is aquatic and fishery, and wildlife resources found in the project areas.

#### *Aquatic and Fishery Resources*

The watersheds of the North Coast Range draining east toward the Sacramento Valley contain native and non-native species, warm-water and coldwater species, and anadromous and resident fish species. At least 24 species of fish are present in these watersheds. Several State or federally listed fish species occur in the region including steelhead, and various runs of Chinook salmon. Coldwater habitats are present in the upper watersheds of the major streams including Cottonwood Creek, Red Bank Creek, and Thomes Creek. Appendix E provides a summary of relevant biological survey results.

Fishery evaluations performed at Antelope, Stone Corral, and Funks Creeks within the footprint of Sites Reservoir indicated the presence of several native and non-native species. All of these streams are ephemeral within the reservoir area and do not provide cold-water habitat. Most are degraded with extensive downcutting and little riparian vegetation. However, a single adult spring-run Chinook salmon was observed in Antelope Creek within the inundation area. Habitat surveys indicate that the stream reaches above the reservoir do not provide suitable rearing habitat for anadromous species.

Fishery evaluations were performed on three ephemeral streams within the Colusa Cell footprint (Logan, Hunters, and Minton Creeks). Survey results indicate the presence of only one native species and several introduced warm water species. All of these streams are ephemeral upstream from the proposed dam sites and do not provide cold-water habitat. No State or federally listed fish species were identified within the reservoir area. Habitat surveys indicate that the stream reaches above the reservoir do not provide suitable rearing habitat for anadromous species.

Surveys from the 1980s of the ephemeral streams within the Newville Reservoir footprint resulted in capturing California roach, Sacramento pike minnow, Sacramento sucker, and green sunfish. Rainbow trout were present in the perennial headwater areas of Salt and Heifer Camp Creeks above the proposed reservoir inundation area. The lower Thomes Creek watershed contained a diverse fish assemblage that included runs of fall-run, late fall-run, and spring-run Chinook salmon and steelhead.

DFG conducted studies in lower Cottonwood Creek (below the north fork confluence) and in South Fork Cottonwood Creek in 1976. They found ten resident game species and 13 nongame species of fishes. The 1976 DFG survey also found runs of fall-run, late fall-run, and spring-run Chinook salmon in lower Cottonwood Creek and spring-run Chinook salmon and steelhead in South Fork Cottonwood Creek. A more recent survey on South Fork Cottonwood Creek and Red Bank Creek within the Red Bank Project area located four species of resident game fishes and four species of non-resident game fishes. Steelhead were identified within the Red Bank Creek watershed.

***Wildlife***

A wide variety of wildlife species utilize areas in and around the four proposed reservoir areas either seasonally or year-round. Surveys are ongoing of the proposed reservoir sites for the presence of State and federally listed species. However, substantially less information has been collected on non-listed species density and distribution.

Some general statements about relative wildlife species' diversities can be made based on the variety of habitat types and successional stages present within each of the proposed reservoir locations. The Colusa Cell is strongly dominated by annual grasslands with little habitat or structural diversity. This monotypic habitat would not support the same diversity of wildlife species that would be expected at the other proposed reservoir locations where a greater diversity of habitats is present. Sites Reservoir contains a greater diversity of habitat types than found within the Colusa Cell. Thomes-Newville and Red Bank Project areas support a greater diversity of habitat type than the Sites and Colusa Cell areas. This increased habitat diversity should provide habitat for a number of wildlife species not found within the Colusa Cell. Although the Red Bank Project area is the smallest of the four proposed reservoir locations, it contains the greatest diversity of habitats and several stages of habitats and should support the highest diversity of vertebrate wildlife.

State or federally listed wildlife species have been studied and documented at or near each proposed reservoir location. Wintering bald eagles (State endangered, federal threatened) occur in low numbers at each proposed reservoir. Both wintering sandhill cranes (State threatened) and a migrating bank swallow

(State threatened) have been detected at or near the proposed Colusa Cell. Extensive surveys of the proposed Sites and Colusa Cell project areas have failed to detect any California tiger salamanders, red-legged frogs, or giant garter snakes. Protocol for the field surveys requires that the study include areas around the proposed reservoirs where proposed facilities, roads, and utilities will be relocated. Surveys are not yet complete. One red-legged frog (federal threatened) has been reported within the Red Bank Project area. Numerous federal species of concern, California Species of Special Concern, federal Migratory Nongame Birds of Management Concern, or candidate species occur within each of the proposed reservoirs.

Several DFG harvest species occur within the proposed reservoirs. Upland game includes black-tailed deer, black bear, feral pig, gray squirrel, wild turkey, California and mountain quail, and mourning dove. Waterfowl use is limited within each of the proposed reservoirs and generally restricted to winter use of stock ponds and small lakes. Limited wood duck and mallard nesting also occurs within stock ponds and along the stream channels where adequate brooding water exists. Relatively high deer use of portions of the Thomes-Newville and Red Bank project areas during winter has been reported. Substantially less deer use has been observed within the Sites Reservoir area and no use has been noted within the Colusa Cell area. Observations indicate that feral pigs occur in low to moderate numbers within each of the proposed reservoirs, with the greatest use within the Red Bank Project area. Wild turkeys are relatively common in portions of the Red Bank Project area and Newville Reservoir area.

According to the Natural Diversity Database, several federally listed invertebrate species may occur within the four proposed reservoir sites. These species include valley elderberry longhorn beetle, vernal pool fairy shrimp, Conservancy fairy shrimp, and vernal pool tadpole shrimp (see Appendix E).

***Summary of Evaluated Animal and Plant Species***

Table G-2 summarizes the animal and plant species evaluated and the probability of species occurrence with the reservoir project areas.

**Table G-2**

**Probability of Occurrence and Listing Status of Animal and Plant Species Evaluated**

| Species | Status[1] | | | Occurrence Probability within Reservoir Sites[2] | | | | |
|---|---|---|---|---|---|---|---|---|
| *Scientific Name* (Common Name) | Federal | State | Other | Sites | Funks | Colusa | Thomes-Newville | Red Bank |
| **Invertebrates** | | | | | | | | |
| *Desmocerus californicus dimorphus* (valley elderberry longhorn beetle) | FT | None | None | X | X | X | X | X |
| *Lepidurus packardi* (vernal pool tadpole shrimp) | FE | None | None | * | * | * | * | - |
| *Branchinecta lynchi* (vernal pool fairy shrimp) | FT | None | None | * | * | * | * | - |
| *Branchinecta conservatio* (Conservancy fairy shrimp) | FE | None | None | * | * | * | * | - |
| *Anthicus antiochensis* (Antioch Dunes anthicid beetle) | FSC | None | None | - | - | - | - | - |

