Appendix B
Fishery Resources

APPENDIX B

Fishery Resources

Affected Environment

The fishery resources in the Sacramento River near the Red Bluff Diversion Dam (RBDD) consist of a diverse assemblage of fish species including native and non-native (introduced species). Table B-1 provides a species list of those fish that may likely be found at or near RBDD at some time during their life history. Of those species shown in Table B-1, four groups of fish species will be discussed together in this section because of their family relationship, life history characteristics, legal status, and occurrence within the project area. These groups include:

- Native anadromous salmonids (NAS)
- Other native anadromous fish (NAO)
- Non-native anadromous fish (NNA)
- Resident native and non-native fish (RN and RNN)

TABLE B-1
Fish Found in the Sacramento River near RBDD

Common Name	Scientific Name	Group	Native	Introduced
Chinook salmon[a]	*Oncorhynchus tshawytscha*	NAS[b]	X	
Steelhead[c]	*Oncorhynchus mykiss irideus*	NAS	X	
Sockeye salmon	*Oncorhynchus nerka*	NNAS[d]		X[e]
Pink salmon	*Oncorhynchus gorbuscha*	NNAS		X[f]
Pacific lamprey	*Lampetra tridentata*	NAO[g]	X	
River lamprey	*Lampetra ayresi*	NAO	X	
Green sturgeon	*Acipenser medirostris*	NAO	X	
White sturgeon	*Acipenser transmontanus*	NAO	X	
Striped bass	*Morone saxatilis*	NNA[h]		X
American shad	*Alosa sapidissima*	NNA		X
Rainbow trout[i]	*Oncorhynchus mykiss*	RN[j]	X	
Hitch	*Lavinia exilicauda*	RN	X	
Sacramento splittail	*Pogonichthys macrolepidotus*	RN	X	
Hardhead	*Mylopharodon conocephalus*	RN	X	
Sacramento pikeminnow	*Ptychocheilus grandis*	RN	X	
Speckled dace	*Rhinichthys osculus*	RN	X	
California roach	*Hesperoleucus symmetricus*	RN	X	
Sacramento sucker	*Catostomus occidentalis*	RN	X	
Tule perch	*Hysterocarpus traski*	RN	X	
Prickly sculpin	*Cottus asper*	RN	X	

TABLE B-1
Fish Found in the Sacramento River near RBDD

Common Name	Scientific Name	Group	Native	Introduced
Riffle sculpin	*Cottus gulosus*	RN	X	
Sacramento blackfish	*Orthodon microlepidotus*	RN	X	
Threespine stickleback	*Gasterosteus aculeatus*	RN	X	
Brown trout	*Salmo trutta*	RNN[k]		X
Threadfin shad	*Dorosoma petenense*	RNN		X
Largemouth bass	*Micropterus salmoides*	RNN		X
Spotted bass	*Microterus punctulatus*	RNN		X
Smallmouth bass	*Micropterus dolomieui*	RNN		X
Green sunfish	*Lepomis cyanellus*	RNN		X
Bluegill	*Lepomis macrochirus*	RNN		X
Redear sunfish	*Lepomis microlophus*	RNN		X
Pumkinseed	*Lepomis gibbosus*	RNN		X
Black crappie	*Pomoxis nigromaculatus*	RNN		X
White crappie	*Pomoxis annularis*	RNN		X
Channel catfish	*Ictalurus punctatus*	RNN		X
White catfish	*Ictaurus catus*	RNN		X
Black bullhead	*Ictalurus melas*	RNN		X
Yellow bullhead	*Ictalurus nalalis*	RNN		X
Golden shiner	*Notemigonus crysoleucas*	RNN		X
Fathead minnow	*Pimephales promelas*	RNN		X
Goldfish	*Carassius auratus*	RNN		X
Carp	*Cyprinus carpio*	RNN		X
Mosquitofish	*Gambusia affinis*	RNN		X

a Fall, late-fall, spring, and winter Chinook salmon runs

b Native anadromous salmonid

c Anadromous form of *O. mykiss*

d Non-native anadromous salmonid

e Likely non-native kokannee salmon

f Non-native to the Sacramento River

g Native anadromous other

h Non-native anadromous

i Resident form of *O. mykiss*

j Resident native

k Resident non-native

Sources: Moyle, 1976; Lee et al., 1980; and K. Brown and D. Killam, pers. comm.

Native Anadromous Salmonid Species

The Sacramento River near RBDD provides essential habitat for the freshwater life stages of Chinook salmon as well as steelhead. Within California's Central Valley, the Sacramento River provides a corridor for the anadromous salmonid resources between upstream reaches and the tributaries to the Sacramento River and the Pacific Ocean. The Sacramento River is the largest river system in California with more than 90 percent of the Central Valley salmon spawning and rearing within the Sacramento River system. The Sacramento River supports four runs (races) of Chinook salmon: fall, late-fall, winter, and spring run. The fall-run Chinook salmon is the predominant salmon in the Central Valley. Fall-run steelhead are also found in the Central Valley with almost the entire population restricted to the Sacramento River watershed. The Sacramento River does not contain native coho or other salmon species or native coastal cutthroat trout. The number of Chinook salmon and steelhead spawners estimated passing upstream of RBDD from 1970 through 1999 are summarized in Table B-2.

TABLE B-2
Estimated Chinook Salmon Spawning Escapement Upstream of RBDD (1970 to 2000)

Species	Average	Low (year)	High (year)
Fall	75,017	29,898 (1977)	205,487 (1997)
Late-fall	10,131	291 (1994)	19,261 (1975)
Winter	10,783	189 (1994)	53,089 (1971)
Spring	6,960	163 (1998)	25,095 (1976)
Steelhead	4,189	104 (1998)	13,240 (1970)

Fall-run Chinook salmon are the dominate run in the watershed, and on the average over the 30-year period, escapement upstream of RBDD exceeded all other Chinook runs by greater than 7-fold (Table B-2). However, as shown on Figure B-1, the annual escapement of fall Chinook salmon upstream of RBDD has varied greatly over the last 30 years. (All figures are located at the end of this appendix.) The annual fall Chinook escapement upstream of RBDD has ranged from over 205,000 (1997) to less than 30,000 (1977) with an increasing trend in escapement over that period (Figure B-2). Since 1970, late-fall-run Chinook salmon escapement upstream of RBDD has averaged approximately 10,000 adults and has ranged from greater than 53,000 (1971) to less than 300 (1994) (Table B-2). The trend for late-fall Chinook escapement upstream of RBDD has been a gradual decline since 1970 (Figure B-3).

Annual winter-run Chinook salmon escapement has also averaged approximately 10,000 adults upstream of RBDD. The annual escapement of winter-run upstream of RBDD has declined significantly over the 30 years since 1970 (Figure B-4). As shown in Table B-2, winter Chinook salmon escapement upstream of RBDD in 1971 was greater than 53,000 adults. Also as shown on Figure B-4, except for the year 1981, annual estimates of winter-run Chinook passing RBDD since 1977 have never exceed 5,000 adults, a decrease greater than 10-fold over the last 30 years.

Spawning escapement of Central Valley spring-run Chinook salmon has also varied since 1970 (Table B-2). The annual spring-run Chinook salmon escapement upstream of RBDD in the last 30 years has averaged less than 7,000 spawners and has ranged from greater than 25,000 in 1975 to less than 200 adults in 1998. Since 1990, spring-run Chinook salmon spawning escapement upstream of RBDD has not exceeded 1,000 adults (Figure B-5).

The annual spawning escapement upstream of RBDD since 1970 is summarized in Table B-2. As shown in Table B-2, the annual number of steelhead spawners has averaged approximately 4,000 adults. The trend over the last 30 years has indicated a steady decline in the annual numbers of spawners (Figure B-6) from over 10,00 in the early 1970s to less than a thousand by the later 1990s (Figure B-6). Furthermore, it is estimated that, currently, approximately 10 percent to 30 percent of adult steelhead in the Sacramento River are of natural (non-hatchery) origin (McEwan and Jackson, 1996).

Life History Characteristics and Habitat Requirements

Specific life history timing for the anadromous salmonids near the project area is provided in Table B-3.

TABLE B-3
Life History Timing for Native Anadromous Salmonids in the Sacramento River in the Vicinity of RBDD

Name	Adult Immigration	Spawning	Incubation	Rearing	Juvenile Emigration
Fall Chinook	July-December	October-December	October-March	December-June	December-July
Late-fall Chinook	October-April	January-April	January-June	April-November	April-December
Spring Chinook	April-July	August-October	August-December	October-April	October-May
Winter Chinook	December-July	April-August	April-October	July-March	July-March
Steelhead	August-March	December-April	December-June	Year-round (1-2 years)	January-October

As shown on Figure B-7, each of the five salmonid species have distinct periods when the adults are actively immigrating upstream through the project area. Factors that may affect the timing adult passage include water-year type, river flows, weather events, and RBDD operations.

Habitat needs of the four runs of salmon and steelhead are similar, but each species differs somewhat in its freshwater habitat requirements. These differences are important and have implications from a resource management standpoint. The habitat needs of salmon and steelhead include physical habitat for adult migration and holding, spawning and egg incubation, fry and juvenile rearing, and smolt emigration. Adequate flows, water temperatures, water depths and velocities, appropriate spawning and rearing substrates, and the availability of in-stream cover and food are critical for the propagation and survival of all salmonids in the Sacramento River.

Each of the life stages of these species has its own specific habitat requirements. Adult spawning and egg incubation requires suitable water velocity, temperature, depth, and substrate (gravel) size. Adult spring-run Chinook salmon and steelhead have additional habitat needs for longer-term holding habitat, in which pool size and depth, temperature, cover, and proximity to cover and spawning areas are important requirements. Newly emerged fry and juvenile salmonids require rearing habitat where low velocities, open cobble substrate for predator refuge, cool water temperatures, and adequate food

production are critical features. Emigration of smolts to the ocean and the immigration of spawning adults require adequate barrier-free passage, adequate transport flows, and adequate water depths and temperatures to complete those migrations.

In the vicinity of RBDD the Sacramento River acts primarily as a transport corridor for adults immigrating upstream, juvenile fry rearing and dispersing, and smolts emigrating downstream. In addition, fall-run Chinook salmon and, to a lessor degree, the winter-run and other salmon species are known to spawn in the vicinity of RBDD both immediately upstream and, to a lessor degree, downstream of RBDD. Inundation of Lake Red Bluff may act to discourage these fish from spawning in the reach of the Sacramento River immediately upstream of RBDD because of inadequate velocities and excessive water depths during RBDD gates–in operations.

The periods when juveniles (fry, pre-smolt, and smolt salmon and fry, sub-yearling, and yearling steelhead) are migrating downstream past RBDD are shown on Figure B-8. In addition to passage, fry, pre-smolt salmon, and sub-yearling, and yearling steelhead may rear or reside near RBDD. These life stages are particularly vulnerable to predation by either fish or avian predators as they pass through or reside in the project locale. Timing of smolt emigration is dependent on species, flow conditions, and water year.

Impacts of Current Operations on Native Anadromous Salmonid Fish

Current operation of RBDD includes a 4-month period of time (mid-May through mid-September) when the dam gates are placed in the river, creating a velocity barrier and whitewater turbulence that prevents or impedes adult fish passage. Placement of the dam gates into the river results in blockage and delay of migrating adult salmon and steelhead (Vogel et al., 1988; Hallock et al., 1982; Hallock, 1987). Vogel et al., (1988) determined from salmon tagging studies conducted from 1983 through 1998 that between 8 percent and 44 percent of adult Chinook salmon, depending on run, were blocked from passing upstream of RBDD. Similarly, Hallock et al., (1982) determined that passage of 15 percent to 43 percent of adult Chinook salmon, depending on run, were blocked by RBDD. Fish ladders are currently operational on the east and west ends and at the center of RBDD. These currently operate during the gates-in period to provide upstream passage of adult salmonids. Vogel et al., (1988) determined that the mean time of delay in passage of adult Chinook salmon at RBDD was greater than 3 to greater than 13 days, depending on the run. Radio telemetry investigations conducted from during the months of August and September 1999 to 2001, using adult fall-run Chinook salmon, indicate that delay in passage, under existing conditions at RBDD, may average approximately 21 days (USFWS, unpublished data). However, the existing fish ladders at RBDD may be inefficient in passing spring-run Chinook salmon at RBDD (CDFG, 1998). Currently adult late-fall Chinook salmon pass unimpeded at RBDD because they immigrate during months (October through March) when the RBDD gates are out of the water and, therefore, no barrier exists. The passage timing for adult salmonids was obtained from data collected from fish ladder counts conducted at RBDD from 1982 to 1986 for fall, late-fall, and winter Chinook salmon and steelhead (USFWS/CDFG, unpublished data). For spring Chinook salmon, some of which may pass RBDD prior to installation of the RBDD dam gates, the current (1995 though 2000) ladder counts were used to estimate passage timing (USFWS/CDFG, unpublished data). For ladder counts made during 1995 and 2000, the average monthly percent (44) of spring Chinook passing RBDD during May were distributed equally between

the before gates-in (<May 15) and after gates-in (>May 15) periods. For the following discussion, refer to Figure B-7 for timing of adult salmonids near RBDD.

Under current operations, approximately 15 percent of winter Chinook adult spawners passing through the project area may be blocked or delayed by the current 4 months of gates-in operation (CDFG, 1998; USFWS/CDFG, unpublished data). The approximate average percentages of entire adult population of winter-run Chinook that are attempting to pass RBDD and may be impacted are listed by month as follows:

- Late May—5 percent of annual total
- June—7 percent of annual total
- July—3 percent of annual total

For migrating adult steelhead, approximately 17 percent of the annual adult steelhead run may be affected by the current gates-in operation. The approximate average percentages of the annual run of adult steelhead passing RBDD that may be affected are listed by month as follows:

- June—1 percent
- July—1 percent
- August—5 percent
- Early September—10 percent

Up to 25 percent of the annual run of fall Chinook salmon may be affected by the current gates-in operation. The approximate average percentages of the annual population passing RBDD that may be impacted are listed by month as follows:

- July—2 percent
- August—13 percent
- Early September—10 percent

By far, the greatest effect on adult anadromous salmonids is to spring-run Chinook salmon. Approximately 72 percent of the annual adult spring Chinook spawners passing through the project area must do so during the current gates-in operation (Figure B-7). The approximate average percentages of the annual population passing RBDD are listed by month as follows:

- Late May—22 percent
- June—38 percent
- July—9 percent
- August—2 percent

Impedance of these adult spring Chinook by RBDD operations may adversely affect their ability to successfully pass upstream into and through the Sacramento River and into tributary streams and headwater reaches (CDFG, 1998). It is in these headwater reaches in the tributaries and the most upstream portion of the mainstem Sacramento River that the majority of spring-run Chinook salmon must hold throughout the summer months before spawning in the early fall. The biological consequences of blockage or passage delay at RBDD results in changes in spawning distribution (Hallock, 1987), hybridization with fall Chinook (CDFG, 1998), increased adult pre-spawning mortality (USBR, 1985), and

decreased egg viability (Vogel et al., 1988), all of which result in the reduction of annual recruitment of this species.

Currently, it is difficult to precisely characterize the temporal distribution of spring-run Chinook salmon as they pass RBDD. This is because prior to mid-May the gates-out operations at RBDD preclude the use of the fish ladders and therefore the enumeration of adults as they pass RBDD. However, once the RBDD gates go in during in May, spring run Chinook are identified as they pass. The exact effect of lowering the gates during this species peak immigration period is unknown but as this species is threatened, it cannot be desirable to interrupt their migration.

During gates-in periods at RBDD, juvenile life stages of all anadromous salmonids migrate downstream (emigrate) through the project facilities. During gates-in operation, existing pathways for juvenile salmonids at RBDD include passage under the dam gates or through the fish ladders and their auxiliary water systems; or they are subjected to impingement, entrainment, and passage through diversion bypass systems at the Research Pumping Plant (RPP) and Tehama-Colusa Canal (TC Canal) headworks. An additional effect of the existing operations of RBDD on juvenile salmonids, especially on steelhead smolts, includes predation by avian species while passing through Lake Red Bluff and downstream of the dam (Vogel et al., 1988; USFWS/USBR, 1998).

Vondracek and Moyle (1983) reported that the cause of mortality of juvenile salmonids at RBDD was the result of a dysfunctional predator-prey relationship created by RBDD and Sacramento pikeminnow (formerly squawfish). Through investigations conducted at RBDD, USFWS (1981) concluded that mortalities of up to 42 percent of downstream-migrant steelhead and greater than 50 percent of Chinook salmon occurred, likely as a result of predation of those juveniles by pikeminnow downstream of the dam. Using divers, surface observations, and stomach contents analysis, Vogel et al., (1988) determined that adult Sacramento pikeminnow were the principal predator on juvenile salmon passing RBDD. Hallock (1987) reported that stomach content analysis confirmed that adult striped bass were also preying on juvenile salmon passing through RBDD. Furthermore, Tucker et al., (1998) determined that during summer months (gates-in operations), approximately 66 percent (by weight) of the stomach contents of Sacramento pikeminnow consisted of juvenile salmonids.

Recently, Tucker et al., (1998) found that nearly four times as many pikeminnow passed the RBDD ladders in May and June of 1981 as compared to May and June of 1996. This is an indication that the densities of these predators are now much lower since the RBDD gates are in only from mid-May through mid-September.

The following discussion refers to Figure B-8, which depicts juvenile salmonid passage at RBDD. The passage timing for juvenile salmonids was obtained from data collected from rotary screw trapping investigations conducted downstream of RBDD during 1994 through 2000 (Gaines and Martin, 2001). The following discussion is based on the timing information obtained from those investigations. With the current gates-in operations, on average approximately 8 percent of annual juvenile fall-run Chinook salmon passing RBDD are subjected to the operational effects of the dam and its associated diversion facilities.

The annual percentage of juvenile fall-run Chinook salmon passing RBDD that are presently subject to operational impacts are listed by month as follows:

- Late May—2 percent
- June—3 percent
- July—2 percent
- August—1 percent

For spring-run Chinook, on average approximately less than 1 percent of the annual number of juveniles passing RBDD are vulnerable to operations and facilities at RBDD. However, a potentially large number of late-fall and winter Chinook salmon and steelhead juveniles are subject to operations and facilities of RBDD and its associated diversion facilities (Figure B-8). For winter Chinook salmon, the earliest dispersing and outmigrating juveniles may be subjected to adverse effects from RBDD operations. Approximately 39 percent of juvenile winter Chinook salmon, on average, are subjected to the operational effects of RBDD and its associated diversion facilities. The passage timing for juvenile salmonids was obtained from data collected from rotary screw trapping investigations conducted downstream of RBDD during 1994 through 2000 (Gaines and Martin, 2001). The following discussion is based on the timing information obtained from those investigations. The approximate annual percentage of the annual juvenile winter-run Chinook salmon passing RBDD that are presently subject to operational impacts are listed by month as follows:

- July—1 percent
- August—12 percent
- Early September—26 percent

On average, approximately 35 percent of the juvenile late-fall run Chinook salmon passing RBDD presently subject to operational impacts are listed by month as follows:

- Late-May—4 percent
- June—4 percent
- July—7 percent
- August—14 percent
- Early September—6 percent

On average, approximately 36 percent of juvenile steelhead passing RBDD during the gates-in period subject to operational impacts are listed by month as follows:

- Late May—6 percent
- June—4 percent
- July—4 percent
- August—12 percent
- Early September—10 percent

Anadromous Salmonid Species Listed or Candidates for Listing under Federal Endangered Species Act and California Endangered Species Act

All five of the anadromous salmonids that are present at RBDD during some period in their life history are either listed by the California Endangered Species Act (CESA) and/or the federal Endangered Species Act (ESA), or are listed as candidates under ESA.

The following list includes each species' status, date of listing, and their date of Critical Habitat Designation (if applicable):

- Winter-run Chinook salmon: California Endangered (9/22/89); Federal Endangered (1/4/94); Habitat Designated (3/32/99)
- Spring-run Chinook salmon: California Threatened (2/5/99); Federal Threatened (9/16/99); Habitat Designated (2/16/00)
- Steelhead—Central Valley Chinook salmon evolutionary significant unit (ESU): Federal Threatened (3/19/98); Habitat Designated (2/16/00)
- Central Valley fall/late-fall Chinook salmon ESUs: Federal Candidate/Not Warranted for listing (9/16/99)

For Sacramento River winter-run Chinook salmon, ESU critical habitat is designated to include the following: Sacramento River from Keswick Dam in Shasta County (River Mile [RM] 302) to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta; all waters from Chipps Island westward to Carquinez Bridge including Honker Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 9,329 square miles in California. The following counties lie partially or wholly within these basins: Butte, Colusa, Contra Costa, Glenn, Napa, Nevada, Placer, Plumas, Sacramento, Shasta, Solano, Sutter, Tehama, Trinity, Yolo, and Yuba.

Critical habitat for federal Central Valley spring-run Chinook salmon ESU is designated to include all river reaches accessible to listed Chinook salmon in the Sacramento River and its tributaries in California. Also included are adjacent riparian zones, as well as river reaches and estuarine areas of the Sacramento-San Joaquin Delta; all waters from Chipps Island westward to Carquinez Bridge including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge (see Table B-4).

Excluded are tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 9,329 square miles in California. The following counties lie partially or wholly within these basins (or contain migration habitat for the species): Alameda, Butte, Colusa, Contra Costa, Glenn, Marin, Napa, Nevada, Placer, Sacramento, San Francisco, San Mateo, Shasta, Solano, Sonoma, Sutter, Tehama, Yolo, and Yuba.

TABLE B-4
Hydrologic Units and Counties Containing Critical Habitat for Central Valley California
Spring-run Chinook Salmon and Dams/Reservoirs Representing the Upstream Extent of Critical Habitat

Hydrologic Unit Name	Hydrologic Unit	Counties[a] within Hydrologic Unit and within Range of ESU	Dams/Reservoirs
Sacramento-Lower Cow-Lower Clear	18020101	Shasta, Tehama	
Lower Cottonwood	18020102	Shasta, Tehama	
Sacramento-Lower Thomes	18020103	Butte, Glenn, Tehama	Black Butte Dam
Sacramento-Stone Corral	18020104	Butte, Colusa, Glenn, Sutter, Yolo	
Lower Butte	18020105	Butte, Colusa, Glenn, Sutter	Centerville Dam
Lower Feather	18020106	Butte, Sutter, Yuba	Oroville Dam
Lower Yuba	18020107	Yuba	
Lower Bear	18020108	Placer, Sutter, Yuba	Camp Far West Dam
Lower Sacramento	18020109	Sacramento, Solano, Sutter, Placer, Yolo	
Sacramento-Upper Clear	18020112	Shasta	Keswick Dam, Whiskeytown Dam
Upper Elder-Upper Thomes	18020114	Tehama	
Upper Cow-Battle	18020118	Shasta, Tehama	
Mill-Big Chico	18020119	Butte, Shasta, Tehama	
Upper Butte	18020120	Butte, Tehama	
Upper Yuba	18020125	Nevada, Yuba	Englebright Dam
Suisun Bay	18050001	Contra Costa, Napa, Solano	
San Pablo Bay	18050002	Alameda, Contra Costa, Marin, Napa, San Mateo, Solano, Sonoma	
San Francisco Bay	18050004	Alameda, Contra Costa, Marin, San Francisco, San Mateo	

[a]Some counties have very limited overlap with estuarine, riverine, and riparian habitats identified as critical habitat for this ESU.

Critical habitat for Central Valley steelhead ESU is designated to include all river reaches accessible to listed steelhead in the Sacramento and San Joaquin Rivers and their tributaries in California. Also included are adjacent riparian zones, as well as river reaches and estuarine areas of the Sacramento-San Joaquin Delta; all waters from Chipps Island westward to Carquinez Bridge including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded are areas of the San Joaquin River upstream of the Merced River confluence, tribal lands, and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least

several hundred years). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 13,096 square miles in California. The following counties lie partially or wholly within these basins (or contain migration habitat for the species): Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, Glenn, Marin, Merced, Nevada, Placer, Sacramento, San Francisco, San Joaquin, Shasta, Solano, Sonoma, Stanislaus, Sutter, Tehama, Tuolumne, Yolo, and Yuba.

On September 16, 1999, National Marine Fisheries Service (NMFS) determined that listing was not warranted for the Central Valley fall and late-fall-run Chinook salmon ESU. However, the ESU is designated as a candidate for listing because of concerns over specific risk factors. The ESU includes all naturally spawned populations of fall-run Chinook salmon in the Sacramento and San Joaquin River Basins and their tributaries east of Carquinez Strait, California. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 13,760 square miles in California. The following California counties lie partially or wholly within these basins: Alameda, Butte, Calaveras, Colusa, Contra Costa, Glenn, Mariposa, Merced, Napa, Nevada, Placer, Plumas, Sacramento, San Joaquin, Santa Clara, Shasta, Solano, Stanislaus, Sutter, Tehama, Trinity, Tuolumne, Yolo, and Yuba.

Other Native Anadromous Species (Sturgeon, Pacific Lamprey, River Lamprey)

In addition to the native anadromous salmonid species found in the vicinity of the project area, several other native anadromous species occupy or have the potential to occupy the Sacramento River at various stages of their life history and during seasonal intervals. These include:

- White sturgeon (*Acipenser transmontanus*)
- Green sturgeon (*Acipenser medirostris*)
- Pacific lamprey (*Lampetra tridentata*)
- River lamprey (*Lampetra ayresi*)

Sturgeon are a highly specialized group of large, primitive, bony fish. Of the 24 species worldwide, all are found in the temperate waters of the northern hemisphere. Seven species are found in the United States, with two occurring in California. The white sturgeon are the largest freshwater fish in North America, with the largest documented record at 1,300 pounds (Moyle, 1976). Of the two sturgeon species in the Sacramento River, green sturgeon are known to commonly pass into Sacramento River reaches upstream of RBDD, and white sturgeon are not generally recognized to occur at locations upstream of RBDD (K. Brown, USFWS, pers. comm.). Both lamprey species are recognized to pass into Sacramento reaches upstream of RBDD. Detailed information on these lamprey species is much less than that for anadromous salmonids and sturgeon in the Sacramento River. Of the two lamprey, the Pacific lamprey is physically larger in size and are more common than river lamprey.

Populations of these species in the Sacramento River are generally unknown. However, white sturgeon populations in California seem to be abundant. CDFG population estimates based on their trawling surveys range from 11,000 to 128,000 white sturgeon in the San Francisco Bay estuary (Kohlhorst, 1991 as cited by Moyle et. al, 1995). The Sacramento River population has rebounded after many years of over fishing, and recently the sport catch has nearly equaled the commercial catch of the late 1800s. Because of the importance of the white sturgeon fishery in the Sacramento delta, the number and size of the annual catch of

white and green sturgeon is closely monitored. While there is no direct evidence that populations of green sturgeon are declining in the Sacramento River, the small size of the population increases the risk that a decline in numbers would be difficult to detect until a collapse in the population occurs (Moyle et al., 1995).

Green sturgeon populations have been reduced throughout their entire range. In North America, only three known spawning populations still exist (Sacramento, Klamath, and Rogue rivers), with several historically important populations ~~expirated~~ extirpated (Eel River and South Fork Trinity River) (Moyle et al., 1995). The primary causes for this decline include: (1) loss of access to spawning habitat by dam construction, (2) degraded spawning habitat, and (3) overfishing by commercial, sport, Native American, and illegal fisheries. In studies conducted by CDFG between 1954 and 1991, a ratio of green sturgeon to white sturgeon for fish <101 centimeter (cm) fork length (approximately 40 inches) of 1:9 and fish >101 cm fork length of 1:76 has been determined (Moyle et. al., 1995). Assuming that green and white sturgeon are equally vulnerable to CDFG's capture gear, and using those ratios, green sturgeon populations (fish greater than 101 cm) in the San Francisco Bay estuary are approximately 200 to 1,800 fish (Moyle et. al., 1995).

Pacific lamprey are still common in most watersheds in California and throughout the Pacific northwest. In California, dams on several major watersheds have decreased the spawning distribution of Pacific lamprey. Population numbers in the Sacramento River are not known. Population trends of river lamprey are not known in California, but are assumed to have declined along with losses in habitat quantity and quality, especially within the Sacramento-San Joaquin River system (Moyle et al., 1995).

Life History Characteristics and Habitat Requirements

White and Green Sturgeon. White sturgeon has been caught in salt water from Ensanada, Mexico, to the Gulf of Alaska (Miller and Lea, 1972). In California, large populations occur only in the Sacramento and Feather rivers, but small numbers of white sturgeon have been noted in the San Joaquin River, Russian River, and Klamath River (Moyle, 1976). In California, spawning has been confirmed only in the Sacramento and Feather rivers (Moyle, 1976) and the San Joaquin River (Kohlhorst, 1991 as cited by PSMFC, 1992). A spawning population was trapped upstream of Shasta Dam following its completion in 1944, reproducing successfully until the early 1960s (Fisk, 1963 as cited by PSMFC, 1992). Following the construction of Keswick Dam and water storage in 1948, white sturgeon probably spawned in the Sacramento River downstream of Keswick Dam to Grimes (RM 125) (Kohlhorst pers. comm., as cited by USFWS, 1998). In the Sacramento River, most spawning seems to occur upstream of the Feather River confluence (Moyle, 1976). Under existing conditions, white sturgeon spawning is likely restricted in the Sacramento River to reaches downstream of RBDD (K. Brown, USFWS, pers. comm.).

A summary of white sturgeon life history characteristics is presented in Table B-5. Spawning in California occurs between March and early June, is dependent on water temperature, and takes place in swift, deep water where eggs are broadcast over cobble substrate (Moyle, 1976). Peak spawning in the Sacramento River in 1973 occurred at 58 degrees Celsius (°C) (Kohlhorst, 1976). The timing of white sturgeon spawning in the Sacramento River, based on the recovery of larvae and back calculation of spawning, is shown on Figure B-9. During 1973, it was estimated that white sturgeon in the Sacramento

River downstream of Colusa (RM 145) spawned from mid-February through late May, with 93 percent spawning between March 3 and May 5 (Kohlhorst, 1976). During this investigation, all larvae were captured downstream of RBDD with the majority of larval white sturgeon captured at Colusa (RM 145) and downstream at RM 112.

TABLE B-4
Life History Timing for Native Anadromous Fish in the Sacramento River in the Vicinity of RBDD

Name	Adult Immigration	Spawning	Incubation	Larval/Juvenile Rearing	Juvenile Emigration
White sturgeon	February-May	February-June	Embryos planktonic drifting downstream	Larvae in river, juveniles in Delta	N/A
Green sturgeon	February-June	March-July	Embryos planktonic drifting downstream	Larvae in river, juveniles in Delta	June-August
Pacific lamprey	February-June	Spring-Summer	Brief followed by ammocoete larval stage	Up to 7 years	September-April
River lamprey	February-June	Spring-Summer	Brief followed by ammocoete larval stage	Up to 5 years	March-June

N/A = White sturgeon are not known to spawn upstream of RBDD.

Female sturgeon spawn only about once every 5 years, but may produce nearly 5 million eggs (Moyle, 1976). Larval white sturgeon are flushed downstream and rear in the upper reaches of the Sacramento-San Joaquin Delta and Suisun-San Pablo Bay estuary. Transport into the Suisun-San Pablo Bay estuary is greater in years with high river flows (Kohlhorst, 1976). Except during spawning runs, adult white sturgeon are primarily found in the lower reaches of the Delta and in Suisun/San Pablo and San Francisco bays. White sturgeon are less marine-oriented than green sturgeon and tend to spend most of their lives in the estuaries of large rivers. Little is known about the age and growth of white sturgeon except that they are long lived and reach a maximum size of 4 meters fork length and 590 kilograms.

Green sturgeon have been caught in saltwater from Ensanada, Mexico, to the Bering Sea (Miller and Lea, 1972). In California, green sturgeon have been recorded in lower reaches of the Sacramento-San Joaquin River system, the Eel River, Mad River, Klamath River, and Smith River (Moyle, 1976). In California, spawning has been confirmed only in the Sacramento River and the Klamath River (Moyle et al., 1995). After the construction of Keswick Dam and storage of the reservoir in 1948, the primary spawning areas were from Keswick Dam to Hamilton City (U.S. Fish and Wildlife Service [USFWS], 1998).

USFWS routinely observes adult sturgeon in the vicinity and downstream of RBDD when the dam gates are in (K. Brown, pers. comm.). It is unclear if these are all adult green sturgeon or not. However, to date, all sturgeon larvae that have been captured at RBDD and grown out to determine species have been green sturgeon (D. Killam, pers. comm.). Green sturgeon have been observed downstream of RBDD at Dairyville, Tehama County (RM 234), in the 10-mile reach of the Sacramento River downstream of RBDD, and near Hamilton City, Glenn County (RM 197) (Moyle et al., 1995). Green sturgeon life history characteristics are

summarized in Table B-5. The presumed timing of spawning green sturgeon passing in the vicinity of RBDD is shown on Figure B-10. Adult green sturgeon generally pass RBDD during March though June (K. Brown, pers. comm.).

The habitat requirements for green sturgeon are poorly known, but spawning and larval ecology is likely similar to that of white sturgeon (Moyle et al., 1995). Green sturgeon are thought to require colder and cleaner water than do white sturgeon (Moyle et al., 1995). Spawning occurs between March and July when water temperatures reach between 46°C and 57°C (Moyle et al., 1995). Spawning takes place in swift, deep water (>10 feet) where eggs are broadcast over clean sand to large cobble substrates.

Following egg hatching, larvae drift passively downstream and reach juvenile stages beginning at about 2 cm in length. Juvenile sturgeon are routinely captured in traps at RBDD during the summer months (K. Brown, pers. comm.). The presence of juvenile green sturgeon near RBDD as indicated by trapping data is shown on Figure B-11. The passage timing for juvenile green sturgeon was obtained from data collected from rotary screw trapping investigations conducted downstream of RBDD during 1994 through 2000 (Gaines and Martin, 2001). The majority of juveniles pass through the vicinity of RBDD from June through August (Figure B-11). Juvenile green sturgeon emigrate downstream ~~are transported~~ and rear in the Sacramento-San Joaquin Delta and Suisun-San Pablo Bay estuary for one or more years before entering the deeper San Francisco Bay and exiting into the ocean primarily during the summer and fall before they are 2 years old (Moyle et al., 1995). Individual green sturgeon have been tagged in San Pablo Bay and recovered from Santo Cruz, California, to Gray's Harbor, Washington (Chadwick, 1959 and Miller, 1972 as cited by Moyle, 1995). Little is known about the age and growth of green sturgeon except that they are long lived and reach a maximum size of 2.3 meters fork length and 159 kilograms (Skinner, 1962).

Pacific Lamprey. Pacific lamprey (*Lampetra tridentata*) are distributed along the Pacific coast from Unalaska, Alaska, south to California's Santa Ana River, with populations occurring in most coastal watersheds. In the ocean, Pacific lampreys have been collected off the Japan coastline as well as off Baja, California. In California, large spawning populations are rare south of Monterey Bay (Moyle, 1976). The adults are predatory during the 1- to 2-year period spent in the ocean. It is unlikely that during this oceanic phase adults of this species migrate very far from the mouths of their native spawning streams (Moyle, 1976). Spawning adults range from 12 to 27 inches in total length. Spawning runs into freshwater generally occurs from April to late July. Trapping information at RBDD indicates that adult Pacific lamprey are found to be migrating upstream past RBDD primarily in the spring and summer months (D. Killam, pers. comm.). According to the observations by CDFG and USFWS at RBDD, the presumed timing of adult Pacific lamprey immigration at RBDD occurs as shown on Figure B-12.

Lamprey form a simple nest by dislodging larger stones from a gravel area in moderate current (Moyle, 1976). The nest is a depression with the loosened stones piled at the bottom. Eggs are then released into the pit and eventually buried with more gravels. Depending on size, the fecundity of female Pacific lamprey is from 20,000 to 200,000 eggs (Moyle, 1976). All adult lamprey die after spawning. After hatching, the young lamprey (ammocoetes) stay in the nest gravel for a short period before emerging and disbursing downstream. Following their initial disbursal, ammocoetes locate areas of silt and mud in the river bottom where

they burrow tail first and exist from 3 to 7 years as filter feeders (Moyle, 1976). At a length of approximately 14 to 16 cm the ammocoetes begin to undergo a metamorphosis transformation life stage (termed "transformer") during which they develop into adults. During this phase they develop large eyes, a sucking disc, and change color to silver on sides with a dark back (McPhail and Lindsey, 1970 as cited by Moyle, 1976). The timing of lamprey transformer life stages passing RBDD was obtained from data collected from rotary screw trapping investigations conducted downstream of RBDD during 1994 through 2000 (Gaines and Martin, 2001). From trapping studies conducted at RBDD, the downstream passage of emigrating Pacific lamprey transformers in the Sacramento River is shown on Figure B-13. The transformers of this species occur at RBDD during the fall through early spring (September through April). Following their migration downstream, little is known about the movement or distribution of adults within the lower Sacramento River, Delta, or into the ocean.

River Lamprey. River lamprey are an anadromous species which have been collected in coastal watersheds from Juneau, Alaska to San Francisco Bay, California (Moyle, 1976). In California they appear to be most common in the Sacramento and San Joaquin rivers and their tributaries. They have also been found in the Russian River, and a land-locked population may exist in Sonoma Creek, California (Wang, 1986 as cited by Moyle et al., 1995). The abundance of this species is unknown in California. The biology of river lamprey has not been studied in California; therefore, the following discussion is based on life history information from studies from British Columbia, Canada (Moyle et al., 1995). Unlike Pacific lamprey, adults of river lamprey are parasitic during both freshwater and saltwater phases. This species is much smaller than Pacific lamprey, with adults reaching approximately 10 to 12 inches in length (Moyle et al, 1995). As adults, they prey on a variety of small- to intermediate-sized (4 to 12 inch) fish including salmon and herring (Moyle et al., 1995).

Adult migration is thought to take place in winter months with spawning taking place in clean gravelly riffles and pool tails of small tributaries usually during April and May (Moyle, 1976). The fecundity of female river lamprey is between 11,000 and 37,000 eggs. All adults die after spawning. Similar to Pacific lamprey, the ammocoetes of river lamprey remain buried in silty bottoms of river backwaters and eddies feeding on algae and micro-organisms for 3 to 5 years (Moyle et al., 1995). The silty habitat utilized by river lamprey ammocetes requires high water quality with summer temperatures that do not exceed 25°C (Moyle et al., 1995). Metamorphosis into adults begins when the ammocoetes are approximately 4 inches long during summer months and may take up to 10 months to complete this transformation. According to trapping conducted at RBDD (Gaines and Martin, 2001), the passage/presence of river lamprey transformers at RBDD occurs during the spring and early summer months (March through June) as shown on Figure B-13.

Impacts of Current Operations on Other Native Anadromous Fish

When the dam gates are placed in the river, a physical barrier is created that prevents passage of adult sturgeon. Placement of the dam gates into the river results in complete blockage of migrating adult green sturgeon. Because of their preference for spawning in the lower portions of the Sacramento River, white sturgeon are generally not blocked by RBDD on their spawning migrations (K. Brown, pers. comm.). Currently, a large portion of the green sturgeon spawning run successfully passes RBDD unimpeded because they are

immigrating during months prior to May 15 when the RBDD gates go in (Figure B-10). However, because sturgeon prefer lower water velocity and do not readily jump fish ladder weirs like salmonids, the existing fish ladders that operate during gates-in operations prevents any upstream passage of adult green sturgeon.

Under current operations, approximately 35 percent of adult green sturgeon spawners passing through the project area may be blocked by RBDD. The percentages of entire adult population of green sturgeon that are attempting to pass RBDD and may be impacted are listed by month as follows:

- Late May—approximately 15 percent
- June—approximately 20 percent of the annual upstream of RBDD

In addition, some adult green sturgeon are delayed in their down-river migration by RBDD if these fish arrive at RBDD on or after May 16 when the dam gates go in.

During gates-in periods at RBDD, nearly 100 percent of the larval or juvenile life stages of anadromous green sturgeon migrate downstream (emigrate) through the project facilities. During gates-in operation, existing pathways for these life stages includes passage under the dam gates or through the fish ladders and their auxiliary water systems, or they are subjected to impingement, entrainment, and passage through diversion bypass systems at RPP and TC Canal headworks. An additional effect of the existing operations of RBDD on larvae or juvenile green sturgeon includes predation by both fish and avian species while passing through Lake Red Bluff and downstream of the dam.

The following discussion refers to Figure B-11, which depicts the timing of larval and juvenile green sturgeon passage at RBDD. With the current gates-in operations, a total of approximately 99 percent of annual juvenile green sturgeon passing RBDD are subjected to the operational effects of the dam and it's associated diversion facilities. The annual percentage of juvenile green sturgeon passing RBDD that are presently subject to operational impacts are listed by month as follows:

- Late May—less than 1 percent
- June—37 percent
- July—50 percent
- August—11 percent

A majority of the adults of the two lamprey species are believed to pass RBDD during the months of February through August. Of these, approximately 25 percent of the annual lamprey spawning run may be affected by the gates-in operation (Figure B-12).

The percentages of the entire annual adult migrating population of Pacific and river lamprey passing RBDD that may be affected each month by operation of RBDD are estimated as follows:

- Late May—approximately 10 percent
- June—approximately 5 percent
- July—approximately 3 percent
- August—approximately 2 percent
- Early September—approximately 5 percent

While there may be some impedance of migration during gates-in operation, adult lamprey are known to actively pass through fish ladders at RBDD (D. Killam, pers. comm.) and fish ladders and obstacles at locations throughout the world (Kimsey and Fisk, 1964 as cited by Moyle, 1976). Their ability to attach on to the walls of the ladders allows for their passage through these structures. The potential biological consequences of delay at RBDD results in changes in adult spawning distribution (temporal and spatial), an increase in adult pre-spawning mortality, and decreased egg viability, all of which may result in the reduction of annual recruitment for these species.

During gates-in periods at RBDD, transformer life stages of Pacific lamprey migrate downstream (emigrate) through the project facilities. During gate-in operation, existing pathways for these lamprey life stages at RBDD includes passage under the dam gates or through the fish ladders and their auxiliary water systems, or they are subjected to impingement, entrainment, and passage through diversion bypass systems at RPP and TC Canal headworks. An additional effect of the existing operations of RBDD on lamprey transformers includes predation by both fish and avian species while passing through Lake Red Bluff and downstream of the dam.

The following discussion refers to Figure B-12, which depicts lamprey transformer passage at RBDD. With the current gates-in operations, approximately 6 to 7 percent of the annual run of Pacific lamprey transformers passing RBDD are subjected to the operational effects of the dam and its associated diversion facilities. The annual percentage of Pacific lamprey transformers passing RBDD that are presently subject to operational impacts are listed by month as follows:

- Late May—<2 percent
- June—1 percent
- July—<1 percent
- August—<1 percent
- Early September—less than 5 percent of the annual run at RBDD

The current gates-in operations affect approximately 30 percent of the annual run of river lamprey transformers passing RBDD. The annual percentage of this species passing RBDD that are presently subject to operational impacts are listed by month as follows:

- Late May—<15 percent
- June—>11 percent
- July—none
- August—none
- Early September—<6 percent of the annual run at RBDD

The greatest threat to any of the larval, juvenile, or transformer life stages of these non-salmonid anadromous fish passing through the project area are the direct losses related to passing under the RBDD gates and subsequent predation by Sacramento River pikeminnows and striped bass congregated immediately below the dam. Additionally, predation by avian and fish species within Lake Red Bluff may also be a significant threat to all larval, juvenile, or transformer life stages in the vicinity of RBDD.

Species Listed or Proposed for Listing under ESA or CESA

None of the four species discussed above is currently listed as endangered or threatened or a candidate for listing as endangered or threatened under ESA or CESA. Green sturgeon was petitioned for listing under ESA (June 11, 2001), but NMFS has not yet issued findings of the review of the Petition. However, green sturgeon is a California State Species of Special Concern (SSC), Class 1 (Moyle et al., 1995). River lamprey is a California SSC, Class 3 (Moyle et al., 1995). Anadromous Pacific lamprey is a California SSC, Class 4 (Moyle et al., 1995).

Non-native Anadromous Species (American Shad, Striped Bass)

The two non-native anadromous fish species found in the Sacramento River in the vicinity of the RBDD are: striped bass (stripers) (*Morone saxatilis*) and American shad (*Alosa sapidissima*). Both of these species were introduced into California from the eastern United States between 1871 and 1882 (Moyle, 1976). Striped bass populations were established from a total of 432 fish released into the San Francisco-San Pablo Bay estuary from two shipments delivered in 1879 and ~~1982~~1882. By 1888 a commercial fishery had been established, harvesting in excess of 1.2 million pounds by 1899 (Moyle, 1976). American shad were derived from approximately 830,000 fry collected in New York State and released into the Sacramento River between 1871 and 1881. A commercial fishery for American shad was developed in California by 1879, and over 1 million mature shad were captured in the commercial fishery by 1886, soon glutting the market (Skinner, 1962).

The commercial gill net fishery for striped bass ended in California in 1935 because sport angling took over the fishery (Skinner, 1962). From the 1930s and after, the striped bass fishery was one of the most successful recreational fisheries in California with over 1 to 2 million fish caught by sport fishers every year through at least 1957 (Skinner, 1962). By the 1940s, however, a decline in striped bass populations was noted by CDFG, and populations were severely depleted by 1970. CDFG records indicated that populations declined from an average of 3 million fish in the early 1960s to less than an average of 1.7 million adults by the late 1960s (U.S. Bureau of Reclamation [USBR], 1997). The average adult striped bass population during the period from 1967 to 1991 was approximately 1.25 million fish. By 1990, the annual population of adult striped bass had declined to approximately 680,000 adults. Sport catches of striped bass declined from an average annual catch of more than 300,000 fish in the early 1970s to less than 150,000 by the late 1980s (USBR, 1997). Beginning in 1981, juvenile striped bass were raised in hatcheries and released into the Delta and Bay to supplement the wild populations (USBR, 1997).

The commercial catch for shad in California peaked with over 5.6 million pounds landed in 1917 with an annual average of 1 to 2 million fish landed commercially until 1945. The California Legislature banned the use of gill nets for shad in 1957, virtually eliminating the commercial fishery for shad (Skinner, 1962). Shad was never popular among consumers in the Western United States because it is a bony species, and there were shortages of skilled boners/filleters. Additionally, the flesh of this fish is delicate and does not ship well. The primary use of shad was for its roe, which in the 1950 to 1960s brought 6 to 8 cents a pound (Skinner, 1962). A sport fishery was born for shad in the 1950s following the closure of commercial gill netting. Fly anglers and fishermen using “bump netting” methods caught over 30,00 fish in 1954. It remains a viable sport fishery in the lower Sacramento River to Red Bluff and in the Feather and American rivers. CDFG estimated that population of adult

shad in 1976 and 1977 were approximately 3.04 million and 2.79 million adults, respectively (USBR, 1997).

Habitat Characteristics and Requirements

Striped Bass. Stripers are an anadromous species with adults spawning in freshwater, larvae and juveniles rearing in the Delta, and then migrating between the Delta, San Francisco Bay estuary, and Pacific Ocean as adults. Definite adult spawning migrations occur when mature adults enter the Carquinez Strait from San Francisco Bay in the fall months where they over-winter in Suisun Bay and the Delta (Mitchell, 1987 as cited by USBR, 1997). During the spring months, adults move into the upper Delta and its tributary rivers to spawn. Spawning occurs beginning in April in the Delta and May in the Sacramento River continuing through June. Spawning is dependent on water temperature, and begins when temperatures exceed approximately 58°C. It intensifies when water temperatures are between 63 to 68°C (Mitchell, 1987 as cited by USBR, 1997). Approximately 40 percent of stripers spawn in the Delta and the lower San Joaquin River, and 60 percent spawn in the Sacramento River and its tributaries (USBR, 1997). Spawning occurs during brief "peak" periods when most eggs are released within one or a few days. Moyle (1976) states that two major spawning areas are in the Central Valley: the San Joaquin River from Venice Island downstream to Antioch and the Sacramento River from Isleton upstream to Butte City (approximately RM 165). The habitat requirements for striped bass are presented in Table B-6.

Striped bass are mass spawner, broadcasting eggs and sperm into the water column, in a group of 5 to 30 fish near the surface of the main current, usually in the late afternoon or early evening. Fertilized egg are slightly denser that fresh water, and they slowly sink to the bottom in slow currents (Moyle, 1976) and are transported greater distances in swifter currents. Eggs hatch within approximately 2 days and have absorbed their yolk sac within approximately 7 to 9 days depending on the water temperature. Larvae begin feeding on zooplankton and increase in size and swimming ability. Early larval striped bass are poor swimmers. Eggs and larvae are transported by river currents within the Sacramento River into the Delta before larvae begin external feeding. The location of their geographic delivery into the Delta is a function of the volume of flows in the Sacramento River during egg and larval transport. Larval stages last 4 to 5 weeks before obtaining all the characteristics of juvenile fish. By July they will have grown to approximately 38 millimeters (mm) (USBR, 1997). The juveniles remain in the Delta or Suisun Bay depending on outlfows through the Delta where they forage and grow. Young-of-the-year striped bass move downstream into the Suisun or San Pablo bays during the late fall and winter . Their movements as juveniles following their first winter is similar to adults, migrating downstream into San Francisco Bay and Pacific Ocean in the summer and into Suisun Bay/Delta in the winter.

TABLE B-6
Habitat Requirements for Common Native and Non-native Resident and Anadromous Fish in the Vicinity of RBDD (Moyle, 1976)

Common Name	Scientific Name	Temperature Requirements	Preferred Spawning Habitat; Substrate	Adult Food Preference	Preferred Habitat Types	Notes or Comments
Striped Bass	*Morone saxatilis*	Spawning at 58-70°F (63-68 F optimal)	Broadcast spawns in moving water; n/a	Highly predatory of fish	Open water-pelagic predators	Extensive migratory patterns in the rivers, Delta, San Francisco Bay and ocean
American Shad	*Alosa sapidissima*	Spawning at 59-68°F	Broadcast spawns in moving water over sand, gravel, cobble	Large zooplankton, insects, crustaceans, molluscs	Prefers open water, but young will feed in dead-ended sloughs	Primarily found in saltwater except to spawn and early life stages
Sacramento Splittail	*Pogonichthys marcrolepidotus*	Optimal abundance in Delta: 59-73°F	Spawning over flooded vegetation in dead-ended sloughs	Bottom feeders: benthic invertebrates, insects, zooplankton, worms, and molluscs	Slow moving sections of main channel in rivers and sloughs	Tolerant of salinities up to 10-18 ppt; presently found in very restricted portions of their historical range
Hardhead	*Mylopharodon conocephalus*	Warm water conditions typical of low- to mid-elevation streams	Low-velocity riffles with gravel, (thought to be mass spawners)	Filamentous algae, small invertebrates, aquatic plants	Clear warm streams with large deep, rock and sandy bottom pools	Found in undisturbed sections of larger streams; move into smaller tributaries to spawn
Sacramento Pikeminnow	*Ptychocheilus grandis*	Do not flourish in waters less than 59°F; spawn above 57°F	Gravel riffles, congregate to spawn over rocky-gravely areas	Highly predatory on fish and crayfish	Clear well-shaded sand-rock bottomed pools with rocks/logs	Sedentary habits, often remaining in one pool for long intervals; also known to migrate up-, downstream to spawn and forage
Sacramento Sucker	*Catostomus occidentalis*	Wide temperature range, most abundant in cool streams-pools	Congregate over clean gravel	Filamentous algae, detritus, invertebrates associated with the bottom	Feed in small groups at head of pools or edge beds of aquatic vegetation; deep pools	Typically spend 2-3 years in natal stream before migrating into larger rivers with high water (in the fall)

ppt = parts per thousand.
°F = degrees Fahrenheit.

Near the project area, adult striped bass are known to begin congregating in the late spring/early summer month in the vicinity of RBDD. These fish move into the project area after spawning in downstream areas of the Sacramento River (M. Tucker, pers. comm.). From investigations conducted to determine predatory habits of Sacramento pikeminnow and striped bass, Tucker et. al., (1998) determined that the average catch per hour for striped bass captured near RBDD peaked in July during the years 1994 to 1996 (Figure B-14). As shown on Figure B-14, striped bass are present near RBDD from May through October.

During this period, adult striped bass congregate downstream of RBDD to prey on any appropriately sized juvenile fish, including salmonids that pass through the diversion complex (under the dam gates, through the fish ladders, or through the diversion bypasses). Striped bass are generally not known to pass through the fish ladder at RBDD (M. Tucker, pers. comm.).

American Shad. American shad are anadromous fish that are found in freshwater only when they move inland to spawn. Young shad migrate into saltwater almost immediately after hatching, and spend the majority of their lives (3 to 5 years) in saltwater (Moyle, 1976). Adult shad move into the lower San Francisco Bay estuary in the fall but do not move into freshwater until temperatures exceed 50-52°C, usually in late March or April. Spawning runs begin in late May or June when water temperatures reach 59°C or greater. Some evidence has indicated that increased flows initiate spawning runs, not just temperature (Painter et al., 1980 as cited by USBR, 1997). Spawning runs will continue until water temperatures exceed 68°C, usually in July. Spawning is done in mass in the main channels of the San Joaquin and Sacramento rivers and their tributaries. In the mainstem Sacramento River, shad spawning runs reach as far as unimpeded passage allows. Presently, passage of shad is generally blocked at RBDD. American shad do not pass above RBDD when the gates are in (D. Killam, pers. comm.) and generally do not use ladders to any appreciable extent (Skinner, 1962). Most shad die following spawning, but some return to the ocean following their spawning run. The estimated seasonal distributions of adult and larval American shad in the Sacramento River near Red Bluff are shown on Figure B-15. Shad eggs are slightly heavier that water and drift near the bottom of the currents they are spawned in. Hatching is completed in 6 days or more, depending on water temperature. Shad larvae and juveniles remain in the Delta until late summer when the juveniles are approximately 8 to 18 mm and they enter saltwater (Moyle, 1976). As previously stated, shad remain in the ocean for up to 5 years and are believed to undergo wide migrations along the Pacific Coast of California before returning to spawn in the Sacramento/San Joaquin rivers.

Impacts of Current Operations on Non-native Anadromous Fish

As stated previously, gates-in operations at RBDD results in restricting adult striped bass to reaches downstream of the dam following their spawning in the lower reaches of the Sacramento River. Because of either their inability or desire to distribute upstream of RBDD, stripers congregate downstream of and feed on juvenile fish passing the facilities at RBDD (Tucker et al., 1998). Therefore, predatory striped bass near RBDD are benefited by the creation of a "feeding station" when juvenile fish migrate through the vicinity. Striped bass are not recognized as spawning or rearing in the Sacramento River upstream of RBDD. Therefore, there are no adverse impacts to these life stages as result of RBDD operations.

American shad generally do not use the existing fish ladders at RBDD. Therefore, this species are prevented from migrating upstream of RBDD to spawn by the gates-in operations. This restriction however, does not likely adversely affect their population because this reach of the Sacramento River is at the northernmost extent of their geographic range in the Sacramento River watershed. Optimal spawning temperature for American shad is 62 to 70°F (Skinnner, 1962), and these water temperatures are unlikely to occur in the Sacramento River during the period when American shad are in the vicinity of RBDD. Consequently, American shad are only occasionally observed upstream of RBDD (USBR, 1997).

Resident Native and Resident Non-native Species (Pikeminnow, Rainbow Trout, and Others)

Habitat Characteristics and Requirements

As shown in Table B-1, large number of native and non-native resident species are found in the Sacramento River near RBDD. Principal species include: Sacramento pikeminnow, hardhead, hitch, Sacramento splittail (all *Cyprinid* species), resident rainbow trout, and Sacramento suckers. Life history characteristics for many of these species are shown in Table B-6. A large number of non-native sportfish species including large and smallmouth bass, various sunfish, catfish, and crappie, as well as brown trout, are commonly found near RBDD. Non-game species such as carp, shiners, minnows, and mosquito fish are also commonly found at RBDD. Many of these species have life histories that requires them to move up and downstream of the dam seasonally for spawning, rearing, or foraging life stages.

Sacramento Pikeminnow. In the case of the highly predatory Sacramento pikeminnow (formerly referred to as squawfish), current RBDD gates-in operations result in large congregations of adults that are known to prey heavily on Chinook salmon smolts as they pass through RBDD. Several investigators have conducted predation assessments on pikeminnows and have concluded that predation is a serious threat to juvenile salmonids passing RBDD. In studies conducted by USFWS it was determined that predation is the primary cause of downstream migrant salmon mortalities at RBDD (Vogel et al., 1988). This investigation estimated that losses from predation, primarily by pikeminnows, are substantial and may range up to 55 percent of smolts passing RBDD. Tucker et al., (1998) found that in their investigations, the relative abundance of predatory pikeminnows at RBDD was lower than previous estimates. However, from their studies, Tucker et al., (1998) determined that the highest densities of pikeminnows occurred in the spring and early summer months when RBDD gates are in and when pikeminnows were attempting to migrate upstream to spawn. The stomach contents of pikeminnows captured near RBDD consisted predominately of juvenile salmonids but only during months when the RBDD gates were in (Tucker et al., 1998).

Populations of this species are generally not known. Some recent investigations however have determined the seasonal changes in the relative abundance of Sacramento pikeminnow near RBDD (Tucker et al., 1998). Pikeminnows are known to use the existing fish ladders at RBDD to migrate upstream during their spawning season. A summary of the current pattern of Sacramento pikeminnow presence near RBDD is shown on Figure B-16. This figure depicts the current relative abundance of predatory pikeminnows near RBDD.

Rainbow Trout. Resident native rainbow trout also are found in the Sacramento River near RBDD. The adults of this species migrate seasonally within the Sacramento River, but unlike steelhead, do not return to the ocean. Adult fish are known to use the existing ladders at RBDD to pass upstream, and juveniles are commonly observed at RBDD (D. Killam, pers. comm.) (Figure B-17). Adult rainbow trout migrate through RBDD as shown on Figure B-17. These fish are seeking upstream or tributary locations for spawning and/or are re-distributing within the Sacramento River to forage. It is difficult to differentiate between juvenile rainbow trout and steelhead as they're captured passing through RBDD. For the purposes of the analysis of impacts to juveniles of this species, it was assumed that rainbow

trout and steelhead pass through RBDD as shown on Figure B-17. The timing of juvenile rainbow trout passing RBDD was obtained from data collected from rotary screw trapping investigations conducted downstream of RBDD during 1994 through 2000 (Gaines and Martin, 2001).

Other Resident Species. Population of other resident native species including hitch, hardhead, and Sacramento suckers have life histories that include seasonal migrations and re-distributions that, for the most part, are largely unaffected by operations of RBDD. Adults of some of these species are known to seasonally pass through the ladders at RBDD (e.g., hardheads and Sacramento suckers) (D. Killam, pers. comm.). Juveniles of these species are found at RBDD and are less preferred as forage species by the large predators that seasonally congregate at RBDD. The presumed presence and passage of adult hardheads and Sacramento suckers are shown on Figure B-18. Trapping investigations conducted by USFWS have determined the presence and the passage of juvenile hardheads and Sacramento suckers as shown on Figure B-19 (Gaines and Martin, 2001). The operations of RBDD may largely be inconsequential to populations of non-native resident species such as bass, sunfish, and others. Furthermore, the status of these species populations is generally unknown.

Impacts of Current Operations on Resident Native and Non-native Fish

Operation of the gates at RBDD may not directly adversely affect populations of most of the resident species, but operations may seasonally limit their access into optimal habitats. Rates of predation on juveniles of species such as rainbow trout and other native species near RBDD may be affected by the operations of the RBDD because of the congregation of adult pikeminnows and striped bass. Except for juvenile rainbow trout, predation on juvenile resident native and non-native fish may be inconsequential, as these species are less-preferred prey.

Species Listed or Proposed for Listing under ESA or CESA

Sacramento splittail (*Pogonichthys macrolepidotus*) was first listed by the USFWS as federal threatened on February 8, 1999. This listing applies to this species throughout its entire range within California. Splittail are native to California's Central Valley, where they were once widely distributed (Moyle, 1976). Historically, splittail were found as far north as Redding on the Sacramento River. In recent times, dams and diversions have increasingly prevented splittail from upstream access to the large rivers, and the species is now restricted to a small portion of its former range (Moyle and Yoshiyama, 1992). However, during wet years, they migrate up the Sacramento River as far as RBDD (Federal Register 64:25, February 8, 1999).

Splittail abundance varies widely in response to environmental conditions, but the general population numbers are declining. The splittail is primarily threatened by the altered hydraulics and reduced Delta outflow caused by the export of freshwater from the Sacramento and San Joaquin rivers through operation of the state and federal water projects (Federal Register 64:25, February 8, 1999). Additional threats to this species include:

1. Direct and indirect mortality at power plants and in-Delta water diversion sites

2. Reduced river flows and changes in the seasonal patterns of flows in the Sacramento and San Joaquin rivers and their tributaries
3. Loss of spawning and nursery habitat as a consequence of draining and diking for agriculture
4. Loss of shallow-water habitat from levee slope protection, marina construction, and other bank oriented construction activities
5. Reduction in the availability of highly productive brackish-water habitat
6. Presence of toxic substances, especially agricultural and industrial chemicals and heavy metals in their aquatic habitat
7. Human and natural disturbance of the food web through altered hydrology and introduction of exotic species
8. Flood control operations that strand eggs, larvae, juveniles, and adults
9. Increase in severity of these effects by 6 years of drought
10. Entrainment of fish through unscreened or inadequately screened municipal and agricultural diversions

Environmental Consequences

Methodology

The analysis of the environmental consequences was conducted by comparing each of the proposed alternatives with the No Action Alternative (NAA). Each fish species' adult and juvenile monthly and annual passage indices calculated and obtained as output from the Fishtastic! analysis tool were used to compare the effects of each alternative. See Attachment B1 of this appendix for a description and discussion of the development of Fishtastic!, its methodology, and assumptions.

The analyses of the environmental consequences to fisheries resources through the use of the Fishtastic! tool was conducted for a large number of fish species that were identified by various resources agency participants. However, the available information and knowledge of life history characteristics at RBDD for many of these species (e.g., Sacramento sucker) limited the usefulness of this analysis tool. Therefore, the bulk of the analysis output from Fishtastic! was directed at those species for which a large amount of life history information is available. These species, termed the "focus species" in this analysis, included:

- Winter-run Chinook Salmon
- Spring-run Chinook Salmon
- Fall-run Chinook Salmon
- Late-fall-run Chinook Salmon
- Steelhead
- Rainbow Trout
- Green Sturgeon
- Pacific Lamprey
- River Lamprey

Compared to many of the salmonid species, less is known of the river lamprey's life history characteristics. However, this species is a California Species of Special Concern (SSC) and a native anadromous species known to transit RBDD. Therefore, this species was analyzed using the Fishtastic! impact analysis tool. Finally, because it is a native anadromous species, has similar morphology and somewhat similar life history characteristics, and is commonly known to transit RBDD, the Pacific lamprey was also analyzed using the Fishtastic! impact analysis tool.

For the remaining fish species, a qualitative evaluation was conducted to determine the environmental consequences of project alternatives.

Significance Criteria

Significance criteria represent the thresholds that were used to identify whether an impact or benefit would be potentially measurable. Under the California Environmental Quality Act (CEQA), any adverse impact to State Listed Species would be considered significant, and mitigation would be required to reduce impacts to less than significant levels.

For the purposes of distinguishing project alternatives from No Action, the following significance criteria for evaluating passage improvements were used in the analyses of impacts and benefits:

- No Difference in Passage Indices = No change
- <10-percent Difference in Passage Indices = No measurable impact (-) or benefit (+)
- ≥10-percent <25-percent Difference in Passage Indices = Measurable impact (-) or benefit (+)
- ≥25-percent Difference in Passage Indices = Large measurable impact (-) or benefit (+)

Analyses of the Environmental Consequences of Project Alternatives to Fishery Resources

This section provides a discussion of the consequences of the project alternatives on fishery resources as compared to NAA. Additional analyses of the consequences of project alternatives on fishery resources are provided in Attachment B2 of this appendix. The impact analysis is conducted for four groups of fish commonly found at RBDD: NAS, NAO, NNA, and RN and RNN.

The results of the analysis of the project alternatives are summarized and discussed in the sections below. In the case of adult life stages of the four fish groups listed above, a discussion of the consequences of all of the alternatives listed below are provided in the Summary Results section and Alternatives Discussion sections that follow. For analysis purposes, it was assumed that there would be no impacts or benefits to juvenile life stages from the ladder and/or bypass elements of the alternatives. Therefore, the summary and discussion of the consequences for juveniles are presented in the summary discussion sections as noted below. The project alternatives analyzed include:

- No Action Alternative (NAA)—(presented for adults and juveniles)
- 1A: 4-month Improved Ladder Alternative—(presented for adults)
- 1B: 4-month Bypass Alternative—(presented for adults)

- 4-month Gates-in—(presented for juveniles)
- 2A: 2-month Improved Ladder Alternative—(presented for adults)
- 2B: 2-month with Existing Ladders Alternatives—(presented for adults)
- 2-month Gates-in—(presented for juveniles)
- 3: Gates-out Alternative—(presented for adults and juveniles)

Summary of Consequences

The results of the Fishtastic! analyses are present in Tables B-7 through B-12. These tables provide the summary of the passage index scores (scaled to 100 as a maximum value). The index values represent the approximate portion of the species and lifestage that is un-affected by operations of the RBDD facilities for the entire calendar year. For example, an adult passage index of 89 means that approximately 89 percent of the entire annual population would pass RBDD and Lake Red Bluff without blockage, delay or some loss or injury.

Additionally, these tables present the percent difference between existing conditions and the No Action Alternative; the percent difference between an alternative and NAA; the percentage improvement over the NAA, and a measure of effect based on the significance criteria provided above.

Summary tables for adult fish passage are as follows:

- Table B-7—NAS species
- Table B-9—NAO species
- Table B-11—RN (rainbow trout)

Summary tables for juvenile fish passage are as follows:

- Table B-8—NAS species
- Table B-10—NAO species
- Table B-12—RN (rainbow trout)

The analysis of the consequences of changes in passage indices for adult native anadromous salmonid species (NAS) is summarized in Table B-7. In this table, the calculated adult passage indices are presented for each of the five species and the differences from those for the NAA. Also summarized in Table B-7, for each species, are the percentage improvement from NAA and the effect of each alternative compared to NAA.

The analysis reveled that, in all cases, for all species and all alternatives, the adult passage indices were equal to or greater than those for NAA. Therefore, no alternative resulted in measurable adverse impacts to adults of any of the five NAS species.

TABLE B-7
Index Value, Relative Difference, and Improvement in Passage Index for Adult Anadromous Salmonids between Existing Conditions and NAA, and NAA and Project Alternatives

Alternative	Index Value	Difference	Percent Improved	Effect	Index Value	Difference	Percent Improved	Effect
	Winter-run Chinook Salmon				**Spring-run Chinook Salmon**			
NAA	89	n/a	n/a	*No Change*	52	n/a	n/a	*No Change*
1A	91	2	2	*No Measurable Benefit*	61	8	16	*No Measurable Benefit*
1B	91	1	1	*No Measurable Benefit*	57	5	9	*No Measurable Benefit*
2A	98	8	9	*No Measurable Benefit*	94	41	79	*Large Measurable Benefit*
2B	98	8	9	*No Measurable Benefit*	93	40	77	*Large Measurable Benefit*
3	100	10	12	*Measurable Benefit*	100	48	91	*Large Measurable Benefit*
	Fall-run Chinook Salmon				**Late-fall-run Chinook Salmon**			
NAA	83	n/a	n/a	*No Change*	100	n/a	n/a	*No Change*
1A	86	3	4	*No Measurable Benefit*	100	0	0	*No Change*
1B	85	2	2	*No Measurable Benefit*	100	0	0	*No Change*
2A	91	8	8	*No Measurable Benefit*	100	0	0	*No Change*
2B	89	6	8	*No Measurable Benefit*	100	0	0	*No Change*
3	100	17	20	*Measurable Benefit*	100	0	0	*No Change*
	Steelhead							
NAA	89	n/a	n/a	*No Change*				
1A	91	2	2	*No Measurable Benefit*				
1B	90	1	1	*No Measurable Benefit*				
2A	97	8	9	*No Measurable Benefit*				
2B	96	7	8	*No Measurable Benefit*				
3	100	11	12	*Measurable Benefit*				

The results of the analyses of changes in juvenile native anadromous salmonid passage indices are summarized in Table B-8. In this table, the calculated juvenile passage indices are presented for each of the five species and their differences from those for the NAA. Also summarized in Table B-8, for each species, are the percentage improvement from NAA and the effect of each alternative compared to NAA.

In all cases, for all species and all alternatives, the juvenile passage indices were equal to or greater than those for NAA. Therefore, no alternative resulted in measurable adverse impacts to juveniles of any of the five NAS species.

The principal NAO fish species occurring at RBDD are green and white sturgeons and Pacific and river lampreys. Of these, the Fishtastic! analyses focused on the green sturgeon, because this species is known to congregate downstream of RBDD during periods when the dam gates are in place (K. Brown, pers. comm.). An additional non-native anadromous species, white sturgeon, are believed to migrate into lower segments of the Sacramento River to approximately Colusa (River Kilometer 231) to spawn (Schaffter, 1997). However, this species are generally not known to spawn upstream of RBDD. For this reason, it was assumed for the analysis that white sturgeon are not presently affected by operations at RBDD, and further impacts analysis was not conduced.

The timing and passage of both of the lamprey species are less precisely known than the anadromous native salmonid species. Therefore, conclusions concerning these species are based on their general life history characteristics, their physical morphology, and their observed passage at RBDD. The summary of the passage indices for all alternatives for adult NAO species is shown in Table B-9. Juvenile passage indices for all project alternatives and NAA for juvenile green sturgeon and transformer life stages of the lamprey species are shown in Table B-10.

The adult passage index values for rainbow trout for all alternatives are summarized in Table B-11. The juvenile passage indices for rainbow trout for all alternatives are shown in Table B-12.

No Action Alternative

Under NAA, there would be no impacts or benefits to adult or juvenile fishery resources from the construction/expansion of RPP. The expansion of the existing RPP would be built within the existing off-channel footprint of RPP and not within the Sacramento River proper.

Operations under NAA would result in no adverse impacts or benefits to fishery resources compared to existing conditions. Under NAA, the RPP's capacity would be expanded to 320 cubic feet per second (cfs) from 240 cfs (existing conditions). There would be no measurable adverse impacts or benefits from this operational increase in pumping capacity because the fundamental assumption for all new screened diversion elements, including those for the expansion of the RPP, was that all screens and bypasses would meet all requirements and criteria for the protection of juvenile fish.

TABLE B-8
Index Value, Relative Difference, and Improvement in Passage Index for Juvenile Anadromous Salmonids between Existing Conditions and NAA, and NAA and Project Alternatives

Alternative	Index Value	Difference	Percent Improved	Effect	Index Value	Difference	Percent Improved	Effect
	Winter-run Chinook Salmon				**Spring-run Chinook Salmon**			
NAA	96	n/a	n/a	*No Change*	100	n/a	n/a	*No Change*
4-Month Gates-in	96	0	0	*No Change*	100	0	0	*No Change*
2-Month Gates-in	99	3	3	*No Measurable Benefit*	100	0	0	*No Change*
Gates-out	100	4	4	*No Measurable Benefit*	100	0	0	*No Change*
	Fall-run Chinook Salmon				**Late-fall-run Chinook Salmon**			
NAA	97	n/a	n/a	*No Change*	93	n/a	n/a	*No Change*
4-Month Gates-in	97	0	0	*No Change*	93	0	0	*No Change*
2-Month Gates-in	100	2	2	*No Measurable Benefit*	98	4	5	*No Measurable Benefit*
Gates-out	100	3	3	*No Measurable Benefit*	100	7	7	*No Measurable Benefit*
	Steelhead							
NAA	92	n/a	n/a	*No Change*				
4-Month Gates In	92	0	0	*No Change*				
2-Month Gates In	99	6	7	*No Measurable Benefit*				
Gates-out	100	8	8	*No Measurable Benefit*				

TABLE B-9
Index Value, Relative Difference, and Improvement in Passage Index for Adult Other Native Anadromous Species between Existing Conditions and NAA, and NAA and Project Alternatives

Alternative	Index Value	Difference	Percent Improved	Effect	Index Value	Difference	Percent Improved	Effect
	Green Sturgeon				**Pacific Lamprey**			
NAA	65	n/a	n/a	*No Change*	83	n/a	n/a	*No Change*
1A	65	0	0	*No Change*	86	3	4	*No Measurable Benefit*
1B	69	4	6	*No Measurable Benefit*	85	2	2	*No Measurable Benefit*
2A	100	35	54	*Large Measurable Benefit*	97	14	17	*Measurable Benefit*
2B	100	35	54	*Large Measurable Benefit*	96	13	16	*Measurable Benefit*
3	100	35	54	*Large Measurable Benefit*	100	17	20	*Measurable Benefit*
	River Lamprey							
NAA	83	n/a	n/a	*No Change*				
1A	86	3	4	*No Measurable Benefit*				
1B	85	2	2	*No Measurable Benefit*				
2A	97	14	17	*Measurable Benefit*				
2B	96	13	16	*Measurable Benefit*				
3	100	17	20	*Measurable Benefit*				

TABLE B-10
Index Value, Relative Difference, and Improvement in Passage Index for Juvenile (and transformers) for Other Native Anadromous Species between Existing Conditions and NAA, and NAA and Project Alternatives

Alternative	Index Value	Difference	Percent Improved	Effect	Index Value	Difference	Percent Improved	Effect
	Green Sturgeon Juveniles				**Pacific Lamprey Transformers**			
0	73	n/a	n/a	*No Change*	99	n/a	n/a	*No Change*
4-Month Gates-in	73	0	0	*No Change*	99	0	0	*No Change*
2-Month Gates-in	88	15	21	*Measurable Benefit*	100	1	1	*No Measurable Benefit*
Gates-out	100	27	38	*Large Measurable Benefit*	100	1	1	*No Measurable Benefit*
	River Lamprey Transformers							
NAA	87	n/a	n/a	*No Change*				
4-Month Gates-in	87	0	0	*No Change*				
2-Month Gates-in	100	13	15	*Measurable Benefit*				
Gates-Out	100	13	15	*Measurable Benefit*				

TABLE B-11
Index Value, Relative Difference, and Improvement in Passage Index for Adult Rainbow Trout between Existing Conditions and NAA, and NAA and Project Alternatives

Alternative	Index Value	Difference	Percent Improved	Effect
NAA	73	n/a	n/a	*No Change*
1A	78	5	7	*No Measurable Benefit*
1B	76	3	4	*No Measurable Benefit*
2A	91	18	25	*Measurable Benefit*
2B	90	17	23	*Measurable Benefit*
3	100	27	37	*Large Measurable Benefit*

TABLE B-12
Index Value, Relative Difference, and Improvement in Passage Index for Juvenile Rainbow Trout between Existing Conditions and NAA, and NAA and Project Alternatives

Alternative	Index Value	Difference	Percent Improved	Effect
NAA	92	n/a	n/a	*No Change*
4-Month Gates-in	92	0	0	*No Change*
2-Month Gates-in	99	7	7	*No Measurable Benefit*
Gates-out	100	8	8	*No Measurable Benefit*

1A: 4-month Improved Ladder Alternative

Construction. Impacts from constructing fish ladder and pump stations, including screens and bypasses, would include direct and indirect losses of adult and or juvenile fish. These

impacts would principally occur during installation of cofferdams. The construction areas would include areas near the existing east and west bank fish ladders and the new pump station location at the "Mill Site." At the Mill Site, a large sheet pile cofferdam would be required, up to approximately 1,400 LF. Construction of the right bank fish ladder would require a 270-LF sheet pile cofferdam. Construction of the left bank fish ladder would require installation of a 166-LF sheet pile cofferdam.

In addition, impacts could also occur at these locations because of de-watering active channel areas following sheet pile installation. Acoustic shock from pile driving activities could destroy any incubating embryos within 200 feet of any sheet pile installation. Both adults and juveniles could be physically crushed during earth movement or sheet pile installation. Both adults and juveniles may be stranded and lost during de-watering actions following the installation of sheet piling.

These activities would adversely affect migrating adults, rearing stages of fry and juveniles, and migrating smolts. These impacts would be significant and would require mitigation or conservation measures, depending on species, to reduce these impacts to less than significant.

Additionally, direct losses and adverse indirect effects to adults, embryos, and juvenile life stages would occur as a result of sediment disturbances and turbidity that would result from construction of project fish ladders and pump stations. These impacts would be significant and would require mitigation to reduce them to less than significant.

Operations. No significant adverse impact to fishery resources would occur with operations of this alternative. Therefore, no mitigation is required.

Native Anadromous Salmonids (NAS)

Adults. As previously discussed and shown in Table B-7, the adult passage index values for the 4-month Improved Ladder Alternative for NAS are equal to or greater than those for the NAA. The index values for these species are shown on Figure B-20. There is no change in the adult passage index for late-fall Chinook salmon from implementing this alternative (Table B-7). This is because this species does not immigrate through RBDD during the gates-in operational period (mid-May through mid-September). There are small improvements (2 to 4 percent) in passage indices for adult winter-run and fall-run Chinook salmon and steelhead . There is a measurable improvement for adult spring-run Chinook salmon (16 percent). While the percent improvement in the passage index for adult spring-run Chinook salmon seems relatively large (16 percent), the overall annual passage index for this species remains a rather low 61 out of a possible 100 (Table B-7).

