Feasibility Report Appendixes

December 1991

American River Watershed Investigation, California

VOLUME 6 – APPENDIX S
PART 1

US Army Corps of Engineers

Sacramento District
South Pacific Division

American River Watershed Investigation, California

FEASIBILITY REPORT

LIST OF APPENDIXES

American River Watershed Investigation, California

APPENDIX S

PART 1

Fish and Wildlife Coordination Act Report (Main Report, Auburn Area)

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

AMERICAN RIVER WATERSHED INVESTIGATION

A DETAILED REPORT ON

FISH AND WILDLIFE RESOURCES

REGION ONE

NOVEMBER 1991

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

AMERICAN RIVER WATERSHED INVESTIGATION

A DETAILED REPORT ON
FISH AND WILDLIFE RESOURCES

November 1991

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INTRODUCTION

Our analysis of project impacts on fish and wildlife resources is based on a literature review; personal communication with recognized experts; field investigations and surveys; preliminary engineering and other information provided by the Corps; and a projection of future conditions using current land-use information and analysis provided by the Corps. Our analysis will not remain valid if the project, the resource base, or anticipated futures change significantly. This report is accompanied by separate substantiating reports for the three major segments of the American River Watershed Investigation: Auburn area, Lower American River area, and Natomas area.

We applied the Fish and Wildlife Service's Habitat Evaluation Procedures (HEP) methodology to measure the value of terrestrial resources in the project area (refer to the substantiating reports). The methodology provides a species-habitat approach to resource assessment and a means to calculate an index of habitat values using both qualitative and quantitative factors. The cover types used by wildlife are appraised with respect to their value in providing the necessary habitat requirements for selected evaluation species. Habitat value is displayed as habitat units, the product of habitat quality (Habitat Suitability Index) and acres. The objectives of these procedures are to define (in nonmonetary terms) the impacts of the project, and to provide a basis for determining mitigation measures needed to maintain the integrity of the ecosystem. It is important to note that other means of analysis, including other studies, and professional experience and opinion, are used as needed to ensure that resource protection goals are met. The HEP methodology is not used to evaluate project impacts on Federally listed endangered or threatened species.

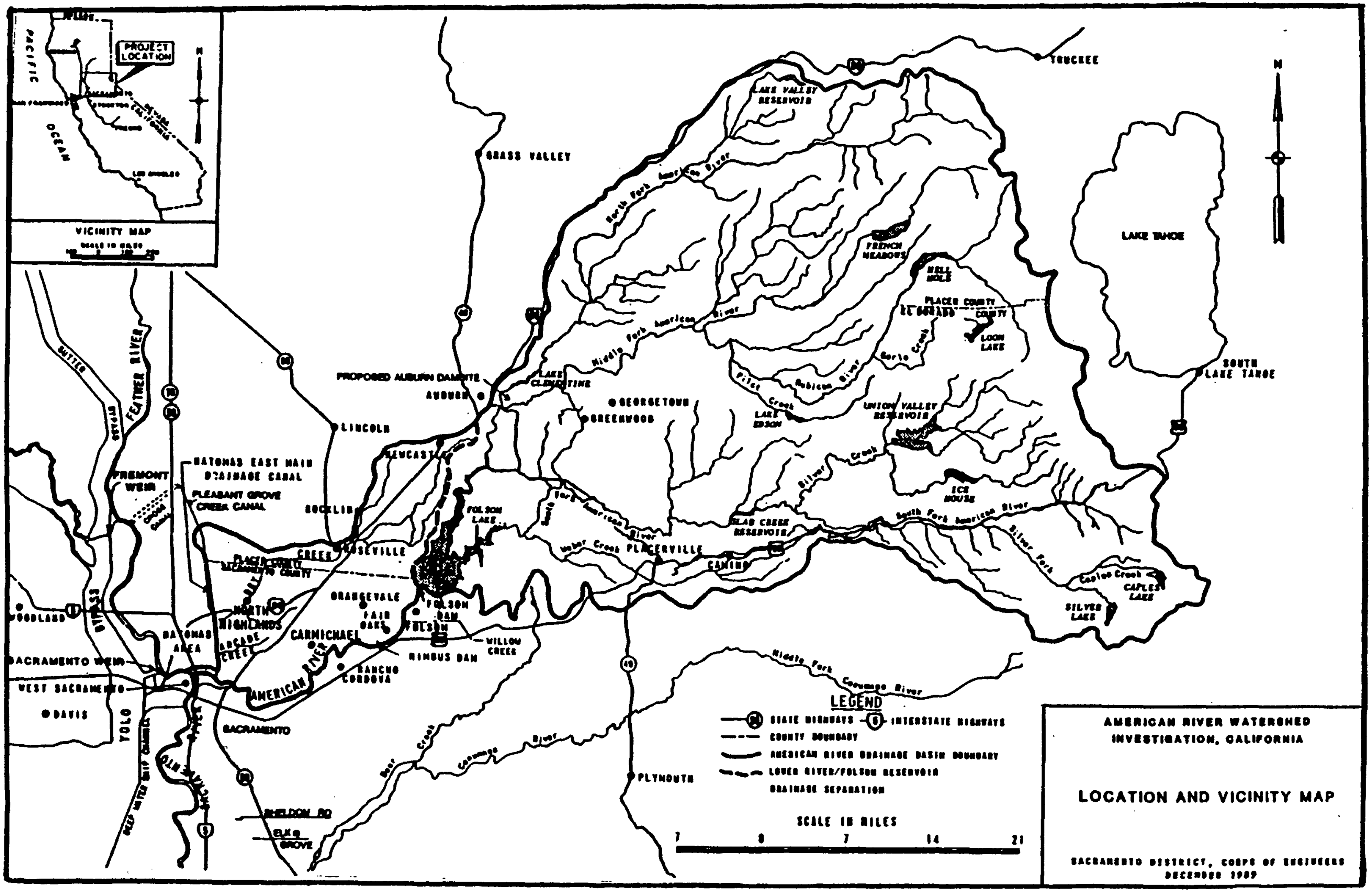
Recommended mitigation is commensurate with the habitat values involved. Habitats range in value from those considered to be unique and irreplaceable to those believed to be of relatively low value to fish and wildlife. The recommendations are designed to assure: (1) full protection of unique and irreplaceable habitats, (2) replacement of high-value habitats, and (3) minimal damage to low-value habitats. All of the habitat types identified within the project area would be impacted to some degree. Because of their high values for wildlife, their dramatic decline in areal extent, and ongoing fragmentation, the Auburn canyons and their free flowing rivers were placed in Resource Category 2. Similarily, the wetlands and deep water aquatic habitat along the lower American River and in Natomas were also placed in Resource Category 2. Therefore, our mitigation goal for these habitat types is no net loss of in-kind habitat value or acreage. Conversely, since the valley grasslands, meadows, woodlands, and agricultural habitat types are more common throughout the region and State, we placed them in Category 3 thus the mitigation goal is no net loss of habitat value while minimizing loss of in-kind habitat value.

In response to an April 24, 1989 Corps of Engineers request, the Service on May 18, 1989 provided a list of endangered and threatened species, and candidates for Federal listing, that may be in the project area. The Corps subsequently initiated formal consultation and requested that the Service prepare a biological opinion addressing the effects of the project on the Federally listed threatened valley elderberry longhorn beetle. We concluded in our November 27, 1991 biological opinion that the proposed project, including mitigation developed to offset adverse impacts to the beetle, would not jeopardize the continued existence of this species or destroy or adversely modify its designated critical habitat.

BACKGROUND

The American River Watershed Investigation covers an area of approximately 2,100 square miles within El Dorado, Placer, Sacramento, Sutter, and Yolo Counties (Figure 1). The investigation is focused on: (1) the Natomas area bounded by (and including) the Natomas East Main Drainage Canal (NEMDC), Natomas Cross Canal and the east bank of the Sacramento River; (2) Dry Creek from just downstream of Marysville Boulevard to the creek's confluence with the NEMDC, (3) Arcade Creek from the Southern Pacific Railroad to the creek's confluence with the NEMDC, (4) the Sacramento River from the American River confluence upstream to Verona, including part of the adjacent Yolo Bypass, and the Sacramento Weir and Bypass, (5) the lower American River to the Sacramento River confluence, (6) the American River from Nimbus Dam to the ends of the north and south fork arms of Folsom Reservoir, (7) the North Fork American River above Folsom Reservoir to an elevation of 1,135 feet, and (8) the Middle Fork American River, including the north fork of the Middle Fork to an elevation of 1,135 feet.

Historically, floods occurred almost annually in the region of the American River and Sacramento River confluence. This region (which includes all of the Natomas area) lies at the terminus of an enormous drainage area, the American Basin. From the confluence of the Sacramento and American Rivers the flood plain extends north to Coon Creek in Sutter and Placer Counties and east to the NEMDC (Figure 2). Although the floodplain undoubtedly once extended beyond the NEMDC as a consequence of the flat topography of the area, at present the Southern Pacific Railroad levee to the east of the NEMDC effectively defines the limits of the designated 100-year flood zone. The Natomas area


AMERICAN RIVER WATERSHED
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WILLOW CREEK
PLACERVILLE
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ORANGEVALE
FAIR OAKS
CARMICHAEL
RANCHO CORDOVA
NORTH HIGHLANDS
ARCADE CREEK
AMERICAN RIVER
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WEST SACRAMENTO
SACRAMENTO WEIR
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YOLO
FREMONT WEIR
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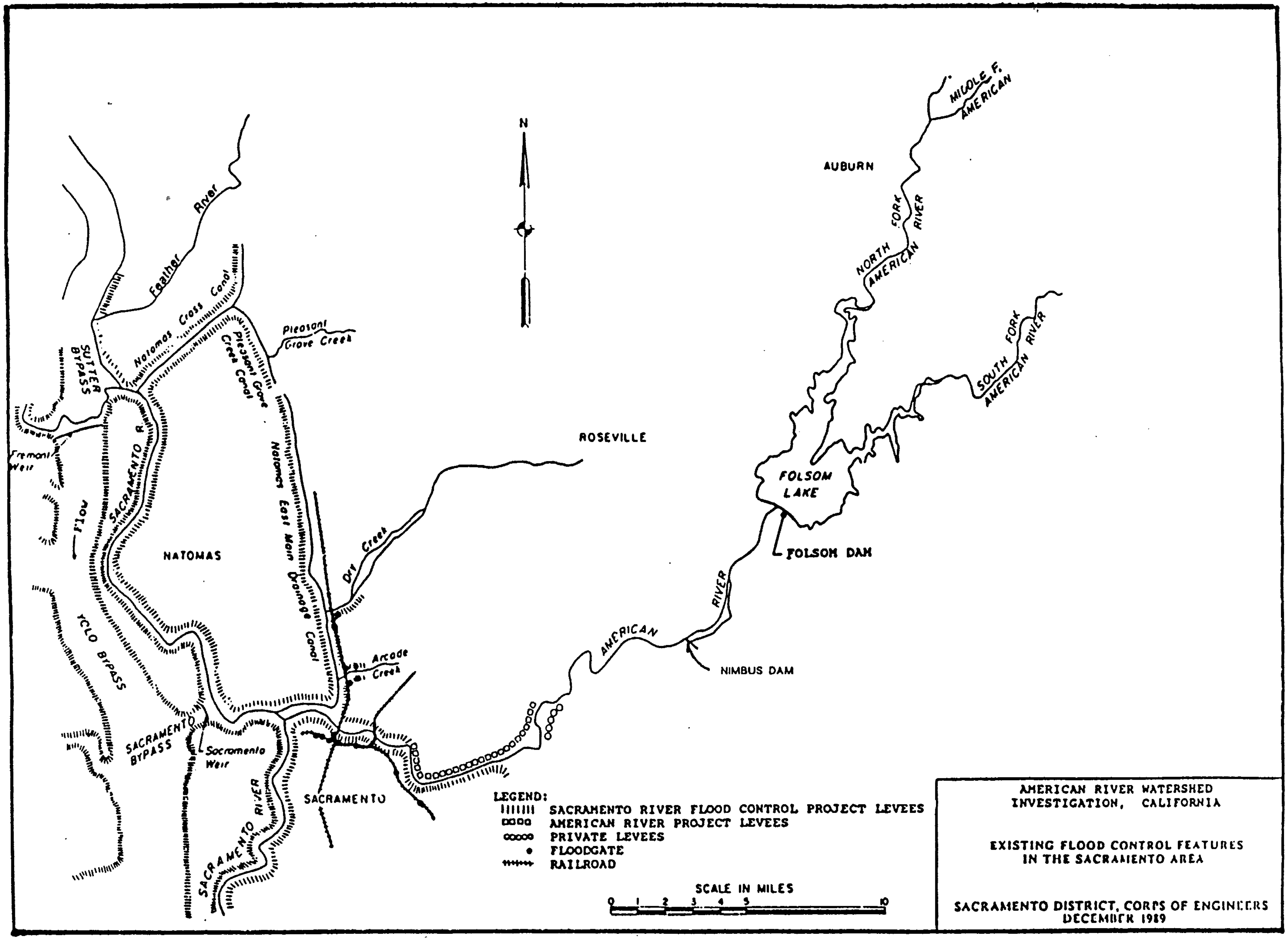
Figure 1


N
AUBURN
MIDDLE F. AMERICAN
NORTH FORK AMERICAN RIVER
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AMERICAN RIVER WATERSHED INVESTIGATION, CALIFORNIA
EXISTING FLOOD CONTROL FEATURES IN THE SACRAMENTO AREA
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
DECEMBER 1989

Figure 2

historically flooded on a regular basis as a result of periodic overbank flows and local storm runoff into the shallow, poorly drained lowlands of the area.

The first flood control efforts in the Sacramento region involved construction of low levees on the rimlands by farmers to protect their crops. By 1894, many miles of low levees had been constructed by private entities along most of the major rivers and streams, and a number of flood protection districts had been formed. Reclamation District 1000 was established in 1911, under the authority of the State Reclamation Act, to protect the farms in the Natomas area floodplain. The District's role was to build, maintain, and operate a system of canals, weirs, levees, pumping plants and other facilities to protect agricultural lands in the area by managing flood waters and agricultural drainage.

The Federal Flood Control Act of 1917 authorized a major flood control project for the Sacramento River that involved a series of overflow weirs, bypass channels and construction of a major levee network, most of which was completed at Federal expense. These major flood control projects and activities began and greatly facilitated the now ongoing process of systematic conversion of the land from its natural, periodically flooded state, which was a highly productive natural ecosystem, to uses less and less compatible with fish and wildlife and natural riverine processes and dynamics.

The American River Watershed Investigation is being conducted to evaluate alternative flood-control measures for the lower American River, Natomas area, and Sacramento and Yolo Bypasses to provide a greater level of flood protection for the Sacramento metropolitan area. The study was initiated following severe flooding that occurred in February 1986 when major storms produced record flows in the American River Basin. Prior to that time, it was believed that Folsom Dam and Reservoir could control a flood event having a return period of about once in 120 years, on the average. However, re-examination of Folsom Reservoir flood operation and recent hydrological data relationships by the Corps indicated that the facility is capable of controlling only about a 63-year flood event. Hence, the outflows from Folsom Dam capable of causing major flood damage along the lower American River are expected to occur significantly more often than previously believed.