**Table G-2**
**(Continued)**

| Species | Status[1] | | | Occurrence Probability within Reservoir Sites[2] | | | | |
|---|---|---|---|---|---|---|---|---|
| *Scientific Name* (Common Name) | Federal | State | Other | Sites | Funks | Colusa | Thomes-Newville | Red Bank |
| *Anthicus sacramento* (Sacramento anthicid beetle) | FSC | None | None | - | - | - | - | - |
| *Dubiraphia brunnescens-* (brownish dubiraphian riffle beetle) | FSC | None | None | - | - | - | - | - |
| *Ochthebius reticulatus* (Wilbur Springs minute moss beetle) | FSC | None | None | - | - | - | - | - |
| *Paracoenia calida* (Wilbur Springs shore fly) | FSC | None | None | - | - | - | - | - |
| *Hydroporus leechi* (Leech's skyline diving beetle) | FSC | None | None | - | - | - | - | - |
| **Amphibian** | | | | | | | | |
| *Ambystoma californiense* (California tiger salamander) | FC | DFG | None | - | - | - | - | - |
| *Rana aurora ssp. draytonii* (California red-legged frog) | FT | CSC, DFG | None | - | - | - | - | X |
| *Rana boylii* (Foothill yellow-legged frog) | FSC | CSC, DFG | None | - | - | - | * | X |
| *Scaphiopus hammondii* (western spadefoot toad) | None | DFG | None | * | - | * | X | * |
| **Fish** | | | | | | | | |
| *Lampetra tridentata* (Pacific lamprey) | FSC | None | None | * | * | * | X | X |
| *Mylopharodon conocephalus* (Hardhead) | FS | CSC | None | X | X | X | X | X |
| *Oncorhynchus mykiss* (Steelhead) | FT | None | None | - | - | - | X | X |
| *Oncorhynchus tshawytscha-* (Late fall-run Chinook salmon) | FPT | CSC | None | - | - | - | - | - |
| *Oncorhynchus tshawytscha* (Spring-run Chinook salmon) | FPE, FS | ST | None | X | - | - | X | X |
| *Pogonichthys macrolepidotus* (Splitail) | FE | SE | None | - | * | - | - | - |
| **Reptile** | | | | | | | | |
| *Clemmys marmorata ssp. marmorata* (Northwestern pond turtle) | FSC | CSC, DFG | None | X | X | X | X | X |
| *Phrynosoma coronatum ssp. frontale* (California horned lizard) | FSC | CSC, DFG | None | * | - | * | * | - |
| *Thamnophis gigas* (Giant garter snake) | FT | ST, DFG | None | - | * | - | - | - |
| **Birds** | | | | | | | | |
| *Accipiter cooperii* (Cooper's hawk) | None | CSC | None | X | X | X | X | X |
| *Accipiter gentilis* (Northern goshawk) | None | CSC | SC | - | - | - | - | - |
| *Accipiter striatus* (Sharp-shinned hawk) | None | CSC | None | X | X | X | * | X |

**Table G-2**
**(Continued)**

| Species | Status[1] | | | Occurrence Probability within Reservoir Sites[2] | | | | |
|---|---|---|---|---|---|---|---|---|
| *Scientific Name* (Common Name) | Federal | State | Other | Sites | Funks | Colusa | Thomes-Newville | Red Bank |
| *Agelaius tricolor* (Tri-colored blackbird) | None | CSC | SC | X | * | X | X | - |
| *Ammodramus savannarum* (Grasshopper sparrow) | None | CSC | CS | * | X | X | * | * |
| *Amphispiza belli ssp. belli* (Bell's sage sparrow) | None | CSC | SC | - | - | - | * | - |
| *Aquila chrysaetos* (Golden eagle) | PR | CSC, CFP | None | X | X | X | X | X |
| *Asio flammeus* (Short-eared owl) | None | CSC | None | * | * | X | * | * |
| *Asio otus* (Long -eared owl) | None | CSC | None | X | * | X | X | X |
| *Athene cunicularia* (Burrowing owl) | FSC | CSC | None | X | X | X | X | * |
| *Botaurus lentiginosus* (American bittern) | MNBMC | None | None | * | X | * | * | * |
| *Branta canadensis ssp. leucopareia* (Aleutian Canada goose) | FT | None | None | - | * | - | - | - |
| *Bucephala islandica* (Barrow's goldeneye) | None | CSC | None | - | * | - | - | * |
| *Buteo regalis* (Ferruginous hawk) | None | CSC | SC | X | X | * | * | - |
| *Buteo swainsoni* (Swainson's hawk) | None | ST | None | * | * | * | * | - |
| *Carduelis lawrencei* (Lawrence's goldfinch) | MNBMC | None | None | * | X | X | * | X |
| *Chaetura vauxi* (Vaux's swift) | MNBMC | CSC | None | * | * | * | * | * |
| *Charadrius semipalmatus* (Western snowy plover) | FT | CSC | None | - | - | - | - | - |
| *Charadrius montanus* (Mountain plover) | PLT | CSC | None | * | - | * | * | - |
| *Chondestes grammacus* (Lark sparrow) | MNBMC | None | None | X | X | X | X | X |
| *Circus cyaneus* (Northern harrier) | None | CSC | None | X | X | X | X | X |
| *Coccyzus americanus ssp. occidentalis* (Western yellow-billed cuckoo) | None | SE | None | - | - | - | - | - |
| *Dendroica occidentalis* (Hermit warbler) | MNBMC | None | None | * | * | * | * | * |
| *Dendroica petechia* (Yellow-warbler) | None | CSC | None | X | - | - | - | - |
| *Elanus caeruleus* (White-tailed kite) | None | None | None | X | X | * | * | * |
| *Empidonax traillii* (Willow flycatcher) | None | SE | None | - | - | - | - | - |

**Table G-2**
**(Continued)**

| Species | Status[1] | | | Occurrence Probability within Reservoir Sites[2] | | | | |
|---|---|---|---|---|---|---|---|---|
| *Scientific Name* (Common Name) | Federal | State | Other | Sites | Funks | Colusa | Thomes-Newville | Red Bank |
| *Eremophila alpestris ssp. actia* (California horned lark) | None | None | SC | X | X | X | X | X |
| *Falco columbarius* (Merlin) | None | CSC | None | X | * | * | X | X |
| *Falco mexicanus* (Prarie falcon) | None | CSC | None | X | X | X | X | X |
| *Falco peregrinus* (Peregrine falcon) | FE | SE | None | * | * | * | * | * |
| *Gavia immer* (Common loon) | MNBMC | CSC | None | - | X | - | - | * |
| **Mammals** | | | | | | | | |
| *Antrozous pallidus* (Pallid bat) | FS | CSC | None | X | NE | * | X | * |
| *Bassariscus astutus* (Ringtail) | None | CFP | None | X | NE | * | X | X |
| *Corynorhinus townsendii ssp. pallescens* (Pale big-eared bat) | FSC, FS | CSC | None | * | NE | * | * | * |
| *Corynorhinus townsendii ssp. townsendii* (Pacific western big-eared bat) | FS, FSC | CSC | None | * | NE | * | * | * |
| *Euderma maculatum* (Spotted bat) | FSC | CSC | None | - | NE | - | - | - |
| *Eumops perotis californicus* (Western mastiff bat) | FSC | CSC | None | - | NE | - | * | * |
| *Lasiurus blossivillii* (Western red bat) | FS | None | None | X | NE | * | * | X |
| *Martes americana* (Pine marten) | FS | None | None | * | NE | * | * | * |
| *Martes pennanti ssp. pacificus* (Pacific fisher) | FSC, FS | CSC | None | * | NE | * | * | * |
| *Myotis ciliolabrum* (Small-footed myotis) | FSC | None | None | * | NE | * | * | * |
| *Myotis evotis* (Long-eared myotis) | FSC | None | None | * | NE | * | * | * |
| *Myotis thysanodes* (Fringed myotis) | FSC | None | None | - | NE | - | * | * |
| *Myotis volans* (Long-legged myotis) | FSC | None | None | - | NE | - | * | * |
| *Myotis yumanensis* (Yuma myotis) | FSC | CSC | None | * | NE | * | * | X |
| *Perognathus inornatus ssp. inornatus* (San Joaquin pocket mouse) | FSC | CSC | None | * | NE | * | * | - |
| *Taxidea taxus* (American badger) | None | CSC | None | X | NE | X | * | * |