These small improvements in adult passage are a result of increased efficiencies in attraction to and passage within the new fish ladders featured in this alternative. Except for spring-run Chinook, the magnitude of these improvements however, is generally not sufficiently beneficial to be considered a measurable improvement for adult passage of NAS species. Rather large components (approximately 39 percent) of threatened adult spring-run salmon would continue to be blocked or impeded under this alternative. In addition, approximately 9 percent of endangered winter-run Chinook salmon and threatened adult steelhead would also continue to be blocked or impeded by the gates at RBDD under this alternative (Figure B-20).

Juveniles. The juvenile passage indices for the NAS species are rather large (greater than 92 on a scale of 100) (Table B-8). For the 4-month Improved Ladder Alternative, there are no differences in the juvenile passage indices for the NAS species as compared to NAA. This result is because of the lack of operational changes (Gates In/Out) for this alternative that affects the principal impact mechanism for juvenile anadromous salmonids at RBDD, namely, predation. The juvenile passage indices for the NAS, NAO, and RN/RNN species analyzed using the Fishtastic! tool are presented on Figure B-22.

Other Native Anadromous Species (NAO)

Adults. The adult passage indices for the three NAO species for the 4-month Improved Ladder Alternative are equal to or greater than those for NAA (Table B-9). These indices are also shown on Figure B-21. There is no improvement in the adult passage index for green sturgeon from implementing this alternative (Table B-9). This is because this species does not generally successfully use fish ladders constructed for salmonid species, and even with improvement in the fish ladders, this species would not benefit.

The small (4 percent) improvements in adult Pacific and river lamprey passage indices are a result of increased efficiencies in attraction to and passage within the new fish ladders featured in this alternative. However, the magnitude of these improvements are not sufficiently beneficial nor a measurable improvement for adult passage. For all project alternatives and NAA, the passage indices for the lamprey species are great (>83 on a scale of 100) because of these species' passage timing and their efficiency in passing ladders (Table 9). Lamprey are known to transit fish ladders by physically attaching to the ladder structures with their oral disc (sucker) (Killam, pers. comm.), thereby resting between bursts of swimming activity while passing through the ladder.

Juveniles. For this alternative, there are no differences in the juvenile passage indices for green sturgeon and the transformer lifestages for the lamprey species as compared to NAA (Table B-10). This result is because of the lack of operational changes for this alternative that affects the principal impact mechanism for juveniles or transformers of these species at RBDD, namely, predation. Juvenile/transformer passage indices are shown on Figure B-22.

Non-native Anadromous Species (NNA)

Adults. Non native anadromous species that may occur periodically at RBDD include American shad (shad), and striped bass (stripers). These species more commonly occur in the lower portions of the Sacramento River and Delta but seasonally occur at RBDD. In is not necessary for either of these introduced species to migrate to areas upstream of RBDD to spawn or rear their young. Adult shad would be expected to arrive at RBDD during their spawning run primarily from May through July. However, this species does not generally use fish ladders successfully that are primarily designed to pass salmon, steelhead, or trout. For this species, little if any benefit would be expected to occur from the implementation of the 4-month Improved Ladder Alternative. Furthermore, the continued impedance of shad from passing RBDD is not likely to adversely affect the continued success of this species.

New ladders on the east and west banks would provide additional flow and passage improvement for salmonids but would likely not measurably improve adult passage of striped bass. It has been observed that striped bass arrive at RBDD in the spring/early summer months after spawning in the lower reaches of the Sacramento and Feather Rivers. After arriving at RBDD stripers seem prefer to remain immediately downstream of the dam.

These highly predatory fish continue to forage on juvenile fishes passing through the dam (Tucker, pers. comm.). It is unlikely that this alternative would measurably alter their behavior and therefore this alternative would not alter passage of adult of either American shad or striped bass.

Juveniles. Juvenile striped bass are not likely to be present in the project area as they are typically spawned in the lower reaches of the Feather and Sacramento rivers and rear in the Sacramento-San Joaquin River Delta. There would be no change from NAA in operations that would affect juvenile American Shad. Therefor this alternative would provide neither any benefit nor adverse impact to juveniles of either shad or striped bass.

Resident Native and Resident Non-native Species (RN/RNN)

Adults. Rainbow trout are a species of native resident fish that were analyzed using the Fishtastic! tool. For the 4-month Improved Ladder Alternative, the adult rainbow trout passage index is approximately 7 percent greater than that for NAA (Table B-10). The small improvement in adult rainbow trout passage for this alternative is a result of increased efficiencies in attraction to and passage within the new fish ladders featured in this alternative. However, the change in adult passage index for this species is small and not considered a measurable improvement for rainbow trout. A rather large component (22 percent) of adult rainbow trout remains blocked or impeded by the gates at RBDD with this alternative Figure B-20.

Other than rainbow trout, the principal resident native species found near RBDD include Sacramento pikeminnow, splittail, hardhead, and Sacramento sucker. These species have evolved within the Sacramento River and have distinct life history characteristics and requirements. All of these species maintain residency within the freshwater portion of the Sacramento River watershed. However, these species do migrate upstream and downstream throughout the river system to meet their spawning, rearing, and foraging needs. In that way, the operations of RBDD can hinder these species to a greater or lessor degree depending on time of year and the species needs.

Adult Sacramento pikeminnow (formerly squawfish) are known to migrate upstream in the spring months spawn and therefore when the RBDD gates go in these fish tend to congregate below the dam. Operation of RBDD under the Reasonable and Prudent Alternatives specified in the Winter-run Chinook Salmon Biological Opinion (NMFS, 1993) which specified that the gates may not go in prior to May 15th, have greatly reduced the impacts of predation on salmonids from pikeminnows. This species can and does readily pass through the existing fish ladders at RBDD. However, there continues to be a congregation of predators, including pikeminnows, downstream of RBDD under existing conditions and the NAA. Tucker (1998) found that during sampling during 1994-1996, the largest catch/per/unit effort (26 percent of annual total) of Sacramento pikeminnows occurred at RBDD during June when the gates are in.

Under the 4-month Improved Ladder Alternative there may be additional passage opportunity provided for adult pikeminnow through the new fish ladders proposed for the left and right banks. However, the incremental increase in ladder passage provided to pikeminnows by the new ladders is likely to be small and not measurable. Other species such as hardhead, and Sacramento suckers are also not likely to measurably benefit from this alternative. These species also are known to successfully use fish ladders but their

passage is greatly restricted by fish ladders principally designed for salmonids. Ladder modifications to attract and pass salmonids may increase their use by these species but not likely to a large degree. Splittail do not successfully pass fish ladders and therefore would not benefit from this alternative.

Adult passage of other resident non-native species (e.g. brown trout) may benefit somewhat from this alternative as this species readily passes fish ladders. Most of the other resident non-native fishes such as basses, sunfishes, catfishes and shiners that are commonly found near RBDD (see Table B-1) would not benefit from this alternative. On the other hand, most of these non-native species have life history characteristics that do not require migration over large geographic distances and therefore passage impediments such as RBDD do not greatly affect their populations.

Juveniles. For this alternative, there is no difference in the juvenile rainbow trout passage index when compared to NAA (Table B-12). This result is because of the lack of operational changes for the alternative that affects the principal impact mechanism for juvenile rainbow trout at RBDD, namely, predation. Juvenile passage indices are shown on Figure B-22. Juveniles of other resident native and resident non-native species would nether benefit or are adversely affected by this alternative. The alternative will not change any operation (RBDD gates) that affects predation of juvenile lifestages of these species.

1B: 4-month Bypass Alternative

Construction. Impacts from constructing a fish bypass channel, new right bank fish ladder, and a pump station, including screens and bypasses, would include direct and indirect losses of adult and or juvenile fish. Impacts from constructing a new fish ladder, pump stations, including screens and screen bypasses, and a bypass channel would include direct and indirect losses of adult and or juvenile fish. These impacts would principally occur during installation of cofferdams. The construction areas would include areas near the existing right (west) bank fish ladder, the take-out and put-back confluence areas of the bypass channel on the left (east) bank of the Sacramento River, and the new pump station location at the "Mill Site." At the Mill Site, a large sheet pile cofferdam would be required, up to approximately 1,400 LF. Construction of the right bank fish ladder would require a 270-LF sheet pile cofferdam. The exact dimensions of the coffer dammed areas for the bypass channel take-out and put-back areas is unknown.

The impacts would occur during installation of sheet piling and de-watering of project areas following sheet pile installation. Both adults and juveniles could be physically crushed during earth movement or sheet pile installation. Both adults and juveniles may be stranded and lost during de-watering actions following the installation of sheet piling.

These activities would adversely affect migrating adult fish, rearing stages of fry and juveniles, and migrating smolts. These impacts would be significant and would require mitigation or conservation measures, depending on species, to reduce these impacts to less than significant.

Additionally, direct losses and adverse indirect effects to adults and juvenile life stages would occur as a result of sediment disturbances and turbidity that would result from construction of project bypass channel and the pump station. These impacts would be significant and would require mitigation to reduce them to less than significant.

Operations. No significant adverse impact to fishery resources would occur with operations of this alternative. Therefore, no mitigation is required.

Native Anadromous Salmonid Species (NAS)

Adults. As shown in Table B-7, the adult passage index values for the 4-month Bypass Alternative for the five NAS species are equal to or greater than those for NAA. The index values for these NAS species are shown on Figure B-20. As was previously stated for the 4-month Improved Ladder Alternative, there is no change or improvement in the adult passage index for late-fall Chinook salmon for any project alternative (this species does not immigrate through the RBDD during the gates-in operational period). There are small (from 1 to approximately 2 percent) improvements in adult passage indices for winter-run, spring-run, and fall-run Chinook salmon, and steelhead. These small improvements in adult passage are a result of small incremental increases in adult passage that may occur by these species using the bypass channel and a new right bank fish ladder. However, the magnitudes of these improvements are generally not sufficiently beneficial to be considered a measurable improvement for passage of these species with this alternative. A rather large (43 percent) component of threatened adult spring-run Chinook salmon and smaller components of endangered adult winter-run (9 percent) and threatened adult steelhead (10 percent) remains blocked or impeded by the RBDD gates for this alternative (Figure B-20).

Juveniles. See the discussion of juvenile passage for NAS species for the 4-month Improved Ladder Alternative.

Other Native Anadromous Species (NAO)

Adults. The adult passage indices for the three NAO for the 4-month Bypass Alternative are greater than those for NAA (Table B-9). These indices are shown on Figure B-21. For this alternative, and compared to NAA, there is a small (6 percent) improvement in the adult passage index for green sturgeon. This is because adult green sturgeon may use the constructed bypass channel. However, the likelihood and ability of this species to use the bypass channel is unknown. Therefore, the uncertainty of adult green sturgeon to successfully pass through this channel is reflected as a small increase in passage index for this species. This alternative would likely result in no measurable passage benefit to adult green sturgeon.

There are similar small (2 percent) increases in passage indices for adult Pacific and river lamprey. These species may also use the bypass channel to some, but unknown, extent as well as passing through the improved right bank fish ladder featured for this alternative. The magnitude of these improvements as shown in Table B-9 are generally not sufficiently great enough to be considered a measurable benefit for adult passage for these species. As previously discussed, the passage indices for the lamprey species are large (>85 on a scale of 100) because of these species' life history characteristics and their ability to pass through salmonid fish ladders.

Juveniles. See the discussion of juvenile/transformer passage of NAO species for the 4-month Improved Ladder Alternative.

Non-native Anadromous Species (NNA)

Adults. Adult American shad and striped bass may benefit somewhat by successfully passing RBDD via the bypass channel that would be constructed for the alternative. A low gradient bypass channel that would be designed to provide slower water velocities and abundant resting segments that may assist species like shad and stripers which have some difficulty with or reluctance to pass conventional fish ladders designed primarily for salmonids. However, the extent to which these two species would successful pass through the bypass channel is unknown. As previously, stated, adult stripers currently prefer to remain immediately downstream of the RBDD and generally do not pass the existing fish ladders. It is likely that with the RBDD gates in the river (similar to the NAA) stripers would chose to remain downstream of the gates, preying on juvenile fish rather than re-distributing to upstream areas via the bypass channel.

The benefit to adult passage for either of these species is unknown or is likely small and not measurable. A more likely scenario, for this alternative, is that stripers would remain downstream of RBDD or possibly move into the bypass channel and continue to prey on juvenile salmonids or other species. Furthermore, given the opportunity to transit the bypass channel, shad may or may not actually move further upstream to spawn.

Juveniles. See the discussion for NNA species for the 2-month Improved Ladder Alternative.

Resident Native and Non-native Species (RN/RNN)

Adults. The adult passage index value for adult rainbow trout for the 4-month Bypass Alternative is approximately 4 percent greater than that for NAA (Table B-11). The index value for this species is shown on Figure B-20. The small improvement in passage index for adult rainbow trout for this alternative is a result of slight increases in efficiencies of attraction and passage in the new right bank fish ladder. There may also be some small but uncertain increase in passage through the bypass channel featured in this alternative. However, the magnitude of these improvements is generally not sufficient to be considered a measurable improvement for adult passage of rainbow trout. A rather large component (24 percent) of adult rainbow trout remains blocked or impeded by the gates at RBDD under this alternative (Figure B-20).

Adult passage of other RN/RNN species may benefit from the construction of the bypass channel. The channel will provide lower velocities than the existing fish ladders and will provide long segments of flatwater. These conditions would potentially be more suitable for successful passage of most if not all of these species. However, the extent and the successful use of this channel to migrate around RBDD is unknown, and therefore the benefits of this alternative to most RN/RNN species would have to be considered small and likely not measurably beneficial.

Juveniles. See the discussion of juvenile passage of RN/NNR species for the 4-month Improved Ladder Alternative.

2A: 2-month Improved Ladder Alternative

Construction. Impacts from constructing new left and right bank fish ladders and a pump station, including screens and bypasses, would include direct and indirect losses of adult and or juvenile fish. The major construction impact areas are the, the right and left bank fish

ladder vicinities, and the pump station location at the "Mill Site." These impacts would principally occur during installation of cofferdams. The construction areas would include areas near the existing east and west bank fish ladders and the new pump station location at the "Mill Site." At the Mill Site, a large sheet pile cofferdam would be required, up to approximately 1,400 LF. Construction of the right bank fish ladder would require a 270-LF sheet pile cofferdam. Construction of the left bank fish ladder would require installation of a 166-LF sheet pile cofferdam.

In addition, impacts could also occur at these locations because of de-watering active channel areas following sheet pile installation. Both adults and juveniles may be stranded and lost during de-watering actions following the installation of sheet piling.

These activities would adversely affect migrating adult fish, rearing stages of fry and juveniles, and migrating smolts. These impacts would be significant and would require mitigation or conservation measures, depending on species, to reduce these impacts to less than significant.

Additionally, direct losses and adverse indirect effects to adults and juvenile life stages would occur as a result of sediment disturbances and turbidity that would result from construction of project fish ladders and the pump station. These impacts would be significant and would require mitigation to reduce them to less than significant.

Operations. No significant adverse impact to fishery resources would occur with operations of this alternative. Therefore, no mitigation is required. Below is a summary of the adult passage index values for this alternative.

Native Anadromous Salmonid Species (NAS)

Adults. As shown in Table B-7, the adult passage indices for the five NAS species for the 2-month Improved Ladder Alternative are equal to or greater than those for NAA. These indices are shown on Figure B-20. As previously stated for all alternatives, there is no change in the adult passage index for late-fall Chinook salmon with this alternative. There are, however, modest differences in adult passage indices for winter-run and fall-run Chinook salmon, and steelhead (9 percent each). The principal benefit of this alternative occurs for spring-run Chinook salmon where the adult passage index increased over 79 percent compared to NAA (Table B-7). This improvement is clearly a measurably large benefit to this species. The large passage improvement for adult spring-run Chinook salmon occurs because the dam gates at RBDD would remain out until July 1, allowing nearly 94 percent of the adults of this species to migrate pass RBDD unimpeded.

An improvement to adult passage for this alternative also occurs during months of gates-in operation from the new fish ladders on the left and right banks of the river. However, the magnitude of these improvements to the ladders are, by far, less beneficial than the removal of the gates during the early to mid-summer months. The ladder improvements alone would not generally be considered a measurable improvement for adult passage (see discussion of adult NAS species for the 4-month Improved Ladder Alternative). However, the 2-month Improved Ladder Alternative is quite effective in reducing the impedance of the NAS species. Approximately 6 percent of threatened adult spring-run, 2 percent of endangered adult winter-run Chinook salmon, and 3 percent of threatened adult steelhead would remain blocked or impeded under this alternative (Figure B-20).

Juveniles. Under this alternative, the juvenile passage indices for all five of the NAS species are greater when compared to NAA (Table B-8). However, the differences are small, and not measurably beneficial. The differences from NAA for these juvenile passage indices ranges from no change for spring-run to 5 percent for late-fall-run Chinook salmon, and 7 percent for steelhead. These results are because of the reduction in rates of predation of these species during longer gates-out periods, especially during the early to mid-summer months (mid-May through June 30). The operational changes (gates-out) featured in the alternative reduces the effects of the principal impact mechanism (predation), but not measurably, for juvenile NAS species. Juvenile passages indices are shown on Figure B-22.

Other Native Anadromous Species (NAO)

Adults. The adult passage indices for the three NAO species for the 2-month Improved Ladder Alternative are all greater than those for NAA (Table B-9). The index values for these NAO species are shown on Figure B-21. This alternative provides a large (54) improvement in the adult passage index for green sturgeon (Table B-9). This large measurable benefit (54 percent compared to NAA) occurs because adults of this species primarily migrate past RBDD in the late spring-early summer ending July 1. This alternative would eliminate all blockage and impedance of adult green sturgeon at RBDD.

There are also smaller (17 percent), but measurably beneficial improvements in passage indices for adult Pacific and river lamprey from the implementation of this alternative (Table B-9). For this alternative, adult passage for the lamprey species may be improved to nearly 97 percent of unobstructed passage.

Juveniles. For the 2-month Improved Ladder Alternative, there are modest but measurably beneficial improvements in juvenile green sturgeon (21 percent) and river lamprey (15 percent) transformer passage indices (Table B-10) as compared to NAA. There is a small (1 percent) but not measurable Improvement in juvenile passage index for Pacific lamprey. This result is because of the juvenile Pacific lampreys' passage timing which principally occurs prior to the RBDD operational period for this alternative (before July 1). Juvenile passage indices are shown on Figure B-22.

Non-native Anadromous Species (NNA)

Adults. For this alternative, the RBDD gates would remain out until July 1. This gate operation would likely result in less congregation of predatory striped bass than would occur if gates remained in during this period. Stripers would either choose to move farther upstream of RBDD, remain in the deeper holding pools at RBDD, or possibly would not remain at RBDD in search of prey. This alternative, while it provides less restriction of upstream movement for stripers, may not be beneficial to this species because it removes the physical impediment that disorients and injures prey fish as they pass through the RBDD gates. Lake Red Bluff, which is good habitat for predatory species like stripers, would exist for only 2 months annually under this alternative. This is a disadvantage for striped bass. These fish would have fewer ambush opportunities to prey on juveniles salmonids and other species when they are transiting Lake Red Bluff. However, this alternative would allow adult stripers additional opportunity to migrate upstream as far as Redding. This may result in undesirable increases in predation by striped bass on juvenile salmonids upstream of RBDD.

The construction of new ladders as part of this alternative would provide little, if any, benefit for stripers because this species generally do not readily pass fish ladders designed principally for salmonid fishes. See the discussion for Non-native Anadromous species for the 4-month Improved Ladder Alternative above.

Upstream passage of adult shad upstream of RBDD would likely improve with this alternative. Approximately 80 percent of the annual spawning run would transit RBDD unimpeded during the gates-out period under this alternative. This would be in contrast to approximately 35 percent for NAA. The removal of the gates until July 1 each year would allow shad to move farther upstream into habitats that may (or may not) be more suitable for successful spawning, incubation, and early fry rearing. This however, may not provide benefits to the species because the reach of the Sacramento River upstream of RBDD is at the northernmost extent of their geographic range in the Sacramento River watershed. Furthermore, optimal spawning temperatures for shad range from 62 to 70°F (Skinnner, 1962), and these water temperatures are unlikely to occur in the Sacramento River upstream of RBDD during the months when shad would have access upstream of RBDD.

Juveniles. Juvenile American shad would likely benefit from this alternative by the reduction in the rate at which they are preyed upon by adult striped bass and Sacramento pikeminnow. The RBDD gates would be out until July 1 and would likely discourage predatory species, particularly pikeminnow, from congregating downstream of RBDD. This would lessen the potential for predation and allow a greater number of shad to pass unmolested downstream through the project area. There would be no benefit or adverse impact to juvenile striped bass, as this species does not occur in the project area.

Resident Native and Non-native Species (RN/RNN)

Adults. For the 2-month Improved Ladder Alternative, adult rainbow trout passage index is approximately 25 percent greater than that for NAA (Table B-11). The indices for this species are shown on Figure B-20. The improvement in adult rainbow trout passage for this alternative is a result of the gates-out operational period through June 30. A substantial number of adult rainbow trout pass RBDD during the period from May 15 through June 30. The adult passage index is 91 (on a scale of 100) and the magnitude of the passage improvement is considered measurably beneficial. However, approximately 9 percent of adult rainbow trout remain blocked or impeded by the gates at RBDD under this alternative (Figure B-20).

This alternative would provide measurably beneficial conditions for passage of other adult RN/RNN species. The removal of the RBDD gates for 2 months from mid-May to June 30 and after September 1 would remove passage impedance for these species for 2 months compared to NAA. The construction of a new fish ladder as a feature of this alternative would provide little or no benefit to most adults of RN/RNN species, with the exception of rainbow and brown trout.

Juveniles. For this alternative, there is a small improvement (approximately 7 percent) in the juvenile passage index for rainbow trout as compared to NAA (Table B-12). This small improvement in juvenile passage index would not measurably benefit this species. The change in passage index is because of the reduction in rates of predation of these species during longer gates-out periods, especially during the early to mid-summer months (through June 30). The operational changes of this alternative reduces, but not measurably,

the effects of the principal impact mechanism (predation) for juvenile rainbow trout. Juvenile passage indices are shown on Figure B-22.

Other juvenile RN/RNN species would likely benefit from this alternative by reducing the rate somewhat at which they are preyed upon by adult striped bass and Sacramento pikeminnow. The RBDD gates would be out through June 30 and would likely discourage predatory species, particularly pikeminnow, from congregating downstream of RBDD. This would lessen the potential for predation and allow a greater number of juveniles of the RN/RNN species to pass unmolested downstream through the project area. This benefit, however, may be offset by the removal of Lake Red Bluff for 2 months annually. Habitats that are preferred by many of the RN/RNN species, particularly the non-native bass, sunfish, and catfish, would be reduced measurably for this alternative, particularly nesting sites and rearing habitats for many RNN species.

2B: 2-month Existing Ladders Alternative

Construction. Impacts from constructing a pump station, including screens and bypasses, would include direct and indirect losses of adult and or juvenile fish. The major construction impact areas are at the pump station location at the "Mill Site." These impacts would occur during installation of sheet piling. At the Mill Site, a large sheet pile cofferdam would be required, up to approximately 1,400 LF.

In addition, impacts could also occur at these locations because of de-watering active channel areas following sheet pile installation. Both adults and juveniles may be stranded and lost during de-watering actions following the installation of sheet piling.

These activities would adversely affect migrating adult fish, rearing stages of fry and juveniles, and migrating smolts. These impacts would be significant and would require mitigation or conservation measures, depending on species, to reduce these impacts to less than significant.

Additionally, direct losses and adverse indirect effects to adults and juvenile life stages would occur as a result of sediment disturbances and turbidity that would result from construction of the pump station. These impacts would be significant and would require mitigation to reduce them to less than significant.

Operations. No significant adverse impact to fishery resources would occur with operations of this alternative. Therefore, no mitigation is required. Below is a summary of the adult passage index values for this alternative.

Native Anadromous Salmonid Species (NAS)

Adults. For the 2-month Existing Ladders Alternative, the adult passage indices for all five NAS species are equal to or greater than those for NAA (Table B-7). These indices are shown on Figure B-20. As previously stated for other alternatives, there is no benefits or adverse impacts to the adult late-fall Chinook salmon for this alternative. There are modest differences (increases) compared to NAA in the passage indices for adult winter-run Chinook salmon (9 percent), fall-run (8 percent) Chinook salmon, and steelhead (8 percent). The principal benefit of NAS passage at RBDD occurs to adult spring-run Chinook salmon. For this species, the adult passage index increased nearly 77 percent compared to NAA (Table B-7). This is clearly a measurably large benefit to this species. The large improvement

to migrating adult spring-run Chinook salmon occurs because the dam gates at RBDD would remain out until July 1, allowing approximately 93 percent of this species to pass RBDD unimpeded. When compared to the 2-month Improved Ladder Alternative, the 2-month Existing Ladders Alternative benefits are nearly identical.

This alternative is quite effective in reducing the blockage and impedance of RBDD on the NAS species. However, approximately 7 percent of threatened adult spring-run, 2 percent of endangered adult winter-run Chinook salmon, and 4 percent of threatened adult steelhead remain blocked or impeded under this alternative (Figure B-20).

Juveniles. See the discussion for NAS species for the 2-month Improved Ladder Alternative.

Other Native Anadromous Species (NAO)

Adults. The adult passage indices for all three NAO species for the 2-month Existing Ladders Alternative are greater than those for NAA (Table B-9). The index values for these species are shown on Figure B-21. For this alternative, compared to NAA, there is a large (54 percent) improvement in the adult passage index for green sturgeon (Table B-9). This is a measurably large beneficial passage improvement and occurs because this species primarily migrates past RBDD during late spring-early summer ending July 1. This alternative would eliminate blockage and impedance of adult green sturgeon at RBDD. The relative benefits of this alternative to the NAO species are nearly identical to those for the 2-month Improved Ladder Alternative.

There are smaller (16 percent) but measurably beneficial improvements in passage indices for adult Pacific and river lampreys from the implementation of this alternative (Table B-9). Adult passage for the lamprey species may be improved to approximately 96 percent of unobstructed passage.

Juveniles. See the discussion for juvenile/transformers of NAO species for the 2-month Improved Ladder Alternative.

Non-native Anadromous Species (NNA)

Adults. This alternative may or may not benefit the adult passage of striped bass and American shad. See the discussion for adults of these species for the 2-month Improved Ladder Alternative above.

Juveniles. See the discussion for juveniles of NNA species for the 2-month Improved Ladder Alternative.

Resident Native and Resident Non-native Species (RN/RNN)

Adults. The adult rainbow trout passage index value for the 2-month Existing Ladders Alternative is approximately 23 percent greater than that for NAA (Table B-11). The passage indices for this species are shown on Figure B-20. The improvement in adult rainbow trout passage indices for this alternative is a result of gates-out operations through June 30. A substantial number of adult rainbow trout pass RBDD during the period ending June 30. The magnitude of these passage improvements is sufficient to be considered a measurable improvement for adult rainbow trout. However, approximately 10 percent of adult rainbow trout remain blocked or impeded by the gates at RBDD under the 2-month Improved Ladder Alternative (Figure B-20).

This alternative would result in the same benefits and liabilities for other adult RN/RNN species as described in the discussion of operational impacts of 2-month Improved Ladder Alternative above.

Juveniles. See the discussion for the RN/RNN species for the 2-month Improved Ladder Alternative.

3: Gates-out Alternative

Construction. Impacts from constructing a pump station, including screens and bypasses, would include direct and indirect losses of adult and or juvenile fish. The major construction impact area is at the pump station location at the "Mill Site." These impacts would principally occur during installation of cofferdams. At the Mill Site, a large sheet pile cofferdam would be required, up to approximately 1,400 LF.

These impacts would be the same as discussed for the 2-Month Improved Ladder Alternative.

Operations. No significant adverse impact to fishery resources would occur with operations of this alternative. Therefore, no mitigation is required. Below is a summary of the adult passage index values for this alternative.

Native Anadromous Salmonid Species (NAS)

Adults. The adult passage indices for all five NAS species for the Gates-out Alternative are equal to or greater than those for NAA (Table B-7). In all instances, the adult passage indices indicate unobstructed passage (optimal fish passage conditions = adult passage index of 100). The index values for these NAS species are shown on Figure B-20. As previously stated for other alternatives, there is no impact to or improvement in the adult passage index for late-fall Chinook salmon from implementing this alternative (Table B-7). There are measurable differences (improvements) in passage indices for adult winter-run (12 percent) and fall-run (20 percent) Chinook salmon, and steelhead (12 percent). The principal benefit for passage of adult NAS species occurs to spring-run Chinook salmon. The passage index for spring-run increased approximately 91 percent compared to NAA (Table B-7). This is clearly a large measurable benefit for passage for this species. These improvements to migrating adult NAS species occurs because the dam gates at RBDD would remain out year-round and allows those species to pass unimpeded.

Juveniles. The juvenile passage indices for all NAS species are improved, but do not measurably, when compared to NAA (Table B-8). These juvenile passage improvements range from less than 1 percent for spring-run to 7 percent for late-fall-run Chinook salmon, and 8 percent for steelhead. However, this alternative would result in passage indices of 100 (on a scale of 100). These species benefit from reductions predation when the RBDD gates are removed throughout the entire year. Juvenile passage indices are shown on Figure B-22.

Other Native Anadromous Species (NAO)

Adults. The adult passage indices for all three NAO species for the Gates-out Alternative are greater than those for NAA (Table B-9). The index values for these species are shown on Figure B-21. For green sturgeon adults, there is a large (54 percent) improvement from NAA with this alternative (Table B-9). For Pacific lamprey and river lamprey, adult passage indices indicate improved passage by approximately 20 percent over that for NAA. This

alternative would result in unimpeded passage (index of 100) and a measurable benefit for adult NAO species.

Juveniles. For the Gates-out Alternative there is a measurably large improvement, compared to NAA (38 percent) in the juvenile passage index for green sturgeon Table B-10. For river lamprey transformers, a smaller (15 percent) but measurably beneficial increase, compared to NAA, in the passage index occurs. As compared to NAA, there is a small (1 percent), but not measurable, improvement in the passage index for Pacific lamprey transformers. Under the Gates-out Alternative, juvenile/transformer passage is optimal (indices of 100) for all NAO species. These results are because of the reduction in rates of predation on these species when the RBDD gates are removed throughout the entire year, thereby eliminating the congregations of predatory fish downstream of the gates. Juvenile passage indices are shown on Figure B-22.

Non-native Anadromous Species (NNA)

Adults. This alternative would allow full-unimpeded passage of both American shad and striped bass to upstream habitat. However, as stated in the discussion for the 2-month Improved Ladder Alternative above, this may or may not be beneficial for adults of these species. The alternative would allow adult stripers to migrate unimpeded as far as Redding, and by doing so, may result in undesirable increases in predation of rearing anadromous salmonids in the Sacramento River upstream of RBDD.

Juveniles. Similar to the 2-month Alternative, juvenile American shad would benefit from the Gates-out Alternative. This would occur because of dispersal of predator species like striped bass and particularly Sacramento pikeminnow. No benefit or adverse impact would occur to juvenile striped bass as they would not be expected to occur at RBDD.

Resident Native and Non-native Species (RN/RNN)

Adults. The adult rainbow trout passage index for the Gates-out Alternative is approximately 37 percent greater than that for NAA (Table B-11). The index values for rainbow trout is shown on Figure B-20. The passage improvement in adult rainbow trout for this alternative is a result of gates up operations year-round. The magnitude of these improvements over NAA is sufficiently beneficial to be considered a measurably large benefit for passage of adult rainbow trout. This alternative would result in unimpeded passage of adult rainbows.

For the other resident native species at RBDD, this alternative would also greatly benefit adult passage. The reach of the Sacramento River at Red Bluff would return to natural riverine habitats with the RBDD Gates-out Alternative. With the gates removed year-round unrestricted movement for reproduction, rearing, and foraging needs would occur. Many of the resident non-native species however, would suffer losses in preferred habitats with this alternative. The lacustrine (lake) habitat created by Lake Red Bluff would be lost with the Gates-out Alternative. Many of the non-native species prefer these habitats, and without the lake, habitat quantity and quality would diminish. As a result, resident non-native species abundance's may decline. This however, may be a benefit to the resident native and the anadromous native species because of less competition with and predation from aggressive and predatory species such as bass and crappie.

Juveniles. For the Gate-out Alternative, there is a small difference (approximately 8 percent) in the juvenile rainbow trout passage index compared to NAA (Table B-12). This difference in and of itself would not be measurably beneficial, but with the implementation of the Gates-out Alternative, juvenile rainbow passage is optimal with a passage index of 100. The small improvement is because of the reduction in rates of predation on these species during the entire year by eliminating the congregations of predatory fish downstream of the gates. Juvenile passage indices are shown on Figure B-22.

Juveniles of the resident native and non-native species would benefit from less predation downstream of RBDD than NAA. Furthermore, as previously described for the 2-month Alternative, juvenile resident native fishes would benefit from less predation if Lake Red Bluff were to no long exist. Juveniles of resident non-native species may not benefit from the elimination of Lake Red Bluff, as rearing habitats favoring these species would be lost.

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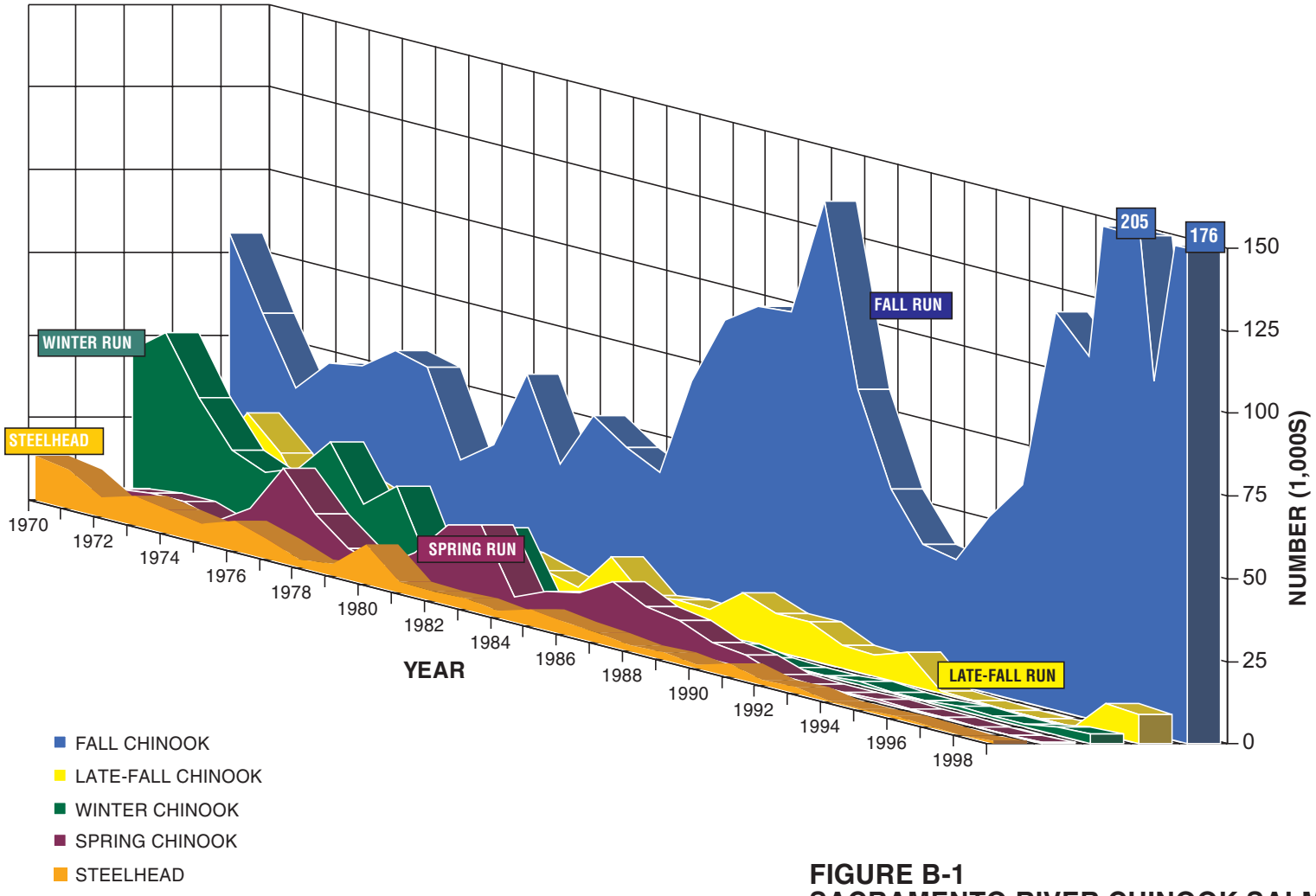

FIGURE B-1
SACRAMENTO RIVER CHINOOK SALMON AND STEELHEAD SPAWNING ESCAPEMENT ESTIMATES FOR 1970 TO 1999 UPSTREAM OF RBDD
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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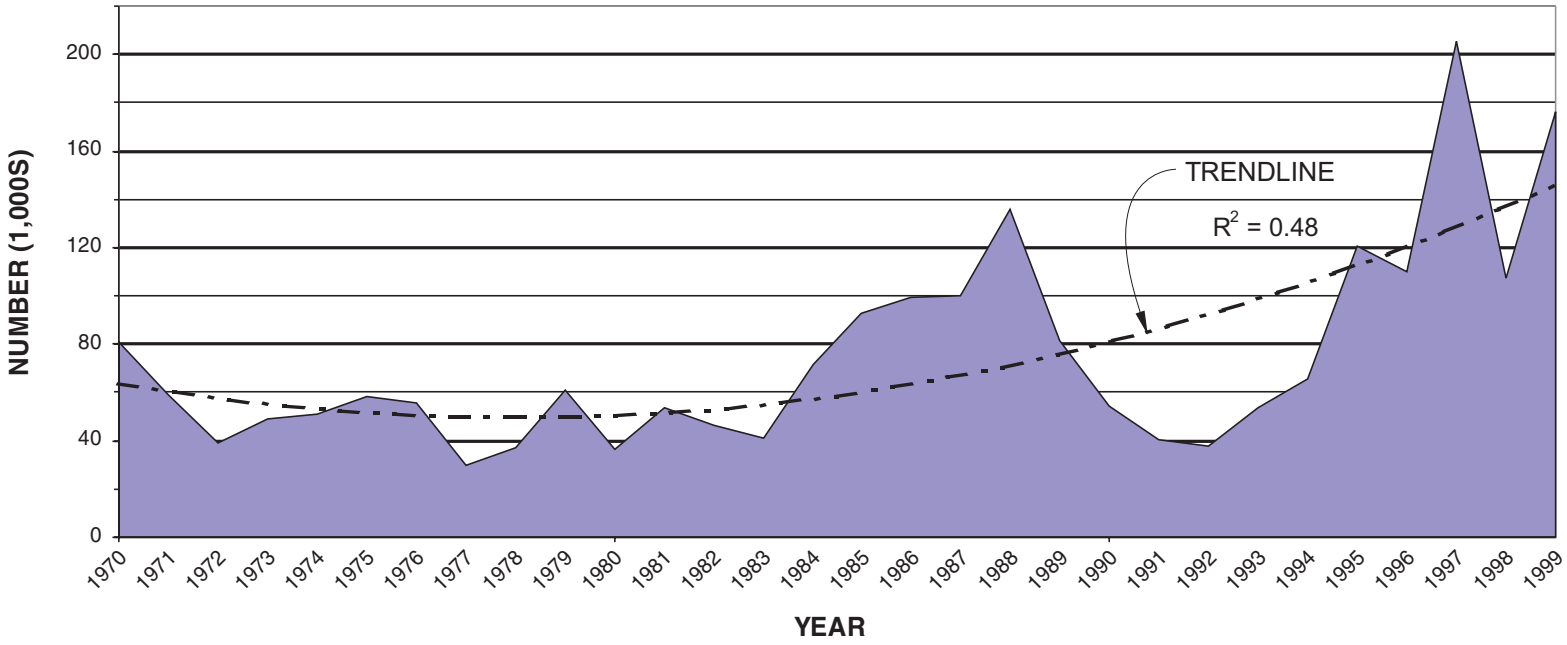

FIGURE B-2
SACRAMENTO RIVER FALL-RUN CHINOOK SALMON SPAWNING ESCAPEMENT ESTIMATES UPSTREAM OF RBDD FROM 1970 TO 1999
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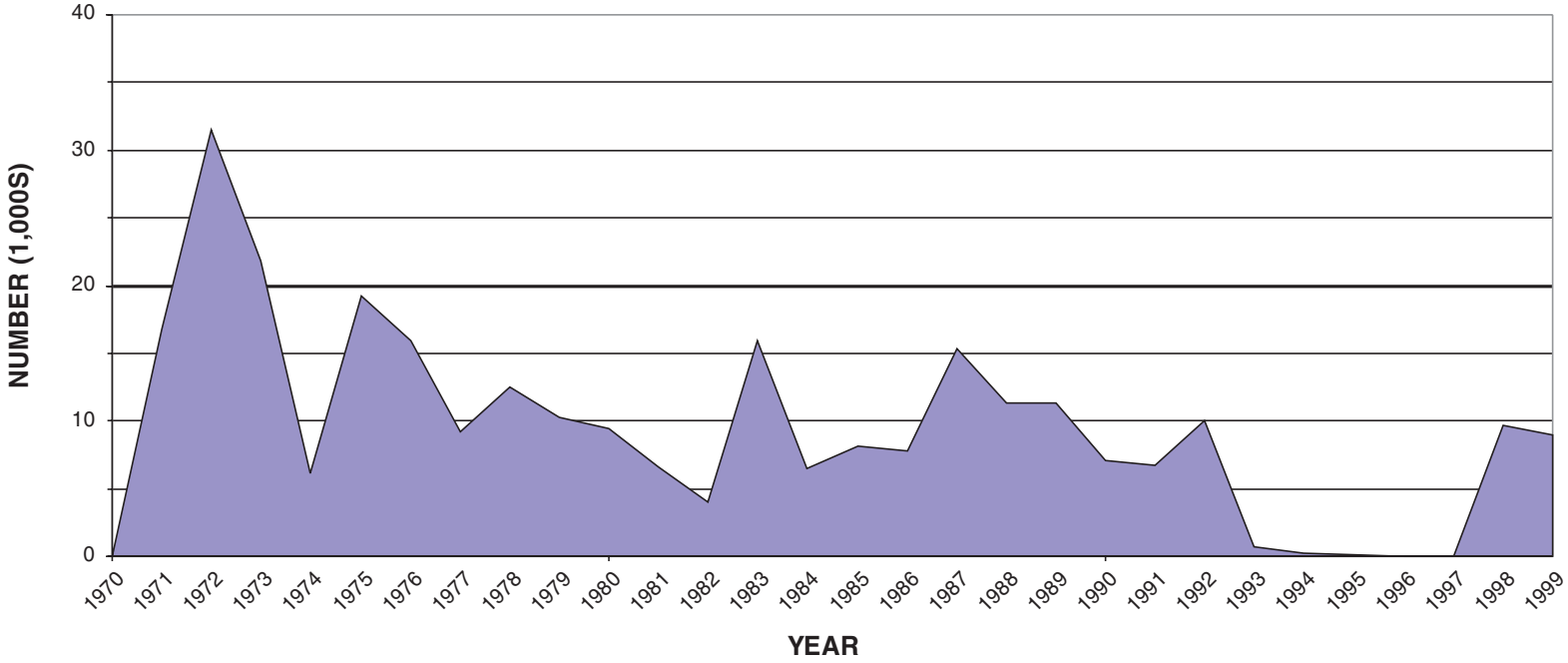

FIGURE B-3
SACRAMENTO RIVER LATE- FALL-RUN CHINOOK SALMON SPAWNING ESCAPEMENT ESTIMATES UPSTREAM OF RBDD FROM 1970 TO 1999
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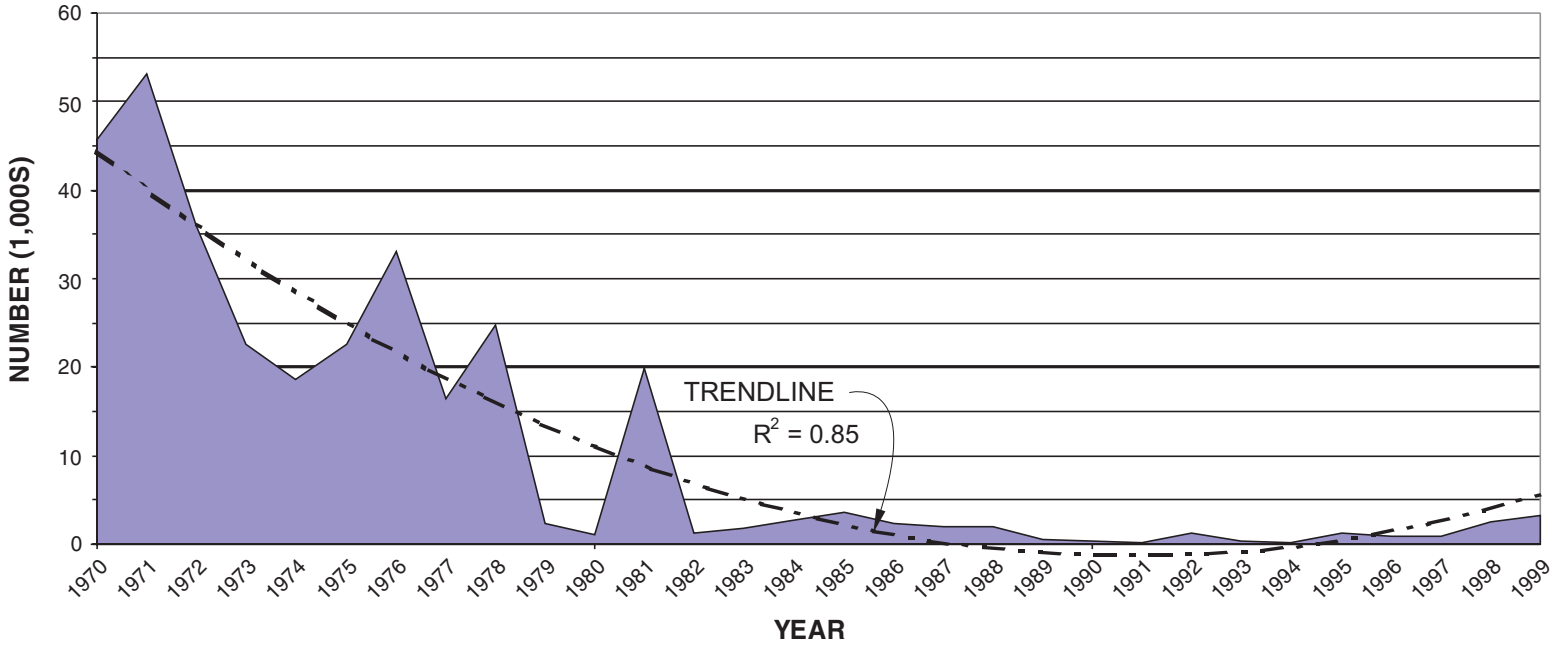

FIGURE B-4
SACRAMENTO RIVER WINTER-RUN CHINOOK SALMON SPAWNING ESCAPEMENT ESTIMATES UPSTREAM OF RBDD FROM 1970 TO 1999
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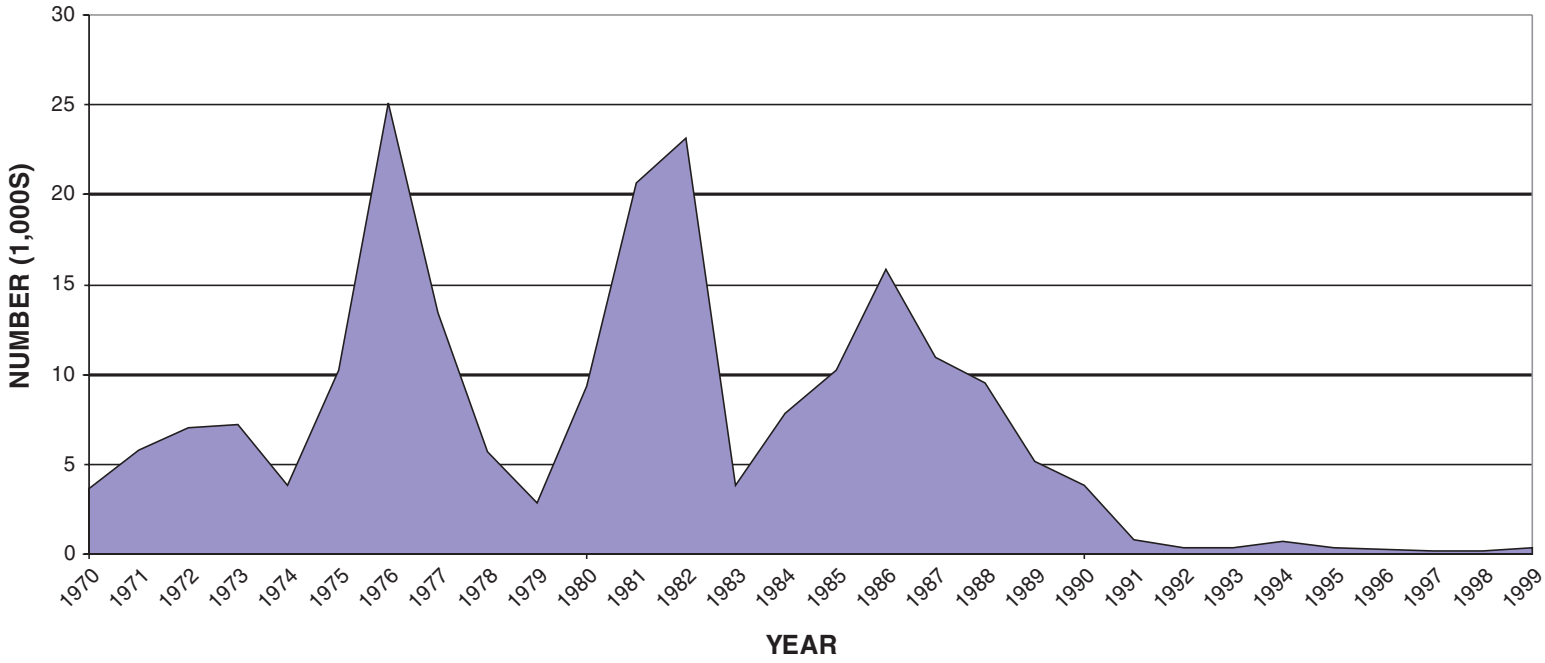

FIGURE B-5
SACRAMENTO RIVER SPRING-RUN CHINOOK SALMON SPAWNING ESCAPEMENT ESTIMATES UPSTREAM OF RBDD FROM 1970 TO 1999
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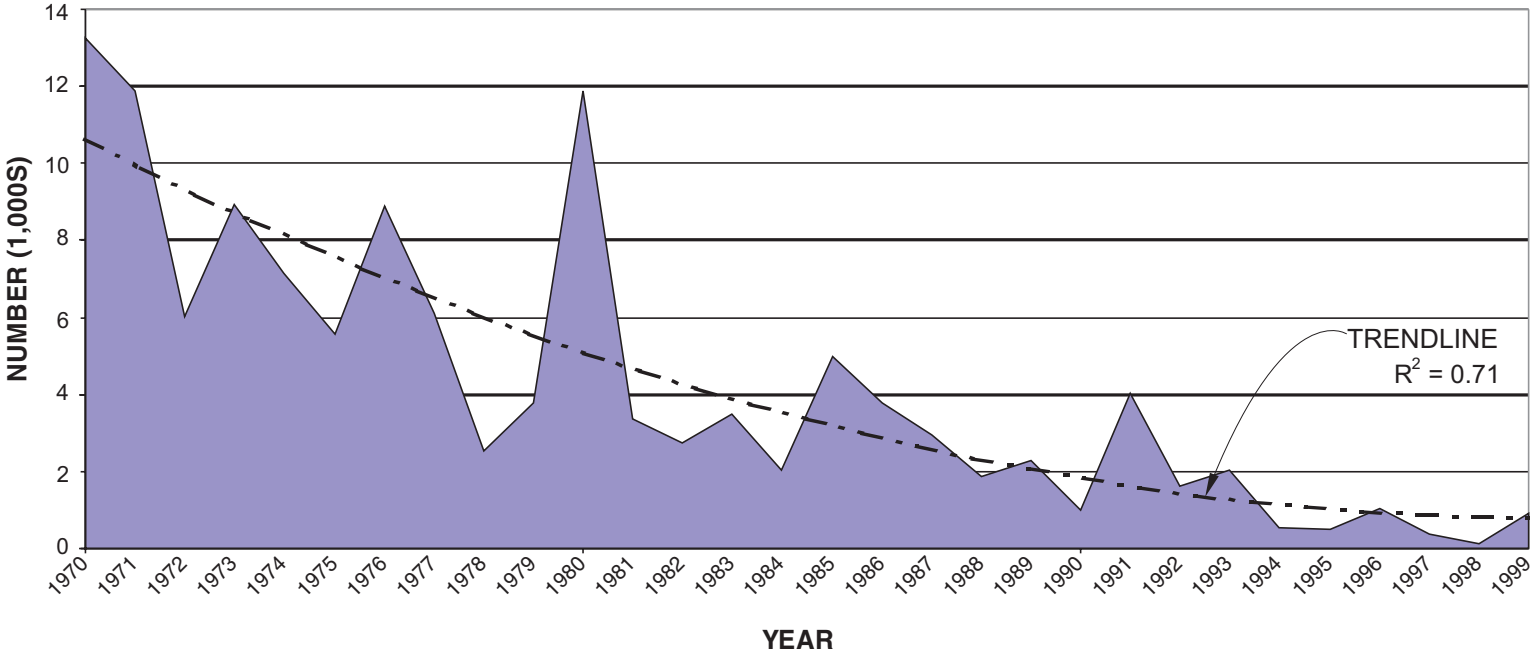

FIGURE B-6
SACRAMENTO RIVER STEELHEAD SPAWNING ESCAPEMENT ESTIMATES UPSTREAM OF RBDD FROM 1970 TO 1999
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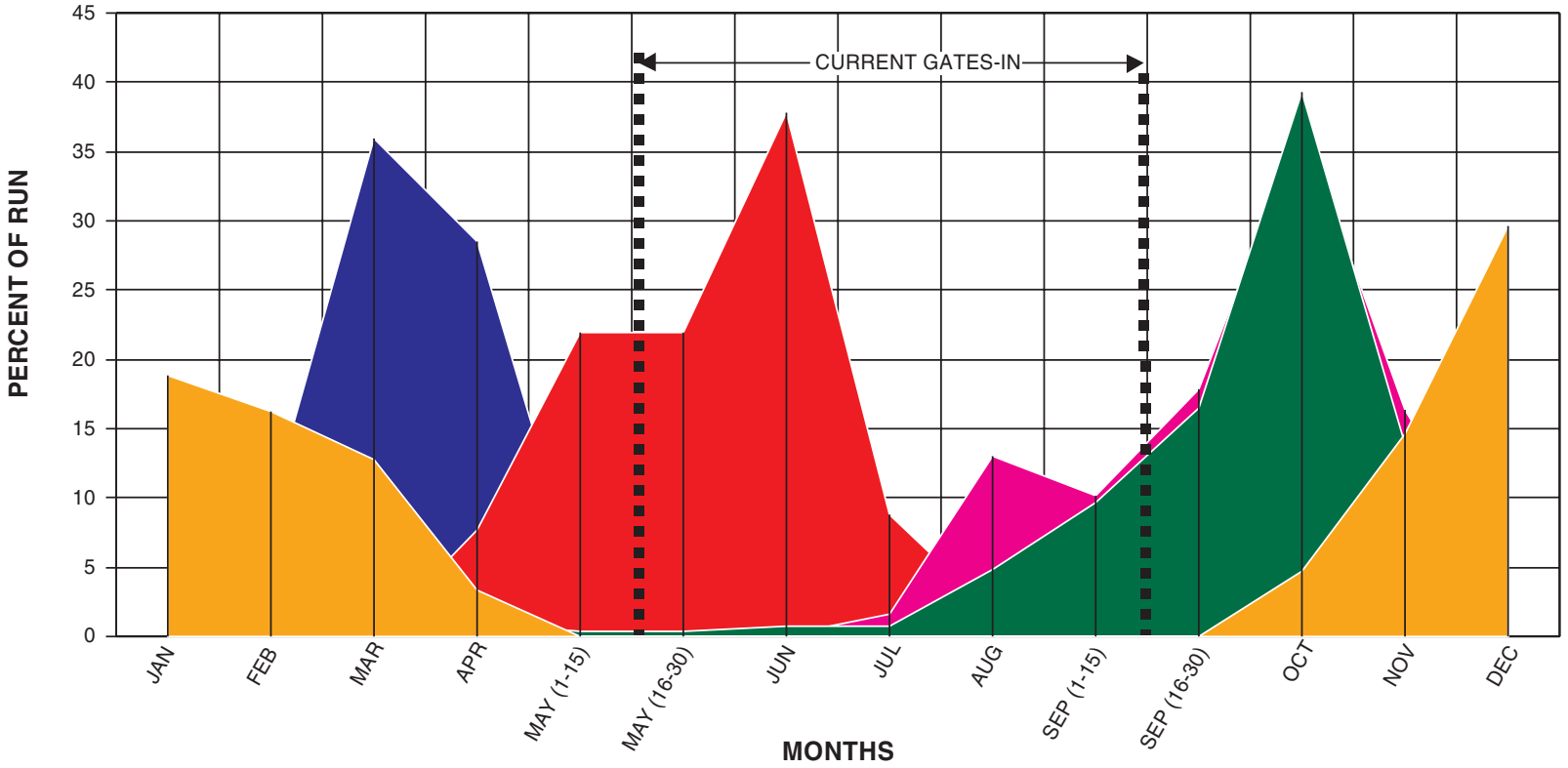

LEGEND

- WINTER CHINOOK (1982-1986)
- LATE-FALL CHINOOK (1982-1986)
- SPRING CHINOOK (CURRENT)
- STEELHEAD (1982-1986)
- FALL CHINOOK (1982-1986)

FIGURE B-7
ADULT CHINOOK SALMON AND STEELHEAD PASSAGE AT RBDD
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

CH2MHILL

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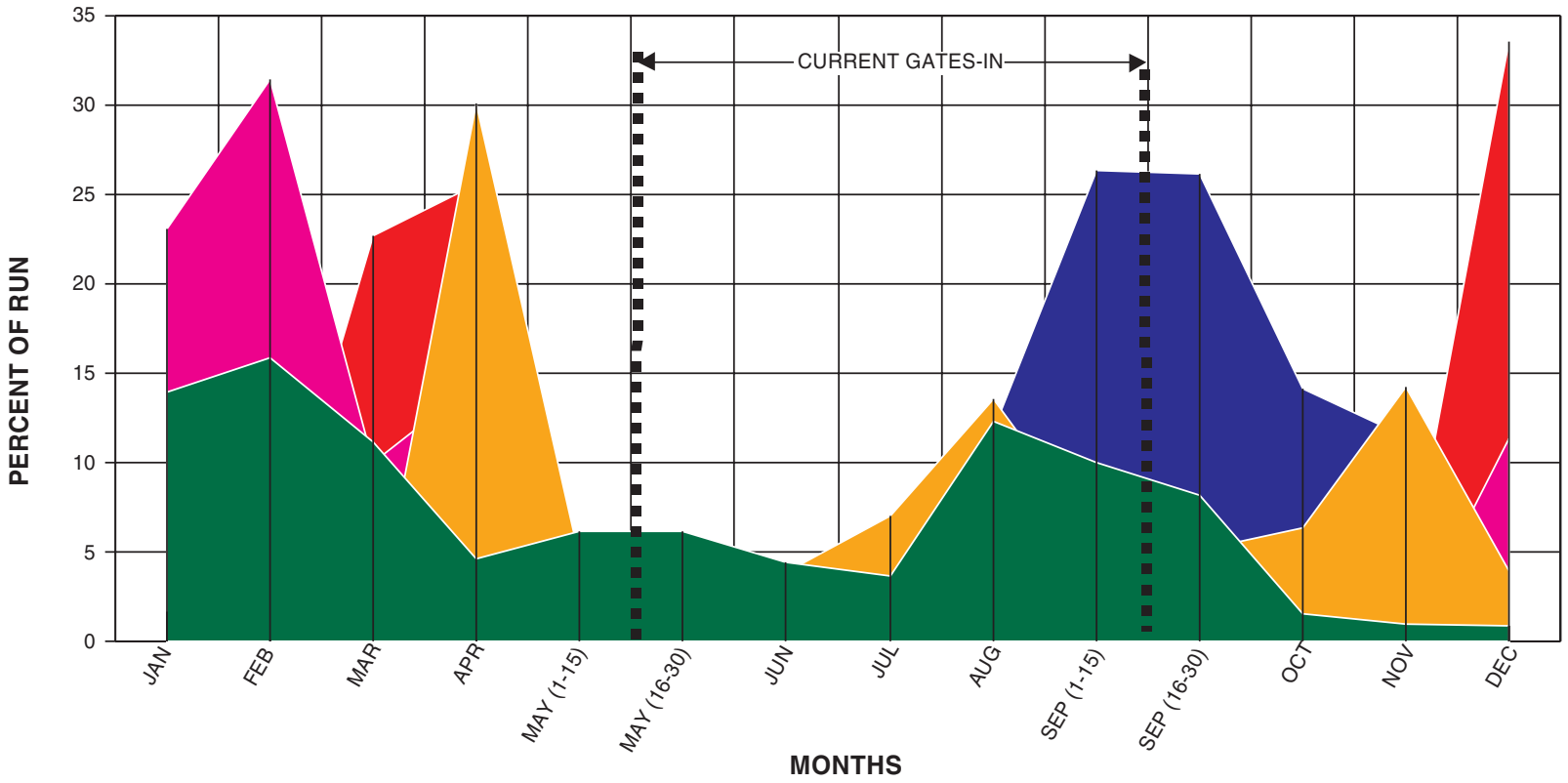

LEGEND

- WINTER CHINOOK (1995-2000)
- LATE-FALL CHINOOK (1995-2000)
- SPRING CHINOOK (1995-2000)
- STEELHEAD (1995-2000)
- FALL CHINOOK (1995-2000)

FIGURE B-8
JUVENILE CHINOOK SALMON AND STEELHEAD PASSAGE AT RBDD
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

W072002003RDD_09 (8/8/02)

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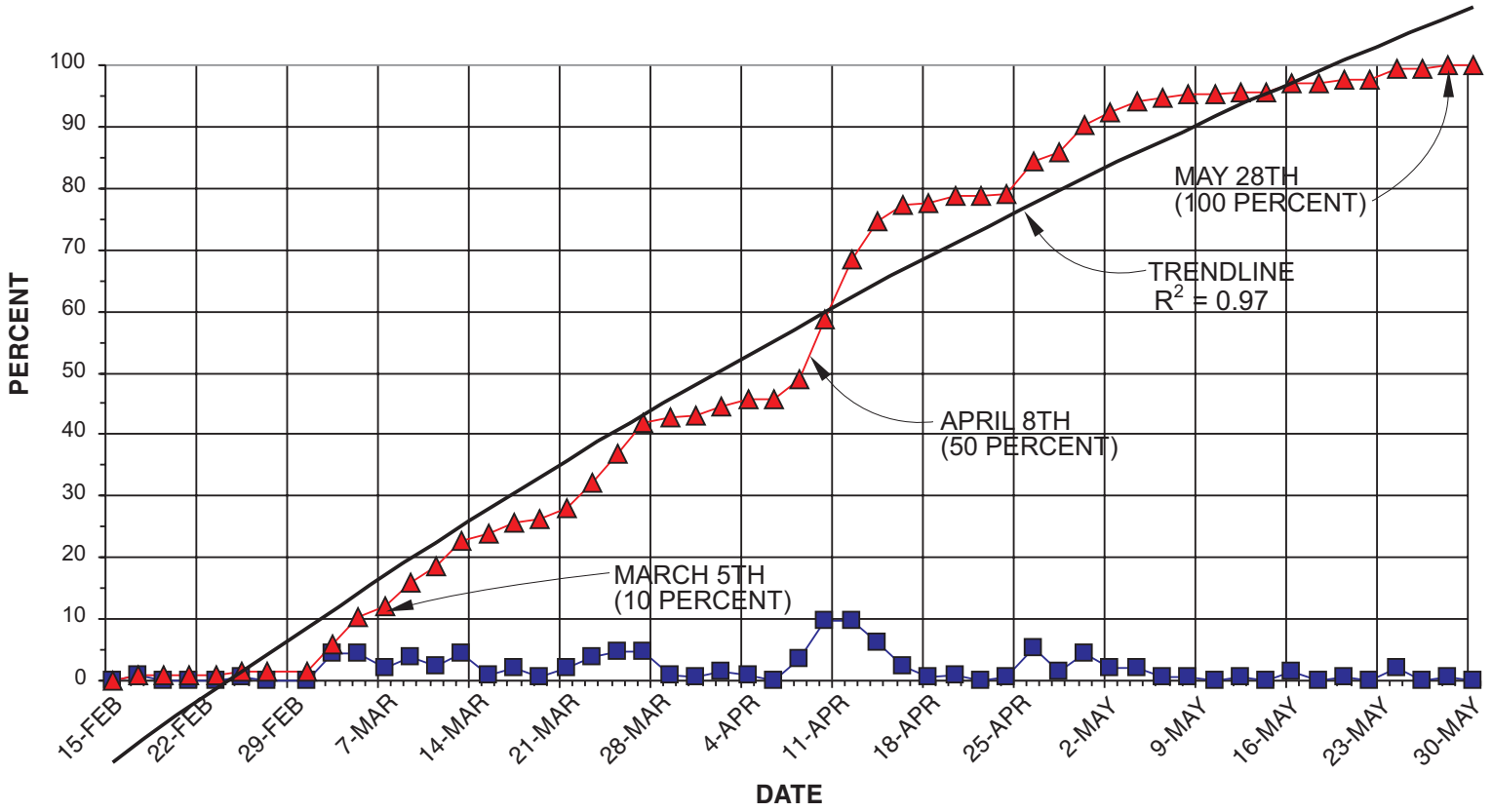

FIGURE B-9
ESTIMATED TIMING OF WHITE STURGEON SPAWNING IN THE SACRAMENTO RIVER DURING 1973
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

W072002003RDD_09 (8/8/02)

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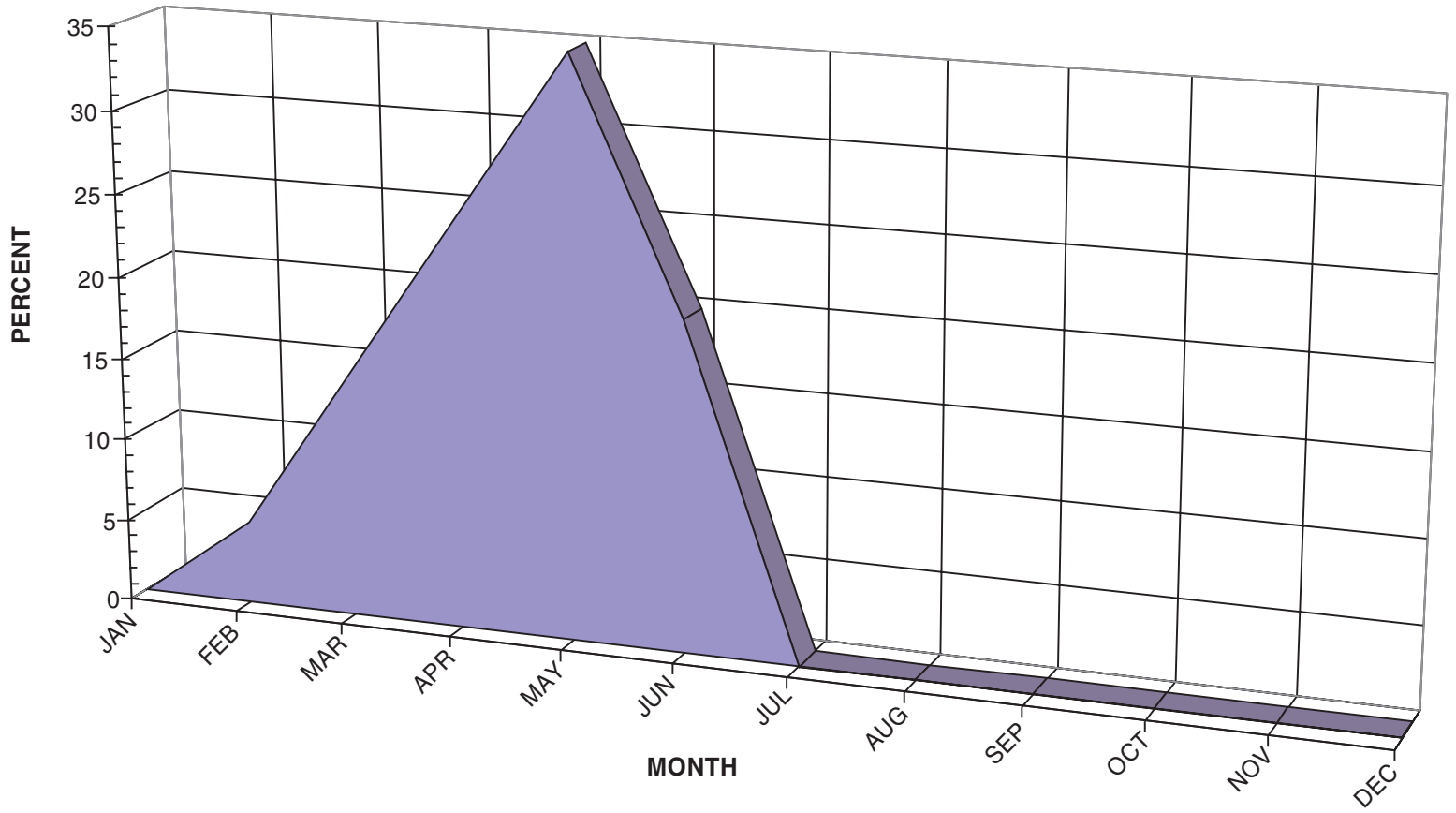

FIGURE B-10
ESTIMATED PRESENCE OF MIGRATING ADULT GREEN STURGEON IN THE SACRAMENTO RIVER IN THE VICINITY OF RBDD
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

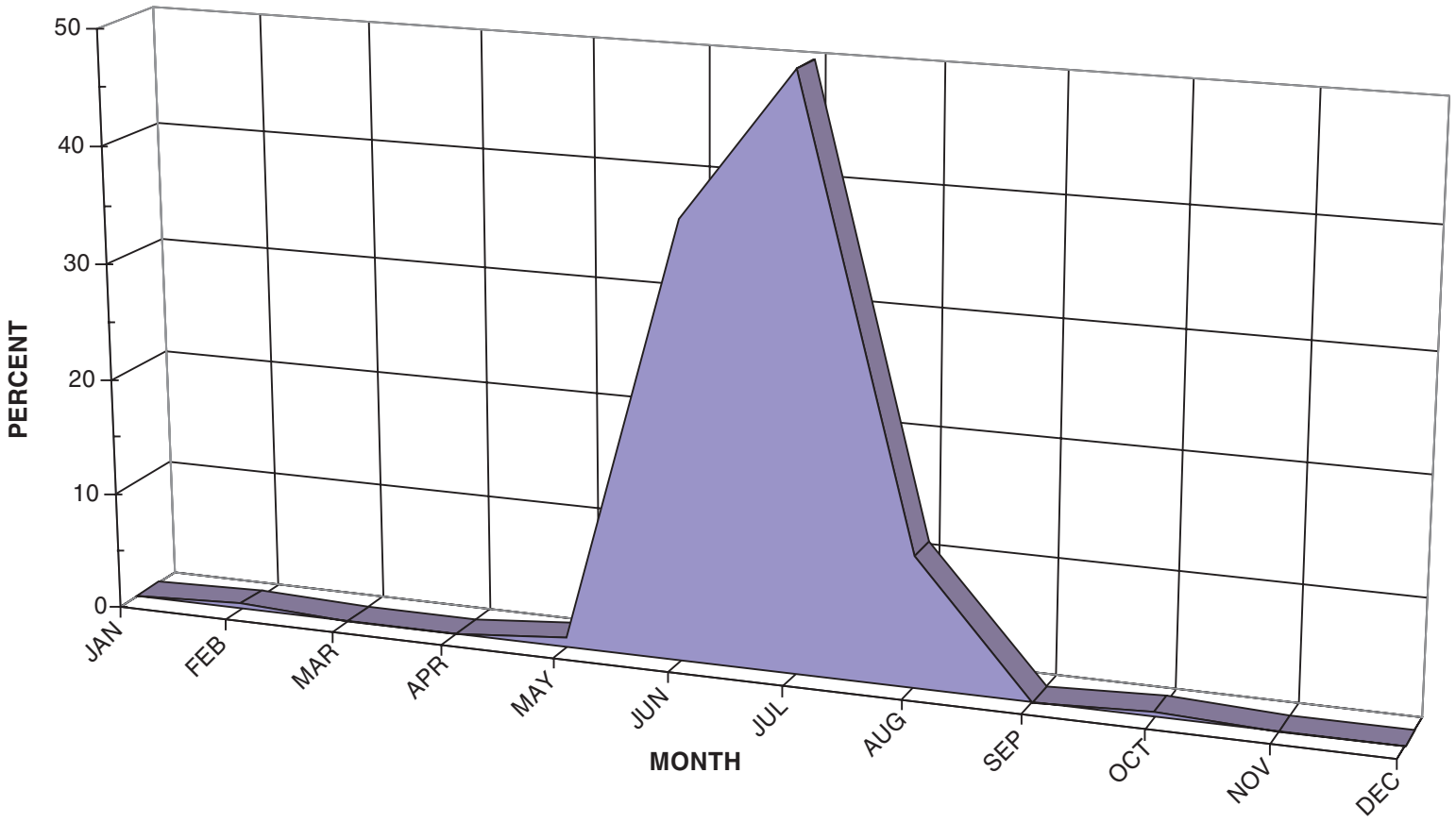

FIGURE B-11
PRESENCE OF JUVENILE GREEN STURGEON IN THE SACRAMENTO RIVER CAPTURED IN THE VICINITY OF RBDD (1995 TO 1999)
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

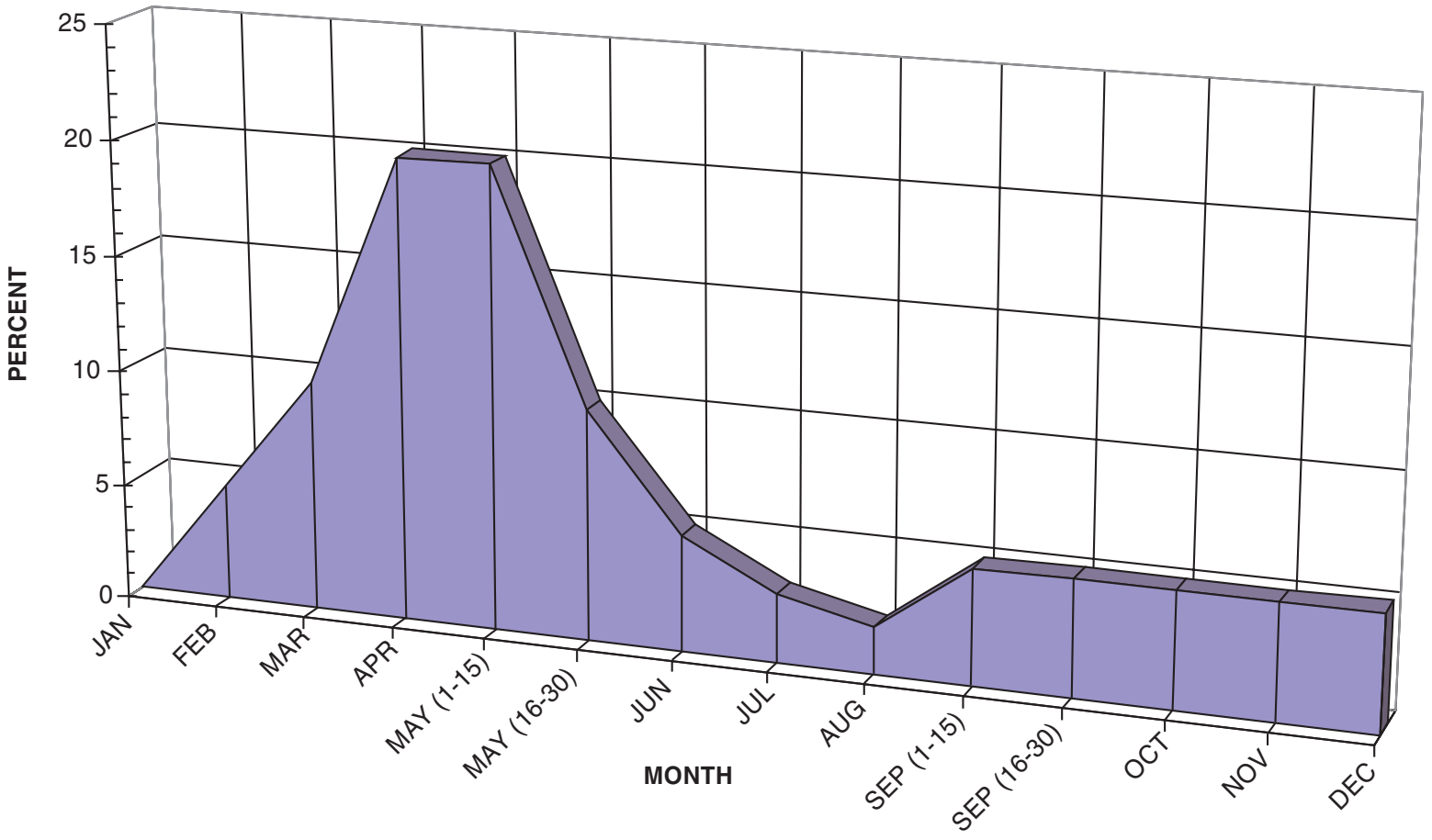

FIGURE B-12
PASSAGE/PRESENCE OF MIGRATING ADULT PACIFIC LAMPREY IN THE SACRAMENTO RIVER IN THE VICINITY OF RBDD
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