The 1986 flood raised the questions of levee reliability and floodplain classification throughout the lower American River and portions of the Sacramento River above and below the mouth of the American River. As a result, the Federal Emergency Management Agency (FEMA) studied the entire area and found that a significantly larger segment of the greater Sacramento Area was within the 100-year floodplain than previously determined. Results of the FEMA study brought the area under a different set of criteria for the National Flood Insurance Program which would affect Federal participation in future development of the area. In response to this change, special Congressional legislation was passed in November 1988 to defer the use of the new flood elevations and flood insurance rates in the area for a period of four years. Deferral was made contingent upon the local agencies implementing measures to eliminate flooding problems in the area consistent with Federal guidelines, regulations and policies.

Although the special legislation was somewhat general in terms of defining local progress to eliminate flooding, the Corps is cooperating with local sponsors in a feasibility study to carry out remedial repairs of deficient levees in the Sacramento area. The evaluation of flood control alternatives for the American River watershed assumes that levee deficiencies will be corrected as a result of work performed by the Corps under its Sacramento River Flood Control System Evaluation being conducted in cooperation with local agencies.

The American River Watershed Investigation is one of several studies by the Corps of Engineers to evaluate potential solutions to identified flooding problems, and to select and implement an appropriate course of action to resolve the flood threats facing the Sacramento metropolitan area. Other interrelated flood control studies being conducted by the Corps are the Sacramento Metropolitan Study, Folsom Dam and Reservoir Re-operation Study, the Sacramento River Flood Control System Evaluation, and the Yuba River Reconnaissance Study. These studies encompass a major portion of the southern Sacramento Valley which contains an important segment of California's remnant, high-value riverine, riparian, and farmed wetland habitats.

DESCRIPTION OF PROJECT ALTERNATIVES

I. 400-Year Protection Alternative

Auburn Area. This alternative includes construction of a 498-foot-high, 2,700 foot-long concrete gravity design, dam on the downstream side of the existing Auburn Dam foundation. The facility would be designed to act in conjunction with seasonal flood control storage in Folsom Reservoir to maintain the current maximum release of 115,000 cfs from Folsom Reservoir to the lower

American River. During high flows, the new dam would temporarily (1 to 12 days) store up to 894,000 acre-feet of water to allow optimum operation of the downstream flood control system. At maximum storage the reservoir would inundate approximately 5,450 acres. A total of 22,600 acres of land would be required for the project. At full capacity the reservoir would inundate about 19.5 miles of the North Fork American River and Lake Clementine, and 20.5 miles of the Middle Fork American River. Flood flows would pass through eight sluices through the dam. The existing diversion tunnel constructed for Auburn Dam would be blocked with a bulkhead. The dam would be designed to enable future expansion to a multipurpose project. This plan includes relocation of 2.8 miles of State Highway 49 and a two-lane bridge across the American River at River Mile 23. Also, Ponderosa Way would be relocated and Ponderosa bridge on the North Fork raised to avoid inundation.

Lower American River Area. No changes would occur in this area.

Natomas Area. The plan would provide flood protection to approximately 55,000 acres in the Natomas area. Levees would be raised along portions of the NEMDC, Natomas Cross Canal, Pleasant Grove Canal, Dry Creek and Arcade Creek. New levees would be constructed along Dry Creek. A gated pump structure would be installed on the NEMDC just north of Dry Creek, and a 308-acre floodwater detention basin constructed in the northeast corner of the Natomas area. Bridges would be raised or replaced on Dry Creek and Arcade Creek. A 2 mile-long, 3,000 cfs drainage canal would be constructed from Riego Road to Sankey Road.

II. 200-Year Protection Alternative

Auburn Area. This alternative would include construction of a 434-foot-high 2,700-foot-long dam located as described for the 400-year protection alternative. At full capacity the reservoir would store temporarily (1 to 12 days) 545,000 acre-feet of flood water. When full, the reservoir would inundate approximately 4,000 acres of land, and 16.5 miles of the North Fork American River, including Lake Clementine, and 17.5 miles of the Middle Fork American River. Relocation of 2.8 miles of State Highway 49 and a two-lane bridge across the American River are included in the plan. The dam would be designed to enable future expansion to a multipurpose project. As with the 400-year protection alternative, Ponderosa Way and bridge, would be relocated and raised.

Lower American River Area. No changes would occur in this area.

Natomas Area. Measures are essentially as described for the 400-year alternative.

III. 150-Year Protection Alternative

Auburn Area. This alternative does not involve construction of a dam at the Auburn site.

Lower American River Area. With this alternative, flood storage capacity at Folsom Reservoir would be increased from the present 400,000 acre-feet to 650,000 acre-feet. This would seasonally lower water levels in the reservoir resulting in increased flows to the American River in the fall and decreased flows during spring. To achieve the larger storage capacity, the Folsom Dam spillway would be lowered 15 feet and five new tainter gates installed. Maximum controlled release to the lower American River would be increased from the existing 115,000 cfs to about 180,000 cfs. To accommodate the increased downstream release, 11.4 miles of levee along the lower American River would be raised, 1 mile of new levee constructed, 4.1 miles of slurry wall and 7.8 miles of toe drain installed, and 10 miles of levee and/or bank riprapped. Bridge raising and replacement would be required as well as widening the Sacramento Weir and Bypass by 3,600 feet. It would also be necessary to raise the Yolo Bypass east and west levees from Sacramento Bypass southward.

Natomas Area. Measures are essentially the same as with the 400-year and 200-year protection alternatives.

IV. 100-Year (FEMA) Levees/Storage Alternative

Auburn Area. This alternative does not involve construction of a dam at the Auburn site.

Lower American River Area. Flood storage space in Folsom Reservoir would be increased from 400,000 to 470,000 acre-feet by lowering the spillway 15 feet and installing new tainter gates. Maximum controlled release to the lower American River would be increased from 115,000 to 130,000 cfs. To accommodate the increased downstream release, 0.9 mile of new levee would be built, 1.3 miles of slurry wall and toe drain installed, and 10 miles of levee and/or bank riprapped. The north trestle of the Union Pacific Railroad bridge would be raised and the Sacramento Weir and Bypass widened by 500 feet.

Natomas Area. Measures are essentially as described for the preceding alternatives.

V. 100-Year (FEMA) Levees Alternative

Auburn area. No construction at the Auburn site would be required.

Lower American River Area. Maximum controlled release to the lower American River would be increased from 115,000 to 145,000 cfs. To accommodate the increased downstream release, 5 miles of levee would be raised, 1 mile of new levee constructed, 3 miles of slurry wall and 7 miles of toe drain installed, and 10 miles of levee and/or bank riprapped. The north trestle of the Union Pacific Railroad bridge and the north end of H Street bridge would be raised and the Sacramento Weir and Bypass widened by 1,400 feet.

Natomas Area. Measures are essentially as described for the preceding alternatives.

VI. 100-Year (FEMA) Storage Alternative

Auburn Area. No construction at the Auburn site would be involved with this alternative.

Lower American River Area. This alternative would increase the flood control storage space in Folsom Reservoir from 400,000 to 590,000 acre-feet. The objective, or controlled, release from the reservoir to the river would remain at 115,000 cfs. No modification of flood protection works along the lower American River would be required.

Natomas Area. Measures are essentially as described for the preceding alternatives.

BIOLOGICAL RESOURCES

Vegetation

The large study area, extending from the mid-elevation foothills of the Sierra Nevada down to the valley floor, encompasses a major cross section of California's Central Valley and foothill regional plant communities. The major types encountered include montane conifer forest, montane and foothill mixed evergreen forest, foothill woodlands (including evergreen and deciduous types), foothill meadows and grasslands, chaparral, riparian forests (montane, foothill and valley types), freshwater marshes, valley grasslands, and vernal pools. Consequently, this project involves a substantial segment of the biotic diversity of the region.

Rapid human development in the Sacramento region today continues on a scale unprecedented in former years. Lowland areas, especially the wetlands, streams and rivers, have been most severely altered. The formerly extensive habitats along the riparian margins, which once supported abundant fish and wildlife populations, have been greatly diminished. The once-common seasonal wetlands and vernal pools scattered throughout the transition zone between the valley floor and the foothills have been reduced to a fraction of their former extent. Even the foothill areas are now showing evidence of the massive adverse changes to the environment of the region.

Fish

Although the level of resources is far below that of pre-settlement time, the American River watershed continues to support abundant and varied fishery resources. From headwaters high in the Sierras to the Natomas floodplain, the watershed provides highly significant habitat for resident and anadromous fish populations which, in turn, provide aesthetic pleasure, recreation, and livelihood for commercial fishermen. In recognition of its high fishery resource values, the 37-mile segment of the North Fork American River from Colfax-Iowa Hill Bridge upstream to Palisade Creek is designated a State Wild Trout Stream. In 1978, Congress added the North Fork American River from the Colfax Iowa-Hill Bridge upstream to near Heath Springs to the National Wild and Scenic Rivers System. In 1981, the 23-mile-long lower American River was also included in the National Wild and Scenic Rivers System, primarily because of its "outstandingly remarkable" fishery resources.

Auburn Area. Within the project area are approximately 44 miles of valuable free-flowing river in the North and Middle Forks which support numerous resident riverine fish species, and 5 miles of reservoir which contain both riverine and lacustrine (lake) species.

The North Fork flows unimpeded from the Colfax-Iowa Hill Bridge 13 miles downstream to Lake Clementine. Self-sustaining populations of brown trout, smallmouth bass and sunfish are the primary gamefish. Clementine Dam backs water for about 5 miles upstream to Long Point. Similar fish species occur in the reservoir and occasional planting of rainbow trout supports a popular fishery. Below Clementine Dam, the river once again flows freely for about two miles before it is joined by the Middle Fork. The North Fork then continues three additional miles downstream to the Auburn Dam site at River Mile 20.1.

The Middle Fork contains 24 miles of free-flowing river below Oxbow Reservoir/Ralston Afterbay downstream to the North Fork confluence. Year-round cool water and required minimum flow releases from the Placer County Water Agency's Middle Fork American River Project have increased low summer flows and lowered water temperatures during the summer period, thus improving habitat for coldwater species. Habitat conditions for rainbow and brown trouts are most suitable below the reservoir, whereas conditions for smallmouth bass are best in downstream segments.

Folsom Reservoir. Below the Auburn Dam site, Folsom Dam blocks about 20 miles of the North Fork and 10 miles of the South Fork. Folsom Reservoir (1,000,000 acre-foot storage capacity) supports a coldwater fishery and a warmwater fishery with self-sustaining populations of largemouth and smallmouth bass, white catfish, channel catfish, and brown bullhead. Rainbow trout are planted regularly by the California Department of Fish and Game. Sportfishing is an important part of the recreational activity at Folsom Reservoir.

Lake Natoma. Lake Natoma, the afterbay for Folsom Reservoir, extends from Folsom Dam downstream for 5 miles to Nimbus Dam. Resident fish species similar to those occurring in Folsom Reservoir are present in Lake Natoma, although fish productivity is much lower due to cooler water temperatures and fluctuating water levels. Coldwater releases from Folsom Dam reduce food production and fluctuating water levels reduce spawning success.

Lower American River. The lower American River flows 23 miles from Nimbus Dam to the Sacramento River confluence, near downtown Sacramento. This segment of the river has a greater abundance and variety of species than other upstream segments. The production of anadromous species at Nimbus Salmon and Steelhead Hatchery, along with natural production in the river, contribute to the abundance of species. Fall-run chinook salmon are considered the most important species due to recreational and commercial values; steelhead are ranked second in importance based on recreational values; and American shad and striped bass, while important, are of lesser value.

Natomas Area. An even greater variety of fish species are present in the Sacramento River and its various tributary streams which flow through the Natomas area (see Substantiating Report).

Many bypass drains and canals are not suitable spawning or rearing habitat for anadromous or coldwater species such as salmon and trout; however, they often serve as essential corridors for passage during the spawning season to more suitable upstream areas. The NEMDC, Natomas Cross Canal, and Yolo Bypass are examples of important seasonal corridors. Although runs have been greatly reduced, fall-run chinook salmon and steelhead trout migrate from the Sacramento River through these corridors during the winter rainy season to upstream spawning areas such as Dry Creek, Coon Creek and Auburn Ravine. Other anadromous gamefish such as sturgeon, striped bass, and American shad generally remain in the Sacramento River and major tributaries but may temporarily enter or be involuntarily entrained in the large bypasses like the Yolo Bypass.

Wildlife

Auburn Area. In the Auburn Area, lands acquired by the Bureau of Reclamation encompass about 28,000 acres of Sierra Foothill Landscape Province which provide essential disturbance-free habitat for wide-ranging wildlife species such as black bear, bobcat, ringtail cat, black-tailed deer, badger, coyote and gray fox. The foothill oak woodlands and riparian canyons support California quail, band-tailed pigeon, ring-necked pheasant, mourning dove and wild turkey. Waterfowl, including Canada geese, green-winged teal, goldeneye, and common merganser, often frequent the Middle and North Forks of the American River. Bald eagle, golden eagle and prairie falcon are frequent winter visitors. Red-tailed hawk, kestrel, black-shouldered kite, and turkey vulture are commonly seen above the canyons.

Folsom Reservior. Progressing downstream into the Folsom Lake area, the abundance of wider ranging and more secretive species such as wild turkey, black bear, bobcat and ringtail cat declines. Human activity and development have fragmented their habitat and eliminated conditions for successful reproduction and rearing of young. However, many of the more adaptable species such as California quail, coyote, gray fox, and dove are common. Various species of waterfowl use backwater and nearshore resting and foraging habitat during the winter season. Bald eagles commonly are seen foraging for fish in the winter. A variety of other water-oriented birds including sea gull, sandpipers and killdeer are also common year-round.

Lake Natoma. Further downstream in Lake Natoma, a large heron rookery and numerous waterfowl including mallard, goldeneye, and pintail are present. Species similar to those noted below for the lower American River area occur in the habitat remaining around Lake Natoma.

Lower American River. Because of its proximity to Sacramento, the lower American River receives much attention. Parkway recreationists are abundant, as are permanent and seasonal wildlife species. Although reservoirs, levees, diversions and other developments have drastically altered the river and adjacent lands, they remain a valuable and productive wildlife habitat area. More than 220 species of birds, including great blue heron, mallard, red-tailed and red-shouldered hawks, California quail, belted kingfisher, northern flycatcher and American robin to name a few, are commonly observed. In the uplands, more than 30 species of mammals including Virginia opossum, brush rabbit, raccoon, western gray squirrel, black-tailed deer, gray fox and coyote are commonly seen. Beaver, muskrat, and occasionally river otter, are seen in the open water and backwater areas. Riparian forest along the parkway supports many egrets, herons, hawks and owls. Ringtail cat and western gray squirrel frequent the closed riparian canopy.