**Table G-2**
**(Continued)**

| Species | Status[1] | | | Occurrence Probability within Reservoir Sites[2] | | | | |
|---|---|---|---|---|---|---|---|---|
| *Scientific Name* (Common Name) | Federal | State | Other | Sites | Funks | Colusa | Thomes-Newville | Red Bank |
| **Plants** | | | | | | | | |
| *Antirrhinum subcordatum* (Dimorphic snapdragon) | None | None | 1B | * | NE | * | X | X |
| *Asclepias solanoana* (Serpentine milkweed) | None | None | 1B | - | NE | - | - | - |
| *Astragalus rattanii var. jepsonianus* (Jepson's milk-vetch) | None | None | 1B | - | NE | - | X | X |
| *Astragalus tener var. ferrisiae* (Ferris's milk-vetch) | FSC | None | 1B | * | NE | * | * | * |
| *Atriplex cordulata* (Heartscale) | FSC | None | 1B | * | NE | * | * | * |
| *Atriplex depressa* (Brittlescale) | FSC | None | 1B | * | NE | * | * | * |
| *Atriplex joaquiniana* (San Joaquin spearscale) | FSC | None | 1B | * | NE | * | * | * |
| *Atriplex persistens* (Vernal pool saltbush) | None | None | 1B | * | NE | * | * | - |
| *Balsamorhiza macrolepis var. macrolepis* (Big-scale balsamroot) | None | None | 1B | * | NE | * | * | * |
| *Brodiaea coronaria ssp. rosea* (Indian Valley broadiaea) | FSC | SE | 1B | * | NE | * | * | * |
| *Chamaesyce hooveri* (Hoovers spurge) | FT | None | 1B | * | NE | * | * | - |
| *Cordylanthus palmatus* (Palmate-bracted bird's-beak) | FE | SE | 1B | * | NE | * | * | - |
| *Cryptantha crinita* (Silky cryptantha) | None | None | 1B | * | NE | * | * | * |
| *Delphinium recurvatum* (Recurved larkspur) | None | None | 1B | * | NE | * | * | * |
| *Eleocharis quadrangulata* (Four-angled spikerush) | None | None | 2 | * | NE | * | * | - |
| *Eriastrum brandegeae* (Brandegee's eriastrum) | FSC | None | 1B | - | NE | - | * | X |
| *Eschscholzia rhombipetala* (Diamond-petaled California poppy) | FSC | None | 1A | * | NE | * | * | * |
| *Fritillaria pluriflora* (Adobe lilly) | FSC | None | 1B | * | NE | * | X | X |
| *Gratiola heterosepala* (Bogg's Lake hedge-hyssop) | None | SE | 1B | * | NE | * | * | * |
| *Hesperevax acaulis var. acaulis* (Dwarf evax) | None | None | 1B | * | NE | * | * | * |
| *Hesperolinon drymarioides* (Drymaria-like western flax) | FSC | None | 1B | - | NE | - | * | * |
| *Hesperolinon tehamense* (Tehama Co. western flax) | FSC | None | 1B | - | NE | - | X | * |

**Table G-2**
**(Continued)**

| Species | Status[1] | | | Occurrence Probability within Reservoir Sites[2] | | | | |
|---|---|---|---|---|---|---|---|---|
| *Scientific Name* (Common Name) | Federal | State | Other | Sites | Funks | Colusa | Thomes-Newville | Red Bank |
| *Juncus leiospermus var. leiospermus* (Red Bluff dwarf rush) | None | None | 1B | * | NE | * | * | * |
| *Layia septentrionalis* (Colusa layia) | None | None | 1B | * | NE | * | * | * |
| *Legenere limosa* (Legenere) | None | None | 1B | * | NE | * | * | - |
| *Lepidium latipes var. heckardii* (Heckard's pepper-grass) | None | None | 1B | * | NE | * | * | * |
| *Lotus rubriflorus* (Red-flowered lotus) | FSC | None | 1B | * | NE | * | * | * |
| *Lupinus milo-bakeri* (Milo Baker's lupine) | FSC | ST | 1B | * | NE | * | * | * |
| *Lupinus sericatus* (Cobb Mountain lupine) | None | None | 1B | - | NE | - | * | * |
| *Madia hallii* (Hall's madia) | FSC | None | 1B | - | NE | - | * | * |
| *Madia stebbinsii* (Stebbin's madia) | None | None | 1B | - | NE | - | * | * |
| *Microseris sylvatica* (Woodland mocroseris) | None | None | 3 | * | NE | * | * | * |
| *Myosurus minimus var. apus* (Little mouse tail) | FSC | None | 3 | * | NE | * | * | - |
| *Myosurus sessilis* (Sessile mousetail) | None | None | 3 | * | NE | * | * | * |
| *Neostaphia colusana* (Colusa grass) | FT | SE | 1B | * | NE | * | * | - |
| *Orcuttia pilosa* (Hairy Orcutt grass) | FT | SE | 1B | * | NE | * | * | - |
| *Orcuttia tenuis* (Slender Orcutt grass) | PT | SE | 1B | * | NE | * | * | - |
| *Paronychia ahartii* (Ahart's paronychia) | FSC | None | 1B | * | NE | * | * | * |
| *Sagittaria sanfordii* (Sandford's arrowhead) | FSC | None | 1B | * | NE | * | * | * |
| *Silene campanulata var. campanulata* (Red mountain catchfly) | FC | SE | 1B | * | NE | * | * | * |
| *Streptanthus morrisonii* (Morrison's jewel flower) | FSC | None | 1B | - | NE | - | * | - |
| *Trichocoronis wrightii var. wrightii* (Wright's trichocoronis) | None | None | 2 | * | NE | * | * | - |
| *Tropidocarpum capparideum* (Caper-fruited tropidocarpum) | FSC | None | 1B | * | NE | * | * | * |

**Table G-2**
**(Continued)**

| Species | Status[1] | | | Occurrence Probability within Reservoir Sites[2] | | | | |
|---|---|---|---|---|---|---|---|---|
| *Scientific Name* (Common Name) | Federal | State | Other | Sites | Funks | Colusa | Thomes-Newville | Red Bank |
| *Tuctoria greenei* (Green's tuctoria) | FE | CR | 1B | * | NE | * | * | - |
| *Viburnum ellipticum* (Western viburnum) | None | None | 3 | - | NE | - | * | * |

[1] **Status Key:**

1A = Presumed to be extinct in California (California Native Plant Society)
1B = Rare, Threatened or Endangered in California and elsewhere (California Native Plant Society)
2 = Rare,Threatened or endangered in California but more common elsewhere
3 = More information is needed
CFP = Fully protected under California Fish and Game
CR = State Listed as rare (Section1904, DFG code 1994)
CSC = California Species of Special Concern
DFG = California Department of Fish and Game Protected
FC = Federal Candidate Species
FE = Federally Endangered
FPE = Federally Proposed for listing as endangered
FPT = Federally Proposed as threatened
FS = Forest Service Sensitive Species
FSC = Federal Special Concern Species
FT = Federally Threatened
MNBMC = Migratory non-game bird of management concern (USFWS)
PL = Proposed for listing as threatened under ESA
PR = Protected under the Bald Eagle Act
PT = Federally Proposed, threatened
SB = Specified birds under California Fish and Game Code
SC = Other species of concern identified by CALFED
SE = State endangered
ST = State threatened

[2] Includes species that have been observed in survey efforts and the probability of species that may be present in the area, based on preliminary habitat evaluations, but have not been observed to date.