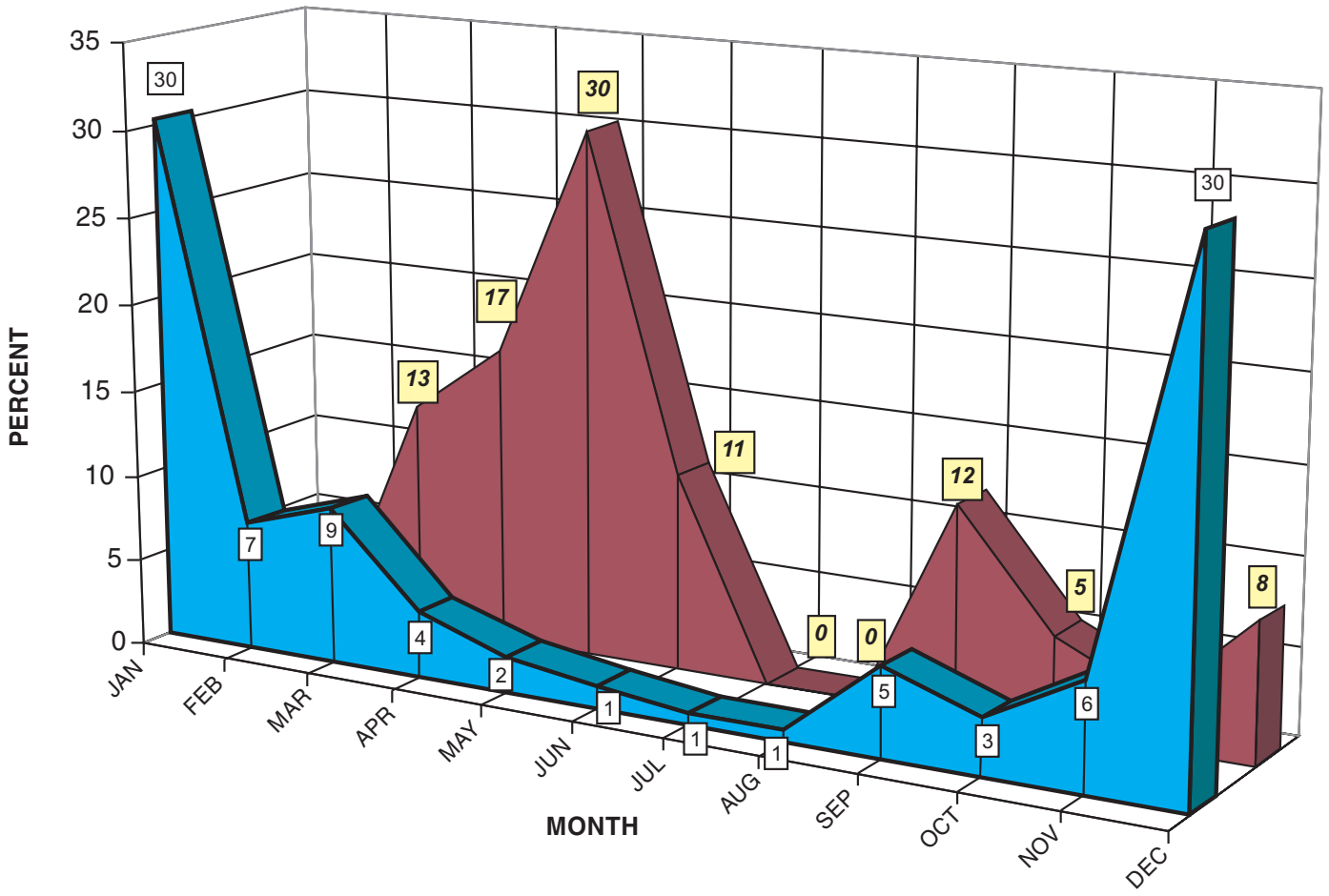

FIGURE B-13
PASSAGE/PRESENCE OF EMIGRATING PACIFIC AND RIVER LAMPREY TRANSFORMERS IN THE SACRAMENTO RIVER IN THE VICINITY OF RBDD
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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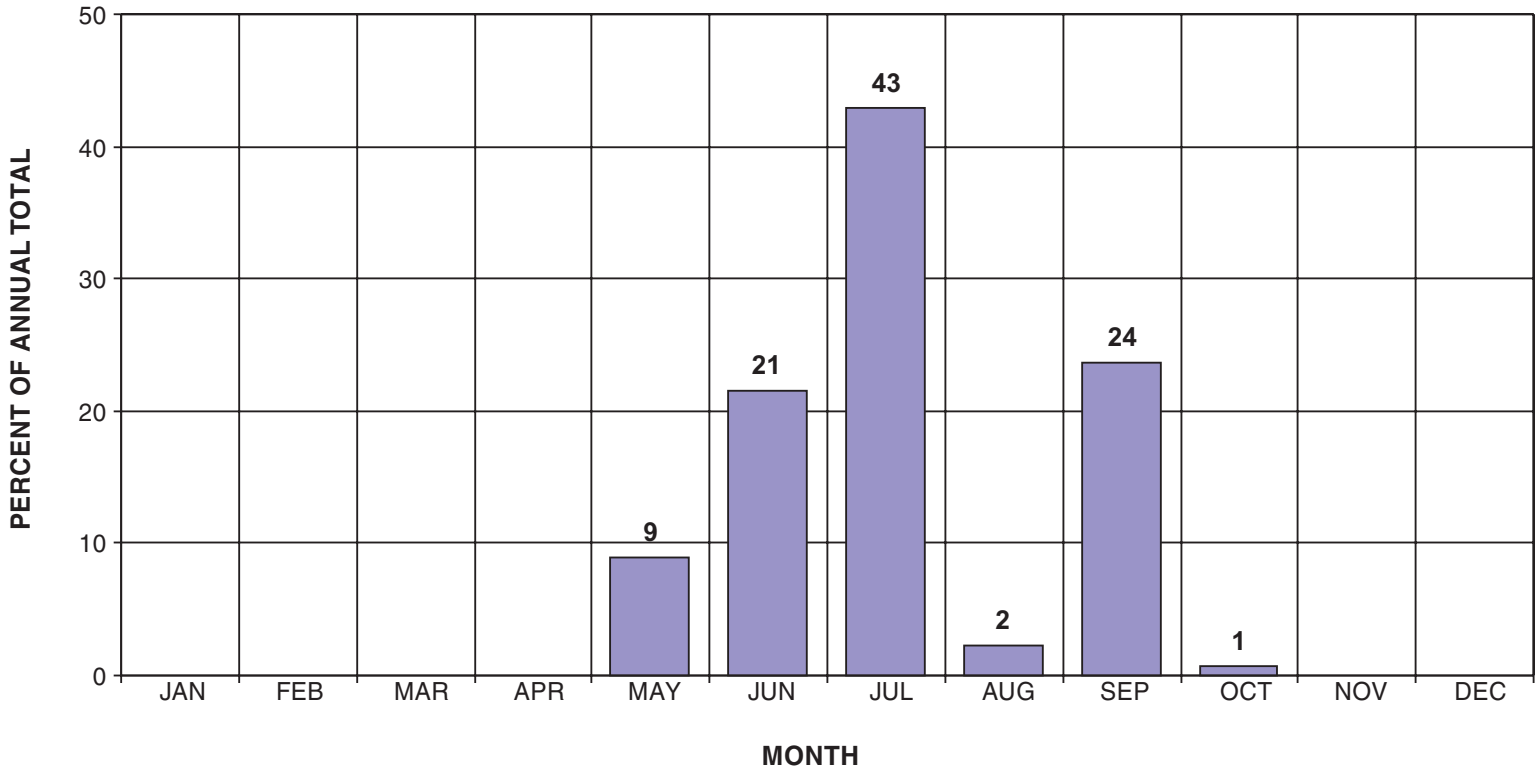

FIGURE B-14
THE MONTHLY RELATIVE ABUNDANCE OF ADULT STRIPED BASS IN THE VICINITY OF RBDD
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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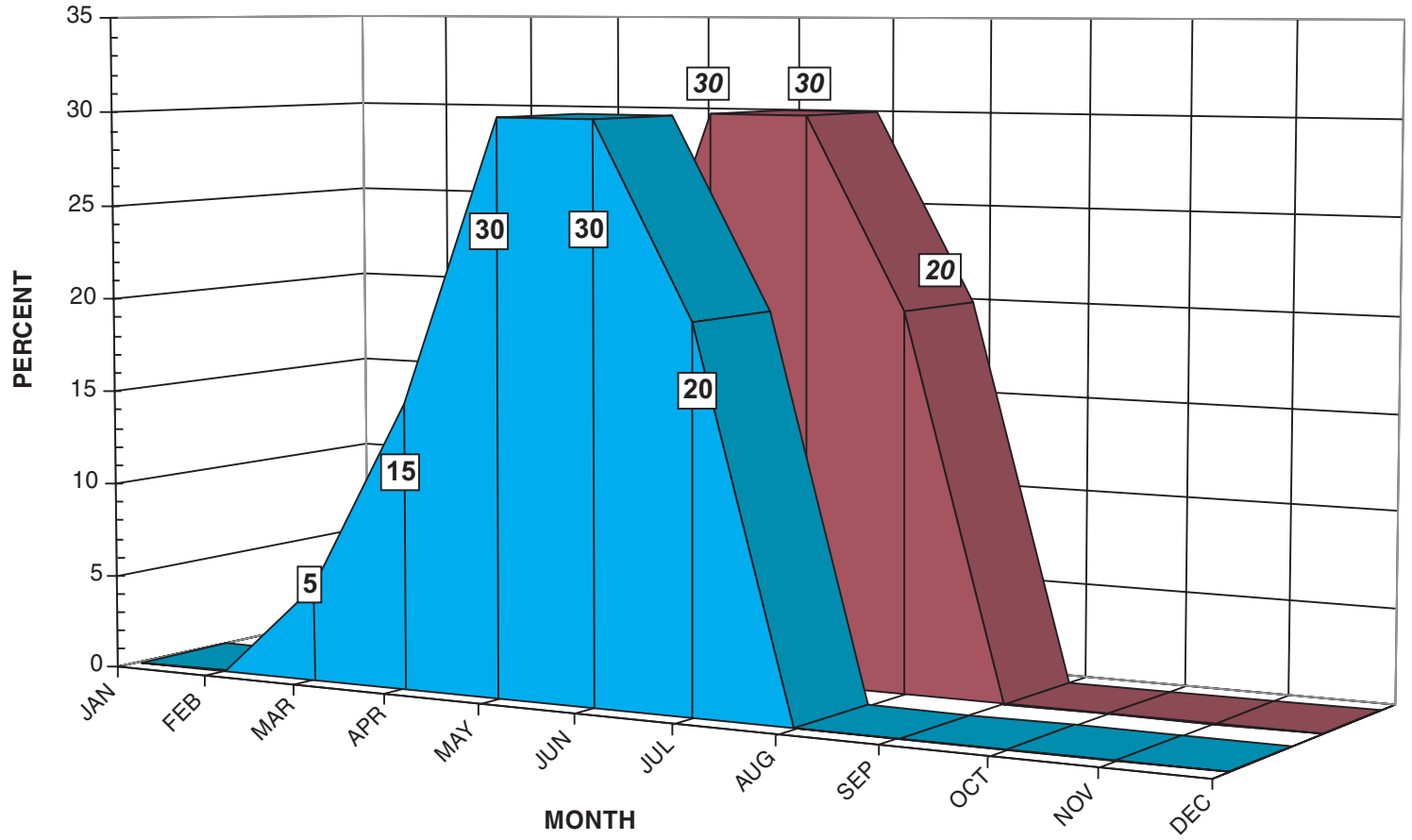

FIGURE B-15
ESTIMATED PRESENCE OF AMERICAN SHAD NEAR RBDD
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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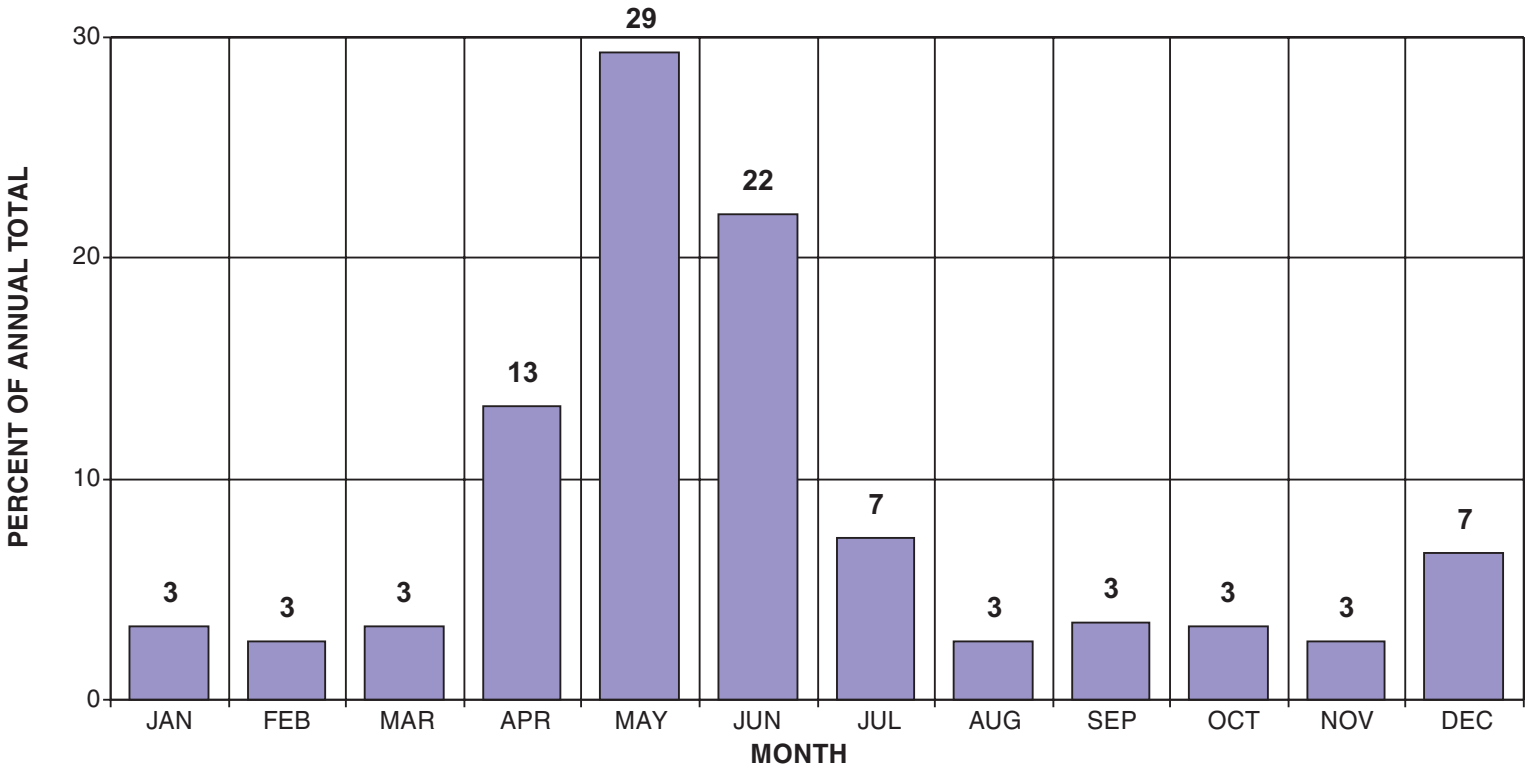

FIGURE B-16
RELATIVE ABUNDANCE OF ADULT SACRAMENTO PIKEMINNOW AT RBDD (1994 TO 1996)
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

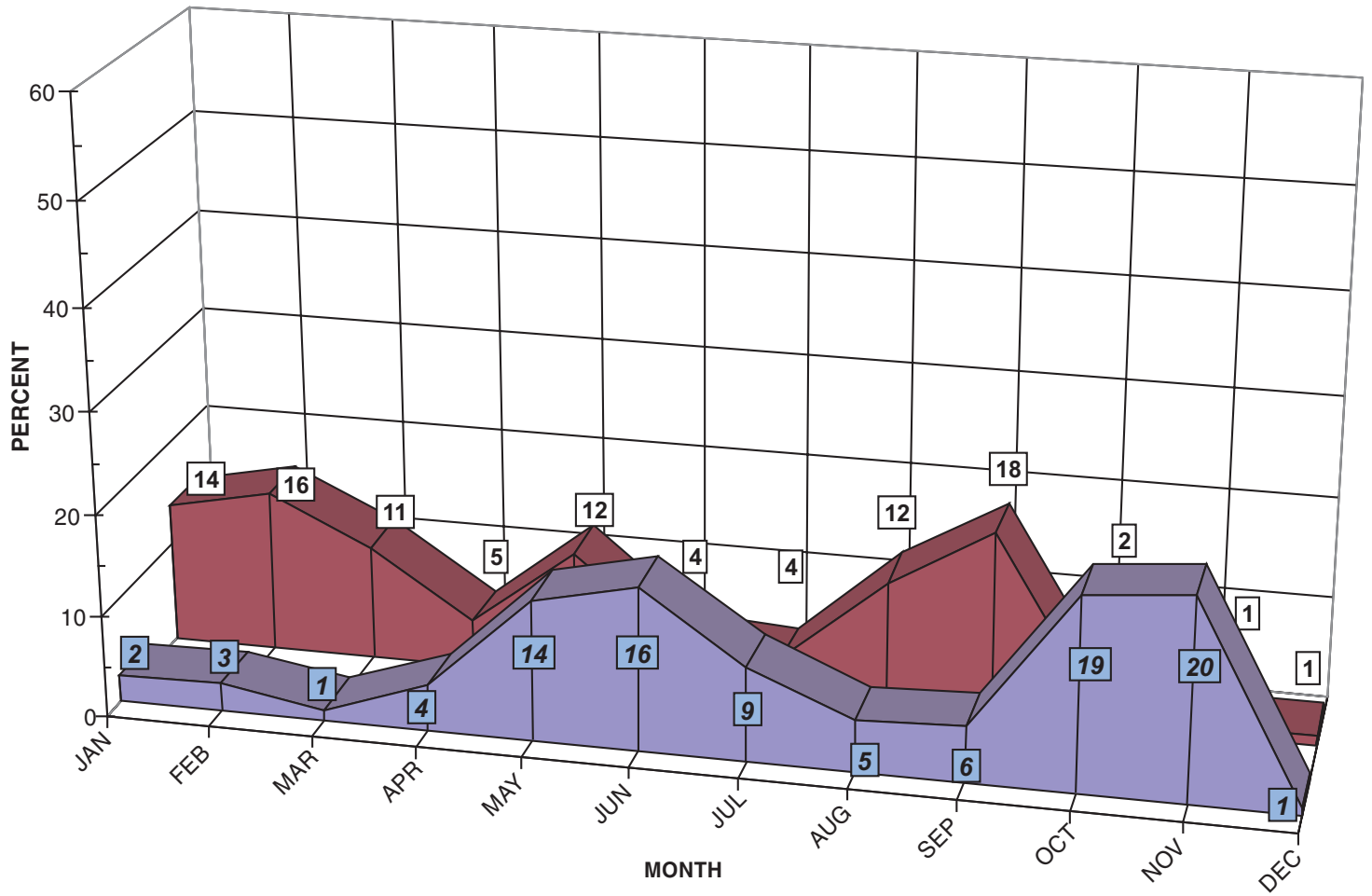

FIGURE B-17
PRESENCE AND PASSAGE OF RAINBOW TROUT AT RBDD
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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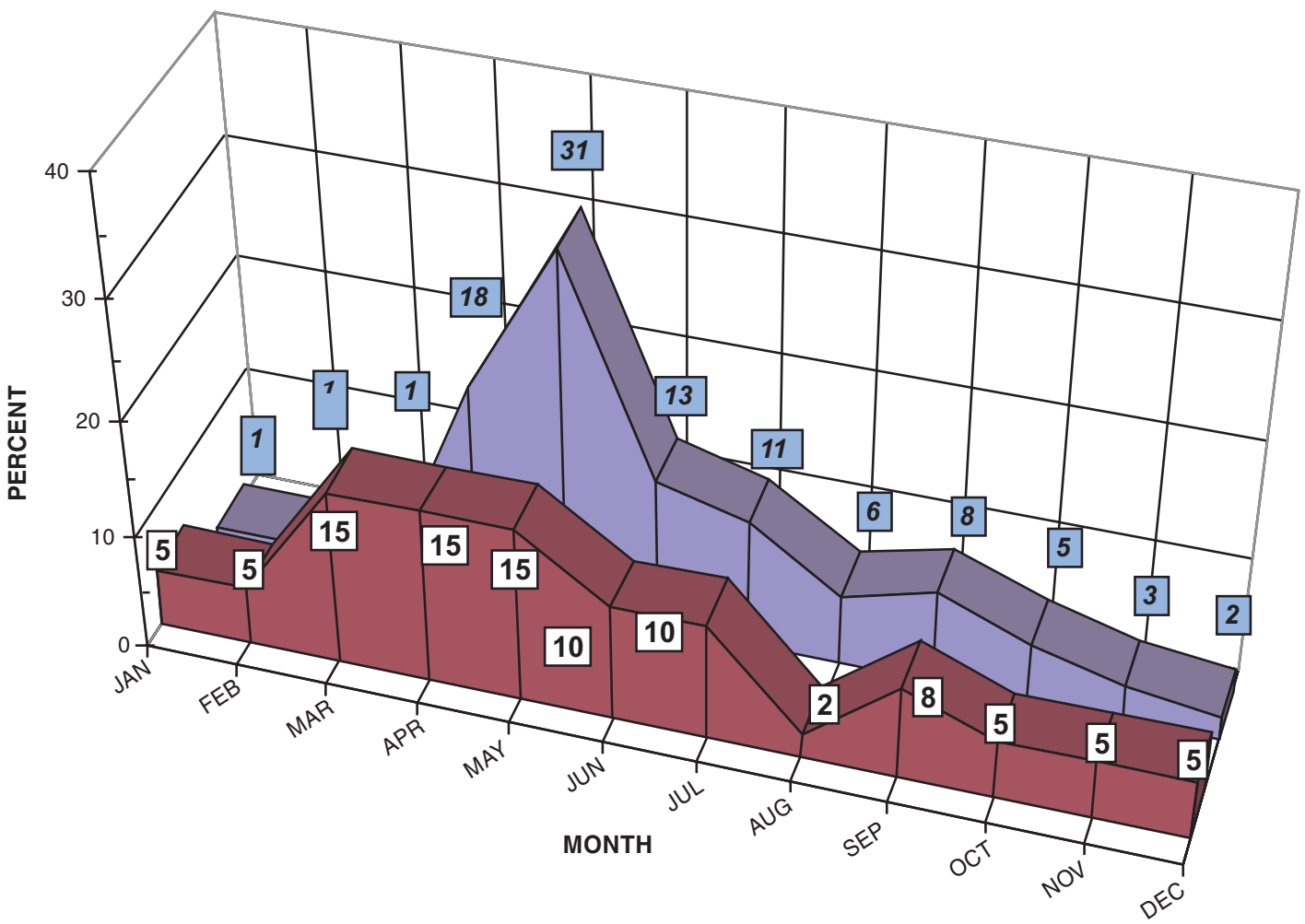

FIGURE B-18
PRESENCE AND PASSAGE OF ADULT HARDHEAD AND SACRAMENTO SUCKER AT RBDD
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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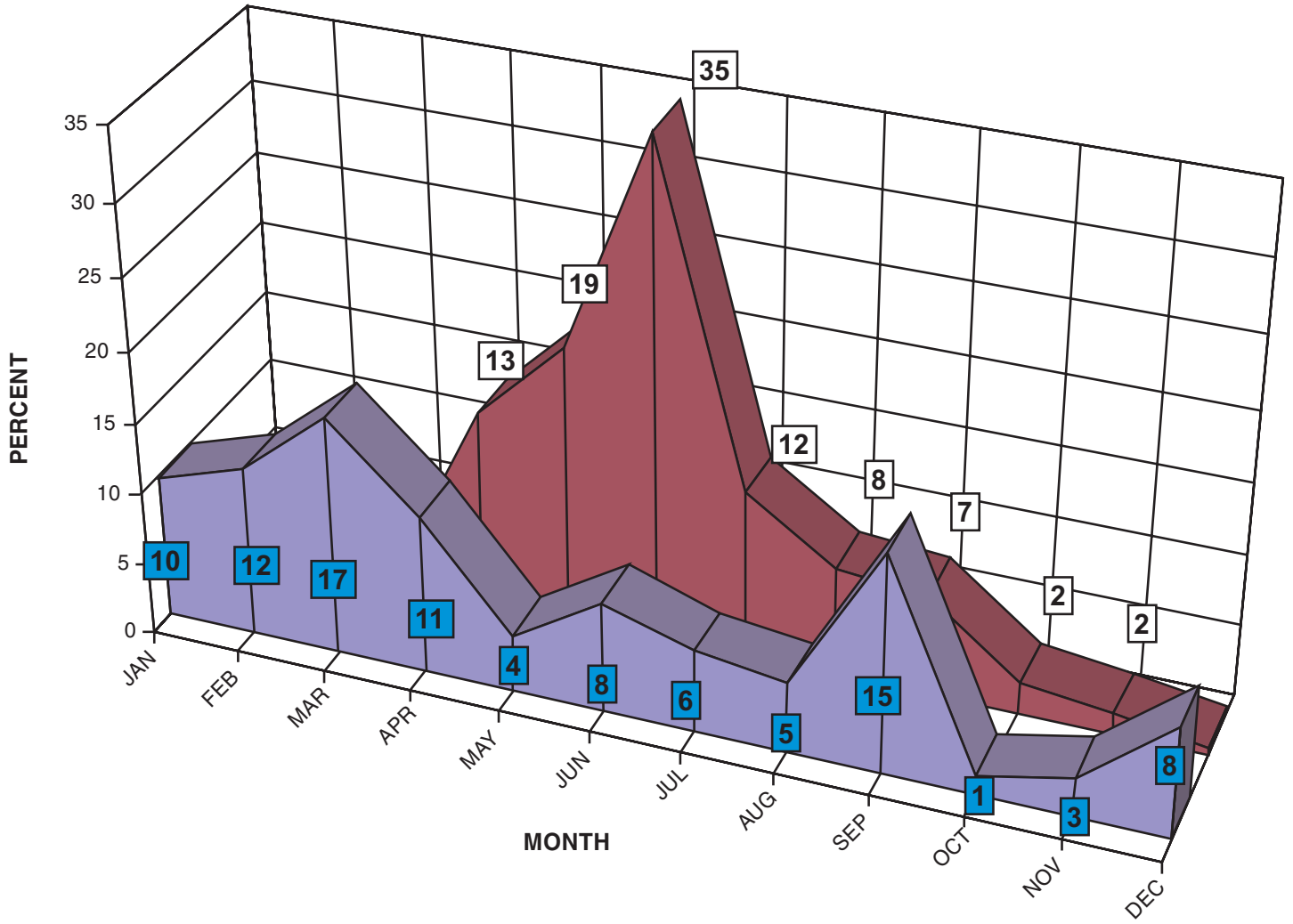

FIGURE B-19
PRESENCE AND PASSAGE OF JUVENILE HARDHEAD AND SACRAMENTO SUCKER AT RBDD
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

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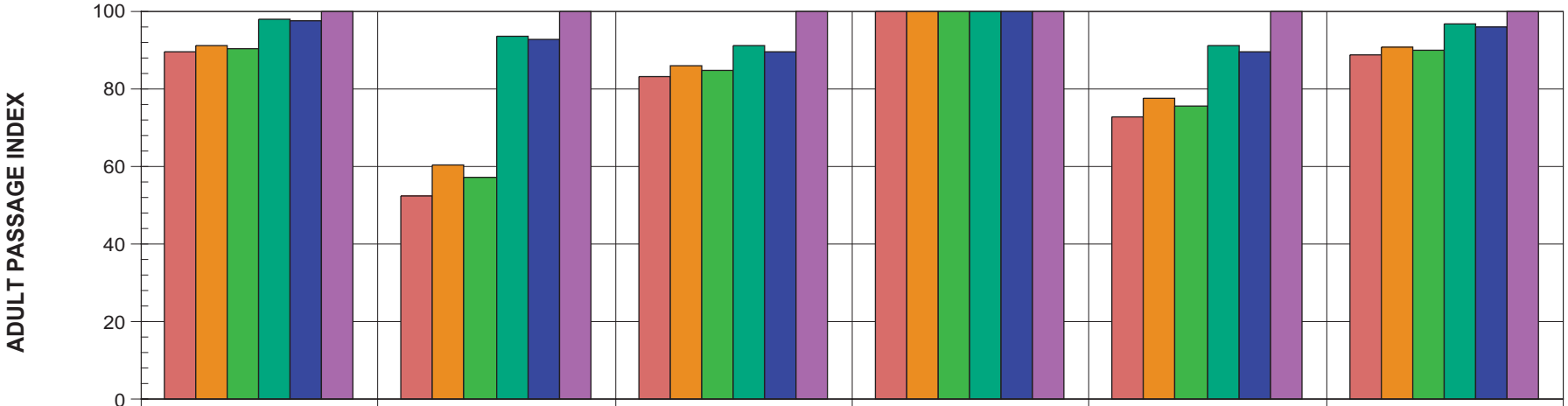
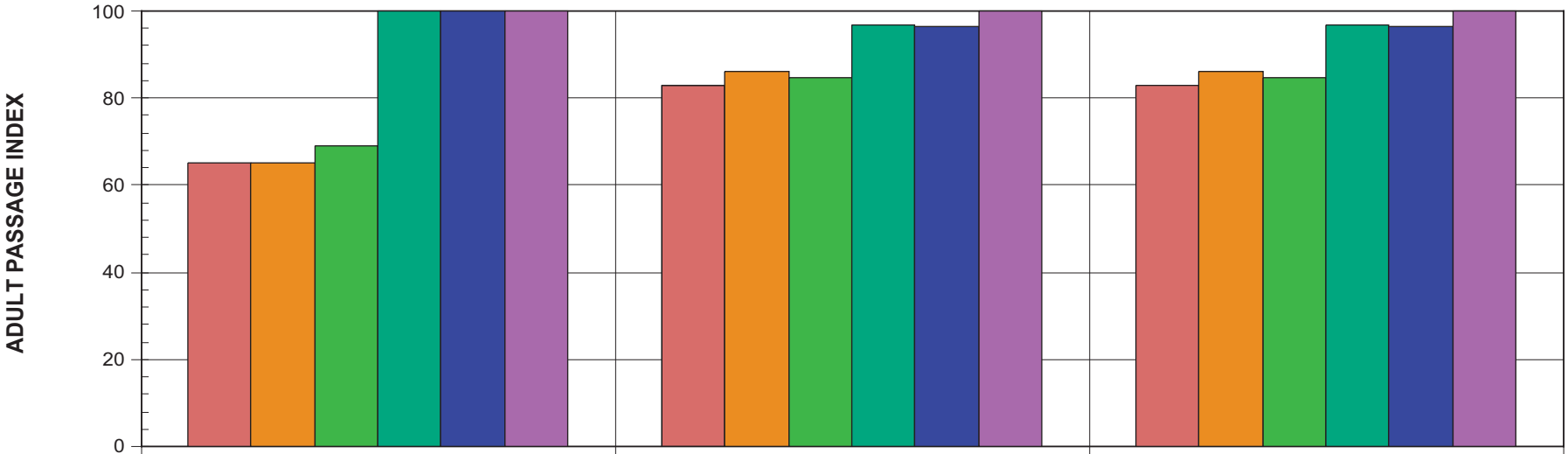


	WINTER-RUN CHINOOK SALMON	SPRING-RUN CHINOOK SALMON	FALL-RUN CHINOOK SALMON	LATE-FALL-RUN CHINOOK SALMON	RAINBOW TROUT	STEELHEAD
NAA	89	52	83	100	73	89
ALT. 1A	91	61	86	100	78	91
ALT. 1B	91	57	85	100	76	90
ALT. 2A	98	94	91	100	91	97
ALT. 2B	98	93	89	100	90	96
ALT. 3	100	100	100	100	100	100

NAA
ALTERNATIVE 1A
ALTERNATIVE 1B
ALTERNATIVE 2A
ALTERNATIVE 2B
ALTERNATIVE 3

FIGURE B-20
ADULT PASSAGE INDICES FOR NATIVE ANADROMOUS SALMONID SPECIES AND RESIDENT NATIVE RAINBOW TROUT
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR



	GREEN STURGEON	PACIFIC LAMPREY	RIVER LAMPREY
NAA	65	83	83
ALT. 1A	65	86	86
ALT. 1B	69	85	85
ALT. 2A	100	97	97
ALT. 2B	100	96	96
ALT. 3	100	100	100

NAA
ALTERNATIVE 1A
ALTERNATIVE 1B
ALTERNATIVE 2A
ALTERNATIVE 2B
ALTERNATIVE 3

FIGURE B-21
ADULT PASSAGE INDICES FOR OTHER NATIVE ANADROMOUS SPECIES
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

W072002003RDD_103 (8/14/02)

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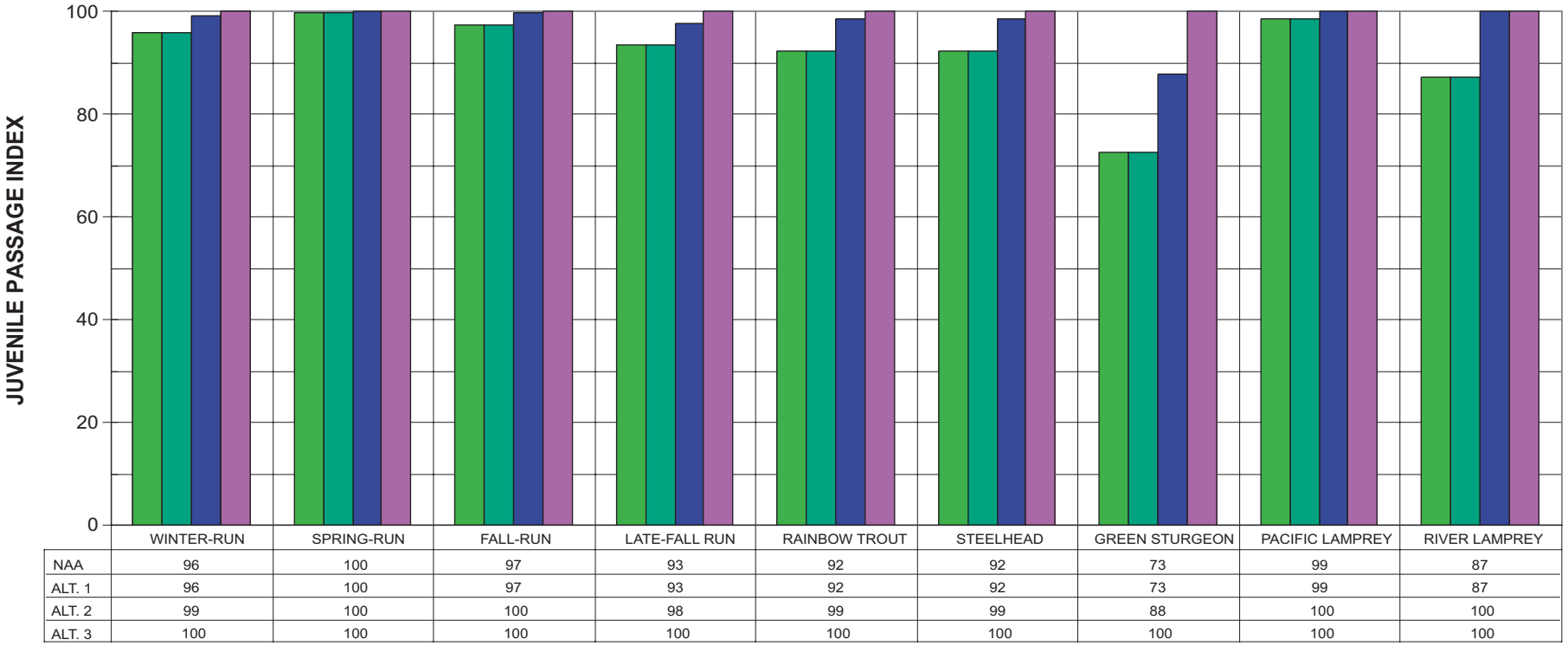

	WINTER-RUN	SPRING-RUN	FALL-RUN	LATE-FALL RUN	RAINBOW TROUT	STEELHEAD	GREEN STURGEON	PACIFIC LAMPREY	RIVER LAMPREY
NAA	96	100	97	93	92	92	73	99	87
ALT. 1	96	100	97	93	92	92	73	99	87
ALT. 2	99	100	100	98	99	99	88	100	100
ALT. 3	100	100	100	100	100	100	100	100	100

NAA
ALTERNATIVE 1
ALTERNATIVE 2
ALTERNATIVE 3

FIGURE B-22
JUVENILE PASSAGE INDICES SPECIES ANALYZED USING THE FISHTASTIC! TOOL
FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

W072002003RDD_22 (8/14/02)

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Attachment B1
Fishtastic! Approach, Assumptions, and Methodology

ATTACHMENT B1

Fishtastic! Approach, Assumptions, and Methodology

Introduction

The following describes the development of a tool for quantifying fish passage under a variety of dam facility management scenarios (Project Alternatives), and to describe the results and repercussions of this analysis. The analytical tool is called Fishtastic!, and was developed specifically to gain a better understanding of fish passage at the Red Bluff Diversion Dam (RBDD) in Red Bluff, California. Although quantification of natural processes, particularly involving complex organisms, is at best, only an approximation based on many assumptions, Fishtastic! was designed to be a decision-making tool. It is not intended to predict actual changes in numbers of individuals or populations of fish and thus is not a "spawner-recruit model." Its function is to distinguish differences between project alternatives using life history characteristics for several key Sacramento River fish species under average or "typical" conditions.

The selection of a preferred management alternative would therefore reflect factors aimed at improving dam passage efficiency for species requiring the most assistance, while maintaining an adequate water supply for agriculture and other uses. The macro-based spreadsheet tool was developed to calculate an average annual index of fish passage efficiency at RBDD. This index is intended to represent an annual cumulative measure of energy expenditure, stress, delay, blockage, injury, or loss, affecting a species as it transits the RBDD project area. The annual index calculated ranges from zero (the species is negatively affected fully) to 100 (the species is unaffected whatsoever). The greater the index value, the less adversely affected the species is.

The RBDD has a unique operation, in that it utilizes movable gates to control flow in the Sacramento River. With the gates in the down position (gates-in), water ponded behind the dam (Lake Red Bluff) is diverted into the Tehama-Colusa irrigation canal (TC Canal) to serve agricultural needs. Currently, gates are in from mid-May to mid-September, per direction of the 1993 Biological Opinion (National Marine Fisheries Service [NMFS], 1993) during which three ladders facilitate adult fish passage through the dam and upstream within the Sacramento River. Fishtastic! attempts to evaluate the use of the existing and improved ladders, as well as alternative passage approaches such as an engineered bypass channel alone or in combination with ladders, as well as different gates-in operations timings.

To develop a detailed understanding of the factors affecting fish passage, a number of Fishtastic! versions were developed. Each new version includes modifications to the types of input information and the nature of the calculations, as Fishtastic! development has been an iterative process. The two versions presented below have provided the most valuable and useful information. The following sections principally describe the methodology of

versions 5.2-5.5, the latest operational version of Fishtastic!. However, version 1.4 is also briefly described to provide background on the results of early analysis efforts and their effects on the development and output of versions 5.2-5.5.

Assumptions

Adult Module

Adult fish passage simulation analysis included a variety of assumptions regarding immigration, structural facilities and their configurations, and facility passage efficiencies. The following describes input variable assumptions for the adult Fishtastic! module.

In Fishtastic! versions 5.2-5.5, seven management alternatives were evaluated for selected species. These included:

- No Action Alternative – RBDD Gates-in 4 months (May 15 through September 15), existing ladders in all positions
- 1A: 4-month Improved Ladder Alternative – Gates-in 4 months (May 15 through September 15), new ladders in two positions (left and right banks)
- 1B: 4-month Bypass Alternative – Gates-in 4 months (May 15 through September 15), new left bank bypass channel, new fish ladder on right bank
- 2A: 2-month Improved Ladder Alternative – Gates-in 2 months (July and August), new fish ladders in two positions (left and right banks)
- 2B: 2-month with Existing Ladders Alternative – Gates-in 2 months (July and August), existing fish ladders
- 3: Gates-out Alternative – Gates-out year-round, no operational fish ladders

Annual adult temporal migration distributions, which represent the percentages of each species' annual migration occurring each month, are provided in Table 1. As previously stated, these values are the monthly passage percentages at RBDD without any impediments and would correspond to the Gates-out Alternative. Temporal distributions for many species affected by RBDD were developed by reviewing existing RBDD fish ladder and trapping data over several years. Additional historical data for species currently in low abundance were reviewed and incorporated into the adult and juvenile distributions. Finally, through consensus of fishery professionals familiar with the upper Sacramento River watershed, workshops were conducted by this Technical Working Group to determine and finalize the life-history characteristics of species used for the analyses.

The number of days of delay related to locating RBDD dam facilities are shown in Table 2. These values are based on radio telemetry data collected from 1999 through 2001 for fall-run Chinook salmon captured and released at RBDD by the U.S. Fish and Wildlife Service (USFWS). The existing (with "old" ladders) average delay value, which was based on seasonal (August through September, during 3 different years, 1999 through 2001) ~~the 3 years of~~ radio telemetry data currently available, is approximately 21 days to pass RBDD.

TABLE 1
Average Monthly Adult Temporal Distribution at RBDD

Species	Jan	Feb	Mar	Apr	May (1-15)	May (16-30)	Jun	Jul	Aug	Sep (1-15)	Sep (16-30)	Oct	Nov	Dec	Total
Winter-run Chinook Salmon[a]	5.1	9.6	36.0	28.6	3.6	5.3	6.8	3.4	0.0	0.0	0.0	0.0	0.0	1.7	100
Spring-run Chinook Salmon[b]	0.0	0.0	0.0	7.6	22	22	37.8	8.8	1.7	0.0	0.0	0.0	0.0	0.0	100
Fall-run Chinook Salmon[a]	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.6	13.0	10.1	17.8	37.0	16.3	4.0	100
Late-fall-run Chinook Salmon[a]	18.8	16.2	12.7	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	14.6	29.6	100
Rainbow Trout[c]	2.5	2.7	1.0	4.4	6.9	6.9	16.1	9.3	5.0	2.8	2.8	18.8	20.0	0.8	100
Sacramento Pikeminnow[d]	1.0	1.0	1.0	18.0	16.0	15.0	13.0	11.0	6.0	4.0	4.0	5.0	3.0	2.0	100
Steelhead[a]	2.9	1.8	1.9	1.0	0.3	0.4	0.8	0.7	4.8	9.6	16.5	39.3	13.9	6.1	100
Splittail[e]	10.0	10.0	20.0	20.0	10.0	10.0	10.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	100
Green Sturgeon[e]	0.0	5.0	15.0	25.0	20.0	15.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100
White Sturgeon[f]	0.0	5.8	37.4	42.7	9.7	3.9	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100
Pacific Lamprey[e]	0.0	5.0	10.0	20.0	20.0	10.0	5.0	3.0	2.0	5.0	5.0	5.0	5.0	5.0	100
River Lamprey[e]	0.0	5.0	10.0	20.0	20.0	10.0	5.0	3.0	2.0	5.0	5.0	5.0	5.0	5.0	100
Striped Bass[e]	1.0	1.0	1.0	10.0	8.0	8.0	20.0	27.0	4.0	5.0	6.0	7.0	1.0	1.0	100
Hardhead[e]	1.0	1.0	1.0	18.0	16.0	15.0	13.0	11.0	6.0	4.0	4.0	5.0	3.0	2.0	100
American Shad[e]	0.0	0.0	5.0	15.0	15.0	15.0	30.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	100
Sacramento Sucker[e]	5.0	5.0	15.0	15.0	10.0	5.0	10.0	10.0	2.0	3.0	5.0	5.0	5.0	5.0	100

[a]RBDD ladder counts/trapping from 1982-1986.

[b]RBDD ladder counts/trapping from 1970-1988; CDFG, 1998; RBDD ladder counts/trapping from 1995-2000, consensus of Technical Working Group.

[c]RBDD ladder counts/trapping 1984-2000.

[d]Tucker, 1997.

[e]Consensus of Technical Working Group.

[f]Consensus of Technical Working Group, Kohlhorst, 1976 (note: this species may not actually pass RBDD).

TABLE 2
Estimated (Assigned) Number of Days of Delay for Each of the Facility Structures at RBDD Based on Radio Telemetry Data for Fall-run Chinook Salmon During 1999 through 2001

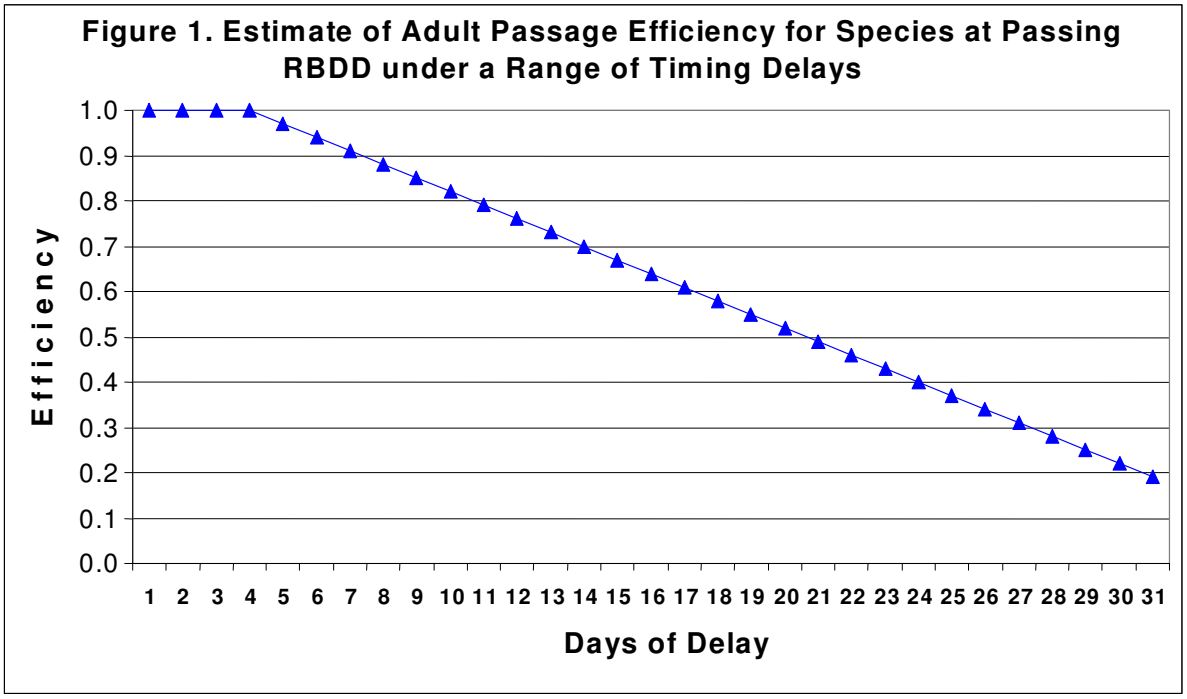
Species	Old Ladders	New Ladders	Bypass	Old Ladders and Bypass	New Ladders and Bypass	Lock	Old and New Ladders
Winter-run Chinook Salmon	21	18	19	19	16	21	19
Spring-run Chinook Salmon	21	18	19	19	16	21	19
Fall-run Chinook Salmon	21	18	19	19	16	21	19
Late-fall-run Chinook Salmon	21	18	19	19	16	21	19
Other	21	18	19	19	16	21	19
Sacramento Pikeminnow	21	18	19	19	16	21	19
Steelhead	21	18	19	19	16	21	19
Splittail	21	18	19	19	16	21	19
Green Sturgeon	21	18	19	19	16	21	19
White Sturgeon	21	18	19	19	16	21	19
Pacific Lamprey	21	18	19	19	16	21	19
River Lamprey	21	18	19	19	16	21	19
Striped Bass	21	18	19	19	16	21	19
Hardhead	21	18	19	19	16	21	19
American Shad	21	18	19	19	16	21	19
Sacramento Sucker	21	18	19	19	16	21	19

The efficiency values assigned to the "future" facilities (e.g., "new" ladders) were estimated based on perceptions of their relative efficiency as compared to the existing facilities' efficiencies. For example, new ladders as compared to the existing ladders that were designed for salmonids, but are decades old, may reduce average passage by 3 days. However, compared to the old ladders alone, the old ladders with a bypass channel may only reduce passage delay by 1 day.

Due to a limited set of actual field data, the delay values for any structural facility other than existing fish ladders that were used in the analysis were assumed to be the same among all of the species. It is recognized that it is likely that there are differences in delay timing dependent on species/run of fish, time of year, water temperatures/quality, and river flow conditions. In some instances, values used in the analysis are conservative estimates, and this was necessary because the facility component being assessed has not yet been built. For example, only existing ladders have been used at RBDD. Therefore, the assumed adult passage delay from other dam facilities (e.g., new ladders or a bypass channel), were extrapolated and were subjective. However, these efficiency values were applied uniformly across all alternatives for all species. A detailed explanation of the passage delay calculations as they were applied in the analysis is described later in this attachment.

In the case of the bypass channel, the efficiency of a facility such as this to successfully pass species such as salmon, sturgeon, and others is highly uncertain. The bypass channel as proposed is a highly designed channel with "hardscape" features such as cement/rock baffles and weirs to control velocity. This bypass channel would more resemble an alternative "fish ladder." However, because of its total size and other features that would be necessary to physically locate this bypass, its efficiency to pass fish is very uncertain. In the case of conventional fish ladders, there is sufficient experience documenting the successful use of this technology, and therefore, the uncertainty of passage efficiency is much less that that for a bypass channel. There is no practical means to test or determine the usefulness of a bypass channel other than to build one and then determine its efficiency.

Figure 1 presents the estimated passage efficiencies as they relate to the number of days delayed, where an increase in the number of delay days reduced the passage efficiency of the species. As with delay days in Table 2, values for delay-related passage efficiencies are the same among all of the species, due to the scarcity of available field data. As there are no empirical data to develop a curve of passage delay versus time (efficiency), a linear relationship was assumed. The Technical Working Group estimated that biologically, a delay of less than 3 days would result in no adverse biological consequences. Therefore, on Figure 1, the reduction in efficiency does not begin until delays greater than three days occur.



As described in the methodology discussion (below), passage efficiencies for each facility (e.g., right bank dam) represent a portion of the total passage. Table 3 provides passage efficiencies used in the analysis for ladders and bypass for each management alternative. Ladder efficiencies vary depending on whether a given alternative includes old or new ladders at specific locations. The efficiencies assigned in Table 3 were developed by the Technical Working Group based on a relative basis of efficiencies. For example, it was assumed that the passage efficiency of the existing left bank ladder component of the No Action passage facilities was 0.2 (out of a total efficiency of 0.5 for the alternative). Then the passage efficiency of a new left bank fish ladder (e.g., 4-month Improved Ladder Alternative) might be 25 percent more efficient or have a resulting component efficiency of 0.25. Furthermore, for the bypass channel it was assumed that the efficiency of this facility may be similar to that of a new ladder (0.25) and thereby was assigned an efficiency value of 0.25 for that component.

TABLE 3
Facilities' Specific Passage Efficiencies for Adult Analysis Module

Alternative	Left Bank Ladder	Center Ladder	Right Ladder	Bypass
No Action	0.2	0.1	0.2	n/a
1A	0.25	0.1	0.25	n/a
1B	0.25	0.1	0.2	0.25
2A	0.25	n/a	0.25	n/a
2B	0.2	n/a	0.2	n/a
3	n/a	n/a	n/a	n/a

Juvenile Module

Fishtastic! analyses for juvenile fish were run on similar, albeit less complicated, alternatives as the adult simulations. Facilities management alternatives included:

- No Action Alternative – Gates-in 4 months (May 15 through September 15), existing ladders in current locations (left and right banks and in the center)
- 4-month Alternatives – Gates-in 4 months (May 15 through September 15), functionally identical to No Action Alternative
- 2-month Alternatives – Gates-in 2 months (July and August)
- Gates-out – Gates out all year (natural river flow)

It was assumed that ladder designs were not sufficiently important in estimating juvenile fish downstream passage efficiency. The assumption was that predation was the single most important factor contributing to reduced passage efficiency at RBDD. It was assumed that any alternative would include juvenile fish protection facilities in accordance to existing NMFS and California Department of Fish and Game (CDFG) criteria, and therefore, there would be no difference in juvenile passage efficiencies related to these facilities. Thus, it was assumed that ladder design (and pump station/fish screen designs) would have no calculable effect on juvenile passage efficiency and calculation of their indices. The principal mechanism of impact to downstream migrating juvenile fish was therefore assumed to be from predation related to RBDD facilities.

Similar to adult temporal distributions, monthly juvenile presence at RBDD was determined using the most pertinent and current data available and consensus of knowledgeable fishery specialists from the Technical Working Group. Monthly temporal distribution (presence) for juveniles of each species are illustrated in Table 4. As is evident from the table, juvenile fish migration for each species occurs at different times than adult fish due to the life history characteristics and life stages (spawning, incubation, growth and development, migration, and re-distribution) for each species. Thus, passage improvements for juvenile life stages due to changes in RBDD facilities, management, or operations may not necessarily be reflected similarly to adults and juveniles of the same species.

In the juvenile analysis module of Fishtastic!, provisions for spatially distributing down-stream migrating juvenile fish present at RBDD were built into the tool. The parsing of juveniles could be assigned to each of the RBDD's facilities and other locations around RBDD depending upon the proportion of river flow at each location. However, after much discussion with the Fish Technical Advisory Team, it was decided that differential predation rates based on the location of juveniles within the river or at various RBDD facilities was not feasible. Therefore, in Fishtastic!, juveniles were subjected to the predation assessment ("*E. A. Gobbler*" sub-routine) without regard to any flow-based spatial juvenile distributions. The principal factors applied to assess potential predation at RBDD were based on a maximum literature value for predation for juvenile salmonids (Vogel et al., 1988) and the actual presence of predatory species at RBDD (Tucker, 1997). The estimated predation rate of 55 percent (Vogel et. al, 1988) was weighted by predator presence as estimated by catch per unit effort (CPE) of Sacramento pikeminnow and striped bass at RBDD (Tucker, 1997).

TABLE 4
Average Monthly Juvenile Temporal Presence (percent of total annual) at RBDD

Species	Jan	Feb	Mar	Apr	May (1 through 14)	May (15 through 30)	Jun	Jul	Aug	Sep (1 through 15)	Sep (16 through 30)	Oct	Nov	Dec	Total
Winter-run Chinook Salmon[a]	2.8	2.3	1.4	0.1	0.0	0.0	0.0	1.3	11.8	26.3	26.2	14.1	11.4	2.3	100
Spring-run Chinook Salmon[a]	8.2	3.2	22.7	25.6	1.0	0.6	0.1	0.0	0.0	0.0	0.0	2.4	2.6	33.6	100
Fall-run Chinook Salmon[a]	23.1	31.4	10.0	14.5	2.0	1.9	3.4	1.7	0.6	0.1	0.1	0.0	0.0	11.3	100
Late-fall-run Chinook Salmon[a]	1.6	0.1	0.0	30.1	4.7	4.0	3.8	7.0	13.6	5.7	5.1	6.3	14.2	3.9	100
Sacramento Pikeminnow[a]	8.6	15.3	11.9	4.7	1.7	2.0	26.2	7.8	3.8	3.1	3.0	0.5	4.0	7.4	100
Steelhead/ Rainbow Trout[a]	13.9	15.9	11.2	4.6	6.2	6.2	4.4	3.7	12.3	10.0	8.2	1.5	1.0	0.9	100
Splittail[b]	0.0	10.0	10.0	20.0	20.0	10.0	10.0	10.0	10.0	0.0	0.0	0.0	0.0	0.0	100
Green Sturgeon[a]	0.0	0.4	0.0	0.0	0.3	0.5	37.1	50.1	11.1	0.0	0.0	0.5	0.0	0.0	100
White Sturgeon[c]	0.0	0.0	5.8	37.4	42.7	9.7	3.9	0.5	0.0	0.0	0.0	0.0	0.0	0.0	100
Pacific Lamprey[d]	30.3	7.4	9.0	3.8	1.1	1.0	1.3	0.7	0.7	2.6	2.6	3.3	6.3	30.1	100
River Lamprey[d]	0.0	0.0	13.1	17.2	15.3	15.0	11.3	0.0	0.0	5.9	6.0	5.4	2.9	8.0	100
Striped Bass[e]	1.0	1.0	1.0	1.0	10.0	8.0	8.0	20.0	27.0	4.0	5.0	6.0	7.0	1.0	100
Hardhead[a]	10.0	11.9	16.7	11.1	4.1	4.0	3.8	5.8	5.1	8.0	7.4	1.5	2.8	7.9	100
American Shad[b]	0.0	0.0	0.0	5.0	15.0	15.0	15.0	30.0	20.0	0.0	0.0	0.0	0.0	0.0	100
Sacramento Sucker[a]	0.2	0.7	1.1	13.4	9.2	10.0	34.7	11.7	7.7	4.0	3.0	2.3	1.5	0.5	100

[a]From juvenile trapping data collected during 1995-1999 by USFWS at RBDD.

[b]Consensus of Technical Working Group (note: this may be theoretical as adults of this species may not pass RBDD).

[c]Consensus of Technical Working Group; Kohlhorst (1976) (note, this may be theoretical as adults of this species may not pass RBDD).

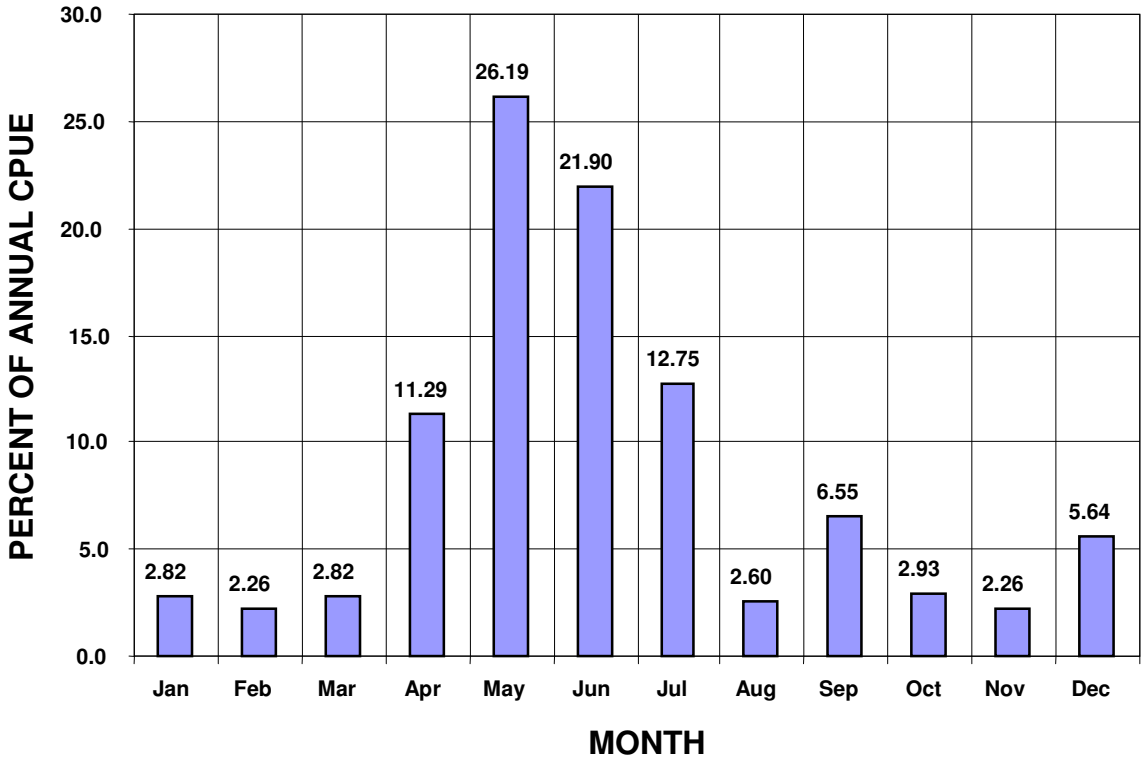
[d]From lamprey transformer trapping data collected during 1995-1999 by USFWS at RBDD.

[e]Consensus of Technical Working Group.

Monthly combined predator presence at RBDD as derived for this analysis is shown on Figure 2.

To estimate monthly rates of predation, or a predation hazard index, the maximum predation rate (55 percent) estimated by Vogel et al. (1988) was scaled against the monthly weighted combined predator presence estimates. The resulting monthly predator hazard index was then applied in the calculations for the *E.A. Gobbler* sub-routine of Fishtastic! juvenile analysis module. These monthly hazard indices are shown in Table 5.

Figure 2. Combined Monthly Percent of Total Striped Bass and Pikeminnow Catch/Unit Effort at RBDD (1994-1996)



Methods: Fishtastic! Version 1.4

Fishtastic! version 1.4 used a large set of tabular input data for adult fish inputs, specifically low-end and high-end flow-based passage efficiencies for fish at various facilities. Project alternatives included a no change alternative (current conditions) with gates-in from May 15 through September 15 and current ladders, a second alternative with new fish ladders and the same gate timings (current conditions), a bypass channel alternative, and a gates-out scenario (natural river flow).

For juvenile fish, data input tables relate reduced passage efficiencies to a variety of hazards (e.g., increased predation in Lake Red Bluff and downstream of the dam, impingement or entrainment on dam structures, or injury). In version 1.4, juvenile fish were also distributed

to various structures on the dam (e.g., right ladder, diversion channel, etc.) depending on river flow and behavioral placement in the river channel. Hazards causing reduced passage efficiency were selected by the user depending on the location to which fish were flow-distributed.

TABLE 5
Estimated Monthly Hazard Estimate Used to Assess Predation in the *E.A. Gobbler* Sub-routine of the Fishtastic! Juvenile Analysis Module

Month	CPUE (% of yearly total)	Scaled Predation Rate (%)	Hazard Multiplier (0-1)
Jan	2.82	5.88	0.94
Feb	2.26	4.83	0.95
Mar	2.82	5.88	0.94
Apr	11.29	23.72	0.76
May	26.19	55[(2)]	0.45
Jun	21.90	45.97	0.54
Jul	12.75	26.87	0.73
Aug	2.60	5.46	0.95
Sept	6.55	13.85	0.86
Oct	2.93	6.09	0.94
Nov	2.26	4.83	0.95
Dec	5.64	11.76	0.88

Sources: Tucker (1997); Vogel et al., 1988.

Output from Fishtastic 1.4 provided enlightening information on the factors affecting fish passage. Perhaps most importantly, passage efficiencies were similar with old and new ladders, contrary to the hypothesis that improved ladder design would result in substantial increases in passage efficiency. These results indicated that reduced passage efficiencies associated with ladder designs only incorporated reduced efficiencies at the dam itself, but not delays in the approach to the dam. Fishtastic! version 5.2-5.5 therefore included delays due to locating dam passage facilities, as well as a greater number of facilities management combinations for simulation.

Scrutiny of the results of the juvenile fish analysis from Fishtastic! version 1.4 revealed that the analysis tool incorporated many factors that most likely will not be substantially affected by modifications to the dam. Essentially, the most important factor affecting juvenile fish passage was determined to be predation. Thus, versions 5.2-5.5 was simplified, whereby facilities-related injury, entrainment, and impingement factors were removed from the inputs. The resultant version was a simpler approach employing flow routing and predation at specific areas of the dam.

Methods: Fishtastic! Versions 5.2-5.5

These versions of Fishtastic! provide interfaces for both adult and juveniles of 15 species commonly found at RBDD, including anadromous salmonids (e.g., Chinook salmon and steelhead), other native anadromous species (e.g., sturgeon and lamprey species), non-native anadromous species (e.g., striped bass and American shad), and native/non-native resident species (e.g., rainbow trout and brown trout). The following sections highlight the

operational and user interface characteristics of Fishtastic! versions 5.2-5.5. Descriptions of the assumptions included in the program were previously detailed (above). Discussions are provided in the systematic order in which the user encounters each data entry step of the program.

Adult Analysis Module

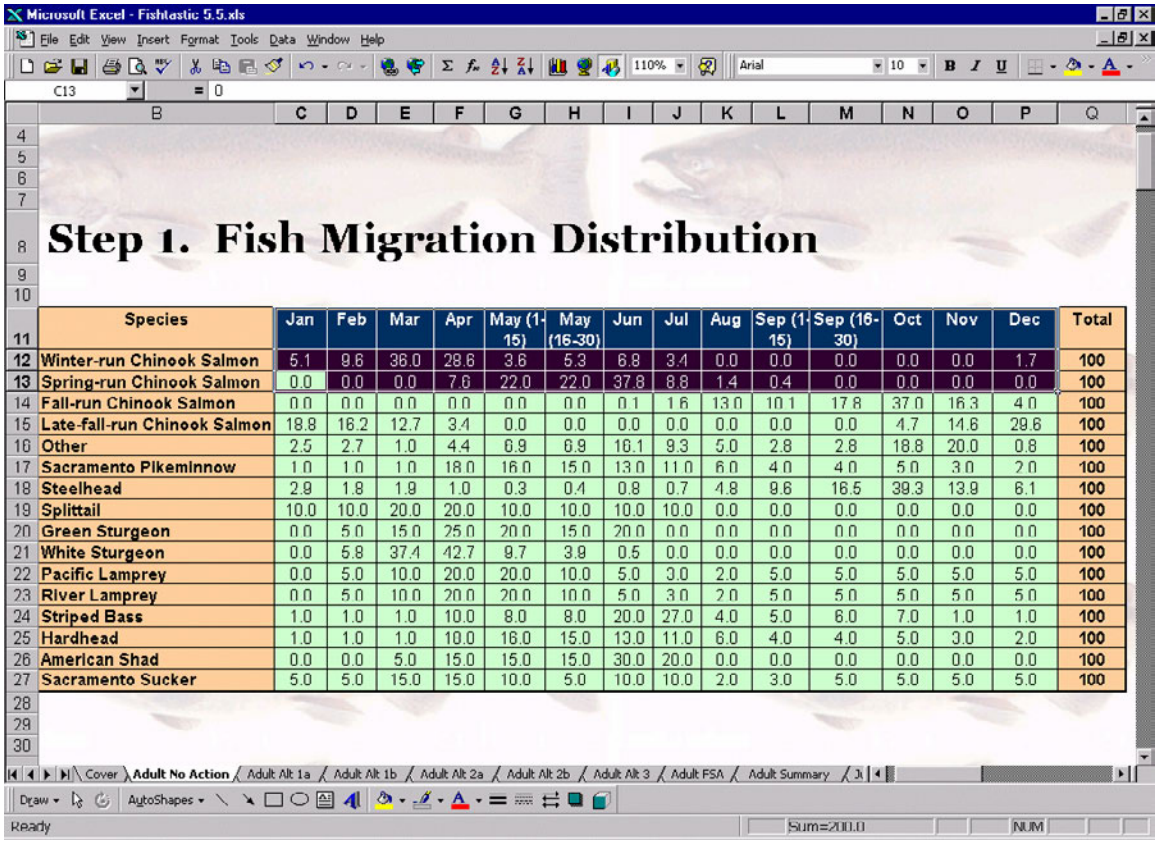
The adult computations in Fishtastic! involve the approach and subsequent passage of upstream migrating adult fish species at RBDD. The ultimate output of the adult module in Fishtastic! is neither actual numbers of fish passing the dam, nor percentages of the overall population passing the dam, but instead a relative index score (from 0 to 100). At each step in the adult module, an ecological "cost" or consequence of passage to that species is calculated. Although this concept is relative and somewhat abstract, it is necessary to avoid inappropriate assumptions or conclusions regarding species survivorship or injury and consequent changes in populations. Therefore, the passage index represents a relative score in terms of a composite of possible costs, such as reduced energy for egg development, swimming stamina, reduced survivorship, recovery from injury, etc. Thus, it is important for the user to understand that Fishtastic! is merely a tool for evaluating the relative effects of RBDD facilities management, rather than an absolute cost, in numbers (mortalities), to a given population.

The objective of the adult analysis computations is to aid in estimating which dam facilities impact the success of upstream migrating adults and to what extent passage of these fish are affected. The challenge to this analysis is to account for the variety of each species' life history characteristics in a manner that will produce the most meaningful results in collectively distinguishing the effects of project alternatives on those species.

Step 1. Adult Temporal Distribution

Data entry in adult Fishtastic! begins with establishment of the timing distributions of immigrating adult fish. Temporal distribution values are the fractional proportion of each species' adult migrating population reaching RBDD during each month. For example, if 44 percent of all adult spring-run Chinook salmon annually migrate past RBDD in May, then the May temporal distribution is 0.44 (of the annual total of 1.00). In this manner, each month was assigned a temporal passage value that when summed represents the annual temporal distribution (100 percent or a value of 1.00). Because the gates have historically been lowered in mid-May and raised in mid-September, each of those months is split into two 2-week components.

Thus the annual temporal distribution score for any species cannot exceed 1.00, representing 100 percent of the annual migration. In the spreadsheet input area, where the temporal distribution data is entered into the spreadsheet, the summation area is highlighted orange if the annual distribution sum exceeds 1.00, indicating an error in data entry. All subsequent passage index scores calculated in Fishtastic! due to RBDD facilities and operations are relative to these initial ("natural or unaffected") temporal distributions. Therefore, subsequent calculations of passage indices, due to project-specific facilities and operation at RBDD will result in index scores that are some fraction of 1.00 (unaffected passage). Figure 3 summarizes the temporal distribution data for adults of the species commonly found at RBDD.



Species	Jan	Feb	Mar	Apr	May (1-15)	May (16-30)	Jun	Jul	Aug	Sep (1-15)	Sep (16-30)	Oct	Nov	Dec	Total
Winter-run Chinook Salmon	5.1	9.6	36.0	28.6	3.6	5.3	6.8	3.4	0.0	0.0	0.0	0.0	0.0	1.7	100
Spring-run Chinook Salmon	0.0	0.0	0.0	7.6	22.0	22.0	37.8	8.8	1.4	0.4	0.0	0.0	0.0	0.0	100
Fall-run Chinook Salmon	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.6	13.0	10.1	17.8	37.0	16.3	4.0	100
Late-fall-run Chinook Salmon	18.8	16.2	12.7	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	14.6	29.6	100
Other	2.5	2.7	1.0	4.4	6.9	6.9	16.1	9.3	5.0	2.8	2.8	18.8	20.0	0.8	100
Sacramento Pikeminnow	1.0	1.0	1.0	18.0	16.0	15.0	13.0	11.0	6.0	4.0	4.0	5.0	3.0	2.0	100
Steelhead	2.9	1.8	1.9	1.0	0.3	0.4	0.8	0.7	4.8	9.6	16.5	39.3	13.9	6.1	100
Splittail	10.0	10.0	20.0	20.0	10.0	10.0	10.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	100
Green Sturgeon	0.0	5.0	15.0	25.0	20.0	15.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100
White Sturgeon	0.0	5.8	37.4	42.7	9.7	3.9	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100
Pacific Lamprey	0.0	5.0	10.0	20.0	20.0	10.0	5.0	3.0	2.0	5.0	5.0	5.0	5.0	5.0	100
River Lamprey	0.0	5.0	10.0	20.0	20.0	10.0	5.0	3.0	2.0	5.0	5.0	5.0	5.0	5.0	100
Striped Bass	1.0	1.0	1.0	10.0	8.0	8.0	20.0	27.0	4.0	5.0	6.0	7.0	1.0	1.0	100
Hardhead	1.0	1.0	1.0	10.0	16.0	15.0	13.0	11.0	6.0	4.0	4.0	5.0	3.0	2.0	100
American Shad	0.0	0.0	5.0	15.0	15.0	15.0	30.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	100
Sacramento Sucker	5.0	5.0	15.0	15.0	10.0	5.0	10.0	10.0	2.0	3.0	5.0	5.0	5.0	5.0	100

Figure 3. Step 1-The Adult Analysis Module's Temporal Distribution Data Input Area.

Step 2. Select Monthly Gate Positions

The next user data entry step is simple in its interface and operation, but critical in determining all passage calculations after the adult temporal distribution entry. RBDD gate positions are selected by toggle button for each month, where the toggle-on position (button pushed) indicates that all gates are down and passage must occur through dam facilities (e.g., fish ladders) for the given time period (Figure 4). Ecological cost calculations associated with the approach to the dam and subsequent passage are then performed for all species of that month as described later in this discussion.

If the gates are up (toggle-out) for any month, RBDD and its facilities are assumed to not affect the migration of adult fish, as the river becomes free flowing ("natural-state"). In this case, the output of the adult module will simply default to the monthly temporal distribution value entered by the user in Step 1. This does not suggest that there will be no ecological cost to adult fish moving past the RBDD during the gate-out operation, only that this is the facility-operational "unaffected" condition. As in any other part of the river, migrating fish will encounter natural hazards that incur some ecological cost in the freely flowing river. Therefore, during the gates-in operation at RBDD, the ecological costs to the passage of adult fish are due to anthropogenic activities calculated by Fishtastic! and are considered relative to naturally occurring ecological costs.

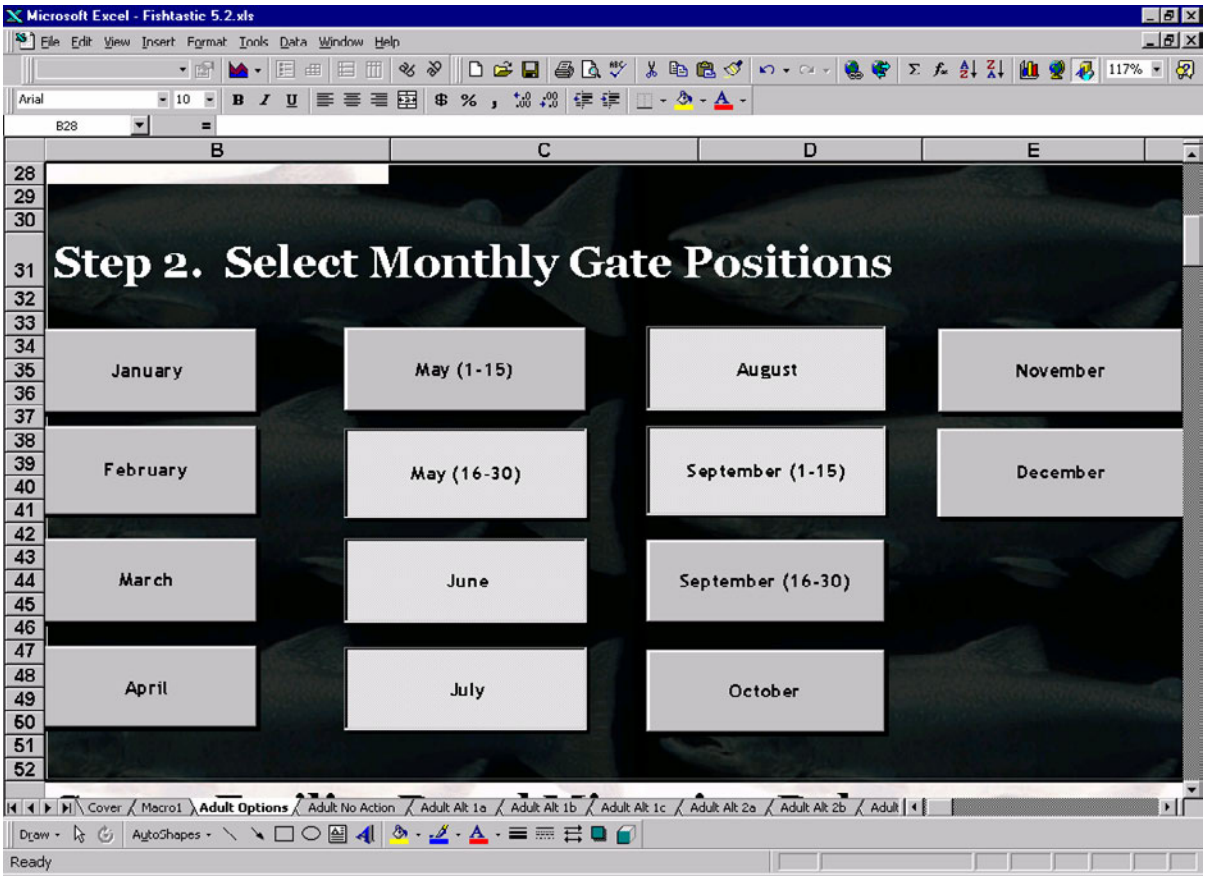


Figure 4. Monthly Gate Position Selection (Note: May 16-30, June, July, August, and September 1-15 are all toggled to down position in this example).