Natomas Area. Except for South Natomas, the Natomas area is primarily in agricultural use. Wetlands comprised of riparian forest, scrub-shrub, emergent marsh and open waters surrounding and within agricultural lands in the Natomas area have high wildlife values. Thousands of acres of flooded rice fields provide significant habitat for wintering waterfowl. This area is an important segment of the Pacific Flyway, a major migration route for waterfowl and other waterbirds. Thousands of ducks, geese, swans and shorebirds use it. More than 1,200 acres of canals, drainage ditches and ponds support a wide variety of wildlife which is adapted to the seasonal nature of agricultural activities, or survives in the remaining vestiges of wildlands. Herons, egrets, grebes, and coots are commonly seen in the waterways and along the rice checks. Kingfisher, bittern, wood duck and other more-secretive birds also frequent the waterways. Several heron rookeries are located on waterways in the Natomas area.

Endangered Species

The American River Watershed Investigation covers an extensive area including portions of the Central Valley, Sierra Foothills and, with consideration of the proposed flood control dam near Auburn, canyons of the North and Middle Forks of the American River. This extensive area encompasses the ranges of many endangered, threatened, and candidate species of plants and animals, and several species of special concern. Seven animals and nine plants protected under State or Federal endangered species legislation (or both) have been identified as occurring or possibly occurring in the American River Watershed Investigation area (see Substantiating Reports). In addition, fifteen candidate and five special status species may be found within the study area boundary.

SUMMARY OF IMPACTS

I. 400-Year Protection Alternative

AUBURN AREA

Vegetation

The effects of the project on vegetation in the Auburn area would be those associated with construction and operation of the reservoir, and with the realignment of Highway 49 and Ponderosa Way. The effects of highway realignment would be direct, resulting from construction.

As explained in detail in the Auburn Area Substantiating Report, the extent to which operation of a "dry" dam would cause soil erosion and loss of vegetation in the reservoir basin is a matter of much uncertainty. Estimates range from a very moderate loss of vegetation to a total loss over the 100-year period of analysis. In a worst-case scenario, it would be assumed that the design event (either a 200-year or 400-year flood) would occur soon after the project is constructed and be continuous for a period of several weeks so that all habitat was inundated and lost, and that subsequent events prevented any habitat recovery. An alternative scenario would assume a linear decline of habitat over the life of the project. Our review of information on the effects of intermittent inundation on soil and vegetation; evidence from past flood events in the project area; "dry" dam facilities in California and elsewhere; and published and other data on flood tolerance of plant taxa in the Auburn area leads us to conclude that the effect of the project on vegetation in the reservoir basin would fall somewhere between a minimal effect and a linear decline over the period of analysis.

For our analysis of project effects, we relied on project information provided by the Corps of Engineers, including hydrologic, geologic and land use data; literature on habitat and wildlife in the Auburn canyons; data developed by the Bureau of Reclamation for the authorized Auburn Dam project; information provided in a special vegetation impact report by Fugro-McClellan Consultants; and observations made during our field studies. We concluded that there are at least four important elements of information that would allow us to assess operational impacts with some degree of confidence: (1) the Corps' predicted inundation regime, (2) the effect of Auburn coffer dam operation on soil and slope stability in the Auburn canyons, (3) vegetation sensitivity to inundation, and (4) other physical effects of inundation on wildlife habitat in the Auburn canyons. Each of these elements is dealt with in the Auburn Area Substantiating Report.

Construction impacts associated with relocation of Highway 49 and Ponderosa Way would result in the loss of 9.6 acres of south slope oak woodland, 12.3 acres of north slope oak woodland, 2.0 acres of grassland, and 6.0 acres of conifer forest, and 0.9 acre of chaparral. Transport of aggregate from the quarry at Cool would result in the loss of 6.2 acres of south slope oak woodland, 3.0 acres of north slope oak woodland, 24.1 acres of grassland, and 3.1 acres of chaparral.

Operation of the 400-year protection reservoir would result in the loss of 623 acres of north slope-oak woodland 596 acres of south slope oak woodland, 74 acres of chaparral, 74 acres of conifer forest, and 739 acres of montane riverine habitat. There would be a reciprocal gain of 401 acres of grassland, 1,327 acres of rocky/ruderal, and 378 acres of upland scrub habitat. Net changes in wildlife cover types due to reservoir construction and operation are displayed in Table 1.

<u>Fish</u>

With this alternative, approximately 20 miles of stream habitat in each of the Middle and North Forks of the American River, including Lake Clementine, would be submerged for as much as two weeks. Except for the loss of 764 acres of wetlands, temporary inundation would have less adverse impact than permanent inundation over without-project conditions, because (1) some inundation presently occurs during flood flows, and (2) the condition would be temporary. The loss of 764 acres of wetland habitat due to temporary submergence would be a significant loss. Some sedimentation and scouring would occur upstream and downstream of the dam. The adverse impact would be significant.

North Fork. Inundation of up to 20 miles of the North Fork would have little adverse impact on Lake Clementine fish resources with Clementine Dam remaining in place. Since the habitat and fish populations are of reservoir type, inundation would have less adverse effect than on riverine habitat. At planned flood control capacity the lake would be covered by about 227 feet of water. The inundation of the 10-mile segment from upper Clementine to the Indian Creek area would impact the valuable smallmouth bass and trout spawning habitat in the North Fork. However, since the inundation period is from December through February, prior to the bass and trout spawning and incubation period, eggs and fry would be at low risk. More significant impacts in this river segment would occur due to sloughing of canyon walls into the river and resultant sediment deposition over spawning riffles. Some stranding of fish in side channels and pools might also occur as waters recede. The least impact on fish resources would occur in the 5-mile segment below Lake

Table 1. Wildlife Cover Acreages (Auburn) With- and Without-Project Comparison, 400-Year Protection Alternative*

	Without Project	With Project	Net Change
Wetlands			
Montane Riverine	862	98	-764
Subtotals	862	98	-764
Uplands			
So. Slope-oak woodland	892	275	-617.2
No. Slope-oak woodland	901	237.4	-663.6
Chaparral	115	37	- 78.0
Conifer forest	135	55	- 80.0
			-157.5
Grassland	97	594.6**	+401.0
Rocky/Ruderal	133	1,460**	+1327.0
Upland Scrub	0	378**	+378.0
Subtotals	2,273	3,037	+2,106
Total Acres	3,135	3,135	

Grand total of wildlife Cover Acreage Loss - 2360.3 acres

*Change represents the difference comparing with- and without-project acreages remaining at the end of the analysis period (108 years).

**These cover types increased in areal extent. In part they were used to balance the no net loss acreage equation.

Clementine. Fishery values in that segment of the stream have already been reduced as a result of operation of the Auburn coffer dam and other project activities. Most settling of suspended sediments would likely occur in this section.

Middle Fork. In a large storm event, inundation of 20 miles of the Middle Fork for several days would impact several miles of important spawning riffles and rearing habitat for trout below Oxbow Reservoir and also spawning and rearing habitat for smallmouth bass. There would, however, be few inundation impacts on spawning and incubation activities because storm events typically occur prior to spawning season. But, sediment deposition over spawning beds and stranding in side channels and pools during flow recession would cause significant impacts. Overall, the severity of impacts would be determined by the frequency, duration and intensity of storm events. Sloughing of canyon walls and sediment deposition over spawning habitat would probably cause the greatest adverse impact on fish populations.

Wildlife

The conversion and degradation of over 2,360 acres of wildlife habitat would have a detrimental impact on the diverse assemblage of wildlife species in the project area. Construction of the dam would permanently displace wildlife using the area at the dam site; and temporary inundation of wildlife habitat would cause a loss and/or displacement of wildlife. Many species such as reptiles and some small mammals would be lost as flood waters rise in the reservoir. Larger mammals such as black-tailed deer and black bear, some small mammals, and most bird species that can escape rising waters would move into adjacent areas. However, those areas would normally be at carrying capacity; therefore, losses would occur. Although habitat conditions would be poorest in areas inundated the longest, some animals would return to the reservoir areas as flood waters receded.

The permanent loss or degradation of habitat would reduce the carrying capacity of the area. Under with-project conditions, the conversion and degradation of wildlife habitat would adversely affect large mammals (black-tailed deer, black bear), small mammals, upland game birds (California and mountain quail, wild turkey), passerine birds, and reptiles. Other animals would benefit since many plant species unable to tolerate inundation are replaced by grassland and short-lived shrub species.

The overall loss of habitat diversity would result in a substantial reduction in wildlife habitat value and thus lower the area's capability to maintain its present diversity and abundance of wildlife.

LOWER AMERICAN RIVER AREA

The 400-year alternative would have minimal impact on lower American River conditions as no structural changes are planned. Some effect on frequency of peak discharge releases from Folsom Reservoir due to flood control operation of the Auburn Dam facility would occur.

Changes in vegetation and fish and wildlife would follow the without-project scenario described in the lower American River Substantiating Report. Vegetation patterns would continue to change with early successional woody riparian species such as cottonwood, willow and alder gradually declining and being replaced by upland oak woodland savanna type. Approximately 1,480 acres of wetland cover would be converted to upland cover under this alternative. Buildout of Bureau of Reclamation water contracts would cause a gradual decline in salmon habitat due to reduced flows and higher water temperatures, thereby reducing natural salmon populations. Other species, including American shad and striped bass, would decline in numbers. Wildlife supported by riparian habitat within the lower American River corridor would gradually decline as the habitat converts to upland types.

NATOMAS AREA

Vegetation

Under with-project conditions, construction of flood protection facilities would directly impact 17 acres of wetland and 209 acres of upland habitat. The wetland loss would occur for the most part along the alignment of the 2-mile-long drainage channel.

In addition to its direct construction impacts, the 400-Year Protection alternative would significantly accelerate the conversion of 22,491 acres of wild and agricultural lands to residential, commercial, and other urban-related uses over that expected without the project. The loss of an additional 22,491 acres would essentially eliminate much of the existing wildlife cover types in the area, except in those areas under public ownership or along the levee slopes and toe drains in the area. The with-and without-project comparison of wildlife cover acreages is shown in Table 2.

Fish

Under with-project conditions, resident fish populations would continue to decline at an accelerated rate above that expected under without-project conditions. Over time, loss of the agricultural waterways, major canals and open drainages would result in declines of the resident fishery in Natomas. As residential and commercial dwellings encroach upon open waterways, water quality would be degraded, debris would accumulate in the channels and eventually the fishery would disappear. Existing conditions in the NEMDC and Arcade Creek demonstrate the adverse effects of urban encroachment.

Construction and operation of a gated structure and pump station in the NEMDC at the mouth of Dry Creek would adversely impact chinook salmon and steelhead trout that use these waterways as migration corridors. Although the runs are small and episodic, any impediment such as a barrier and pump station would severely impact both upstream and downstream migrants. Migration of both adults and juveniles could be blocked, delayed, or ever diverted depending on weir and pump location and operation, thereby precluding upstream access to adults and downstream access to the Sacramento River for migrating juveniles.

Table 2. Wildlife Cover Acreages (Natomas) With- and Without-Project Comparison, 400-Year Protection Alternative*

	Without Project	With Project	Net Change
Wetlands			
Marsh	457	22	-435
Riparian Forest	2	0	- 2
Scrub-Shrub	381	31	-350
Subtotal	840	53	-787
Uplands			
Rice	7,776	584	-7,192
Grain	6,234	366	-5,868
Pasture	686	44	- 642
Grassland	1,749	532	-1,217
Orchard	622	49	- 573
Row Crop	6,989	551	-6,438
Subtotal	24,056	2,126	-21,930
Totals	24,896	2,179	-22,717

*Based on melded Corps of Engineers land-use projections of 6/13/89 and 8/31/90.

Wildlife

The 400-year level of flood protection for the Natomas Area would result in a significant loss of wildlife over the life of the project. Most of the loss would be caused by development in the floodplain that would follow increased flood protection.

Although levee construction and other facilities would result in the loss of 17 acres of wetland and 209 acres of upland habitat, the subsequent urbanization of 770 acres of wetland and 21,721 acres of upland over without-project conditions would have a substantially greater impact on wildlife use and values of the area. The total loss of 22,717 acres (Table 2) of wildlife habitat (787 acres of wetland and 21,930 acres of upland) would be a significant increase in wildlife habitat losses over those expected without the project. A nearly total loss of wetland and upland wildlife habitats would occur in the flood-protected areas.

The most significant impact to wildlife would occur with the loss of 787 acres of wetlands, 5,868 acres of grain fields, and 7,192 acres of seasonally flooded rice fields (classified as upland). This loss would virtually eliminate the use of the Natomas area by thousands of migratory waterfowl and other water-associated birds--birds protected under the Migratory Bird Treaty Act. Although habitat for these species might be available in adjacent areas, 90 percent of the wetlands along the Pacific Flyway in California has been lost and the remainder is diminishing rapidly. Wetland loss results in the crowding of birds onto smaller and smaller areas, significantly increasing the potential for mortality from disease and predation.

The loss of wetlands would also eliminate important resting, nesting and/or foraging areas for songbirds, raptors, small mammals, amphibians and reptiles that inhabit the Natomas area. Loss of riparian forest and scrub-shrub habitat would reduce populations of black-shouldered kite, red-shouldered hawk, woodpeckers, flicker, yellow warbler, gray squirrel and others.

Loss of 21,930 acres of upland would also result in major wildlife population reductions. Most of the loss would be of rice and grain fields which support large populations of migratory waterfowl, raptors, herons, and egrets. They also support significant resident populations of pheasants, rabbits, and small rodents.

Loss of 5,868 acres of grain field and 6,438 acres of row crop would generally eliminate the rodent populations which are the primary food source for raptors such as the State-listed Swainson's hawk and others like the red-tailed hawk and black-shoulder kite. Raptor nesting activity along the Natomas side of the Sacramento River could be greatly diminished or eliminated due to lack of a nearby food source. In addition, ring-necked pheasant, mourning dove and California quail populations would be lost.

Habitat for most wildlife species inhabiting the Natomas area would be lost, except in places such as levee slopes, canals and drains. Even wildlife species that are able to migrate to adjacent areas would eventually be lost because those niches are fully occupied. In addition, the wildlife values of those areas are expected to diminish with urbanization because of significantly increased human disturbance and intensified maintenance practices.

II. 200-Year Protection Alternative

AUBURN AREA

Vegetation

The direct loss of vegetation attributable to the 200-year protection alternative due to relocation of Highway 49 and

Ponderosa Way and transport of aggregate would be the same as described previously for the 400-year protection alternative. Changes in vegetative cover within the reservoir basin due to operation of a 200-year "dry" dam would be of the same kind as with a 400-year "dry" dam, but losses and gains in acreages of the several types would be of lesser magnitude. Net changes are shown in Table 3.