**Occurrence Probability Key:**

X = Observed in the reservoir footprint or within 1 mile of it
* = Not observed to date but potential habitat exists in the reservoir footprint or within 1 mile of it
- = Not observed and not likely to occur in the reservoir footprint or within 1 mile of it
NE = Not evaluated in inundation area studies, see site 1-mile perimeter column for potential occurrence at Funks Reservior.

## G.3 SOCIOECONOMIC RESOURCES

The following subsections discuss socio-economic resources encountered in the study area.

### G.3.1 Land Use

The watersheds draining the east slope of the Coast Range are subject to a variety of land use practices. Upper elevations are primarily commercial forest lands and managed for timber production, outdoor recreation, and grazing. Foothill areas are currently managed primarily for livestock grazing. Some foothill valleys support dryland grain or orchard production. Extensive mineral extraction activities have historically occurred throughout foothill and mountain areas. Sacramento Valley portions of the watersheds support a wide variety of agricultural uses including livestock grazing, irrigated grain and truck-crops, and orchards.

Land use within the proposed Sites Reservoir area is dedicated primarily to livestock production. Both year-round and winter/spring cattle grazing is the dominant land use, while a small amount of both horse and sheep grazing also occurs. Other agricultural land uses include minor amounts (200 to 300 acres) of dryland grain production. Some residential land use also occurs within the small community of Sites (population 20) and on 10 to 14 scattered ranch sites. A small commercial rock quarry is present near the proposed Sites Dam site. Limited commercial firewood harvesting has occurred within and adjacent to the inundation area.

Land use within the proposed Colusa Cell area is almost exclusively dedicated to livestock production. Both year-round and winter/spring cattle grazing is the dominant land use. No other agricultural land use practices have been identified. Only one occupied ranch homesite has been identified within the inundation area and no other residential or commercial developments are present.

Seasonal and year-round livestock grazing dominates land use within the Newville Reservoir area. However, limited horse and sheep grazing also occurs. At least 20 occupied ranch sites are found within the reservoir area. Limited firewood harvest has occurred in some areas.

Land use within the Red Bank Project area is similar to that at the other three proposed reservoirs. Both year-round and winter/spring cattle grazing is the dominant land use. Other agricultural land uses include a small walnut orchard and a few acres of irrigated pasture. Several landowners operate hunting clubs and at least one landowner operates a fee-for-fishing business.

### G.3.2 Water Supply

***Hydrology of Optional Water Supplies***

Project formulation for the alternative offstream projects includes identification of water supply sources that will be diverted to storage. A list of optional water supply sources and conveyance has been developed and evaluation has been initiated to determine preferred sources for each project. The Red Bank Project has only one water supply source under consideration. The project formulation decisions have not yet been made and will require environmental, engineering, and economic evaluation of the water supply source options. The following discussion reflects the evaluation of the water supply sources to date.

Flows of various nearby streams were evaluated to determine the quantity of water that could be diverted to storage in the four alternative offstream reservoirs. In general, three steps were required in determining the hydrologic and water supply characteristics of the optional water supply sources. First, historical flows of the streams were reviewed to provide a preliminary assessment of the relative scale of available water in a given stream.

Second, the historical flows were subjected to local and downstream operational constraints to determine the divertible flow. Local operational constraints include instream flow requirements of the source stream, limitations related to the operations and water rights of existing local water supply projects, and existing or proposed diversion and conveyance facility capacities. Downstream operational constraints include lower Sacramento River flow requirements and requirements in the Sacramento–San Joaquin Delta.

Third, divertible flows of optional sources are combined to determine the water supply yield associated with alternative water supply projects by using a reservoir simulation model (CALSIM). In this step, water supplies are subject to the offstream reservoir capacity and the system-wide operational constraints of the Central Valley Project and State Water Project. System-wide operational constraints include pumping limitations in the Delta, availability of other systemwide water supplies, and customer demands.

***Optional Water Supply Sources***

Table G-3 shows the optional water supply sources considered for the alternative north of the Delta offstream storage projects. Sites, Colusa, and Thomes-Newville Projects each have a number of optional water supply sources. These sources may be packaged in various combinations to generate sufficient water supply for a specific project. The Red Bank Project is unique because there is only one major water supply source being considered for diversion and storage. The six optional sources are the same for Sites and Colusa. Thomes-Newville has three optional water supply sources. Local inflow sources are not shown, but each offstream project would receive some local inflow from the relatively smaller streams that flow directly to the offstream reservoirs.

Streamflow records were reviewed to determine the relative quantity of water that has historically flowed in various streams. Table G-4 shows November through March streamflow volumes at representative locations for the period 1945-1994. The November through March period was chosen to avoid any operational conflicts with existing facilities and water rights. Local irrigation operations often begin in April and conveyance facilities are being used for deliveries. Most of the data shown are directly from gage station streamflow records. A number of the data records needed to be extended or adapted using basic hydrologic correlations. Correlations for the entire period of record were required for Grindstone Creek, inflow to East Park Reservoir, and South Fork Cottonwood Creek.

**Table G-3**

**Optional Water Supply Sources for North-of-the-Delta Offstream Projects**

| Sites/Colusa | Thomes-Newville | Red Bank |
|---|---|---|
| ❖ Colusa Basin Drain<br>❖ Grindstone Creek<br>❖ Little Stony Creek<br>❖ Sacramento River<br>❖ Stony Creek<br>❖ Thomes Creek | ❖ Sacramento River<br>❖ Stony Creek<br>❖ Thomes Creek | ❖ South Fork Cottonwood Creek |

**Table G-4**

**November – March Streamflow Volumes, 1945-1994 of Optional Water Supply Source Streams**

| Source and Location | Minimum (MAF) | Maximum (MAF) | Average (MAF) |
|---|---|---|---|
| Sacramento River At Butte City | 1.613 | 14.415 | 5.4607 |
| Stony Creek Below Black Butte Dam | 0.001 | 1.052 | 0.2345 |
| Colusa Basin Drain At Highway 20 | 0.039 | 0.759 | 0.2089 |
| Inflow To Stony Gorge Res. | 0.004 | 0.509 | 0.1513 |
| Thomes Creek At Paskenta | 0.007 | 0.359 | 0.1509 |
| Inflow To Proposed Grindstone Res. | 0.009 | 0.301 | 0.0854 |
| Inflow To East Park Res. W/ Rainbow Diversion | 0.001 | 0.222 | 0.0762 |
| South Fork Cottonwood Creek At Dippingvat | 0.005 | 0.259 | 0.0754 |

MAF = million acre feet

The Sacramento River is by far the largest water supply source of the options considered. With an average historical five-month flow volume at Butte City of almost 5.5 MAF, the river's flow is over 23 times the size of the second largest option, Stony Creek. The three smallest optional water supply sources are Grindstone Creek, East Park Reservoir, and South Fork Cottonwood Creek, each with an average November through March runoff of less than 0.1 MAF. The sources are not independent options. All of the tributary streams contribute to the flow of the Sacramento River. Outflow from East Park Reservoir becomes inflow to Stony Gorge and then ultimately contributes to the flow below Black Butte.