Step 3. Facility-based Migration Delay

If gates are toggled in (gates-in), Fishtastic! calculates the first level of ecological costs incurred by upstream-migrating adult fish. Step 3 requires the user to enter species-specific delay estimates for each of six possible dam facility configurations: 1) old ladders, 2) new ladders, 3) dam bypass channel, 4) old ladders used in conjunction with a dam bypass channel, 5) new ladders used in conjunction with a dam bypass channel, and 6) fish lock/mechanical lift.

This step requires the user to enter an estimate of the average behavioral delay (in days) exhibited by each species with a given facility configuration. The delay data used here were empirically derived from radio-tagging studies recently performed by USFWS (unpublished data) over a limited number of years with data collected seasonally with Chinook salmon at RBDD and are consistent with findings of Vogel (1989). A discussion of the derivation of the delay times is provided in the assumptions for the adult analysis module above. It is important to note that these delays are not flow-based (flow-weighted) (i.e., varying time of delay depending on the proportion of the ladder flow to river flow during any month). Flow-weighted delay relationship data was omitted for two reasons: 1) flow-specific delay data are not available; and 2) the use of flow-weighted delay values without supporting

empirical data increases the complexity of the analysis methodology without a concomitant increase in precision. Thus, given the limitations in available data, the approach that minimizes the magnitude of the error is that which maintains simplicity.

Each facility, whether a set of old ladders, new ladders, or other combination has a given capability to delay fish passage by providing impediments or distractions. Ideally, passage facilities are designed to attract fish into them, thereby improving the efficiency at which the fish find and pass through the dam. However, a variety of factors related to flow, velocity, turbulence, facility location and orientation, and/or other hydraulic conditions may serve to hinder a fish's ability to locate and efficiently transit the specific structure. Thus, the implicit assumption in the Step 3 calculation is that a passage facility (e.g., ladder) can either result in some delay to migration or no delay relative to migration in a freely flowing river (the gate-out condition).

Figure 5 provides an illustration of the Step 3 input table. To operate, the user enters facility-specific migration delay estimates (in days of delay-Table 2) for each species (green boxes), and then selects the radio button for the facility configuration under analysis.

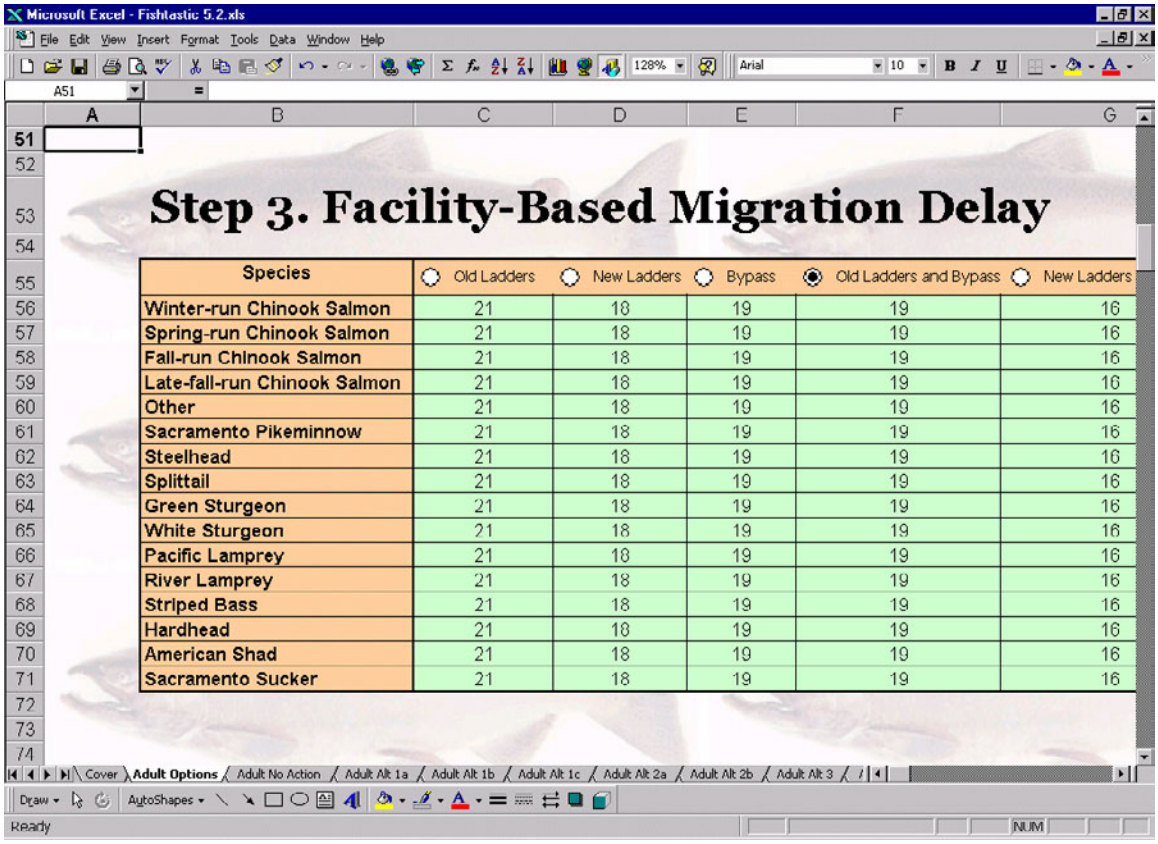


Figure 5. Step 3-Facility-based Migration Delay (Note: this example has the "Old Ladders" and "Bypass" channel facilities toggled on).

Step 4a. Delay versus Efficiency Values Worksheet

Step 3 required the user to enter the length of time over which each species' migration is delayed at RBDD due to various facility configurations. Step 4a requires the length of delay

to be related to an ecological (passage) cost. The implicit assumption in this step is that the longer the delay incurred below RBDD, the greater the magnitude passage cost. Although some species, such as the lamprey, may actually benefit from delay, particularly if migrating prey accumulate at the dam as they search for suitable passage, Step 4a assumes that there will be either delay or no delay. For the latter, particularly with the absence of either empirical evidence that suggests a potential facility migratory delay, the default delay value will be 1.00 (no delay), indicating the natural riverine condition.

If a species will experience some degree of energetic, reproductive, or other ecological diminishment (passage cost) related to delay, the user enters cost values proportional to the length of the delay. Figure 6 illustrates the user interface for this exercise. Costs for each number of delay days (from 0-30 days) are entered for each species. As illustrated on Figure 6, an important assumption is that a short delay (3 days or less) will have no measurable impact on migrating adults. The length of this no-impact period is likely species-dependent; however, the assumption was that effects of delay of passage was similar for all species (see discussion of assumptions above). In all cases, as the number of delay days continues to increase, ecological costs to passage concomitantly increases.

In likely cases where empirical data are only available for parts of this curve, other points must be interpolated. For example, there may be data or evidence available for the point at which relative passage efficiency equals 0, but not other points. Even with this scarcity of data, it may be possible to enter values for this curve using only hypothesis. In other words, it is accurate to imply that a short delay will not result in a change in relative passage efficiency. The assumption was that the relative efficiency values in this case are 1.00 (for the first 3 days) and was entered as such. If data or evidence were available, the user would enter that information for the most likely point(s) at which the relationship curve would change (i.e., rate of relative efficiency changes with increasing delay). For other portions of the relationship curve, a linear relationship to a known point on the curve (e.g., relative efficiency of zero) would be extrapolated and used.

Step 4b. Delays

Once delay-relative efficiency data have been entered, Step 4b presents an automated efficiency value lookup. The efficiency for the selected facilities scenario delay duration is automatically generated. This is the first ecological cost with which the temporal distribution values are multiplied together if the RBDD gates are in.

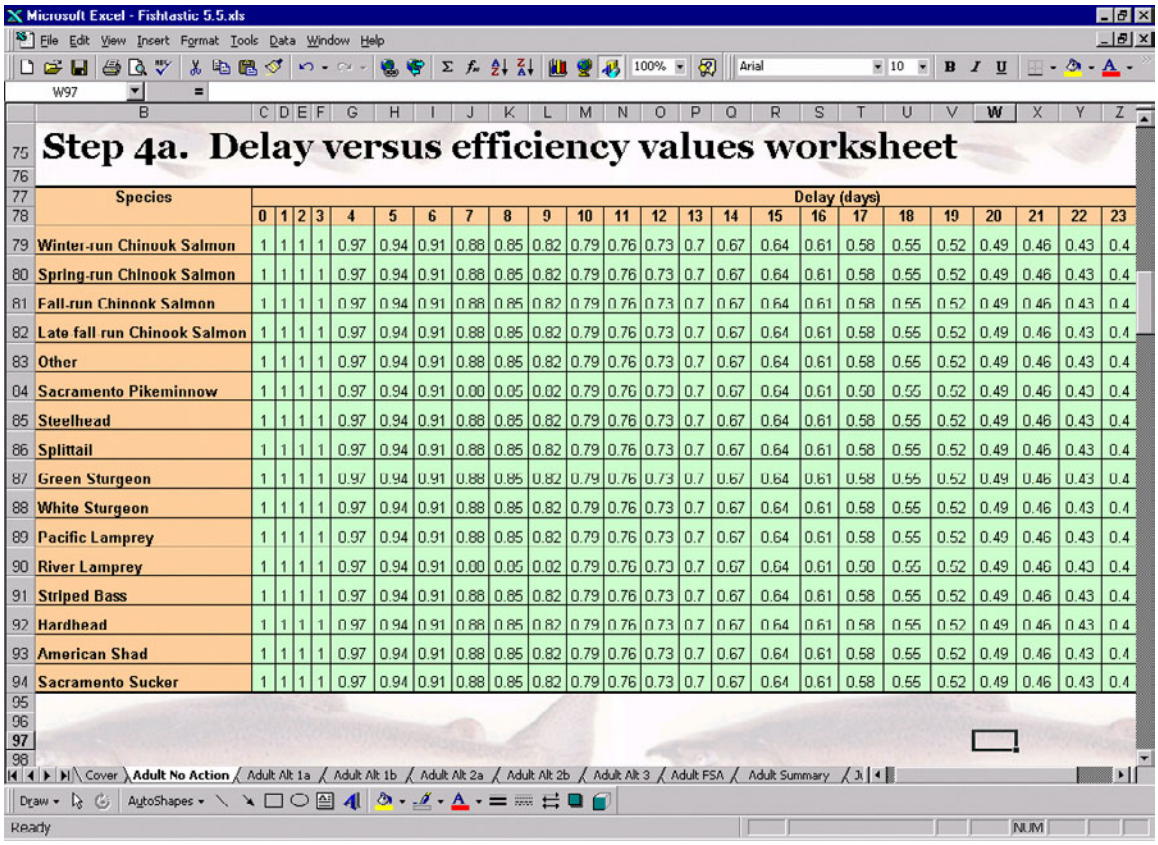
Step 5. Dam Passage

Once migrating adult fish reach the dam, regardless of the time of delay, it was assumed that there is a physiological cost (e.g., fatigue) associated with actual passage (e.g., within a ladder or the bypass channel). For some species, such as sturgeon, passage through the ladders is likely not possible. For many other species, improvement in ladders may result in increased efficiency and reduction in physiological cost to pass RBDD.

Step 5a. RBDD Facility Structure Passage Efficiency

Step 5 consists of a macro-based program where the inherent passage efficiency for a structural facility is entered for each species and each facility. Facility efficiency values for

the: 1) right bank ladder; 2) center ladder; 3) left- bank ladder; and 4) bypass channel are entered into the macro.



Microsoft Excel - Fishtastic 5.5.xls

Step 4a. Delay versus efficiency values worksheet

Species	Delay (days)																							
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Winter-run Chinook Salmon	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4
Spring-run Chinook Salmon	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4
Fall-run Chinook Salmon	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4
Late fall run Chinook Salmon	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4
Other	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4
Sacramento Pikeminnow	1	1	1	1	0.97	0.94	0.91	0.00	0.05	0.02	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.50	0.55	0.52	0.49	0.46	0.43	0.4
Steelhead	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4
Splittail	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4
Green Sturgeon	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4
White Sturgeon	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4
Pacific Lamprey	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4
River Lamprey	1	1	1	1	0.97	0.94	0.91	0.00	0.05	0.02	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.50	0.55	0.52	0.49	0.46	0.43	0.4
Striped Bass	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4
Hardhead	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4
American Shad	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4
Sacramento Sucker	1	1	1	1	0.97	0.94	0.91	0.88	0.85	0.82	0.79	0.76	0.73	0.7	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43	0.4

Cover | Adult No Action | Adult Alt 1a | Adult Alt 1b | Adult Alt 2a | Adult Alt 2b | Adult Alt 3 | Adult FSA | Adult Summary

Ready

Figure 6. Efficiency Value Entry for Delay Days (note in this example the efficiency at day 4 is 0.97).

The passage efficiency program reflects two mathematical processes that occur in Fishtastic! simultaneously. First, upstream migrating adult fish are parsed evenly among the existing facilities in the dam. Therefore, if the right bank, center, and left bank ladders were the only facilities in operation, each would receive a 33 percent distribution (0.33) of the fish reaching ladders. (Recall that delays in approaching the ladders have already reduced the ecological efficiency of migrating fish, whereby reaching the ladder are at some level less than their natural temporal distribution). Because observations at RBDD indicate no consistent flow-related preference in the distribution of fish to one ladder over another, an even distribution was assigned to each structural facility.

In the above example, if adult fish reaching the facility passed each of the facilities with 100 percent efficiency (i.e., all fish passed the ladders successfully and with no ecological cost), the total score for Step 5 would be 1.0 (0.33 + 0.33 + 0.33). However, as with other aspects of migration, ladder passage has some ecological cost, whereby the overall passage efficiency for a given species will be some value less the 1.0.

Therefore, the second element that is reflected in the facilities passage efficiency score for Step 5a is a reduction in the ideal (or no ecological cost) distribution at each facility. Table 3 provides an example of this operation. In the No Action Alternative, it was assumed that

33 percent of the fish reached the right bank, center, and left bank ladders (the bypass was not considered in this alternative). Therefore, the scores of 0.25 for right bank and left bank ladders indicated the ladder passage reduced the maximum possible passage from 0.33 (at each facility) to 0.25, the difference being the ecological cost of passing that facility. Therefore, approximately 75 percent of the fish reaching the right bank and left bank ladders passed the dam with no ecological cost. For the center ladder, the ecological cost was even greater, whereby the maximum potential passage efficiency of 0.33 was reduced to 0.1, indicating the only 30 percent of the fish reaching the center ladder passed the dam with no ecological cost.

For Alternatives 1A, 1B, and 2A, new ladders were simulated in the right bank and left bank positions, resulting in a slightly greater facility-based passage efficiency of 0.25, compared to 0.20 in the No Action Alternative (Table 3). In all cases, passage efficiencies of dam facilities (70 percent for old right bank and left bank ladders and 75 percent for new right bank and left bank ladder) were based on evidence of fish passage at RBDD and assuming typical design parameters for salmonid fish ladders.

Step 5b. Dam Structure Selection

Unlike previous steps, Step 5b is an automated table, where the selected RBDD facility (e.g., right bank ladder) is matched with the appropriate facilities configuration (Step 3) (e.g., old ladders). Thus, if the user selected the radio button for new ladders and bypass in Step 3 (see Figure 4), the matching facilities' passage efficiency values (right bank ladder, left bank ladder, center ladder, and bypass) would be multiplied by the monthly temporal distribution values.

Step 6. Output

The final step in Fishtastic!'s adult analysis module computation is an automated generation of output. As previously stated, the output reflects two possible analysis routes for each month: 1) gates-out configuration with output values equaling the monthly temporal distribution in Step 1; or 2) passage efficiency values reflecting delays and inherent passage efficiency at the structural facilities for each species.

In the event that the second scenario is toggled in the spreadsheet, Fishtastic! calculates its output stepwise. Migration distribution values are first multiplied by delay-specific efficiencies. These values are then multiplied by facility-specific passage efficiency values, where the output is parsed to each facility. The final output stage adds efficiency values for each facility into a combined table.

The last user interface is the Output Generator, where the user selects the management alternative under evaluation and selects the appropriate button. Output data are then copied to an output sheet with the appropriate name, where graphs or other media may be viewed.

Figure 7. Facility Passage Efficiencies Data Entry for Each Species Is Entered Using a Macro-based Form Program.

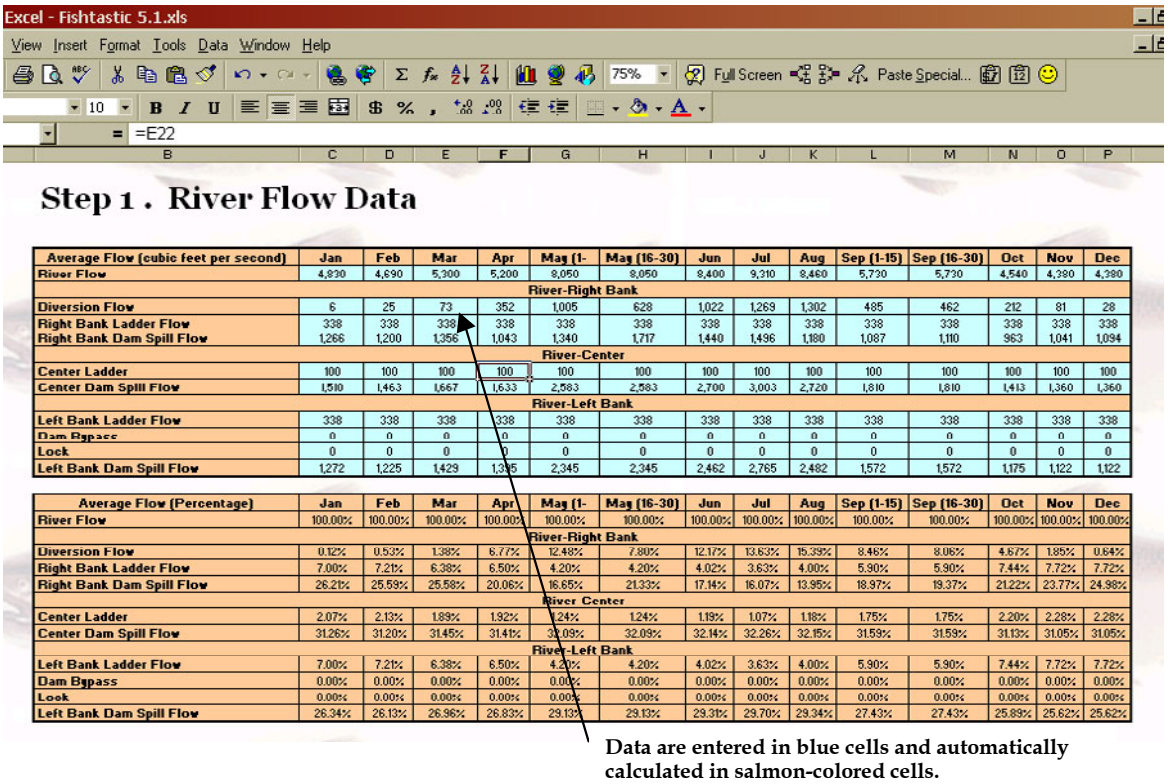
Juvenile Analysis Module

Juvenile fish computations in Fishtastic! all relate to the cost of downstream migration of juvenile fish passing RBDD dam. The interface and computations are simpler than in the adult analysis module, as they account for only predation losses. The assumption used in the juvenile analysis module is that ecological costs, such as injury or entrainment of juvenile fish at various facilities will not be appreciably changed with structural improvements in ladder design, the addition of bypass channels, or other structural changes.

Step 1. River Flow Data

The adult computations of Fishtastic! assumes that fish have some level of control over which facility they use, based on delays, attraction flow, and other rudimentary decision processes. In contrast, juvenile fish are likely to pass through facilities based upon flow to each facility. Furthermore, unlike the adult module, juvenile computations in Fishtastic! incorporate a spatial element in assessing ecological cost.

In Step 1, the user enters river flow to each of the facilities or other areas at the dam, accounting for all of the flow passing RBDD (Figure 8). These include the facilities with which the user may be familiar from the adult module (e.g., right bank ladder, bypass channel), as well as other possible areas to which flow may carry juvenile fish (e.g., spill flows under the dam). Ecological (predator) costs for each flow area will affect only the fish at that specific location.



Average Flow (cubic feet per second)	Jan	Feb	Mar	Apr	May (1-15)	May (16-30)	Jun	Jul	Aug	Sep (1-15)	Sep (16-30)	Oct	Nov	Dec
River Flow	4,830	4,690	5,300	5,200	9,050	9,050	8,400	9,310	8,460	5,730	5,730	4,540	4,390	4,390
River-Right Bank														
Diversion Flow	6	25	73	352	1,005	628	1,022	1,269	1,302	485	462	212	81	28
Right Bank Ladder Flow	338	338	338	338	338	338	338	338	338	338	338	338	338	338
Right Bank Dam Spill Flow	1,266	1,200	1,356	1,043	1,340	1,717	1,440	1,496	1,180	1,087	1,110	963	1,041	1,094
River-Center														
Center Ladder	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Center Dam Spill Flow	1,510	1,463	1,667	1,633	2,583	2,583	2,700	3,003	2,720	1,810	1,810	1,413	1,360	1,360
River-Left Bank														
Left Bank Ladder Flow	338	338	338	338	338	338	338	338	338	338	338	338	338	338
Dam Bypass	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lock	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Left Bank Dam Spill Flow	1,272	1,225	1,429	1,376	2,345	2,345	2,462	2,765	2,482	1,572	1,572	1,175	1,122	1,122

Average Flow (Percentage)	Jan	Feb	Mar	Apr	May (1-15)	May (16-30)	Jun	Jul	Aug	Sep (1-15)	Sep (16-30)	Oct	Nov	Dec
River Flow	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
River-Right Bank														
Diversion Flow	0.12%	0.53%	1.38%	6.77%	12.48%	7.80%	12.17%	13.63%	15.39%	8.46%	8.06%	4.67%	1.85%	0.64%
Right Bank Ladder Flow	7.00%	7.21%	6.38%	6.50%	4.20%	4.20%	4.02%	3.63%	4.00%	5.90%	5.90%	7.44%	7.72%	7.72%
Right Bank Dam Spill Flow	26.21%	25.59%	25.58%	20.06%	16.65%	21.33%	17.14%	16.07%	13.95%	18.97%	19.37%	21.22%	23.77%	24.98%
River Center														
Center Ladder	2.07%	2.13%	1.89%	1.92%	1.24%	1.24%	1.19%	1.07%	1.18%	1.75%	1.75%	2.20%	2.28%	2.28%
Center Dam Spill Flow	31.26%	31.20%	31.45%	31.41%	32.09%	32.09%	32.14%	32.26%	32.15%	31.59%	31.59%	31.13%	31.05%	31.05%
River-Left Bank														
Left Bank Ladder Flow	7.00%	7.21%	6.38%	6.50%	4.20%	4.20%	4.02%	3.63%	4.00%	5.90%	5.90%	7.44%	7.72%	7.72%
Dam Bypass	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Lock	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Left Bank Dam Spill Flow	26.34%	26.13%	26.96%	26.83%	29.13%	29.13%	29.31%	29.70%	29.34%	27.43%	27.43%	25.89%	25.62%	25.62%

Figure 8. River Flow Data Entry for Spatial Placement of Downstream-migrating Juvenile Fish.

Step 2. Juvenile Temporal Distribution

Step 2 of the juvenile analysis module is identical in its function to the adult analysis module. The temporal distribution of juvenile fish moving past RBDD is entered for each month (or half month for May and September) for each species. As with the adult analysis module, data may be collected from empirical data, such as trapping.

Step 3. Flow-weighted Spatial Distribution of Juvenile Fish

Step 3 is a fully automated series of calculations based upon river flow and migration data. Because predator computations in the juvenile analysis module may be designed for each area or facility, Step 3 is required to distribute juvenile fish based upon flow. Subsequent calculations will be performed on fish at each of the locations. Only at the end of the juvenile analysis module will efficiency scores for each species be re-totaled to calculate an overall score.

Step 4. Select Monthly Gate Position

Step 4 is identical to Step 2 in the adult analysis module in both its user execution and consequences. If gates are toggled in the out position, then the final score will be equal to the original migration distribution. As with the adult analysis module, these scores reflect natural predator effects, rather than predation augmented by dam facilities.

Step 5. Predator Factor Distribution

Step 5 is the most critical data entry component in Fishtastic!'s juvenile analysis module. The gates-in operation of RBDD results in more ideal foraging conditions for predators such as the Sacramento pikeminnow and striped bass.

As in the adult analysis module, juvenile scores reflect an ecological cost or passage efficiency, rather than loss of numbers of fish. However, regardless of the intention of Fishtastic! to compute the ecological costs from all potential impact mechanisms, the cost of predator presence is more closely related to changes in actual numbers of juveniles than are ecological costs related to the facilities' passage efficiency or delay. Predator factors are based empirically upon the presence of adult pikeminnows and striped bass (both known predator species) at various RBDD locations. The cost to migrating juveniles reflects both direct predation (i.e., actual reduction of juveniles from the population), but also other factors, such as energy costs due to predator avoidance, altered feeding behavior, or delayed migration ultimately affecting the viability of the population.

In Step 5, the user selects a general juvenile passage efficiency value for each facility at each month. Because there are not sufficient data to provide species-specific dietary preferences for predators, the passages efficiency values are not species-specific. The efficiency value selected by the user (see Figure 9) for each facility is calculated as the reciprocal of predator presence, where predator presence is determined empirically using predator study data (Vogel et al., 1988). Based on that data, the maximum predator effect is a 55 percent reduction in juvenile passage efficiency, corresponding to a downstream dam passage efficiency value of 0.45.

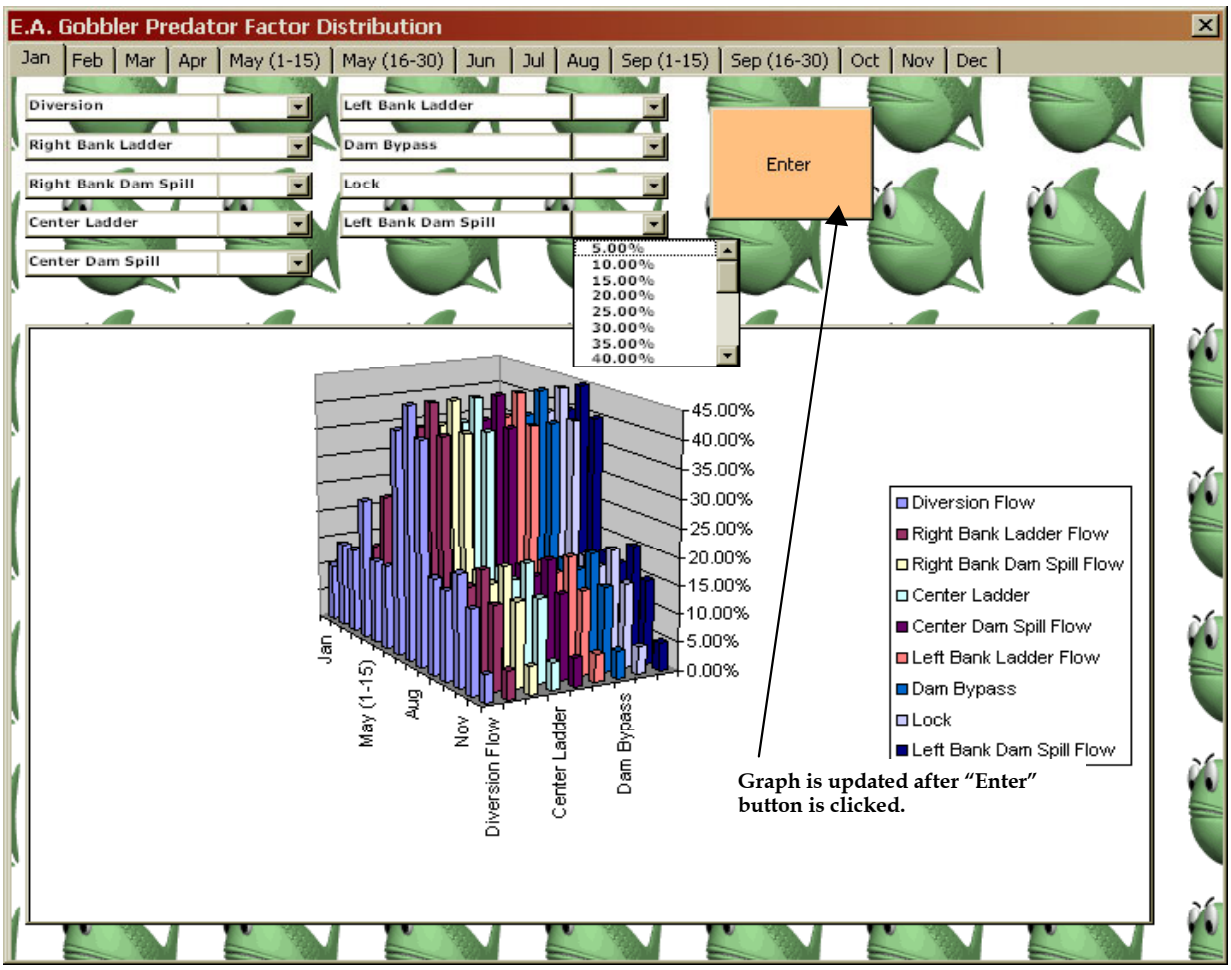


Figure 9. Predator Factor Distributions for Each Month or Half Month Are Entered with Drop-down Menus and Viewed with an Interactive 3-D Graph.

Attachment B2
Results Summary

ATTACHMENT B2

Results Summary

Significance Criteria

For the purposes of distinguishing project alternatives from No Action using the Fishtastic! analysis tool, the following significance criteria were used:

- No Difference in Passage Indices = No change
- Difference in Passage Indices of <10 = No measurable impact (-) or benefit (+)
- Difference in Passage Indices of ≥10<25 = Measurable impact (-) or benefit (+)
- Difference in Passage Indices of ≥25 = Large measurable impact (-) or benefit (+)

Native Anadromous Salmonid Species

Adults

The results of the fish passage impact analysis using the Fishtastic! for adult native anadromous salmonid species (NAS) are summarized in Table 1. In all cases, for all species, and all alternatives, the adult passage indices were equal to or greater than those for the No Action Alternative. Therefore, no alternative resulted in measurable adverse impacts to adults of any of the five NAS species. The Gates-out Alternative (or Alternative 3) resulted in no impediment to passage for any species. Therefore, the benefits to all NAS species shown in Table 1 are a result of year-round gates-out operation. Additionally, the analysis indicated there are no measurable impairments to passage from the implementation of any of the alternatives for late-fall Chinook salmon (Table 1). Due to this species' life history characteristics, adult late-fall Chinook salmon are not immigrating past RBDD during the months of May through September; therefore, there in no passage impediment of migrating adults. The adult passage indices for project alternatives for all NAS species are shown on Figures 1a through 1e. (All figures are located at the end of this attachment; note "Key to Figures" on page B2-10).

Except for spring-run Chinook salmon (measurable benefit), t~~T~~he implementation of the 4-month gates-in with new fish ladder (1A) and the 4-month gates-in with bypass channel (1B) alternatives resulted in no measurable improvements for adult passage for any of the five NAS species (Table 1 and Figure 2). The 2-month gates-in with new fish ladder (2A) and 2-month gates-in with existing fish ladders (2B) alternatives provided large measurable differences and improvements for passage of spring-run Chinook as compared to the No Action Alternative. The improvement in the passage index difference over that for the No Action Alternative was 41, a 79 percent passage improvement for Alternative 2A. A passage index difference of 40 over that for the No Action Alternative and a 77 percent improvement was seen for Alternative 2B. The monthly adult passage indices for all alternatives for spring-run Chinook salmon are shown on Figure 1c.

These results indicate that the alternatives that remove the gates for 2 months, and Gates-out all year are largely beneficial to spring-run Chinook. For the Gates-out Alternative,

passage conditions improve to a measurable extent for the other adult NAS species compared to the No Action Alternative (Figure 2). As seen on Figure 1b, large improvements in adult spring-run Chinook passage are provided by the Alternatives 2A, 2B, and 3 during the May 15 to July 1 period, and additionally during the September 1 to 16 period for the Gates-out Alternative. These improvements for adult passage have crucial implications for adult spring-run Chinook salmon that must reach upstream tributary streams before those streams become blocked due to low flows and or high water temperatures. Continued delay and blockage of spring-run Chinook salmon at RBDD has severe consequences for this species and may jeopardize its recovery. Action alternatives that remove or greatly reduce impediments to passage for this species would allow adults to successfully pass RBDD in a timely manner.

TABLE 1
Adult Passage Indices, Relative Difference, and the Improvement in Passage Indices for Native Anadromous Salmonid Species between No Action and the Action Alternatives.

Alternative	Index Value	Difference	% Improvement	Effect on Species
Winter-run Chinook Salmon				
No Action	89	n/a	n/a	*n/a*
1A	91	2	2	*No Measurable Benefit*
1B	91	1	1	*No Measurable Benefit*
2A	98	8	9	*No Measurable Benefit*
2B	98	8	9	*No Measurable Benefit*
3	100	10	12	*Measurable Benefit*
Spring-run Chinook Salmon				
No Action	52	n/a	n/a	*n/a*
1A	61	8	16	~~*No*~~ *Measurable Benefit*
1B	57	5	9	*No Measurable Benefit*
2A	94	41	79	*Large Measurable Benefit*
2B	93	40	77	*Large Measurable Benefit*
3	100	48	91	*Large Measurable Benefit*
Fall-run Chinook Salmon				
No Action	83	n/a	n/a	*n/a*
1A	86	3	4	*No Measurable Benefit*
1B	85	2	2	*No Measurable Benefit*
2A	91	8	8	*No Measurable Benefit*
2B	89	6	8	*No Measurable Benefit*
3	100	17	20	*Measurable Benefit*
Late-fall run Chinook Salmon				
No Action	100	n/a	n/a	*n/a*
1A	100	0.0	0.0	*No change*
1B	100	0.0	0.0	*No change*
2A	100	0.0	0.0	*No change*
2B	100	0.0	0.0	*No change*
3	100	0.0	0.0	*No change*
Steelhead				
No Action	89	n/a	n/a	*n/a*
1A	91	2	2	*No Measurable Benefit*
1B	90	1	1	*No Measurable Benefit*
2A	97	8	9	*No Measurable Benefit*
2B	96	7	8	*No Measurable Benefit*
3	100	11	12	*Measurable Benefit*

Juveniles

The results of the analysis of the juvenile passage indices for NAS species are summarized in Table 2 and Figures 3a through 3e. In all cases, for all species and all alternatives, the juvenile passage indices were equal to or greater than those for the No Action Alternative. Therefore, no alternative resulted in measurable adverse impacts to juveniles of any of the NAS species. However, while the indices indicated differences in passage indices, juvenile passage for the NAS species did not measurably benefit from any of the alternatives compared to the No Action Alternative (Figure 4). For the 4-month Alternative, the annual juvenile passage indices for NAS species, compared to No Action, would remain unchanged. For the 2-month Alternative, the differences (improvements) in the annual juvenile passage indices for NAS species, compared to the No Action Alternative, were from less than 1 to approximately 6, depending on species. Similarly, for the Gates-out Alternative, the difference (improvement) in the annual juvenile passage indices were only from less than 1 to approximately 8 compared to the No Action Alternative (Table 2). None of the alternatives would measurably improve (<10 percent improvement) the passage of juveniles compared to the No Action Alternative (Figure 4). These results are due to the life history characteristics of these species. Compared to other periods of the year, relatively few NAS juveniles pass RBDD during the current operational period (mid-May to mid-September).

With the implementation of the Gates-out Alternative, the passage indices for juvenile NAS species would be maximized. While the juvenile passage indices for this alternative were not measurably greater than those for the No Action Alternative, there were some passage benefits for juveniles of NAS species during the mid-May through mid-September period (Table 2 and Figures 3a through 3e). These are small to moderate passage improvements for juvenile salmonids during this 4-month operational period.

TABLE 2
Juvenile Passage Indices, Relative Difference, and the Improvement in Passage Indices for Native Anadromous Salmonid Species between No Action and the Action Alternatives.

Alternative	Index Value	Difference	% Improvement	Effect on Species
Winter-run Chinook Salmon				
No Action	96	n/a	n/a	*No Change*
4-month Gates-in	96	0	0	*No Change*
2-month Gates-in	99	3	3	*No Measurable Benefit*
Gates-out	100	4	4	*No Measurable Benefit*
Spring-run Chinook Salmon				
No Action	100	n/a	n/a	*No Change*
4-month Gates-in	100	0	0	*No Change*
2-month Gates-in	100	0	0	*No Change*
Gates-out	100	0	0	*No Change*

TABLE 2
Juvenile Passage Indices, Relative Difference, and the Improvement in Passage Indices for Native Anadromous Salmonid Species between No Action and the Action Alternatives.

Fall-run Chinook Salmon				
No Action	97	n/a	n/a	*No Change*
4-month Gates-in	97	0	0	*No Change*
2-month Gates-in	100	2	2	*No Measurable Benefit*
Gates-out	100	3	3	*No Measurable Benefit*
Late-fall run Chinook Salmon				
No Action	93	n/a	n/a	*No Change*
4-month Gates-in	93	0	0	*No Change*
2-month Gates-in	98	4	5	*No Measurable Benefit*
Gates-out	100	7	7	*No Measurable Benefit*
Steelhead				
No Action	92	n/a	n/a	*No Change*
4-month Gates-in	92	0	0	*No Change*
2-month Gates-in	99	6	7	*No Measurable Benefit*
Gates-out	100	8	8	*No Measurable Benefit*

Other Native Anadromous Species

Adults

The results of the adult fish passage analysis for other native anadromous (NAO) species are summarized in Table 3. The Gates-out Alternative resulted in no impediments to passage to any of the three NAO species. This is a result of a year-round gates-out operation. There was no change from the No Action Alternative for adult green sturgeon passage with Alternative 1A. It was assumed that ladders would not assist adults of this species (Table 3) and Figure 5. The analysis indicated there is no measurable difference from the No Action Alternative for the adult green sturgeon passage index with the implementation of Alternative 1B. The improvement in the adult green sturgeon passage index for Alternative 1B is approximately 6 percent when compared to the No Action Alternative. It was assumed that adult green sturgeon would be able to use the bypass channel to some extent to move past RBDD. However, due to the uncertainty of the success of this species in passing through an artificial channel, its passage index increased by only a small increment (Figure 6). The majority of adult green sturgeon migrate past RBDD during the months of April through the end of June. Therefore, the removal of the dam gates with the implementation of Alternatives 2A, 2B, and 3 greatly improves (54 percent greater than the No Action Alternative) the annual passage indices for adult green sturgeon (Figure 6). Both of the

2-month alternatives and the Gates-out Alternative result in unimpaired passage for adults of this species.

The changes in adult passage indices for Pacific and river lamprey are shown in Table 3. Unlike green sturgeon, passage indices for both lamprey species would increase with the construction of new ladders in Alternative 1B (Figures 7a and 7b). However, there are only small improvements in passage indices, and these are not measurably different from the No Action Alternative. Similarly, the passage indices for both lamprey species also improved from the No Action Alternative, but not measurably, for Alternative 1B. This is because of the uncertainty of use of the bypass by the lamprey species. Measurable passage improvement (approximately 16 to 17 percent) from the No Action Alternative for adult Pacific and river lamprey would result from Alternatives 2A and 2B (Table 3 and Figures 7a and 7b). The Gates-out year round alternative would remove all passage impedance for adult lampreys and would result in an annual improvement of approximately 20 percent over the No Action Alternative (Table 3 and Figure 8 and 9).

The summary of the changes in adult passage occurring during the 4-month operational period (mid-May to mid-September) for the three NAO species is shown in Table 3. As discussed above, the passage of adult green sturgeon greatly improves during the period from mid-May through mid-September for Alternatives 2A, 2B, and 3. During this period, the percent passage improvements for adult lamprey for both of the 2-month gates-in alternatives and the Gates-out Alternative are measurably large (Figure 8). However, these results are numerically misleading. The potential numerical difference in the adult lamprey passage indices for the 2-month and Gates-out alternatives is an increase in passage index value of up to 25 (from approximately 8 for the No Action Alternative) for a maximum index difference of 17. Therefore a passage index improvement of approximately 14 results in a extremely large numerical improvement (172 percent improvement) for this 4-month period as shown on Figure 8. However, the actual increment of passage improvement during the 4-month period is rather small.

In summary, passage conditions for adult green sturgeon largely benefit from Alternatives 2A, 2B, and 3 resulting in unimpeded passage. Adult lamprey of both species also benefit from all of these alternatives, but to a lessor extent than green sturgeon. This is principally because these species pass RBDD on their upstream migration at times outside of when the RBDD gates are in. All of the NAO species would pass unimpeded with the Gates-out Alternative.

TABLE 3
Adult Passage Indices, Relative Difference, and the Improvement in Passage Indices for Other Native Anadromous Species between No Action and the Action Alternatives.

Alternative	Index Value	Difference	% Improvement	Effect on Species
Green Sturgeon				
No Action	65	n/a	n/a	*n/a*
1A	65	0	0[a]	*No Change*
1B	69	4	6	*No Measurable Benefit*
2A	100	35	54	*Large Measurable Benefit*
2B	100	35	54	*Large Measurable Benefit*
3	100	35	54	*Large Measurable Benefit*

(a) % improvement cannot be calculated.

TABLE 3
Adult Passage Indices, Relative Difference, and the Improvement in Passage Indices for Other Native Anadromous Species between No Action and the Action Alternatives.

Alternative	Index Value	Difference	% Improvement	Effect on Species
Pacific Lamprey				
No Action	83	n/a	n/a	*No Change*
1A	86	3	4	*No Measurable Change*
1B	85	2	2	*No Measurable Change*
2A	97	14	17	*Measurable Benefit*
2B	96	13	16	*Measurable Benefit*
3	100	17	20	*Measurable Benefit*
River Lamprey				
No Action	83	n/a	n/a	*No Change*
1A	86	3	4	*No Measurable Change*
1B	85	2	2	*No Measurable Change*
2A	97	14	17	*Measurable Benefit*
2B	96	13	16	*Measurable Benefit*
3	100	17	20	*Measurable Benefit*

Juveniles

There would be no benefit to juvenile green sturgeon from the 4-month Alternative (Table 4). This is due to no change in RBDD gate operations or a resulting reduction in predation of juvenile green sturgeon by Sacramento pikeminnow or striped bass. However, juvenile green sturgeon would measurably benefit from reductions in predation from congregations of pikeminnows and striped bass when the gates are removed under the 2-month (21 percent improvement) and Gates-out (38 percent improvement) alternatives (Table 4). The improvement in downstream passage for juvenile green sturgeon is a measurable benefit for the 2-month Alternative and a large measurable benefit for Gates-out Alternative. The passage improvements for juvenile green sturgeon are shown on Figure 9 (entire year) and Figure 10 (mid-May to mid-September).

Yearly passage indices for downstream migrating Pacific and river lamprey transformers are shown on Figure 11. The differences between the No Action Alternative and project alternatives for lamprey transformers are summarized in Table 4. The 4-month Alternative results in no benefit to either of these species as there is no change in predation or passage of predators congregating downstream of the RBDD. For the 2-month and 4-month alternatives, the passage indices for Pacific lamprey transformers improves, but not measurably (Figure 9). This is principally due to the passage timing of transformers of this species in which greater than 99 percent move downstream prior to mid-May. However, the passage index for river lamprey transformers is measurably greater than that of the No Action Alternative (an increase in the passage index of approximately 13) for both the 2-month and the Gates-out alternatives (Table 4 and Figure 9). This species benefits from these two alternatives due to its outmigration timing in which a substantial portion pass RBDD after mid-May and prior to September 15 of each year.

In summary, with the implementation of the Gates-out Alternative, the yearly juvenile passage indices for NAO species would be maximized, and passage would be unimpeded.

Juvenile green sturgeon and river lamprey transformers would measurably benefit from reductions of predation downstream of RBDD for the 2-month as well as the Gates-out alternatives.

Resident Native Species

Adults

The results of the fish passage impact analysis using the Fishtastic! tool for adult resident rainbow trout are summarized in Table 5. Adult rainbow trout passage indices for all alternatives are shown on Figure 12. For all alternatives, the adult passage indices were equal to or greater than those for the No Action Alternative. Therefore, no alternative resulted in measurable adverse impacts to adult rainbow trout. The Gates-out Alternative resulted in no impediment to passage for this species. A 37 percent improvement in adult passage index for the Gates-out Alternative is a result of year-round gates-out operation (Figure 13). Alternatives 1A and 1B resulted in small differences (<7 percent) in passage indices from the No Action Alternative. These alternatives would provide no measurable benefit for adult rainbow trout populations (Figure 13).

TABLE 4
Juvenile and Transformer Passage Indices, Relative Difference, and the Improvement in Passage Indices for Other Native Anadromous Species between No Action and the Action Alternatives.

Alternative	Index Value	Difference	% Improvement	Effect on Species
Green Sturgeon Juveniles				
No Action	73	n/a	n/a	*n/a*
4-month Gates-in	73	0	0	*No Change*
2-month Gates-in	88	15	21	*Measurable Benefit*
Gates-out	100	27	38	*Large Measurable Benefit*
Pacific Lamprey Transformers				
No Action	99	n/a	n/a	*n/a*
4-month Gates-in	99	0	0	*No Change*
2-month Gates-in	100	1	1	*No Measurable Benefit*
Gates-out	100	1	1	*No Measurable Benefit*
River Lamprey Transformers				
No Action	87	n/a	n/a	*n/a*
4-month Gates-in	87	0	0	*No Change*
2-month Gates-in	100	13	15	*Measurable Benefit*
Gates-out	100	13	15	*Measurable Benefit*

Measurable improvements in adult passage indices, from the No Action Alternative, occurred for both Alternatives 2A and 2B (Table 5). Approximately 25 percent improvement

in annual adult passage resulted for Alternative 2A. Similarly, a passage improvement of 23 percent over that for the No Action Alternative occurred for Alternative 2B (Figure 13). The small difference in the benefits to adult passage between these two alternatives occurred as a result of the new ladder component of Alternative 2A. The passage benefit to adult rainbows principally occurred during the period from May 16 through June 30 (Figure 12), with a lesser improvement for the July 1 through September 15 period.

Juveniles

The results of the analysis of the annual juvenile passage indices for rainbow trout are summarized in Table 6. The annual juvenile rainbow trout passage indices for all alternatives are seen on Figure 14. In all cases, for all alternatives, the juvenile passage indices were equal to or greater than those for the No Action Alternative. Therefore, no alternative resulted in measurable adverse impacts to juvenile rainbow trout. However, while the results indicated differences (improvement) in annual passage indices compared to the No Action Alternative for the 2-month an the Gates-out alternatives, juvenile passage for this species did not measurably benefit (Figure 15).

TABLE 5

Adult Passage Indices, Relative Difference, and the Improvement in Passage Indices for Resident Rainbow Trout between No Action and the Action Alternatives.

Alternative	Index Value	Difference	% Improvement	Effect on Species
No Action	73	n/a	n/a	*n/a*
1A	78	5	7	*No Measurable Change*
1B	76	3	4	*No Measurable Benefit*
2A	91	18	25	*Measurable Benefit*
2B	90	17	23	*Measurable Benefit*
3	100	27	37	*Large Measurable Benefit*

TABLE 6

Juvenile Passage Indices, Relative Difference, and the Improvement in Passage Indices for Resident Rainbow Trout between No Action and the Action Alternatives.

Alternative	Index Value	Difference	% Improvement	Effect on Species
No Action	92	n/a	n/a	*n/a*
4-month Gates-in	92	0	0	*No Change*
2-month Gates-in	99	6	7	*No Measurable Benefit*
Gates-out	100	8	8	*No Measurable Benefit*

Summary

The analysis of adult and juvenile fish passage at RBDD indicated several benefits for fish passing RBDD. The discussion below summarizes the overall outcome of this analysis by fish assemblages. In all cases, for all species and all alternatives, the adult and juvenile passage indices generated using the Fishtastic! tool were equal to or greater than those for

the No Action Alternative. Therefore, no alternative resulted in measurable adverse impacts to adults or juveniles of any of the species analyzed.

Native Anadromous Salmonid Species

The analysis revealed that passage for adult late-fall Chinook salmon were unaffected by any proposed alternative compared to the No Action Alternative. This is due to characteristics of this species' life history, for they migrate past RBDD from October through April – outside the period of gates-in operations at RBDD. The results also indicated that the alternatives that removed the gates for 2 months and the gates-out all year operation are highly beneficial to spring-run Chinook. Alternatives 2A, 2B, and 3 provided large improvements in passage for adult spring-run Chinook salmon compared to the No Action Alternative (79 percent, 77 percent, and 91 percent improvement, respectively). The improvements in passage provided by these alternatives are especially important to this species. Spring-run Chinook salmon must reach upstream tributary streams (e.g., Cottonwood, Clear, and Battle creeks) to successfully migrate into their cool headwater reaches prior to the occurrence of inhospitable water temperature and discharge conditions. Alternatives 2A, 2B, and 3 would provide that opportunity.

Only small improvements in adult passage of NAS species resulted from Alternatives 1A and 1B. The new fish ladder and/or bypass channel components of these alternatives provided only small incremental improvement in passage. Alternatives 2A, 2B, and 3 provided somewhat better passage conditions due to gates-out operations, but again provided only small benefits for the other Chinook salmon and steelhead species.

Juveniles of NAS species did not measurably benefit from any of the alternatives compared to the No Action Alternative. Juvenile passage indices for these species for all proposed alternatives were generally less than 5 percent greater than those for the No Action Alternative. This is principally due to life history characteristics of NAS juveniles in which their out-migration occurs at times when the RBDD gates are not in operation. In the case of juvenile winter-run Chinook salmon, large numbers begin to occur near RBDD during the later portion of the gates-in operations but predator species have correspondingly dispersed. Therefore, numerically small benefits in the juvenile passage index were shown for that species.

Other Native Anadromous Species

Adult green sturgeon did not measurably benefit from Alternatives 1A and 1B. However, gates-out operations for Alternatives 2A and 2B provided conditions for unimpeded passage through RBDD and Lake Red Bluff. Due to adult green sturgeons' life history and passage timing at RBDD, the additional period of gates-out for the Gates-out Alternative provided no additional passage benefit beyond that afforded from Alternatives 2A and 2B.

Passage for adult river lamprey and Pacific lamprey measurably benefited from Alternatives 2A, 2B, and 3. For both species, approximately 20 percent improvement in passage occurred with the Gates-out Alternative.

Passage of green sturgeon juveniles and river lamprey transformers measurably improved for the 2-month Alternative. Passage conditions (as reflected in the passage index) for juvenile green sturgeon greatly improved with a gates-out operation due to this species' life

history pattern of presence near RBDD in July and August. River lamprey transformers also measurably benefited for the Gates-out Alternative, but not to the extent that green sturgeon juveniles did.

Resident Native Species

Rainbow trout was the only resident native species analyzed using the Fishtastic! tool. The results of the analyses of passage for this species indicated that all alternatives provided some additional increase in passage for adults of this species. However, only Alternatives 2A, 2B, and 3 had passage indices that were measurably greater than the No Action Alternative. Of these alternatives, the Gates-out Alternative provided a large measure of improvement over that for the No Action Alternative. The biological importance of these improvements are unclear as adults of this species, during the months of RBDD operation, are not obligated to migrate upstream of RBDD as are adult salmon or steelhead. Except for periods when summer water temperatures could exceed lethal thresholds, adult rainbow trout would not be adversely affected by delay or blockage currently created by operations of RBDD.

Juvenile passage of rainbow trout was not measurably different for any of the proposed alternatives compared to the No Action Alternative. This is principally due to life history characteristics of the species in that they generally pass RBDD during periods when RBDD gates are out or during periods when predation is potentially reduced (August and September).

Key to Figures

The figure legends reference the alternatives differently than previous text. A key is provided below.

Alternatives	
Referenced on Figure as:	**Referenced in Text as:**
NAA	No Action
4Mo.NLadd.	1A or 4-month Improved Ladder
4Mo.Byp.	1B or 4-month Bypass
2Mo.NLadd.	2A or 2-month Improved Ladder
2Mo.ELadd.	2B or 2-month with Existing Ladders
Gates-Out	3 or Gates-out
4 Mo.	1 or 4-month Gates-in
2 Mo.	2 or 2-month Gates-in

Appendix C
U.S. Fish and Wildlife Service Species List

ENCLOSURE A

Endangered and Threatened Species that May Occur in
or be Affected by Projects in the Selected Quads Listed Below
Reference File No. 00-SP-0217
Red Bluff Diversion Dam
November 7, 2000

QUAD : 610B RED BLUFF EAST

Listed Species

Birds

Aleutian Canada goose, *Branta canadensis leucopareia* (T)

bald eagle, *Haliaeetus leucocephalus* (T)

Reptiles

giant garter snake, *Thamnophis gigas* (T)

Amphibians

California red-legged frog, *Rana aurora draytonii* (T)

Fish

delta smelt, *Hypomesus transpacificus* (T)

Central Valley steelhead, *Oncorhynchus mykiss* (T)

Critical habitat, winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)

winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)

Central Valley spring-run chinook salmon, *Oncorhynchus tshawytscha* (T)

Critical Habitat, Central Valley spring-run chinook, *Oncorhynchus tshawytscha* (T)

Sacramento splittail, *Pogonichthys macrolepidotus* (T)

Invertebrates

vernal pool fairy shrimp, *Branchinecta lynchi* (T)

valley elderberry longhorn beetle, *Desmocerus californicus dimorphus* (T)

vernal pool tadpole shrimp, *Lepidurus packardi* (E)

Candidate Species

Fish

Central Valley fall/late fall-run chinook salmon, *Oncorhynchus tshawytscha* (C)

Species of Concern

Mammals

pale Townsend's big-eared bat, *Corynorhinus (=Plecotus) townsendii pallescens* (SC)

Pacific western big-eared bat, *Corynorhinus (=Plecotus) townsendii townsendii* (SC)

spotted bat, *Euderma maculatum* (SC)

small-footed myotis bat, *Myotis ciliolabrum* (SC)

long-eared myotis bat, *Myotis evotis* (SC)

fringed myotis bat, *Myotis thysanodes* (SC)

long-legged myotis bat, *Myotis volans* (SC)

Yuma myotis bat, *Myotis yumanensis* (SC)

San Joaquin pocket mouse, *Perognathus inornatus* (SC)

Birds

western burrowing owl, *Athene cunicularia hypugea* (SC)

Swainson's hawk, *Buteo Swainsoni* (CA)

ferruginous hawk, *Buteo regalis* (SC)

little willow flycatcher, *Empidonax traillii brewsteri* (CA)

American peregrine falcon, *Falco peregrinus anatum* (D)

white-faced ibis, *Plegadis chihi* (SC)

bank swallow, *Riparia riparia* (CA)

Reptiles

northwestern pond turtle, *Clemmys marmorata marmorata* (SC)

Amphibians

foothill yellow-legged frog, *Rana boylii* (SC)

western spadefoot toad, *Scaphiopus hammondii* (SC)

Fish

green sturgeon, *Acipenser medirostris* (SC)

river lamprey, *Lampetra ayresi* (SC)

longfin smelt, *Spirinchus thaleichthys* (SC)

Invertebrates

Antioch Dunes anthicid beetle, *Anthicus antiochensis* (SC)

Sacramento anthicid beetle, *Anthicus sacramento* (SC)

California linderiella fairy shrimp, *Linderiella occidentalis* (SC)

Plants

silky cryptantha, *Cryptantha crinita* (SC)

adobe lily, *Fritillaria pluriflora* (SC)

KEY:

(E)	*Endangered*	Listed (in the Federal Register) as being in danger of extinction.
(T)	*Threatened*	Listed as likely to become endangered within the foreseeable future.
(P)	*Proposed*	Officially proposed (in the Federal Register) for listing as endangered or threatened.
(PX)	*Proposed Critical Habitat*	Proposed as an area essential to the conservation of the species.
(C)	*Candidate*	Candidate to become a *proposed* species.
(SC)	*Species of Concern*	May be endangered or threatened. Not enough biological information has been gathered to support listing at this time.
(MB)	*Migratory Bird*	Migratory bird
(D)	*Delisted*	Delisted. Status to be monitored for 5 years.
(CA)	*State-Listed*	Listed as threatened or endangered by the State of California.
(*)	*Extirpated*	Possibly extirpated from this quad.
(**)	*Extinct*	Possibly extinct.
	Critical Habitat	Area essential to the conservation of a species.

ENCLOSURE A

Endangered and Threatened Species that May Occur in or be Affected by

PROJECTS IN TEHAMA COUNTY

Reference File No. 00-SP-0217

November 7, 2000

Listed Species

Birds

Aleutian Canada goose, *Branta canadensis leucopareia* (T)

bald eagle, *Haliaeetus leucocephalus* (T)

Critical habitat, northern spotted owl, *Strix occidentalis caurina* (T)

northern spotted owl, *Strix occidentalis caurina* (T)

Reptiles

giant garter snake, *Thamnophis gigas* (T)

Amphibians

California red-legged frog, *Rana aurora draytonii* (T)

Fish

Critical habitat, winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)

winter-run chinook salmon, *Oncorhynchus tshawytscha* (E)

delta smelt, *Hypomesus transpacificus* (T)

Central Valley steelhead, *Oncorhynchus mykiss* (T)

Central Valley spring-run chinook salmon, *Oncorhynchus tshawytscha* (T)

Critical Habitat, Central Valley spring-run chinook, *Oncorhynchus tshawytscha* (T)

Sacramento splittail, *Pogonichthys macrolepidotus* (T)

Invertebrates

Conservancy fairy shrimp, *Branchinecta conservatio* (E)

vernal pool tadpole shrimp, *Lepidurus packardi* (E)

vernal pool fairy shrimp, *Branchinecta lynchi* (T)

valley elderberry longhorn beetle, *Desmocerus californicus dimorphus* (T)

Plants

hairy Orcutt grass, *Orcuttia pilosa* (E)

Greene's tuctoria, *Tuctoria greenei* (E)

Hoover's spurge, *Chamaesyce hooveri* (T)

slender Orcutt grass, *Orcuttia tenuis* (T)

Candidate Species

Fish

Klamath Mts. Province steelhead, *Oncorhynchus mykiss* (C)

Central Valley fall/late fall-run chinook salmon, *Oncorhynchus tshawytscha* (C)

Species of Concern

Mammals

California wolverine, *Gulo gulo luteus* (CA)

Sierra Nevada red fox, *Vulpes vulpes necator* (CA)

pale Townsend's big-eared bat, *Corynorhinus (=Plecotus) townsendii pallescens* (SC)

Pacific western big-eared bat, *Corynorhinus (=Plecotus) townsendii townsendii* (SC)

spotted bat, *Euderma maculatum* (SC)

Sierra Nevada snowshoe hare, *Lepus americanus tahoensis* (SC)

Pacific fisher, *Martes pennanti pacifica* (SC)

small-footed myotis bat, *Myotis ciliolabrum* (SC)

long-eared myotis bat, *Myotis evotis* (SC)

fringed myotis bat, *Myotis thysanodes* (SC)

long-legged myotis bat, *Myotis volans* (SC)

Yuma myotis bat, *Myotis yumanensis* (SC)

San Joaquin pocket mouse, *Perognathus inornatus* (SC)

Birds

Swainson's hawk, *Buteo Swainsoni* (CA)

little willow flycatcher, *Empidonax traillii brewsteri* (CA)

greater sandhill crane, *Grus canadensis tabida* (CA)

bank swallow, *Riparia riparia* (CA)

American peregrine falcon, *Falco peregrinus anatum* (D)

Black-Crowned Night Heron, *Nycticorax nycticorax* (MB)

northern goshawk, *Accipiter gentilis* (SC)

tricolored blackbird, *Agelaius tricolor* (SC)

grasshopper sparrow, *Ammodramus savannarum* (SC)

Bell's sage sparrow, *Amphispiza belli belli* (SC)

short-eared owl, *Asio flammeus* (SC)

western burrowing owl, *Athene cunicularia hypugea* (SC)

American bittern, *Botaurus lentiginosus* (SC)

ferruginous hawk, *Buteo regalis* (SC)

Lawrence's goldfinch, *Carduelis lawrencei* (SC)

Vaux's swift, *Chaetura vauxi* (SC)

black tern, *Chlidonias niger* (SC)

lark sparrow, *Chondestes grammacus* (SC)

black swift, *Cypseloides niger* (SC)

hermit warbler, *Dendroica occidentalis* (SC)

white-tailed (=black shouldered) kite, *Elanus leucurus* (SC)

loggerhead shrike, *Lanius ludovicianus* (SC)

Lewis' woodpecker, *Melanerpes lewis* (SC)

long-billed curlew, *Numenius americanus* (SC)

white-faced ibis, *Plegadis chihi* (SC)

rufous hummingbird, *Selasphorus rufus* (SC)

Brewer's sparrow, *Spizella breweri* (SC)

California spotted owl, *Strix occidentalis occidentalis* (SC)

Bewick's wren, *Thryomanes bewickii* (SC)

Reptiles

northwestern pond turtle, *Clemmys marmorata marmorata* (SC)

California horned lizard, *Phrynosoma coronatum frontale* (SC)

Amphibians

tailed frog, *Ascaphus truei* (SC)

foothill yellow-legged frog, *Rana boylii* (SC)

mountain yellow-legged frog, *Rana muscosa* (SC)

western spadefoot toad, *Scaphiopus hammondii* (SC)

Fish

green sturgeon, *Acipenser medirostris* (SC)

river lamprey, *Lampetra ayresi* (SC)

longfin smelt, *Spirinchus thaleichthys* (SC)

Invertebrates

Antioch Dunes anthicid beetle, *Anthicus antiochensis* (SC)

Sacramento anthicid beetle, *Anthicus sacramento* (SC)

Leech's skyline diving beetle, *Hydroporus leechi* (SC)

California linderiella fairy shrimp, *Linderiella occidentalis* (SC)

Plants

Indian Valley brodiaea, *Brodiaea coronaria ssp. rosea* (CA)

upswept moonwort, *Botrychium ascendens* (SC)

scalloped moonwort, *Botrychium crenulatum* (SC)

Wilkins' harebell, *Campanula wilkinsiana* (SC)

silky cryptantha, *Cryptantha crinita* (SC)

clustered lady's-slipper, *Cypripedium fasciculatum* (SC)

Oregon fireweed, *Epilobium oreganum* (SC)

Brandegee's woolly-star, *Eriastrum brandegeae* (SC)

Butte fritillary, *Fritillaria eastwoodiae* (SC)

adobe lily, *Fritillaria pluriflora* (SC)

Tehama dwarf-flax, *Hesperolinon tehamense* (SC)

legenere, *Legenere limosa* (SC)
Mt. Tedoc linanthus, *Linanthus nuttallii ssp. howellii* (SC)
red-flowered lotus, *Lotus rubriflorus* (SC)
Anthony Peak lupine, *Lupinus antoninus* (SC)
Stebbins' madia, *Madia stebbinsii* (SC)
The Lassics sandwort, *Minuartia decumbens* (SC)
Ahart's whitlow-wort, *Paronychia ahartii* (SC)
valley sagittaria, *Sagittaria sanfordii* (SC)
Tracy's sanicle, *Sanicula tracyi* (SC)
Butte County (western) catchfly, *Silene occidentalis ssp. longistipitata* (SC)

KEY:

(E)	*Endangered*	Listed (in the Federal Register) as being in danger of extinction.
(T)	*Threatened*	Listed as likely to become endangered within the foreseeable future.
(P)	*Proposed*	Officially proposed (in the Federal Register) for listing as endangered or threatened.
(PX)	*Proposed Critical Habitat*	Proposed as an area essential to the conservation of the species.
(C)	*Candidate*	Candidate to become a *proposed* species.
(SC)	*Species of Concern*	Other species of concern to the Service.
(D)	*Delisted*	Delisted. Status to be monitored for 5 years.
(CA)	*State-Listed*	Listed as threatened or endangered by the State of California.
*	*Extirpated*	Possibly extirpated from the area.
**	*Extinct*	Possibly extinct
	Critical Habitat	Area essential to the conservation of a species.

Federal Endangered and Threatened Species that may be Affected by Projects in the RED BLUFF EAST 7 1/2 Minute Quad

Database Last Updated: June 17, 2002
Today's Date is: June 26, 2002

Listed Species

Invertebrates
Branchinecta lynchi - vernal pool fairy shrimp (T)
Desmocerus californicus dimorphus - valley elderberry longhorn beetle (T)
Lepidurus packardi - vernal pool tadpole shrimp (E)

Fish
Hypomesus transpacificus - delta smelt (T)
Oncorhynchus mykiss - Central Valley steelhead (T) (NMFS)
Oncorhynchus tshawytscha - Central Valley spring-run chinook salmon (T) (NMFS)
Pogonichthys macrolepidotus - Sacramento splittail (T)

Amphibians
Rana aurora draytonii - California red-legged frog (T)

Reptiles
Thamnophis gigas - giant garter snake (T)

Birds
Haliaeetus leucocephalus - bald eagle (T)

Candidate Species

Fish
Oncorhynchus tshawytscha - Central Valley fall/late fall-run chinook salmon (C) (NMFS)

Birds
Coccyzus americanus occidentalis - Western yellow-billed cuckoo (C)

Species of Concern

Invertebrates
Anthicus antiochensis - Antioch Dunes anthicid beetle (SC)
Anthicus sacramento - Sacramento anthicid beetle (SC)
Linderiella occidentalis - California linderiella fairy shrimp (SC)

Fish
Acipenser medirostris - green sturgeon (SC)
Lampetra ayresi - river lamprey (SC)
Spirinchus thaleichthys - longfin smelt (SC)

Amphibians
Rana boylii - foothill yellow-legged frog (SC)
Spea hammondii - western spadefoot toad (SC)

Reptiles
Clemmys marmorata marmorata - northwestern pond turtle (SC)

Birds
Agelaius tricolor - tricolored blackbird (SC)
Ammodramus savannarum - grasshopper sparrow (SC)
Asio flammeus - short-eared owl (SC)
Athene cunicularia hypugaea - western burrowing owl (SC)
Baeolophus inornatus - oak titmouse (SLC)
Branta canadensis leucopareia - Aleutian Canada goose (D)
Buteo regalis - ferruginous hawk (SC)
Buteo Swainsoni - Swainson's hawk (CA)
Carduelis lawrencei - Lawrence's goldfinch (SC)
Chaetura vauxi - Vaux's swift (SC)
Chlidonias niger - black tern (SC)

Elanus leucurus - white-tailed (=black shouldered) kite (SC)
Empidonax traillii brewsteri - little willow flycatcher (CA)
Falco peregrinus anatum - American peregrine falcon (D)
Lanius ludovicianus - loggerhead shrike (SC)
Melanerpes lewis - Lewis' woodpecker (SC)
Numenius americanus - long-billed curlew (SC)
Picoides nuttallii - Nuttall's woodpecker (SLC)
Plegadis chihi - white-faced ibis (SC)
Riparia riparia - bank swallow (CA)
Selasphorus rufus - rufous hummingbird (SC)

Mammals

Corynorhinus (=Plecotus) townsendii pallescens - pale Townsend's big-eared bat (SC)
Corynorhinus (=Plecotus) townsendii townsendii - Pacific western big-eared bat (SC)
Euderma maculatum - spotted bat (SC)
Myotis ciliolabrum - small-footed myotis bat (SC)
Myotis evotis - long-eared myotis bat (SC)
Myotis thysanodes - fringed myotis bat (SC)
Myotis volans - long-legged myotis bat (SC)
Myotis yumanensis - Yuma myotis bat (SC)
Perognathus inornatus - San Joaquin pocket mouse (SC)

Plants

Cryptantha crinita - silky cryptantha (SC)
Fritillaria pluriflora - adobe lily (SC)
Juncus leiospermus var. leiospermus - Red Bluff (dwarf) rush (SC)

Species with Critical Habitat Proposed or Designated in this Quad

Central Valley fall/late fall-run chinook (C)
Central Valley spring-run chinook (T)
winter-run chinook salmon (E)

Key:
(E) Endangered - Listed (in the Federal Register) as being in danger of extinction.
(T) Threatened - Listed as likely to become endangered within the foreseeable future.
(P) Proposed - Officially proposed (in the Federal Register) for listing as endangered or threatened.
(NMFS) Species under the Jurisdiction of the National Marine Fisheries Service. Consult with them directly about these species.
Critical Habitat - Area essential to the conservation of a species.
(PX) Proposed Critical Habitat - The species is already listed. Critical habitat is being proposed for it.
(C) Candidate - Candidate to become a proposed species.
(CA) Listed by the State of California but not by the Fish & Wildlife Service.
(D) Delisted - Species will be monitored for 5 years.
(SC) Species of Concern/(SLC) Species of Local Concern - Other species of concern to the Sacramento Fish & Wildlife Office.

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If you have a project that may affect endangered species, please contact the Endangered Species Division, Sacramento Fish and Wildlife Office, U.S. Fish and Wildlife Service

Federal Endangered and Threatened Species that may be affected by projects in Tehama County

Database Last Updated: June 17, 2002
Today's Date is: June 26, 2002

Listed Species

Invertebrates

Branchinecta conservatio - Conservancy fairy shrimp (E)
Branchinecta lynchi - vernal pool fairy shrimp (T)
Desmocerus californicus dimorphus - valley elderberry longhorn beetle (T)
Lepidurus packardi - vernal pool tadpole shrimp (E)

Fish

Hypomesus transpacificus - delta smelt (T)
Oncorhynchus mykiss - Central Valley steelhead (T) (NMFS)
Oncorhynchus tshawytscha - winter-run chinook salmon (E) (NMFS)
Pogonichthys macrolepidotus - Sacramento splittail (T)

Amphibians

Rana aurora draytonii - California red-legged frog (T)

Reptiles

Thamnophis gigas - giant garter snake (T)

Birds

Haliaeetus leucocephalus - bald eagle (T)
Strix occidentalis caurina - northern spotted owl (T)

Plants

Chamaesyce hooveri - Hoover's spurge (T)
Orcuttia pilosa - hairy Orcutt grass (E)
Orcuttia tenuis - slender Orcutt grass (T)
Tuctoria greenei - Greene's tuctoria (=Orcutt grass) (E)

Candidate Species

Fish

Oncorhynchus tshawytscha - Central Valley fall/late fall-run chinook salmon (C) (NMFS)

Birds

Coccyzus americanus occidentalis - Western yellow-billed cuckoo (C)

Species of Concern

Invertebrates

Anthicus antiochensis - Antioch Dunes anthicid beetle (SC)
Anthicus sacramento - Sacramento anthicid beetle (SC)
Hydroporus leechi - Leech's skyline diving beetle (SC)
Linderiella occidentalis - California linderiella fairy shrimp (SC)

Fish

Acipenser medirostris - green sturgeon (SC)
Lampetra ayresi - river lamprey (SC)
Spirinchus thaleichthys - longfin smelt (SC)

Amphibians

Ascaphus truei - tailed frog (SC)
Rana boylii - foothill yellow-legged frog (SC)
Rana muscosa - mountain yellow-legged frog (SC)
Spea hammondii - western spadefoot toad (SC)

Reptiles

Clemmys marmorata marmorata - northwestern pond turtle (SC)
Phrynosoma coronatum frontale - California horned lizard (SC)

Birds

Accipiter gentilis - northern goshawk (SC)
Agelaius tricolor - tricolored blackbird (SC)
Ammodramus savannarum - grasshopper sparrow (SC)
Amphispiza belli belli - Bell's sage sparrow (SC)
Asio flammeus - short-eared owl (SC)
Athene cunicularia hypugaea - western burrowing owl (SC)
Baeolophus inornatus - oak titmouse (SLC)
Botaurus lentiginosus - American bittern (SC)
Branta canadensis leucopareia - Aleutian Canada goose (D)
Buteo regalis - ferruginous hawk (SC)
Buteo Swainsoni - Swainson's hawk (CA)
Carduelis lawrencei - Lawrence's goldfinch (SC)
Chaetura vauxi - Vaux's swift (SC)
Chlidonias niger - black tern (SC)
Cypseloides niger - black swift (SC)
Dendroica occidentalis - hermit warbler (SC)
Egretta thula - Snowy Egret (MB)
Elanus leucurus - white-tailed (=black shouldered) kite (SC)
Empidonax traillii brewsteri - little willow flycatcher (CA)
Falco peregrinus anatum - American peregrine falcon (D)
Gavia immer - common loon (SC)
Grus canadensis tabida - greater sandhill crane (CA)
Lanius ludovicianus - loggerhead shrike (SC)
Melanerpes lewis - Lewis' woodpecker (SC)
Numenius americanus - long-billed curlew (SC)
Picoides nuttallii - Nuttall's woodpecker (SLC)
Plegadis chihi - white-faced ibis (SC)
Riparia riparia - bank swallow (CA)
Selasphorus rufus - rufous hummingbird (SC)
Strix occidentalis occidentalis - California spotted owl (SC)
Toxostoma redivivum - California thrasher (SC)

Mammals

Corynorhinus (=Plecotus) townsendii pallescens - pale Townsend's big-eared bat (SC)
Corynorhinus (=Plecotus) townsendii townsendii - Pacific western big-eared bat (SC)
Euderma maculatum - spotted bat (SC)
Gulo gulo luteus - California wolverine (CA)
Lepus americanus tahoensis - Sierra Nevada snowshoe hare (SC)
Martes pennanti pacifica - Pacific fisher (SC)
Myotis ciliolabrum - small-footed myotis bat (SC)
Myotis evotis - long-eared myotis bat (SC)
Myotis thysanodes - fringed myotis bat (SC)
Myotis volans - long-legged myotis bat (SC)
Myotis yumanensis - Yuma myotis bat (SC)
Perognathus inornatus - San Joaquin pocket mouse (SC)
Vulpes vulpes necator - Sierra Nevada red fox (CA)

Plants

Agrostis hendersonii - Henderson's bent grass (SC)
Arctostaphylos canescens ssp sonomensis - Sonoma manzanita (SLC)
Astragalus rattanii var jepsonianus - Jepson's milk-vetch (SLC)
Balsamorhiza macrolepis var macrolepis - big-scale (=California) balsamroot (SLC)
Botrychium ascendens - upswept moonwort (SC)
Botrychium crenulatum - scalloped moonwort (SC)
Brodiaea coronaria ssp. rosea - Indian Valley brodiaea (CA)
Calystegia atriplicifolia ssp. buttensis - Butte County morning-glory (SC)
Campanula wilkinsiana - Wilkin's harebell (SC)
Chamaesyce ocellata ssp. rattanii - Stony Creek spurge (SLC)

Chlorogalum pomeridianum var minus - dwarf soaproot (=wavyleaf soap plant) (SLC)
Clarkia gracilis ssp albicaulis - white-stemmed (=whitestem) clarkia (SLC)
Cryptantha crinita - silky cryptantha (SC)
Cypripedium fasciculatum - clustered lady's-slipper (SC)
Epilobium oreganum - Oregon fireweed (SC)
Eriastrum brandegeae - Brandegee's woolly-star (=eriastrum) (SC)
Eriogonum libertini - Dubakella Mountain buckwheat (SLC)
Fritillaria eastwoodiae - Butte fritillary (SC)
Fritillaria pluriflora - adobe lily (SC)
Gratiola heterosepala - Boggs Lake hedge-hyssop (CA)
Hesperolinon tehamense - Tehama dwarf-flax (SC)
Iliamna bakeri - Baker's globe mallow (=Baker's wild hollyhock) (SLC)
Juncus leiospermus var. leiospermus - Red Bluff (dwarf) rush (SC)
Layia septentrionalis - Colusa layia (=Colusa tidytips) (SLC)
Legenere limosa - legenere (SC)
Linanthus nuttallii ssp. howellii - Mt. Tedoc linanthus (SLC)
Lotus rubriflorus - red-flowered lotus (SC)
Lupinus antoninus - Anthony Peak lupine (SC)
Madia stebbinsii (=Harmonia stebbinssii) - Stebbins's madia (=Stebbins's harmonia) (SC)
Navarretia leucocephala ssp. bakeri - Baker's narvarretia (SC)
Oreostemma elatum - tall alpine-aster (= Plumas alpine aster) (SLC)
Paronychia ahartii - Ahart's whitlow-wort (=Ahart's paronychia) (SC)
Rupertia hallii - Hall's rupertia (=Hall's California tea) (SLC)
Sagittaria sanfordii - valley sagittaria (=Sanford's arrowhead) (SC)
Silene campanulata ssp. campanulata - Red Mountain catchfly (=campion) (CA)
Silene occidentalis ssp. longistipitata - Butte County catchfly (=long-stiped campion) (SC)

Species with Critical Habitat Proposed or Designated in this County

Central Valley fall/late fall-run chinook (C)
Central Valley spring-run chinook (T)
Central Valley steelhead (T)
northern spotted owl (T)
winter-run chinook salmon (E)

Key:
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environment.

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Appendix D
Sensitive Plant and Wildlife Species

APPENDIX D

Sensitive Plant and Wildlife Species

Sensitive plant and wildlife species with the potential to occur within the project area were determined from a records search of the California Natural Diversity Data Base (CNDDB) and consultation with the U.S. Fish and Wildlife Service (USFWS). The species that have the potential to occur within the project area are discussed below and potential impacts resulting from project activities are evaluated. Table D-1 (at the end of this appendix) summarizes status, habitat, season, and reported occurrences of those species.

Birds

American Bittern (Botaurus lentiginosus)

The American bittern is widely distributed throughout North America. Breeding range extends from the central U.S. northward into Canada. The breeding season extends from March to early May. Fall migration to wintering range in the southern U.S., Mexico, and central America begins in September and continues through November. Bitterns are non-migratory along the Pacific Coast from California to British Columbia. Nests sites are typically located in dense emergent vegetation in shallow-water wetlands. Foraging occurs at dawn and dusk with insects, amphibians, crayfish, small fish, and mammals as primary prey. Wetlands habitat loss is the primary factor responsible for the decline of this species as well as contaminants and pollution. This species has been observed on rare occasions near Red Bluff during breeding bird surveys. The American bittern is a Federal species of concern.