Table 3. Wildlife Cover Acreages (Auburn) With- and Without-Project Comparison, 200-Year Protection Alternative*

	Without Project	With Project	Net Change
Wetlands			
Montane Riparian	862	389.9	-472.1
Subtotals	862	389.9	-472.1
Uplands			
So. Slope-Oak Woodland	892	565.8	-326.2
No. Slope-Oak Woodland	901	534.4	-366.6
Chaparral	115	70.0	-45.0
Conifer Forest	135	93.0	-42.0
			-157.5
Grassland	97	426.9**	+234.0
Rocky/Ruderal	133	875**	+742.0
Upland Scrub	0	180**	+180.0
Subtotals	2,273	2,745.1	-937.3
			+1156.0
Total Acres	3,135	3,135	

Grand total of Wildlife Cover Acreages loss is 1409.4 acres

*Loss represents the difference comparing without- and with-project acreages remaining at the end of project analysis period (108 years).

**These cover types increased in areal extent. In part they were used to balance the no net loss acreage equation.

Fish

With this alternative, approximately 18 miles of stream habitat in each of the Middle and North Forks of the American Rivers, including Lake Clementine, would be submerged for as much as two weeks. Except for the loss of 447 acres of wetlands, temporary inundation would have less adverse impact than permanent inundation on fish resources over without-project conditions, because (1) some inundation presently occurs during flood flows, and (2) the condition would be temporary. The loss of 447 acres of wetland habitat due to temporary submergence would be a significant loss. Some sedimentation and scouring would occur upstream and downstream of the dam. The adverse impact would be significant.

North Fork. Inundation of up to 18 miles of the North Fork would have little adverse impact on Lake Clementine fish resources with Clementine Dam remaining in place. Since the habitat and fish populations are of reservoir type, inundation would have less adverse effect than on riverine habitat. At planned flood control capacity, the lake would be covered by about 154 feet of water. The inundation of the 7-mile segment from upper Clementine to the Big John Hill area would impact the valuable smallmouth bass and trout spawning habitat in the North Fork. However, since the inundation period is from December through February, prior to the bass and trout spawning and incubation period, eggs and fry would be at low risk. More significant impacts in this river segment would occur due to sloughing of canyon walls into the river and resultant sediment deposition over spawning riffles. Some stranding of fish in side channels and pools might also occur as waters recede. The least impact on fish resources would occur in the 5-mile segment below Lake Clementine. Fishery values in that segment of the stream have already been reduced as a result of operation of the Auburn coffer dam and other project activities. Most settling of suspended sediment would likely occur in this section.

Middle Fork. In a large storm event, inundation of 18 miles of the Middle Fork for 15 days or longer would impact several miles of important spawning riffles and rearing habitat for trout below Oxbow Reservoir and also spawning and rearing habitat for smallmouth bass. There would, however, be few inundation impacts on spawning and incubation activities because the storm events typically occur prior to spawning season. But, sediment deposition over spawning beds and stranding in side channels and pools during flow recession would cause significant impacts. Overall, the severity of impacts would be determined by the frequency, duration and intensity of storm events. Sloughing of canyon walls and sediment deposition inundation during spawning would probably cause the greatest adverse impact on fish populations.

Wildlife

The conversion and degradation of wildlife habitat would have a detrimental impact on the diverse assemblage of wildlife species in the project area. Construction of the dam would permanently displace wildlife using the dam site; temporary inundation of wildlife habitat would cause a loss and/or displacement of wildlife. Many species such as reptiles and some small mammals would be lost as flood waters rise in the reservoir. Larger mammals such as black-tailed deer and black bear, some small mammals, and most bird species that can escape rising waters would move into adjacent areas. However, those areas are normally at carrying capacity; therefore, losses would occur. Although habitat conditions would be poorest in areas inundated the longest, some animals would return to the reservoir area as flood waters receded.

The permanent loss or degradation of habitat would reduce the carrying capacity of the area. Under with-project conditions, the conversion and degradation of wildlife habitat would adversely affect large mammals (black-tailed deer, black bear), small mammals, upland game birds (California and mountain quail, wild turkey), passerine birds, and reptiles. Other animals would benefit since many plant species unable to tolerate inundation are replaced by grassland and short-lived shrub species. The overall loss of habitat diversity would result in a substantial reduction in wildlife habitat value and thus lower the area's capability to maintain its present diversity and abundance of wildlife.

LOWER AMERICAN RIVER AREA

Conditions would be as described for the 400-year Protection Alternative.

NATOMAS AREA

The impacts resulting from the 200-Year Protection Alternative would be essentially the same as those described for the 400-year Protection Alternative.

III. <u>150-Year Protection Alternative</u>

AUBURN AREA

This alternative does not include construction of a dam at the Auburn site.

LOWER AMERICAN RIVER AREA

<u>Vegetation</u>

Increasing flood storage at <u>Folsom Reservoir</u> from 400,000 to 650,000 acre-feet would have no significant adverse impact on terrestrial vegetation in, and adjacent to, the reservoir. Since the area that would be affected lies within the present drawdown zone, no vegetation exists. There would, however, be some adverse impacts on backwater marsh areas that are now inundated at the 400,000 acre-foot level. These areas would be dewatered. However, since a portion of the drawdown season occurs when the plants (woody vegetation) are dormant, the adverse effects would be reduced.

Modifying and riprapping levees and riverbanks along the lower American River to increase channel capacity of the river to 180,000 cfs, and widening of the Sacramento Weir and Bypass, and raising Yolo Bypass levees would adversely impact valuable and scarce riparian forest and scrub-shrub cover (wetlands) and upland cover. About 679 acres of riparian forest, marsh, and scrub-shrub located adjacent to the levees would be lost over without-project conditions. Since this acreage would be maintained as part of the levee system, recolonization by riparian forest and scrub-shrub species would not be allowed.

The timing and magnitude of water releases from Folsom Reservoir down the lower American River would change. In general, there would be a decrease in mean flow peaks during early spring which would reduce scouring flows and inundation of the active zone (point bars, erosional banks and areas above banks) where early succession is occurring. There would also be a reduction of flow into and out of the backwater areas, side channels and gravel ponds. The altered timing of water releases would exacerbate the ongoing changes caused by the operation of Folsom Dam. The natural diversity of riparian vegetation would be reduced further by the altered streamflows and sediment regimes. Also, summer flows would increase with this alternative, causing adverse impacts to species in both active and border zones. Many moderate- to low-tolerant border zone trees and shrubs such as cottonwood, elderberry, various oak species, blackberry, sycamore, ash and boxelder would likely decline with increasing summer irrigation. There would be a general lowering of habitat diversity and a narrowing of the border zone habitat.

Regeneration and maintenance of a highly diverse riparian area is dependent upon properly-timed periodic high- and low-intensity flooding and sediment deposition. Moist banks with sediments deposited in the early spring typically provide regeneration sites for willow-cottonwood forest. Without these processes, much of the area would slowly change from riparian forest, scrub-shrub, and emergent marsh to oak-grassland. Net changes in wildlife cover acreages with the project are shown in Table 4.

Fish

Under with-project conditions, many of the existing fisheries problems would be exacerbated. With an increase in the flood storage pool, water level fluctuations in the reservoir would worsen, thereby further impacting warmwater fish spawning (April-June period). Evacuation of the reservoir flood storage pool would alter existing thermocline patterns, reduce the cool water storage pool, reduce the shallow littoral zone habitat

Table 4. Wildlife Cover Acreages (Lower American River), With- and Without-Project Comparison, 150-Year Protection Alternative*

	Without Project	With Project	Net Change
Wetlands			
Open Water	181	56	- 125
Marsh	27	6	- 21
Riparian Forest	782	534	- 248
Scrub-Shrub	1,532	1,247	- 285
Subtotal	2,522	1,843	- 679
Uplands			
Oak Woodland	114	132	18
Grassland	1,796	2,937	1,141
Grain	561	0	- 561
Riprap	0	81	81
Subtotal	2,471	3,150	679
Totals	4,993	4,993	

*Loss represents the difference comparing without- and with project acreages remaining at the end of project analysis period (103 years).

(most productive area of a lake or reservoir), and increase predation on smaller fish which normally seek shelter in shallow water.

The loss of cool water and change in thermocline would essentially eliminate the coldwater fishery of Folsom Reservoir. Land-locked salmon and rainbow trout would not survive the summer without cool, deep, well-oxygenated water. Annual stocking of rainbow trout could be continued to provide fishing; however, the present carryover of larger-size fish to the following winter and spring would not occur.

The degradation of the fish resource of Folsom Reservoir would result in a corresponding decrease in fishing in the reservoir. Under with-project condition, average annual angler-use is expected to decrease to 92,500 days, a decline of 27,500 days over the period of analysis.

Increasing the lower American River channel capacity to 180,000 cfs would have no measurable adverse impact on the fishery resource. Since storm events that require reservoir releases of 115,000 (present capacity) or 180,000 cfs are rare, and the difference in hydraulic effects between the flows small, any additional impact over existing conditions would not be significant. However, some loss of spawning gravels would occur as higher flows are released down the river. Since Folsom Dam precludes gravel replenishment in the lower river, the long-term impact to naturally spawning chinook salmon and other fish would be adverse.

The greatest impact on fish resources, especially anadromous species, would be the result of increased flood control storage at Folsom Reservoir. Increased storage would mean a reduction in flows and hence spawning habitat for fall chinook salmon in dry and critically dry water years, thereby crowding fish into the remaining areas. This would result in late-arriving salmon spawning over previously made redds and the loss of the early redds.

In addition, increased flood control storage in Folsom Reservoir would reduce the pool of coldwater in the reservoir, resulting in downstream water temperature increases. Higher water temperatures during the month of November would significantly impact natural spawning stock of the lower American River over existing and without-project conditions. Although these conditions are not expected to occur every year, they would eventually eliminate natural spawning of chinook salmon in the river. Also, more flood control space in the reservoir would increase the temperature of releases in April above existing and without-project levels. Suitable water temperature would be exceeded more often, causing additional stress and probably increased losses of emigrating salmon smolts.

American River chinook salmon must reach a minimum size of about 75 mm (fork length) by mid-May to early June if they are to successfully outmigrate in their first year. Those that do not outmigrate are forced to over-summer in the river, and, because of higher water temperatures in the lower reaches, concentrate in the reach immediately below the Nimbus Dam where they are subjected to intense competition for food and to predation. These adverse conditions become more common under with-project conditions.

Under with-project conditions, average annual spawning production would decline to 140,620 salmon, 37,220 fish less than under without-project conditions (Table 5). The ocean commercial catch would decline from an annual average of 891,900 pounds with a value of $2,489,000 to 705,000 pounds valued at $1,968,000. The chinook salmon sport catch would also decline from 54,000 fish to 42,699 fish, with a resulting average annual decline in ocean and freshwater sport fishing of 9,041 and 2,260 days, respectively.

With this alternative, steelhead numbers would remain relatively constant because the run is essentially hatchery maintained with little natural production. The 8,000 to 10,000 fish that spawn

Table 5. Lower American River Chinook Salmon Production (average annual under with-project conditions) 150-Year Protection Alternative

	Without Project	With Project	Net Change
Escapement (spawners)	42,750	33,803	- 8947
Production	177,840	140,620	-37220
Ocean Commercial Catch	81,090	64,118	-16972
Ocean Sport Catch	43,200	34,159	- 9041
River Sport Catch	10,800	8,540	- 2260
Harvest (Total Catch)	135,090	106,817	-28273

in the lower American River apparently do not produce returning adults because of unsuitable rearing habitat in the river. Since hatchery production would remain as under without-project conditions, average annual angler-use would remain at 27,700 days.

This alternative flood control project would not have a significant adverse impact on American shad, striped bass, or other game species. American shad and striped bass would continue to ascend the river to spawn and feed, respectively, as they do today, and shad anglers would probably be more successful with moderate spring flows. However, angler-use would remain at an average annual of 75,000 and 8,000 days, respectively, for American shad and striped bass. Angler-use for other game species would remain as under without-project conditions.

Wildlife

Using levee construction to increase floodway capacity of the lower American River from 115,000 cfs to 180,000 cfs would result in a loss of riparian forest and scrub-shrub habitat. Although the total acreage lost is relatively small in comparison to the habitat remaining in the area, any further loss or degradation of habitat would be significant. The wildlife habitats in the floodway are especially valued because the area is almost completely surrounded by developments.

In addition to construction impacts, the increased flood storage at Folsom Reservoir and the resulting reduction of downstream water releases (except for flood flows) would dewater and/or reduce inundation of the active zone (point bars, eroding banks, and areas behind banks where early riparian succession is occurring). Much of the area would slowly change from riparian forest, scrub-shrub, and emergent marsh to oak-grassland. Over the period of analysis, a significant conversion would occur, and wetland wildlife habitat values would be lost.

Increasing flood storage in Folsom Reservoir from 400,000 to 650,000 acre-feet would have a significantly greater adverse impact on wildlife resources inhabiting and frequenting the area than on vegetation. The larger drawdown zone would: (1) reduce aquatic vertebrate and invertebrate species which are food for wildlife, (2) expose many wildlife species to greater predation as they travel greater distances to seek food and water, and (3) eliminate existing usable wildlife habitat for small mammals, California quail, and other species that will not travel long distances to food and water.

Populations of piscivorous birds such as mergansers, grebes, terns, gulls, and eagles would decline as fish populations decline. Most species would not be able to migrate to other areas with suitable habitat. Even if migration was successful, most adjacent areas would already be at full carrying capacity and unable to support larger populations.

The large numbers of geese and ducks which annually winter on the large expanse of open water at Folsom Reservoir would be adversely affected with the increased drawdown. These species favor the backwater wetlands and sloughs in the upper arms which would be dewatered with the project. Open waters are becoming scarcer with rapid development of nearby areas.

Increased flood storage at Folsom Reservoir would have little adverse effect on existing vegetation at Lake Natomas. The lake would continue to fluctuate greatly; therefore, no additional vegetation would be exposed or inundated.

NATOMAS AREA

For the Natomas area, construction and land use impacts associated with this alternative are essentially the same as for the 200-Year and 400-Year Protection Alternatives.

IV. <u>100-Year (FEMA) Storage Alternative</u>
and
V. <u>100-Year (FEMA) Levees/Storage Alternative</u>
and
VI. <u>100-Year (FEMA) Levees Alternative</u>

AUBURN AREA

These alternatives do not include a dam at the Auburn site.

LOWER AMERICAN RIVER AREA

Vegetation

Increasing the flood control storage space in Folsom Reservoir, a feature of the 100-Year (FEMA) Storage and 100-Year (FEMA) Levees/Storage alternatives, would have no significant adverse impact on terrestrial vegetation in, and adjacent to, Folsom Reservoir. Because the affected area lies below the existing drawdown zone, there is no vegetation. There could, however, be some adverse impact on established backwater marsh areas that are now inundated at the 400,000 acre-foot storage level. These areas would be dewatered. However, since a portion of the drawdown season occurs when woody vegetation is dormant, any adverse effect would be reduced. Lake Natoma would continue to fluctuate within existing ranges; therefore, no additional vegetation would be exposed or inundated.