Streamflow volumes are dependent upon diversion location. In general, volumes increase in the downstream direction. Optional diversion locations for the Sacramento River are at the existing Tehama-Colusa Canal diversion in Red Bluff, the existing Glenn-Colusa Irrigation District Canal diversion in Hamilton City, a new diversion at Chico Landing, and a new diversion opposite Moulton Weir. Diversion locations investigated for Stony Creek include Black Butte Lake, Stony Gorge Reservoir, and East Park Reservoir with additional water from the Rainbow Diversion, and at the GCID Canal crossing. The diversion location investigated for Colusa Basin Drain is due west of Moulton Weir, almost 10 miles north of Highway 20. Thomes Creek diversion locations include a number of options west of Paskenta and at the Tehama-Colusa Canal crossing. The Grindstone Creek diversion location is from a potential Grindstone Reservoir. The Grindstone Dam site is approximately 2-1/2 miles upstream from the confluence with Stony Creek. The diversion location for South Fork Cottonwood Creek is at the proposed Dippingvat Reservoir.

***Divertible Flow of Water Supply Sources***

Divertible flow is computed by imposing local and downstream restrictions on the streamflow volume, including applicable instream flow requirements of tributary streams and the Sacramento River. Divertible flow is also limited by diversion and conveyance capacity of new or existing facilities. A representative divertible flow is shown in Table G-5 for each of the water supply sources for comparison. The divertible flow value is used as input for the CALSIM operations model.

**Table G-5**

**November-March Average Divertible Flow**

| Stream and Location | Conveyance Capacity (cfs) | Divertible Flow (MAF) |
|---|---|---|
| Sacramento River At Butte City | 5,000 | 0.5873 |
| Stony Creek Below Black Butte Dam | 1,700 | 0.2345 |
| Colusa Basin Drain | 3,000 | 0.1365 |
| Stony Gorge Reservoir | 1,500 | 0.0702 |
| Thomes Creek | 2,100 | 0.1089 |
| Grindstone Reservoir | 750 | 0.0679 |
| East Park Reservoir W/ 300 Cfs Rainbow Diversion | 1,200 | 0.0301 |
| South Fork Cottonwood Creek At Dippingvat | 800 | 0.0529 |

cfs = cubic feet per second
MAF = million acre feet

***Stony Creek Hydrology and Water Supply***

Subsequent to the initial evaluations of optional water supply sources, members of the Technical Advisory Group requested that DWR refine its treatment of options from the upper watershed of Stony Creek. Based on input from TAG members and local project operators, some adjustments were made to the assumptions related to these optional sources. These adjustments did generate corresponding changes in available streamflow volume and the water supply characteristics of these sources. Following is a more comprehensive description of the Stony Creek options.

Stony Creek is a potential source of water supply for an offstream storage reservoir along the western edge of the Sacramento Valley. More specifically, water from Stony Creek could be conveyed to Sites, Colusa, or Thomes-Newville project alternatives for storage. Stony Creek diversion and conveyance options that take advantage of existing reservoirs or conveyance facilities were evaluated for this study.

The major surface water projects in the Stony Creek basin include the Orland Project and Black Butte Dam and Lake. The Orland Project is one of the oldest reclamation projects in the country and includes two main dams and reservoirs, East Park and Stony Gorge. The project is locally operated by the Orland Unit Water Users' Association and provides irrigation water for up to 20,000 acres near Orland, as well as residential, commercial and industrial water supply to about 2,500 residents. East Park Dam and Reservoir are located on Little Stony Creek, about 33 miles southwest of Orland. The capacity of East Park Reservoir is about 51,000 AF. In addition to the inflow from Little Stony Creek, East Park receives water from Rainbow Diversion Dam on the mainstem. The Rainbow Feeder Canal is about 7 miles long with a design capacity of 300 cfs. Stony Gorge Dam and Reservoir are located about 18 miles downstream of East Park at the confluence of Little Stony and Stony Creeks. The capacity of Stony Gorge Reservoir is about 50,000 AF.

The U.S. Army Corps of Engineers developed Black Butte Dam and Lake, approximately 22 miles downstream of Stony Gorge and 9 miles west of Orland, primarily for flood control in the early 1960s. Black Butte is operated in coordination with a number of other agencies including the OUWUA and Reclamation for water supply. In addition, the City of Santa Clara generates hydroelectric power. The lake's capacity is about 143,000 AF.

***Stony Creek Water Supply Source Options***

A number of options have been considered for diverting Stony Creek winter flows to offstream storage including:

- Diversion from Black Butte Reservoir to Newville Reservoir;
- Diversion from lower Stony Creek into existing Tehama-Colusa and GCID canals for conveyance to Sites or Colusa Reservoirs;
- Diversion from East Park Reservoir to Sites or Colusa Reservoirs;
- Diversion from Stony Gorge Reservoir to Sites or Colusa Reservoirs; and
- Diversion from proposed Grindstone Reservoir to Stony Gorge Reservoir and rediversion to Sites or Colusa Reservoirs.

The Grindstone Reservoir water supply source option was evaluated at a cursory level. Ranges of reservoir and diversion capacities were considered. The cursory analysis of Grindstone Reservoir indicated a number of undesirable characteristics related to this option, including susceptibility to large landslides, relatively large embankment quantities for the dam and saddles, relatively high sediment load

in the creek, and close proximity to a fault. While these characteristics would not make the Grindstone Reservoir option technically infeasible, a number of other options appear to be more feasible at this stage of evaluation. Therefore, Grindstone Reservoir as an optional source has been set aside.

The following analysis has focused on the reservoir diversions to Sites or Colusa Reservoirs. Simplified operation simulations using the historic hydrology and current reservoir operations have been used to estimate potential water supply diversions from East Park and Stony Gorge Reservoirs. Potential water supply diversions are simply the amount of water that can be diverted from a source with given conveyance capacities, instream flow, and other operational requirements. Unimpaired inflow to Stony Gorge Reservoir was determined based on historic outflow and changes in storage in East Park and Stony Gorge. Inflow to East Park and Rainbow were estimated as a percentage of the unimpaired Stony Gorge inflow. The area of the watersheds above Stony Gorge, East Park, and Rainbow diversions was determined. Area/precipitation factors of 45 and 31 percent were used for Rainbow and East Park respectively. This means that 45 percent of the unimpaired inflow to Stony Gorge flows past the Rainbow location and 31 percent flows into East Park.

A review of available data and discussions with local project operators provided helpful information. For example, a review of monthly reservoir storage indicates that a significant shift in Orland Project reservoir operations occurred subsequent to construction of Black Butte Reservoir in 1963. After Black Butte Reservoir was built, water in storage at the end of the irrigation season in the Orland Project reservoirs increased to an average of about 16,000 AF. Local project operators helped refine current project operating criteria, including estimates of instream water releases below the dams.

Criteria were established to determine the potential water supply diversions from Orland Project reservoirs including:

- Instream flow requirements for the creeks below East Park, Stony Gorge, and Black Butte were set at 10, 20, and 30 cfs, respectively. These are based on operator's estimates of current operating practices;
- Diversion was limited to the November through April period to avoid potential impacts to existing projects. This diversion period is one month longer than for other options, but will not conflict with the rights of existing water users;
- Diversion was limited such that end of the month reservoir storage during the diversion period was equal to or greater than historic levels in all three reservoirs; and
- A minimum diversion storage level of 20,000 AF in East Park and Stony Gorge was established to provide adequate tunnel submersion.

A range of conveyance capacities to the offstream storage alternatives was evaluated to determine optimal sizing of diversion and conveyance facilities. For Stony Gorge, conveyance of 500, 1,000, 1,500, and 2,000 cfs were considered; for East Park, conveyance of 800, 1,000, and 1,200 cfs; the Rainbow Feeder Canal to East Park was sized at 300, 500, 750, and 1,000 cfs.