Black-crowned Night Heron (*Nycticorax nycticorax*)

The black-crowned night heron breeds throughout most of the U.S. and is a resident throughout most of California. The breeding season lasts from February to July. Nests are built in areas with dense foliage including trees, shrubs and wetlands. This species forages at night feeding on fish, crustaceans, insects, amphibians, reptiles, and mammals. Winter migration for non-resident species begins in July and continues through October. Wintering range includes areas in the southern U.S. to South America. Nest sites are generally built near aquatic habitats, as most foraging occurs in shallow waters such as swamps, ponds, marshes, lakes, and rice fields. Primary threats to this species include habitat loss, pesticides, and human disturbance of nest sites. The black-crowned night heron has been spotted only on rare occasions in the Red Bluff area during breeding bird surveys. The black-crowned night heron is a Federal species of concern.

White-faced Ibis (*Plegadis chihi*)

In the U.S., the breeding and wintering range of the white-faced ibis is concentrated in Southern California and the southern portion of the gulf states. Local breeding occurs in northern California and southern Oregon as well as areas in the Great Basin states and the Midwest. Large flocks gather in wintering habitats in the U.S. and Mexico. Fall migration begins in early August and continues through mid-September. Freshwater wetlands with

dense emergent vegetation provide the primary habitat, but agricultural fields are often used for foraging. Breeding begins in April and continues through June. Nests are built in shallow wetlands areas with emergent vegetation such as cattails, bulrush, or low trees and shrubs or tamarisk over shallow water. The white-faced ibis feeds in wetlands and flooded fields where primary prey items include crayfish, insects, and earthworms. Habitat loss, illegal hunting, and pesticides pose the greatest threats to this species. No nest sites have been reported in the vicinity of the project area. The white-faced ibis is a State and Federal special-status species.

Aleutian Canada Goose (*Branta canadensis leucopareia*)

The breeding areas for the Aleutian Canada goose are restricted to the Aleutian and Semidi islands in the North Pacific, but they migrate to the northern Central Valley during the winter. Southern migration begins in mid-October, and the geese remain in California through early April. Flocks gather in agricultural fields and feed on the remaining post-harvest grains during the day and roost in areas with shallow water at night. Introduced predators, overhunting, and disease resulted in dramatic population declines; however, protection and conservation measures have allowed the population to increase in recent years. There are no specific reports for this subspecies in the vicinity of the project area; however, 1999 Audubon Christmas bird counts for Red Bluff reported over 170 Canada geese (subspecies not determined), thus there is potential for this subspecies to occur near the project area. The Aleutian Canada goose was delisted in 2001.

Cooper's Hawk (*Accipiter cooperii*)

Cooper's hawks are widely distributed residents throughout North America. They can be found in a variety of habitats including woodlands, riparian forests, wetlands, grasslands, and agricultural fields. Breeding season begins in March and continues through June. Nests are built in large trees, generally near streams or open water. Small birds are the primary prey for Cooper's hawks, but small mammals are also important prey items. Historical population declines resulted from pesticides and loss of suitable nesting sites. While generally uncommon, the populations in the West are presumably stable (Rosenfield and Bielefeldt, 1993). Breeding bird surveys and 1999 Audubon Christmas bird counts in the Red Bluff area have reported Cooper's hawks present in the area. Cooper's hawks are a State species of special concern.

Sharp-shinned Hawk (*Accipiter cooperii*)

Sharp-shinned hawks are widely distributed throughout North America, with the breeding range largely in the northern parts of the continent and wintering areas in the southern half of the U.S. into Mexico and Central America. In California there is a small resident population, but the population increases from mid-September to mid-April during the winter migration (Small, 1994). During winter migration, a variety of habitats are used; however, wetlands and grasslands are rarely used, as plucking perches are required for sharp-shinned hawks. Breeding begins in April with nest sites in open woodlands and conifer forests. Small birds are the primary prey as well as small mammals, reptiles, amphibians, and insects. Habitat loss and pesticides are the principle factors responsible for population declines of this species. Breeding bird surveys and 1999 Audubon Christmas

bird counts in the Red Bluff area have reported sharp-shinned hawks present in the area. The sharp-shinned hawk is a State species of special concern.

Northern Goshawk (*Accipiter gentilis*)

The northern goshawk is a widespread resident throughout the western U.S. and Canada. They are typically associated with montane conifer forests but may migrate to lower elevations in the winter to forage. Northern goshawks are the largest of the North American accipters and are well adapted for hunting in forests but may also forage in open areas. Breeding season occurs between March and April, with nests built in either conifer, deciduous, or mixed forests with suitable large trees. In California, most nesting occurs in old-growth ponderosa pine forests with high canopy closure. Relative to other areas throughout its range, the Sierra Nevada montane conifer forests are an important nesting area for northern goshawks (Squires and Reynolds, 1997). Prey includes a variety of birds and small mammals. Habitat loss resulting from timber harvest and pesticides have been responsible for historical population declines. Goshawks are uncommon in the lower areas of the State, but have been observed on rare occasions during breeding bird surveys in the Red Bluff area. The goshawk is a State species of special concern.

Golden Eagle (*Aquila chrysaetos*)

Golden eagles are widespread throughout most of North America and are resident species in California. They occupy primarily mountain and canyon habitats, usually avoiding dense forested areas where hunting is difficult because of their large wingspan. Breeding occurs between March and April. Nests are constructed on cliff ledges, high rocky outcrops, in large trees, and on top of telephone poles. Golden eagles hunt in a variety of habitat types including grasslands, oak savannah, meadows, open woodland, chaparral, and wetlands. Prey include hares, marmots, rodents, snakes, birds, and carrion. Habitat loss and pesticides have led to reduced population levels throughout its range. There are an estimated 500 breeding pairs in California (California Department of Fish and Game [CDFG], 1987). This species has been observed on rare occasions during breeding bird surveys near Red Bluff, and one golden eagle was noted in the 1999 Red Bluff Audubon Christmas bird count. Golden eagles are a State species of special concern and are a California fully protected species.

Ferruginous Hawks *(Buteo regalis)*

Ferruginous hawks are uncommon winter migrants in northern California where they forage in open grasslands and agricultural areas between September and April. Small mammals are the primary prey, but birds, reptiles, and amphibians are also taken. Ferruginous hawks will roost in scattered trees and on utility poles. Pesticides, shooting, agricultural conversion, and rodent control programs have led to historical declines in the population; however, current populations appear to be stable (Bechard and Schmutz, 1995). Non-nesting ferruginous hawks have been observed in the Red Bluff area during 1999 Audubon Christmas bird counts. Ferruginous hawks are California State and Federal special-status species.

Sawinson's Hawk (*Buteo Swainsoni*)

Swainson's hawks are widespread throughout much of central and western North America; during the winter, large flocks of Swainson's hawks migrate to South America. Although this species was historically widespread throughout California, most of the populations are now restricted to the Central Valley and Great Basin areas of the State. Breeding season begins in late March, and fall migration begins in August. Insects are an important prey, especially during the nonbreeding season, and large flocks of Swainson's hawks often congregate in fields to forage. During the breeding season, small mammals, birds, lizards, and amphibians are taken. Nest sites occur in mature riparian forests, oak groves, or in large trees adjacent to grasslands or agricultural fields. Loss of nesting habitat throughout California and pesticide use throughout the wintering range are the two most significant factors in the decline of this species. One nesting pair was observed in 1993 north of the project site along Salt Creek. Swainson's hawks are listed as threatened in California.

Northern Harrier (*Circus cyaneus*)

Northern harriers are widespread throughout North America. In California, they are common winter migrants and occasional residents in the Central Valley. Harriers are generally found in open habitats such as grasslands, rangelands, agricultural fields, marshes, and open woodlands and conifer forests. Northern harriers construct nests on the ground in areas of tall, dense vegetation, usually near water such as rivers, lakes, and marshes, but may also nest in grasslands and agricultural fields. Breeding occurs between April and September. Small mammals and birds are the primary prey, but reptiles and frogs are also taken. Habitat loss and degradation as well as pesticides are the most significant threats to this species. While the overall population appears to be declining, they remain locally abundant in California (Zeiner et al., 1990). Few northern harriers have been observed during breeding bird surveys in the Red Bluff area, but they were relatively common during 1999 Audubon Christmas bird counts. Northern harriers are a California species of special concern.

White-tailed Kite (*Elanus leucrus*)

White-tailed kites have a disjunct distribution throughout much of North America, and in California are uncommon to common residents in coastal areas and valley lowlands. They nest in a variety of habitats including oak woodlands, savannas, and riparian areas in tall trees and shrubs in and near open foraging grounds. Breeding season lasts from February through August with a peak between March and May. Voles are the principle prey, but other small mammals, birds, reptiles, and amphibians are also taken. Kites are often found foraging in agricultural areas as well as grasslands and wetlands. Although the population has historically declined, this species has become well adapted to human-modified landscapes, and the population appears to be increasing (Zeiner et al., 1990). This species in known to nest in riparian areas near Gerber and has been observed on rare occasions during breeding bird surveys and 1999 Audubon Christmas bird counts in the Red Bluff area. White-tailed kites are listed as State and Federal special-status species.

Bald Eagle (*Haliaectus leucocephalus*)

In western North America bald eagles are resident species from northern California to Alaska. Breeding populations in California are restricted to the northeast part of the State

with half of the wintering population found in the Klamath Basin (Zeiner et al., 1990). Nests are constructed in large old-growth trees with open canopies, often in ponderosa pines. Nesting begins in November, and breeding season extends from February through July. Nest sites are built close to water such as lakes, rivers, and estuaries as fish are a significant part of bald eagle's diet. Eagles are sensitive to nest site disturbance and will not nest around human activity. Eagles will also take small mammals, birds, reptiles, and carrion. Human activity such as logging and off-road vehicle traffic can result in nest abandonment. Pesticides, habitat loss, and illegal shooting have led to population declines, but protection measures have resulted in an increase in the population in recent decades. Bald eagles are only rare breeders in Tehama County and occasional migrants through the area. Eagles are not known to nest in the project area and have been observed only rarely during breeding bird surveys in the Red Bluff area. However, they may be somewhat more common during the winter as they have been recently observed in Red Bluff 1999 Audubon Christmas bird surveys. Bald eagles are a California State endangered and Federal-listed threatened species.

Osprey (*Pandion haliaetus*)

The osprey is a widespread species and has an extensive breeding range throughout northern California. During the winter, osprey migrate to more southern latitudes of California, the Gulf Coast, and Central and South America. Large trees, snags, and utility poles are used as nest sites. Osprey feed predominately on fish, and nest sites are generally located close to open water. The breeding season begins in late March and continues through April. Fall migration may begin as soon as September and continue through mid-November, but the peak migration period occurs between late September and early October. Pesticides resulted in dramatic population declines; however, since the ban on DDT, populations have been increasing. However, pesticide use in the winter range stills poses a threat to this species. Two nesting pair were observed within the project area near the confluence of Red Bank Creek and the Sacramento River. Osprey are a California State species of concern.

Prairie Falcon (*Falco mexicanus*)

Prairie falcons occur throughout the western half of North America, breeding as far north as southern Canada and wintering in Mexico and Central America. In California they are residents throughout much of the Sierra Nevada and Coast Range, with the exception of the northwest part of the State. Winter migrants are also common throughout the Central Valley. Nests are built on cliffs, bluffs, and rock outcrops with sheltered ledges overlooking large open areas. Breeding season occurs from mid-February through September, with a peak between April and August. Small mammals are the primary prey, with occasional small birds and reptiles also included in the diet. Foraging occurs in open habitats including annual grasslands, savannas, rangelands, and agricultural fields. Pesticides have resulted in historical population declines of this species. This species has not been observed nesting in the vicinity of the project area, but has been observed in the Red Bluff area during 1999 Audubon Christmas bird counts and has been observed on rare occasions during breeding bird surveys in the area. The prairie falcon is a State species of special concern.

Peregrine Falcon (*Falco peregrinus anatum*)

The American peregrine falcon, which is the most southerly subspecies of peregrine falcon in North America, breeds south of the Arctic Tundra of Canada and Alaska to Mexico. In winter and during migration, the American peregrine falcon extends its range southward to the Caribbean and parts of South America. In California it is a resident species throughout the Coast Range and Sierra Nevada, and a winter migrant throughout the Central Valley. Breeding season occurs between March and August, with nests located on ledges, human-made structures, trees, snags, or in old raptor nests in forests and woodlands near wetlands, lakes, and rivers. Riparian areas and wetlands are particularly important habitats for this species (Zeiner et al., 1990). Peregrine falcons prey mostly on birds, but will also take small mammals, fish, and insects. This species is not known to nest in the vicinity of the project area, but has been observed in the Red Bluff area during 1999 Audubon Christmas bird counts and observed on rare occasions during breeding bird surveys in the area. Habitat loss and pesticides led to dramatic population declines, but the population has made a significant recovery in recent decades and has been delisted by USFWS. Peregrine falcons remain listed as endangered by the State of California.

Black Tern (*Chlidonias niger*)

The current breeding range of the black tern includes the northern U.S. and southern Canada, and its winter range includes the southern U.S., Mexico, and Central America. In California, it was historically a common spring and summer migrant, but populations have declined throughout its range, especially in the Central Valley as a result of habitat loss and pesticides. Spring migration begins in April, and fall migration begins as early as June and lasts through September; however, some birds may remain throughout the season (Zeiner et al., 1990). Breeding occurs between May and August in freshwater wetlands with extensive emergent vegetation and areas of open water. Nests are built on mats of floating vegetation or on the ground near water. Black terns forage on insects and fish but will also take tadpoles, frogs, crustaceans, and worms. Foraging habitats include wetlands, wet meadows, rice fields, irrigated agricultural crops, and riparian areas They have been observed only rarely during breeding bird surveys in the Red Bluff area. Black terns are State and Federal special-status species.

Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*)

Historically, the yellow-billed cuckoo was widespread throughout the western U.S.; however, the extensive loss of mature riparian forest has resulted in dramatic declines of this species. In California it is now an uncommon to rare summer resident in scattered locations of its former range. Fall migration to South America begins in August and continues through September. Cuckoos maintain large territories, and suitable habitat of at least 25 acres may be required for breeding to occur. Breeding season begins in late June in the Sacramento River Valley. Dense cottonwood-willow stands are used by the yellow-billed cuckoo for nesting sites. Cuckoos are primarily insectivores, but will occasionally consume small reptiles and amphibians. This species has historically nested at Todd and Mooney islands, several miles to the southeast of the project area, but there are no recent observations in the vicinity of the project area. The western yellow-billed cuckoo is a California State endangered species and a candidate for Federal listing.

Short-eared Owl (*Asio flammeus*)

Short-eared owls occur throughout North America and historically breed throughout much of California, but breeding populations are now largely restricted to the northeastern portion of the State. They are more common and widespread winter migrants, especially in the Central Valley between September and April. Breeding season is between March and July. Nesting occurs in open habitats with dense vegetation such as grasslands and upland areas in marshes. Voles are the principal prey item, but other rodents, small mammals, birds, reptiles, amphibians, and arthropods are also taken. Foraging occurs in open habitats including grasslands, pastures, agriculture fields, and wetlands. Fence posts and small mounds are often used as perch sites. Agricultural conversion and urban development have significantly diminished suitable breeding habitat throughout much of the State, and the historical range and populations in California have been greatly reduced (Zeiner et al., 1990). This species has been observed only rarely in the Red Bluff area. The short-eared owl is a State and Federal special-status species.

Burrowing Owl (*Athene cunicularia hypougea*)

Burrowing owls occur in western North America from southern Canada to central Mexico. The species is generally non-migratory; however, owls in the northern parts of the range migrate south during the winter months. They are residents throughout much of California excluding the mesic coastal forests in the northwest and the high sierras. Breeding season starts in late March and continues through April. Burrowing owls generally forage on large arthropods, but will also consume small mammals, birds, reptiles, and amphibians. Burrows created by other animals, most commonly the California ground squirrel, are used as nest sites. Nests are generally located in dry, open areas such as grasslands, pastures, and agricultural fields; but burrowing owls will also nest in road embankments and near open urban areas. Population declines have resulted from extensive habitat loss, rodent control programs, pesticides, predators, and collisions with vehicles. There is one reported occurrence located several miles to the northeast of the project area along Little Salt Creek, and they have been observed on rare occasions during breeding bird surveys in the Red Bluff area. The burrowing owl is a State and Federal special-status species.

Vaux's Swift (*Chaetura vauxi*)

Vaux's swift breeds in western North America and winters in Mexico and Central America. In California, they primarily nest in the Coast Range south to Monterey County, but are also likely to breed in low densities in Lake, Butte, Tehama, Plumas, and other interior California counties. Breeding season is between May and August. They nest in conifer forests along the central and northern California coast, and mixed oaks and conifers in the interior mountain ranges. Nests are typically built in hollow trees or snags, especially those charred by fire. Migrating birds may be common throughout the State in the spring, between April and May, and again in the fall between August and September. Foraging occurs above the forest canopy and at lower levels in meadows, over lakes, rivers, ponds, and above burned areas. Vaux's swifts feed exclusively on insects captured in flight (Zeiner et al., 1990). Significant population declines of the Vaux's swift have been documented in Oregon and Washington, and most populations are believed to be declining throughout the species' range. The removal of large broken-top trees and large hollow snags, most of which are found in late-seral stage forests, has been suggested as contributing to population declines. This species

has only been observed on rare occasions during breeding bird surveys in the Red Bluff area. Vaux's swift is a State and Federal special-status species.

Black Swift (*Cypseloides niger*)

The black swift occurs in western North America, breeding very locally from southeastern Alaska, through western Canada and the U.S. and into Mexico. The winter range is poorly known but it may be found in northern South America and in the West Indies (DeGraaf and Rappole, 1995). In California, black swifts breed very locally in the Sierra Nevada and Cascade Range, the San Gabriel, San Bernardino, and San Jacinto mountains, and in coastal bluffs and mountains from San Mateo County south probably to San Luis Obispo County. Black swifts are present in California between May and September, and breeding occurs from June to August. Nests are built on cliffs, often in deep canyons behind waterfalls or on coastal bluffs. Foraging occurs over a wide variety of habitats where insects are captured in flight. Common prey items include wasps, flies, mayflies, caddisflies, beetles, leafhoppers, and beetles. The current status of black swifts is uncertain. Kaufman (1996) characterized the population as probably stable, but DeGraaf and Rappole (1995) consider the species to be experiencing a long-term decline. They have been observed only on rare occasions in the vicinity of Red Bluff and seldom occur outside of their breeding range (Zeiner et al., 1990). The black swift is a State and Federal special-status species.

Rufous Hummingbird (*Selasphorus rufus*)

The rufous hummingbird breeds from northwestern California in the Trinity Mountains to southeastern Alaska, and winters in the Southern U.S., Mexico- and Central America. In California it is an uncommon breeder, but a fairly common migrant species. Spring migration through the lowlands and foothills of California occurs between February and May, where riparian areas, open woodlands, chaparral, orchards, and gardens provide migrational habitats. Breeding is thought to occur only in montane conifer forests in the Trinity Mountains in California between April and July. Nests are constructed in berry tangles, shrubs, and conifers. Fall migration occurs between June and July, but is generally restricted to the higher elevation areas in the Coast Range and Sierra Nevada where nectar-producing flowers are abundant. While nectar is the principal food item, they will also glean insects from flowers and foliage and forage on tree sap. In general, the population appears to be stable, and no significant threats have been identified for this species. This species has been only rarely observed during breeding bird surveys in the Red Bluff area. Migrating populations may use the riparian area along Red Bank Creek. It is a California watch list species and a Federal species of concern.

Lewis' Woodpecker (*Melanerpes lewis*)

The Lewis' woodpecker occurs in localized populations throughout the U.S. west of the Great Plains. It is a resident throughout much of California and southern Oregon. They can be found in a variety of habitats depending on the season. Open conifer forests, especially burned-over pine forests appear to be preferred summer habitats at higher elevations, and oak woodlands are used extensively in the winter. Other habitats such as cottonwood riparian forests and fruit and nut orchards are also commonly used by this species. Nests are constructed in snags, generally in well-decayed dead trees, and breeding occurs between April and May. During the breeding season they forage primarily on insects, switching to

acorns and other nuts during the winter. This species is generally uncommon throughout its range, and the population has declined dramatically since the 1960s (Tobalske, 1997). Principal threats include loss of habitat, pesticides, and competition from European starlings for nest sites. In the Red Bluff area, this species is rarely observed during the summer, but is a common winter resident according to 1999 Audubon Christmas bird counts, which recorded 34 sightings in 1999. The Lewis' woodpecker is a Federal species of concern.

Olive-sided Flycatcher (*Contopus borealis*)

The olive-sided flycatcher breeds from Alaska to southern California west into the Rocky Mountains and throughout most of Canada and the Northeastern U.S., and winters in South America. In California it is an uncommon to common summer resident between April and October. Breeding occurs in montane conifer forests where tall conifers are used for nest and perch sites. Olive-sided flycatchers forage on insects above the forest canopy, in meadows, clearings, and over chaparral-covered slopes. They are uncommon transients in low-elevation woodlands (Zeiner et al., 1990). Early breeding bird surveys indicated that this species was declining throughout much of its range, but populations in California appeared to be relatively stable (Robbins, et al., 1986). While the olive-sided flycatcher is benefited in the short term by clear-cutting, dense stands of even-aged timber are not used by this species. This species has been reported only rarely in breeding bird surveys in the Red Bluff area and is unlikely to occur within the vicinity of the project site. The olive-sided flycatcher is a California State and Federal watch list species.

Little Willow Flycatcher (*Empidonax traillii brewsteri*)

The little willow flycatcher is a rare to uncommon summer resident in California from May through September, migrating to South America during the winter months. Migrational habitats include narrow riparian corridors as well as shrubs and trees in parks and gardens. They require extensive dense stands of willows for nesting and roost sites. Preferred breeding habitats include willow thickets along the margins of wet montane meadows, ponds and back waters, and montane riparian areas. During the spring (May to June) and fall (August to September) migrations they are more common at lower elevations and less selective of habitat type. They forage primarily on insects, and less on berries and seeds, by making short forays from perches within the shrub thicket. Habitat loss and degradation, along with extensive nest parasitism by brown-headed cowbirds, has led to dramatic declines in the population in recent decades. Reports of this species during breeding bird surveys are rare in the Red Bluff area, and it is expected to occur only as a spring and fall migrant. The little willow flycatcher is a California State endangered species.

California Horned Lark (*Eremophila alpestris actia*)

While horned larks are generally widespread and common residents throughout the U.S., this subspecies has a restricted distribution from the North Coast Range in California south to Mexico and are relatively uncommon. The breeding season extends from March through July with a peak in May. Horned larks are ground nesters, preferring areas with low, sparse vegetation in grassland and open woodland habitats. They forage on the ground for insects and seeds, often in large flocks after the breeding season. Habitat loss, predation, and nest disturbances are the most significant threats to this subspecies. Horned larks are abundant

in the Red Bluff area, but surveys have not distinguished between subspecies. The California horned lark is a California species of special concern.

Purple Martin (*Progne subis*)

The purple martin breeds west of the Cascade Range and Sierra Nevada from southwestern British Columbia south to Baja California and Arizona as well as areas east of the Rocky Mountains. In fall, it migrates to South America. Old woodpecker nests in tall, mature trees along rivers, estuaries, and other large water bodies are preferred nest sites, but they will occasionally nest in more urban areas (Zeiner et al., 1990). They arrive in California in late March, and breeding begins April and lasts through August, followed by fall migration in September. Purple martins forage by capturing insects in flight and occasionally on the ground. Foraging can occur over any habitat types where insects are abundant. A variety of habitats are used during migration including grasslands, wet meadows, wetlands, woodlands, and riparian areas. Significant declines in purple martins have been reported in California as a result of nest site competition with the introduced European starlings and the loss of suitable nest and roost trees, and loss of wetlands and riparian habitat. This species has been reported on rare occasions during breeding bird surveys in the Red Bluff area. The purple martin is a California State species of special concern.

Bank Swallow (*Riparia riparia*)

Bank swallows are neotropical migrants ranging throughout much of the U.S. and Canada. The largest breeding populations in California occur along the Sacramento and Feather rivers and their associated tributaries. Bank swallows are coloniel breeders, building nests in the friable soils of vertical streambanks between April and September. Vegetation and adjacent land use are highly variable and less important than soil type, slope, and bank height in determining nesting location. Bank swallows forage primarily over open riparian areas, but will also forage over agricultural fields, grasslands, and chaparral. They feed primarily on flying insects but will occasionally feed on terrestrial and aquatic insects. During the breeding season, foraging occurs within 650 feet of the nest sites. The population in California has declined largely as a result of flood control measures and bank stabilization projects. Nesting sites have been reported (1987) approximately a mile upriver from the Red Bluff Diversion Dam and at Blackberry Island, located several miles to the southwest of the project area. The bank swallow is a California State threatened species.

Bewick's Wren (*Thryomanes bewickii*)

Bewick's wren is a widespread resident species throughout the central and southern U.S. It is a widespread resident throughout most of California, with the exception of high elevations in the Sierra Nevada range and the Sonoran Desert. Breeding season lasts from mid-February through August with peak activity occurring between May and June. They prefer to nest in natural cavities and rock crevices in chaparral, woodlands, conifer forests, and riparian areas. They are associated with dense, shrubby vegetation where they glean insects from the foliage and branches. Populations east of the Mississippi have declined dramatically, and many populations have been extirpated; however, populations west of the Mississippi appear to be stable. The reason for the dramatic declines in the East are uncertain, but may have to do with competition from the house wren. The California populations do not appear to be threatened. Bewick's wrens have been observed in the Red Bluff area during breeding bird surveys and

1999 Audubon Christmas bird counts. Because of the steady decline of this species in the East, the Bewick's wren has been listed as a Federal species of concern.

Loggerhead Shrike (*Lanius ludovicianus*)

Loggerhead shrikes formerly nested throughout much of North America, from Canada south through the Great Basin, along the Gulf Coast, and south to Florida and Mexico; but their current range is more restricted, encompassing mainly the southern portions of the historical range. Loggerhead shrikes prefer open country such as grasslands, meadows, scrublands, deserts, pastures, and certain ruderal or agricultural lands with scattered shrubs, trees, fences, or other perch sites. They require dense shrubs or small trees in sparse riparian woodlands, foothill woodlands, and mixed conifer forests. Breeding occurs from February to July. Shrikes are carnivorous, eating a variety of prey including mice, small birds, reptiles, insects, and spiders, which are hunted from perches. Thorny trees and bushes, barbed wire and crevices are used to impale and store prey. The primary reason loggerhead shrikes are thought to have declined is loss and degradation of breeding habitat. Other causes of decline that have been suggested include possible adverse effects from pesticides (Cade and Woods, 1997). Despite general population declines, populations in the Pacific states appear to have remained relatively stable (Ziener et al., 1990). During 1999 Audubon Christmas bird counts, five loggerhead shrikes were observed in the Red Bluff area. The loggerhead shrike is a State and Federal special-status species.

Tri-colored Blackbird (*Agelaius tricolor*)

Tri-colored blackbirds are resident species primarily in California's Central Valley and coastal districts from Sonoma County south. In northeastern California, where the species is present only during summer, it occurs regularly only at Tule Lake; but breeding pairs have been observed in some years as far south as Honey Lake. Tri-colored blackbirds roost and nest in large flocks in areas with emergent wetland vegetation, especially cattails and tules, and in trees and shrubs adjacent to wetland areas. Breeding season is between April and July. Nests are usually located a few feet over, or near, fresh water or may be hidden on the ground among low vegetation. This species is highly colonial, often nesting in a minimum colony of about 50 pairs. They forage on the ground in croplands, grassy fields, flooded lands, and along edges of ponds feeding on insects, spiders, seeds, and cultivated grains, such as rice and oats. Tri-colored blackbirds are uncommon, but have been reported in 1999 breeding bird surveys and Audubon Christmas bird counts in the Red Bluff area. Tri-colored blackbird populations have declined in recent decades because of habitat loss and are California State and Federal special-status species.

Grasshopper Sparrow (*Ammodramus savannarum*)

Grasshopper sparrows are widespread in North America, occurring in a variety of grassland habitats including native prairie, hayfields, pastures, and grassy fallow fields. In California, they are uncommon local summer residents west of the Sierra Nevada and along the coast between March and September. They are ground nesting species, breeding between April and mid-July. Nest sites are generally constructed in dense grasslands with occasional shrubs for singing perches. They forage on the ground for insects and seeds, and other than singing males, are highly secretive. Recent population declines have occurred throughout its range primarily because of habitat loss and degradation. This species has been observed on

rare occasions during breeding bird surveys in the Red Bluff area. The grasshopper sparrow is a Federal species of concern.

Lark Sparrow (Chondestes grammacus)

The breeding range of the lark sparrow includes most of the U.S.; it also migrates south into Mexico and Central America during the winter. In much of California, however, the lark sparrow is a non-migratory resident. It is commonly found in foothill woodlands, mixed conifer-hardwood forests, chaparral, and savannas along the margins of the Central Valley. Breeding begins in April, and nests are built on the ground in dense herbaceous cover or under shrubs. Lark sparrows forage on the ground or occasionally in small trees and shrubs, often in large flocks. Primary food items include insects, grains, and seeds. The national trend for this species is one of decline; however, California populations appear to be stable. This species is common in the Red Bluff area with as many as 184 observed in 1999 Audubon Christmas bird counts. The lark sparrow is a Federal species of concern.

Hermit Warbler (*Denroica occidentalis*)

The hermit warbler breeds in coastal Oregon and Washington as well as in the North Coast Range and Sierra Nevada in California. Generally, spring and fall migrations are in mountain areas, but occasionally, this species can be found in lowlands. Spring migration is between April and May, and breeding occurs from April to July with a peak in June. Nests are built in mature conifers in montane forests. Hermit warblers forage in the mid to upper canopy of hardwoods and conifers where they glean insects and spiders from the foliage. Fall migration to wintering habitats in Central America occurs between August and early September. Habitat destruction by logging and development of breeding grounds as well as brood parasitism by brown-headed cowbirds have led to population declines. This species has been observed on rare occasions during breeding bird surveys in the Red Bluff area. There is no suitable breeding habitat within the project area, and project activity is not expected to have any significant impacts on occasional migrants passing through the area. The hermit warbler is a Federal species of concern.

Yellow Warbler (*Dendroicia petechia brewsteri*)

The yellow warbler is a neotropical migrant with a wide distribution throughout North America and is locally common throughout central and northern California. Yellow warblers nest in riparian habitats with willows and other small trees and shrubs. Breeding season starts in April and early May, and fall migration begins in August and continues through September. Breeding occurs in a variety of habitats including chaparral and conifer forests with multi-layered canopies, but prefers to nest in riparian woodlands. Nests are usually built in deciduous saplings or shrubs. Breeding populations in the Sacramento River valley have presumably been extirpated due to the loss of suitable breeding habitat; however, areas are still heavily used by migrating birds, especially during May and late July through October. Yellow warblers are predominantly insectivores and forage in riparian areas, but will also feed on fruits and seeds. In addition to breeding-ground habitat loss, nest parasitism by brown-headed cowbirds in North America as well as pesticide use and habitat loss in wintering grounds continue to threaten this species Yellow warblers historically nested at Todd Island, along the Sacramento River, several miles south of the

project area, and have been observed on rare occasions during breeding bird surveys in the Red bluff area. The yellow warbler is a California State species of special concern.

Yellow-breasted Chat (*Icteria virens*)

The yellow-breasted chat is widespread throughout the western U.S. and northern Mexico. Breeding season starts in mid-May and continues through mid-June. Well-developed riparian areas with dense shrub thickets provide suitable nesting habitat. Fall migration to southern Mexico and Central America begins in mid-August. During the spring, yellow-breasted chats are primarily insectivores, but fruits and berries become an important food item later in the summer. Loss of suitable nesting habitat and nest parasitism by brown-headed cowbirds are the main factors for the population declines of this species, with habitat loss in wintering range also an important factor. Nesting pairs have been reported at Mooney and Todd islands along the Sacramento River, several miles to the southeast of the project area, and they have been observed on rare occasions during breeding bird surveys in the Red Bluff area. The yellow-breasted chat is a California State species of concern.

Lawrence's Goldfinch (*Carduelis lawrencei*)

Lawrence's goldfinch breeds in the foothills surrounding California's Central Valley and in the slopes of the south Coast Range. In northern California, they are present from March through September where they inhabit foothill woodlands. Breeding season extends from late March through April. They prefer to nest in oaks with dense foliage near water. Migration south begins in September, to wintering grounds in southern California, Arizona, and Mexico. They forage on seeds from common forbs including pigweed, fiddleneck, and yellow starthistle, but will occasionally eat insects. This species has been observed on rare occasions during breeding bird surveys in the Red Bluff area. Lawrence's goldfinch is a Federal species of concern.

Reptiles

Northwestern Pond Turtle (*Clemmys marmorata marmorata*)

The northwestern pond turtle ranges from the San Francisco Bay north to Washington. It occurs in a variety of aquatic habitats including ponds, marshes, rivers, streams, and irrigation ditches. They require basking sites such as partially submerged logs, rocks, mats of floating vegetation, or muddy open banks. Pond turtles are omnivorous, eating a variety of aquatic plants, invertebrates, fishes, frogs, and carrion. Breeding season occurs between April and May, after which time females will build a nest in adjacent uplands, occasionally several hundred feet from the water. Nests are constructed in a variety of soil types between July and August. Predation of hatchlings and juveniles by introduced bullfrogs along with habitat loss and degradation have led to declines in pond turtle populations in recent decades. No occurrences of this species have been reported in the project area. The northwest pond turtle is a California State and Federal special-status species.

Giant Garter Snake (*Thamnophis gigas*)

The giant garter snake is a California endemic species that inhabits a variety of freshwater habitats including marshes, sloughs, seasonal pools, irrigation ditches, and rice fields. Historically, its range extended throughout the Central Valley from Butte County south to

Bakersfield in Kern County. Because of habitat loss, this species has been extirpated throughout much of its former range, including all areas north of Chico and most areas in the San Joaquin Valley. The largest remaining intact habitat is found in the American River Basin in Sacramento County. Giant garter snakes are diurnal, foraging along streams where a variety of fish and amphibians are the primary prey. Occasionally, small mammals and invertebrates such as leaches and earthworms may be eaten. Garter snakes are vivaparous, giving birth to active young between July and August. In addition to habitat loss, pesticides may have also been responsible for decline of this species (Zeiner et al., 1988). There are no reports of this species in the vicinity of the project area. The giant garter snake is a California State- and Federal-listed threatened species.

California Horned Lizard (*Phrynosoma coronatum frontale*)

The California horned lizard is an endemic species that ranges from southern Tehama County to the desert regions of southern California. It can be found in a variety of habitat types including grasslands, chaparral, and riparian areas. Horned lizards construct shallow burrows in loose soil or used mammal burrows and spaces under logs and rocks to escape predators and to hibernate. This species typically occurs in open areas with low rocks for basking and sandy soils, including washes and floodplains. Breeding season is between May and June. Horned lizards are diurnal and forage on a variety of insects including ants, beetles, grasshoppers, and flies. Threats to this species include habitat loss from agricultural conversion and urban development. This species is also collected for distribution as pets because of its unique appearance. There are no reports of this species in the vicinity of the project area. The California horned lizard is a State and Federal special-status species.

Amphibians

Western Spadefoot Toad (*Scaphiopus hammodii*)

The western spadefoot toad ranges throughout the Central Valley and adjacent foothills. They are found in grasslands and woodlands often associated with washes, floodplains, alluvial fans, and playas, but have also been reported to use orchards and vineyards on occasion (Zeiner et al., 1988). Spadefoot toads are nocturnal, foraging on a variety of insects and other invertebrates such as worms and spend the day in deep burrows. Breeding occurs between February and March, usually in shallow temporary pools. Habitat loss due to land development poses the greatest threat to the spadefoot toad. There are no reported occurrences of this species in the project area. The spadefoot toad is a is a State and Federal special-status species.

California Red-legged Frog (*Rana aurora draytonii*)

The red-legged frog was once widely distributed throughout western California but has been extirpated from approximately 70 percent of its former range (USFWS, 1996). The red-legged frog is the largest native frog in California and can be found in a variety of habitats including streams, marshes, ponds, and quiet pools. They require areas with dense shoreline vegetation such as willow thickets and deep pools. They feed on a variety of prey including aquatic insects, crustaceans, snails, worms, small fish, tadpoles, and smaller frogs. Breeding season occurs from March through July. Habitat loss and degradation along with the introduction of bullfrogs have lead to dramatic population declines. There are no reported

occurrences in the vicinity of the project site. The red-legged frog is a California species of special concern and a Federal-listed threatened species.

Foothill Yellow-legged Frog (*Rana boylii*)

The foothill yellow-legged frog occurs throughout northwestern California, along the Coast Range south to Los Angeles County, and along the western foothills of the Sierras south to Kern County. This species inhabits rocky streams in hardwood, conifer, and riparian forests as well as coastal scrub and wet meadow habitats. They are diurnal and feed on a variety of aquatic and terrestrial invertebrates. Breeding occurs between March and May in open areas with slow-moving water with rocks and gravel bars. Predation of eggs by centrachid fish and introduced bullfrogs have negatively impacted this species as well as habitat loss and modification. There are no reported occurrence of this species in the vicinity of the project area. The foothill yellow-legged frog is a California State and Federal special status-species.

Invertebrates

Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*)

The valley elderberry longhorn beetle is entirely dependent on its host plant, elderberry (*Sambucus* spp.) for food and reproduction. Mating occurs on the plants, and eggs are laid in the cracks and crevices of the bark. Upon emergence, the larva bore into the plant and remain in the spongy pith of the plant for the majority of their lifetime. The developing beetle remain inside of the plant for up to 2 years, after which time the adults emerge and reproduce. Adults emerge in March and feed on foliage and flowers until late June. Because elderberry plants are vital to the continued existence and recovery of this species, any reduction in shrubs or habitat quality is considered to have an adverse impact on this species. There are several know occurrences along the Sacramento River in the vicinity of the project area. The valley elderberry longhorn beetle is a Federal-listed threatened species.

Sacramento Anthicid Beetle (*Anthicus sacramento*) and Antioch Dunes Anthicid Beetle (*Anthicus antiochensis*)

These two small beetles, approximately 3.5 millimeters long are found in sandy habitats in the San Joaquin and Sacramento Delta and at numerous sandy habitats along the Sacramento River, including sandy and eroded banks, sandbars, and sandy beaches. They are also known to inhabit sandy dredge spoils that have been deposited some distance from water sources; loose sand appears to be an essential habitat requirement (Davis, 1991). Anthicid beetles are nocturnal and forage on the surface of the sand for organic debris and detritus. During the day, they remain burrowed under the sand. Adults oviposite in the spring, and new adults emerge in the summer (Hagen, 1986). They are active throughout the year and presumably have excellent dispersal ability as they are often found in areas subject to frequent inundation (Davis, 1991). Habitat loss from urban expansion, industrial development, and off-road vehicles pose the most significant threats to these species. These species are known to occur in Tehama County along the Sacramento River and are a California State species of special concern.

Leech's Skyline Diving Beetle (*Hydroporus leechii*)

Leech's skyline diving beetle is a medium-sized freshwater beetle that inhabits springs, creeks, ponds, and pools in drying streams. Nothing is known about the life history of this particular species. It was originally described as originating from San Mateo County, but this population has presumably been extirpated. Recent studies have found Leech's skyline diving beetle to be more widely distributed throughout the West than originally thought (Hafernik, 1989). In California, it occurs from the Owens Valley to the Oregon border. In southwest Tehama County it has been reported 2 miles southwest of Government Camp. It is a Federal species of concern.

Vernal Pool Fairy Shrimp (*Branchinecta lynchi*)

Vernal pool fairy shrimp inhabit small ephemeral freshwater wetlands that are commonly found in grassland areas. Vernal pool fairy shrimp are wide ranging occurring from Tulare County, California, to Jackson County in southwestern Oregon; however, within a given vernal pool complex they are often sparsely distributed. These shallow pools fill with water during the wet winter months but soon dry as the rains decrease during the spring. Adult fairy shrimp may be found in pools from December to May. Their eggs, deposited on the bottom of the pool, are capable of withstanding long periods of desiccation and high soil temperatures. As the pools fill with water, some of the eggs hatch and quickly develop into adults and reproduce. Extensive losses in vernal pool habitat as a result of agricultural and urban development have led to significant reductions in vernal pool fairy shrimp populations. Vernal pool fairy shrimp have been reported to occur in Tehama County along the PG&E pipeline 4 mile east of the Black Butte Dam north of Stony Creek. The vernal pool fairy shrimp is a Federal-threatened species.

Mammals

Townsend's Big-eared Bat (*Corynorhinus townsendii*)

The Townsend's big-eared bat occurs in a variety of habitat types including woodlands, grasslands, riparian communities, and active agricultural areas. Roost sites are in cavernicolous spaces in caves, mines, tunnels, and less often in buildings and bridges. Sometimes rock crevices and hollow trees are used as roosts. The Townsend's big-eared bat is extremely sensitive to disturbance and may abandon a roost if disturbed. During the reproductive period in spring and summer, roost abandonment may cause mortality of the young. Foraging associations include edge habitats along streams and areas adjacent to and within a variety of wooded habitats. Suitable habitat for this species occurs in the project area, but no evidence was found during preliminary roost searches conducted in 2002. The Townsend's big-eared bat is a State and Federal special-status species.

Spotted Bat (*Euderma maculatum*)

The spotted bat occurs in a variety of habitat types including woodlands, riparian communities, and conifer forests, but is closely associated with rock-faced cliff roosting habitat. It roosts in crevices in rocky cliffs but will also use caves and buildings. The spotted bat may roost singly but with a number of individuals at the same site. Foraging associations include forest meadows, woodlands, and large riverine/riparian habitats. This

species is not likely to be found in the project area because of a lack of suitable roosting habitat. The spotted bat is a State and Federal special-status species considered to be rare in California.

Pallid Bat (*Antrozous pallidus*)

The pallid bat is characteristically a species of arid and semiarid lowland habitats such as oak woodlands, grasslands, active agricultural areas, and desert scrub. Roost sites include crevices and cavities in cliffs, rocks, trees, caves, bridges, buildings, and mines. Foraging habitat includes grasslands and woodlands. Reproductive colonies are formed in spring and summer and are highly vulnerable to disturbance. This species was confirmed to be occupying the project area during a survey conducted in 2002. The pallid bat is a State species of special concern.

Red Bat (Lasiurus blossevillii)

The red bat is characteristically found in riparian habitat, especially Central Valley cottonwood, sycamore, and willow riverine galleries. Roost sites are in the foliage of trees and shrubs, and possibly in leaf litter on the ground. Reproductive females and young are especially vulnerable to habitat loss in spring and summer. Suitable habitat for this species occurs in the project area. The red bat is a State and Federal special-status species.

Yuma Myotis (*Myotis yumanensis*)

The Yuma myotis occurs throughout the State and is closely associated with foraging areas at water sources such as reservoirs, rivers, streams, and ponds. Roost sites include buildings, bridges, mines, and caves. Reproductive colonies are highly vulnerable in spring and summer. This species is highly likely to be among the myotid bats (*Myotis* spp.) present in the project area during a preliminary survey conducted in 2002. The Yuma myotis is relatively common in California but is a Federal species of concern.

Long-legged Myotis (*Myotis volans*)

The long-legged myotis occurs throughout the State primarily in conifer forests, but also seasonally in riparian and desert habitats. Roost sites include crevices and cavities in trees, rocks, caves, mines, and buildings. It often feeds around the forest canopy. This species is not likely to be found in the project area but may occur in the surrounding higher elevation conifer forests. The long-legged myotis is a Federal species of concern.

Fringed Myotis (*Myotis thysanodes*)

The fringed myotis occurs in a wide range of habitats from low-desert scrub to high-elevation coniferous forest. This species appears to be most common in xeric woodlands (oak and pinyon-juniper). Roost sites include trees, caves, mines, rock crevices, and buildings. Reproductive colonies are highly vulnerable during spring and summer. This species is widely distributed but rare and sensitive to roost disturbance. The fringed myotis is a Federal species of concern.

Long-eared Myotis (*Myotis evotis*)

The long-eared myotis is found throughout the State in higher elevations associated with conifer forests and lower elevations in mixed conifer/hardwood forests. It roosts singly or

in small groups in crevices and cavities under exfoliating tree bark, in hollow trees, cliffs, caves, mines, bridges, and rocky outcrops on the ground. Foraging associations include rivers and streams. This species is highly vulnerable during spring and summer reproductive periods. Suitable habitat occurs in the project area, although it is somewhat more likely to occur at higher elevations. The long-eared myotis is a Federal species of concern.

Small-footed Myotis (*Myotis ciliolabrum*)

The small-footed myotis occurs in a variety of habitats including woodlands, riparian communities, chaparral, and conifer forests. It roosts singly or in small groups in rock crevices, buildings, bridges, caves, mines, and occasionally under bark. Researchers are still investigating tree roosting by this species, but maternity colonies have been found in tree cavities. Colonies are highly vulnerable during reproductive periods in spring and summer. This species may have been among the myotid bats (*Myotis* spp.) that were found roosting in the project area during a survey conducted in 2002. The small-footed myotis is a Federal species of concern.

San Joaquin Pocket Mouse (*Perognathus inornatus*)

The San Joaquin pocket mouse is endemic to California's Central Valley ranging from Colusa County south to Ventura County. It inhabits dry, open grasslands, oak savannas, and chaparral. Fine-textured soils with an abundance of grasses and forbs are necessary for this species (Zeiner et al., 1990). This species is nocturnal, spending the day in constructed burrows. Their diet consists largely of seeds, but foliage and small insects are occasionally eaten. Breeding occurs between March and July. Habitat loss due to agricultural conversion and urban development are the principle threats to this species. There is only one historical record for the San Joaquin pocket mouse in Tehama County, near Beegum. It has not been reported to occur in the vicinity of the project site. The San Joaquin pocket mouse is listed as a Federal species of concern.

Plants

For the purposes of this evaluation, special-status plant species are vascular plants that are (1) designated as rare, threatened, or endangered by the State or Federal governments; or (2) are proposed for rare, threatened, or endangered status; and/or (3) are State or Federal candidate species; and/or (4) are listed as species of concern by USFWS and/or (5) are included on the California Native Plant Society (CNPS) List 1A, 1B, or 2. Primary sources on plant descriptions, distribution, habitats, and status were obtained from the following sources: CNDDB, the California Flora Occurrence Data base, the California Native Plant Society's Inventory of Rare and Endangered Vascular Plants of California (Skinner and Pavlik, 1994) and the Jepson Manual (Hickman, 1993).

Dwarf downingia (*Downingia pusilla*)

Dwarf downingia is a small annual in the bellflower family (Campanulaceae). It occurs throughout the Central Valley in California and is also found in Chile at elevations less than 1,300 feet. Habitats include vernal pools, wet meadows, and margins of small lakes, stock ponds, and drainage ditches. It typically occurs in areas with sparse vegetation and little

competition from neighboring plants. The minute white flowers are present from April through May. While this species is relatively common in Tehama County, it is considered to be rare in California and threatened in some areas by grazing, non-native species, urbanization, and agricultural conversion. This species is a CNPS category 2 species (rare outside of California) but has no State or Federal designations. There is one known occurrence in the vicinity of the project area, along Belle Mill Road, several miles to the northeast of the project site.

Red Bluff Dwarf Rush (*Juncus leiospermus* var. *leiospermus*)

Red Bluff dwarf rush is a small, inconspicuous plant in the rush family (Juncaceae). Less than 5 inches tall at maturity, this variety is endemic to the Sacramento Valley and adjacent foothills in Tehama, Butte, and southern Shasta counties at elevations less than 1,650 feet. Habitats include vernal pool margins and moist areas in chaparral and woodlands where this species is often found in small patches of open ground with sparse vegetation. Mature plants may appear reddish-brown in color, and flowering occurs from late April to early June. There are currently no State or Federal listings for this species; however, it is considered to be rare due to restricted populations and is endangered in parts of its range due to extensive habitat loss. This species has been historically reported to occur (1916) in the project area at the confluence of Red Bank Creek and the Sacramento River, but no species were observed during 2001 plant surveys.

Silky Cryptantha (*Cryptantha crinita*)

Silky cryptantha is a hairy annual forb in the borage family (Boraginaceae). It is endemic to the northern Sacramento Valley and only known from Shasta and Tehama counties. This species is found in riparian areas associated with seasonal and perennial streams where it occurs on sand and gravel deposits at elevations between 500 and 1,000 feet. The small white flowers appear from late April through May. This species is considered to be rare in California due to limited population occurrences, and it is threatened in some areas as a result of habitat loss from flood control measures and water diversions. The only occurrence reported in the project area is at the mouth of Dibble Creek, to the northwest of the project site. The silky cryptantha is a Federal species of concern.

Woolly Meadowfoam (*Limnanthes floccosa* sp. *floccossa*)

Woolly meadowfoam is a small annual in the meadowfoam family (Limnanthaceae). It is distributed from the Central Valley to Southern Oregon where it occurs on the margins of vernal pools and in wet meadows at elevations less than 1,300 feet. The white flowers bloom between April and May. This species is considered to be uncommon in California, but widespread in other parts of its range. Continued threats include habitat loss due to agricultural conversion and development. One occurrence of this species has been reported near Tuscan Springs, several miles north of the project area. This species is a CNPS category 2 and has no State or Federal designations.

Adobe Lily (Fritillaria pluriflora)

The adobe lily is a member of the lily family (Liliaceae). This species is only known to occur in the northern Central Valley and southwestern Oregon. It can be found in a variety of habitats including grasslands, chaparral, and foothill woodlands, generally on clay soils

below 1,650 feet. The pink-lavender flowers are present from February through April. The adobe lily is currently threatened by grazing, off-road vehicles, and horticultural collecting. Most of the occurrences of this species are in and around the Nature Conservancy's Vina Plains Preserve in southeastern Tehama County. This species is also found north of Lowrey, along Dry and Red Bank creeks. While it is considered to be rare in California due to limited distribution, the population does not appear to be immediately at risk; however, it is a Federal species of special concern.

Hairy Orcutt Grass (*Orcuttia pilosa*)

Hairy orcutt grass is a densely tufted annual grass (Poaceae) endemic to California. This species occurs in vernal pools along the eastern side of Sacramento Valley from Tehama to Stanislaus counties at elevations less than 650 feet. This small-stature grass grows between 2 and 8 inches tall and flowers between May and August. Currently, there are only 24 native populations and one introduced population known for the entire State, and only 12 of these populations are considered stable (USFWS, 1997). Nine populations occur in Tehama County, four of which are found on the Nature Conservancy's Vina Plains Preserve south of Red Bluff. The remaining populations are at risk from agricultural conversion, urbanization, and over-grazing. All reported occurrences are located in southern Tehama County. Hairy orcutt grass is a California State- and Federal-listed endangered species.

Slender Orcutt Grass (*Orcuttia tenuis*)

Slender orcutt grass is an annual grass (Poaceae) similar to hairy orcutt grass, but easily distinguished by its narrow leaves and loosely flowered inflorescence, which is present from May through July. Endemic to northern California, this species occurs in vernal pools at elevations less than 3,600 feet. There are currently 60 known populations of this species, with approximately half of the known occurrences from Tehama County. Primary threats include agricultural conversion, urbanization, and over-grazing; the overall trend for this species is one of decline (USFWS, 1997). Several large populations are known to occur north of the project site in the vicinity of Hog and Dales lakes and at the base of Table Mountain and the Tuscan Buttes. No populations have been reported in the immediate vicinity of the project site. Slender orcutt grass is listed as endangered by the State of California and is a Federal-listed threatened species.

Green's Tuctoria (*Tuctoria greenei*)

Green's tuctoria is a low-growing tufted annual grass (Poaceae) endemic to northern California vernal pools. It occurs at elevations less than 700 feet, and flowering culms are present from May through July. Nearly half of the original populations have been extirpated and currently only 20 known populations remain in five counties: Butte, Glenn, Merced, Shasta, and Tehama (USFWS, 1997). Threats includes agricultural and urban development, over-grazing, and off-road vehicles. All reported populations occur in the Vina Plains area, in southeastern Tehama County. The general trend for this species is one of decline, and it is a Federal-listed endangered species.

Hoover's Spurge (*Chamaesyce hooveri*)

Hoover's spurge is a prostrate, annual herb in the spurge family (Euphorbiaceae). This plant is associated with vernal pools along the eastern edge of California's Central Valley at

elevations less than 850 feet. The small axially flowers bloom in July. Habitat loss from agricultural conversion and urbanization is the principal threat, and there are currently only 25 known populations, of which nearly half occur in Tehama County (USFWS, 1997). All reported populations in Tehama County occur in the southeastern portion of the county near Vina Plains. Hoover's spurge is a Federal-listed threatened species.

Indian Valley Brodiaea (*Brodiaea coronaria* sp. *rosea*)

A perennial forb in the lily family (Liliaceae), the Indian Valley Brodiaea, is endemic to California. This species occurs on serpentine soils in a variety of habitats including chaparral, grasslands, and conifer forests at elevations less than 500 feet. It may occur in wetland areas, gravelly creek bottoms, and swales as well. The lavender-pink flowers bloom between May and June. CNDDB lists only two historical occurrences at Hall and Riley Ridges in southwestern Tehama County. The CALFLORA database list an additional five occurrences in Tehama County. Threats includes off-road vehicles and illegal dumping. This species is considered to be extremely rare in California and is listed as a State endangered species as well as a Federal species of concern.

Oregon Fireweed (*Epilobium oreganum*)

Oregon fireweed is a large perennial in the evening primrose family (Onigraceae) associated with bogs, fens, and wet meadows in montane conifer forests in northern California and southern Oregon at elevations between 1,600 and 5,250 feet. The pink to rose purple flowers are present from June to August. There is limited information on the population status of this species in California, but in Oregon it is only known from 20 locations, with a total estimated population of around 1,000 plants. Logging appears to be the most significant threat to this species. There are only two reported occurrences of this species in Tehama County from Regan Meadow and Buck Rock in the Coast Range along the western edge of the county. It is not expected to occur in the project area due to lack of suitable habitat. Oregon fireweed is a Federal species of concern.

Butte Fritillary (*Fritillaria eastwoodiae*)

Endemic to northern California, the Butte fritillary is a conspicuous perennial in the lily family (Liliaceae). The species can be found in chaparral, woodlands, and lower montane conifer forests on a variety of soil types including serpentine, clay, and sandy loams at elevations between 100 and 5,000 feet. The pale greenish-yellow to red flowers are in bloom between March and May. Threats to this species include logging and land development. The populations in Tehama County are found in the Cascade Foothills in the northeastern part of the county. The closest population to the project area occurs at the western base of Inskip Hill; however, this population may have been improperly identified and may be the more common scarlet fritillary. The Butte fritillary is a Federal species of concern.

Legenere (*Lengenere limosa*)

Legenere is an annual in the bellflower family (Campanulaceae) endemic to California's Central Valley. It occurs in vernal pools with generally long periods of inundation at elevations up to 3,300 feet. The plant is heterophyllous, meaning it produces two types of leaves. Submerged leaves are about an inch long and linear, and the terrestrial leaves are shorter and more elliptical. This plant blooms between May and June and flowers are often

without petals. Many of the historical occurrences have been extirpated due to agricultural conversion and urbanization, and there are currently only 36 reported occurrences remaining. Large populations have been observed at Dales and Hog lakes to the northeast of the project site and near Gerber and Rawston Station south of the project site. Legenere is currently listed as a Federal species of concern.

Red-Flowered Lotus (*Lotus rubriflorus*)

The red-flowered lotus is an annual forb in the pea family (Fabaceae). It is endemic to California and known to occur in only four counties, Colusa, Stanislaus, Tehama, and Santa Clara. This species occurs in grasslands and woodlands at elevations between 600 and 1,500 feet. The small pinkish-red flowers are present from April through June. In Tehama County, the only population reported occurs on red soils derived from volcanic mudflow deposits along the PG&E pipeline west of Dales Lake. While no specific threats have been identified, because of its limited distribution and extreme rarity, it has been listed as a Federal species of special concern.

Ahart's Paronychia (*Paronychia ahartii*)

Ahart's paronychia is an inconspicuous annual in the pink family (Caryphyollace) found in only Butte, Shasta, and Tehama counties in northern California. This species occurs in grasslands, chaparral, and woodlands on rocky soils, often associated with the upper margins of vernal pools at elevations less than 1,650 feet. The small, tightly clustered flowers bloom from April to June. This plant has a very limited distribution and is considered to be extremely rare throughout its range. Current threats include habitat loss, overgrazing, and trampling. The largest known populations have been found in Tehama County. While there are no reported occurrences in the immediate vicinity of the project site, several populations have been reported from the surrounding areas including Gerber, near Antelope and Salt creeks east of the HogBack, along the pipeline north of Paynes Creek, and around Hog Lake. Ahart's paronychia is a Federal species of concern.

Valley Sagittaria (*Sagittaria sanfordii*)

The valley sagittaria is an emergent, rhizomatous perennial in the water-plantain family (Alismataceae). Endemic to California, this species occurs in freshwater wetlands in areas of standing or slow-moving water including marshes, ponds, and ditches. Flowering period occurs from May through August. While it was once widely distributed throughout much of central California from Orange County to Del Norte County at elevations below 2,000 feet, habitat loss from development, water diversion, and over-grazing have resulted in the extirpation of many of the Central Valley populations. No populations have been reported in the immediate vicinity of the project site, but several large populations are known to occur around Hog and Dales lakes north of the project area. Valley sagittaria is a Federal species of concern.

Tracy's Sanicle (*Sanicula tracyi*)

Tracy's sanicle is a conspicious perennial in the carrot family (Apiaceae) that is endemic to northwestern California. It occurs in openings in woodlands and conifer forests at elevations between 300 and 3,500 feet. The flowering period is from April through July. This species is considered rare, but there are several large localized populations throughout its range.

Current threats include logging, grazing, and development. While it has been historically reported to occur in Tehama County, there are no recent reports of this species. Tracy's sanicle is a Federal species of concern.

Baker's Navarretia (*Nabarretia leucocephala* sp.*bakerii*)

Baker's navarretia is a small annual in the phlox family (Polemoniaceae) endemic to California. It occurs in a variety of habitats including woodlands, grasslands, meadows, vernal pools, and seeps on moist to wet clay soils at elevations ranging from sea level to 5,500 feet. The small white to blue flowers are present from April to June. This subspecies is uncommon and is considered to be endangered in portions of its range due to habitat loss resulting from urban expansion and industrial development. There is one known occurrence of this species in Tehama County 8.5 miles south of Corning. Baker's navarretia is a Federal species of concern.

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TABLE D-1
Special-status Species

Species	Status			Habitat	Season	Reported Occurrences
	CA	Fed.	CNPS			
Birds						
American Bittern *Botaurus lentiginosus*		SC		Freshwater and brackish wetlands with dense vegetation	Resident	BBS: Rare
Black–crowned Night Heron *Nycticorax nycticorax*		SC		Freshwater and brackish wetlands, occasionally rice fields	Resident	BBS: Rare
White-faced Ibis *Plegadis chihi*	SC	SC		Freshwater wetlands and irrigated fields	April-September	No reported occurrences
Aleutian Canada Goose *Branta canadensis leucopareia*		T		Freshwater wetlands and agricultural fields	October-April	Non-specific Canada Goose BBS: Rare; CBC: 172
Cooper's Hawk *Accipiter cooperii*	SC			Woodlands, riparian forests, and agricultural fields	Resident	BBS: Rare; CBC: 5
Sharp-shinned Hawk *Accipiter striatus*	SC			Woodlands, riparian forests, and shrub thickets	September-April (Resident)	BBS: Rare; CBC: 3
Northern Goshawk *Accipiter gentilis*	SC	SC		Montane coniferous forests; woodlands; and, rarely, agricultural fields	Resident	BBS: Rare
Golden Eagle *Aquila chrysaetos*	SC			Grasslands, open woodland, chaparral, wetlands, and agricultural areas	Resident	BBS: Rare; CBC: 1
Ferruginous Hawk *Buteo regalis*	SC	SC		Grasslands and agricultural fields	September-April	CBC: 4
Swainson's Hawk *Buteo swainsoni*	T			Mature riparian forests, oak woodlands, and agricultural fields	March-August	BBS: Rare; CNDDB: 1 (Salt Creek)
Northern Harrier *Circus cyaneus*	SC			Wetlands, grasslands, and agricultural fields	Resident	BBS: Rare; CBC: 14
White-tailed Kite *Elanus leucurus*		SC		Grasslands, oak woodlands, riparian forest habitat, and agricultural fields	Resident	BBS: Rare; CBC: 3
Bald Eagle *Haliaeetus leucocephalus*	E	T		Lakes, rivers, and wetlands.	September-April	BBS: Rare; CBC: 3

TABLE D-1
Special-status Species

Species	Status			Habitat	Season	Reported Occurrences
	CA	Fed.	CNPS			
Osprey *Pandion haliaetus*	SC			Lakes and rivers	March-September	BBS: Rare; CBC: 4; CNDDB: 1 (Red Bank Creek)
Prairie Falcon *Falco mexicanus*	SC			Grasslands and agricultural fields	Resident	BBS: Rare; CBC: 2
Peregrine Falcon *Falco peregrinus anatum*	SE	D		Wetlands, lakes, rivers, grasslands, and agricultural fields	Resident	BBS: Rare; CBC: 2
Black Tern *Chlidonias niger*	SC	SC		Lakes, wetlands, and agricultural fields	April-September	BBS: Rare
Western Yellow-billed Cuckoo *Coccyzus americanus occidentalis*	SE	MBMC		Riparian forest habitats	June-September	CNDDB: 1 (Mooney-Todd islands)
Short-eared Owl *Asio flammeus*	SC	SC		Wetlands, grasslands, and agricultural fields	Resident	BBS: Rare
Western Burrowing Owl *Athene cunicularia hypougea*	SC	SC		Grasslands, pastures, agricultural fields, road embankments, and near open urban areas	Resident	BBS: Rare; CNDDB: 1 (Little Salt Creek)
Vaux's Swift *Chaetura vauxi*	SC	SC		Mixed oak and conifer woodlands, forages over grasslands, lakes, and streams	April-September	BBS: Rare
Black Swift *Cypseloides niger*	SC	SC		Open habitats such as grasslands, agricultural fields, and along rivers	May-September	BBS: Rare
Rufous Hummingbird *Selasphorus rufus*	WL	SC		Riparian habitat, open woodlands, chaparral, orchards, and gardens	February-May	BBS: Rare
Lewis' Woodpecker *Melanerpes lewis*		SC		Open woodlands and riparian habitats	Resident	BBS: Rare; CBC: 34
Olive-sided Flycatcher *Contopus borealis*	WL	SC		Montane coniferous forests and woodlands	April-October	BBS: Rare
Little Willow Flycatcher *Empidonax traillii brewsteri*		SC		Riparian habitat dominated by dense willows	May-September	BBS: Rare

TABLE D-1
Special-status Species

Species	Status			Habitat	Season	Reported Occurrences
	CA	Fed.	CNPS			
California Horned Lark *Eremophila alpestris*	SC			Grasslands and open woodlands	Resident	BBS: Rare; CBC: 205
Purple Martin *Progne subis*	SC			Grasslands, wet meadows, wetlands, woodlands, and riparian habitat	March-September	BBS: Rare
Bank Swallow *Riparia riparia*	T			Riparian areas; nest in friable soils of vertical streambanks	April-September	BBS: Rare; CNDDB: 2 (Blackberry Island, Red Bluff Diversion Dam)
Bewick's Wren *Thryomanes bewickii*		SC		Chaparral, woodlands, conifer forests, and riparian habitat	Resident	BBS: Uncommon; CBC: 7
Loggerhead Shrike *Lanius ludovicianus*	SC	SC		Grasslands, savannas, and chaparral	Resident	CBC: 5
Tricolored Blackbird *Agelaius tricolor*	SC	SC		Wetlands in dense emergent vegetation	Resident	BBS: Uncommon; CBC: 6
Grasshopper Sparrow *Ammodramus savannarum*		SC		Grasslands and agricultural fields	March-September	BBS: Rare
Lark Sparrow *Chondestes grammacus*		SC		Chaparral, oak woodlands, and conifer forests	Resident	BBS: Rare; CBC: 184
Hermit Warbler *Dendroica occidentalis*		SC		Montane conifer forests and woodlands	April-September	BBS: Rare
Yellow Warbler *Dendroica petechia*	SC			Riparian habitat	April-September	BBS: Rare; CNDDB: 1 (Todd Island)
Yellow-breasted Chat *Icteria virens*	SC			Riparian habitat	April-September	BBS: Rare; CNDDB: 1 (Todd Island)
Yellow-headed Blackbird *Xanthocephalus xanthocepha*	?	?		Wetlands	Residents	BBS: Rare
Lawrence's Goldfinch Carduelis lawrencei	WL			Oak woodlands	March-September	BBS: Rare

TABLE D-1
Special-status Species

Species	Status			Habitat	Season	Reported Occurrences
	CA	Fed.	CNPS			
Reptiles						
Western Pond Turtle *Clemmys marmorata*		SC		Wetlands, ponds, irrigation ditches, rivers, and streams	Resident	No reported occurrences
Giant Garter Snake *Thamnophis gigas*	T	T		Wetlands, sloughs, irrigation ditches, and rice fields	Resident	No reported occurrences
California Horned Lizard *Phrynosoma coronatum frontale*		SC		Grasslands, chaparral, and riparian habitat	Resident	No reported occurrences
Amphibians						
Western Spadefoot Toad *Scaphiopus hammodii*		SC		Streams and pools in grasslands and woodlands, particularly vernal pools	Resident	No reported occurrences
California Red-legged Frog *Rana aurora draytonii*		T		Streams, ponds, wetlands, and stock ponds	Resident	No reported occurrences
Foothill Yellow-legged Frog *Rana boylii*		SC		Large streams with open gravel bars and rocks	Resident	No reported occurrences
Invertebrates						
Valley Elderberry Longhorn Beetle *Desmocercus californicus dimorphus*		T		Elderberry shrubs in riparian areas, savannas, and woodlands	Resident	CNDDB: Several occurrences along Sacramento River near project area
Sacramento Anthicid Beetle *Anthicus sacramento*		SC		Sandbars		No reported occurrences
Antioch Dunes Anthicid Beetle *Anthicus antiochensis*		SC		Sandbars		No reported occurrences
Leech's Skyline Diving Beetle *Hydroporus leechii*		SC		Streams		No reported occurrences
Vernal Pool Fairy Shrimp *Branchinecta lynchi*		SC		Vernal pools	March-May	No reported occurrences in the project area.

TABLE D-1
Special-status Species

Species	Status			Habitat	Season	Reported Occurrences
	CA	Fed.	CNPS			
Mammals						
Townsend's Big-eared Bat *Plecotus townsendii palescens*		SC		Grasslands, chaparral, woodlands, and conifer forests	Resident	No reported occurrences in the project area
Western Big-eared Bat *Corynorhinus townsendii townsendii*		SC		Grasslands, chaparral, woodlands, and conifer forests	Resident	No reported occurrences the project area
Spotted Bat *Euderma maculatum*		SC		Grasslands and mixed conifer forest	Resident	No reported occurrences the project area
Long-eared Myotis *Myotis evotis*		SC		Chaparral, woodlands, coniferous forests, riparian habitats	Resident	No reported occurrences the project area
Fringed Myotis *Myotis thysanodes*		SC		Oak woodlands, mixed conifer-hardwood forests, riparian habitats	February-September	No reported occurrences the project area
Long-legged Myotis *Myotis volans*		SC		Chaparral, woodlands, coniferous forests, riparian habitats	Resident	No reported occurrences the project area
Small–footed Myotis *Myotis leibii*		SC		Open forests, woodlands, chaparral, riparian habitats	April-October	No reported occurrences the project area
Yuma Myotis *Myotis yumanensis*		SC		Open forests, woodlands, riparian habitats	Resident	No reported occurrences the project area
San Joaquin Pocket Mouse *Perognathus inornatus*		SC		Grasslands and oak woodlands	Resident	No reported occurrences the project area
Plants						
Dwarf Downingia *Downingia pusilla*			2	Vernal pools, wet meadows	March-May	CNDDB
Red Bluff Dwarf Rush *Juncus leiospermus* var. *leiospermus*			1B	Vernal pools, wet meadows, riparian areas, chaparral, and woodlands	March-May	CNDDB
Silky Cryptantha *Cryptantha crinita*		SC	1B	Riparian areas, gravelly streambeds	April-May	CNDDB

TABLE D-1
Special-status Species

Species	Status			Habitat	Season	Reported Occurrences
	CA	Fed.	CNPS			
Wooly Meadowfoam *Limnanthes floccosa* sp. *Floccosa*			2	Vernal pools, wet meadows	March-June	CNDDB
Adobe Lily *Fritillaria pluriflora*		SC	1B	Grasslands, chaparral, and woodlands	February-April	No reported occurrences in the project area
Hairy Orcutt Grass *Orcuttia pilosa*	E	E	1B	Vernal pools	May-August	No reported occurrences in the project area
Slender Orcutt Grass *Orcuttia tenuis*	E	T	1B	Vernal pools	May-July	No reported occurrences in the project area
Green's Tuctoria T*uctoria greenei*	R	E	1B	Vernal pools	May-July	No reported occurrences in the project area
Hoover's Spurge *Chamaesyce hooveri*		T	1B	Vernal pools	July	No reported occurrences in the project area
Indian Valley Brodiaea *Brodiaea coronaria* sp. *rosea*	E	SC	1B	Chaparral, woodlands, and coniferous forests / Serpentine soils	May-June	No reported occurrences in the project area
Oregon Fireweed *Epilobium oreganum*		SC	1B	Wetlands, lower montane conifer forests / mesic	June-August	No reported occurrences in the project area
Butte Fritillary *Fritillaria eastwoodiae*		SC	1B	Chaparral, woodlands, open conifer forests	March-May	No reported occurrences in the project area
Legenere *Legenere limosa*		SC	1B	Vernal pools	May-June	No reported occurrences in the project area
Red-flowered Lotus *Lotus rubriflorus*		SC	1B	Woodlands and grasslands	April-June	No reported occurrences in the project area
Ahart's Paronychia *Paronychia ahartii*		SC	1B	Woodlands, grasslands, and vernal pools	April-June	No reported occurrences in the project area
Valley Sagittaria S*agittaria sanfordii*		SC	1B	Wetlands	May-August	No reported occurrences in the project area

TABLE D-1
Special-status Species

Species	Status			Habitat	Season	Reported Occurrences
	CA	Fed.	CNPS			
Tracy's Sanicle *Sanicula tracyi*		SC	1B	Woodlands and open conifer forests	April-July	No reported occurrences in the project area
Baker's Navarretia *Navarretia leucocephala* sp. *bakeri*		SC	1B	Lower montane conifer forests, meadows and seeps, valley and foothill grassland, vernal pools	May-July	No reported occurrences in the project area

E: Endangered
T: Threatened
SC: Species of Concern
D: Delisted
CNDDB: California Natural Diversity Database
BBS: Breeding bird surveys, abundance rank based on mean counts from the Red Bluff area between 1982 and 1996.
CBC: Audubon Christmas bird counts from the Red Bluff area in December 1999.
CNPS: California Native Plant Society Rare and Endangered Plants
1B: Plants rare, threatened or endangered in California and elsewhere.
2: Plants rare or endangered in California, but more common elsewhere
3: Plants about which more information is needed
4: Plants of limited distribution

Appendix E
Conservation Guidelines for Valley Elderberry Longhorn Beetle

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
3310 El Camino Avenue, Suite 130
Sacramento, California 95821-6340

Conservation Guidelines for the Valley Elderberry Longhorn Beetle

9 July 1999

The following guidelines have been issued by the U.S. Fish and Wildlife Service (Service) to assist Federal agencies and non-federal project applicants needing incidental take authorization through a section 7 consultation or a section 10(a)(1)(B) permit in developing measures to avoid and minimize adverse effects on the valley elderberry longhorn beetle. The Service will revise these guidelines as needed in the future. The most recently issued version of these guidelines should be used in developing all projects and habitat restoration plans. The survey and monitoring procedures described below are designed to avoid any adverse effects to the valley elderberry longhorn beetle. Thus a recovery permit is not needed to survey for the beetle or its habitat or to monitor conservation areas. If you are interested in a recovery permit for research purposes please call the Service's Regional Office at (503) 231-2063.

BACKGROUND INFORMATION

The valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), was listed as a threatened species on August 8, 1980 (*Federal Register* 45: 52803-52807). This animal is fully protected under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). The valley elderberry longhorn beetle (beetle) is completely dependent on its host plant, elderberry (*Sambucus* species), which is a common component of the remaining riparian forests and adjacent upland habitats of California's Central Valley. Use of the elderberry by the beetle, a wood borer, is rarely apparent. Frequently, the only exterior evidence of the elderberry's use by the beetle is an exit hole created by the larva just prior to the pupal stage. The life cycle takes one or two years to complete. The animal spends most of its life in the larval stage, living within the stems of an elderberry plant. Adult emergence is from late March through June, about the same time the elderberry produces flowers. The adult stage is short-lived. Further information on the life history, ecology, behavior, and distribution of the beetle can be found in a report by Barr (1991) and the recovery plan for the beetle (USFWS 1984).

SURVEYS

Proposed project sites within the range of the valley elderberry longhorn beetle should be surveyed for the presence of the beetle and its elderberry host plant by a qualified biologist. The beetle's range extends throughout California's Central Valley and associated foothills from about the 3,000-foot elevation contour on the east and the watershed of the Central Valley on the west (Figure 1). All or portions of 31 counties are included: Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Fresno, Glenn, Kern, Kings, Lake, Madera, Mariposa, Merced, Napa, Nevada, Placer, Sacramento, San Benito, San Joaquin, San Luis Obispo, Shasta, Solano, Stanislaus, Sutter, Tehama, Tulare, Tuolumne, Yolo, Yuba.

If elderberry plants with one or more stems measuring 1.0 inch or greater in diameter at ground level occur on or adjacent to the proposed project site, or are otherwise located where they may be directly or indirectly affected by the proposed action, minimization measures which include planting replacement habitat (conservation planting) are required (Table 1).

All elderberry shrubs with one or more stems measuring 1.0 inch or greater in diameter at ground level that occur on or adjacent to a proposed project site must be thoroughly searched for beetle exit holes (external evidence of beetle presence). In addition, all elderberry stems one inch or greater in diameter at ground level must be tallied by diameter size class (Table 1). As outlined in Table 1, the numbers of elderberry seedlings/cuttings and associated riparian native trees/shrubs to be planted as replacement habitat are determined by stem size class of affected elderberry shrubs, presence or absence of exit holes, and whether a proposed project lies in a riparian or non-riparian area.

Elderberry plants with no stems measuring 1.0 inch or greater in diameter at ground level are unlikely to be habitat for the beetle because of their small size and/or immaturity. Therefore, no minimization measures are required for removal of elderberry plants with no stems measuring 1.0 inch or greater in diameter at ground level with no exit holes. Surveys are valid for a period of two years.

AVOID AND PROTECT HABITAT WHENEVER POSSIBLE

Project sites that do not contain beetle habitat are preferred. If suitable habitat for the beetle occurs on the project site, or within close proximity where beetles will be affected by the project, these areas must be designated as avoidance areas and must be protected from disturbance during the construction and operation of the project. When possible, projects should be designed such that avoidance areas are connected with adjacent habitat to prevent fragmentation and isolation of beetle populations. Any beetle habitat that cannot be avoided as described below should be considered impacted and appropriate minimization measures should be proposed as described below.

Avoidance: Establishment and Maintenance of a Buffer Zone

Complete avoidance (i.e., no adverse effects) may be assumed when a 100-foot (or wider) buffer is established and maintained around elderberry plants containing stems measuring 1.0 inch or greater in diameter at ground level. Firebreaks may not be included in the buffer zone. In buffer areas construction-related disturbance should be minimized, and any damaged area should be promptly restored following construction. The Service must be consulted before any disturbances within the buffer area are considered. In addition, the Service must be provided with a map identifying the avoidance area and written details describing avoidance measures.

Protective Measures

1. Fence and flag all areas to be avoided during construction activities. In areas where encroachment on the 100-foot buffer has been approved by the Service, provide a minimum setback of at least 20 feet from the dripline of each elderberry plant.

2. Brief contractors on the need to avoid damaging the elderberry plants and the possible penalties for not complying with these requirements.

3. Erect signs every 50 feet along the edge of the avoidance area with the following information: "This area is habitat of the valley elderberry longhorn beetle, a threatened species, and must

not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment." The signs should be clearly readable from a distance of 20 feet, and must be maintained for the duration of construction.

4. Instruct work crews about the status of the beetle and the need to protect its elderberry host plant.

Restoration and Maintenance

1. Restore any damage done to the buffer area (area within 100 feet of elderberry plants) during construction. Provide erosion control and re-vegetate with appropriate native plants.

2. Buffer areas must continue to be protected after construction from adverse effects of the project. Measures such as fencing, signs, weeding, and trash removal are usually appropriate.

3. No insecticides, herbicides, fertilizers, or other chemicals that might harm the beetle or its host plant should be used in the buffer areas, or within 100 feet of any elderberry plant with one or more stems measuring 1.0 inch or greater in diameter at ground level.

4. The applicant must provide a written description of how the buffer areas are to be restored, protected, and maintained after construction is completed.