For the 100-Year (FEMA) Levees and 100-Year (FEMA) Levees/Storage alternatives, raising and extending levees and riprapping banks and levees along the lower American River to increase its channel capacity, and widening the Sacramento Bypass, would adversely impact valuable and scarce riparian forest and scrub-shrub cover types (wetlands) and upland cover types. Riparian forest, marsh, and scrub-shrub located adjacent to the existing levees would be lost over without-project conditions. Since the area would become part of the levee system and maintained, recolonization of these areas by riparian forest and scrub-shrub species would not be allowed.

Grassland vegetation on the existing levee berms and adjacent landside fields would be lost, but after construction, those areas would be allowed to revegetate with grasses. Therefore, the loss of wildlife value would be temporary (2 to 3 years after construction) and the areas would recover essentially to preproject condition.

Except for the 100-Year (FEMA) Levees alternative, the timing of water releases from Folsom Reservoir to the lower American River would change. Flows and impacts would differ, depending on the water year classification, but, in general, there would be a decrease in mean flow peaks in early spring. This change would reduce spring scouring flows and inundation of the active zone (point bars, eroding banks and areas behind banks) where early plant succession occurs. There would also be a reduction of inflow to backwater areas, side channels and gravel ponds. The timing of water releases would further exacerbate the adverse changes caused by the construction and operation of Folsom Dam. The natural diversity of riparian vegetation would be reduced further by the altered streamflow and sediment regimes.

Also summer flows would increase, causing adverse impacts to species of both the active and border zones. Many moderate- to low-tolerance border zone trees and shrubs such as cottonwood, elderberry, various oak species, blackberry, sycamore, ash and boxelder would decline with increasing summer irrigation. The result would be a general lowering of the habitat and woody species diversity and narrowing of the border zone habitats.

Regeneration and maintenance of a highly diverse riparian area is dependent upon properly timed, periodic high- and low-intensity flooding and sediment deposition. Moist banks with newly deposited sediments in the early spring typically provide regeneration sites for young growth willow-cottonwood forests. Without these processes, much of the area would slowly change from riparian forest, scrub-shrub, and emergent marsh to oak-grassland. Over the project life, a conversion would occur. Net changes in wildlife cover acreages (with and without project) are shown in Tables 6, 7, and 8.

Fish

Except for the 100-Year (FEMA) Levees alternative, many of the existing fisheries problems at Folsom Reservoir would be exacerbated. With an increase in the flood storage pool, water level fluctuations in the reservoir would worsen, thereby further impacting warmwater fish spawning (April-June period). Evacuation of the reservoir flood storage pool would alter existing thermocline patterns, reduce the cool water storage pool, reduce the shallow littoral zone habitat (the most productive area of a reservoir), and increase predation on smaller fish which normally seek shelter in shallow water.

Table 6. 100-Year (FEMA) Levees Wildlife Cover Types (acres)

Wetland Cover Type	Without Project	With Project	Difference
Marsh	27	22	- 5
Open water	181	56	-125
Riparian forest	782	675	-107
Scrub-shrub	1,532	1,307	-225
Subtotal	2,522	2,060	-462
Upland Cover Type			
Grassland	1,796	2,357	561
Woodland	114	131	17
Grain	561	364	-197
Riprap	0	81	81
Subtotal	2,471	2,933	462

Table 7. 100-Year (FEMA) Levees/Storage Wildlife Cover Types (acres)

Wetland Cover Type	Without Project	With Project	Difference
Marsh	27	27	0
Open water	181	56	-125
Riparian forest	782	676	-106
Scrub-shrub	1,532	1,309	-223
Subtotal	2,522	2,068	-454
Upland Cover Type			
Grassland	1,796	2,153	357
Woodland	114	132	18
Grain	561	559	- 2
Riprap	0	81	81
Subtotal	2,471	2,925	454

Table 8. 100-Year (FEMA) Storage Wildlife Cover Types (acres)

Wetland Cover Type	Without Project	With Project	Difference
Marsh	19	18	- 1
Open	72	66	- 6
Riparian forest	707	652	-55
Scrub-shrub	1,472	1,391	-81
Subtotal	2,270	2,127	-143
Upland Cover Type			
Grassland	1,568	1,700	132
Woodland	103	114	11
Subtotal	1,671	1,814	143

The loss of cool water and change in thermocline would essentially eliminate the coldwater fishery of Folsom Reservoir. Land-locked salmon and rainbow trout would not survive the summer without cool, deep, well-oxygenated water. Annual stocking of rainbow trout could be continued to provide fishing; however, the present carryover of larger-size fish to the following winter and spring would not occur. The degradation of the fish resource of

Folsom Reservoir would result in a corresponding decrease in fishing in the reservoir.

Increasing the river channel capacity to convey flows up to 145,000 cfs would have no measurable adverse impact on fish resource. Since storm events that require downstream releases of that magnitude are rare, and the difference in hydraulic effects between the flows small, any additional impact over existing and without-project conditions would not be significant. However, some loss of spawning gravels would occur as higher flows are released down the river. Since Folsom Dam precludes gravel replenishment in the lower river, the long-term impact to naturally spawning chinook salmon and other fish would be adverse.

The greatest impact on fish resources, especially anadromous species, would result from the increase in flood control storage at Folsom Reservoir. Increasing the flood storage pool would reduce fall chinook salmon spawning flows in dry and critical water years, significantly decreasing spawning success. Reduced flows would decrease the amount of usable spawning habitat in the river, thereby crowding fish into the remaining areas. This would result in later-arriving salmon spawning over existing redds so that early redds would be lost.

In addition, increased flood control space in Folsom Reservoir would reduce the pool of coldwater in the reservoir, resulting in downstream water temperature increases. An increase of water temperature during the month of November would have a significant adverse impact on naturally spawning stock of the lower American River over existing and without-project conditions. Although these conditions would not occur annually, increased water temperature during this period would eventually eliminate natural spawning of chinook salmon in the river.

Also, greater flood control space would increase spring water temperatures in the month of April above existing without-project levels. Suitable water temperatures would be exceeded more often, causing additional stress and probably increased losses in emigrating salmon smolts.

American River chinook salmon must reach a minimum size of about 75 mm (fork length) before mid-May to early June if they are to successfully outmigrate as juveniles. Those that do not are forced to over-summer in the river. However, because of higher water temperatures in the lower reaches, these juveniles concentrate in the reach immediately below the Nimbus Dam where they are subject to intense competition and predation, thus few survive. These adverse conditions would become more common under with-project conditions.

With the 100-Year (FEMA) Storage and 100-Year (FEMA) Levees/Storage alternatives, chinook salmon numbers would decline. However, the decline would be less than with the 150-Year Protection Alternative--the net change numbers shown in Table 5 would be 3 percent and 4 percent less, respectively, for the 100-Year Storage and 100-Year Levees/Storage alternatives. With all 100-Year alternatives, steelhead numbers would remain relatively constant because the run is essentially dependent on hatchery production. The 8,000 to 10,000 fish that spawn in the lower American River evidently do not produce returning adults. The existing rearing habitat in the river is not conducive to steelhead production. Since hatchery production would remain as under without-project conditions, average annual angler-use is expected to remain at 27,700 days.

Neither would the alternatives have a significant adverse impact on American shad, striped bass, and other game species in the river. American shad and striped bass would continue to ascend the river to spawn and feed. Shad fishing would probably be more successful at moderate spring flow. However, angler-use would remain at an average annual of 75,000 and 8,000 days, respectively, for American shad and striped bass. Angler-use for other game species would remain as under without-project conditions.

Wildlife

Increasing the flood storage space in Folsom Reservoir would have a significantly greater adverse impact on wildlife inhabiting and frequenting the area than on vegetation. The larger drawdown zone would (1) reduce aquatic vertebrate and invertebrate species which are food for wildlife, (2) expose many wildlife species to greater predation as they travel greater distance to seek food and water, and (3) eliminate existing wildlife habitat for small mammals, California quail, and other species that will not travel long distances to food and water.

Picivorous bird species such as mergansers, grebes, terns, gulls, and eagles would be impacted adversely by the reduction in fish population. Even if migration to adjacent areas were successful, most such areas would be at full carrying capacity and unable to support larger populations. These animals would be lost.

The large numbers of geese and ducks which annually winter on the expanse of open water at Folsom Reservoir would be adversely affected by reduced water levels. These species favor the backwater wetlands and sloughs in the upper arms which would be dewatered with the project. Open waters are becoming scarcer with rapid development of nearby areas. Increasing the flood storage space in Folsom Reservoir would have no significant adverse impact on the wildlife of Lake Natoma. Conditions within

Lake Natoma would essentially be the same as under without-project conditions.

Increasing floodway capacity in the lower American River would result in a loss of from 143 to 679 acres of wetland habitat, depending on the alternative considered. Because of the relatively high wildlife value of the habitat remaining in the area, any degradation or loss of habitat would be significant. The area is almost completely surrounded by developments, affording little room for relocation of displaced wildlife. Thus, those animals displaced would be lost.

In addition to construction impacts, the increase in flood storage capacity in Folsom Lake and the resultant reduction in releases downstream into the lower American River would reduce inundation of the active zone (point bars, eroding banks, and areas behind banks where early riparian succession occurs). Much of the area would slowly change from riparian forest, scrub-shrub, and emergent marsh to oak-grassland. Over the period of analysis, a significant conversion would occur; valuable wetland wildlife habitat would be lost.

NATOMAS AREA

For the Natomas area, construction and land use impacts associated with 100-Year alternatives are essentially the same as with the other alternatives.

DISCUSSION

We understand the urgency of providing flood protection to the city of Sacramento and adjacent urban areas. However, we are concerned with the cumulative impacts of the many flood control measures proposed and the accelerated time frame imposed on the environmental studies. We are especially concerned with the proposal to provide additional flood protection to the undeveloped part of the Natomas area.

As Federal agencies, the Fish and Wildlife Service and the Corps of Engineers must heed the policy guidance set forth in Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands). The objectives of the orders are, respectively, to (1) "avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative", and (2) "avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct and indirect support of new construction in wetlands wherever there is a practicable alternative."

Floodplain managers across the nation are finding overwhelming evidence that wetlands and natural floodplains can provide a multitude of benefits for fish and wildlife and the public for reasonable costs. Natural flood basins similar to Natomas offer free on-or off-stream storage potential during high flow periods. They act as retention basins -- retarding stream flow, reducing damaging high velocity flow, recharging ground waters, settling silts and sediments, and providing high quality fish and wildlife habitat. In addition, these natural flood basins are highly suitable for many other types of land use such as agriculture, recreation, open space, and wildlife education in the non-flood season. Costs to set aside and manage these natural flood basins are generally quite reasonable when compared to other forms of more-intensive structural development.

In contrast, failure to retain natural floodplains and basins by permitting development encroachment adjacent to and within them sets the stage for future flooding problems due to diminished floodway capacity. In turn, the construction of structual features for flood protection generally requires environmental mitigative measures. This alternative generally leaves us with less fish and wildlife, less agricultural production, fewer recreation opportunities, and higher land use maintenance costs.

In our opinion, providing additional flood protection for the vast agricultural lands of Natomas, as proposed in the American River Watershed Investigation, is contrary to the intent of the Floodplain Management and Wetland Protection Executive Orders. We believe there is a practicable alternative that, by the improvement of existing levees and construction of new levees, would provide full flood protection for urbanized areas; comply with Executive Orders 11988 and 11990; and meet the President's goal of no overall net loss of wetlands. Implementation of a plan similar to the Corps of Engineers 100-Year Alternative (Environmental Quality Plan) discussed in the Corps' April 1990 draft working paper would meet all of these goals.

100-Year Level of Protection

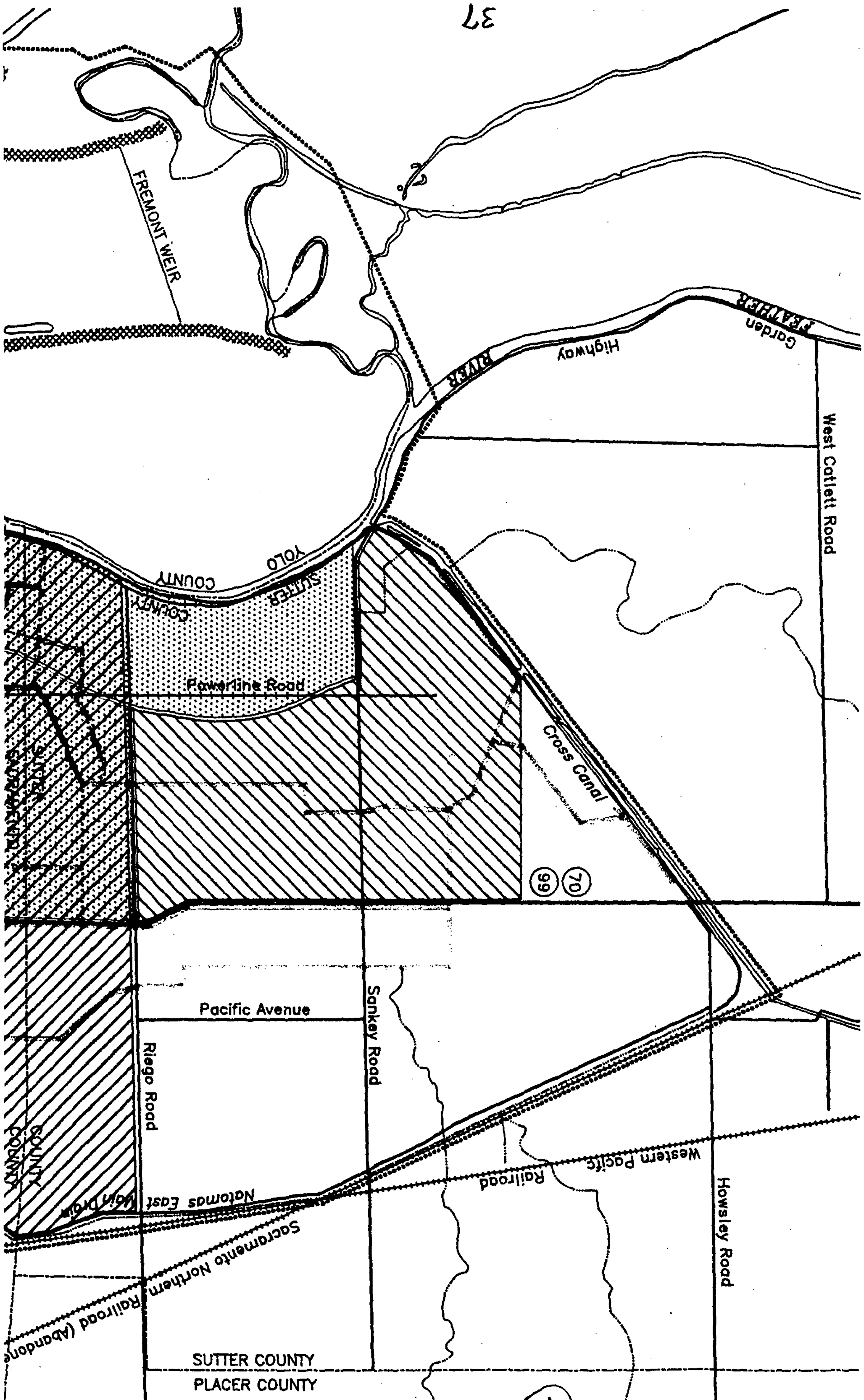
A project to provide a 100-year level of protection, and to meet the Federal Emergency Management Agency's standard for national flood insurance eligibility, would not require construction of a flood control dam at the Auburn site. We believe this level of protection could be accomplished by increasing flood control storage at Folsom Reservoir from 400,000 to 470,000 acre-feet; lowering the Folsom Dam spillway; using additional existing upstream storage reservoir space; widening the Sacramento Weir and Bypass by 500 feet to convey additional flow into Yolo Bypass; raising portions of existing levees and constructing new levees in Natomas to protect urban areas south of Del Paso Road (roughly one-third of the Natomas area); and constructing a levee around Sacramento Metropolitan Airport.