Potential water supply diversions were analyzed for the above range of facilities for the 1964 through 1994 period. This period was chosen based on the previously mentioned effect of Black Butte operations and the data requirements of CALSIM. The potential water supply diversion data was then extended to the standard CALSIM period, 1922 through 1994, by correlation with the Sacramento River Index. Annual potential water supply diversions from Stony Creek sources are shown in Table G-6 for the 1922-1994 period.

***Water Supply Contribution***

Water supply contribution (Table G-7 is the amount of water actually diverted in an operation simulation to an offstream reservoir from a specific source and is an output from CALSIM. Water supply contribution to an offstream reservoir is dependent on potential water supply diversions and a number of other hydrologic and operational variables that are input to the CALSIM model. These variables include capacity of the offstream reservoir, water supply diversions from other sources, instream flow requirements, Delta conditions, demands, and Delta diversion facilities.

**Table G-6**

**Stony Creek Reservoir Options Average Potential Water Supply Diversions (MAF)**

| Diversion And Conveyance (Cfs) | Existing or Rainbow (300) | Rainbow (500) | Rainbow (750) | Rainbow (1,000) |
|---|---|---|---|---|
| Stony Gorge (500) | 0.060 | | | |
| Stony Gorge (1,000) | 0.090 | | | |
| Stony Gorge (1,500) | 0.107 | | | |
| Stony Gorge (2,000) | 0.117 | | | |
| East Park (800) | 0.060 | 0.066 | 0.068 | 0.069 |
| East Park (1,000) | 0.062 | 0.070 | 0.074 | 0.076 |
| East Park (1,200) | 0.063 | 0.071 | 0.077 | 0.080 |

cfs = cubic feet per second
MAF = million acre feet

**Table G-7**

**Water Supply Contribution (MAF) from Sources to 1.8 MAF Sites Reservoir (Typical Operational Studies)**

| Conveyance Package | Stony Creek | Sacramento River | Colusa Basin Drain | Total |
|---|---|---|---|---|
| 2,000 CFS Tunnel from Stony Gorge | 0.117 | | | 0.117 |
| 2,100 CFS T-C Canal | | 0.143 | | 0.302 |
| 1,800 CFS GCID Canal | | 0.159 | | |
| 2,100 CFS T-C Canal | | 0.127 | | 0.325 |
| 1,800 CFS GCID Canal | 0.058 | 0.141 | | |
| 2,000 CFS Tunnel from SG | | | | |
| 2,100 CFS T-C Canal | | 0.085 | | 0.317 |
| 1,800 CFS GCID Canal | | 0.168 | 0.063 | |
| 3,000 CFS canal from CBD | | | | |

cfs = cubic feet per second
MAF = million acre feet

Yield is difficult to assign to a specific source for a project with multiple sources of water. The portion of total water supply contribution from a specific source is an indicator of the yield from a specific source

(using specific sources and conveyances for a project). Yield of a given offstream reservoir project can be determined by computing the difference between deliveries with and without the project and is discussed in the section describing CALSIM results.

***Factors Related to the Upper Stony Creek Options***

Factors other than potential water supply diversions, water supply contribution, and yield may be considered in evaluating the upper Stony Creek reservoir diversion options. Using Stony Creek as a water supply source may offer a number of unique advantages compared to other sources. Since the East Park and Stony Gorge diversions are from existing reservoirs, fishery impacts and their associated mitigation costs may be significantly less. While Stony Creek would not provide enough water for an offstream reservoir by itself, maximizing diversion from Stony Creek sources would provide opportunities to limit diversions from the Sacramento River. Since potential Stony Creek diversions are at greater elevation than Colusa or Sites Reservoirs, no pumping is required and additional hydroelectric power may be generated. All of the other source options must be pumped up 120 to 320 feet from Funks Reservoir.

Finally, conveyance from these reservoirs to Sites or Colusa would be independent of existing conveyance systems. All of the other source options are dependent upon the Tehama-Colusa Canal, at a minimum, to get water into Sites or Colusa. The independence described above means that water could continue to be conveyed to offstream storage after deliveries begin in the Tehama-Colusa and GCID service areas.

***Project Operation Studies***

Two important characteristics of a surface water project are the size of its increased water supply and the cost of the project. The new or additional yield that a proposed project could generate is predicted by conducting operation studies. This is an accounting process over a historic period using recorded or estimated streamflows. This accounting includes all water hypothetically supplied to, stored in, lost to seepage and evaporation, and released from the reservoir. Operation studies are performed using a computer-based hydrologic simulation model. CALSIM allows an operation simulation of a project under investigation simultaneously with other major reservoir systems such as the Central Valley Project and the State Water Project over a historic period. The current operation simulation uses the 1922 through 1994 hydrologic sequence.

For a project operation study, water is released on a schedule representing project water demands at some point in the future (in this investigation the year 2020). The difference between the total system water supply with and without the project under investigation is considered to be the water supply attributable to the proposed project. The model is run using average monthly flows; whereas the availability of water supplies from various streams is developed using average daily flow data. Although the model is running on monthly steps, the result is refined enough to determine water supply yield estimates that are acceptable for making comparisons between competing alternatives.

For this phase of the offstream storage investigation, 42 CALSIM operation studies were run. These studies include 3 base studies, 31 for the Sites Project, 4 for the Colusa Project, and 4 for the Thomes-Newville Project. These studies include various optional sources of water and conveyance facilities for filling the reservoirs to allow identification of a preferred source and conveyance alternative for each project. The 1993 operation studies for the Red Bank Project were considered adequate for this phase of evaluation.

For the Sites and Colusa Projects, seven possible diversion locations were considered as sources of water to fill the reservoir: the Sacramento River at Red Bluff Diversion Dam; the Sacramento River at the

GCID pumps; the Sacramento River at Chico Landing; the Sacramento River at mile 158.5 (opposite Moulton Weir); the Colusa Basin Drain; Stony Gorge Reservoir; East Park Reservoir; Thomes Creek at the Tehama-Colusa Canal crossing; and lower Stony Creek at the Glenn-Colusa Canal crossing.

For the Thomes-Newville Project, five possible diversion locations were considered: Thomes Creek about 5 miles upstream from Paskenta; Stony Creek at Black Butte Lake; the Sacramento River at the Red Bluff Diversion Dam; the Sacramento River at the GCID pumps; and Thomes Creek at the Tehama-Colusa Canal crossing.

The general formulation of the CALSIM operation studies:

- Runs on a monthly basis for years 1922 through 1994;
- Uses estimated 2020 level of development;
- Uses a surrogate demand for project water supply. A surrogate demand is representative of currently unassigned project beneficiaries of the offstream project yield. After project beneficiaries have been identified, an actual projected demand schedule will replace the surrogate in subsequent operation study runs;
- Models flows of both the Sacramento and San Joaquin River systems, with coordinated operation of CVP and SWP reservoirs; and
- Generates data to estimate water supply, power use and power generation, fishery maintenance flows, recreation use, and Delta flow requirements.

The computation of project yield is one of the most useful outputs from an operation study. Yields are computed by comparing total system-wide deliveries for a proposed project to the deliveries under a base study. Table G-8 summarizes the yields or increase in system deliveries for specific project formulations completed to date. Average and drought yields have been determined for each study. An average yield is the average annual increase in system deliveries from 1922 through 1994. Similarly, drought yield is the average annual increase in system deliveries during the 1928 through 1934 drought period.