5. Mowing of grasses/ground cover may occur from July through April to reduce fire hazard. No mowing should occur within five (5) feet of elderberry plant stems. Mowing must be done in a manner that avoids damaging plants (e.g., stripping away bark through careless use of mowing/trimming equipment).

TRANSPLANT ELDERBERRY PLANTS THAT CANNOT BE AVOIDED

Elderberry plants must be transplanted if they can not be avoided by the proposed project. All elderberry plants with one or more stems measuring 1.0 inch or greater in diameter at ground level must be transplanted to a conservation area (see below). At the Service's discretion, a plant that is unlikely to survive transplantation because of poor condition or location, or a plant that would be extremely difficult to move because of access problems, may be exempted from transplantation. In cases where transplantation is not possible the minimization ratios in Table 1 may be increased to offset the additional habitat loss.

Trimming of elderberry plants (e.g., pruning along roadways, bike paths, or trails) with one or more stems 1.0 inch or greater in diameter at ground level, may result in take of beetles. Therefore, trimming is subject to appropriate minimization measures as outlined in Table 1.

1. Monitor. A qualified biologist (monitor) must be on-site for the duration of the transplanting of the elderberry plants to insure that no unauthorized take of the valley elderberry longhorn beetle occurs. If unauthorized take occurs, the monitor must have the authority to stop work until corrective measures have been completed. The monitor must immediately report any unauthorized take of the beetle or its habitat to the Service and to the California Department of Fish and Game.

2. Timing. Transplant elderberry plants when the plants are dormant, approximately November through the first two weeks in February, after they have lost their leaves. Transplanting during the non-growing season will reduce shock to the plant and increase transplantation success.

3. Transplanting Procedure.

   a. Cut the plant back 3 to 6 feet from the ground or to 50 percent of its height (whichever is taller) by removing branches and stems above this height. The trunk and all stems measuring 1.0 inch or greater in diameter at ground level should be replanted. Any leaves remaining on the plant should be removed.

   b. Excavate a hole of adequate size to receive the transplant.

   c. Excavate the plant using a Vemeer spade, backhoe, front end loader, or other suitable equipment, taking as much of the root ball as possible, and replant immediately at the conservation area. Move the plant only by the root ball. If the plant is to be moved and transplanted off site, secure the root ball with wire and wrap it with burlap. Dampen the burlap with water, as necessary, to keep the root ball wet. Do not let the roots dry out. Care should be taken to ensure that the soil is not dislodged from around the roots of the transplant. If the site receiving the transplant does not have adequate soil moisture, pre-wet the soil a day or two before transplantation.

   d. The planting area must be at least 1,800 square feet for each elderberry transplant. The root ball should be planted so that its top is level with the existing ground. Compact the soil sufficiently so that settlement does not occur. As many as five (5) additional elderberry plantings (cuttings or seedlings) and up to five (5) associated native species plantings (see below) may also be planted within the 1,800 square foot area with the transplant. The transplant and each new planting should have its own watering basin measuring at least three (3) feet in diameter. Watering basins should have a continuous berm measuring approximately eight (8) inches wide at the base and six (6) inches high.

   e. Saturate the soil with water. Do not use fertilizers or other supplements or paint the tips of stems with pruning substances, as the effects of these compounds on the beetle are unknown.

   f. Monitor to ascertain if additional watering is necessary. If the soil is sandy and well-drained, plants may need to be watered weekly or twice monthly. If the soil is clayey and poorly-drained, it may not be necessary to water after the initial saturation. However, most transplants require watering through the first summer. A drip watering system and timer is ideal. However, in situations where this is not possible, a water truck or other apparatus may be used.

PLANT ADDITIONAL SEEDLINGS OR CUTTINGS

Each elderberry stem measuring 1.0 inch or greater in diameter at ground level that is adversely affected (i.e., transplanted or destroyed) must be replaced, in the conservation area, with elderberry seedlings or cuttings at a ratio ranging from 1:1 to 8:1 (new plantings to affected stems). Minimization

ratios are listed and explained in Table 1. Stock of either seedlings or cuttings should be obtained from local sources. Cuttings may be obtained from the plants to be transplanted if the project site is in the vicinity of the conservation area. If the Service determines that the elderberry plants on the proposed project site are unsuitable candidates for transplanting, the Service may allow the applicant to plant seedlings or cuttings at higher than the stated ratios in Table 1 for each elderberry plant that cannot be transplanted.

PLANT ASSOCIATED NATIVE SPECIES

Studies have found that the beetle is more abundant in dense native plant communities with a mature overstory and a mixed understory. Therefore, a mix of native plants associated with the elderberry plants at the project site or similar sites will be planted at ratios ranging from 1:1 to 2:1 [native tree/plant species to each elderberry seedling or cutting (see Table 1)]. These native plantings must be monitored with the same survival criteria used for the elderberry seedlings (see below). Stock of saplings, cuttings, and seedlings should be obtained from local sources. If the parent stock is obtained from a distance greater than one mile from the conservation area, approval by the Service of the native plant donor sites must be obtained prior to initiation of the revegetation work. Planting or seeding the conservation area with native herbaceous species is encouraged. Establishing native grasses and forbs may discourage unwanted non-native species from becoming established or persisting at the conservation area. Only stock from local sources should be used.

Examples

Example 1

The project will adversely affect beetle habitat on a vacant lot on the land side of a river levee. This levee now separates beetle habitat on the vacant lot from extant Great Valley Mixed Riparian Forest (Holland 1986) adjacent to the river. However, it is clear that the beetle habitat located on the vacant lot was part of a more extensive mixed riparian forest ecosystem extending farther from the river's edge prior to agricultural development and levee construction. Therefore, the beetle habitat on site is considered riparian. A total of two elderberry plants with at least one stem measuring 1.0 inch or greater in diameter at ground level will be affected by the proposed action. The two plants have a total of 15 stems measuring over 1.0 inch. No exit holes were found on either plant. Ten of the stems are between 1.0 and 3.0 inches in diameter and five of the stems are greater than 5.0 inches in diameter. The conservation area is suited for riparian forest habitat. Associated natives adjacent to the conservation area are box elder (*Acer negundo californica*), walnut (*Juglans californica* var. *hindsii*), sycamore (*Platanus racemosa*), cottonwood (*Populus fremontii*), willow (*Salix gooddingii* and *S. laevigata*), white alder (*Alnus rhombifolia*), ash (*Fraxinus latifolia*), button willow (*Cephalanthus occidentalis*), and wild grape (*Vitis californica*).

Minimization (based on ratios in Table 1):

- Transplant the two elderberry plants that will be affected to the conservation area.
- Plant 40 elderberry rooted cuttings (10 affected stems compensated at 2:1 ratio and 5 affected stems compensated at 4:1 ratio, cuttings planted:stems affected)
- Plant 40 associated native species (ratio of associated natives to elderberry plantings is 1:1 in areas with no exit holes):
  5 saplings each of box elder, sycamore, and cottonwood

5 willow seedlings
5 white alder seedlings
5 saplings each of walnut and ash
3 California button willow
2 wild grape vines
Total: 40 associated native species

- Total area required is a minimum of 1,800 sq. ft. for one to five elderberry seedlings and up to 5 associated natives. Since, a total of 80 plants must be planted (40 elderberries and 40 associated natives), a total of 0.33 acre (14,400 square feet) will be required for conservation plantings. The conservation area will be seeded and planted with native grasses and forbs, and closely monitored and maintained throughout the monitoring period.

Example 2

The project will adversely affect beetle habitat in Blue Oak Woodland (Holland 1986). One elderberry plant with at least one stem measuring 1.0 inch or greater in diameter at ground level will be affected by the proposed action. The plant has a total of 10 stems measuring over 1.0 inch. Exit holes were found on the plant. Five of the stems are between 1.0 and 3.0 inches in diameter and five of the stems are between 3.0 and 5.0 inches in diameter. The conservation area is suited for elderberry savanna (non-riparian habitat). Associated natives adjacent to the conservation area are willow (*Salix* species), blue oak (*Quercus douglasii*), interior live oak (*Q. wislizenii*), sycamore, poison oak (*Toxicodendron diversilobum*), and wild grape.

Minimization (based on ratios in Table 1):

- Transplant the one elderberry plant that will be affected to the conservation area.

- Plant 30 elderberry seedlings (5 affected stems compensated at 2:1 ratio and 5 affected stems compensated at 4:1 ratio, cuttings planted:stems affected)

- Plant 60 associated native species (ratio of associated natives to elderberry plantings is 2:1 in areas with exit holes):
  20 saplings of blue oak, 20 saplings of sycamore, and 20 saplings of willow, and seed and plant with a mixture of native grasses and forbs.

- Total area required is a minimum of 1,800 sq. ft. for one to five elderberry seedlings and up to 5 associated natives. Since, a total of 90 plants must be planted (30 elderberries and 60 associated natives), a total of 0.37 acre (16,200 square feet) will be required for conservation plantings. The conservation area will be seeded and planted with native grasses and forbs, and closely monitored and maintained throughout the monitoring period.

CONSERVATION AREA—PROVIDE HABITAT FOR THE BEETLE IN PERPETUITY

The conservation area is distinct from the avoidance area (though the two may adjoin), and serves to receive and protect the transplanted elderberry plants and the elderberry and other native plantings. The Service may accept proposals for off-site conservation areas where appropriate.

1. Size. The conservation area must provide at least 1,800 square feet for each transplanted elderberry plant. As many as 10 conservation plantings (i.e., elderberry cuttings or seedlings and/or associated native plants) may be planted within the 1800 square foot area with each transplanted elderberry. An additional 1,800 square feet shall be provided for every additional 10 conservation plants. Each planting should have its own watering basin measuring approximately three feet in diameter. Watering basins should be constructed with a continuous berm measuring approximately eight inches wide at the base and six inches high.

   The planting density specified above is primarily for riparian forest habitats or other habitats with naturally dense cover. If the conservation area is an open habitat (i.e., elderberry savanna, oak woodland) more area may be needed for the required plantings. Contact the Service for assistance if the above planting recommendations are not appropriate for the proposed conservation area.

   No area to be maintained as a firebreak may be counted as conservation area. Like the avoidance area, the conservation area should connect with adjacent habitat wherever possible, to prevent isolation of beetle populations.

   Depending on adjacent land use, a buffer area may also be needed between the conservation area and the adjacent lands. For example, herbicides and pesticides are often used on orchards or vineyards. These chemicals may drift or runoff onto the conservation area if an adequate buffer area is not provided.

2. Long-Term Protection. The conservation area must be protected in perpetuity as habitat for the valley elderberry longhorn beetle. A conservation easement or deed restrictions to protect the conservation area must be arranged. Conservation areas may be transferred to a resource agency or appropriate private organization for long-term management. The Service must be provided with a map and written details identifying the conservation area; and the applicant must receive approval from the Service that the conservation area is acceptable prior to initiating the conservation program. A true, recorded copy of the deed transfer, conservation easement, or deed restrictions protecting the conservation area in perpetuity must be provided to the Service before project implementation.

   Adequate funds must be provided to ensure that the conservation area is managed in perpetuity. The applicant must dedicate an endowment fund for this purpose, and designate the party or entity that will be responsible for long-term management of the conservation area. The Service must be provided with written documentation that funding and management of the conservation area (items 3-8 above) will be provided in perpetuity.

3. Weed Control. Weeds and other plants that are not native to the conservation area must be removed at least once a year, or at the discretion of the Service and the California Department of Fish and Game. Mechanical means should be used; herbicides are prohibited unless approved by the Service.

4. Pesticide and Toxicant Control. Measures must be taken to insure that no pesticides, herbicides, fertilizers, or other chemical agents enter the conservation area. No spraying of these agents must be done within one 100 feet of the area, or if they have the potential to drift, flow, or be washed into the area in the opinion of biologists or law enforcement personnel from the Service or the California Department of Fish and Game.

5. Litter Control. No dumping of trash or other material may occur within the conservation area. Any trash or other foreign material found deposited within the conservation area must be removed within 10 working days of discovery.

6. Fencing. Permanent fencing must be placed completely around the conservation area to prevent unauthorized entry by off-road vehicles, equestrians, and other parties that might damage or destroy the habitat of the beetle, unless approved by the Service. The applicant must receive written approval from the Service that the fencing is acceptable prior to initiation of the conservation program. The fence must be maintained in perpetuity, and must be repaired/replaced within 10 working days if it is found to be damaged. Some conservation areas may be made available to the public for appropriate recreational and educational opportunities with written approval from the Service. In these cases appropriate fencing and signs informing the public of the beetle's threatened status and its natural history and ecology should be used and maintained in perpetuity.

7. Signs. A minimum of two prominent signs must be placed and maintained in perpetuity at the conservation area, unless otherwise approved by the Service. The signs should note that the site is habitat of the federally threatened valley elderberry longhorn beetle and, if appropriate, include information on the beetle's natural history and ecology. The signs must be approved by the Service. The signs must be repaired or replaced within 10 working days if they are found to be damaged or destroyed.

MONITORING

The population of valley elderberry longhorn beetles, the general condition of the conservation area, and the condition of the elderberry and associated native plantings in the conservation area must be monitored over a period of either ten (10) consecutive years or for seven (7) years over a 15-year period. The applicant may elect either 10 years of monitoring, with surveys and reports every year; or 15 years of monitoring, with surveys and reports on years 1, 2, 3, 5, 7, 10, and 15. The conservation plan provided by the applicant must state which monitoring schedule will be followed. No change in monitoring schedule will be accepted after the project is initiated. If conservation planting is done in stages (i.e., not all planting is implemented in the same time period), each stage of conservation planting will have a different start date for the required monitoring time.

Surveys. In any survey year, a minimum of two site visits between February 14 and June 30 of each year must be made by a qualified biologist. Surveys must include:

1. A population census of the adult beetles, including the number of beetles observed, their condition, behavior, and their precise locations. Visual counts must be used; mark-recapture or other methods involving handling or harassment must not be used.

2. A census of beetle exit holes in elderberry stems, noting their precise locations and estimated ages.

3. An evaluation of the elderberry plants and associated native plants on the site, and on the conservation area, if disjunct, including the number of plants, their size and condition.

4. An evaluation of the adequacy of the fencing, signs, and weed control efforts in the avoidance and conservation areas.

5. A general assessment of the habitat, including any real or potential threats to the beetle and its host plants, such as erosion, fire, excessive grazing, off-road vehicle use, vandalism, excessive weed growth, etc.

The materials and methods to be used in the monitoring studies must be reviewed and approved by the Service. All appropriate Federal permits must be obtained prior to initiating the field studies.

Reports. A written report, presenting and analyzing the data from the project monitoring, must be prepared by a qualified biologist in each of the years in which a monitoring survey is required. Copies of the report must be submitted by December 31 of the same year to the Service (Chief of Endangered Species, Sacramento Fish and Wildlife Office), and the Department of Fish and Game (Supervisor, Environmental Services, Department of Fish and Game, 1416 Ninth Street, Sacramento, California 95814; and Staff Zoologist, California Natural Diversity Data Base, Department of Fish and Game, 1220 S Street, Sacramento, California 95814). The report must explicitly address the status and progress of the transplanted and planted elderberry and associated native plants and trees, as well as any failings of the conservation plan and the steps taken to correct them. Any observations of beetles or fresh exit holes must be noted. Copies of original field notes, raw data, and photographs of the conservation area must be included with the report. A vicinity map of the site and maps showing where the individual adult beetles and exit holes were observed must be included. For the elderberry and associated native plants, the survival rate, condition, and size of the plants must be analyzed. Real and likely future threats must be addressed along with suggested remedies and preventative measures (e.g. limiting public access, more frequent removal of invasive non-native vegetation, etc.).

A copy of each monitoring report, along with the original field notes, photographs, correspondence, and all other pertinent material, should be deposited at the California Academy of Sciences (Librarian, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118) by December 31 of the year that monitoring is done and the report is prepared. The Service's Sacramento Fish and Wildlife Office should be provided with a copy of the receipt from the Academy library acknowledging receipt of the material, or the library catalog number assigned to it.

Access. Biologists and law enforcement personnel from the California Department of Fish and Game and the Service must be given complete access to the project site to monitor transplanting activities. Personnel from both these agencies must be given complete access to the project and the conservation area to monitor the beetle and its habitat in perpetuity.

SUCCESS CRITERIA

A minimum survival rate of at least 60 percent of the elderberry plants and 60 percent of the associated native plants must be maintained throughout the monitoring period. Within one year of discovery that survival has dropped below 60 percent, the applicant must replace failed plantings to bring survival above this level. The Service will make any determination as to the applicant's replacement responsibilities arising from circumstances beyond its control, such as plants damaged or killed as a result of severe flooding or vandalism.

SERVICE CONTACT

These guidelines were prepared by the Endangered Species Division of the Service's Sacramento Fish and Wildlife Office. If you have questions regarding these guidelines or to request a copy of the most recent guidelines, telephone (916) 414-6600 after August 5, 1999, or write to:

U.S. Fish and Wildlife Service
Ecological Services
2800 Cottage Way, W-2605
Sacramento, CA 95825

LITERATURE CITED

Barr, C. B. 1991. The distribution, habitat, and status of the valley elderberry longhorn beetle *Desmocerus californicus dimorphus*. U.S. Fish and Wildlife Service; Sacramento, California.

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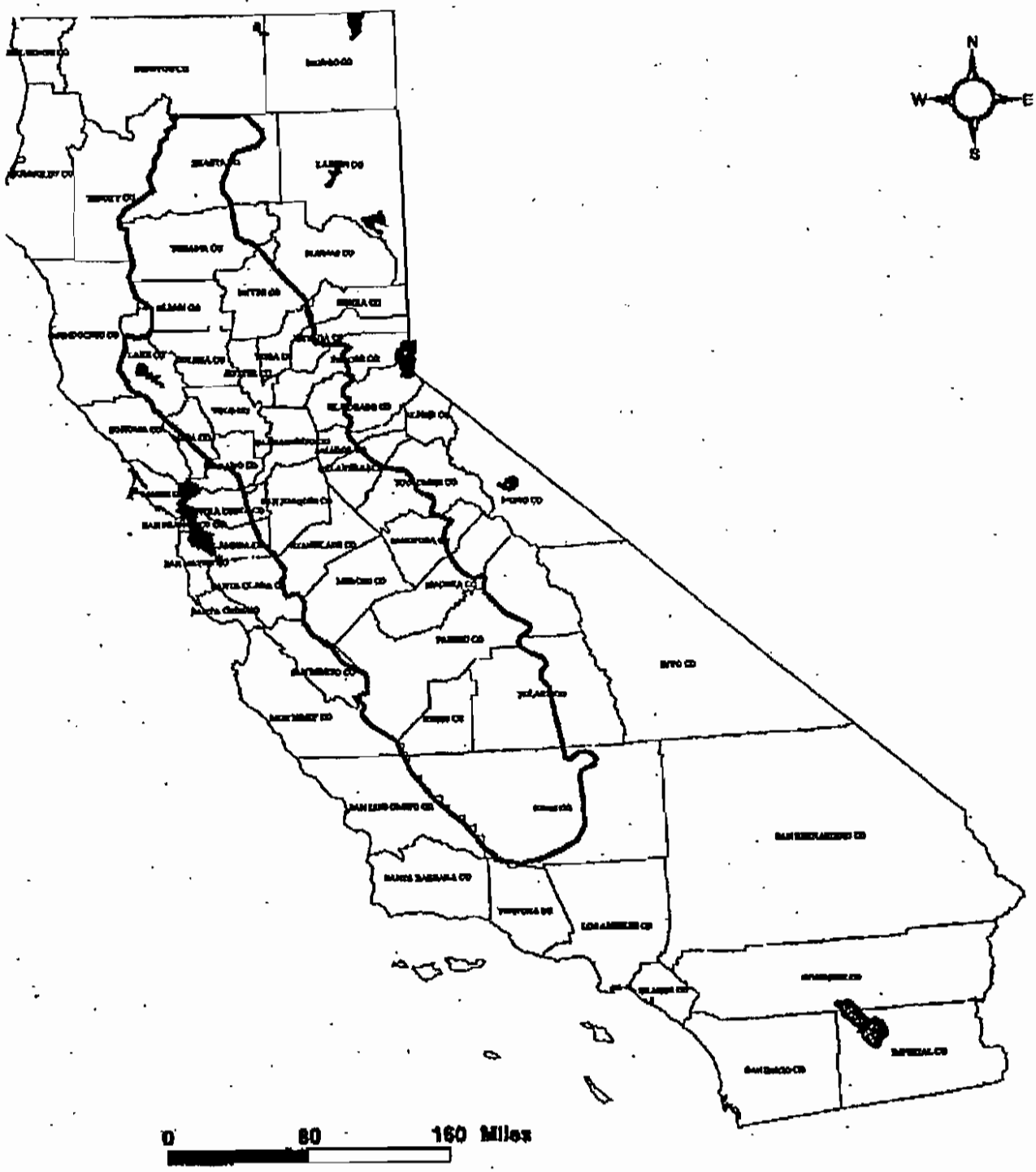


Figure 1: Range of the Valley Elderberry Longhorn Beetle

Table 1: Minimization ratios based on location (riparian vs. non-riparian), stem diameter of affected elderberry plants at ground level, and presence or absence of exit holes.

Location	Stems (maximum diameter at ground level)	Exit Holes Y/N (quantify)	Elderberry Seedling Ratio[1]	Associated Native Plant Ratio[2]
non-riparian	stems ≥ 1" & ≤ 3"	No:	1:1	1:1
		Yes:	2:1	2:1
non-riparian	stems > 3" & < 5"	No:	2:1	1:1
		Yes:	4:1	2:1
non-riparian	stems ≥ 5"	No:	3:1	1:1
		Yes:	6:1	2:1
riparian	stems ≥ 1" & ≤ 3"	No:	2:1	1:1
		Yes:	4:1	2:1
riparian	stems > 3" & < 5"	No:	3:1	1:1
		Yes:	6:1	2:1
riparian	stems ≥ 5"	No:	4:1	1:1
		Yes:	8:1	2:1

[1] Ratios in the *Elderberry Seedling Ratio* column correspond to the number of cuttings or seedlings to be planted per elderberry stem (one inch or greater in diameter at ground level) affected by a project.

[2] Ratios in the *Associated Native Plant Ratio* column correspond to the number of associated native species to be planted per elderberry (seedling or cutting) planted.

10 September 1999

Ms. Lori Rinek, Mr. Brian Twedt, and Mr. Chris Davis
U.S. Fish & Wildlife Service
3300 Cottage Way
Sacramento, CA 95825

RE: Potential Inconsistencies in Interpretation of VELB Mitigation Issues

Dear Lori, Brian, and Chris:

At my request, Chris recently mailed me a copy of the Tulare Irrigation District's Low-Effect HCP (TID HCP) for the Valley Elderberry Longhorn Beetle (VELB). He also sent me copies of the permit application and the Service's screening form for low-effect HCP determinations. Although the copy of the TID HCP that I received is missing pages i, 1, 4, 5, and 8, the information on these missing pages seems to be summarized elsewhere in the document.

Since I am preparing an HCP for remediation of contaminated soils at the Sacramento Rail Yard for Union Pacific Rail Road Company (UPRR), where the VELB is also an issue, I was interested in reviewing another current VELB HCP. In reviewing the TID HCP and comparing it to the UPRR HCP, I noticed several potential inconsistencies that I would like to bring to your attention. My comments are <u>not</u> meant to be included in the public comments on the TID HCP; rather I seek clarification on the proper interpretation of the Service's 1996 VELB mitigation guidelines, which were used to inventory the elderberries and to formulate mitigation recommendations for both project sites. In particular, I am concerned that UPRR may be proposing to mitigate the impacts of its rail yard remediation project at a higher level than is necessary, particularly when compared to the TID HCP.

<u>Low vs. Medium-Effect HCP</u>.

The attached table summarizes information on the number of elderberries, stems ≥ 1 inch, mitigation ratios, VELB mitigation units, and mitigation costs (based on $1,800/unit cost to the VELB Conservation Fund) for both HCPs and one alternative scenario for each project. The first scenario for each project presents the mitigation ratios and elderberry numbers described in the respective HCPs submitted to the Service. The alternative UPRR scenario interprets the 1996 VELB mitigation guidelines in the manner of the TID HCP, while the alternative TID analysis interprets the VELB guidelines as I did for the UPRR HCP. I would appreciate learning from you which scenarios correctly interpret the VELB guidelines.

For both projects, the number of stems ≥ 1 inch are similar, 253 for UPRR and 222 for TID. Only 2 bona fide VELB exit holes were noted for UPRR, while as many as 11 exit holes were noted for TID. As author of the Service's recovery plan on the VELB and with over 20 years experience in surveying for it, I can state that the density of exit holes for the TID project area is one of the highest densities I have ever encountered for the VELB, which normally occurs at very low density compared to most other insects. In addition, the density for the TID project area is 6.26 times greater than the VELB density at the UPRR site. Despite the potential for a greater impact on the VELB the Service's screening form states that the TID project qualifies as a low effect HCP, while the Service has previously advised me that the UPRR project does not qualify as a low effect HCP. Furthermore, all of the criteria stated on the screening form (p. 2) to substantiate the low-effect designation for the TID project seem to me to also apply to the UPRR project, hence my confusion.

Application of Mitigation Ratios.

The application of mitigation ratios from the 1996 VELB mitigation guidelines differs substantially in the two HCPs. Examples presented in these guidelines (pp. 5 & 6) imply that the migitation ratio is based on the percentage of all elderberries at a site that exhibit exit holes, which is the way I calculated the number of mitigation elderberries needed for UPRR HCP (i.e., < 50% of all 87 plants bearing 253 stems ≥ 1 inch at the project site had exit holes, so a 3:1 mitigation ratio resulted in a requirement of 759 mitigation elderberry plantings).

In contrast, the TID HCP applies different mitigation ratios to different elderberry groups within its project area. The 3:1 ratio was used only for those plant locations within the project area that had potential exit holes, while a 2:1 ratio was used for all other locations that lacked exit holes (Table 2, p. 13 of TID HCP). Thus, either the TID HCP underestimated it elderberry mitigation requirement or the UPRR HCP overestimated its requirement.

As is illustrated in the attached table, the application of different mitigation ratios for various groups of elderberries instead of one ratio for all elderberries yields substantially different numbers of required mitigation plants and corresponding VELB units. The table also illustrates how the cost of mitigation varies dramatically with each scenario.

Mitigation for Transplants.

The Service's 1996 VELB guidelines (p. 3) state that elderberries, which cannot be avoided, should be transplanted. Because UPRR did not feel it was appropriate to transplant impacted elderberry plants with contaminated soils from the rail yard, which is a state recognized superfund site, it proposed to double the normal 3:1 mitigation ratio to 6:1. This doubling of the mitigation ratio comes from p. 4 of the guidelines, which says, "the Service may allow the applicant to plant seedlings or cuttings at twice the stated ratios for each elderberry plant that cannot be transplanted. Thus, the total number of mitigation elderberries presented in the UPRR HCP is 1,518 plants or 304 units.

The TID HCP does not seem to discuss the issue of transplanting elderberries that cannot be avoided along the canal or any other form of compensation for impacted elderberries (at least in the pages of the HCP that I have). The only mitigation described in the TID HCP is elderberry cuttings. Similarly, the attached documents for the VELB Conservation Fund do not mention any need to compensate for impacted elderberries that would otherwise be transplanted, as do the VELB guidelines. This implies that if an applicant uses the VELB Conservation Fund, no compensation is necessary for impacted elderberries that would otherwise need to be transplanted to a mitigation site. If the TID HCP and VELB Conservation Fund do not include compensation for transplants, why does UPRR need to provide additional mitigation for not transplanting elderberries growing in contaminated soils that cannot be avoided during remediation of the rail yard? The inclusion of compensation for transplants substantially increases the mitigation costs for either project, as detailed in the attached table.

Clearly, each of these issues alone affects the required number of mitigation elderberries (VELB units). As the attached table illustrates, the combination of these three issues causes the mitigation costs for either the TID or UPRR project to vary by hundreds of thousands of dollars.

I am prepared to revise the draft UPRR HCP, and to prepare an EA for a medium-effect HCP if necessary, but in light of these apparent discrepancies I need clarification on the proper interpretation of these issues before I proceed. UPRR is anxious to obtain its take permit as quickly as possible, and is prepared to undertake whatever mitigation is necessary and consistent with the proper interpretation of the 1996 VELB guidelines. Indeed UPRR would like to contribute to the VELB Conservation Fund or purchase its mitigation credits before the end of 1999 and we anticipate that some lead time will be necessary to consumate such a transaction either through the VELB Conservation Fund or a Service-approved mitigation bank. However, as noted in the attached table, UPRR's contribution amount to the VELB Conservation Fund could be as low as $108,000 or as high as $547,200 depending upon how the VELB guidelines are interpreted. Please advise me as to the correct interpretation of the guidelines, so UPRR can secure its necessary credits as quickly as possible and I can complete the necessary documents for the permit application.

Thank you for your assistance. I look forward to your prompt reply. Feel free to call me at (925) 825-3784 or email me at **bugdctr@home.com** to discuss these matters further.

Comparison of Proposed and Alternative Mitigation Scenarios for TID and UPRR HCPs

Project Inventory Data	Mitigation Scenarios			
	Draft UPRR HCP	UPRR Alternative	TID Low Effect HCP	TID Alternative
Number of elderberry plants with stems ≥ 1"	87	87	54	54
Number of stems ≥ 1"	253	253	227	227
Number of VELB exit holes	2	2	11	11
Mitigation ratio(s) used	3:1 for all plants within project site	2:1 for plants lacking exit holes; 3:1 for only plants (≤50%) that possess exit holes; and 5:1 for only plants (>50%) possess exit holes	2:1 for plants lacking exit holes; and 3:1 for only plants (≤ 50%) that possess exit holes	3:1 for all plants within project site
Preliminary required number of mitigation plants	759	297	465	681
Additional mitigation for not transplanting impacted elderberries	2:1 (2 x 759)	none	none	2:1 (2 x 681)
Total number of elderberry plants	1518	297	465	1362
Preservation of VELB habitat	304	60	93	272
Cost of Conservation Fund Contribution to VELB Conservation Fund	$547,200	$108,000	$167,400	$489,600

Footnotes:

[1] = interprets 1996 VELB guidelines in the same manner as the TID Low Effect HCP

[2] = interprets 1996 VELB guidelines in the same manner as the draft UPRR HCP

Appendix F
Preliminary Bat Survey

Preliminary Bat Survey for the Tehama-Colusa Canal Authority Fish Passage Improvement Project at the Red Bluff Diversion Dam, Red Bluff, California

PREPARED FOR: Laurel Karren/SAC

PREPARED BY: Heather L. Johnson/SAC

COPIES: Marjorie Tsang/SAC
Mike Urkov/RDD

DATE: June 14, 2002

Introduction

The Tehama-Colusa Canal Authority (TCCA) Fish Passage Improvement Project at the Red Bluff Diversion Dam (RBDD) is being proposed to improve the long-term ability to reliably pass anadromous fish and other species of concern past RBDD and improve the long-term ability to reliably and cost-effectively move sufficient water into the TCCA systems. New facilities will be constructed to facilitate the environmental and agricultural needs of the involved parties.

A preliminary bat survey was conducted in the proposed project area as part of biological surveys required by the National Environmental Protection Act (NEPA) and the California Environmental Quality Act (CEQA). The preliminary survey was conducted at RBDD, the abandoned storage buildings at the old mill site on the south side of the Sacramento River, and the U.S. Forest Service (USFS) campground on the north side of the Sacramento River. The preliminary bat survey was also conducted on other adjacent lands as a follow-up to observations of roosting bats made on a May 11, 2001, reconnaissance-level biological survey and to further assess habitat and document presence.

Project Location

The proposed RBDD alternative project is located near the City of Red Bluff, in Tehama County, California, along and through the Sacramento River. The project site is located on U.S. Geological Survey (USGS) quadrangle map Red Bluff East, CA, Township 27 N, Range 3 W, Section 33.

Methods

Two CH2M HILL biologists conducted the field survey on June 5, 2002. The survey consisted of daytime habitat assessment and focal roost searches, and nighttime monitoring of bat activity. The daytime survey was conducted by car and on foot; it consisted of driving

the limits of the project area and walking and driving around the project site. U.S. Bureau of Reclamation (USBR) and USFS maintenance personnel were interviewed. Habitat conditions, surrounding land uses, and specific features that might provide roosting and foraging habitat for bats were noted and investigated. Specific roosting habitat features included abandoned buildings; dam facilities; and mature riparian vegetation with crevice, cavity, and foliage features suitable for bat occupancy.

Focal roost searches were conducted on portions of the dam and associated facilities, in abandoned storage buildings, and at most of the outbuildings in the Red Bluff Recreation Area. Outbuildings at the Recreation Area included bathroom exteriors, sheds, and picnic area roof structures. Structures were investigated visually with the aid of spotlights and a digital handycam with external light source attachment. Bat roost sites were located by the presence of sign, which includes guano deposits, urine stains, audible vocalizations, carcasses, and discarded prey remains. Roost locations were noted, and accessible roosts were investigated to identify species if possible.

The nighttime survey portion consisted of monitoring bat activity in two adjacent locations at the abandoned storage buildings. Emerging bats were concurrently monitored at two roost sites for approximately 45 minutes around the time of sunset. At one roost site, emergence was observed to note behavior and make a limited number count using the unaided eye and ambient light. At the second roost site, emerging and foraging bats were acoustically monitored using an ultrasonic detector (Anabat II, Titley Electronics, Ballina, Australia) in conjunction with a laptop computer to view real-time sonograms of bat echolocation calls.

Results

Bat species potentially occurring in the project area were identified by querying the California Natural Diversity Database (CNDDB), reviewing a U.S. Fish and Wildlife Service (USFWS) list for the project, reviewing information from the USFS and Bureau of Land Management (BLM), and performing field surveys (see Table 1). The presence of three species was visually confirmed, and a fourth species was acoustically detected. Numerous roost locations were documented in the two abandoned storage buildings. Evidence was found that bats roost in some of the hydroelectric structures of RBDD in concrete weep holes and under metal overhangs. Several areas appeared to provide potential roosting and foraging habitat: the camping and recreational park area on the north side of the Sacramento River, the upland vegetation and open grasslands on the southwest side of the river, and riparian and wetlands areas. Figure 1 illustrates potential bat roosting and foraging habitat that were identified during the survey conducted on June 5, 2002.

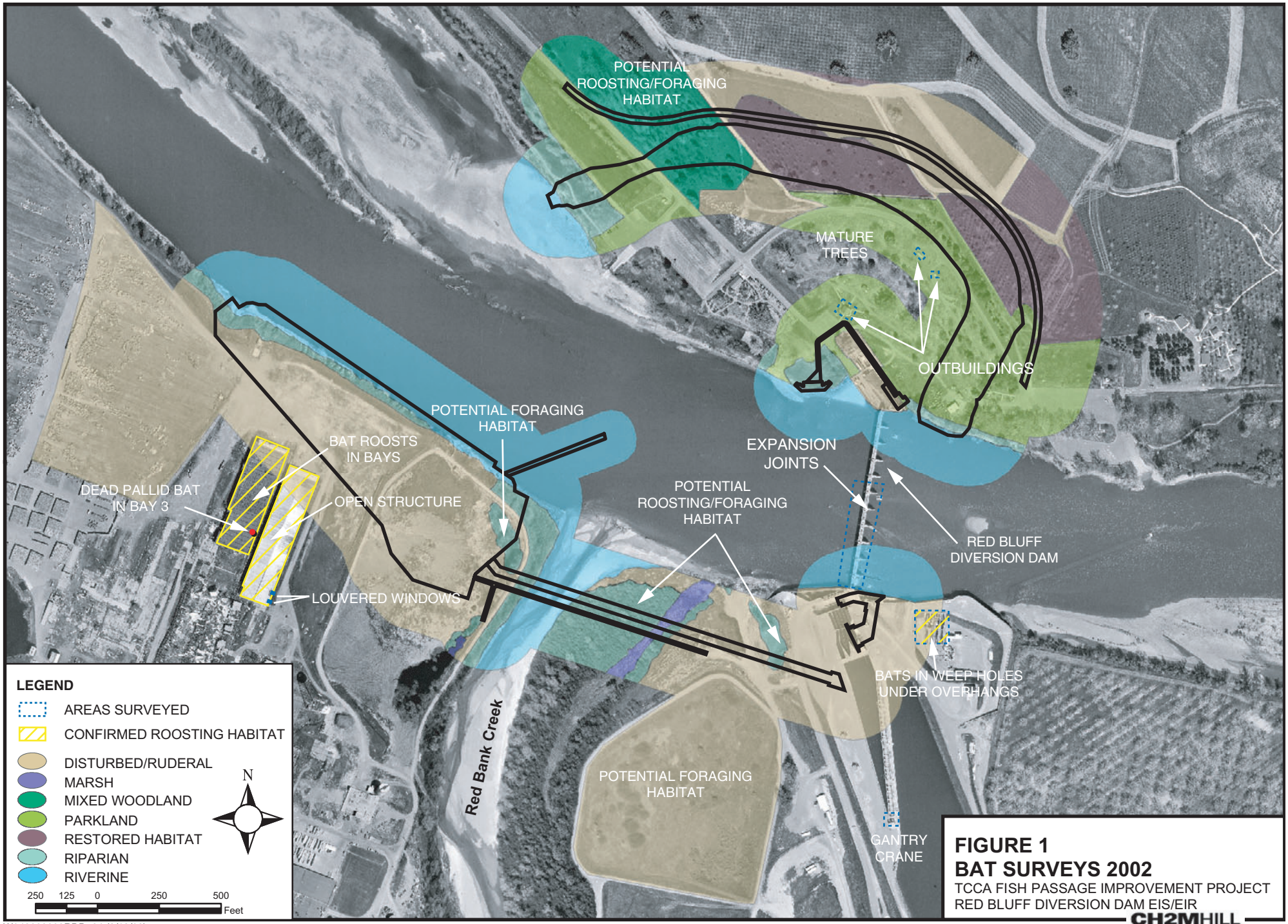


FIGURE 1
BAT SURVEYS 2002
TCCA FISH PASSAGE IMPROVEMENT PROJECT
RED BLUFF DIVERSION DAM EIS/EIR

CH2MHILL

W042002002RDD_84 (8/13/02)

TABLE 1
Bat Species Potentially Occurring in the Red Bluff Diversion Dam Area

Species	Status	Habitat in Project Area	Comments
Mexican free-tailed bat *Tadarida brasiliensis*	NA	Oak woodland	Over 600 observed emerging after sunset, more are present
Townsend's big-eared bat *Corynorhinus townsendii*	CDFG-SC FWS-C USFS-S BLM-S	Oak woodland, riparian, active agricultural areas	Suitable habitat present, no evidence found
Spotted bat *Euderma maculatum*	CDFG-SC FWS-C	Mixed conifer forest	Not likely to be present, lack of suitable roosting habitat
Pallid bat *Antrozous pallidus*	CDFG-SC USFS-S BLM-S	Oak woodland, grasslands	Desiccated carcass found
Big brown bat *Eptesicus fuscus*	NA	Agricultural areas, oak woodland, pasture	Possible evidence of presence
Silver-haired bat *Lasionycteris noctivagans*	NA	Conifer/hardwood forests, in winter and during seasonal migrations in low elevation, more xeric habitats	Possibly migrating along river
Red bat *Lasiurus blossevillii*	CDFG-SC FWS-C USFS-S	Riparian, edge habitats adjacent to streams or open fields, orchards	Potential habitat present
Hoary bat *Lasiurus cinereus*	NA	Forested habitats, oak woodland	Potential habitat present
Yuma myotis *Myotis yumanensis*	FWS-C	Associated with rivers and streams, riparian, oak woodland, forests	*Myotis* sp. bats were observed, likely to be present
Little brown bat Yuma lucifugus	NA	Woodlands and coniferous forest	Not likely to be present, more common at higher elevations
Long-legged myotis *Myotis volans*	FWS-C	Woodlands and coniferous forest	Not likely to be present, more common at higher elevations
Fringed myotis *Myotis thysanodes*	CDFG-SC FWS-C	Oak woodland	*Myotis* sp. bats were observed, potential evidence of presence
Long-eared myotis *Myotis evotis*	CDFG-SC FWS-C	Agricultural areas, coniferous forests, oak woodland	*Myotis* sp. bats were observed, potentially present
California myotis *Myotis californicus*	NA	Coniferous forests, oak woodland	*Myotis* sp. bats were observed, likely to be present
Small-footed myotis *Myotis ciliolabrum*	FWS- C	Riparian, coniferous forests, oak woodland	*Myotis* sp. bats were observed, possible evidence of presence

NA Not Applicable
CDFG-SC California Department of Fish and Game Species of Special Concern
FWS-C U.S. Fish and Wildlife Service Species of Concern
USFS-S U.S. Forest Service Sensitive Species
BLM-S Bureau of Land Management Sensitive Species

Abandoned Storage Buildings

One abandoned, enclosed storage building consisted of a row of 25 (numbered) large bays made of concrete blocks (see Figure 2). Each bay provided a large, dark, cave-like environment, similar to a mine adit. Bats are roosting inside almost all of the bays during the day and at night, as revealed by guano deposits on the floor. Day roost sites consisted of crevices and cavities formed by crumbling cement plaster on the interior walls. Often the crevices opened up into cavities within the walls (see Figure 3). In two of the bays, bats roosted in large cracks in the cement frame of the bay openings. These day roosts were probably also occupied at night. In addition, guano deposits scattered along the floor and urine stains high on the walls indicated that bats night roost along the bay walls in the mid-section, and in or on the rear wall. Table 2 provides a summary of these observations.

FIGURE 2
Bat Habitat—Large Bays Made of Concrete Block in Abandoned Covered Storage Building

Three guano types were distinguishable; that of myotis (*Myotis* sp.), Mexican free-tail bats (*Tadarida brasiliensis*), and a larger type, probably pallid bats (*Antrozous pallidus*) or big brown bats (*Eptesicus fuscus*). Bats were also roosting in the corners at either side of the bay openings, and the guano type here was usually pallid bat, or possibly big brown bat since the guano did not have discarded prey remains, which is characteristic of pallid bat roosts.

FIGURE 3
Mexican Free-tail Bats Inside Cement Wall Cavity Roost

TABLE 2
Occupied Areas of the Two Abandoned Storage Buildings

Bay	Observation	Comments
1	No sign	
2	Guano on right (R) side	
3	Roosts on left (L) and R walls	L side occupied, R side not occupied
		Pallid bat carcass below roost, large bat partially seen inside roost
		Many Mexican free-tails seen and heard inside
4	Guano on R side	
5	Guano on L and R sides	
6	Guano on L and R sides	L side large pile
7	No sign	
8	Roost in back wall	*Myotis* sp. seen and heard inside
9	No sign	

TABLE 2
Occupied Areas of the Two Abandoned Storage Buildings

Bay	Observation	Comments
10	Guano in R corner	Pallid or big brown type
		Possible night roost only
11	Guano in R corner	Pallid or big brown type
		Possible night roost only
12	Guano in R corner	Pallid or big brown type in corner
	Guano mid-way below R wall	Mexican free-tail type below wall
13	Guano in R corner	Myotis-type guano
14	No sign	
15	Some guano in R corner	Pallid or big brown type-, and myotis-type guano in corner
16	Some guano in R corner, along back wall, along R wall	
17	Some guano in R corner, along back wall	Pallid or big brown type in corner
18	Guano in R corner	Pallid or big brown type
19	Guano on R wall mid-way, along back wall	
20	Guano in R corner, large amount scattered on R wall, possible roosting bats above ceiling beams	Pallid or big brown type- in corner, and large amounts of Myotis-type guano
	Possibly heard bats	
21	Some guano in R corner, some guano scattered on R wall	Pallid or big brown type in corner
22	Some guano in R corner, scattered below R wall, some in middle of floor toward the rear of the bay	
23	Roost in cracked frame of opening	Mexican free-tails in roost
	Guano scattered along R wall	Myotis-type guano below R wall
24	Guano in R corner, along R wall, along rear wall, large concentration below L wall mid-way	Mexican free-tail-type guano along rear wall, and myotis-type guano below L and R wall
25	Some guano in L corner, probable roost, heard bats but unable to locate them	Myotis-type guano
Storage Building	Guano deposits below louvers in several locations, bats roosting behind louvers and under loose board on upright pole	Mexican free-tails and myotis roosting on plywood boards under louvers, in window frame, and myotis roosting under loose board on pole
		Possible visual on two myotis species

The second abandoned storage building was a large, open, corrugated metal roof structure supported by a wooden frame (see Figure 4). This open-roofed structure had some interior walls of plywood and corrugated plastic sheets and one relatively short exterior wall that appeared to have been louvered windows that were backed by plywood squares. A few myotis and Mexican free-tail bats were roosting on the plywood behind the louvers and in the window frames. Greater numbers of bats were observed roosting here on May 11, 2001, and the guano deposits below suggested greater numbers. Also, myotis bats were roosting under a loose board on an upright pole. Video of the myotis bats under the board possibly revealed more than one species (based on morphology). Capture would be necessary for further identification.

FIGURE 4
Bat Habitat—Louvered Windows Backed by Plywood and Loose Boards at Open-walled Abandoned Storage Building

Behavior Observations

Over 600 Mexican free-tail bats were observed emerging from Bays 1 through 3. Up to 10 bats appeared to be a larger size than the rest; based on the carcass discovery they were pallid bats or possibly big brown bats. Bats flew in and out of adjacent bays. About 1.5 hours after sunset-myotis bats were seen flying in and out of Bay 8, which contained the rear wall roost site (evidence of night roosting).

Acoustic Monitoring

Four types of echolocation calls were recorded. Echolocation calls of the Mexican free-tail were distinctive in this case. A second call type could have been pallid bat or big brown bat;

either species (or both) are likely. The final two call types were myotis, which are often reported as phonic types based on the characteristic frequency of the sonagrams (40 kilohertz [kHz] and 50 kHz). The echolocation calls of many species of bats are indistinguishable by acoustic means alone (especially when recorded near roosts), and capture is required to confirm identification. However, the Yuma myotis is a 50-kHz phonic type and would be expected to occur in buildings along the Sacramento River. The 40-kHz calls may have been attributable to the small-footed myotis.

Conclusions

The following conclusions are made relevant to the June 5, 2001 survey:

- Additional species identification (especially myotis species) and habitat use characterization would require further surveys. A combination of capture and acoustic methods, as well as roost searches and emergence observations, would be necessary. Capture methods would also be required to obtain demographic information such as sex, reproductive condition, and the presence of juveniles, which would indicate site occupancy by maternity colonies. In addition, bat presence and activity is highly variable both seasonally and on a night-to-night basis; therefore, multiple surveys across habitats and seasons would be necessary.
- Foraging habitat would be lost as a result of the new facility construction. Replacement of the habitat by replanting vegetation is planned as part of project mitigation.
- The project area contains areas of riparian vegetation that include mature sycamores, cottonwoods, and willows; this is habitat that may potentially be used by the red bat and the hoary bat. Further surveys would be required to determine presence of these species.
- The two abandoned buildings used as bat roosts are within the 200-foot buffer area considered to be temporarily impacted by all project alternatives. Currently, there are no plans to remove these buildings. If at the time of project construction a decision is made to permanently impact the roosting habitat by removing the buildings, demolition would occur following confirmed exclusion of the bats. Observations of the type and location of bat roosts in these structures appear to support exclusion as a viable mitigation measure.

Mitigation

Temporary Impacts: Building Avoidance During Construction

To reduce temporary impacts, the following actions should be taken during construction:

- The buildings occupied by bats should be avoided during construction.
- Construction should not be conducted at night within 200 feet of the buildings occupied by bats.
- Construction materials should not be stored in the buildings occupied by bats.

Permanent Impacts: Exclusion and Building Removal

Removal of the abandoned buildings would displace hundreds and possibly thousands of bats and be a significant loss of roosting habitat. Current information on numbers and species of bats present is preliminary; additional special-status species may be present. The species currently identified are colonial, and displacement from the roosts may disrupt colony cohesion. Displaced bats may roost in exposed locations and be at increased risk of predation.

If the buildings are to be removed, prior mitigation in the form of exclusion would be performed. Exclusion is the process of preventing the bats from occupying the roosts. Bat emergence is controlled, and re-entry is prevented by covering the roost entrance with draped netting. The netting is secured on the top and sides, and the bottom is left open. Bats are able to walk down the wall and underneath the netting to escape from the bottom but are usually unable to re-enter in this manner. One-way valves made of plastic pipe may also be used. Exclusion consists of two phases: allowing emergence while temporarily blocking re-entry for 1 week, followed by permanently blocking the roost entrances. Surveys must be conducted to ensure that all bats have exited the roost before the entrances are permanently blocked to avoid direct mortality by entombment. Screening and insulation material such as expanding foam are often used to permanently block roost entrances.

It is vital that exclusion only be performed in the winter (November to February) after any young of the year are volant. A qualified nuisance control professional should perform the exclusion. A qualified biologist should monitor the bats during the procedures to prevent any mortalities from bats becoming entangled in the netting, and to conduct surveys to ensure that bats are successfully excluded.

Permanent Impacts: Provision of Alternate Roosting Habitat

To mitigate for the loss of roosting habitat, provision of alternate roosting habitat in the form of offsite installation of large bat houses is recommended. Large bat houses ("bat condos") may be erected. The Red Bluff Recreation Area would be a good bat house construction site since the managers are already promoting the presence of bats in recognition of the bat's beneficial role in insect pest management. Bat condos have been successful artificial roosts for large numbers of Mexican free-tail bats.

Bat condos are similar to raised wooden chicken coops with internal partitions to form roost crevices. The overall size should be 8 x 8 x 8 feet, and the width of the internal partitions should be approximately 0.75 to 1.0 inches for the free-tail bats and also 1.0 to 1.5 inches for the pallid bats. Bat condos should be oriented properly (usually southern or southeastern exposure), and the temperature regime and humidity inside the condo should replicate that found in the original roosts.

It is recommended that the existing exterior wall with the plywood-backed louvers be reconstructed in a suitable offsite location to provide for myotis bat roosting habitat. Alternately, bat houses mounted on poles may be erected that simulate the existing roost (the gap under the loose board attached to a pole). Managers at the Red Bluff Recreation Area are currently experimenting with bat house style and placement and may provide a cooperative bat management opportunity.

Appendix G
Agency Comments

United States Department of Agriculture | Forest Service | Mendocino N.F. Supervisor's Office | 825 N. Humboldt Ave. Willows, CA 95988 (530) 934-3316 TTY: (530) 934-7724

File Code: 1920, 1950

Date: *

Mr. Art Bullock
Tehama-Colusa Canal Authority
P.O. Box 1025
Willows, CA 95988

Dear Mr. Bullock:

This letter provides comment from the U.S. Forest Service, Mendocino National Forest on the proposal to address needs for water delivery and fish passage at the Red Bluff Diversion Dam (RBDD). The focus of these comments is the Alternative 1b fish bypass channel option, located and designed as shown in Volume II of the Phase II Preliminary Design Report (CH2MHill, February 2001), and as discussed during our meeting in Willows on May 3, 2001. As you know, the Forest Service was first informed of planning for this alternative in late February 2001. This letter therefore represents our initial formal response to the fish bypass channel proposal.

The U.S. Forest Service manages the 488-acre Red Bluff Recreation Area on the east bank of the Sacramento River at the RBDD site (Attachment A). The U.S. Bureau of Reclamation transferred jurisdiction of the site to the Forest Service in 1988 with the assurance that the Forest Service would develop a management plan for the area, with appropriate documentation under the National Environmental Policy Act. The Mendocino National Forest undertook planning for the Red Bluff Recreation Area in 1988, conducting numerous meetings and receiving input from hundreds of agencies, organizations, businesses, and individuals. Many of these agencies and organizations agreed to act as partners with us in implementing the selected alternative of the Red Bluff Recreation Area Development Plan (Record of Decision signed in 1991). This plan was subsequently incorporated into the Mendocino National Forest Land and Resource Management Plan (Record of Decision signed in 1995).

Recreation development of the Red Bluff site plays a key role in the U.S. Fish and Wildlife Service's plan for a Sacramento River National Wildlife Refuge (SRNWR). The environmental assessment for the SRNWR identifies sites such as the Red Bluff Recreation Area as appropriate locations for achieving the dual objectives of preserving Sacramento River riparian habitat while meeting increased demand for outdoor recreation. By concentrating public use and interpretive facilities at nodes such as the Red Bluff Recreation Area, both the public and natural systems benefit.

The Red Bluff Recreation Area plan emphasizes interpretation of natural systems through displays, facilities, and programs. The Recreation Area plan re-creates on the site the type of riparian habitat that existed prior to 1800, and provides facilities for interpreting the relationship between the river's aquatic system and its riparian and upland surroundings.

The bypass channel as presently envisioned (CH2MHill 2001: 1-G-15) lies entirely within the Red Bluff Recreation Area. The only sizeable portion of the recreation area above the 100-year flood plain, and thus available for facility construction, is located within the area between the proposed bypass channel and the river. If the bypass channel were built according to the present design, the site's existing and proposed interpretive facilities would be cut off from the riparian and upland habitat they are intended to interpret by a ninety-foot-wide moat surrounded by an eight-foot-tall fence (CH2MHill 2001: 90-C-1, 90-C-2). The only suitable sites for day-use facilities on the riverbank would also be lost. The value of the Red Bluff Recreation Area for the interpretation of interconnected natural systems would be effectively destroyed.

During the ten years since completion of the Red Bluff Recreation Area plan, the Mendocino National Forest and its partners have been actively engaged in its implementation. Several million dollars and thousands of hours of volunteers' time have been invested in restoring riparian habitat and constructing recreation and interpretive facilities. The Forest Service has contributed over $950,000 in construction funds for recreation, interpretive, and administrative facilities. Partners including the State of California, Bureau of Reclamation, and the Red Bluff Chamber of Commerce have contributed an additional $810,000 for facility construction.

The Forest Service has invested another $350,000 in restoring riparian forests, wetlands, and oak woodlands on the site. Partners including the State of California Wildlife Conservation Board, the Sacramento River Discovery Center, Pacific Gas and Electric, and Ben's Trucking have contributed an additional $600,000 toward this effort.

The facilities that would be removed to allow for the fish bypass channel as currently designed could be replaced. What could not be replaced is the unique quality of the Red Bluff Recreation Area; the good faith efforts made by our many partners; the thousands of hours that volunteers have devoted to the site; or the potential to educate future students and visitors about the interconnected ecosystems of Sacramento River Valley.

For these reasons Alternative 1b would not comply with our Land and Resource Management Plan. It would significantly alter the character of the Lake Red Bluff Recreation Area from desired condition set forth in the Plan. It would also significantly impair our ability to achieve the interpretive objectives established in the Plan. Consequently, implementation of Alternative 1b would require a Plan amendment.

The Forest Service understands the need and supports the proposal to respond to biological and social needs at the RBDD site. However, in view of the concerns outlined above, we believe there is a strong basis for not considering Alternative 1b as a viable alternative to meet those needs. Specifically, Alternative 1b has a high project cost, a significant conflict with established uses and management of Lake Red Bluff Recreation Area, but no clearly superior fish passage efficacy compared to the other alternatives. These significant shortcomings do not commend a great deal of investment of time, effort, and expense in a detailed analysis.

Nevertheless, we recognize that there may be other considerations that might cause you to decide to analyse Alternative 1b in detail. In that event, we request that the draft EIS for the fish passage improvement project respond to the following questions:

- Have designs for bypass channels located outside the Red Bluff Recreation Area been considered in detail?

- Have the potential social and land-use impacts of various bypass options been compared to those associated with the current design?
- Have improved fish ladders been carefully considered and compared to bypass options?
- Would a bypass channel provide for fish passage so much better than the current or improved fish ladders as to warrant the additional expense, disturbance to the site, and opportunities foregone?
- Have other alternatives designed to allow for sturgeon passage, such as locks, been considered?

We appreciate the opportunity to comment on this project, and are hopeful that these initial comments will assist in preparation of the draft EIS. Should you have any questions regarding these comments, please contact me. Or, have your staff contact our Forest Planner, Mike Van Dame, at (530) 934-1141.

Sincerely,

JAMES D. FENWOOD
Forest Supervisor

Cc: Mike Ryan, Area Manager
U.S. Bureau of Reclamation, Shasta Lake Office

Max Stodolski
U.S. Bureau of Reclamation, Red Bluff Office

United States Department of the Interior

BUREAU OF RECLAMATION
Northern California Area Office
16349 Shasta Dam Boulevard
Shasta Lake, California 96019-8400

IN REPLY REFER TO:

NC-600
PRJ-8.10

NOV 0 2 2001

MEMORANDUM

To: Acting Regional Director
Attention: MP-100

Through: Chet Bowling
Acting Deputy Regional Director

From: Max J. Stodolski
Chief, Red Bluff Division

Subject: Tehama-Colusa Canal Authority Fish Passage Improvement Project at the Red Bluff Diversion Dam – Response to Proposed Alternatives

Reclamation has received, and is currently reviewing, the attached Planning Aid memorandum from the Fish and Wildlife Service, dated October 19, 2001. Letters of concurrence from the California Department of Fish and Game and the National Marine Fisheries Service are also attached.

The Fish and Wildlife Service memorandum discusses their concerns, and the opinions of other agencies, regarding the alternatives offered in the Tehama-Colusa Canal Authority's most recent planning document for this project.

This correspondence is being forwarded to you for informational purposes. Please send any comments you might have to me, at the address above, no later than November 30, 2001. You can also provide comments by electronic mail to mstodolski@mp.usbr.gov, or by fax to (530) 529-3895.

If you have any questions, please contact me at (530) 529-3890; TDD: (530) 275-8991.

Attachments

Mr. Ralph Hinton
California Department of Water Resources
2440 Main Street
Red Bluff, California 96080

Mr. Arthur Bullock
Tehama-Colusa Canal Authority
PO Box 1025
Willows, California 95988

Mr. Dale Canon
CH2M Hill
PO Box 492478
Redding, California 96049-2478

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1886

October 19, 2001

Memorandum

To: Chief, Red Bluff Division, Bureau of Reclamation, Red Bluff, California

From: Acting Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California

Subject: Planning Aid Memo on the Fish Passage and Water Reliability Improvement Project Red Bluff Diversion Dam, Red Bluff, California

This Planning Aid Memorandum (Memorandum) transmits the U.S. Fish and Wildlife Service's (Service) comments on alternatives for the Tehama-Colusa Canal Authority (TCCA) Fish Passage Improvement Project at the Red Bluff Diversion Dam (RBDD). These comments have been prepared under the authority, and in accordance with the provisions of Section 2(b) of the Fish and Wildlife Coordination Act [(FWCA) 48 stat. 401, as amended: 16 U.S.C. 661 et seq.]. The purpose of the FWCA is to provide for equal consideration of fish and wildlife conservation with other project features of federally funded or permitted water resource development projects. Pursuant to the FWCA, the Service has coordinated with the National Marine Fisheries Service (NMFS) and the California Department of Fish and Game (DFG) before providing these comments. We have been assured that these co-trustee agencies will be affirming the content of this Memorandum in subsequent submittals to the lead agencies under the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) requirements. These comments have been developed in coordination with our Red Bluff Fish and Wildlife Office.

On October 1, 2001, the Service began collaborations with DFG and NMFS biologists in an effort to jointly develop this memorandum to assist the Bureau of Reclamation (Reclamation) with the interagency planning process for the Fish Passage Improvement at RBDD. Reclamation is the Federal nexus cooperator to the TCCA, the project lead agency.

A multi-agency team has been working on evaluating the existing conditions and alternatives for the fish passage project for over two years. This planning process has resulted in the development of the following alternatives, including the current condition (No Action):

No Action	Dam Gates in four months existing fish ladders.
Alternative 1(a)	Gates-in 4 months; new fish ladders; 1,700 cfs total pumping capacity.
Alternative 1(b)	Gates-in 4 months; new right bank fish ladder; bypass channel; 1,700 cfs total pumping capacity
Alternative 1(c)	Gates-in 4 months; old fish ladders; develop water supply from Stony Cr.
Alternative 2(a)	Gates-in 2 months; old fish ladders; 2,000 cfs total pumping capacity.
Alternative 2(b)	Gates-in 2 months; new fish ladders; 2,000 cfs total pumping capacity.
Alternative 3	Gates-out year-round; 2,500 cfs total pumping capacity.

The Service, in collaboration with NMFS and DFG, has arrived at the following preliminary recommendations:

Alternative 1(c) does not appear to meet the intent of the presently established "Project Need, Purposes, and Goal" ("needs and purpose") listed in the CH2MHILL February 2001 document, *"Tehama-Colusa Canal Authority Fish Passage Improvement Project at the Red Bluff Diversion Dam", Phase II, Preliminary Design Report, Volume I of II."* This needs and purpose clearly states the project must "substantially improve the long-term reliability" of both water delivery and adult and juvenile fish passage at the dam. Alternative 1(c) appears unlikely to substantially improve the reliability of water deliveries due to the many uncertainties associated with the water supply on Stony Creek. In April, 2001, CH2MHILL conducted a preliminary investigation of the reliability of the Stony Creek water supply, indicating that in one of every four years no water would be available for rediversion to the Tehama-Colusa Canal (TCC). There are additional uncertainties regarding the use of Stony Creek water dependant on the outcome of ongoing biological analyses and regulatory reviews of Stony Creek water management practices.

Most importantly, from our perspective, Alternative 1(c) does not improve fish passage over the No Action Alternative (gates in four months); especially for focus species of the alternatives, including spring-run chinook salmon and green sturgeon. Therefore, we recommend this alternative be dropped from further consideration. All remaining alternatives appear to meet, to various degrees, the intent of the "needs and purpose" statements.

The following list ranks the remaining alternatives, beginning with the alternative that we feel provides the greatest fishery resource benefits, to the alternative with the least fishery benefits:

1 Alternative 3
2 Alternative 2(b)
3 Alternative 2(a)
4 Alternative 1(a)
5 Alternative 1(b)

To date, the lead agency and the multi-agency planning process has generated certain amounts of fisheries information to enable this preliminary evaluation of the alternatives. However, a similar level of evaluation in relation to project alternative effects to terrestrial wildlife resources has not been possible. Therefore, as such information becomes available, issuance of additional planning aid memos may be necessary.

Discussion:

Our analysis is based upon the proceedings of numerous multi-agency technical teams spanning two decades. These efforts examined biological consequences of impaired passage at RBDD for both adult and juvenile anadromous fish as well as remedial alternatives. The most significant biological finding from this process is that populations of winter and spring-run chinook salmon, natal to the main-stem Sacramento River, require reliable and unimpaired passage at RBDD because one hundred percent of their spawning habitat is located above the dam. Likewise, salmon and steelhead populations natal to Battle, Cottonwood, Cow, and Clear creeks require reliable and unimpaired passage to sustain their separate populations. The need for restoration and recovery of these specific populations is exemplified by existing efforts to provide extensive and costly habitat restoration in the Sacramento River above RBDD, and in its major tributaries.

New ladder designs being considered as part of Alternatives 1(a), 1(b), and 2(b) are not known to produce substantial improvements in fish passage efficiency and reliability over the existing ladders. However, existing ladders at RBDD are 40 years old and engineering advancements could provide some measure of incremental improvement. Of the two permanent ladders at the dam, the west bank facility is a good candidate for modernization (size, attraction flow, baffling etc.) and effectiveness monitoring.

There are many uncertainties attached to the bypass being considered as part of alternative 1(b). While a bypass or even a fish ladder of this scale has never been tried before, the bypass does represent experimental technology that may pass non-salmonids. Clearly, there is no predictive capability that non-salmonids such as sturgeon, Sacramento pikeminnow, American shad, and striped bass will find the opening of the bypass or swim completely through the bypass if they enter it. There are also a number of operation and maintenance concerns, including seasonal closure of the facility and handling all the entrained fish during dewatering.

Our analysis of Alternatives 2(a) and 2(b) concludes there is a substantial improvement in the long-term reliability of adult and juvenile fish passage at RBDD over the No Action condition.

While we are not able to determine the incremental benefits provided by new ladders associated with the 2(a) and 2(b) alternatives, we believe the beneficial increment is not substantial in comparison to the benefit provided by the additional two months of gate openings. There are a number of specific benefits with alternatives 2(a) and 2(b). For example, the upstream migration of adult Sacramento pikeminnow would be facilitated during the gates up period, minimizing harmful accumulation of these predatory species on juvenile salmonids at the dam. Adult spring-run chinook salmon would have unimpaired passage up to the end of their migration period in late June. Unimpaired passage is particularly important for spring-run chinook salmon migrating to their natal tributaries on the Sacramento River above RBDD during the drier months. Delays in migration can result in late arrival to natal tributaries where low flow and high temperatures would prevent passage. Many of the Sacramento River tributaries above RBDD are undergoing comprehensive and expensive restoration, focusing on spring-run chinook salmon. Spring-run broodstock are extremely rare above the dam, making it essential to recruit the maximum number of natural spawners possible. Downstream migrating juveniles would be less susceptible to predation since during the gates up operation, they would not pass underneath the gates of the RBDD and become disorientated or impaired. Additonally, the spawning migration of adult green sturgeon would be unimpaired through the last portion of their spawning migration in the spring.

Alternative 3, except for diversions and their associated construction and operational impacts, provides a situation closest to the original ecosystem form and function. A free-flowing condition year-round under Alternative 3 would eliminate upstream or downstream impediments to migration and associated predation problems for all species and life-stages. Therefore, this is the best alternative for passage of all fish species and their associated life stages.

The migration timing for all anadromous fish species past Red Bluff is such that the increment of the populations migrating in July and August is relatively small. Therefore, the direct incremental benefit of totally unimpaired passage for anadromous fish species with Alternative 3, compared to that for Alternative 2, is relatively small. However, we think overall ecosystem-level benefits will be greater with Alternative 3. If the gates are up year-round, Lake Red Bluff would no longer exist, and a large amount of currently inundated shoreline would be exposed. If the natural river conditions were allowed to continue year-round, riparian vegetation would once again become established along and adjacent to the river. Shaded Riverine Aquatic (SRA) habitat, a Resource Category 1 type habitat along the Sacramento River, would become established providing shade, large woody debris, temperature attenuation, and food organisms for fish species, including salmon and steelhead.. SRA is important for biodiversity and increases fish and wildlife habitat values. Other species of native vegetation could also become established along and adjacent to the Sacramento River, further enhancing habitat, and fish and wildlife diversity. A year-round, free flowing river would greatly reduce predator "feeding stations" currently created when juvenile salmonids pass under the gates. Alternative 3 would also eliminate the need for fish ladders, reducing migration related stress and delay on adult fish attempting to pass upstream.

A related planning analysis is needed to consider how the RBDD alternative selection would affect the river as a navigable water of the state. Most angler use on the Sacramento River is by boat and river navigability does affect angler opportunities when pursing migratory fish species.

If you have any further questions regarding these comments, please contact Ryan Olah of my staff at (916) 414-6639 or Tom Kisanuki of the Red Bluff Fish and Wildlife Office at (530) 527-3043.

cc: Michael Aceituno, NMFS, Sacramento, CA
Donald Koch, CDFG, Redding CA
James Smith, USFWS, Red Bluff

State of California - The Resources Agency
DEPARTMENT OF FISH AND GAME
http://www.dfg.ca.gov
601 Locust Street
Redding, California 96001
(530) 225-2300

GRAY DAVIS, *Governor*

Flex your POWER

October 23, 2001

Dear Interested Parties:

Tehama-Colusa Canal Authority Fish Passage Improvement Project
at the Red Bluff Diversion Dam

The Department of Fish and Game concurs with the enclosed "Planning Aid Memorandum" (Memorandum) prepared by the U.S. Fish and Wildlife Service for the draft alternatives prepared for the subject project. The purpose and need of the alternatives is to improve the reliability and performance of both fish passage and water supply at the Red Bluff Diversion Dam. As described in the Memorandum, there is an identified need to improve upon the existing conditions of operation which installs the dam gates for four months each year and relies on existing fish ladders for fish passage.

Thank you for considering the recommendations in the Memorandum during the environmental decision-making processes under the California Environmental Quality Act. If there are any questions regarding this matter, please contact Environmental Specialist IVs Steve Turek (530) 225-2380 or Harry Rectenwald at (530) 225-2368.

Sincerely,

Donald Koch

DONALD B. KOCH
Regional Manager

Enclosure

cc: Messrs. Harry Rectenwald and Steve Turek
Northern California-North Coast Region
Department of Fish and Game
601 Locust Street
Redding, CA 96001

Conserving California's Wildlife Since 1870

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

October 26, 2001

In Reply Refer To:
SWR-99-SA-1048:MET

Mr. Max Stodolski
Chief, Red Bluff Division
U. S. Bureau of Reclamation
16349 Shasta Dam Boulevard
Shasta Lake, California 90802-4213

Dear Mr. Stodolski:

This is in regards to the Planing Aid Memorandum sent to you by the acting Field Supervisor of the Sacramento Fish and Wildlife Office, U.S. Fish and Wildlife Service (FWS), on October 19, 2001. That memorandum discusses the various alternatives being considered by the Bureau of Reclamation (Reclamation) for improving the long term reliability of both fish passage and water delivery at Red Bluff Diversion Dam on the Sacramento River in Red Bluff, California.

The National Marine Fisheries Service (NMFS) has been working closely with Reclamation and FWS as a member of the multi-agency team that has been evaluating the existing conditions and developing alternatives for this fish passage improvement project for over two years. Recently, NMFS began working collaboratively with FWS and the California Department of Fish and Game (DFG) to develop the subject memorandum in order to provide our input on the biological merits of the various alternatives that have been developed within this process. NMFS has reviewed the final memorandum and we fully concur with the statements and determinations put forth by FWS.

Thank you for the opportunity to participate in this very important process. If you have any questions regarding this correspondence or if NMFS can provide of further assistance, please contact Mr. Michael Tucker in our Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, CA 95814. Mr. Tucker may be reached by telephone at (916) 930-3604 or by Fax at (916) 930-3629.

Sincerely,

for Rodney R. McInnis
Acting Regional Administrator

cc: NMFS-PRD, Long Beach, CA
Stephen A. Meyer, ASAC, NMFS, Sacramento, CA

United States Department of the Interior

BUREAU OF RECLAMATION
Northern California Area Office
16349 Shasta Dam Boulevard
Shasta Lake, California 96019-8400

IN REPLY REFER TO:

NC-600
PRJ-8.10

FEB 13 2002

Mr. Arthur Bullock
Tehama-Colusa Canal Authority
P.O. Box 1025
Willows, California 95988

Subject: Red Bluff Diversion Dam Fish Passage Improvement Project

Dear Mr. Bullock:

Reclamation received a letter from the California Department of Water Resources (DWR), regarding the Red Bluff Diversion Dam Fish Passage Improvement Project (Project).

In their January 8, 2002, letter, DWR provides their comments concerning the three alternatives being considered for the Project. We have enclosed a copy of that letter for your information.

If you have any comments or questions, please contact me at (530) 529-3890;
TDD: (530) 275-8991

Sincerely,

Max J. Stodolski
Chief, Red Bluff Division

Enclosure

cc: Mr. Dale Cannon
CH2M Hill
P.O. Box 492478
Redding, California 96049-2478

Mr. Tom Kisanuki
Fish and Wildlife Service
10950 Tyler Road
Red Bluff, California 96080

Mr. Harry Rectenwald
California Department of Fish and Game
601 Locust Street
Redding, California 96001

Mr. Mike Tucker
National Marine Fisheries Service
650, Capitol Mall, Suite 6070
Sacramento, California 95814

Mr. Ralph Hinton
California Department of Water Resources
2440 Main Street
Red Bluff, California 96080
(w/encl)

STATE OF CALIFORNIA -- THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT
2440 MAIN STREET
RED BLUFF, CA 96080 2356

GRAY DAVIS, Governor

January 8, 2002

Mr. Max Stodolski
Chief, Red Bluff Division
U. S. Bureau of Reclamation
Post Office Box 159
Red Bluff, California 96080

Tehama-Colusa Canal Authority Fish Passage Improvement Project
at the Red Bluff Diversion Dam

Dear Mr. Stodolski:

The Department of Water Resources concurs with the attached "Planning Aid Memorandum" prepared by the U. S. Fish and Wildlife Service to evaluate the draft alternatives prepared for the Fish Passage Improvement Project. The purpose of this project is to substantially improve the reliability of both fish passage and water supply at the Red Bluff Diversion Dam.

The Department supports an alternative that best balances the fishery and water supply needs. We also prefer an alternative that provides the capability of diverting approximately 2,000 cfs into the Tehama-Colusa Canal during the winter months as a potential source of water for an offstream storage project, such as Sites Reservoir. As you know, such a project is currently under consideration as part of the CALFED planning process.

The alternatives that best fit these considerations are those which have the Red Bluff Diversion Dam gates out year-round or for 10 months and a total pumping capacity of 2,000 cfs or more, i.e. Alternatives 2 and 3.

Change to a two-month operation, or gates out year-round would lead to an increase in riparian vegetation in the existing Lake Red Bluff footprint. This vegetation would include both native and invasive introduced species, based on the species present in the Lake Red Bluff area today. So, from an aesthetic and wildlife standpoint, this increased growth would have both beneficial and detrimental effects.

The 1992 USBR Appraisal Report (page IV-7) indicates about 234 acres are within the fluctuation zone of Lake Red Bluff, so this is the area subject to increased growth with a two-month operation, or certainly with a gates out year-round alternative. This additional vegetation in the floodplain could have significant effects on water surface elevations in the Red Bluff area during high water events.

COPY

Improvement of Sale Lane and construction of the Bell Mill Shopping Center several years ago both placed considerable fill in the floodplain. In addition, gradual urban development and growth of vegetation during the last 30 years in the several overflow channels through the Antelope area has reduced the flood capacity of these bypass channels. The presence of Lake Red Bluff also has allowed deposition of a considerable amount of cobbles and sediment in the floodway, especially just below the Antelope Boulevard Bridge.

Additional riparian growth due to the Red Bluff Diversion Dam project will further reduce the flood carrying capacity of the Sacramento River in the Red Bluff area. This potential impact must be evaluated following Executive order 11988 and FEMA guidelines to determine if the reduction will increase water surface elevations. We believe that FEMA, the State Reclamation Board, Tehama County, and City of Red Bluff will all have concerns about this potential impact.

Winter-run Chinook salmon counts at the Red Bluff Diversion Dam originally were the basis for determining the allowable incidental take of juvenile winter-run salmon by the State Water Project and the federal Central Valley Project pumps in the Delta. Since the change to a four month gates-in operation several years ago, the estimates of winter-run Chinook have been made mostly by less accurate indirect methods. A two-month operation, or gates open year-round, would mean that only a very small percentage, or even no winter-run, could be directly counted and run-size estimates would be even less accurate. The same considerations also apply to the recently listed spring-run Chinook salmon. Therefore, if one of these alternatives is selected, additional effort should be made to increase the accuracy of the winter- and spring-run Chinook population estimates above Red Bluff.

Thank you for the opportunity to participate in this planning process. If you have any questions, please contact me at (530) 529-7342, or Ralph Hinton at (530) 529-7393.

Sincerely,

Dwight P. Russell

Dwight P. Russell, Chief
Northern District

Attachment

cc: Mr. Art Bullock, General Manager
Tehama-Colusa Canal Authority
Post Office Box 1025
Willows, California 95988

United States Department of the Interior

BUREAU OF RECLAMATION
Northern California Area Office
16349 Shasta Dam Boulevard
Shasta Lake, California 96019-8400

IN REPLY REFER TO:

NC-600
PRJ-8.10

FEB 13 2002

Mr. Brian Laheney
President
Red Bluff-Tehama County Chamber of Commerce
P.O. Box 850
Red Bluff, California 96080

Mr. Marshall Pike
Chairman
Red Bluff-Tehama County Convention and Visitor Bureau
P.O. Box 850
Red Bluff, California 96080

Subject: Red Bluff Diversion Dam Fish Passage Improvement Project

Dear Mr. Laheney and Mr. Pike:

Thank you for your letter of January 3, 2002, and your continuing interest in the Red Bluff Diversion Dam Fish Passage Improvement Project (Project).

Reclamation and the Tehama-Colusa Canal Authority (TCCA), as co-leads for their respective agencies, have considered many alternatives for the improvement of a reliable water supply delivery system to the Tehama-Colusa and Corning canals, and improvement for fish passage at the Red Bluff Diversion Dam (RBDD). Currently, Reclamation and TCCA are considering three basic alternatives:

Alternative 1 (Gates-in four months): This alternative would operate the RBDD with the gates-in, creating Lake Red Bluff to provide gravity flow to the Canals for four months each year, from May 15 to September 15. New fish ladders would be constructed. Pump capacity would increase to 1700 ft^3/s

Alternative 2 (Gates-in two months): This alternative would operate the RBDD with gates-in, creating Lake Red Bluff to provide gravity flow to the Canals for two months each year, from July 1 to September 1. No new fish ladders would be constructed. Pump capacity would increase to 2000 ft^3/s.

Alternative 3 (Gates out twelve months): This alternative would eliminate the operations of the RBDD gates, and would not create a lake for gravity flow. Pump capacity would increase to 2500 ft^3/s.

Although the TCCA Board of Directors has express their preference for Alternative 3, and the U.S. Fish and Wildlife Service, with the concurrence from the National Marine Fisheries Service and the California Departments of Fish and Game, ranked the alternatives in order of fishery resource benefits, (Alternative 3: greatest; Alternative 2: next, and Alternative 1: least beneficial), these are simply statements of resource-specific preferences, and do not represent decisions based upon an analysis of multiple interests.

Reclamation and the TCCA are seeking public input, primarily through the Stakeholders Working Group, to assist in evaluating the alternatives that are being considered. Through this process we will consider other viable alternatives, as well as modifications to the current alternatives being considered.