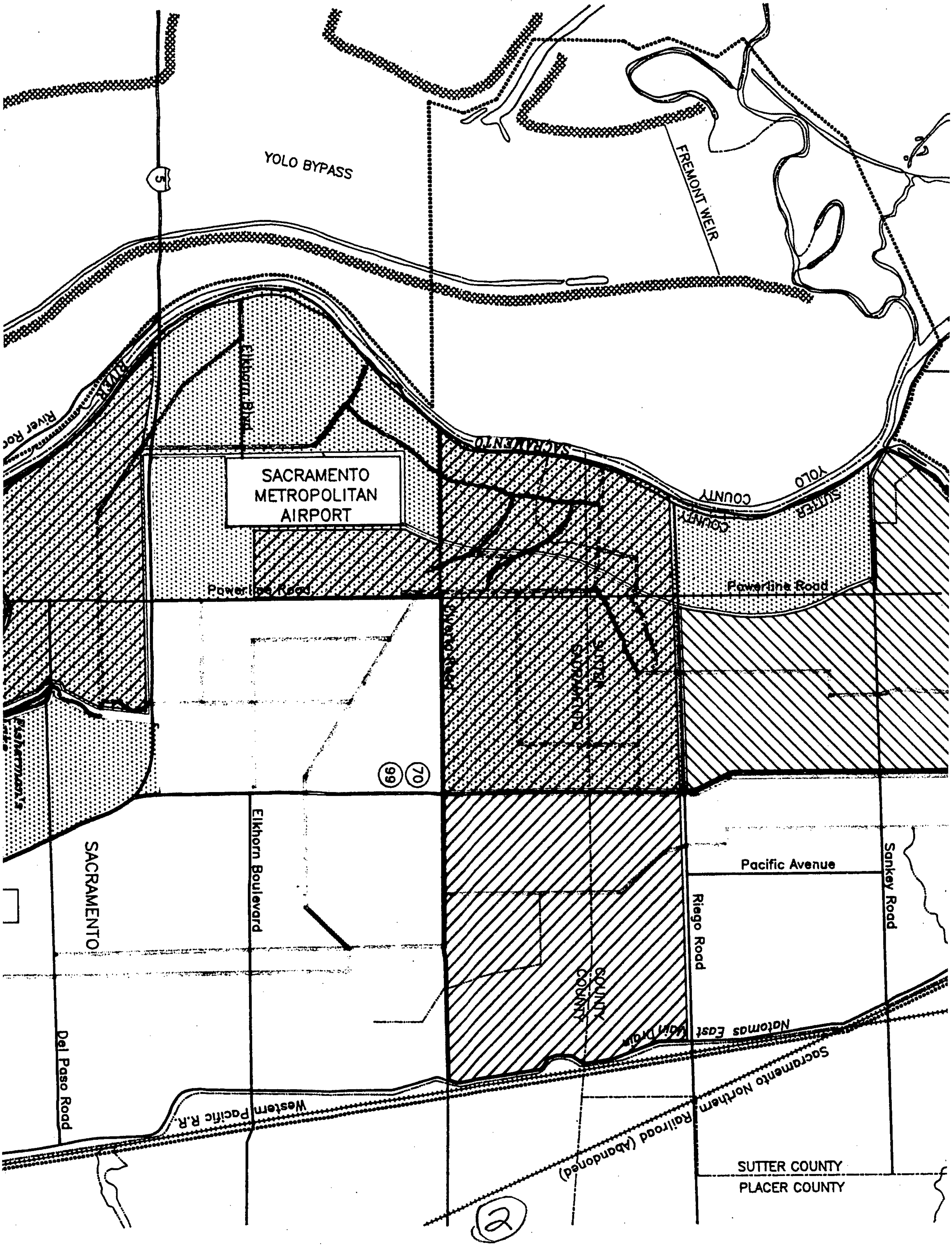
With a 100-year protection project, there would be no need to mitigate fish and wildlife losses in the Auburn area and the mitigation need in the Natomas area would be substantially reduced. In Natomas, wetland habitat losses, by comparison to the 400-Year, 200-Year, and 150-Year Protection alternatives, would be reduced from 787 acres to 104 acres and upland habitat losses from 21,930 acres to 978 acres.

Loss Reduction Proposal

Even with the plans to provide levels of flood protection greater than 100 years, there are excellent opportunities in the Natomas area to reduce needed mitigation by restoring and regaining lost wetland habitat. Prior to construction of the Federal levees that surround Natomas, floodwaters from winter rains regularly overflowed the foothill streams of Pleasant Grove, Curry, Dry, Arcade and other Creeks, creating large expanses of flooded lands throughout Natomas. Dense stands of tules (rushes) and other marsh vegetation covered the basin floor. Waterfowl, raptors, rodents, snakes and other marsh species were abundant. Construction of levees around Natomas enabled conversion of these wetlands to agricultural use and thereby greatly diminished their value to fish and wildlife. The levee improvement proposed in the American River Watershed Investigation would further diminish the fish and wildlife resource base unless concerted efforts are made to protect and restore the natural values of a portion of the lands in the project area. Such efforts should focus on restoration of wetland habitat, and setting aside areas for management of migratory waterfowl, the Federally listed valley elderberry longhorn beetle, and the State-listed Swainson's hawk and giant garter snake.

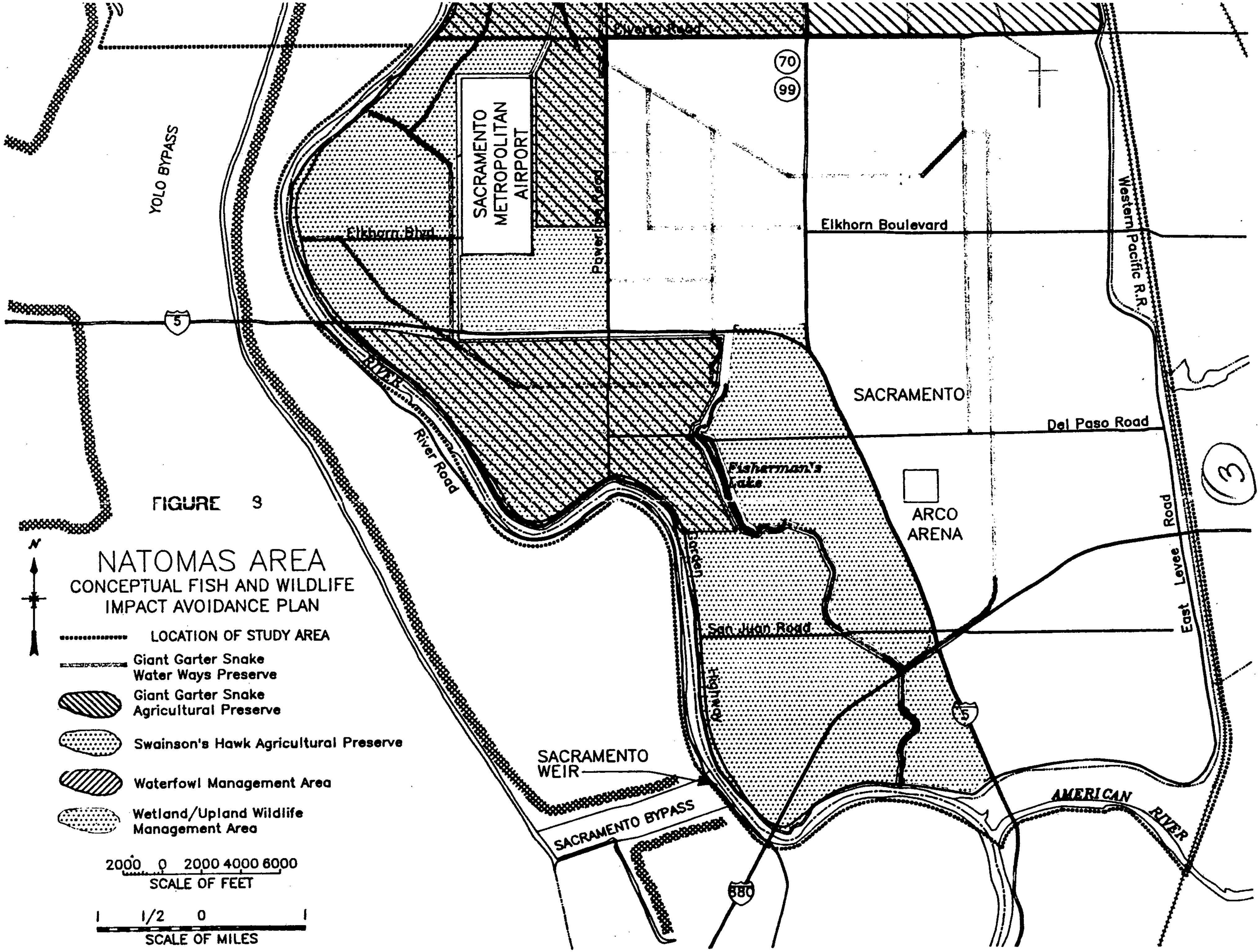
A plan for wetland restoration and habitat management for the valley elderberry longhorn beetle, Swainson's hawk, giant garter snake and fish and wildlife in general should be developed as a cooperative venture involving both public and private interests. Implementation of a plan to accomplish this purpose could be readily facilitated by the Central Valley Habitat Joint Venture, a consortium of public and private interests formed to achieve one of the major goals of the North American Waterfowl Management Plan, namely, protection and restoration of additional wintering habitat for waterfowl in the Central Valley. The North American Waterfowl Management Plan was established in 1986 when the United States and Canada agreed to pursue a course of action to assure the continued survival of abundant continental populations of ducks, geese, and swans. Specific measures that should be included in a plan for the Natomas area are described below; their locations are indicated in Figure 3.


37
FREMONT WEIR
FEATHER
RIVER
Garden
Highway
West Catlett Road
YOLO
COUNTY
SUTTER
COUNTY
Powerline Road
Cross Canal
99
70
Pacific Avenue
Riego Road
Sankey Road
Howsley Road
Western Pacific
Railroad
Natomas East Main Drain
Sacramento Northern Railroad (Abandoned
SUTTER COUNTY
PLACER COUNTY
1



YOLO BYPASS
5
FREMONT WEIR
SACRAMENTO RIVER
River Road
Elkhorn Blvd
SACRAMENTO METROPOLITAN AIRPORT
YOLO COUNTY
SUTTER COUNTY
Powerline Road
Powerline Road
SUTTER COUNTY
70
99
SACRAMENTO
Elkhorn Boulevard
SACRAMENTO COUNTY
Pacific Avenue
Sankey Road
Riego Road
Natomas East Main Drain
Sacramento Northern Railroad (Abandoned)
Western Pacific R.R.
Del Paso Road
SUTTER COUNTY
PLACER COUNTY

(2)



YOLO BYPASS
SACRAMENTO METROPOLITAN AIRPORT
Elkhorn Blvd
Elkhorn Boulevard
Powerline Road
70
99
5
Western Pacific R.R.
SACRAMENTO
Del Paso Road
RIVER
River Road
Fisherman's Lake
ARCO ARENA
Garden
Highway
San Juan Road
East Levee Road
SACRAMENTO WEIR
SACRAMENTO BYPASS
AMERICAN RIVER
880
3
NATOMAS AREA
CONCEPTUAL FISH AND WILDLIFE
IMPACT AVOIDANCE PLAN
N
LOCATION OF STUDY AREA
Giant Garter Snake Water Ways Preserve
Giant Garter Snake Agricultural Preserve
Swainson's Hawk Agricultural Preserve
Waterfowl Management Area
Wetland/Upland Wildlife Management Area
2000 0 2000 4000 6000
SCALE OF FEET
1 1/2 0 1
SCALE OF MILES

FIGURE 9

Wetland Restoration

* Acquisition of fee title to 4,500 acres of agricultural lands in Sutter County and establishment of a fund to support a management program primarily for migratory waterfowl. Acquisition of lands in rice production offers the most cost-effective means of wetland restoration due to minimal landscaping needs and available water supplies.
* Acquisition of conservation easements on 1,200 acres of agricultural lands in Sutter County to assure management that would optimize habitat for the giant garter snake.

* Acquisition of conservation easements on 9,400 acres of agricultural lands in Sacramento County to restore wetlands and to optimize habitat for the giant garter snake, valley elderberry longhorn beetle and other species of fish and wildlife. Restoration planning would be coordinated with the Sacramento Metropolitan Airport's need to establish an undeveloped buffer zone around the airport, and would accommodate the need to prevent bird/aircraft collisions.

Swainson's Hawk Habitat Restoration

* Acquisition of conservation easements on about 11,000 acres in Sutter and Sacramento Counties in a one-mile-wide band along the Sacramento River from Sankey Road south to a point near the mouth of the American River to optimize habitat for the Swainson's hawk. Agricultural crops affording foraging habitat for hawks would be favored.

Giant Garter Snake Habitat Protection/Restoration

* Protection of numerous waterways in the Natomas area by means of 200-foot-wide buffer zones. Restoration of woody riparian vegetation would be encouraged.

Riparian Corridor and Fish Habitat Restoration

* Restoration of habitat value of Natomas Cross Canal, Natomas East Main Drainage Canal, Dry Creek, and Arcade Creek through channel cleanup and contouring, instream structure placement, improving water supply, revegetation, and fencing.

Under this plan, agricultural crops of value to wildlife would remain in production. Crops having low value to wildlife would be phased out and replaced with crops or other vegetation consistent with management purposes. To insure that lands acquired in fee or easement are managed in perpetuity for fish and wildlife purposes, a conservation organization such as the Fish and Wildlife Service, California Department of Fish and

Game, Nature Conservancy or similar interest group should be designated as the management agency.

As with the 100-Year protection plan described at the beginning of this section, the conservation plan described above would be consistent with Executive Orders 11988 and 11990 and the President's goal for the nation of no overall net loss of wetlands. It also has the virtues of preserving agricultural lands; providing open space and outdoor recreational opportunities; protecting wintering habitat for migratory waterfowl; protecting habitat for Swainson's hawks and giant garter snakes; and contributing to implementation of the Cooperative Agreement between the Department of the Army and the Department of the Interior (formulated pursuant to the North American Waterfowl Management Plan) regarding waterfowl habitat conservation opportunities associated with Corps of Engineers civil works projects.