**Table G-8**

**Increase In System Deliveries With Offstream Storage Project (MAF)**

| Study # | T-C Canal | GCID Canal | New Canal | Chico Landing | Colusa Drain | East Park | Stony Gorge | Thomes Creek | Stony Creek | Assumptions | Avg Drought Yield (28-34) | Avg Yield (22-94) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Base Studies**: | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 6 | | | | | | | | | | Banks P.P.=10,300 cfs | 0.079 | 0.184 |
| 7 | | | | | | | | | | Proposed Trinity flows | -0.134 | -0.040 |
| **1.8 MAF Sites Project:** | | | | | | | | | | | | |
| 3 | 2.100 | 1.800 | | | | | | | | | 0.290 | 0.268 |
| 3b | 2.100 | | | | | | | | | | 0.159 | 0.242 |
| 4 | 2.100 | 1.800 | | | 3.000 | | | | | | 0.310 | 0.277 |
| 5 | 2.100 | 1.800 | | | | | 1.000 | | | | 0.290 | 0.268 |
| 8 | 2.100 | 1.800 | | | | | 2.000 | | | | 0.296 | 0.282 |
| 8a | | | | | | | 2.000 | | | | 0.036 | 0.098 |
| 9 | 2.100 | 1.800 | | | | 0.800 | | | | | 0.292 | 0.275 |

**Table G-8**
**(Continued)**

| Study # | T-C Canal | GCID Canal | New Canal | Chico Landing | Colusa Drain | East Park | Stony Gorge | Thomes Creek | Stony Creek | Assumptions | Avg Drought Yield (28-34) | Avg Yield (22-94) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9a | 2.100 | 1.800 | | | | 1.000 | | | | | 0.293 | 0.277 |
| 10 | 2.100 | 1.800 | | | | 1.200 | | | | | 0.295 | 0.278 |
| 11 | 2.100 | 1.800 | | | | | | | | Banks P.P.=10,300 cfs | 0.282 | 0.349 |
| 12 | 2.100 | 1.800 | | | | | 1.000 | | | Banks P.P.=10,300 cfs | 0.299 | 0.354 |
| 13 | 2.100 | 1.800 | | | | 0.800 | | | | Banks P.P.=10,300 cfs | 0.295 | 0.351 |
| 14 | 2.100 | 1.800 | | | 3.000 | | | | | Banks P.P.=10,300 cfs | 0.315 | 0.370 |
| 15 | 2.500 | 2.500 | | | | | | | | | 0.294 | 0.282 |
| 16 | 2.500 | 2.500 | | | 3.000 | | | | | | 0.336 | 0.284 |
| 17 | | | 5.000 | | 3.000 | | | | | | 0.365 | 0.284 |
| 24 | 2.100 | 2.900 | | | | | | | | | 0.294 | 0.279 |
| 25 | 2.100 | 2.900 | | | 3.000 | | | | | | 0.336 | 0.286 |
| 38 | | 5.000 | | | 3.000 | | | | | | 0.331 | 0.286 |
| 39 | | 2.900 | | 2.100 | 3.000 | | | | | | 0.349 | 0.285 |
| 40 | 2.100 | | 2.900 | | 3.000 | | | | | | 0.342 | 0.284 |
| 41 | 3.200 | 1.800 | | | 3.000 | | | | | | 0.339 | 0.287 |
| 42 | 5.000 | | | | 3.000 | | | | | | 0.338 | 0.288 |
| 43 | | | | 5.000 | 3.000 | | | | | | 0.360 | 0.284 |
| 44 | 2.100 | 1.800 | | | | | 1.500 | | | | 0.293 | 0.269 |
| **Sacramento River Flow Requirement:** | | | | | | | | | | | | |
| 18 | 2.100 | 1.800 | | | 3.000 | | | | | Diversion Min=7,000 cfs | 0.314 | 0.266 |
| 19 | 2.100 | 1.800 | | | | | | | | 3000 Diversion Min=10,000 cfs | 0.277 | 0.254 |
| 20 | 2.100 | 1.800 | | | 3.000 | | | | | Diversion Min=13,000 cfs | 0.227 | 0.251 |
| 21 | 2.100 | 1.800 | | | 3.000 | | | | | Trigger=40,000 cfs | 0.192 | 0.228 |
| 22 | 2.100 | 1.800 | | | 3.000 | | | | | Trigger=60,000 cfs | 0.160 | 0.200 |
| 23 | 2.100 | 1.800 | | | 3.000 | | | | | Proposed Trinity | 0.335 | 0.274 |
| **3.0 MAF Colusa Project:** | | | | | | | | | | | | |
| 30 | 2.100 | 1.800 | | | 3.000 | | | | | Diversion Min=10,000 cfs | 0.277 | 0.313 |
| 31 | 2.100 | 1.800 | | | 3.000 | | | | | Trigger=60,000 cfs | 0.159 | 0.236 |
| 32 | 2.100 | 1.800 | | | 3.000 | | | | | Proposed Trinity flows | 0.398 | 0.328 |
| 33 | 2.100 | 1.800 | | | 3.000 | | | | | Banks P.P. =10,300 cfs | 0.412 | 0.428 |
| **1.9 MAF Thomes-Newville Project:** | | | | | | | | | | | | |
| 34 | | | | | | | | 5.000 | 3.000 | | 0.146 | 0.213 |
| 35 | 2.200 | | | | | | | 5.000 | 3.000 | | 0.319 | 0.275 |

**Table G-8**
**(Continued)**

| Study # | T-C Canal | GCID Canal | New Canal | Chico Landing | Colusa Drain | East Park | Stony Gorge | Thomes Creek | Stony Creek | Assumptions | Avg Drought Yield (28-34) | Avg Yield (22-94) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **3.0 MAF Thomes-Newville Project:** | | | | | | | | | | | | |
| 36 | | | | | | | | 5.000 | 3.000 | | 0.146 | 0.248 |
| 37 | 2.200 | | | | | | | 5.000 | 3.000 | | 0.377 | 0.315 |

avg = average
cfs = cubic feet per second
MAF = million acre feet

Three base studies were used in this set of modeling studies. In addition to the general formulation of the studies described above, Base Study 2 assumes the existing Banks Pumping Plant capacity restrictions per the Corps' 1981 Criteria, existing Trinity River instream flow requirements, and existing Sacramento River operating guidelines for flows. Base Studies 6 and 7 model the effect of increased Banks Pumping Plant capacity and proposed instream flow requirements for the Trinity River, respectively.

The proposed instream flow requirements for the Trinity River would reduce the average system yield by about 0.040 MAF. The remaining studies that model these proposed flow requirements are compared against this lesser system yield indicated in Study 7. Other sensitivity analyses performed in this study set are related to potential flow requirements for the Sacramento River. The sensitivity analyses conducted for Sacramento River Diversion include trigger flows of 40,000 and 60,000 cfs and minimum downstream flows of 7,000, 10,000, and 13,000 cfs. A trigger flow is a minimum required flow that must be met once in a water year before diversion can be made to an offstream project. Once the trigger is achieved, only current restrictions related to Sacramento River flow would limit diversion. A minimum downstream flow is a continuing requirement that must be met at all times for diversion to offstream storage to be allowed.

The average project yields for NODOS range from 0.098 to 0.428 MAF. The 0.098 MAF yield is associated with a 2,000 cfs conveyance from Stony Gorge Reservoir for the 1.8 MAF Sites Project. This study formulation is not an actual alternative, but indicates the maximum amount of yield associated with the Stony Gorge source since no other sources would fill up storage space in the reservoir. The 0.428 MAF yield is associated with the 3.0 MAF Colusa Project with increased capacity at Banks Pumping Plant.