We appreciate your participation in planning and evaluating the Project, and look forward to continuing to work with the Red Bluff - Tehama County Chamber of Commerce. A copy of your comments has been forwarded to the Project team members noted below.

If you have any other comments or questions, please contact me at (530) 529-3890.

Sincerely,

Max J. Stodolski
Chief, Red Bluff Division

Enclosure

cc: Mr. Arthur Bullock
Tehama-Colusa Canal Authority
P.O. Box 1025
Willows, California 95988

Mr. Dale Cannon
CH2M Hill
P.O. Box 492478
Redding, California 96049-2478

Mr. Tom Kisanuki
Fish and Wildlife Service
10950 Tyler Road
Red Bluff, California 96080

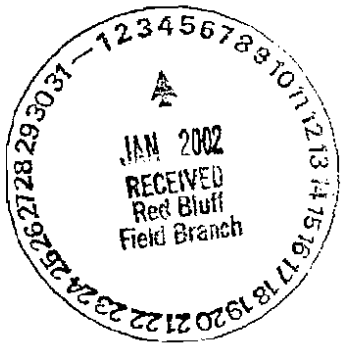
Mr. Harry Rectenwald
California Department of Fish and Game
601 Locust Street
Redding, California 96001

Mr. Mike Tucker
National Marine Fisheries Service
650, Capitol Mall, Suite 6070
Sacramento, California 95814

Mr. Ralph Hinton
California Department of Water Resources
2440 Main Street
Red Bluff, California 96080
(w/encl)

Red Bluff – Tehama County
HAMBER OF COMMERCE
Web Page: www.redbluffchamberofcommerce.com E-mail: rbchamber@tco.net

January 3, 2002



Mr. Max Stodolski
Bureau of Reclamation, Red Bluff Division
P.O. Box 159
Red Bluff, CA 96080

Dear Max:

In light of the pending decision of the TCCA regarding the future of the Red Bluff Diversion Dam and since the public agencies including the US Fish & Wildlife Service, California State Fish & Game, National Marine Fisheries Service and the US Forest Service have found it necessary to make their preferences known to you in writing, the Red Bluff Tehama County Chamber of Commerce and its Convention and Visitors Bureau feel that you should know our position regarding this decision as well.

The Chamber represents over 400 businesses in the Red Bluff and greater Tehama County area not including Los Molinos or Corning both of which have separate Chambers of their own. Our Chamber and Convention and Visitors Bureau have been active participants in the ongoing discussion of this issue for many years.

We have considered the full range of options and alternatives presented to TCCA by the technical advisory committee and concur with the overall purpose and need that the TCCA has adopted for the project with the clearest of understandings that the non-agricultural related features of the diversion dam and any changes to its regimen of use including modification to the four-month seasonal impoundment of the Sacramento River require mitigation as developed in the final record of decision. We understand that public comment will be welcomed at that time and we expect to participate fully.

TCCA and the Bureau of Reclamation should, however, be aware that the Chamber of Commerce will actively oppose any alternative chosen that eliminates the seasonal impoundment of the Sacramento River behind the gates of the Red Bluff Diversion Dam.

As such, we reaffirm our recommendation that the gates be operated in their "gates in" condition for 4 months beginning in May and ending in September of each year. Modification, particularly reduction in the number of months, must only be considered on a year by year basis with consideration given to the true and measurable biological results regarding the stock of those species that require protection under regulations existing at that time. Actions or decisions to elimate the opportunity for a full 4 month "gates in operation" when conditions are acceptable as determined by measurable biological study will be opposed. We are also concerned regarding any increase in

pumping capacity that will allow future water export beyond the legitimate demands of the Authority and its approved District users.

We request that the lead agencies maintain the utmost flexibility as they address the questions of reliable water and reliable protection of the species of concern. The human species is also of concern and many people take joy and life enriching sustenance from the Sacramento River in both its free running state and its lake-like condition each summer. To eliminate that opportunity would be a sad and irreparable disservice to as well as devaluation of the economic base of the community.

Sincerely,

Brian Laheney, President
Red Bluff-Tehama County
Chamber of Commerce

Marshall Pike, Chair
Red Bluff-Tehama County
Convention & Visitors Bureau

cc. Wally Herger, U.S. Congress
Doug Ose, U. S. Congress

Tehama-Colusa Canal Authority

5513 Highway 162
P.O. Box 1025
Willows, CA 95988

F . (530) 934-2125
Fax: (530) 934-2355
EMAIL: tcwaterman@aol.com

January 28, 2002

Mr. Brian Laheney, President
Red Bluff-Tchama County Chamber of Commerce
P.O. Box 850
Red Bluff, CA 96080

Mr. Marshall Pike, Chair
Red Bluff-Tehama County Convention & Visitors Bureau
P.O. Box 850
Red Bluff, CA 96080

Re: Comment Letter of January 3, 2002 regarding the TCCA Fish Passage Improvement Project at the Red Bluff Diversion Dam

Dear Mr. Laheney and Mr. Pike:

Thank you for your letter of January 3, 2002 regarding the "gates in" period at the Red Bluff Diversion Dam and your recommendation that the gate operation be maintained at the current 4 months "gates in" cycle beginning in mid May and ending in mid September of each year. Your position regarding the operation of the dam gates is noted and will be considered and incorporated in the environmental documents currently under preparation.

No final decision has been made on any of the Project alternatives being reviewed and evaluated, nor is any decision expected in the near future. An additional alternative to establish a "flexible" approach to gate closures was proposed at our last Stakeholders Working Group meeting on January 8th and we are currently developing the details on how such an alternative could work. We will then review the alternative with both the Stakeholders Working Group and the Technical Advisory Group to determine if it is feasible and should be more formally evaluated.

Your participation as a member of the Stakeholders Working Group insures that the viewpoints and concerns of the Chamber of Commerce are fully considered. We look forward to continuing the process over the ensuing months to complete the alternative evaluation process and develop the most appropriate solution to the fish passage and water supply reliability problems at the Red Bluff Diversion Dam.

Sincerely,

Arthur R. Bullock
General Manager & Chief Engineer

Red Bluff – Tehama County
HAMBER OF COMMERCE
Web Page: www.redbluffchamberofcommerce.com E-mail: rbchamber@tco.net

January 3, 2002

Mr. Art Bullock
Tehama Colusa Canal Authority
P. O. Box 1025
Willows, CA 95988

Dear Art:

In light of the pending decision of the TCCA regarding the future of the Red Bluff Diversion Dam.....and, since the US Fish & Wildlife Service, California Department of Fish & Game, the National Marine Fisheries Service, and the US Forest Service have found it necessary to make their preferences known to you in writing, the Red Bluff Tehama County Chamber of Commerce and its Convention and Visitors Bureau feel that you should know our position regarding this decision as well.

The Chamber represents over 400 businesses in Red Bluff and the greater Tehama County area, not including Los Molinos or Corning both of which have separate Chambers of their own. Our Chamber and Convention and Visitors Bureau have been active participants in the ongoing discussion of this issue for many years. Mr. Stodolski has been a regular attendee at our meetings, knows the discussions, and has provided us with assistance in understanding the process. We are grateful to him for his active interest in the community and for his understanding of the overall impact that the Diversion Dam has on the travel and tourism industry in our community as well.

We have considered the full range of options and alternatives presented to TCCA by the technical advisory committee and concur with the overall purpose and need that the TCCA has adopted for the project with the clearest of understandings that the non-agricultural related features of the diversion dam and any changes to its regimen of use (including modification to the four-month seasonal impoundment of the Sacramento River) require mitigation as developed in the final record of decision. We understand that public comment will be welcomed at that time and we expect to participate fully.

The Tehama Colusa Canal Authority and the Bureau of Reclamation should, be aware that the Chamber of Commerce will actively oppose any alternative chosen that eliminates the seasonal impoundment of the Sacramento River behind the gates of the Red Bluff Diversion Dam.

As such, we reaffirm our recommendation that the gates be operated in their "gates in" condition for 4 months beginning in May and ending in September of each year. Modification, particularly reduction in the number of months, must only be considered on a year by year basis with consideration given to the true and measurable biological results regarding the stock of those species that require protection under regulations existing at that time. Actions or decisions to elimate the

opportunity for a full 4 month "gates in operation" when conditions are acceptable as determined by measurable biological study will be opposed. We are also concerned regarding any increase in pumping capacity that will allow future water export beyond the legitimate demands of the TCCA and its approved District users.

We request that the lead agencies maintain the utmost flexibility as they address the questions of reliable water and reliable protection of the species of concern. The human species is also of concern and many people take joy and life enriching sustenance from the Sacramento River in both its free running state and its lake-like condition each summer. To eliminate that opportunity would be a sad and irreparable disservice to as well as devaluation of the economic base of the community.

Sincerely,

Brian Laheney, President
Red Bluff-Tehama County
Chamber of Commerce

Marshall Pike, Chair
Red Bluff-Tehama County
Convention & Visitors Bureau

cc: Wally Herger, U.S. Congress
Doug Ose, U. S. Congress

STATE OF CALIFORNIA - THE RESOURCES AGENCY GRAY DAVIS, *Governor*
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT
2440 MAIN STREET
RED BLUFF, CA 96080-2356

January 8, 2002

Mr. Max Stodolski
Chief, Red Bluff Division
U. S. Bureau of Reclamation
Post Office Box 159
Red Bluff, California 96080

Tehama-Colusa Canal Authority Fish Passage Improvement Project
at the Red Bluff Diversion Dam

Dear Mr. Stodolski:

The Department of Water Resources concurs with the attached "Planning Aid Memorandum" prepared by the U. S. Fish and Wildlife Service to evaluate the draft alternatives prepared for the Fish Passage Improvement Project. The purpose of this project is to substantially improve the reliability of both fish passage and water supply at the Red Bluff Diversión Dam.

The Department supports an alternative that best balances the fishery and water supply needs. We also prefer an alternative that provides the capability of diverting approximately 2,000 cfs into the Tehama-Colusa Canal during the winter months as a potential source of water for an offstream storage project, such as Sites Reservoir. As you know, such a project is currently under consideration as part of the CALFED planning process.

The alternatives that best fit these considerations are those which have the Red Bluff Diversion Dam gates out year-round or for 10 months and a total pumping capacity of 2,000 cfs or more, i.e. Alternatives 2 and 3.

Change to a two-month operation, or gates out year-round would lead to an increase in riparian vegetation in the existing Lake Red Bluff footprint. This vegetation would include both native and invasive introduced species, based on the species present in the Lake Red Bluff area today. So, from an aesthetic and wildlife standpoint, this increased growth would have both beneficial and detrimental effects.

The 1992 USBR Appraisal Report (page IV-7) indicates about 234 acres are within the fluctuation zone of Lake Red Bluff, so this is the area subject to increased growth with a two-month operation, or certainly with a gates out year-round alternative. This additional vegetation in the floodplain could have significant effects on water surface elevations in the Red Bluff area during high water events.

Improvement of Sale Lane and construction of the Bell Mill Shopping Center several years ago both placed considerable fill in the floodplain. In addition, gradual urban development and growth of vegetation during the last 30 years in the several overflow channels through the Antelope area has reduced the flood capacity of these bypass channels. The presence of Lake Red Bluff also has allowed deposition of a considerable amount of cobbles and sediment in the floodway, especially just below the Antelope Boulevard Bridge.

Additional riparian growth due to the Red Bluff Diversion Dam project will further reduce the flood carrying capacity of the Sacramento River in the Red Bluff area. This potential impact must be evaluated following Executive order 11988 and FEMA guidelines to determine if the reduction will increase water surface elevations. We believe that FEMA, the State Reclamation Board, Tehama County, and City of Red Bluff will all have concerns about this potential impact.

Winter-run Chinook salmon counts at the Red Bluff Diversion Dam originally were the basis for determining the allowable incidental take of juvenile winter-run salmon by the State Water Project and the federal Central Valley Project pumps in the Delta. Since the change to a four month gates-in operation several years ago, the estimates of winter-run Chinook have been made mostly by less accurate indirect methods. A two-month operation, or gates open year-round, would mean that only a very small percentage, or even no winter-run, could be directly counted and run-size estimates would be even less accurate. The same considerations also apply to the recently listed spring-run Chinook salmon. Therefore, if one of these alternatives is selected, additional effort should be made to increase the accuracy of the winter- and spring-run Chinook population estimates above Red Bluff.

Thank you for the opportunity to participate in this planning process. If you have any questions, please contact me at (530) 529-7342, or Ralph Hinton at (530) 529-7393.

Sincerely,

Dwight P. Russell

Dwight P. Russell, Chief
Northern District

Attachment

cc: ✓Mr. Art Bullock, General Manager
Tehama-Colusa Canal Authority
Post Office Box 1025
Willows, California 95988

Appendix H
Draft Adaptive Management Program

APPENDIX H

Draft Adaptive Management Program

Background

An Adaptive Management Program (AMP) is an important element of the Tehama-Colusa Canal Authority (TCCA) Fish Passage Improvement Project at the Red Bluff Diversion Dam (RBDD). The planning, development, and organizational components for implementing an AMP for all project alternatives considered in this Environmental Impact Statement/ Environmental Impact Report (EIS/EIR) is similar. Prior to project implementation, a specific AMP that is unique for that alternative will be developed and finalized through a Memorandum of Understanding (MOU) between TCCA and the appropriate resource agencies. The following discussion outlines the process for creating and the elements for implementing an effective AMP for any project that may be selected from those considered in the EIS/EIR process.

Definition and Overview

For the purposes of this project, adaptive management is a process that: (1) uses monitoring and research to identify and define problems, (2) examines various alternative strategies and actions for meeting measurable biological goals and objectives, and (3) if necessary, makes timely adjustments to strategies and actions based upon best scientific information available.

The primary reason for using an adaptive management process is to allow for changes in RBDD operating strategies or actions that may be necessary to achieve the long-term goals and/or biological objectives of the Fish Passage Improvement Project. Using adaptive management, activities conducted under the project will be monitored and analyzed to determine if they are producing the desired results (i.e., improvement in adult fish passage).

As implementation of the project proceeds, results will be monitored and assessed. If the anticipated goals and objectives of the project are not being achieved, then adjustments in operations or management actions will be considered and monitored through the Adaptive Management Plan.

Organization

Memorandum of Understanding

The organization for the AMP will follow the guidance provided and agreed upon in an MOU between the cooperating resource agencies and TCCA. The AMP MOU will memorialize an agreement of roles, responsibilities, the range of possible adaptive management measures that may be implemented to meet the goals of the Fish Passage Improvement Project, and the term of the AMP. The AMP will be generally organized as provided below.

Structure

The organizational structure of the AMP will consist of two major elements: the Adaptive Management Policy Committee (AMPC) and the Adaptive Management Technical Advisory Committee (AMTAC) (see Figure 1). Following an initial period of AMPC organizational meetings and discussions, there may be a need to create a(n) additional advisory committee(s). The AMPC will direct the creation or dissolution of any technical advisory committee(s).

Adaptive Management Policy Committee

This AMPC is the decision-making body for the AMP and consists of representatives of the cooperative member parties. A representative from each of the agreeing parties to the MOU will periodically meet and make final decisions on adaptive management strategies and actions relating to this AMP. A committee Chairman will be elected by AMPC and the Chair will rotate as agreed upon by the policy committee.

Members

The AMPC will consist of a management representative from each of the following parties:

- Tehama-Colusa Canal Authority
- U.S. Bureau of Reclamation
- U.S. Fish and Wildlife Service
- California Department of Fish and Game

Roles and Responsibilities

AMPC provides policy direction and resolves disputes and recommendations received from AMTAC. All final adaptive management strategies, actions, and decisions will be made through a consensus of AMPC. During the initial organizational meetings of this committee, AMPC will develop guidelines and processes for dispute resolution. These guidelines will assist in resolving non-consensus decisions within the committee. AMPC will provide strategy and direction for implementing all actions relating to the AMP.

Adaptive Management Technical Advisory Committee

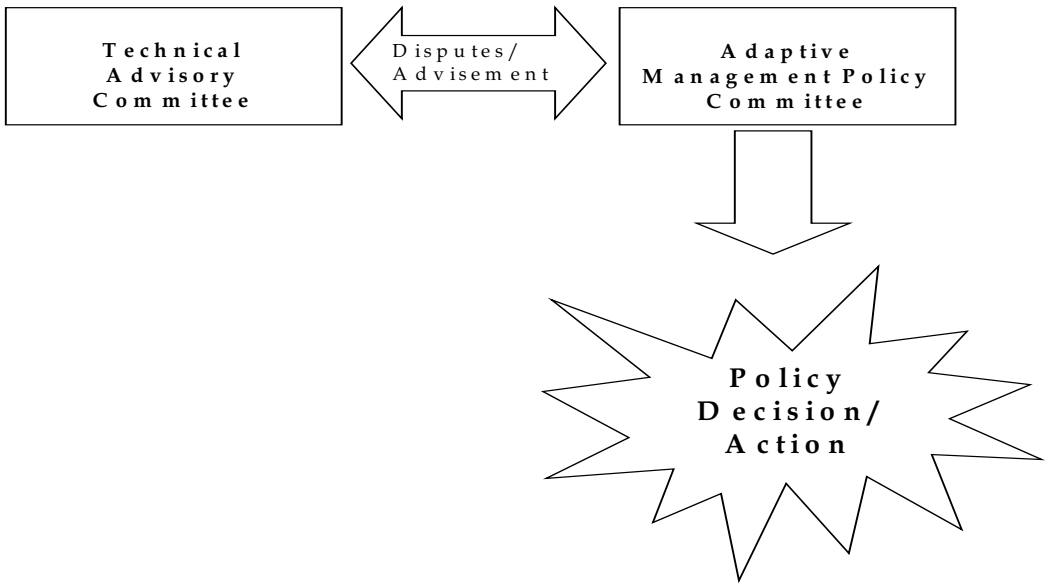
AMTAC will periodically meet, discuss and make recommendations to AMPC on the technical aspects of implementing the AMP. Voting members of AMTAC will consist of a fixed number of representatives who will be appointed by AMPC. The voting members of this Technical Committee will have appropriate education, training, and experience in fisheries and aquatic sciences; hydrology; and/or other expertise as recommended by AMPC. Other non-voting members may be added to the Technical Committee as deemed necessary by agreement of the voting members of AMTAC.

Members

It is anticipated that AMTAC will consist of one voting member from or representing each of the following agencies and groups:

- Tehama-Colusa Canal Authority
- Red Bluff Chamber of Commerce
- California Department of Fish and Game
- A&J Events

Figure 1. Organization of the Adaptive Management Program for the TCCA Fish Passage Improvement Project



- National Marine Fisheries Service
- Sacramento River Discovery Center
- Mendocino National Forest
- U.S. Fish and Wildlife Service
- City of Red Bluff
- U.S. Bureau of Reclamation

Roles and Responsibilities

AMTAC will meet, develop, and make recommendations to AMPC on strategies and actions for implementing the AMP. Following final decisions by AMPC, implementation of all AMP actions will be made by AMTAC. The Chairman of AMTAC will be selected from the voting members of the Technical Committee and will rotate regularly as agreed upon by the voting members of AMTAC.

Funding

Funding for the provisions of the AMP will come from several sources as identified and agreed upon in the AMP MOU. Provisions establishing and administering an interest-bearing Adaptive Management Fund (AMF) for implementing the AMP will be described and agreed upon in the MOU. In addition, terms for any cost-sharing agreement will be provided through agreements reached and memorialized in this MOU. The purpose of the AMF is to provide a readily available source of money to be used for possible actions or changes to the Fish Passage Improvement Project as identified through the adaptive management process.

Term

The term of the AMP will begin following the signing of the Record of Decision for the project. It is anticipated that the effective term of the AMP will be at least 10 years. Any decision to terminate or extend the AMP beyond that period will be made by AMPC. Any AMF funds remaining and uncommitted at the termination of AMP will revert to the original source of funding or as agreed to in the MOU.

Adaptive Management Objectives

The AMP will be based on objectives that meet the goals of improving migratory fish passage at RBDD. The final and specific AMP objectives will be developed by AMPC and AMTAC. It is anticipated that the primary focus of these objectives will be to provide passage of migratory fish species at the RBDD facilities. The AMP objectives will likely seek to provide management actions for RBDD operations sufficient to prevent impedance to migratory fish species and allow recovery of their populations. It is likely that these objectives will include or be similar to those outlined in Table 1.

TABLE 1
Potential Adaptive Management Objectives for the TCCA Fish Passage Improvement Project

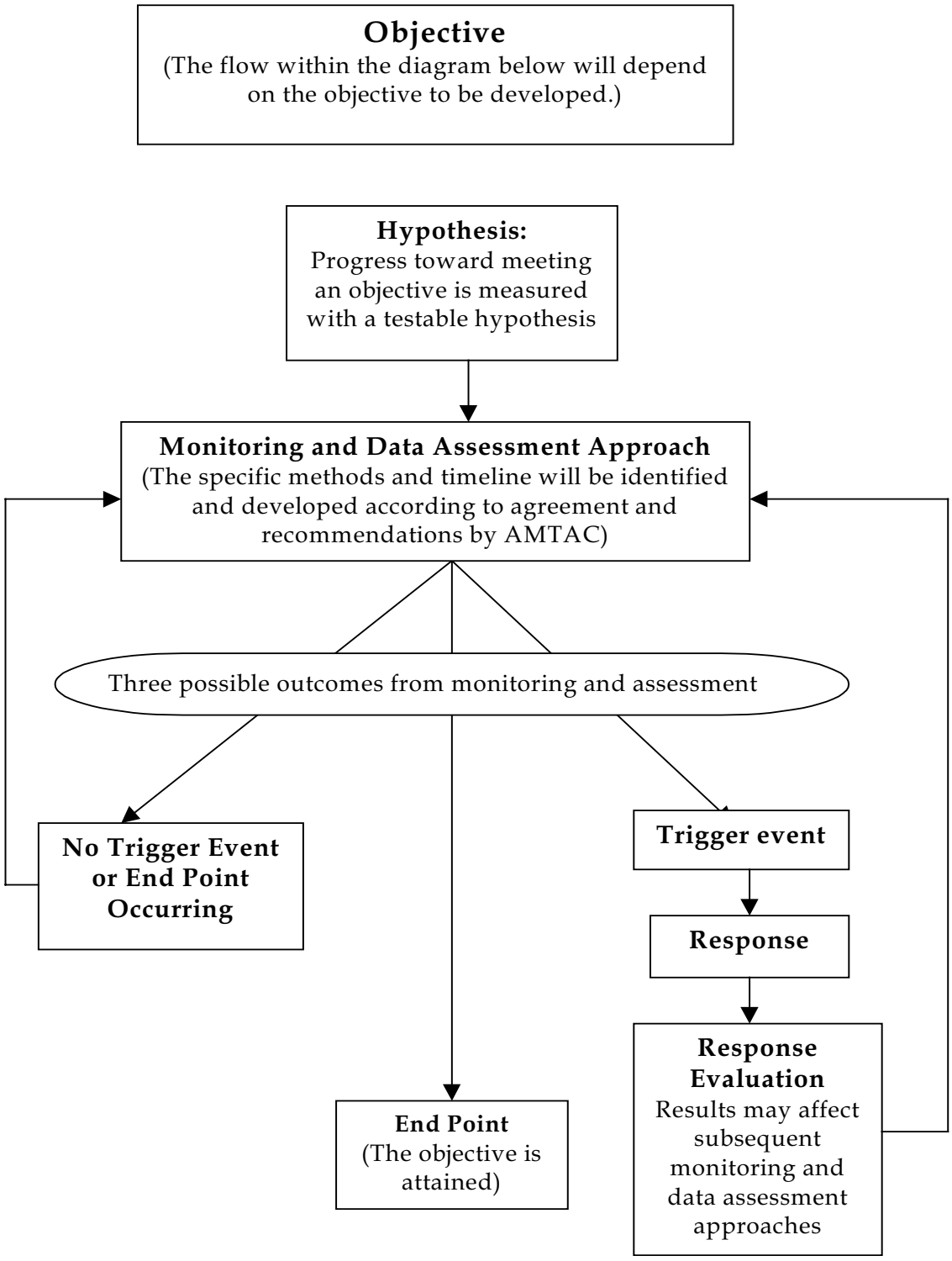
Salmon and Steelhead Passage Objectives
1. Allow upstream passage of adult salmon and steelhead at levels sufficient to ensure that the facilities at RBDD do not impede the overall survival and recovery of these species.
2. Allow downstream passage of juvenile salmon and steelhead at levels sufficient to ensure that the facilities at RBDD do not impede the overall survival and recovery of these species.
Sturgeon and Other Anadromous Fish Passage Objectives
1. Allow upstream passage of adult green sturgeon and lamprey at levels sufficient to ensure that the facilities at RBDD do not impede the overall survival and recovery of these species.
2. Allow downstream passage of juvenile green sturgeon and lamprey transformers at levels sufficient to ensure that the facilities at RBDD do not impede the overall survival and recovery of these species.
Predatory Fish Management Objectives
1. Ensure upstream passage of adult predatory fish at levels sufficient to ensure that their presence at the RBDD facilities does not impede the overall survival and recovery of anadromous species.
2. Minimize congregations of adult predatory fish downstream of the RBDD facilities at levels sufficient to ensure that their presence at the RBDD facilities does not impede the overall survival and recovery of anadromous species.

For any objective eventually selected, all reasonable and implementable measures within the boundaries discussed below will be considered in developing study designs for testing hypotheses and management actions and programs for this AMP. The components of each objective analysis include:

- A hypothesis
- A monitoring and data assessment approach
- A timeline
- Trigger events
- Response(s)
- Response limits
- A response evaluation
- End point(s)
- Reporting of results
- Responsibilities and funding

A generalized flow chart identifying the steps and components of an AMP objectives' evaluation is shown on Figure 2. For each objective identified, the Adaptive Management process will use hypothesis testing to determine if an objective is being met. The methods used to test hypotheses is are shown as the "Monitoring and Data Assessment Approach" box in Figure 2. These methods will likely use existing surveys and data analysis currently being conducted in the upper Sacramento River Watershed (e.g., the California Department of Fish and Game Stream Evaluation Program's annual carcass surveys).

Figure 2. Flow Chart of the Components of Adaptive Management Objectives and Their Relationships



The three possible outcomes of the Monitoring and Data Assessment step include reaching the objective, not reaching the objective, and meeting an objective partially (Figure 2). Monitoring and adaptive management based on the results of monitoring are iterative and long-term processes (Williams et al., 1997). Feedback of the final two scenarios into the Monitoring and Assessment step would result in continued re-definition and subsequent monitoring until the objective has been obtained or the objective timeline expires.

Adaptive Management Boundaries

Boundaries that would constrain adaptive management actions, for any project selected for implementation, would likely include:

- Temporal boundaries (e.g., RBDD gates-in operational periods)
- Spatial boundaries (e.g., geographical vicinity of Lake Red Bluff)
- Physical boundaries (e.g., project structural facilities)
- Operational boundaries (e.g., RBDD gate operational settings)
- Biological boundaries (e.g., native anadromous fish species)

For example, the RBDD gates-in operational periods, as they are presently defined in the Biological Opinion for the Long-term Operation of the Central Valley Project and State Water Project (National Marine Fisheries Service, 1993), may constitute a temporal boundary for adaptive management. This boundary would constrain any adaptive management action for any project alternative selected.

Therefore, for any project alternative selected for implementation, it will be necessary to define all boundary conditions to guide adaptive management study design and subsequent hypothesis testing. These boundary conditions for adaptive management purposes will be developed and specified by AMTAC and AMPCs.

Project-specific Adaptive Management Plans

No Action Alternative

If this alternative is selected, possible management actions would likely be limited to the period from mid-May through mid-September. Therefore, study designs, which would be developed to test hypothesis relating to improving passage of adult or juvenile anadromous fish at RBDD, would likely be restricted to this time interval. Any adaptive management action requiring gate-in operations outside of the existing 4-month operational period (mid-May through mid-September) would necessitate reconsultation with the National Marine Fisheries Service before the action could be implemented.

The physical and operational boundaries would include the existing fish ladders, fish protection facilities, and the RBDD gate operational limitations.

4-month Gates-in with Improved Ladder Alternative

If this alternative is selected, possible management actions would also likely be limited to the period from mid-May through mid-September. Study designs, which would be developed to test hypotheses relating to improving passage of adult or juvenile anadromous

fish at RBDD, would likely be restricted to this time interval. An adaptive management action requiring gate-in operations outside of the existing 4-month operational period (mid-May through mid-September) would necessitate reconsultation with the National Marine Fisheries Service before the action could be implemented.

The physical and operational boundaries would include new fish ladders, any newly constructed pumping and fish protection facilities, and RBDD gate operational limitations.

4-month Gates-in with Bypass Channel Alternative

If this alternative is selected, possible management actions would also likely be limited to the period from mid-May through mid-September. Study designs, which would be developed to test hypotheses relating to improving passage of adult or juvenile anadromous fish at RBDD, would likely be restricted to this time interval. An adaptive management action requiring gate-in operations outside of the existing 4-month operational period (mid-May through mid-September) would necessitate reconsultation with the National Marine Fisheries Service before the action could be implemented.

The physical and operational boundaries would include the new right bank fish ladder, the existing left bank fish ladder, a newly constructed bypass channel, any new pumping plant and fish protection facilities, and RBDD gate operational limitations.

2-month Gates-in with Improved Ladder Alternative

If this alternative is selected, possible management actions would also likely be limited to the period from mid-May through mid-September. Study designs, which would be developed to test hypotheses relating to improving passage of adult or juvenile anadromous fish at RBDD, would likely be restricted to this time interval. An adaptive management action requiring gate-in operations outside of the existing 4-month operational period (mid-May through mid-September) would necessitate reconsultation with the National Marine Fisheries Service before the action could be implemented. However, AMP actions within the existing 4-month gates-in operational period would likely not require reconsultation.

The physical and operational boundaries would include new right and left bank fish ladders, removal of the center fish ladder, any newly constructed pump stations and fish protection facilities, and RBDD gate operational limitations.

2-month Gates-in with Existing Fish Ladders Alternative

If this alternative is selected, possible management actions would also likely be limited to the period from mid-May through mid-September. Study designs, which would be developed to test hypotheses relating to improving passage of adult or juvenile anadromous fish at RBDD, would likely be restricted to this time interval. An adaptive management action requiring gate-in operations outside of the existing 4-month operational period (mid-May through mid-September) would necessitate reconsultation with the National Marine Fisheries Service before the action could be implemented. However, AMP actions within the existing 4-month gates-in operational period would likely not require reconsultation.

The physical and operational boundaries would include the existing right and left-bank fish ladders, removal of the center fish ladder, any newly constructed pump stations and fish protection facilities, and RBDD gate operational limitations.

Gates-out Alternative

If this alternative is selected, possible management actions would also likely be limited to the period from mid-May through mid-September. Any AMP study designs, which would be developed to test hypotheses relating to the efficiency of the passage of adult or juvenile anadromous fish at RBDD, would likely be restricted to this time interval. An adaptive management action requiring gate-in operations outside of the existing 4-month operational period (mid-May through mid-September) would necessitate reconsultation with NMFS before the AMP action could be implemented. However, AMP actions within the existing 4-month gates-in operational period would likely not require reconsultation.

The physical and operational boundaries would include the existing right and left bank fish ladders, removal of the center fish ladder, any newly constructed pump stations and fish protection facilities, and RBDD gate operational limitations.

Linkages with Other Programs

For any project alternative selected, a disclosure and acknowledgement of the linkages between the project's AMP and all pertinent state, federal, and local programs and directives will be prepared and included in the AMP for that project. These linkages would include internal project planning elements (e.g., Project Operations and Management Plans) and non-project program elements (e.g., Central Valley Project Improvement Act-Anadromous Fish Restoration Program) within the Sacramento River. Understanding the linkages of this project with ongoing actions within the Sacramento River watershed and the Central Valley will assist in planning, funding, and Implementing the AMP.

Protocols

Specific guidance protocols for conducting elements the AMP must be developed by the AMTAC under the direction of AMPC. These protocols will provide standards for AMP activities and outline specific responsibilities, methods, and procedures for the activities of the AMP. The following is a partial list of potential protocols that will be needed for the project AMP.

- Data management
- Process
    1. Meeting schedule
    2. Meeting processes
    3. Reporting
    4. Adaptive response process
    5. Prioritizing response proposals
    6. Budget review
- Monitoring and data assessments
- Funds management
- Dispute resolution

Appendix I
Draft Fish and Wildlife Coordination Act Report

State of California - The Resources Agency
DEPARTMENT OF FISH AND GAME
http://www.dfg.ca.gov

601 Locust Street
Redding, CA 96001
(530) 225-2300

GRAY DAVIS, Governor

August 19, 2002

Mr. Wayne White, Field Supervisor
Sacramento Office
U.S. Fish and Wildlife Service
2800 Cottage Way, Room W. 2605
Sacramento, California 95825

Dear Mr. White:

The Department of Fish and Game (Department) has reviewed the "Draft Fish and Wildlife Coordination Act Report: Tehema-Colusa Canal Authority Fish Passage Improvement Project, Red Bluff Diversion Dam, Red Bluff, Tehema County, California." The US Fish and Wildlife Service (USFWS) prepared the report in consultation with biologists from the Department and the National Marine Fisheries Service. The report builds on the USFWS biological analysis of problems at Red Bluff Diversion Dam (RBDD) presented in a final report that was previously endorsed by the Department titled "Supplemental Fish and Wildlife Coordination Act Report: Red Bluff Diversion Dam and the Tehama-Colusa Canal". At this time the Department concurs with the findings and recommendations presented in the current Draft Coordination Act Report which is focused on implementing a solution. The RBDD fish passage problem is considered one of the highest priority projects to attain the objectives for salmon and steelhead restoration.

The draft report supports implementation of the "Gates-out Alternative" to correct adverse effects to fish and wildlife caused by the Central Valley Project's RBDD. Removal of the gates on a year-round basis will reestablish riverine environment at Red Bluff while supplying water to the Tehama-Colusa Canal using a pumping plant with a state of the art fish screen. The performance of this alternative is absolutely certain for providing unimpeded passage of anadromous fish that must move both upstream and downstream of Red Bluff to successfully complete their life cycle. Achieving a remedy with long-term certainty at this site is consistent with the Cal Fed Multispecies Conservation Plan (2000), Draft Sacramento River Winter-run Recovery Plan (1997), Status Review of the Spring-run Chinook in the Sacramento River (1998) and the California Fish and Game Commission (correspondence dated March 22, 1994). In addition, unimpeded passage of migratory fish at RBDD is essential to repopulate the unique and important habitats being restored at great expense in the watershed upstream to Keswick Dam.

Implementing the Gates-out Alternative represents an ecosystem approach to restoration consistent with the Cal Fed Ecosystem Restoration Plan. A significant restoration opportunity is provided along the Sacramento River by allowing the lake to

revert to riverine habitat to provide continuity in the river's riparian corridor. Providing year-round riverine habitat is environmentally superior to seasonal lake habitat for the fish and wildlife that evolved in the river basin. In addition, taking the gates out of the river returns full navigability to this river reach for boat anglers and others. The Cal Fed Program expects this form of recreation to grow in the future as the basinwide restoration efforts restore the fishery.

Thank you for the opportunity to participate in the effort to restore this valuable section of the Sacramento River. If there are any questions regarding our comments, please contact Environmental Specialist IV Harry Rectenwald at (530) 225-2368.

Sincerely,

Donald Koch

DONALD B. KOCH
Regional Manager

cc: Attention Mr. Mike Urkoff
CH2MHill
Post Office Box 492478
Redding CA 96049-2478

Attention Mr. Jim Smith
Central Valley Fish and Wildlife Office
US Fish and Wildlife Service
10950 Tyler Road
Red Bluff CA 96080

Attention Max J. Stodolski, Chief
Red Bluff Division
US Bureau of Reclamation
Post Office Box 159
Red Bluff CA 96080-0159

U.S. Department of the Interior
Fish and Wildlife Service

Draft
Fish and Wildlife Coordination Act Report

Tehama-Colusa Canal Authority Fish Passage Improvement Project, Red Bluff Diversion Dam, Tehama County, California

Prepared By
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EXECUTIVE SUMMARY

This document constitutes the U. S. Fish and Wildlife Service's (Service) Draft Fish and Wildlife Coordination Act (FWCA) report to the U.S. Bureau of Reclamation (Reclamation) for the Tehama-Colusa Canal Authority Fish Passage Improvement Project. The FWCA provides that Federal agencies consult with the Service before undertaking or approving projects carried out under Federal permits and licenses that control or modify any bodies of water for any purpose, and that fish and wildlife resources receive equal consideration and be coordinated with other features of the projects. The purpose of FWCA consultation is to conserve fish and wildlife resources by preventing their loss or damage, and by developing and improving these resources. This report addresses expected beneficial and adverse effects on fish and wildlife resources due to project alternatives, and provides recommendations for implementing the project.

A primary purpose of the project is to substantially improve the long-term capability to reliably pass anadromous fish, both upstream and downstream, past Red Bluff Diversion Dam (RBDD), Tehama County, California. A preferred alternative has not been selected by the Reclamation at the time of this writing. The focus of this report is to assess biological benefits and adverse effects of proposed alternatives in coordination with the California Department of Fish and Game (CDFG) and National Marine Fisheries Service (NMFS), and recommend an alternative to Reclamation that can be supported by the Service, CDFG, and NMFS. The report addresses both construction and operation of the proposed alternatives, and provides mitigation and enhancement recommendations to Reclamation.

Section 3406(b)(10) of the Central Valley Project Improvement Act (CVPIA; Public Law 102-575) authorized and directed the Department of the Interior to develop and implement measures to minimize fish passage problems for anadromous fish at the RBDD. No specific measures were identified. Reclamation is the lead Federal agency for project compliance with the National Environmental Policy Act (NEPA) and the Tehama-Colusa Canal Authority (TCCA) is the State lead agency for compliance with the California Environmental Quality Act (CEQA). The CDFG is a Responsible Agency under CEQA, with respect to issuing a Streambed Alteration Agreement (Fish and Game Code sections 1600 ***et seq***.) and for the purposes of the California Endangered Species Act (Fish and Game Code sections 2080 ***et seq***.). In addition, the California Department of Water Resources (DWR), NMFS, and the Service have been involved as cooperating agencies at both the technical and management levels of project planning.

This report provides support for minimizing the length of time that fish passage is impaired at RBDD. The Gates-out Alternative eliminates the gates-in position entirely, and is the recommended alternative in this report. The alternatives that reduce the gates-in position to two months from four months also provide improved fish passage at RBDD compared to present gate operations; however, the 2-month gates-in alternatives maintain a gravity dam in the river and do not maximize the benefits to resident and anadromous fish. The 2-month gates-in alternatives also do not provide CALFED Bay-Delta Program-supported ecosystem benefits, which would result from restoring the river channel and riparian corridor, nor meet the CVPIA priority for measures that protect and restore natural channel and riparian habitat values.

In addition to maximizing fish passage benefits at the dam, the Gates-out Alternative provides the opportunity to restore two linear miles of riverbank and associated riparian habitat. This habitat presently is adversely affected by the temporary Lake Red Bluff, which forms from backed up river water when the RBDD gates are down.

The Gates-out Alternative is a significant restoration opportunity along the Sacramento River, as restoring one linear mile of riparian forest corridor would help link other riparian forest areas along the river. This would be an ecosystem-wide benefit that has the potential to positively affect numerous aquatic and terrestrial species in the Central Valley of California that use shaded riverine aquatic cover and other components of riparian forest. Many of these species have State or Federal protection status. Restoring the riparian community at Lake Red Bluff, therefore, has the potential to benefit a wide range of the Central Valley's fish and wildlife resources.

Lastly, this section of the Sacramento River is designated as a navigable reach of the river under State of California Harbors and Navigation Code, Section 105, and navigation is an authorized purpose of the Shasta Unit of the Central Valley Project (CVP). The Gates-out Alternative returns this reach of the river to year-round navigation access.

The preparation of this report was coordinated with the Service's Red Bluff Fish and Wildlife Office, CDFG, and NMFS. Concurrence letters from CDFG and NMFS for the findings and recommendations provided in this report are included in Appendix F.

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INTRODUCTION

This is the U.S Fish and Wildlife Service's (Service) Fish and Wildlife Coordination Act (FWCA) report for the proposed Tehama-Colusa Canal Authority (TCCA) Fish Passage Improvement Project at the Red Bluff Diversion Dam (RBDD). The report addresses expected beneficial and adverse effects on fish and wildlife resources due to the project. This report has been prepared under the authority, and in accordance with Section 2(b) of the FWCA (Public Law 85-624; 16 U.S.C. 661-667e). The FWCA provides that fish and wildlife resources receive equal consideration and be coordinated with other features of Federal projects and projects carried out under Federal permits and licenses that control or modify any bodies of water for any purpose. The FWCA requires Federal agencies to consult with the Service before undertaking or approving such projects. The purpose of the consultation is to conserve fish and wildlife resources by preventing their loss or damage, and by developing and improving these resources.

This report has been coordinated with the Service's Red Bluff Fish and Wildlife Office, U.S. Bureau of Reclamation (Reclamation), California Department of Fish and Game (CDFG), and National Marine Fisheries Service (NMFS), and augments the Service's 1998 and 1967 FWCA reports. The CDFG and NMFS have reviewed this report and their concurrence letters are provided in Appendix F. The Service's findings and recommendations would need to be updated should the proposed project change from that presented in this report.

Guidance for the Service's recommendations contained in this report is provided, in part, by goals and objectives of the Service's Anadromous Fish Restoration Program (AFRP). The AFRP was developed in accordance with Section 3406(b)(1) of the CVPIA, which directs the Secretary of the Interior to develop and implement a program which makes all reasonable efforts to double natural production of anadromous fish in Central Valley streams. The AFRP's Final Restoration Plan (USFWS 2001) presents the goal, objectives, and strategies of the AFRP.

The purpose of the proposed project is twofold:

- Substantially improve the long-term ability to reliably pass anadromous fish, including endangered winter-run chinook salmon, threatened spring-run chinook salmon, threatened steelhead, and other species of concern, both upstream and downstream, past RBDD.

- Substantially improve the long-term ability to reliably and cost-effectively move sufficient water into the Tehama-Colusa Canal (TCCA) and Corning Canal systems to meet the needs of the water districts served by TCCA.

Both beneficial and adverse effects on fish and wildlife resources due to the project are evaluated in this report. Impacts to federally listed or proposed species, have been addressed under the Endangered Species Act of 1973, as amended (ESA) (Appendix A). The Service's analysis is based on biological and engineering information provided by the State and Federal lead, responsible, trustee, and cooperating agencies. This report's evaluation also is based on site visits to the project area, review of project-related literature, personal communications with recognized experts, and best professional judgment.

Recommendations to compensate for adverse effects are based on the Service's Mitigation Policy (***Federal Register*** 46:15; January 23, 1981). The Service's Mitigation Policy provides internal guidance for appropriate mitigation recommendations. Under the Mitigation Policy, resources are divided into four categories to assure that recommended mitigation is consistent with fish and wildlife habitat values affected by a project. The categories range from habitat values considered to be unique and irreplaceable (Resource Category 1) to those believed to be of relatively low value (Resource Category 4). How a proposed action affects selected evaluation species occupying these habitats determines the mitigation the Service will seek for the project. In addition, the Service has a Regional policy of "no net loss of wetland values or acreage," whichever is greater.

The Council of Environmental Quality regulations for implementing NEPA define mitigation to include: 1) avoiding the impact; 2) minimizing the impact; 3) rectifying the impact; 4) reducing or eliminating the impact over time; and 5) compensating for the impact. The Service's Mitigation Policy uses this same definition of mitigation and considers those elements, in that order, to represent the desired sequence in the mitigation planning process. The Mitigation Policy outlines internal guidance for Service personnel to protect and conserve fish and wildlife resources while facilitating the balanced development of the Nation's natural resources.

Each of the four Resource Categories has designation criteria and specific mitigation goals (Table 1). The planning goal of Resource Category 2 is "no net loss of in-kind habitat value." To achieve this goal, any unavoidable losses would need to be replaced in-kind. As defined in the Service's Mitigation Policy, "in-kind replacement" means providing or managing substitute resources to replace the habitat value of the resources lost, where such substitute resources are physically and biologically the same or closely approximate those lost.

Table 1. Resource Categories and mitigation planning goals, as provided by the Fish and Wildlife Service Mitigation Policy.

Resource Category	Designation Criteria	Mitigation Planning Goal[1]
1	High value for evaluation species and unique and irreplaceable	No loss of existing habitat value
2	High value for evaluation species and scarce or becoming scarce	No net loss of in-kind habitat value
3	High to medium value for evaluation species and abundant	No net loss of habitat value while minimizing loss of in-kind habitat value
4	Medium to low value for evaluation species	Minimize loss of habitat value

[1]Unavoidable losses of habitat value would need to be replaced in-kind. In-kind replacement means providing or managing substitute resources to replace the habitat value of the resources lost, where such substitute resources are physically and biologically the same or closely approximate to those lost.

In applying the Mitigation Policy, the Service first identifies each specific habitat or cover type that may be impacted by the project. Evaluation species which utilize each habitat or cover type are then selected for resource category determination. Selection of evaluation species can be based on several rationales, including: 1) species known to be sensitive to specific land and water use actions; 2) species that play a key role in nutrient cycling or energy flow; 3) species that utilize a common environmental resource; or 4) species that are associated with important resource problems, such as anadromous fish and migratory birds, as designated by the Director or Regional Directors of the Service.

Based on the relative importance of each specific habitat to selected evaluation species and the habitat's relative abundance, uniqueness, and replaceability, the appropriate Resource Category and associated mitigation planning goal are determined. Recommendations to mitigate unavoidable adverse impacts, as well as to enhance fish and wildlife resource, are provided.

PROJECT BACKGROUND

RBDD is located in north-central California on the Sacramento River about 2 miles southeast of the City of Red Bluff. The dam and the lake formed by the dam, Lake Red Bluff, are owned and operated by Reclamation. The lake is about 3 miles long and contains 3,900 acre-feet of water at normal water surface elevation.

The dam and lake are part of the Sacramento Canals Unit of CVP. The unit was designed to provide irrigation water in the Sacramento Valley, mainly in Tehama, Glenn, and Colusa counties. Also, a part of the unit are the Tehama-Colusa (TC) and Corning canals, which deliver the irrigation water to areas in Tehama, Glenn, and Colusa counties.

The dam is a concrete structure 52 feet high and 740 feet long. It consists of 11 gates, each 18 feet high and 60 feet long. The gates are raised and lowered to control the level of Lake Red Bluff and enable diversions to the TC canal. The headworks of the dam, which is a structure through which water from the lake is diverted into the TC canal, is located on the right abutment of the dam.

The dam gate closest to the right abutment (#11) is operated as a sluice gate to remove sediment accumulation near the headworks. The first section of the TC canal, downstream from the headworks, is enlarged to act as a sediment basin. Sediment deposited in the basin is removed by dredging. The diversion capacity of the first section of the TC and Corning canals is 3,030 cubic feet per second (cfs). A series of drum screens downstream from the headworks prevents fish passing through the headworks from entering the canals. A bypass system then returns those fish to the river.

A fish ladder is located on each abutment of the dam. The steps of the fish ladders drop the water surfaces in the ladders in 1-foot increments as flows pass downstream. Auxiliary flow is added to the ladders near their downstream ends to create a higher flow velocity in the ladders where they enter the river below the dam. This higher velocity is intended to attract upstream

migrating fish to the entrance of the fish ladder. A temporary ladder ("center ladder") is installed annually in gate #6, and operates during the gates-in period. The center ladder was not installed during the 2001 and 2002 gates-in periods due to an experiment whereby the majority of the dam's discharge is released through Gate Nos. 5, 6, and 7. This experiment is referred to as the "Crowning Flow" study and is intended to determine whether this flow release pattern aids fish passage.

Prior to the completion of RBDD, anadromous fish had unimpeded passage through the current dam site. Construction of the dam created a partial barrier in the Sacramento River, by impeding, delaying, and sometimes blocking passage to spawning and rearing habitat in the river and its tributaries above the dam. During 1983, the Service, along with Reclamation, CDFG, NMFS, and DWR initiated a five-year Fish Passage Action Program aimed at developing methods to improve upstream and downstream anadromous fish passage at RBDD (USFWS 1988). This study concluded that the delay of adult chinook salmon was as long as 50 days and blockage was as high as 44 percent (USFWS 1988). Another conclusion was that the RBDD fish ladders operated at maximum design flow capacity do not provide adequate attraction for adult salmon. Since the studies took place in the mid-1980's, the east and west fish ladders have remain unchanged. Radio-telemetry studies conducted on adult fall-run chinook during 2000 and 2001 by the Service suggest that delays are still occurring at RBDD (USFWS, unpublished data).

Constructed in the mid-1960's, the dominant feature of RBDD are its gates. When the gates are lowered into the Sacramento River, the elevation of the water surface behind the dam is raised, allowing gravity diversion into the TC and Corning canals for delivery to irrigation districts. Raising the gates allows the river to flow virtually unimpeded but precludes gravity diversion into the canals. When the gates are lowered, RBDD presents a barrier for both upstream- and downstream-migrating fish because fish ladders, included in the original dam design, have proven to be inefficient at certain flows to pass anadromous fish to upstream spawning grounds. Additionally, the tailrace and lake created by the dam provide habitat for species that prey on juvenile salmon, reducing their overall survival rates and impeding passage downstream of the dam. When the dam gates are lowered, predators congregate below the dam, creating difficult conditions for juvenile downstream passage. Juveniles are forced to pass RBDD in their migration either by using the fish ladders or under the dam gates. Most juveniles pass below the gates, and in the process, are likely disoriented and vulnerable to predation.

A Biological Opinion for endangered winter-run chinook salmon, issued in 1993 by the NMFS, requires that the gates be kept in the raised (non-diverting) position (gates-out) for a greater portion of the year (September 15 to May 14) than had been required previously. This has significantly improved fish passage at RBDD, but does not include the entire time that winter-run and spring-run chinook salmon are migrating upstream.

The removal of the gates has made the facility less effective as a water source for agriculture. The current schedule for gates in the lowered (diverting) position may be subject to further reduction, if it is found to be a reasonable and prudent action, to avoid jeopardy to species recently listed as endangered under the Federal ESA or the California Endangered Species Act if the facility becomes the property of a state or private entity. Species of consideration include

winter-, spring-, and fall/late fall-run chinook salmon, steelhead, and Sacramento splittail. However, further reduction of the gates-in period would further reduce RBDD's ability to divert water for agriculture.

In general, the proposed alternatives focus on the operation of RBDD. Fish ladders constructed under the original dam design have proven to be inefficient (causing delay and blockage of adult fish) at certain flows to pass anadromous fish to upstream spawning grounds as well as fish that predate on juvenile salmonids, creating congregations of predators that impair downstream passage of juveniles. The direct and indirect impacts of the alternatives occur within the Sacramento River basin.

A more thorough description of the project background is provided in the Service's Supplemental FWCA Report dated February 19, 1998.

PROJECT ALTERNATIVES

The planning process has focused on five major alternatives. These alternatives involve modifying or replacing the existing fish ladders, creating a bypass channel, and/or shortening the length of time that the diversion dam gates are lowered. All alternatives include a new pump station at the Mill Site, which is located on the west bank of the Sacramento River immediately north of the existing facilities. The Service ranked these alternatives in order of which provide the most substantial improvements in reliable upstream passage in an earlier Planning Aid Memorandum to Reclamation, dated October 19, 2001 (Appendix B).

Subsequent to issuance of this Service memorandum, decisions at the technical and agency management level have dismissed an early alternative to develop a water diversion from Stony Creek. This alternative would not have improved fish passage conditions at RBDD over the No-Action Alternative. Various changes were also made to other alternatives. All action alternatives accommodate future demand by the water users of TCCA in design of diversion facilities (Table 2). It is therefore anticipated that TCCA will eventually divert the maximum amount of water allowed by their contract. Currently, TCCA diverts less than their maximum allowable amount.

At the time of this writing, Reclamation has not selected a preferred alternative. The state lead agency, TCCA, voted on December 5, 2001 to select the Gates-out Alternative as their preferred alternative. All of the five remaining alternatives will be examined in the NEPA document and in this report. Alternatives are named by the number of months that gates are down and the fish passage solution (improved or existing ladders or bypass)

Alternative 1A: 4-month Improved Ladders

The dam gates would remain down from May 15 to September 15, which is the current dam operation. This alternative includes construction of a 1,380 cfs capacity pump station with a fish screen at the Mill site and continued pumping at the Research Pumping Plant (RPP). A

Table 2. Tehama-Colusa Canal Authority Water Demands (CH2MHill 2002a).		
Period	**Peak Historical Water Order**	**Facilities Design Assumptions**
May 1-15	1901 cfs	1700 cfs
May 16-31	1231 cfs	2000 cfs
June	1545 cfs	2000 cfs
July	2209 cfs	2500 cfs
August	1125 cfs	2500 cfs
September 1-15	1049 cfs	2000 cfs

conveyance facility would be installed across Red Bank Creek to convey water from the pump station to the TC canal.

Alternative 1B: 4-month Bypass

This alternative continues the current operation of the dam with gates down from May 15 to September 15. A new higher flow fish ladder (right bank only) and a 1,000 cfs bypass channel on the left bank would be constructed to achieve improved fish passage. This alternative includes construction of a 1,380 cfs pumping capacity pump station with fish screen at the Mill site and continued pumping at the RPP. A conveyance facility would be installed across Red Bank Creek to convey water from the pump station to the TC canal.

The bypass channel concept that is being evaluated for this project has been configured to reduce costs, limit flood impacts and liability, and minimize adverse water quality changes to the Sacramento River near RBDD. Specifically, the objective has been to establish physical characteristics that allow for fish passage.

Alternative 2A: 2-month with Improved Ladders

This alternative reduces the current gates-in operation of the dam to July 1 to August 31. Improvements to fish passage would be achieved through the reduction in gate operations and with construction and operation of new, higher-flow fish ladders. This alternative includes construction of a 1,680 cfs pumping capacity pump station with a fish screen at the Mill site and continued pumping at the RPP. A conveyance facility would be installed across Red Bank Creek to convey water from the pump station to the TC canal.

Alternative 2B: 2-month with Existing Ladders

This alternative reduces the current gates-in operation of the dam to July 1 to August 31. Improvements to fish passage would be achieved through the reduction in gate operations. Existing ladders would continue to be operated at the right and left abutments. This alternative includes construction of a 1,680 cfs pump station with a fish screen at the Mill site and continued

pumping at the RPP. A conveyance facility would be installed across Red Bank Creek to convey water from the pump station to the TC canal.

Alternative 3: Gates Out

This alternative leaves the dam gates in the raised position year-round, allowing the Sacramento River to return to its unimpeded flow pattern at RBDD. This alternative would allow unimpeded access above and below the dam to all fish in the Sacramento River that occur in the project area. This alternative includes construction of a 2,180 cfs pump station with a fish screen at the Mill site and continued pumping at the RPP. A conveyance facility would be installed across Red Bank Creek to convey water from the pump station to the TC canal.

A fish bypass system may be needed, depending on the length of the fish screens and the type of the pumping system. A minimum of three internal fish bypasses would be required for the Mill site vertical pump station option at the maximum 2,180 cfs pumping capacity. A pumped bypass system would use the fish-friendly screw or helical pumps that have been tested at RPP over the past several years. Fish bypasses would be designed to limit the exposure along the fish screen to 120 seconds, which is the current exposure time criterion, assuming a variance would be granted by NMFS.

BIOLOGICAL RESOURCES

Aquatic Resources

Riverine habitat is defined primarily by water depth, water quality, temperature, velocity, and substrate. Some of these factors at RBDD are tightly controlled by upstream releases from Keswick and Shasta dams. RBDD operations impact river surface elevations upstream of the dam. During the gates-in period, surface-water elevation at the dam is maintained at 252.5 feet. During the gates-out period, surface-water elevations at RBDD range from approximately 238.5 feet to 254 feet. The estimated 100-year flood elevation at RBDD is 262.3 feet. The dam and lake are part of the Sacramento Canals Unit of CVP. The unit was designed to provide irrigation water in the Sacramento Valley, mainly in Tehama, Glenn, and Colusa counties. Also, the TC and Corning canals are a part of the unit which delivers the irrigation water to areas in those counties.

The fluctuations in water levels between the gates-in and gates-out periods of RBDD operations result in a draw-down zone when the dam gates are out. This draw-down zone is void of permanent vegetation or cover of any kind, resulting in habitat with little, if any, value to wildlife. This area also has lesser value to fish when the dam gates are down, as there is no vegetation on the banks to provide nutrients, shading or instream woody cover.

The fishery resources in the Sacramento River near RBDD consist of a diverse assemblage of fish species including native anadromous salmonids, other native anadromous fish, non-native anadromous fish, and resident native and non-native fish. This portion of the Sacramento River

provides essential habitat for the freshwater life stages of chinook salmon and steelhead. Within California's Central Valley, the Sacramento River provides a corridor for the anadromous salmonid resources between upstream reaches and the tributaries to the Sacramento River and the Pacific Ocean. The Sacramento River is the largest river system in California with more than 90 percent of the Central Valley salmon spawning and rearing within the Sacramento River system. The Sacramento River supports four runs (races) of chinook salmon: fall-, late fall-, winter-, and spring-run.

Each of the five salmonid runs have distinct periods when the adults are actively immigrating upstream through the project area (Table 3). Factors that may affect the timing of adult passage include water-year type, river flows, weather events, and RBDD operations. RBDD operations which can affect fish passage includes the length of time the dam gates are down, thus delaying or blocking passage to fish. The range in estimated delay time at RBDD for fish which use the fish ladders during the gates-in period is 16 to 21 days (Table 4). This represents a significant delay for migrating chinook salmon and steelhead, while many fish are not able to locate or use the ladders to bypass the dam. In some cases the delay is so long that it results in blockage of a

Table 3. Life history timing for native anadromous salmonids in the Sacramento River near Red Bluff Diversion Dam, Tehama County, California.

Name	Adult Immigration	Spawning	Incubation	Rearing	Juvenile Emigration
Fall-run Chinook	July-December	October-December	October-March	December-June	December-July
Late Fall-run Chinook	October-April	January-April	January-June	April-November	April-December
Spring-run Chinook	April-July	August-October	August-December	October-April	October-May
Winter-run Chinook	December-July	April-August	April-October	July-March	July-March
Steelhead	August-March	December-April	December-June	Year-round (1 to 2 years)	January-October

portion of the population. The consequences of blockage and/or passage delay at RBDD can result in:

- changes in spawning distribution;
- hybridization between different runs of chinook salmon;
- increased adult pre-spawning mortality;

Table 4. Estimated number of days of delay for each of the facility structures at Red Bluff Diversion Dam, Tehama County, California. Based on Radio Telemetry Data for fall-run chinook salmon from 1999 through 2001 (CH2MHill 2002a).

Species	Old Ladders	New Ladders	Bypass	Old Ladders and Bypass	New Ladders and Bypass
Winter-run Chinook	21	18	19	19	16
Spring-run Chinook	21	18	19	19	16
Fall-run Chinook	21	18	19	19	16
Late Fall-run Chinook	21	18	19	19	16
Sacramento Pikeminnow	21	18	19	19	16
Steelhead	21	18	19	19	16
Sacramento Splittail	21	18	19	19	16
Green Sturgeon	21	18	19	19	16
White Sturgeon	21	18	19	19	16
Pacific Lamprey	21	18	19	19	16
Rive Lamprey	21	18	19	19	16
Striped Bass	21	18	19	19	16
Hardhead	21	18	19	19	16
American Shad	21	18	19	19	16
Sacramento Sucker	21	18	19	19	16

- substantial expenditure of energy;
- decreased egg viability;
- temperature induced mortality to developing eggs, which results in the reduction in annual recruitment of chinook salmon;

- delays that prevent spring-run chinook salmon natal to Beegum Creek, Battle Creek, and Clear Creek from entering their natal streams due to thermal blockage at the mouth of the streams in the late spring to early summer period; and

- juvenile salmonid passage at RBDD with the current gates-in period also is vulnerable to the operational effects of the dam and its associated diversion facilities, due to the congregations of predators that can occur below the dam while the gates are down.

CH2MHill (2002a) states the average delays for fish passage through the ladders, but does not estimate the extent to which fish populations would be blocked from passage as a result of these average delays. The widely accepted standard for delay of salmonids over fish ladders that avoids the risk of blockage is three days (DWR 2000). The average delay for salmonids at the proposed new fish ladders is 18 days. It is not known what the average blockage will be with the new fish ladders, but it is safe to assume that blockage will occur with this high estimate for delays.

Habitat needs of the four runs of salmon and steelhead generally are similar, but each species differs somewhat in its freshwater habitat requirements. The habitat needs of salmon and steelhead include physical habitat for adult migration and holding, spawning and egg incubation, fry and juvenile rearing, and smolt emigration. Adequate flows, water temperatures, water depths and velocities, appropriate spawning and rearing substrates, and the availability of in-stream cover and food are critical for the propagation and survival of all salmonids in the Sacramento River.

In the vicinity of RBDD, the Sacramento River acts primarily as a transport corridor for adults immigrating upstream, juvenile fry rearing and dispersing, and smolts emigrating downstream. All winter- and spring-run chinook spawning habitat within the mainstem Sacramento River occurs upstream of RBDD, making the passage of these runs of salmon at the dam of increased significance for their recovery. In addition, fall-run chinook salmon and other salmon species are known to spawn in the vicinity of RBDD both immediately upstream and, to a lessor degree, downstream of RBDD. However, salmon are known to spawn in the bed of Lake Red Bluff when the gates are removed and the river is allowed to flow more naturally.

The periods when juveniles (fry, pre-smolt, and smolt salmon; and fry, sub-yearling, and yearling steelhead) are migrating downstream past RBDD are shown on Table 3. In addition to passage, fry and pre-smolt salmon and sub-yearling and yearling steelhead may rear or reside in the vicinity of RBDD. Timing of smolt emigration is dependent on species, flow conditions, and water-year type.

In addition to the native anadromous salmonid species found in the vicinity of the project area, several other native anadromous species occupy or have the potential to occupy the Sacramento River at various stages of their life history and during seasonal intervals. They include: white sturgeon, green sturgeon, Pacific lamprey, and river lamprey.

Shaded Riverine Aquatic (SRA) Cover is defined as the unique, near shore aquatic area occurring at the interface between a river (or stream) and adjacent woody riparian habitat (USFWS 1992). Key attributes of this aquatic area include the adjacent bank being composed of natural, eroding substrates supporting riparian vegetation that either overhangs or protrudes into the water. The water contains variable amounts of woody debris, such as leaves, logs, branches and roots, and often substantial detritus. Often much of the instream vegetation consists of dead woody debris that has fallen from the overhanging riparian vegetation. However, whole trees, which periodically become dislodged from the adjacent eroding banks, often also contribute to the instream structure of SRA Cover. Water velocities, depths, and flows are variable. The Service designated SRA Cover along the Sacramento River from Keswick Dam (River Mile (RM) 302) to Rio Vista (RM 13) as Resource Category 1. CH2MHill (2002a) has determined that approximately 200 linear feet of SRA Cover occurs in the project area, most of which occurs along the left bank of the Sacramento River, immediately downstream of the left bank fish ladder.

Due to the anticipated future need of TCCA to divert their maximum allowable amount of water under their contract, it is assumed that flows downstream of RBDD will decrease from the existing amounts. This may decrease the likelihood that the unmet needs of salmon and steelhead described in the Final Restoration Plan (USFWS 2001) for the AFRP will be met in the future.

The AFRP recognizes that under the existing conditions the legal minimum flows downstream of RBDD do not appear to provide all the habitat requirements for salmon and steehead. Action #1 under this plan calls for minimum recommended flows at RBDD. The Service also is completing instream flow studies to better define the flow needs downstream of RBDD. The results of these studies are anticipated to provide technical information that will aid in the recovery of salmon and steelhead in the Sacramento River.

Terrestrial Resources

The project area consists of approximately 100 acres near and adjacent to RBDD. The project consists of land on both sides of the Sacramento River. The project site contains seven primary habitats: riparian, freshwater marsh, mixed woodland, annual grassland, disturbed land, and parkland.

Riparian habitat provides important resources to both obligate riparian species and upland species. Riparian habitat along the Sacramento River has been substantially reduced as a result of flood control, water supply projects, and urban and agricultural development. The project area contains about 26 acres of riparian habitat. Most of the riparian habitat occurs along Red Bank Creek, with additional narrow bands located along the mainstem of the Sacramento River. Cottonwood, willow, and sycamore are the primary plant species at this location. The current operations of RBDD have resulted in a seasonal lake draw-down zone surrounding the Sacramento River which contains no vegetation.

The campground on the east bank of the Sacramento River has retained some of the mature sycamores, but shrubs and native forbs or grasses are largely absent. Small amounts of riparian habitat occur adjacent to seasonal Lake Red Bluff. Isolated cottonwood trees and riparian shrubs such as willows and blackberry occur in a narrow band on the margins of the lake.

Wildlife associated with riparian areas include a variety of Neotropical migratory birds, raptors, reptiles, amphibians, and mammals. Special-status species associated with riparian habitat along the Sacramento River include, among others, Swainson's hawks, bald eagles, bank swallows, western yellow-billed cuckoos, and valley elderberry longhorn beetles.

The project site supports about 2.1 acres of freshwater marsh habitat in two distinct areas. A 1.56 acre area is located in a low-lying band parallel to Red Bank Creek and is adjacent to a disturbed area located just southwest of RBDD. A 0.45 acre area occurs on the west side of Red Bank Creek in the adjacent industrial area. This is an artificially created marsh. Freshwater marsh habitats are among the most productive wildlife habitats in California. They provide food, cover, and water for more than 160 species of birds, and numerous mammals, amphibians, and reptiles.

The project area contains a 7.5 acre area of mixed woodland habitat. This is an isolated block northwest of RBDD adjacent to the road entering the campground. Vegetation consists of a mix of ponderosa pine, Oregon white oak, and sycamore with shrubs and grasses covering the remainder of the area. This parcel is surrounded by disturbed land, parkland, grassland, and restored habitat.

The project site supports about 64 acres of restored habitat consisting of mitigation plantings to create oak woodland and riparian forest habitat. Plants used in this site consist of oaks, sycamores, pines, and cottonwoods. These sites have been established for less than 10 years. The restoration sites are planned to augment the existing mixed woodland habitat. They also will provide habitat for species associated with riparian habitat and oak woodland. Annual grassland occurs on about 9.25 acres of the project site and is adjacent to the mixed woodland habitat.

Most of the project site consists of disturbed areas. About 79 acres are classified as disturbed habitat on both sides of the Sacramento River. These areas have relatively low value to wildlife.

Parkland comprises approximately 38 acres on the north side of the Sacramento River adjacent to RBDD. These areas are subjected to high levels of human use.

Special Status Species

Federal and State special status species potentially occurring on the project area and potential project impacts on these species are identified below. A species list provided to Reclamation for the project can be found in Appendix D.

Anadromous Fish

All four anadromous salmon runs and steelhead are present at RBDD during some period in their life history are either listed by the California Endangered Species Act and/or the Federal ESA, or are listed as candidates under the Federal ESA. The following list of anadromous salmonids, termed Ecologically Significant Units (ESU) for ESA purposes, includes status, date of listing, and date of Critical Habitat Designation, if applicable:

- Winter-run chinook salmon (Sacramento River Winter-run ESU):
  California Endangered; September 22, 1989
  Federal Endangered; January 4, 1994
  Habitat Designated March 31, 1999

- Spring-run chinook salmon (Central Valley Spring-run ESU):
  California Threatened; February 2, 1999
  Federal Threatened; September 16, 1999
  Habitat Designated February 16, 2000; rescinded April 30, 2002

- Steelhead (California Central Valley ESU):
  Federal Threatened; March 19, 1998
  Habitat Designated February 16, 2000; rescinded April 30, 2002

- Fall/Late Fall-run chinook salmon (Central Valley Fall/Late Fall-run ESUs):
  Federal Candidate/Not warranted for listing; September 16, 1999

For the Sacramento River winter-run chinook salmon ESU, critical habitat is designated to include the Sacramento River from Keswick Dam, Shasta County (RM 302), to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta; all waters from Chipp Island westward to Carquinez Bridge including Honker Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge.

For the Central Valley spring-run chinook salmon ESU, critical habitat is designated to include the Sacramento River and its tributaries in California. Also included are river reaches and estuarine areas of the Sacramento-San Joaquin Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait, all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay from San Pablo Bay to the Golden Gate Bridge.

Critical habitat for Central Valley steelhead ESU was designated to include all river reaches accessible to listed steelhead in the Sacramento and San Joaquin rivers and their tributaries in California. Also included were adjacent riparian zones, as well as river reaches and estuarine areas of the Sacramento-San Joaquin Delta; all waters from Chipps Island westward to Carquinez Bridge including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; all waters of San

Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. Excluded were areas of the San Joaquin River upstream of the Merced River confluence, tribal lands, and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). The rescinded critical habitat designation is currently under reconsideration by NMFS.

The Service routinely observes adult sturgeon in the vicinity and downstream of RBDD when the dam gates are down. It is unclear if these are all adult green sturgeon, or if some are white sturgeon as well. However, to date, all sturgeon larvae that have been captured at RBDD and grown out to determine species have been green sturgeon. The estimated time of spawning green sturgeon passing in the vicinity of RBDD is March through June. Green sturgeon was petitioned for listing under the Act (June 11, 2001). The only time that juvenile sturgeon have been documented above RBDD is following periods that the gates were removed during adult migration. During 2001, the Service documented green sturgeon spawning upstream of RBDD by sampling for eggs collected on artificial substrates.

Sacramento Splittail

The Sacramento splittail was first listed by the Service as threatened on February 8, 1999. This listing applies to its entire range in California, which historically extended as far north as Redding on the Sacramento River. However, due to flow reductions caused by dams and diversions, they currently migrate up the Sacramento River as far as RBDD only during wet years (CH2MHill 2002a).

Delta Smelt

The delta smelt was not identified as a species occurring on or near the project area, but occurs in the Sacramento-San Joaquin Delta, downstream of RBDD. Delta smelt could be affected by diversions and changes in river flow related to RBDD if these effects reached the Delta.

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle (VELB) is entirely dependent on its host plant, elderberry (***Sambucus*** spp.) for food and reproduction. Mating occurs on the plants and eggs are laid in the cracks and crevices of the bark. First larval instars then bore into the plant, creating galleries within the pith. Upon emergence, the larvae bore into the plant and remain in the spongy pith of the plant for the majority of their lifetime. The developing beetle remains inside of the plant for 2 years or longer, after which time the adults emerge and reproduce. Elderberry shrubs were identified at 35 locations in and around the project area (CH2MHill 2002a). Potential VELB exit holes were observed on five of the shrubs.

Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp

Vernal pool fairy shrimp was identified in the EIS/EIR as having no habitat on the project area (CH2MHill 2002a), but absence of this species was not further discussed. Vernal pool tadpole shrimp were on the project area species list provided by the Service, but are not mentioned in the EIS/EIR.

Giant Garter Snake and California Red-legged Frog
The giant garter snake and California red-legged frog were identified on the Service's species list for the project area, but were determined not to occur in the project area because there was no suitable habitat and/or the project area was outside the species' ranges (CH2MHill 2002a). These species were not further evaluated by the project proponents.

Bald Eagle
In the project area, bald eagles could use riparian trees as perch sites for foraging for fish in the Sacramento River (CH2MHill 2002a). Bald eagles are rare breeders in Tehama County and are not known to nest in or near the project area. They are more common during the winter and have been recently observed in Red Bluff during 1999 Audubon Christmas bird counts.

Peregrine Falcon
The peregrine falcon has been delisted, but is being monitored by the Service for a 5- year period from the date of delisting. It is not known to nest in the vicinity of the project area, but was observed in the Red Bluff area during the 1999 Audubon Christmas bird counts (CH2MHill 2002a). Peregrine falcons also have been observed on rare occasions during breeding bird surveys in the area.

Western Yellow-billed Cuckoo
The western yellow-billed cuckoo has historically nested at Todd and Mooney Islands, several miles to the southeast of the project area, but there have been no recent observations in the vicinity of the project area (CH2MHill 2002a). Riparian habitat is poor for cuckoos in the project area because it does not consist of mature and dense cottonwood-willow stands. Also, the riparian habitat occurs as narrow bands along the Sacramento River and Red Bank Creek that would not accommodate the species' breeding territory requirements. Therefore, yellow-billed cuckoos are not likely to occur on the project area, although individuals could occur sporadically in the project area during spring and fall migrations.

Osprey
Two osprey nests were observed on the south side of the Sacramento River, and are within the project area (CH2MHill 2002a).

Swainson's Hawk
One nesting pair of Swainson's hawks was observed approximately 1/5 mile northeast of the project site along Salt Creek in 1993 (CH2MHill 2002a). Some of the trees in riparian areas in the project area are large enough to support nesting by Swainson's hawks.

Special Status Bats
Bats were observed using the factory on the PACTIV Corporation property as a roost (CH2MHill 2002a). The species of bats using the factory were not determined, however, most bat species in the Central Valley are special status species (Federal species of Concern). The factory buildings will not be removed with the construction of this project.

Other Species

In addition to the species listed above, 31 other species (all are "species of concern") are present on the species list provided to Reclamation for the project, and could be present on the project area. Among these are four species of raptors, several Neotropical migrant bird species, western pond turtle, foothill yellow-legged frog, and western spadefoot toad.

FUTURE CONDITIONS WITHOUT THE PROJECT

The projected future condition without the project is operation of the existing diversion dam and fish ladders with a gates-in period of May 15 to September 15. Present delay or blockage of fish would continue during these months. The dam with the existing fish ladders have proven to impair fish passage at certain flows to pass anadromous fish to upstream spawning grounds.

The current operations do not meet CVPIA section 3406 requirements. Section 3406(b)(1) states that when all the sections of 3406 have been implemented, the mitigation for the CVP has been completed. Under the future conditions without the project, Reclamation would still need to mitigate for the CVP to meet the requirements under CVPIA section 3406.

There is uncertainty in regard to reliable water deliveries for the TCCA associated with the future without the project conditions. TCCA has expressed that the current operations of RBDD does not allow them to provide stable, reliable water deliveries to their customers. It is forseeable that a change will need to occur with either operations of RBDD, or a new pumping facility will need to be constructed to fulfill TCCA's responsibilities to deliver water.

A large amount of taxpayer-supported funding has been invested in anadromous restoration programs on Clear Creek, Battle Creek, Cottonwood Creek, and Cow Creek, all of which are tributaries upstream of RBDD. The mainstem Sacramento River above RBDD is also integral to the overall efforts to restore and recover anadromous salmonids. The restoration potential of anadromous salmonid populations in the mainstem and these streams is partly dependent upon improved fish passage at RBDD. Without the RBDD project, fish passage at the dam would not improve, thus diminishing the potential for success of these tributary restoration projects.

The AFRP has determined that existing flows downstream of RBDD do not meet all the habitat requirements of salmon and steelhead in the Sacramento River. This unmet need would continue into the future under the conditions without the project.

FUTURE CONDITIONS WITH THE PROJECT

Project Features/Operations

Project features are briefly described under the alternatives section. A detailed description of the proposed project components is provided in CH2MHill (2002a).

Reclamation has stated that water deliveries for TCCA will be consistent with water rights and water contracts (CH2MHill 2002a). The Service expects that conformance of water supply management with existing ESA Biological Opinions for the long-term operation of the Central Valley Project, and with existing water quality standards imposed for the Sacramento River and Bay/Delta, would not change substantially under present diversions. It is uncertain how future increased diversions at the TC and Corning Canals would affect conformance with these regulatory measures.

Effects on biological resources with the project are related to project construction and the long-term operation of the facility. These impacts are summarized in the following sections.

Alternative 1A: 4-month Improved Ladders

Aquatic Resources

This alternative likely would not result in a significant benefit to fish passage past RBDD for chinook salmon and steelhead, even with installment of higher flow fish ladders (Appendix C). Delays and blockages in upstream adult migration would continue to occur during the gates-in period.

Potential effects from the proposed project include, but are not limited to, modification of aquatic habitats, fish passage and survival, alteration of river hydraulics and sedimentation, changes in predation, and water quality effects. In-river construction and channel maintenance activities would result in temporary water quality impacts from increased turbidity and sediment mobilization.

Construction of the proposed pumping plant at the Mill site could result in direct and indirect losses of adult and juvenile fish, unless adequate mitigation measures are incorporated into the project. These impacts would principally occur during installation of cofferdams. The construction areas would include areas near the existing east and west bank fish ladders and the new pump station location at the Mill site. At the Mill site, a large sheet pile cofferdam would be required, up to approximately 1,400 linear feet.

Construction of the right bank fish ladder would require 270 linear feet of sheet pile cofferdam. Construction of the left bank fish ladder would require installation of a 166 linear foot sheet pile cofferdam. In addition, impacts could occur at these locations because of dewatering active channel areas following sheet pile installation. Percussion from large scale pile-driving activities could cause mortality to salmon embryos during their first two weeks of life if they are located within 200 to 600 feet of high energy pile driving equipment. Both adults and juveniles could be crushed during earth movement or sheet pile installation. Both adults and juveniles could be stranded and lost during dewatering actions following the installation of sheet piling.