Wildlife Mitigation

For the Corps of Engineers' selected plan, the 200-Year Protection alternative, mitigation measures to minimize and compensate for unavoidable wildlife impacts in the Auburn Area are needed. However, opportunities to gain back lost wildlife values are very limited in the project area. For this reason, we developed a combination plan that is designed to minimize the ongoing dry dam operation impacts and also compensate for unavoidable losses from operation and construction.

This mitigation plan calls for development and implementation of a wildlife management plan for the North and Middle Forks of the American River. The plan would be developed cooperatively by the Corps and the resource agencies. It would be implemented throughout the life of the project. The wildlife plan would help to offset loss of habitat due to inundation, soil erosion and landsliding. Long-term monitoring would be included along with a management plan to document its effectiveness.

In addition to the mitigation measures for the inundation zone, we developed a conceptual mitigation plan in our Habitat Evaluation Procedues analysis for an area along the South Fork American River. This area was selected because it offers the potential to gain back some of the same wildlife values that would be lost with the project. By means of intensive oak woodland and pine forest restoration, controlled burning of grasslands, removal of cattle grazing, and restoration of riparian vegetation, most of the lost wildlife values and habitat losses would be regained during the project life. As detailed in the Auburn Area substaniated report, the 200-Year Protection alternative would require this type of intensive management on 51,996 acres. Costs are estimated at $172,843,000 for development and monitoring and $100,000 annually for operation and management.

Wildlife losses in the Natomas area associated with the 200-Year Protection alternative could be accomplished by acquisition of 17,650 acres of upland habitat in the northern part of the Natomas area for development into a wetland/upland complex, as described in the Natomas Area substantiating report. Estimated cost, excluding acquisition, and water supply for wetland management, is $171,675,000. Cost of fencing the complex is estimated at $200,000. Annual cost for operation, maintenance and replacement, including monitoring to assure success of the development plan, is estimated at $8,825,000. Management of the mitigation area should be by a public agency.

Fish Mitigation

Mitigation for fish habitat losses in the Auburn reservoir area caused by construction and operation of the 200-Year Protection alternative could be accomplished by placement of log barriers, downfall trees, and rock gabions to create pools and instream cover, and by stabilization and revegetation of slipouts and removal of sediment resulting from sloughing of canyon walls. The cost of developing a management plan incorporating the above elements is estimated at $50,000; and the cost of implementing the plan is estimated at $150,000. Annual operation, maintenance and replacement cost is estimated at $50,000.

Fish habitat losses in the Natomas area caused by construction of the 200-Year Protection alternative could be effected by equipping the gated structure and pump station in Natomas East Main Drainage Canal with screens and other fish-protection facilities, and by restricting in-channel construction activity to the June 1 to August 31 period. The Natomas Area Substantiating Report contains a discussion of these mitigation measures.

RECOMMENDATIONS

For the Corps of Engineers' selected alternative, the 200-YEAR PROTECTION PLAN, the Fish and Wildlife Service recommends that:

1. To assure adequate evaluation of impacts on fish and wildlife resources of any future expansion of a flood-control-only dam at Auburn, the authorizing document for the 200-Year Protection Project include a statement that any alteration of flood control only facilities, or project purpose, be authorized by additional legislation, and that biological evaluation studies be completed prior to such authorization. Necessary studies would be (1) an analysis of project impacts on

the biological resources of the Auburn area, lower American River, Sacramento-San Joaquin Delta, San Francisco Bay, and water supply service areas; and (2) a detailed reanalysis of water allocation for fish and wildlife.

2. To mitigate the loss of 1,409 acres of riverine canyon and upland wildlife habitat due to direct project-induced impacts in and near the North Fork and Middle Fork American River Canyons, 51,996 acres along the South Fork American River be acquired and managed for wildlife and fisheries, in perpetuity. Costs for this are estimated at $172,843,000 for development and monitoring and $100,000 annually for operation and maintenance.

3. To mitigate the increased sedimentation and resultant stream habitat degradation in the lowest elevation zone (490-800 feet), stream habitat be improved above Lake Clementine and above streambed elevation 800 feet in the Middle Fork. Preparation of a long-term fishery management plan in consultation with the California Department of Fish and Game and the Fish and Wildlife Service will be required prior to any revegetation, and placement of structures such as log barriers, downfall trees, and rock gabions or similar instream devices to create pools and instream cover. Cost of plan development, with the Fish and Wildlife Service as lead planning agency, is estimated at $50,000. Cost of implementing the plan is estimated at $150,000. Annual operation, maintenance and replacement costs for equipment, structures and labor is estimated at $50,000. Long-term monitoring annual cost is estimated at $25,000.

4. To minimize any additional impacts on the remaining wildlife lands in the project inundation zone, a wildlife management plan be developed cooperatively by the Corps, Fish and Wildlife Service and the California Department of Fish and Game and implemented throughout the project life. Plan development cost is estimated at $200,000. Average annual operations and maintenance would be $50,000. Long-term monitoring annual cost is estimated at $25,000.

5. To mitigate the impact of sloughing of canyon walls and resultant river sedimentation, slipouts be stabilized by revegetating with indigenous species, sediment be removed from the channel, and the streambed be recontoured to normal gradient. Work should be done promptly after sloughing. Planning and implementation of slipout repair should be coordinated with the

California Department of Fish and Game and the Fish and Wildlife Service.

6. To reduce salmon and steelhead losses at the gated structure and pump station in the Natomas East Main Drainage Canal, fish screens and other fish-protection facilities be installed and in-channel construction activity be limited to the June 1 to August 31 period. The design and costs have not been determined at this time. Fish screen design and other measures should be coordinated with the Fish and Wildlife Service and California Department of Fish and Game.

7. To offset the loss of 878 acres of wetland habitat and 21,930 acres of upland habitat in the Natomas area, an area totalling 17,650 acres be acquired in the Natomas area and developed and managed as a wetland upland complex. Development cost is estimated at $171,675,000, excluding land acquisition and water supply for wetland management. Cost of fencing the wetland/upland complex is estimated at $200,000. Annual cost of replacement, operation and maintenance is estimated at $8,825,000.

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

AMERICAN RIVER WATERSHED INVESTIGATION

AUBURN AREA

SUBSTANTIATING REPORT

VOLUME II

REGION ONE

NOVEMBER 1991

American River Watershed Investigation

Auburn Area

Substantiating Report

November 1991

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Appendices

DESCRIPTION OF AREA

Auburn Area

This analysis of the Corps of Engineers' American River Watershed Investigation includes all of the lands within the U.S. Bureau of Reclamation's Congressionally authorized Auburn Dam Project area (Figure 1). The takeline or boundary for the Bureau of Reclamation Project encompassed portions of the North and Middle Forks of the American River plus adjacent lands from approximately 3 miles south of the city of Auburn and extending approximately 20 to 23 miles north and northeasterly. If constructed, the Bureau of Reclamation Auburn Dam and Reservoir would inundate about 10,000 acres of land and stream courses including about 23.5 miles of the North Fork and 25 miles of the Middle Fork American River. Approximately 31,000 acres of adjacent lands surrounding the reservoir were authorized for acquisition.

The analysis also includes lands adjacent to the Auburn Dam Project area in Placer, and El Dorado Counties that would be impacted by project-induced land-use change and lands that meet criteria for offsite mitigation.

Originating in the Sierra Nevada, the North and Middle Forks of the American River join just upstream of the city of Auburn (Figure 1). From the North Fork and Middle Fork confluence, the river flows past the rapidly growing city of Auburn and the Auburn Dam site before entering Folsom Lake. The Auburn Dam site is located in a narrow, deep, steep-sided canyon about 3 miles downstream of Auburn and 30 miles northeast of the city of Sacramento (Figure 2).

The North Fork American River watershed, in which the Auburn Dam site is located, is generally mountainous with elevations varying from about 500 feet at the base of the dam to more than 8,000 feet at the extreme upper elevations of the basin (at the peaks bordering Lake Tahoe). The watershed, extending from the foot to the crest of the Sierra Nevada, is essentially a tilted fault block sloping from east to west. The Auburn Dam project area lies in the western portion of the fault block near where it dips beneath the sediments of the Central Valley. The principal streams in the watershed, the North and Middle Forks of the American River and the Rubicon River, originate along the eastern edge of the basin above the 7,000-foot level. The combined drainage area above the Auburn Dam site exceeds 980 square miles.

Within the project area, the North Fork flows about 23 miles from the Colfax-Iowa Hill Bridge through a steep bedrock walled canyon to the Auburn Dam site at River Mile 20.1. Within this 23 mile stretch the river drops at a rate of about 33 feet per mile for 9 miles through a series of Class IV and V rapids (Watson, 1985)

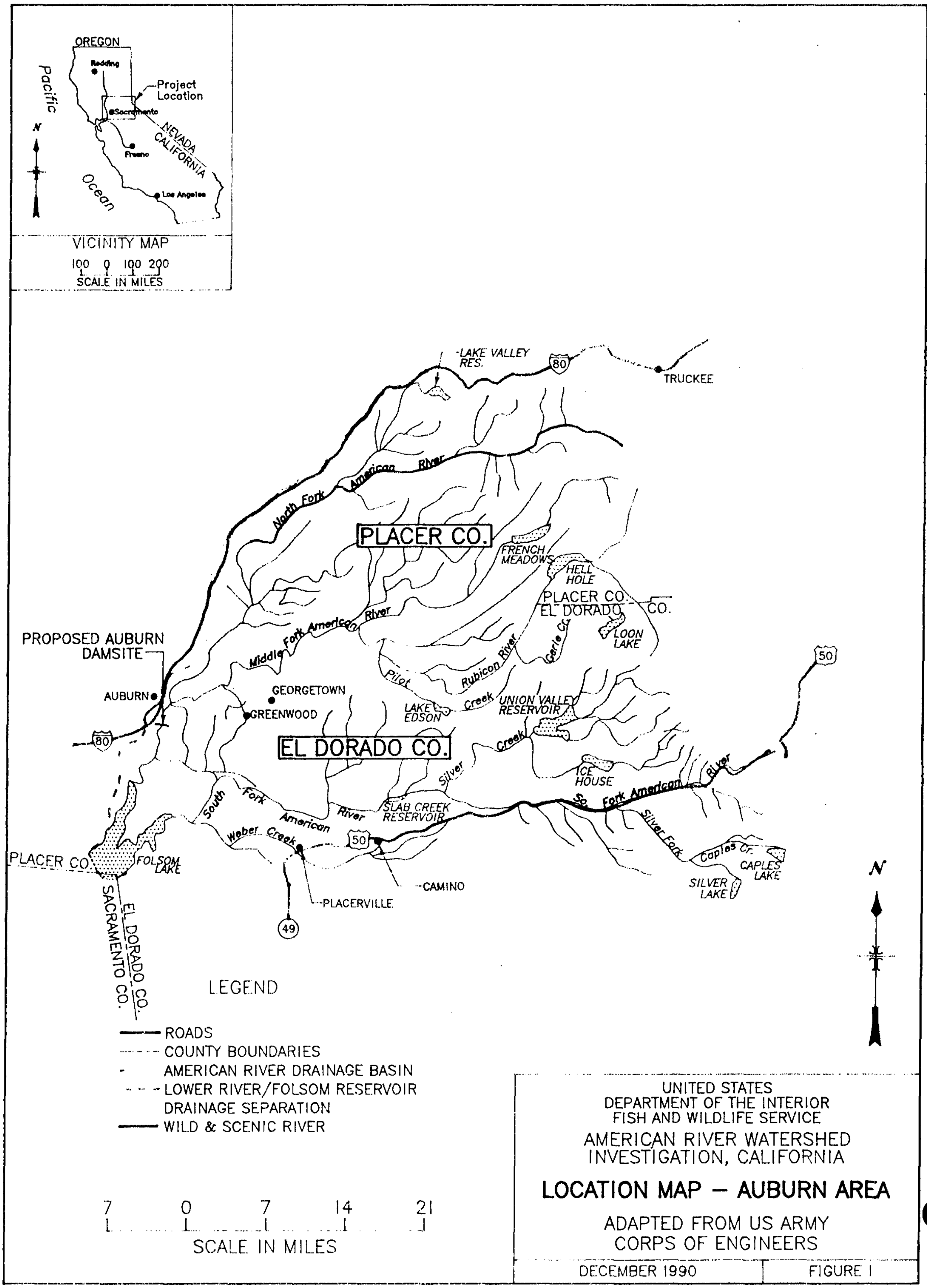

OREGON
Redding
Project Location
Sacramento
Pacific
NEVADA
CALIFORNIA
Fresno
Ocean
Los Angeles
N
VICINITY MAP
100 0 100 200
SCALE IN MILES
LAKE VALLEY RES.
80
TRUCKEE
North Fork American River
PLACER CO.
FRENCH MEADOWS
HELL HOLE
PLACER CO.
EL DORADO CO.
LOON LAKE
Middle Fork American River
PROPOSED AUBURN DAMSITE
AUBURN
GEORGETOWN
GREENWOOD
Pilot Creek
Rubicon River
Gerle Cr.
LAKE EDSON
UNION VALLEY RESERVOIR
50
EL DORADO CO.
Silver Creek
ICE HOUSE
So. Fork American River
South Fork American River
SLAB CREEK RESERVOIR
Weber Creek
Silver Fork
Caples Cr.
CAPLES LAKE
SILVER LAKE
PLACER CO.
FOLSOM LAKE
CAMINO
PLACERVILLE
49
SACRAMENTO CO.
EL DORADO CO.
N
LEGEND
ROADS
COUNTY BOUNDARIES
AMERICAN RIVER DRAINAGE BASIN
LOWER RIVER/FOLSOM RESERVOIR DRAINAGE SEPARATION
WILD & SCENIC RIVER
7 0 7 14 21
SCALE IN MILES
UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
AMERICAN RIVER WATERSHED INVESTIGATION, CALIFORNIA
LOCATION MAP – AUBURN AREA
ADAPTED FROM US ARMY CORPS OF ENGINEERS
DECEMBER 1990
FIGURE 1