In addition to project yield, the operation studies also enable an assessment of impacts to Sacramento River flow and storage in existing reservoirs. By comparing "with project" flows and "without project" flows in specific reaches of the river, an estimate of streamflow changes related to project operation can be made. A comparison of storage in Shasta Lake and Lake Oroville with and without an offstream project indicates the potential change in storage levels in these existing reservoirs associated with project operation.

In general, the timing of flows in the Sacramento River is shifted a few months later in a given year. The shift in flows is mainly related to the exchange, where water that would have been released from Shasta Lake and delivered locally in the Tehama-Colusa and GCID service areas would instead be served by an offstream project. Water that is held in Shasta would then be released for other uses according to a demand schedule that generally requires water later in the year.

This flow information will be evaluated more thoroughly in the next phase of the investigation. In addition to providing a general overview of flow impacts for the Sacramento River, the potential impacts of the flow changes in the river related to operation of an offstream reservoir project will be assessed.

The operation of an offstream project would also impact storage levels in existing reservoirs. Again, changes in the end-of-month storage in Shasta Lake are likely related to the exchange described above. Another factor that appears to affect both Shasta and Oroville is related to the additional storage that would be created by an offstream project and adjustments needed to operate that additional storage with the existing projects. More evaluation of end-of-month storage impacts is anticipated during the next phase of the investigation.

### G.3.3 Cultural Resources

Surveys of cultural resources (see Appendix F) within the Sites project area recorded a total of 41 historic and prehistoric sites. Seventeen sites appear to be significant because they provisionally meet the criteria for eligibility to the National Register of Historic Places. Prehistoric settlement in the project area was constrained by the limited food and fuel resources and the scarcity of water. However, the area would have been important for seasonal hunting and gathering forays. The larger and more permanent villages were situated along the lower reaches of the bigger streams and on the knolls and natural levees along the Sacramento River.

Historic sites, features, and standing structures are significantly underrepresented in the site totals. These resources were not recorded because they are associated with working ranches, occupied buildings, and the town site of Sites. A future survey of historic resources may yield other historic sites in addition to the Historic District of the Town of Sites. Moving the cemetery associated with Sites and several smaller cemeteries would present special consideration.

Results of the record search indicated that there were no site records in the files of the State database for the Colusa Cell. A field survey found greater scarcity of subsistence resources than in the Sites Reservoir area and the ephemeral nature of the water supply were not suitable for extensive use or habitation during the prehistoric past.

Three sites were recorded within the Colusa Cell, two historic ranches and one site with a prehistoric and an historic component. The significance of the sites is undetermined. The assessment of eligibility to the National Register could not be made on the basis of surface indications. Additional studies would be necessary to complete the evaluation.

A comprehensive survey of prehistoric sites within Thomes-Newville project area was completed in 1983. A total of 117 sites was recorded within the footprint of the proposed reservoir, representing a more complete prehistoric settlement pattern that includes evidence of permanent or semi-permanent villages, seasonal campsites, and special resource procurement and use sites. The presence of perennial streams and availability of fuel and subsistence resources accounts for the more intensive use of the project area during prehistoric times. As with the Sites project, moving the historic cemeteries within the footprint of the Thomes-Newville project would be necessary.

Results of the record search for the Red Bank project indicated that the project area had not been surveyed for cultural resources and no site records were present in the State database. The surveys completed in 1994 for the Corps' Cottonwood Creek project were downstream of the project described here, with no overlap of the footprints.

A total of 31 sites were recorded within the Red Bank project. Twenty-eight sites are prehistoric and three are historic. The prehistoric sites in the Red Bank project area were generally small and the artifact distribution relatively sparse. The sites were probably associated with seasonal upland hunting, fishing, and gathering activities. The larger permanent settlements were situated further downstream on the banks of the perennial streams and along the Sacramento River.

### G.3.4 Transportation

The proposed Sites Reservoir is approximately 11 miles west of U.S. Interstate 5. East-to-west access through the project area is via the Maxwell/Sites Road. This Colusa County road receives relatively heavy volumes of traffic, especially on weekends, because it provides access to East Park Reservoir and the southwest portion of the Mendocino National Forest as well as the communities of Stonyford and Lodoga. Other Colusa County roads include Peterson Road, which extends approximately 4 miles north from the community of Sites, and Huffmeister Road, which extends south and west from the community of Sites to the community of Leesville. The closest airport is approximately 17 miles away at the City of Willows.

The Colusa Cell is approximately 7 miles west of Interstate 5. Access to the reservoir area is via Glenn County roads 60 and 69. These gravel/paved roads receive relatively little traffic. No public access currently exists within the reservoir footprint. Ranch roads within the reservoir inundation area are very limited and access is severely restricted during winter and spring due to a high number of unimproved stream crossings. The closest airport is approximately 12 miles away at the City of Willows.

The Thomes-Newville Project area is accessed via Newville Road west from Orland or Corning Road west from Corning. The project area is approximately 18 miles west of Interstate 5. Round Valley Road connects to both Newville and Corning Roads in the northern end of the proposed reservoir. Round Valley Road continues west from the reservoir and provides access to the central portions of the Mendocino National Forest. The southern part of the proposed reservoir area can be accessed via Elk Creek Road and State Highway 162. The closest airport is approximately 18 miles away at the City of Orland.

The Red Bank Project is approximately 18 miles west-southwest from Interstate 5 at Red Bluff. Access to the project area is provided by a variety of Tehama County roads that travel west from Red Bluff including Red Bank Road, Reeds Creek Road, Pettyjohn Road, Johnson Road, and Balis-Bell Road. Red Bank Road provides public access through the Schoenfield Reservoir area. Balis-Bell Road follows Clover Creek and provides public access into Blue Door Reservoir. No public access currently exists into the Lanyan or Dippingvat Reservoir areas. However, several private ranch roads provide some access into both of these proposed reservoirs. The closest airport is approximately 18 miles away at the City of Red Bluff.

### G.3.5 Recreation

Recreational activities within watersheds of the streams flowing through the project areas include hiking, hunting, fishing, camping, boating, mountain biking, and off-road vehicle use. Most of these activities occur primarily on public lands on the Mendocino National Forest and associated private timberlands. Little public access into the foothill private grazing lands occurs. However, public recreation areas are present within the foothill portion of the Stony Creek watershed at Black Butte Lake and Stony Gorge and East Park Reservoirs. Waterfowl and upland game bird hunting are the primary recreational use activities within the Sacramento Valley portions of these watersheds.

Recreation use and opportunity are currently very limited within the proposed project areas. Almost all lands are privately owned and posted against trespass, thus preventing general public access. Recreational activities that do occur are primarily by landowner families, their friends, and employees. This level of recreation use probably amounts to only a few hundred recreation-hours per year per reservoir site. Upland game birds (dove, quail, and pheasant), black-tailed deer and feral pigs are the most commonly hunted species within the proposed reservoir areas. Commercial hunting operations for feral pig, blacktailed deer, and wild turkey occur within the Red Bank Project area, and may operate on individual landholdings within the other reservoirs as well. Fishing is an infrequent activity because of the intermittent nature of the streams in Sites, Colusa Cell, and Newville Reservoir areas. Numerous stock ponds within the project areas are large enough to support bass, catfish, and sunfish. Angling pressure for these ponds appears to be generally low. At least one fee-for-fishing recreational operation is currently in business on a small lake within the Red Bank Project area.