The Service is concerned that the implementation of the proposed alternatives could result in a change in the diversion patterns over the historical diversions at RBDD. The CALFED environmental documents recognize that the RBDD Fish Passage Program, together with a series of specific water supply activities, could lead to, or involve, increased storage and diversion of

water for consumptive use. Cumulatively, these projects could affect river flows or hydrodynamics in the riverine system. An increase in diversions over historical amounts due to implementation of a project alternative could increase terrestrial impacts if more land would be irrigated or converted to municipal or industrial developments. Also, an increase in diversions over historical amounts could reduce flow volumes in the Sacramento River downstream of RBDD. This could increase warming of water temperatures, reduce fish habitat by reducing wetted perimeter, change sediment transport capacity and other geomorphic conditions. These potential impacts should be analyzed to determine their extent and associated mitigation needs.

Terrestrial Resources

Short-term impacts may result from increased noise and construction related disturbances in the local project area. This disturbance may influence the behavior, movements, and distribution of wildlife in the local project area. Impacts from the long-term operation and maintenance of the new screening facility should be similar to without project conditions with the exception that access to, and maintenance of, project features may require intermittent disturbance to terrestrial habitats.

Between 750,000 and 800,000 cubic yards of material would need to be excavated to complete construction for each of the five alternatives. This includes excavation for the pumping station and forebay for all alternatives, as well as the fish ladders, which are included in two of the alternatives. Approximately 580,000 to 600,000 cubic yards of this material would be stored onsite. It is unclear how this material would be stored onsite and what types of habitat would be impacted for this storage.

Disturbed land is the primary habitat impacted by the alternative, and the largest (area) impacts to all habitats are temporary. Acreage of habitats expected to be impacted by Alternative 1A is provided in Table 5.

Special Status Species

Anadromous salmonids and Sacramento splittail. Potential juvenile salmonid impingement on the proposed fish screen would need to be addressed. Sweeping velocities along the screen face would need to meet state and federal guidelines for salmonids in the Sacramento River. A pumped bypass system also might be required by these guidelines to reduce the chances for impingement on the screen face.

Delta smelt. The delta smelt was not identified as a species occurring on or near the project area, but occurs in the Sacramento-San Joaquin Delta, downstream of RBDD. Delta smelt could be affected by diversions and changes in river flow related to RBDD if these effects reached the Delta.

Valley elderberry longhorn beetle. This alternative likely would impact all elderberry shrubs on the south side of the river and several shrubs on the north side of the river (CH2MHill 2002a). Approximately 14 elderberry shrubs would be impacted. These shrubs contain 28 stems between one and three inches in diameter, 16 stems between three and five inches in diameter, and 12 stems more than five inches in diameter. At least five shrubs show signs potential VELB use.

Table 5. Acreage of terrestrial habitat impacts for project alternatives

	No Action Alt.	1A: 4-month Improved Ladder Alt.		1B: 4-month Bypass Alt.		2A: 2-month Improved Ladder Alt.		2B: 2-month with Existing Ladder Alt.		3: Gates-out Alt.	
Habitat		Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp	Perm	Temp
Riparian	0	2.18	5.56	2.60	6.30	2.18	5.56	2.05	4.76	2.05	4.76
Freshwater Marsh	0	0.05	0.71	0.05	0.71	0.05	0.71	0.05	0.71	0.05	0.71
Mixed Woodland	0	0	0	1.37	4.30	0	0	0	0	0	0
Restored Habitat	0	0	0	4.96	4.80	0	0	0	0	0	0
Annual Grassland	0	0	0	0	0	0	0	0	0	0	0
Disturbed	0	11.75	44.12	12.90	51.70	11.75	44.12	11.36	41.35	11.36	41.30
Parkland	0	0.19	4.86	4.19	12.32	0.19	4.86	0	0	0	0

Vernal pool fairy shrimp and vernal pool tadpole shrimp. Potential effects on vernal pool fairy shrimp and vernal pool tadpole shrimp are not discussed in the project EIS/EIR, but habitat for vernal pool fairy shrimp is indicated to be lacking on the project area. Further clarification is needed for potential effects on these species.

Giant garter snake and California red-legged frog. The project EIS/EIR indicates that adverse effects on the giant garter snake and California red-legged frog are not expected to occur, due to lack of habitat on the project area (CH2MHill 2002a). Methods for this determination are not provided in the EIS/EIR. Additional information on survey methods and species-specific habitat assessment would be necessary to further support these conclusions.

Bald eagle. Bald eagles are not known to nest in the project area, but occasionally occur during the winter. Trees in the riparian zone that could be used as perches by foraging bald eagles would be lost under Alternative 1A, but the level of use by bald eagles in the project area is low, and other trees would be available as perch sites. Disturbance of foraging bald eagles from construction activity could occur, but other undisturbed foraging sites would be available nearby.

Peregrine falcon. The peregrine falcon is not known to nest in the vicinity of the project area, but has been observed in the Red Bluff area. The project EIS/EIR indicates that adverse effects on the peregrine falcon are not expected to occur, because of minimal habitat on the project area and availability of prey (waterfowl) on Sacramento Valley wildlife refuges.

Western yellow-billed cuckoo. The western yellow-billed cuckoo has historically nested several miles to the southeast of the project area, but there have been no recent observations in the

vicinity of the project area (CH2MHill 2002a). The project EIS/EIR indicates that adverse effects on the western yellow-billed cuckoo are not expected to occur, due to lack of suitable riparian habitat on the project area, although individuals could occur occasionally in the project area during spring and fall migrations. These individuals could be subject to human disturbance.

Osprey. The two osprey nests located on the south side of the Sacramento River would need to be removed during construction for each of the alternatives. This would be a significant impact to the species.

Swainson's Hawk. Known use of the project area by Swainson's hawks is thought to be low, possibly because of human disturbance and lack of foraging habitat nearby, although suitable nesting habitat appears to exist (CH2MHill 2002a). Some of the potential nesting habitat (riparian woodland) would be lost due to project construction.

Special status bats. Bats were observed using a nearby factory structures as a roost (CH2MHill 2002a), but potential presence in wooded habitats or facilities on the project area were not discussed in the EIR/EIS. The factory buildings will not be removed with the construction of this project, but the Service is concerned that other bats in forested areas or facilities on the project area could be affected by construction, if present.

Other species. Other special status species not federally listed (Appendix D) could also be affected by the project. Among these are four species of raptors, several Neotropical migrant bird species, western pond turtle, foothill yellow-legged frog, and western spadefoot toad.

Alternative 1B: 4-month Bypass

The future with this alternative would have similar effects as for Alternative 1A. Additional impacts are described below.

Aquatic Resources

This alternative is reported in the EIS/EIR to improve fish passage during the four months of gates-in. However, the results of analyses conducted by CH2MHill (2002a), and summarized in Appendix C, show either no change or no measurable benefit to all targeted fish under this alternative. Therefore, a bypass channel will not likely improve passage sufficiently over conditions without the project for the target species of fish. Additionally, the Service is concerned whether the proposed bypass channel would be passable by all species of concern (especially adult sturgeon), structurally stable, and safe. The Service does not believe these concerns have been adequately addressed in the EIR/EIS (CH2MHill 2002a).

The majority of SRA Cover impacts (approximately 200 linear feet in the project area) would occur under the 4-month Bypass Alternative. Approximately 20 linear feet of SRA Cover occurs at the Mill site, which likely would be impacted under all proposed alternatives.

Other potential effects on aquatic resources related to construction and the long-term operation of facilities would be similar to those described under Alternative 1A.

Terrestrial Resources
Disturbed land is the primary habitat impacted by the alternative, and the largest (area) impacts to all habitats are temporary. Acreage of habitats expected to be impacted by Alternative 1B is provided in Table 5. Construction of the proposed bypass channel would result in permanent or temporary impacts to mixed woodland and restored habitat, which are not affected by the other alternatives (Table 5).

The potential for channel capture at the bypass channel site during extremely high flow/flood events may result in a range of both short-term and long-term impacts. Site erosion and inundation would be the expected outcomes, with an unknown level of severity to existing terrestrial resources.

Other potential effects on terrestrial resources related to construction would be similar to those described under Alternative 1A.

Special Status Species
Potential impacts on juvenile fish described under Alternative 1A, including fish impingement and sweeping velocities, also would apply to this alternative. Delta smelt could be affected by diversions and changes in river flow related to RBDD if these effects reached the Delta.

Operation of the proposed bypass channel would result in stranding and loss of listed salmonid species during the annual dewatering of the channel. This loss would be an annual occurrence in contrast to the short-term stranding losses associated with cofferdam construction. Other impacts to special status species would be similar as to those for Alternative 1A.

This alternative likely would impact elderberry shrubs on the south and north side of the river (CH2MHill 2002b). Approximately 19 elderberry shrubs would be impacted. These shrubs contain 47 stems between one and three inches in diameter, 21 stems between three and five inches in diameter, and 17 stems more than five inches in diameter.

Other potential effects on special status species would be similar to those described under Alternative 1A.

Alternative 2A: 2-month with Improved Ladders

Aquatic Resources
This alternative provides substantially improved passage for adult spring-run adults compared to No Action and both 4-month gates-in alternatives. Analysis indicates that no measurable benefit to winter-, fall-, or late fall-run chinook salmon or steelhead is achieved under this alternative (Table C-1, Appendix C). Adult spring-run chinook salmon obtain a large measurable benefit from this alternative. Green sturgeon adults receive a large measurable benefit and juveniles receive a measurable benefit (Table C-3 C-3 and C-4, Appendix C). River lamprey adults and juveniles receive a measurable benefit, and Pacific lamprey adults receive a measurable benefit from the 2-month gates-in Alternative.

During the gates-in period under this alternative, the improved fish ladders would be expected to provide at least a small level of improvement in fish passage over current conditions at RBDD. The tributaries currently being restored upstream of RBDD will benefit from the improved fish passage anticipated from the future with project conditions for this alternative. These large restoration efforts depend partly on fish passage being improved at RBDD.

Other potential effects on aquatic resources related to construction and the long-term operation of facilities would be similar to those described under Alternative 1A.

Terrestrial Resources
Disturbed land is the primary habitat impacted by the alternative, and the largest (area) impacts to all habitats are temporary. Acreage of habitats expected to be impacted by Alternative 2A is provided in Table 5. Impacts to other terrestrial resources would be similar as to those for Alternative 1A.

Special Status Species
Adverse impacts to special status species would be similar as to those for Alternative 1A. Benefits to fish passage from this alternative are described under Aquatic Resources for Alternative 2A.

Alternative 2B: 2-month with Existing Ladders

Aquatic Resources
Impacts on fish passage from this alternative would be similar to those for Alternative 2A. Other potential effects on aquatic resources related to construction and the long-term operation of the facility would be similar to those described under Alternative 1A.

Terrestrial Resources
Disturbed land is the primary habitat impacted by the alternative, and the largest (area) impacts to all habitats are temporary. Acreage of habitats expected to be impacted by Alternative 2B is provided in Table 5. Other terrestrial impacts would be similar to those for Alternative 1A.

Special Status Species
Potential impacts on fish described under Alternative 1A also would apply to this alternative. Benefits to fish passage from this alternative are similar to those described under Aquatic Resources for Alternative 2A.

Approximately nine elderberry shrubs would be impacted under this alternative. These shrubs contain 18 stems between one and three inches in diameter, six stems between three and five inches in diameter, and six stems more than five inches in diameter. Fish passage benefits to special status species from this alternative would be similar to those of Alternative 2A. Other special status species effects would be similar to Alternative 1A.

Adverse impacts to other special status species would be similar as to those for Alternative 1A.

Alternative 3: Gates Out

Aquatic Resources

The Gates-out Alternative represents an improvement in fish passage over the 2-month alternatives and a substantial improvement in fish passage over the 4-month alternatives (CH2MHill 2002a). The Gates-out Alternative is the only alternative that presents no delay to fish passage year-round at RBDD. With gates-in alternatives, migrating juvenile salmonids are forced to pass RBDD either by using the fish ladders or passing under the dam gates. Most juveniles pass below the gates, and in the process, are likely disoriented and vulnerable to predation. With the Gates-out Alternative, juvenile fish migrating downstream would not be subject to difficult conditions passing under the gates, nor exposed to predators that congregate near the gates.

Under the Gates-out Alternative, a measurable benefit to adult winter- and fall-run chinook salmon and steelhead is achieved (Table C-1, Appendix C). This is the only alternative providing these benefits. A large measurable benefit is provided to spring-run chinook salmon by this alternative, and constitutes an incrementally larger benefit than provided by the 2-month gates-in alternatives. Green sturgeon adults and juveniles receive a large measurable benefit, river lamprey adults and juveniles receive a measurable benefit, and Pacific lamprey adults receive a measurable benefit from the Gates-out Alternative (Tables C-3 and C-4, Appendix C). The benefit to juvenile green sturgeon is greater than that provided by the 2-month gates-in alternatives (Table C-4, Appendix C).

The tributaries currently being restored upstream of RBDD will benefit from the improved fish passage anticipated from the future with project conditions for this alternative. These large restoration efforts depend partly on fish passage being improved at RBDD to maximize their benefits.

The Draft Sacramento Winter-run Recovery Plan (NMFS 1997) includes the following specific recommendations for RBDD to contribute significantly to the recovery of winter-run chinook:

1. Operate the RBDD in a gates-up position from September 1 through May 14 of each year, until a permanent remedy for the facility is implemented.

2. Develop and implement a permanent remedy that provides maximum free passage for adult and juvenile winter-run chinook past the Red Bluff area, while minimizing losses of juveniles in water diversion and fish bypass facilities.

Under the Gates-out Alternative, Lake Red Bluff would not be formed. Restoring the seasonal Lake Red Bluff to riverine habitat would reduce vulnerability of juvenile anadromous salmonids to predation during out-migration through the lake zone. Restored riverine habitat in the lake zone also would provide additional spawning habitat for anadromous fish in this section of the Sacramento River.

Over time, the Lake Red Bluff area, which is presently seasonally inundated (draw-down zone), would become re-vegetated as plants colonized the area. This would potentially produce SRA Cover, which would benefit both aquatic, including species listed under the ESA, as well as terrestrial species. With a re-vegetated inundation zone, overall quantity and quality of fisheries habitat within this zone would increase under the Gates-out Alternative. The ultimate value of a re-vegetated riparian zone to SRA Cover would depend on location of re-vegetation, resulting plant species composition, and the type and magnitude of human activity in the area.

Other potential effects on aquatic resources related to construction and the long-term operation of facilities would be similar to those described under Alternative 1A.

Terrestrial Resources

Where sufficient soil moisture is present, riparian vegetation would be expected to become established. In drier portions, annual grasses and forbs and more drought tolerant shrubs would be expected to occur. Invasion by star thistle also is likely, given the proximity of areas dominated by this species, but active restoration of vegetation could help ensure that desirable plant species become established. Riparian forests provide habitat to numerous species living in the Central Valley of California. Riparian forests also contribute shade and woody material for SRA Cover, which benefits terrestrial, as well as aquatic species.

It is not known to what extent SRA Cover would become established at Red Bluff, should this alternative be implemented. Nearby areas with existing SRA Cover could provide a reference for what might be expected to become established at Red Bluff. The Service is planning to examine some of these areas in September, 2002, to determine the quality of habitat they contain. It is reasonable to expect that active restoration would expedite the establishment and enforce the quality of SRA Cover at Red Bluff. Active restoration could consist of native plantings, which would require a limited amount of maintenance after becoming established.

Both SRA Cover and riparian habitat in general, have been much reduced from human alterations to the Central Valley. This alternative offers the rare opportunity to allow the riparian forest, and SRA Cover, to become established in the portion of the river currently affected by formation and draw-down of Lake Red Bluff. If allowed to establish, riparian forest could provide important habitat for a great diversity of terrestrial and aquatic species. The Gates-out Alternative also would allow the Sacramento River to flow more naturally at the Lake Red Bluff site and, therefore, return sediment transport and other fluvial dynamics to a more natural state.

Creating a riparian park at Red Bluff would present an opportunity for the community to create multi-use trails, interpretive signs, and multi-use parks. Other communities have created similar riparian areas, such as the City of Redding (Sacramento River) and City of Sacramento (American River).

Disturbed land is the primary habitat adversely impacted by the alternative, and the largest (area) impacts to all habitats are temporary. Acreage of habitats expected to be adversely impacted by Alternative 3 is provided in Table 5. Other potential effects on terrestrial resources related to construction of facilities would be similar to those described under Alternative 1A.

Special Status Species

Under the Gates-out Alternative, ESA issues for passage fish species would be minimized. However, potential impingement of juvenile fish on the proposed fish screen would need to be addressed. Sweeping velocities along the screen face would need to meet state and federal guidelines for salmonids in the Sacramento River. A pumped bypass system also might be required by these guidelines to reduce the chances for impingement on the screen face. Delta smelt could be affected by diversions and changes in river flow related to RBDD if these effects reached the Delta.

As with the other action alternatives, a new pumping plant would be constructed at the Mill site, and terrestrial/aquatic adverse impacts resulting from site excavation and construction, as described under Alternative 1A, would also occur under the Gates-out Alternative. Adverse impacts of this alternative to VELB and other special status species would be similar as to those for Alternative 1A.

As described above for terrestrial and aquatic resources, re-vegetation of the area within Lake Red Bluff would provide multiple benefits to fish and wildlife, including special status species. Ecosystem-level enhancements to riparian forest and SRA Cover, and riverine habitat, in particular, would benefit of species such as anadromous fish, Neotropical migrant birds, bats, and VELB.

MITIGATION

General Recommendations

Recommendations to compensate for adverse effects are based on the Service's designated Resource Categories, which consider the relative biological importance of each specific habitat to selected evaluation species and the habitat's relative abundance, uniqueness, and replaceability. Resource Categories designated for each habitat on the project area and associated mitigation planning goals are provided in Table 6. In addition, the Service has a Regional policy of "no net loss of wetland values or acreage," whichever is greater.

The Service's recommendation for SRA Cover, as a Resource Category 1 habitat under the Mitigation Policy, would generally be avoidance of existing habitat value. Strict adherence to the Mitigation Policy would require the Service to support the No Action Alternative. For this project to achieve the expected long-term fishery benefits of substantially improving the long-term ability to reliably pass anadromous fish and other species of concern past RBDD, losses of SRA Cover would be unavoidable. The "acceptance" of these SRA Cover losses by the Service is predicated on the lead agencies' environmental commitment to compensate for any unavoidable SRA Cover losses. The best biological compensation for lost SRA Cover values would be planting woody riparian vegetation along natural erodible shoreline of the Sacramento River. Natural erodible shoreline could result from the select removal of site-specific bank revetment. The Gates-out Alternative would be an excellent opportunity to achieve this compensation.

Table 6. Habitat types, representative species, Resource Categories, and mitigation goals for projected impacts due to the proposed Fish Passage Improvement Project for Red Bluff Diversion Dam, Colusa County, California

Habitat Type	Representative Species	Resource Category	Mitigation Goal
SRA Cover	winter-run chinook salmon, spring-run chinook salmon	1	No loss of existing habitat value
Riparian Forest	Swainson's hawk, VELB, Neotropical migrant birds	2	No net loss of in-kind habitat value
Freshwater Marsh	tricolor blackbird, white-faced ibis, western pond turtle	2	No net loss of in-kind habitat value
Mixed Woodland	Cooper's hawk, sharp-shinned hawk	3	No net loss of habitat value, minimize in-kind loss
Restored Woodland	bewick's wren, pocket mouse	3	No net loss of habitat value, minimize in-kind loss
Annual Grassland	California ground squirrel	4	Minimize loss of habitat value

Impacts to VELB habitat (elderberry plants with one or more stems measuring 1.0 inch or greater in diameter at ground level) that cannot be avoided with a minimum 100-foot buffer should be mitigated following the Service's Conservation Guidelines for the Valley Elderberry Longhorn Beetle (USFWS 1999). The required conservation area should be located, if possible, on-site or adjacent to the project area. Should Reclamation select the Gates-out Alternative for implementation, the Service recommends that any mitigation for VELB be performed in conjunction with restoring the riparian corridor at Lake Red Bluff. Impacts to elderberry shrubs would require consultation with the Service for potential impacts to VELB.

Some project construction activities could result in incidental adverse effects to listed species under the jurisdiction of NMFS (spring- and winter-run chinook salmon and steelhead). These effects would likely be minimal and temporary if conservation measures identified in the project's Biological Opinion are successfully incorporated into the project. Potential measures could include limiting construction activities affecting stream channels to periods (construction windows) to avoid or minimize impacts, placing exclusionary fencing to prevent spawning in areas subjected to percussive impacts to embryos (if the incubation period cannot be avoided), minimizing the disturbance in the streambed, and using the least-impacting construction methods.

To adequately compensate for the removal of the osprey nests, new nesting platforms should be constructed using CDFG guidelines prior to removal of the nests. The removal of these nests should be done outside of the breeding season.

Other special status species not federally listed (Appendix D) could also be affected by the project. Among these are five raptors, several Neotropical migrant birds, anadromous fish (fall/late fall-run chinook salmon), western pond turtle, foothill yellow-legged frog, western spadefoot toad, and, potentially, several bat species. Implementation of mitigation measures recommended by the Service should help protect these species. Additional mitigation measures for the project might be recommended by the Service in the future.

To compensate impacts to freshwater wetland habitat, the Service recommends a ratio of three acres created/restored wetland habitat to one acre permanently impacted. For temporary impacts to freshwater wetland habitat, a ratio of one acre restored to one acre impacted is recommended.

The California Regional Water Quality Control Board should be consulted to ensure proper discharge of dredged material on or off the project site. To minimize soil erosion, movement of sediments, loss of topsoil, and associated water quality impacts, Best Management Practices should be developed prior to construction.

If impacts occur to terrestrial habitat from increases in diversions over the historical diversion pattern, proper measures should be developed in collaboration with the Service and other appropriate state and federal agencies to fully mitigate those impacts.

Specific Recommendations

Alternative 1A: 4-month Improved Ladders

With either the 1A or 1B alternatives, the Service recommends that Reclamation investigate the feasibility of either improving the temporary center ladder or the installation of a permanent center ladder. In addition to the improved ladders, the Service recommends that Reclamation rigorously pursue both operational modifications and physical modifications to the RBDD that would improve adult and juvenile fish passage of ESA-listed and target fish species.

Approximately 14 elderberry shrubs would be impacted under this alternative. These shrubs contain 28 stems between one and three inches in diameter, 16 stems between three and five inches in diameter, and 12 stems more than five inches in diameter. Following the Conservation Guidelines for the Valley Elderberry Longhorn Beetle (USFWS 1999), Reclamation estimated that mitigation for these impacts would be approximately 148 elderberry seedlings and 215 native seedlings planted in a conservation area (CH2MHill 2002b). Final compensation needs for impacts to elderberry shrubs under this alternative would require consultation with the Service for potential impacts to the VELB, and would be calculated under guidelines being employed at that time.

Alternative 1B: 4-month Bypass

The upstream end of the channel will need to incorporate a special chamber for electronic or video monitoring fish to enable counting migrating adult fish, or a viewing chamber to allow "live" counts by fish counting personnel. The fish will need to enter into a physically constricted area of the bypass channel that will be conducive for either electronic or manual counting. Depending upon the methodology employed (e.g., manual or direct video counting), an on-site or

remote facility will be needed to house the fish counters and other personnel and equipment necessary.

Approximately 19 elderberry shrubs would be impacted under this alternative. These shrubs contain 47 stems between one and three inches in diameter, 21 stems between three and five inches in diameter, and 17 stems more than five inches in diameter. Following the Conservation Guidelines for the Valley Elderberry Longhorn Beetle (USFWS 1999), Reclamation estimated that mitigation for these impacts would be approximately 203 elderberry seedlings and 328 native seedlings planted in a conservation area. Final compensation needs for impacts to elderberry shrubs under this alternative would require consultation with the Service for potential impacts to the VELB.

Alternative 2A: 2-month with Improved Ladders

For this alternative, the Service recommends that Reclamation continue to research operational modifications that would improve fish passage during the 2-month gates-in period

Impacts to elderberry shrubs for this alternative would be similar as to those for Alternative 1A. The impacts to elderberry shrubs under this alternative would require consultation with the Service for potential impacts to the VELB.

Alternative 2B: 2-month with Existing Ladders

For this alternative, the Service recommends that Reclamation continue to research operational modifications that would improve fish passage during the 2-months gates-in period

Approximately nine elderberry shrubs would be impacted under this alternative. These shrubs contain 18 stems between one and three inches in diameter, six stems between three and five inches in diameter, and six stems more than five inches in diameter. Following the Conservation Guidelines for the Valley Elderberry Longhorn Beetle (USFWS 1999), Reclamation estimated that mitigation for these impacts would require approximately 73 elderberry seedlings and 124 native seedlings planted in a conservation area. Final compensation needs for impacts to elderberry shrubs under this alternative would require consultation with the Service for potential impacts to the VELB.

Alternative 3: Gates Out

Impacts to elderberry shrubs for this alternative would be similar as to those for Alternative 2B. The impacts to elderberry shrubs under this alternative would require consultation with the Service for potential impacts to VELB.

DISCUSSION AND CONCLUSIONS

The Gates-out and 2-month gates-in Alternatives should work toward the CVPIA goal of doubling anadromous fish populations in the Central Valley of California. Section 3406 (b)(10) of the CVPIA directs the Department of the Interior to develop and implement measures to minimize fish passage problems for anadromous fish at RBDD. Existing conditions do not meet

the objectives of section 3406 (b)(10) of the CVPIA because of unmet needs for spring- and winter-run chinook salmon. It is feasible to provide for unmet fish passage needs at RBDD, such as the Gates-out and 2-month gates-in Alternatives. The Gates-out and 2-month gates-in Alternatives also should work toward the CALFED goal of restoring or enhancing fisheries habitat and improving water management for beneficial uses of the Bay-Delta system (CALFED 2000).

The RBDD Fish Passage Program includes evaluating possible long-term solutions to fish passage and water delivery at RBDD. Operation of the dam under the NMFS biological opinion has reduced, but not minimized, fish passage problems for all the anadromous species of concern, particularly spring-run chinook and green sturgeon. In addition, the operations have reduced the reliability of adequate water delivery for certain agricultural operations and maintenance of wetland habitat in the Sacramento National Wildlife Refuge complex.

The North-of-the-Delta Offstream Storage Project north of the Bay-Delta in the northern Sacramento Valley could result in offstream reservoir capacity of up to 1.9 million acre feet (CH2MHill 2002a). Sites Reservoir is a potential offstream storage project presently being examined. The TC canal is one of three water conveyance methods under consideration to fill Sites Reservoir. It is not clear if the proposed fish passage alternatives for RBDD take into account the potential need to fill Sites Reservoir, or if they would preclude filling the reservoir.

The Service has identified priority species for improved fish passage at RBDD (Appendix E). First priority species include Pacific salmon, steelhead, splittail, Pacific and river lamprey, green and white sturgeon, American shad, striped bass, and Sacramento pikeminnow (as a predator of juvenile chinook salmon). The second priority includes Sacramento sucker, hardhead, and other native fish.

The NMFS also has identified priority species for consideration of improved fish passage alternatives for RBDD (Appendix E). The first priority species are winter-run and spring-run chinook salmon, steelhead, and splittail. Second priority species are fall/late fall-run chinook salmon, green and white sturgeon, and Pacific and river lamprey. All other native species are listed as third priority. Due to the varied life-history traits of the first and second priority species, alternatives that rely only on fish ladders to improve fish passage would not effectively obtain improved fish passage for all species of concern. Improved fish passage for all first and second priority species is realized by a selection of alternatives for RBDD that decrease the length of time that the dam gates remain in the down position, when blockage occurs.

The Service supports minimizing the length of time that fish passage is impaired at RBDD. The Gates-out Alternative returns the Sacramento River to flow without restrictions at Red Bluff, allowing unrestricted passage in all months of the year for all priority species of fish around RBDD. Also, due to the necessity to construct a pumping facility for every alternative, each with a similar footprint and similar impacts to fish and wildlife resources, the Service supports the selection of the Gates-out Alternative (Alternative 3). This alternative represents a significant improvement in fish passage at RBDD compared to the future without the project and the 4-month Gates-in Alternatives. The Gates-out Alternative is the only proposed alternative that

provides a measurable benefit to adult winter- and fall-run chinook salmon and steelhead. A large measurable benefit is provided to spring-run chinook salmon by this alternative, and constitutes an incrementally larger benefit than provided by the 2-month gates-in alternatives. Restoring the seasonal Lake Red Bluff to riverine habitat would reduce vulnerability of juvenile anadromous salmonids to predation during out-migration through the lake zone. Restored riverine habitat in the lake zone also would provide additional spawning habitat for anadromous fish in this section of the Sacramento River.

The Service does not support alternatives that do not minimize the length of time that RBDD gates remain in the down position. The 4-month Improved Ladders and 4-month Bypass alternatives include a gates-in period that is similar to the future without the project conditions. The Service assumes that delays and blockage to migrating fish that would occur under the future without project conditions would be the same, or similar, under the 4-month Bypass alternative. The greatest impacts to SRA Cover also would occur under this alternative. The 4-month Improved Ladders alternative provides minimal improvement to fish passage. Should USBR choose to proceed with this alternative, an adaptive management plan would be needed in the event that the anticipated improvements in fish passage are not realized.

The alternatives that shorten the length of time that RBDD gates remain in the down position, but do not eliminate the gates-in period entirely (Alternatives 2A and 2B) provide substantial benefits to fish passage over the No Action alternative. The 2-month with Improved Ladders and 2-month with Existing Ladders alternatives both reduce the time that the gates remain in the down position from four months to two months. This represents a substantial improvement in fish passage around RBDD over the future without the project conditions.

However, the Service recommends that, if either of these 2-month alternatives are selected as the preferred alternative, an adaptive management plan should be prepared in the event that adequate improvements in fish passage are not observed at RBDD, as might be expected under these alternatives. The Service recommends that, in the event adequate improvements are not observed, the gates should remain in the up position year-round, thus returning the Sacramento River to unrestricted flow at Red Bluff.

Full and successful implementation of the Fish Passage Program would produce the following biological benefits:

2-month Gates-in Alternatives

1. Permanently provide unimpaired passage between the migratory corridor below RBDD to river reach that constitutes the sole spawning area for populations of winter-run and spring-run chinook that are natal to the main stem Sacramento river. This attains goals identified in:

    - CALFED Stage 1 Expectation for Dams (page 436, last bullet);

- CALFED Ecosystem Restoration Program (ERP) milestone for Sacramento River dams and other structures (Record of Decision (ROD), Volume 3, Attachment 7, page 18);

- CALFED Multi-Species Conservation Plan prescription/conservation measure at RBDD for winter-run and spring-run chinook salmon;

- Winter-run Chinook Salmon Recovery Plan;

- California Fish and Game Spring-run Chinook Status Review; and

- CALFED Multi-Species Conservation Plan conservation action for spring-run and winter-run chinook salmon.

2. Permanently provide unimpaired passage between the migratory corridor below RBDD and the unique tributary spawning areas for winter-run natal to Battle Creek and spring-run natal to Battle Creek, Begum Creek, and Clear Creek. This attains goals identified in:

    - CALFED Stage 1 Expectation for Dams (page 436, last bullet);

    - CALFED ERP milestone for Sacramento River dams and other structures (ROD, Volume 3, Attachment 7, page 18);

    - CALFED Multi-Species Conservation Plan prescription/conservation measure at RBDD for winter-run and spring-run chinook salmon;

    - Winter-run Chinook Salmon Recovery Plan;

    - California Fish and Game Spring-run Chinook Status Review;

    - CALFED Multi-Species Conservation Plan conservation action for spring-run and winter-run chinook; and

    - Tributaries are identified as contributing to the recovery of winter-run and spring-run chinook salmon in the CALFED species recovery goals (ERP Plan, Volume 1, page 214).

3. Increase survival of juvenile winter-run and spring-run chinook salmon produced in the Sacramento River and tributaries upstream of RBDD. This is accomplished by reducing the level of predation by preventing predatory fish from congregating below RBDD, while removing the disorienting effect of the hydraulics at the dam. This attains goals identified in:

    - CALFED Stage 1 actions in the ERP Plan (Volume 1, page 499, Predation for RBDD);

- CALFED Stage 1 Expectation for Dams (page 436, last bullet);
- CALFED ERP milestone for Sacramento River dams and other structures (ROD, Volume 3, Attachment 7, page 18);
- CALFED Multiple Species Conservation Plan Prescription/Conservation Measure at RBDD for winter-run and spring-run chinook;
- Winter-run Chinook Salmon Recovery Plan;
- California Fish and Game Spring-run Chinook Status Review; and
- CALFED Multiple Species Conservation Plan conservation action for spring-run and winter-run chinook salmon.

Gates-out Alternative

In addition to the benefits gained under the 2-month Gates-in Alternatives, the Gates-out Alternative adds the following benefits:

1. Restoring two miles of riparian habitat along the mainstem Sacramento. In addition, the Gates-out Alternative should restore floodplain and flood processes on one mile of the mainstem Sacramento River to a more natural level and establish aquatic, wetland, and riparian floodplain habitats, including shaded riverine aquatic cover. This attains goals identified in:
    - CALFED Stage 1 Expectation for Sacramento River Floodplain Processes (Page 17, first bullet, and Habitat on page 17, second bullet);
    - AFRP Action No. 9 for the upper mainstem Sacramento River, which directs that opportunities should be pursued that recruit large woody debris (a component of SRA Cover) to moderate temperatures and enhance nutrient input; and
    - CVPIA Section 3406 (b)(1)(A) directs that first priority be given to restoring natural channel and riparian habitat values.

RECOMMENDATIONS

The Service supports and recommends the alternative that returns the Sacramento River at Red Bluff to pre-dam conditions, the Gates-out Alternative. This alternative provides unrestricted passage to all targeted fish species. This alternative provides the opportunity for a substantial natural riparian area to become established at the seasonal Lake Red Bluff, which would provide increased benefits to fish and wildlife resources, while protecting sensitive fish species with a positive barrier fish screen. The Service also recommends that Reclamation remove RBDD

should Reclamation select the Gates-out Alternative, or have a new permit issued from the State Water Sources Control board that aligns operations with whichever alternative is selected. Should Reclamation decide to remove the structure, additional environmental measures would need to be determined to minimize adverse effects to the Sacramento River and the associated riparian areas.

The Central Valley Project Improvement Act mandates changes in the management of the CVP consistent with revised purposes of the CVP to include fish and wildlife mitigation, protection and restoration (CVPIA Section 3406 (a)). Programs and activities are authorized at RBDD that minimize fish passage problems for adult and juvenile anadromous fish and provide water delivery to the Sacramento National Wildlife Refuge complex (CVPIA Section 3406 (b)(10)). A decision that all activities at RBDD minimize passage problems for adults and juveniles and provide reliable water delivery, both now and in the future, will result in a determination that the CVPIA activities at RBDD are fully implemented and deemed to meet the mitigation, protection and restoration purposes of the CVP, thus fulfilling Reclamtion's responsibilities for mitigation of the CVP at RBDD.

In addition to maximizing fish passage benefits at the dam, the Gates-out Alternative provides the opportunity to restore two linear miles of riverbank and associated riparian habitat. This habitat presently is adversely affected by the temporary Lake Red Bluff, which forms from backed up river water when the RBDD gates are down.

The Gates-out Alternative is a significant restoration opportunity along the Sacramento River, as restoring one linear mile of riparian forest corridor would help link other riparian forest areas along the river. This would be an ecosystem-wide benefit that has the potential to positively effect numerous aquatic and terrestrial species in the Central Valley of California that use shaded riverine aquatic cover and other components of riparian forest. Many of these species have State or Federal protection status. Restoring the riparian community at Lake Red Bluff, therefore, has the potential to benefit a wide range of the Central Valley's fish and wildlife resources.

The Service acknowledges that should Reclamation select the Gates-out Alternative, Lake Red Bluff would no longer form. This would result in the loss of some forms of recreation that Lake Red Bluff has been used for historically. However, the Service anticipates that an economic benefit should result from the subsequent expected recreational opportunities to fishermen, other recreational opportunities afforded by a river and associated riparian area, and tourism for the City of Red Bluff.

CALFED environmental documents recognize that projects like RBDD fish passage program together with similar fish restoration actions, would result in cumulative beneficial impact on recreation resources that should increase opportunities for recreation in the CALFED project area and improve commercial fishing. In addition, removal of the gates allows for navigation of the river by recreational interests and fishing guides (this corridor is a designated navigable reach of river under State of California Harbors and Navigation Code Section 105).

The Service recommends that Reclamation issue a formal declaration that the Dual-Purpose Canal and Single Canals and all appurtenant facilities will not be utilized for any future salmonid propagation and/or mitigation purposes. Federal efforts to operate these facilities for production and mitigation purposes were not successful. Formal and permanent closure is necessary by the Department of the Interior to establish an official record to ensure that future Federal, State, and/or private individuals and organizations do not attempt to resurrect these facilities.

The gravels of the Dual Purpose Canal and the Single Canals are an integral component of these federal facilities. Although Reclamation is pursuing current efforts to remove some of the gravel for long-term stockpiling, the Service considers the gravel a federal resource, and hence reserves the ability to influence both the short and long-term disposition of the material. The gravel was originally acquired for resource benefits, and should be reserved for uses that are compatible with resource enhancement, conservation, and mitigation.

The Service recommends that in conjunction with the formal declaration of closure, the Bureau assume operations and maintenance responsibilities for the Single Canals, the associated network of roads, the Lower Control Building, the Lower Wet Lab, Coyote Creek Weir, Coyote Creek Turnout Facility, and various other facility features.

The proposed project is designed to improve the long-term ability to reliably pass anadromous fish both upstream and downstream, past RBDD. Construction of some project components would have temporary adverse impacts in the stream channel, and some upland, riparian, and wetland habitats within construction footprints would be lost. To help maximize the project's contribution to overall ecosystem quality in the project area, the Service provides the following additional recommendations:

24. Minimize and compensate unavoidable impacts to SRA Cover, wetland habitats, and other fish and wildlife habitats, and minimize and compensate adverse impacts that are unavoidable. This would reduce losses of existing biological values in the project area, as well as reduce planning, land acquisition, and funding needed for mitigation.

    A) Reduce bank revetment at the Mill Creek site to the minimum length needed for hydraulic performance and structural integrity of the fish screen.

    B) Avoid dredging and instream cover removal.

2. Develop and implement, in cooperation with the Service, NMFS, CDFG, DWR, and TCCA, a mitigation plan for all aquatic and terrestrial habitats adversely affected by the project.

    C) Minimize and avoid to the extent practicable impacts to SRA Cover. Compensate for unavoidable habitat losses, including impacts to SRA Cover off-site at a 3:1 ratio in addition to revegetating over bank revetment on-site. Compensation for SRA Cover losses should be based on linear feet of SRA Cover impacted and

replaced on non-vegetated, naturally erodible shoreline. Pursuant to the Service's Mitigation Policy, the Service recommends the compensation area ratios in Table 7 for temporary and permanent habitat losses.

D) Compensation for SRA Cover losses should be done in conjunction with the compensation for habitat losses to the valley elderberry longhorn beetle.

E) Implement the selected mitigation options prior to, or concurrent with, project construction to expedite replacement of habitat values lost due to the project.

F) Biological monitoring of terrestrial and aquatic habitat compensation should occur for a minimum of 10 years in combination with the mitigation monitoring for valley elderberry longhorn beetle. Photographic reference points should be established to document on- and off-site compensation area habitat conditions. An annual report of monitoring for terrestrial and aquatic habitat mitigation should be provided to the Service within 45 days of the end of the calendar year. Compensation areas should be self-sustaining for a period of three years without intervention to be determined successful.

Table 7. Compensation ratio recommendations for fish and wildlife impacts.

Impacted Resource	**Permanent Impacts**	**Temporary Impacts**
SRA Cover	3:1	Not applicable
Natural erodible shoreline	1:1	Not applicable
Riparian habitat	3:1	1:1
Freshwater marsh	3:1	1:1
VELB	Follow guidelines in the Service's Conservation Guidelines for VELB	

3) Develop and implement, in cooperation with the Service, NMFS, CDFG, and TCCA, an evaluation and monitoring plan to assess the adequacy of the fish screen in meeting biological and engineering design criteria and propose corrective measures.

A) Monitor screen criteria for the period of time necessary to evaluate screen performance at a range of river flows and pumping rates.

B) Identify operational flexibilities that would provide the greatest level of fisheries protection at various river flows and pumping rates.

C) Perform biological evaluations using available technology (direct observation, video, acoustic/sonar, etc.), as appropriate, to evaluate the effectiveness and/or impacts of the screens to juvenile salmonids and other target species.

4) Initiate ESA section 7 consultation with the Service's Sacramento Fish and Wildlife Office and NMFS to determine potential project effects on listed and other special status species, and incorporate appropriate conservation measures for affected species into project implementation. It also will be necessary to consult with CDFG for State listed species.

5) In the event that a 4-months gates-in scenario alternative is selected for implementation, the Service recommends that Reclamation:

A) Initiate investigations to determine whether the temporary center ladder could be designed or construction of a permanent ladder to improve fish passage.

B) Research feasibility of operational and structural changes to the RBDD that may benefit fish passage. These efforts would need to be coordinated with the resource agencies (CDFG, NMFS, and the Service).

C) Coordinate with the resource agencies to ensure that the results of the "Crowning Flow" experiments are analyzed, and determine whether such efforts (in conjunction with biological monitoring of fish passage response to the experiments) need continuation.

6) For alternatives that incorporate a gates-in condition, the Service recommends that Reclamation assume responsibility for the O&M of the fish ladders (including the temporary center ladder) at the RBDD, and for performing the fish counting work during the gates-in periods. Currently, these responsibilities are held by the Service.

7) For alternatives that incorporate a gates-in condition with a bypass channel, the Service recommends that Reclamation assume responsibility for the operations and maintenance of the bypass channel, the fish counting facilities (RBDD ladders and bypass channel), and performing the fish counting work associated with the operation of the bypass channel.

The Service's recommendations in this report may need to be reconsidered and updated pending potential operations decisions for the Trinity Division of the CVP that are outside of the Service's control, or that modify conditions under which RBDD and related facilities would operate.

REFERENCES

CALFED Bay-Delta Program. 2000. Final Programmatic Environmental Impact Statement/Environment Impact Report. July.

CH2M Hill. 2002a. Administrative draft EIR/EIS: Fish Passage Improvement Project at the Red Bluff Diversion Dam, Tehama County, California.

CH2M Hill. 2002b. Technical Memorandum: TCCA Fish Passage Improvement Project Elderberry Shrub Survey. April.

DWR (California Department of Water Resources). 2000. Battle Creek Salmon and Steelhead Restoration Project Fish Ladder and Fish Screen Features: Inskip Diversion, North Battle Creek Feeder Diversion, Eagle Canyon Diversion, Preliminary Engineering Concepts Technical Report. May.

NMFS (National Marine Fisheries Service). 1997. Sacramento Winter-run Draft Recovery Plan.

USFWS (U.S. Fish and Wildlife Service). 1992. Shaded Riverine Aquatic Cover of the Sacramento River System: Classification as Resource Category 1 under the FWS Mitigation Policy. October.

USFWS. 1998. Red Bluff Diversion Dam and the Tehama-Colusa Canal, Tehama County, California. Supplemental Fish and Wildlife Coordination Act Report. Ecological Services, Sacramento Field Office, Sacramento, California.

USFWS. 1999. Conservation Guidelines for the Valley Elderberry Longhorn Beetle. Sacramento Field Office, Sacramento, California.

USFWS. 2001. Final Restoration Plan for the Anadromous Fish Restoration Program.

APPENDIX A

Federal Agencies' Responsibilities under Section 7(a) and (C)
of the Endangered Species Act.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, W-2605
Sacramento, California 95825-1846

IN REPLY REFER TO:

August 16, 2002

Memorandum

To: Regional Director, U.S. Bureau of Reclamation, Sacramento, California

From: for Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California

Subject: Fish and Wildlife Coordination Act Report for the Fish Passage Improvement Project, Red Bluff Diversion Dam

The Fish and Wildlife Service (Service) has reviewed alternatives for the *Fish Passage Improvement Project, Red Bluff Diversion Dam,* Tehama County, California. This memorandum transmits the Service's Fish and Wildlife Coordination Act Report, which was prepared under the authority of, and in accordance with provisions of section 2(b) of the Fish and Wildlife Coordination Act (48 stat. 401, as amended; 16 U.S. C. 661 et seq.). The report documents assessment of potential project effects on fish and wildlife resources, and provides our recommendations to maximize biological benefits and minimize adverse effects of the project. Project effects on federally listed species, pursuant to section 7 of the Endangered Species Act of 1973, as amended, are being addressed separately.

If you have any questions, please contact A. Leigh Bartoo at (916) 414-6725.

Attachment

David J. Hanlon

cc:

AES, Portland, Oregon
FWS, Red Bluff, California (Attn: Jim Smith)
USBR, Red Bluff, California (Attn: Max Stodolski)
CDFG, Redding, California, (Attn: Harry Rectenwald)
NMFS, Sacramento, California (Attn: Michael Tucker)
DWR, Red Bluff, California (Attn: Ralph Hinton)
CH2MHill, Redding, California (Attn: Mike Urkov)
TCCA, Willows, California

Federal agencies responsiblities under Sections 7(a) and (c) of the Endangered Species Act

SECTION 7 (a) Consultation/Conference

Requires: 1) Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species 2) Consultation with FWS when a Federal action may affect a listed endangered or threatened species to insure that any action authorized, funded or carried out by a Federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The process is initiated by the Federal agency after determining the action may affect a listed species; and 3) Conference with FWS when a Federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed critical habitat.

SECTION 7 (c) Biological Assessment--Major Construction Activity (1)

Requires Federal agencies or their designers to prepare a Biological Assessment (BA) for major construction activities. The BA analyzes the effects of the action (2) on listed and proposed species. The process begins with a Federal agency requesting from FWS a list of proposed and listed threatened and endangered species. The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of this list, the accuracy of the species list should be informally verified with our Service. No irreversible commitment of resources is to be made during the BA process which would foreclose reasonable and prudent alternatives to protect endangered species. Planning, design, and administrative action may proceed; however, no construction may begin.

We recommend the following for inclusion in the BA: an on-site inspection of the area affected by the proposal which may include a detailed survey of the area to determine if the species or suitable habitat are present; a review of literature and scientific data to determine species' distribution, habitat needs, and other biological requirements; interviews with experts, including those within FWS, State conservation departments, universities and others who may have data not yet published in scientific literature; an analysis of the effects of the proposal on the species in terms of individuals and populations, including consideration of indirect effects of the proposal on the species and its habitat; and an analysis of alternative actions considered. The BA should document the results, including a discussion of study methods used, any problems encountered, and other relevant information. The BA should conclude whether or not a listed or proposed species will be affected. Upon completion, the BA should be forwarded to our office.

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(1) A construction project (or other undertaking having similar physical impacts) which is a major Federal action significantly affecting the quality of the human environment as referred to in NEPA (42 U.S.C. 4332(2)C).

(2) "Effects of the action" refers to the direct and indirect effects on an action of the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action.

APPENDIX B

Fish and Wildlife Service Planning Aid Memorandum on the Fish Passage and Water Reliability Improvement Project, Red Bluff Diversion Dam, Tehama County, California.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1886

October 19, 2001

Memorandum

To: Chief, Red Bluff Division, Bureau of Reclamation, Red Bluff, California

From: Acting Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California

Subject: Planning Aid Memo on the Fish Passage and Water Reliability Improvement Project Red Bluff Diversion Dam, Red Bluff, California

This Planning Aid Memorandum (Memorandum) transmits the U.S. Fish and Wildlife Service's (Service) comments on alternatives for the Tehama-Colusa Canal Authority (TCCA) Fish Passage Improvement Project at the Red Bluff Diversion Dam (RBDD). These comments have been prepared under the authority, and in accordance with the provisions of Section 2(b) of the Fish and Wildlife Coordination Act [(FWCA) 48 stat. 401, as amended: 16 U.S.C. 661 et seq.]. The purpose of the FWCA is to provide for equal consideration of fish and wildlife conservation with other project features of federally funded or permitted water resource development projects. Pursuant to the FWCA, the Service has coordinated with the National Marine Fisheries Service (NMFS) and the California Department of Fish and Game (DFG) before providing these comments. We have been assured that these co-trustee agencies will be affirming the content of this Memorandum in subsequent submittals to the lead agencies under the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) requirements. These comments have been developed in coordination with our Red Bluff Fish and Wildlife Office.

On October 1, 2001, the Service began collaborations with DFG and NMFS biologists in an effort to jointly develop this memorandum to assist the Bureau of Reclamation (Reclamation) with the interagency planning process for the Fish Passage Improvement at RBDD. Reclamation is the Federal nexus cooperator to the TCCA, the project lead agency.

A multi-agency team has been working on evaluating the existing conditions and alternatives for the fish passage project for over two years. This planning process has resulted in the development of the following alternatives, including the current condition (No Action):

No Action	Dam Gates in four months existing fish ladders.
Alternative 1(a)	Gates-in 4 months; new fish ladders; 1,700 cfs total pumping capacity.
Alternative 1(b)	Gates-in 4 months; new right bank fish ladder; bypass channel; 1,700 cfs total pumping capacity
Alternative 1(c)	Gates-in 4 months; old fish ladders; develop water supply from Stony Cr.
Alternative 2(a)	Gates-in 2 months; old fish ladders; 2,000 cfs total pumping capacity.
Alternative 2(b)	Gates-in 2 months; new fish ladders; 2,000 cfs total pumping capacity.
Alternative 3	Gates-out year-round; 2,500 cfs total pumping capacity.

The Service, in collaboration with NMFS and DFG, has arrived at the following preliminary recommendations:

Alternative 1(c) does not appear to meet the intent of the presently established "Project Need, Purposes, and Goal" ("needs and purpose") listed in the CH2MHILL February 2001 document, *"Tehama-Colusa Canal Authority Fish Passage Improvement Project at the Red Bluff Diversion Dam", Phase II, Preliminary Design Report, Volume I of II."* This needs and purpose clearly states the project must "substantially improve the long-term reliability" of both water delivery and adult and juvenile fish passage at the dam. Alternative 1(c) appears unlikely to substantially improve the reliability of water deliveries due to the many uncertainties associated with the water supply on Stony Creek. In April, 2001, CH2MHILL conducted a preliminary investigation of the reliability of the Stony Creek water supply, indicating that in one of every four years no water would be available for rediversion to the Tehama-Colusa Canal (TCC). There are additional uncertainties regarding the use of Stony Creek water dependant on the outcome of ongoing biological analyses and regulatory reviews of Stony Creek water management practices.

Most importantly, from our perspective, Alternative 1(c) does not improve fish passage over the No Action Alternative (gates in four months); especially for focus species of the alternatives, including spring-run chinook salmon and green sturgeon. Therefore, we recommend this alternative be dropped from further consideration. All remaining alternatives appear to meet, to various degrees, the intent of the "needs and purpose" statements.

The following list ranks the remaining alternatives, beginning with the alternative that we feel provides the greatest fishery resource benefits, to the alternative with the least fishery benefits:

1 Alternative 3
2 Alternative 2(b)
3 Alternative 2(a)
4 Alternative 1(a)
5 Alternative 1(b)

To date, the lead agency and the multi-agency planning process has generated certain amounts of fisheries information to enable this preliminary evaluation of the alternatives. However, a similar level of evaluation in relation to project alternative effects to terrestrial wildlife resources has not been possible. Therefore, as such information becomes available, issuance of additional planning aid memos may be necessary.

Discussion:

Our analysis is based upon the proceedings of numerous multi-agency technical teams spanning two decades. These efforts examined biological consequences of impaired passage at RBDD for both adult and juvenile anadromous fish as well as remedial alternatives. The most significant biological finding from this process is that populations of winter and spring-run chinook salmon, natal to the main-stem Sacramento River, require reliable and unimpaired passage at RBDD because one hundred percent of their spawning habitat is located above the dam. Likewise, salmon and steelhead populations natal to Battle, Cottonwood, Cow, and Clear creeks require reliable and unimpaired passage to sustain their separate populations. The need for restoration and recovery of these specific populations is exemplified by existing efforts to provide extensive and costly habitat restoration in the Sacramento River above RBDD, and in its major tributaries.

New ladder designs being considered as part of Alternatives 1(a), 1(b), and 2(b) are not known to produce substantial improvements in fish passage efficiency and reliability over the existing ladders. However, existing ladders at RBDD are 40 years old and engineering advancements could provide some measure of incremental improvement. Of the two permanent ladders at the dam, the west bank facility is a good candidate for modernization (size, attraction flow, baffling etc.) and effectiveness monitoring.

There are many uncertainties attached to the bypass being considered as part of alternative 1(b). While a bypass or even a fish ladder of this scale has never been tried before, the bypass does represent experimental technology that may pass non-salmonids. Clearly, there is no predictive capability that non-salmonids such as sturgeon, Sacramento pikeminnow, American shad, and striped bass will find the opening of the bypass or swim completely through the bypass if they enter it. There are also a number of operation and maintenance concerns, including seasonal closure of the facility and handling all the entrained fish during dewatering.

Our analysis of Alternatives 2(a) and 2(b) concludes there is a substantial improvement in the long-term reliability of adult and juvenile fish passage at RBDD over the No Action condition.

While we are not able to determine the incremental benefits provided by new ladders associated with the 2(a) and 2(b) alternatives, we believe the beneficial increment is not substantial in comparison to the benefit provided by the additional two months of gate openings. There are a number of specific benefits with alternatives 2(a) and 2(b). For example, the upstream migration of adult Sacramento pikeminnow would be facilitated during the gates up period, minimizing harmful accumulation of these predatory species on juvenile salmonids at the dam. Adult spring-run chinook salmon would have unimpaired passage up to the end of their migration period in late June. Unimpaired passage is particularly important for spring-run chinook salmon migrating to their natal tributaries on the Sacramento River above RBDD during the drier months. Delays in migration can result in late arrival to natal tributaries where low flow and high temperatures would prevent passage. Many of the Sacramento River tributaries above RBDD are undergoing comprehensive and expensive restoration, focusing on spring-run chinook salmon. Spring-run broodstock are extremely rare above the dam, making it essential to recruit the maximum number of natural spawners possible. Downstream migrating juveniles would be less susceptible to predation since during the gates up operation, they would not pass underneath the gates of the RBDD and become disorientated or impaired. Additonally, the spawning migration of adult green sturgeon would be unimpaired through the last portion of their spawning migration in the spring.

Alternative 3, except for diversions and their associated construction and operational impacts, provides a situation closest to the original ecosystem form and function. A free-flowing condition year-round under Alternative 3 would eliminate upstream or downstream impediments to migration and associated predation problems for all species and life-stages. Therefore, this is the best alternative for passage of all fish species and their associated life stages.

The migration timing for all anadromous fish species past Red Bluff is such that the increment of the populations migrating in July and August is relatively small. Therefore, the direct incremental benefit of totally unimpaired passage for anadromous fish species with Alternative 3, compared to that for Alternative 2, is relatively small. However, we think overall ecosystem-level benefits will be greater with Alternative 3. If the gates are up year-round, Lake Red Bluff would no longer exist, and a large amount of currently inundated shoreline would be exposed. If the natural river conditions were allowed to continue year-round, riparian vegetation would once again become established along and adjacent to the river. Shaded Riverine Aquatic (SRA) habitat, a Resource Category 1 type habitat along the Sacramento River, would become established providing shade, large woody debris, temperature attenuation, and food organisms for fish species, including salmon and steelhead.. SRA is important for biodiversity and increases fish and wildlife habitat values. Other species of native vegetation could also become established along and adjacent to the Sacramento River, further enhancing habitat, and fish and wildlife diversity. A year-round, free flowing river would greatly reduce predator "feeding stations" currently created when juvenile salmonids pass under the gates. Alternative 3 would also eliminate the need for fish ladders, reducing migration related stress and delay on adult fish attempting to pass upstream.

5

A related planning analysis is needed to consider how the RBDD alternative selection would affect the river as a navigable water of the state. Most angler use on the Sacramento River is by boat and river navigability does affect angler opportunities when pursing migratory fish species.

If you have any further questions regarding these comments, please contact Ryan Olah of my staff at (916) 414-6639 or Tom Kisanuki of the Red Bluff Fish and Wildlife Office at (530) 527-3043.

cc: Michael Aceituno, NMFS, Sacramento, CA
Donald Koch, CDFG, Redding CA
James Smith, USFWS, Red Bluff

APPENDIX C

Fishery Benefits Tables

Table C-1
Index Value, Relative Difference, and Improvement in Passage Index for Adult Anadromous Salmonids between Existing Conditions and NAA, and NAA Project Alternatives (CH2MHill 2002a).

Alternative	Index Value	Difference	Percent Improved	Effect
Winter-run Chinook Salmon				
No Action Alternative	98	n/a	n/a	*No Change*
4-Month Improved Ladder Alternative	91	2	2	*No Measurable Benefit*
4-Month Bypass Alternative	91	1	1	*No Measurable Benefit*
2-Month Improved Ladder Alternative	98	8	9	*No Measurable Benefit*
2-Month with Existing Ladders Alternative	98	8	9	*No Measurable Benefit*
Gates-out Alternative	100	10	12	*Measurable Benefit*
Spring-run Chinook Salmon				
No Action Alternative	52	n/a	n/a	*No Change*
4-Month Improved Ladder Alternative	61	8	16	*No Measurable Benefit*
4-Month Bypass Alternative	57	5	9	*No Measurable Benefit*
2-Month Improved Ladder Alternative	94	41	79	*Large Measurable Benefit*
2-Month with Existing Ladders Alternative	93	40	77	*Large Measurable Benefit*
Gates-out Alternative	100	48	91	*Large Measurable Benefit*
Fall-run Chinook Salmon				
No Action Alternative	83	n/a	n/a	*No Change*
4-Month Improved Ladder Alternative	86	3	4	*No Measurable Benefit*
4-Month Bypass Alternative	85	2	2	*No Measurable Benefit*
2-Month Improved Ladder Alternative	91	8	9	*No Measurable Benefit*
2-Month with Existing Ladders Alternative	89	6	8	*No Measurable Benefit*

Gates-out Alternative	100		17	20	*Measurable Benefit*
Late fall-run Chinook Salmon					
No Action Alternative	100	n/a		n/a	*No Change*
4-Month Improved Ladder Alternative	100	0		0	*No Change*
4-Month Bypass Alternative	100	0		0	*No Change*
2-Month Improved Ladder Alternative	100	0		0	*No Change*
2-Month with Existing Ladders Alternative	100	0		0	*No Change*
Gates-out Alternative	100	0		0	*No Change*
Steelhead					
No Action Alternative	89	n/a		n/a	*No Change*
4-Month Improved Ladder Alternative	91	2		2	*No Measurable Benefit*
4-Month Bypass Alternative	90	1		1	*No Measurable Benefit*
2-Month Improved Ladder Alternative	97	8		9	*No Measurable Benefit*
2-Month with Existing Ladders Alternative	96	7		8	*No Measurable Benefit*
Gates-out Alternative	100	11		12	*Measurable Benefit*

Table C-2
Index Value, Relative Difference, and Improvement in Passage Index for Juvenile Anadromous Salmonids between Existing Conditions and NAA, and NAA and Project Alternative (CH2MHill 2002a).

Alternative	Index Value	Difference	Percent Improved	Effect
Winter-run Chinook Salmon				
No Action Alternative	96	n/a	n/a	*No Change*
4-Month Gates-in	96	0	0	*No Change*
2-Month Gates-in	99	3	3	*No Measurable Benefit*
Gates Out	100	4	4	*No Measurable Benefit*
Spring-run Chinook Salmon				
No Action Alternative	100	n/a	n/a	*No Change*
4-Month Gates-in	100	0	0	*No Change*
2-Month Gates-in	100	0	0	*No measurable Benefit*
Gates Out	100	0	0	*No Measurable Benefit*
Fall-run Chinook Salmon				
No Action Alternative	97	n/a	n/a	*No Change*
4-Month Gates-in	97	0	0	*No Change*
2-Month Gates-in	100	2	2	*No Measurable Benefit*
Gates Out	100	3	3	*No Measaurable Benefit*
Late fall-run Chinook Salmon				
No Action Alternative	93	n/a	n/a	*No Change*
4-Month Gates-in	93	0	0	*No Change*
2-Month Gates-in	96	4	5	*No Measurable Benefit*
Gates Out	100	7	7	*No Measurable Benefit*

Steelhead					
	No Action Alternative	92	n/a	n/a	*No Change*
	4-Month Gates-in	92	0	0	*No Change*
	2-Month Gates-in	99	6	7	*No Measurable Benefit*
	Gates Out	100	8	8	*No Measurable Benefit*

Table C-3

Index Value, Relative Difference, and Improvement in Passage Index for Adult Other Native Anadromous Species between Existing Conditions and NAA, and NAA and Project Alternatives (CH2MHill 2002a).

Alternative	Index Value	Difference	Percent Improved	Effect
Green Sturgeon				
No Action Alternative	65	n/a	n/a	*No Change*
4-Month Improved Ladder Alternative	65	0	0	*No Change*
4-Month Bypass Alternative	69	4	6	*No Measurable Benefit*
2-Month Improved Ladder Alternative	100	35	54	*Large Measurable Benefit*
2-Month with Existing Ladders Alternative	100	35	54	*Large Measurable Benefit*
Gates-out Alternative	100	35	54	*Large Measurable Benefit*
Pacific Lamprey				
No Action Alternative	83	n/a	n/a	*No Change*
4-Month Improved Ladder Alternative	86	3	4	*No Measurable Benefit*
4-Month Bypass Alternative	85	2	2	*No Measurable Benefit*
2-Month Improved Ladder Alternative	97	14	17	*Measurable Benefit*
2-Month with Existing Ladders Alternative	96	13	16	*Measurable Benefit*
Gates-out Alternative	100	17	20	*Measurable Benefit*
River Lamprey				
No Action Alternative	83	n/a	n/a	*No Change*
4-Month Improved Ladder Alternative	86	3	4	*No Measurable Benefit*
4-Month Bypass Alternative	85	2	2	*No Measurable Benefit*
2-Month Improved Ladder Alternative	97	14	17	*Measurable Benefit*
2-Month with Existing Ladders Alternative	96	13	16	*Measurable Benefit*
Gates-out Alternative	100	17	20	*Measurable Benefit*

Table C-4
Index Value, Relative Difference, and Improvement in Passage Index for Juvenile (and transformer) for Other Native Anadromous Species between Existing Conditions and NAA, and NAA and Project Alternatives (CH2MHill 2002a).

Alternative	Index Value	Difference	Percent Improved	Effect
Green Sturgeon				
No Action Alternative	73	n/a	n/a	*No Change*
4-Month Gates-in	73	0	0	*No Change*
2-Month Gates-in	88	15	21	*Measurable Benefit*
Gates out	100	27	38	*Large Measurable Benefit*
Pacific Lamprey				
No Action Alternative	99	n/a	n/a	*No Change*
4-Month Gates-in	99	0	0	*No Change*
2-Month Gates-in	100	1	1	*No Measurable Benefit*
Gates out	100	1	1	*No Measurable Benefit*
River Lamprey				
No Action Alternative	87	n/a	n/a	*No Change*
4-Month Gates-in	87	0	0	*No Change*
2-Month Gates-in	100	13	15	*Measurable Benefit*
Gates out	100	13	15	*Measurable Benefit*

APPENDIX D

Federally Listed, Proposed, Candidate, and Species of Concern That Could Occur in the Red Bluff Diversion Dam Service Area, or May Be Affected by the Project.

Endangered and Threatened Species that May Occur in
or be Affected by Projects in the Selected Quads Listed Below
Reference File No. -
August 16, 2002

QUAD: 610B RED BLUFF EAST

Listed Species

Birds

bald eagle, *Haliaeetus leucocephalus* (T)

Reptiles

giant garter snake, *Thamnophis gigas* (T)

Amphibians

California red-legged frog, *Rana aurora draytonii* (T)

Fish

delta smelt, *Hypomesus transpacificus* (T)

Central Valley steelhead, *Oncorhynchus mykiss* (T) NMFS

Critical habitat, winter-run chinook salmon, *Oncorhynchus tshawytscha* (E) NMFS

winter-run chinook salmon, *Oncorhynchus tshawytscha* (E) NMFS

Central Valley spring-run chinook salmon, *Oncorhynchus tshawytscha* (T) NMFS

Critical Habitat, Central Valley spring-run chinook, *Oncorhynchus tshawytscha* (T) NMFS

Sacramento splittail, *Pogonichthys macrolepidotus* (T)

Invertebrates

vernal pool fairy shrimp, *Branchinecta lynchi* (T)

valley elderberry longhorn beetle, *Desmocerus californicus dimorphus* (T)

vernal pool tadpole shrimp, *Lepidurus packardi* (E)

Candidate Species

Birds

Western yellow-billed cuckoo, *Coccyzus americanus occidentalis* (C)

Fish

Central Valley fall/late fall-run chinook salmon, *Oncorhynchus tshawytscha* (C) NMFS

Critical habitat, Central Valley fall/late fall-run chinook, *Oncorhynchus tshawytscha* (C) NMFS

Species of Concern

Mammals

pale Townsend's big-eared bat, *Corynorhinus (=Plecotus) townsendii pallescens* (SC)

Pacific western big-eared bat, *Corynorhinus (=Plecotus) townsendii townsendii* (SC)

spotted bat, *Euderma maculatum* (SC)

small-footed myotis bat, *Myotis ciliolabrum* (SC)

long-eared myotis bat, *Myotis evotis* (SC)
fringed myotis bat, *Myotis thysanodes* (SC)
long-legged myotis bat, *Myotis volans* (SC)
Yuma myotis bat, *Myotis yumanensis* (SC)
San Joaquin pocket mouse, *Perognathus inornatus* (SC)

Birds

tricolored blackbird, *Agelaius tricolor* (SC)
grasshopper sparrow, *Ammodramus savannarum* (SC)
short-eared owl, *Asio flammeus* (SC)
western burrowing owl, *Athene cunicularia hypugaea* (SC)
oak titmouse, *Baeolophus inornatus* (SLC)
Aleutian Canada goose, *Branta canadensis leucopareia* (D)
Swainson's hawk, *Buteo Swainsoni* (CA)
ferruginous hawk, *Buteo regalis* (SC)
Lawrence's goldfinch, *Carduelis lawrencei* (SC)
Vaux's swift, *Chaetura vauxi* (SC)
black tern, *Chlidonias niger* (SC)
white-tailed (=black shouldered) kite, *Elanus leucurus* (SC)
little willow flycatcher, *Empidonax traillii brewsteri* (CA)
American peregrine falcon, *Falco peregrinus anatum* (D)
loggerhead shrike, *Lanius ludovicianus* (SC)
Lewis' woodpecker, *Melanerpes lewis* (SC)
long-billed curlew, *Numenius americanus* (SC)
Nuttall's woodpecker, *Picoides nuttallii* (SLC)
white-faced ibis, *Plegadis chihi* (SC)
bank swallow, *Riparia riparia* (CA)
rufous hummingbird, *Selasphorus rufus* (SC)

Reptiles

northwestern pond turtle, *Clemmys marmorata marmorata* (SC)

Amphibians

foothill yellow-legged frog, *Rana boylii* (SC)
western spadefoot toad, *Spea hammondii* (SC)

Fish

green sturgeon, *Acipenser medirostris* (SC)
river lamprey, *Lampetra ayresi* (SC)
longfin smelt, *Spirinchus thaleichthys* (SC)

Invertebrates

Antioch Dunes anthicid beetle, *Anthicus antiochensis* (SC)

Sacramento anthicid beetle, *Anthicus sacramento* (SC)

California linderiella fairy shrimp, *Linderiella occidentalis* (SC)

Plants

silky cryptantha, *Cryptantha crinita* (SC)

adobe lily, *Fritillaria pluriflora* (SC)

Red Bluff (dwarf) rush, *Juncus leiospermus var. leiospermus* (SC)

KEY:

(E)	*Endangered*	Listed (in the Federal Register) as being in danger of extinction.
(T)	*Threatened*	Listed as likely to become endangered within the foreseeable future.
(P)	*Proposed*	Officially proposed (in the Federal Register) for listing as endangered or threatened.
(PX)	*Proposed Critical Habitat*	Proposed as an area essential to the conservation of the species.
(C)	*Candidate*	Candidate to become a *proposed* species.
(SC)	*Species of Concern*	May be endangered or threatened. Not enough biological information has been gathered to support listing at this time.
(SLC)	*Species of Local Concern*	Species of local or regional concern or conservation significance.
(MB)	*Migratory Bird*	Migratory bird
NMFS	NMFS species	Under the jurisdiction of the National Marine Fisheries Service. Contact them directly.
(D)	*Delisted*	Delisted. Status to be monitored for 5 years.
(CA)	*State-Listed*	Listed as threatened or endangered by the State of California.
(*)	*Extirpated*	Possibly extirpated from this quad.
(**)	*Extinct*	Possibly extinct.
	Critical Habitat	Area essential to the conservation of a species.

APPENDIX E

Planning Aid Memorandum from the Fish and Wildlife Service and Letter from the National Marine Fisheries Service on Species of Concern for the Fish Passage Improvement Project at the Red Bluff Diversion Dam.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

IN REPLY REFER TO:

September 20, 2000

Memorandum

To: Area Manager, Bureau of Reclamation, Northern California Area Office, Shasta Lake, California

From: Acting Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California

Subject: Species of Concern for the Fish Passage Improvement Project for the Red Bluff Diversion Dam

This memorandum is in response to the Bureau of Reclamation's (Reclamation) letter, dated August 18, 2000, which asked for the Fish and Wildlife Service's (Service) guidance as to what fish species should be considered when designing fish passage facilities at the Red Bluff Diversion Dam (RBDD).

Improving fish passage at the Red Bluff Diversion Dam is a priority for the Service. As recommended in the Service's February 1998 Supplemental Fish and Wildlife Coordination Act Report on the Red Bluff Diversion Dam and the Tehama-Colusa Canal, Reclamation, in consultation with the Service, the National Marine Fisheries Service (NMFS) and The California Department of Fish and Game (CDFG), should continue to develop a long term solution to minimize fish passage problems for adults and juveniles of all anadromous fish. In addition to anadromous fish, the Service is also concerned with listed species and native fish of the Sacramento River. By listing which fish are important to pass both upstream and downstream of RBDD, we will be able to more clearly determine if an alternative for the Tehama-Colusa Canal Authority's (TCCA) Fish Passage Improvement Project will be acceptable.

We propose three levels of priority for fish passage considerations at RBDD:

The first level would include all federally and State listed species, proposed and candidate species, and all agency and academically recognized species of concern (See Table 1). This group would include steelhead and all runs (fall, late-fall, winter, and spring) of chinook salmon. Non-native anadromous also should be included in this group based on the Central Valley Project

Improvement Act (P.L. 101-575), which states that the Secretary of the Interior is authorized and directed to "develop and implement measures to minimize fish passage problems for adult and juvenile anadromous fish at Red Bluff Diversion Dam." All life stages for the species in this first level should be considered for upstream and downstream passage. In addition, any unlisted species that adversely affects listed species due to the congregation of the unlisted species above or below the dam due to impaired passage should be included. Specifically, this applies to Sacramento pikeminnow. If pikeminnow, cannot pass the dam, they can adversely affect migrating juvenile listed species by depredation. By allowing passage to the pikeminnow, these adverse impacts can be lessened.

The second level would include all native fish species occurring in the Sacramento River. This group would include such fish as Sacramento sucker and hardhead.

The third level would include non-native fish species in the Sacramento River.

Table 1

Priority Level	Type of Fish Included	Specific Fish Species
Level 1	Federal and state listed fish, proposed and candidate species, species of concern	Pacific salmon (*Oncorhynchus tshawytscha* spp.) Steelhead (*Oncorhynchus mykiss*) Splittail (*Pogonichthys macrolepidotus*) Pacific lamprey (*Lampetra ayresi*) River lamprey (*Lampetra tridentata*) Green sturgeon (*Acipenser medirostris*) White sturgeon (*Acipenser transmontanus*)
	Anadromous fish (covered under CVPIA)	American shad (*Alosa sadidissima*) Striped bass (*Morone saxatilis*)
	Fish, that if they cannot pass the RBDD, could have an adverse effect to juvenile listed species.	Sacramento pikeminnow (*Ptychocheilus grandis*)
Level 2	Native fish of the Sacramento River	Sacramento sucker (*Catostomus occidentalis*) Hardhead (*Mylopharodon conocephalus*) Others
Level 3	Non-native fish of the Sacramento River	Various

If you have any further questions regarding these comments, please contact Ryan Olah of the Sacramento Fish and Wildlife Office at (916) 414-6725, or Tom Kisanuki of the Northern Central Valley Fish and Wildlife Office (NCVFWO) at (530) 527-3043.

Dale A. Pierce

cc: AES, Portland, OR
Dale Cannon, CH2M HILL, Redding, CA
Art Bullock, TCCA, Willows, CA
Harry Rectenwald, CDFG, Redding, CA
Michael Tucker, NMFS, Sacramento, CA
Jim Smith, NCVFWO, Red Bluff, CA

APPENDIX F

Concurrence Letters from the California Department of Fish and Game and National Marine Fisheries Service.

Sacramento Area Office
650 Capitol Mall, Suite 6070
Sacramento, California 95814

October 11, 2000

In Response Refer To:
SWR-00-SA-0152:MET

Mr. Michael J. Ryan, Area Manager
Bureau of Reclamation
Northern California Area Office
16349 Shasta Dam Blvd.
Shasta Lake, California 96019-8400

Dear Mr Ryan:

This is in response to your letter of August 18, 2000, requesting identification of those species of fish which the National Marine Fisheries Service (NMFS) would recommend consideration as you develop a plan for improvement of fish passage at the Red Bluff Diversion Dam (RBDD). I have broken down this list into three levels of priority with the highest level including all federally and state listed species. The second level includes other native species of concern which have demonstrated decreasing population trends, have experienced significant habitat degradation and/or are known to be highly migratory, relying on passage of RBDD to reach historic spawning grounds. The third level includes all other native species known to inhabit this area of the river. All life stages of these species should be considered as the demise of any one stage would mean the eventual loss of the species.

First Priority:

Sacramento River winter-run chinook salmon *(Oncorhynchus tshawytscha)*
Central Valley spring-run chinook salmon *(O. tshawytscha)*
Central Valley steelhead *(O. mykiss)*
Sacramento splittail *(Pogonichthys macrolepidotus)*

Second Priority:

Central Valley fall/late fall-run chinook salmon *(O. tshawytscha)*
Green sturgeon *(Acipenser medirostris)*
White sturgeon *(A. transmontanus)*
Pacific lamprey *(Lampetra tridentata)*
River lamprey *(L. Ayresi)*

Third Priority:

All other native species

If you have any questions regarding this correspondence or if NMFS can provide further assistance on this project, please contact Mr. Michael Tucker in our Sacramento Area Office, 650 Capitol Mall, Suite 6070, Sacramento, CA 95814. Mr. Tucker may be reached by telephone at (916) 498-8988 or by fax at (916) 498-6697.

Sincerely,

Michael E. Aceituno
Sacramento Area Office Supervisor

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

August 16, 2002

In Reply Refer To:
SWR-99-SA-1048:MET

Mr. Wayne White
Field Supervisor
Sacramento Office
U.S. Fish and Wildlife Service
2800 Cottage Way, Room W. 2605
Sacramento, California 95825

Dear Mr. White:

The National Marine Fisheries Service (NOAA Fisheries) has reviewed the Administrative Draft Fish and Wildlife Coordination Act Report (report) on the Fish Passage Improvement Project at the Red Bluff Diversion Dam which was sent out via electronic mail from your office on August 6, 2002. We appreciate the opportunity to participate in the development of this document and offer the following comments.

NOAA Fisheries staff have been working closely with the U.S. Fish and Wildlife Service (FWS) as a member of the multi-agency team that has been evaluating the existing conditions and developing alternatives for this fish passage improvement project for over two years. Recently, NOAA Fisheries was invited to work collaboratively with FWS and the California Department of Fish and Game (DFG) to provide input to the subject report on the fisheries benefits and impacts associated with the various alternatives that have been developed for the project. NMFS has reviewed the draft report and we fully concur with the statements and determinations put forth by FWS.

Of particular importance is the evaluation of the "gates out" alternative and the many important fisheries and other ecological benefits that are unique to this alternative. The gates out alternative is the only one that ensures free passage of migrating salmonids and other fish, throughout the year. This alternative also provides the greatest level of certainty to water users, including the national wildlife refuges that use this water to create and enhance habitat for fish and wildlife resources. Finally, this alternative is the only one that is likely to create conditions upstream of the dam that will allow the regeneration of high quality riparian vegetation and shaded riverine aquatic habitat for approximately one mile on each side of the river. The opportunity to create such a large amount of this critically important category one habitat is very rare on the highly developed Sacramento River.

Again, we appreciate the opportunity to participate in the development of this important report. If you have any questions regarding this correspondence or if NOAA Fisheries can provide further assistance on this project, please contact Mr. Michael Tucker in our Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, CA 95814. Mr. Tucker may be reached by telephone at (916) 930-3604 or by Fax at (916) 930-3629.

Sincerely,

Rodney R. McInnis
Acting Regional Administrator

cc: NOAA Fisheries-PRD, Long Beach, CA
Stephen A. Meyer, ASAC, NOAA Fisheries, Sacramento, CA

Again, we appreciate the opportunity to participate in the development of this important report. If you have any questions regarding this correspondence or if NOAA Fisheries can provide further assistance on this project, please contact Mr. Michael Tucker in our Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, CA 95814. Mr. Tucker may be reached by telephone at (916) 930-3604 or by Fax at (916) 930-3629.

Sincerely,

ORIGINAL SIGNED BY
MICHAEL ACEITUNO FOR
Rodney R. McInnis
Acting Regional Administrator

cc: NOAA Fisheries-PRD, Long Beach, CA
Stephen A. Meyer, ASAC, NOAA Fisheries, Sacramento, CA

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