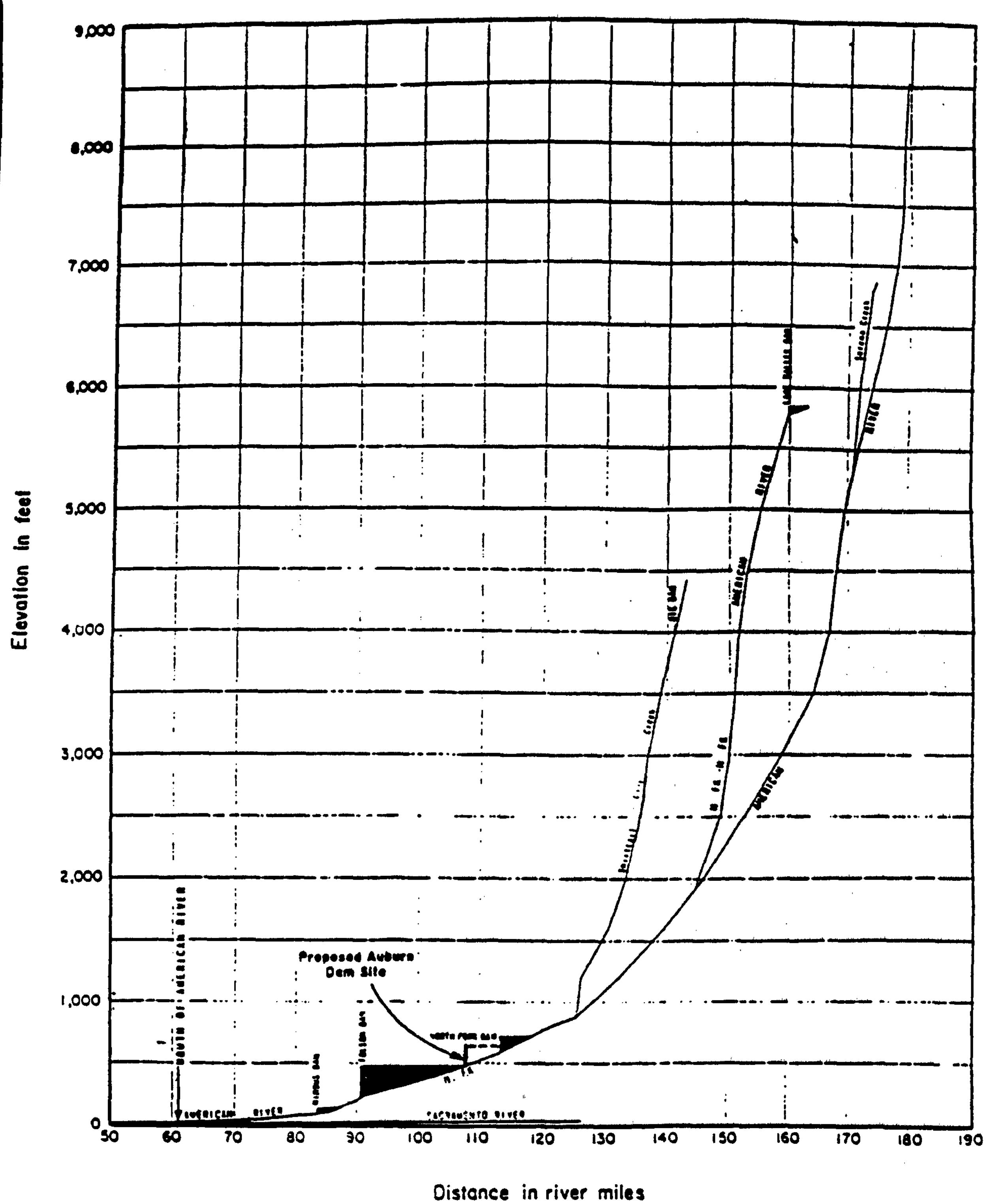
FIGURE 2. Auburn Dam Site

strewn with large boulders and cobbles to the Ponderosa Way Bridge (Figure 3). In this reach, riffle areas are small but gravels are clean. Most of the riffle areas (77 percent of the total observed) occur between Shirttail Creek and Lake Clementine. The 3.5 mile reach from Ponderosa Way Bridge to Lake Clementine has Class III rapids with more gravel bars and occasional bedrock outcrops.

Lake Clementine, formed by the North Fork Dam, was constructed by the Corps of Engineers in 1937 for sediment storage. The 5-mile-long reservoir has a storage capacity of 14,600 acre-feet. Spillway elevation is at about 715 feet (mean sea level). Waters of the North Fork flow over the spillway crest and continue downstream for about 2.5 miles at a somewhat lesser rate of drop (31 feet per mile) to the confluence of the North and Middle Forks. The North Fork flows along the 3.5 mile reach below the confluence and continues at a relatively lower gradient (31 feet per mile) over sand and gravel bars, and randomly distributed boulder clumps Figure 3. Sand and sediment deposits significantly increase toward the damsite. Much of the deposits resulted from the 1986 storm event and the Bureau of Reclamation's coffer dam operation. Runoff in the North and Middle Forks is from rain and snowmelt. Nearly 50 percent of the annual rainfall occurs during a 60-day winter period. Summers by contrast receive less than 1 percent of the annual precipitation, resulting in natural low summer flows. U.S. Geological Survey records 1941 to 1986, Station #11427000) show an average annual flow of 856 cfs, a maximum flow of 65,400 cfs, and a minimum flow of zero on the North Fork American River at the North Fork Dam just above the Middle Fork confluence. About one-mile downstream of the Auburn Dam site on the North Fork, U.S. Geological Survey records 1972 to 1986, Station #11433800) indicate an average annual discharge of 2,262 cfs, a maximum discharge of 66,700 cfs, and a minimum discharge of 51 cfs. Flows recorded at the downstream station reflect operation of the coffer dam and restricted flows through a bypass tunnel. Thus, the coffer dam has reduced peak flows to Folsom Reservoir since 1972 when it was constructed.

Combined storage in Big Reservoir and Lake Valley Reservoir above Lake Clementine is 10,300 acre-feet. Lake Valley Canal diverts water from the north fork of the North Fork American River into the Bear River Basin for Pacific Gas and Electric power production. The relatively small amount of combined storage and diversion have little effect on natural flows in the North Fork.

The Middle Fork American River flows downstream through steep walled rocky canyons past the Placer County Water Agency's Ralston Afterbay Dam/Oxbow Powerhouse for about 1/2 mile where it is joined by the northern arm of the Middle Fork. The Middle



NOTE: MILE 0.0 ON SACRAMENTO RIVER AT COLLINSVILLE

AMERICAN RIVER BASIN, CALIFORNIA

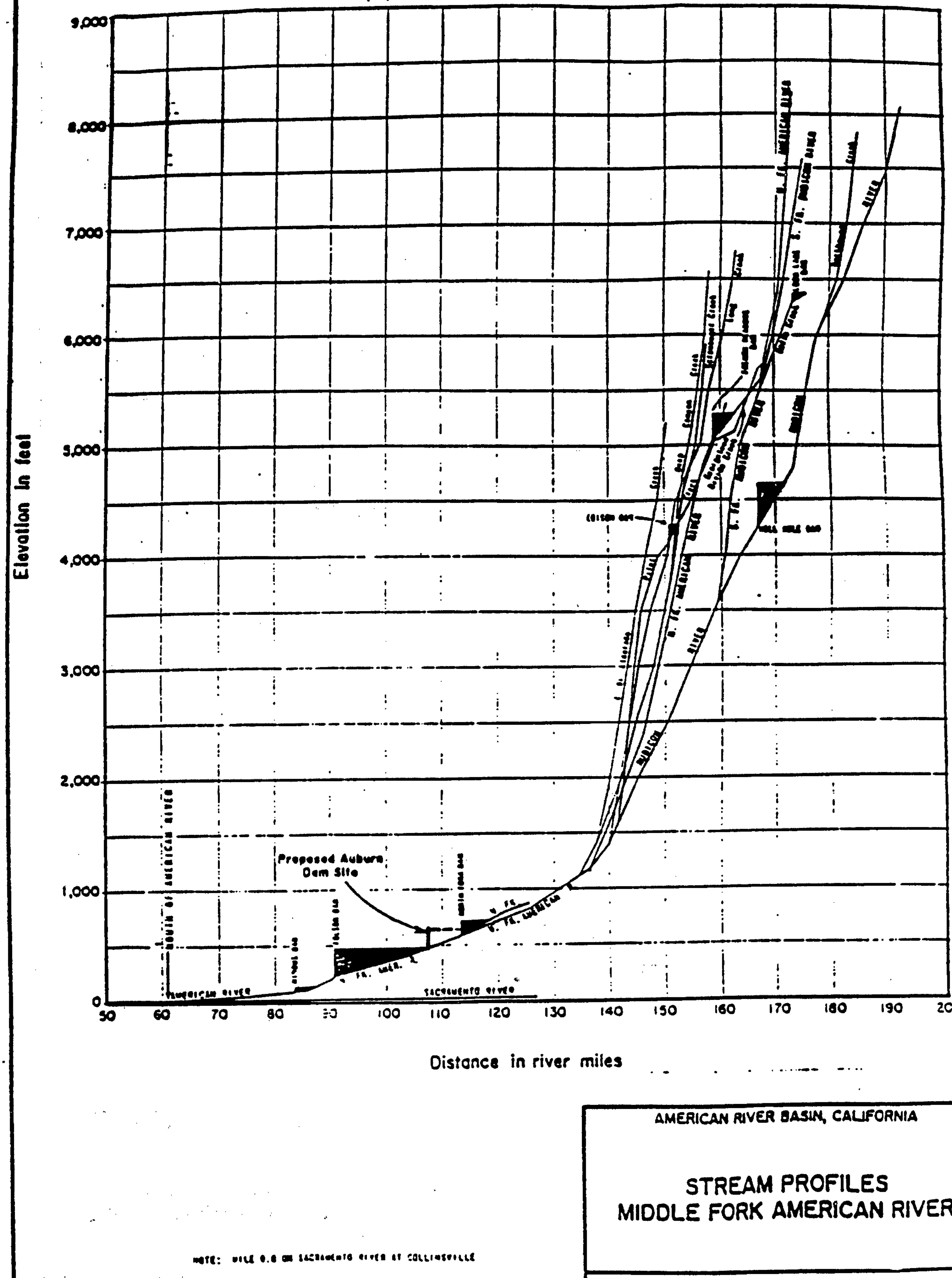
FIGURE 3

STREAM PROFILES NORTH FORK AMERICAN RIVER

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: R.F.C.
Drawn: C.A.P.

Date: MARCH 1989



AMERICAN RIVER BASIN, CALIFORNIA

STREAM PROFILES
MIDDLE FORK AMERICAN RIVER

CORPS OF ENGINEERS. SACRAMENTO. CALIFORNIA

Prepared: R.F.C.
Drawn: C.A.P.
Date: MARCH 1989

FIGURE 3a

Fork continues dropping at a rate of about 27 feet per mile for about 5 miles to Kanaka Rapids (Figure 3a). Large cobble substrate and boulders are common in this reach with less than 25 percent of their surfaces covered with sediments. Gold dredging activities are highest in this upper 5 miles of the Middle Fork. The gradient remains about the same in the next 10 mile reach from Kanaka Gulch to Ruck-A-Chuckey Rapids. There are smaller boulders in this reach and gravels are clean (less than 25 percent sediment coverage).

Below Ruck-a-Chuckey Falls, the gradient lessens to about 9 feet per mile downstream for about 10 miles until it joins the North Fork. Long and wide riffles and pools alternate in this reach. Pools are deep averaging about 16 feet.

U.S. Geological Survey records (Station #11433500, years 1911 to 1986) located on the Middle Fork American River near Auburn (614 square miles drainage area) shows an average annual flow of 1,342 cfs, a maximum flow of 253,000 cfs and minimum flow of 20 cfs. Daily discharges at the station were influenced by several upstream reservoirs including French Meadows, Hell Hole, Loon Lake, Stumpy Meadows Lake, and by Ralston and Oxbow powerplants and smaller diversion dams on the Rubicon and Little Rubicon Rivers. Robbs Peak powerplant diverts water out of the basin. Diversions and storage reservoirs above the Auburn Dam site in the Sacramento Basin and within the study area are shown in Table 1. In addition, discharges recorded up to 1986 were influenced by backwater effects caused by the Auburn coffer dam. Annual average, maximum and minimum discharges, respectively, for the 74 year period of record are 1,342 cfs; 253,000 cfs in 1964; and 20 cfs in 1931 and 1934 (USGS, 1986).

During the winter, flows often exceed upstream reservoir storage capacity and spill occurs. Once spills have ceased, the Placer County Water Agency, sponsor of the Middle Fork American River Project (Federal Energy Regulatory Commission License No. 2079, March, 1963), is required to maintain a minimum flow of 75 cubic feet per second in the Middle Fork American River below the confluence with the north arm of the Middle Fork under all forecast conditions. The agency contracts with the Pacific Gas and Electric Company (PG&E) to operate the hydroelectric power facilities. Flow releases above minimum flow are made according to power demand within the PG&E power grid. The power plants are automatically controlled by computer from PG&E's San Francisco Operations Office.

Table 1. Reservoirs in the Upper American River Drainage Area

Reservoir	Owner*	Capacity ac-ft
Lake Clementine	CDC	14,600
L.L. Anderson (French Meadows)	PCWA	133,700
Hell Hole	PCWA	208,400
Lake Edson	GDPUD	20,000
Loon Lake	SMUD	76,500
Union Valley	SMUD	271,000
Ice House	SMUD	46,000
Slab Creek	SMUD	16,600
Caples Lake	PG&E	21,600
Silver Lake	PG&E	11,800
TOTAL		820,200

* CDC California Debris Commission
PCWA Placer County Water Agency
GDPUD Georgetown Divide Public Utility District
SMUD Sacramento Municipal Utility District
PG&E Pacific Gas and Electric Company

SOURCE: DWR 1982

DESCRIPTION OF THE PROJECT ALTERNATIVES

Two flood control alternatives are being investigated upstream of Folsom Reservoir on the upper American River (Table 2). Each alternative involves construction of a dam and temporary inundation of the river canyons. Construction on the dam would begin in 1994 and continue for about 7 years. The period of analysis is 108 years.

Table 2. Physical Features - Auburn Dam Alternatives		
Components	200-Year Alternative Plan	400-Year NED Plan
Storage capacity	545,000 Acre Ft.	894,000 Acre Ft.
Type of dam	Flood control only	Flood control
Flood storage pool elevation	865 feet	942 feet
Surface acres (maximum pool)	4,000	5,450
Permanent storage	none (could be expanded to 2.3 million Acre ft.)	none (could be expanded to 2.3 million Acre feet)
Highway 49 relocation	yes	yes

200-Year Protection (Flood control only dam)

The 200-year flood control dam would be located slightly downstream of the existing Auburn Dam site, about 3.7 miles downstream from the North and Middle Fork American River confluence. The dam is of a curved alignment concrete gravity design constructed with roller compacted concrete. At full capacity, the reservoir would inundate approximately 16.5 miles of the North Fork, including Lake Clementine, and 17.5 miles of the Middle Fork, and 4,000 acres of land[1/]. The reservoir is designed to store temporarily (1 to 12 days) up to 545,000 acre-feet of water during storms.

The dam extends from elevation 490 feet mean sea level (msl) (channel bottom) to approximately elevation 924 feet msl. The 434-foot-high, 2,700-foot-long, 15-foot-wide (at crest) dam includes a vertical upstream face and a sloped downstream face. The dam is designed not to preclude future expansion to a large multipurpose structure (2.3 million acre-foot reservoir).

Approximately, (6,000 acres) within the temporary inundation zone would be retained (if in Federal ownership) or acquired (if not in Federal ownership). Lands outside of the inundation zone and in Federal ownership would be transferred to other agencies for management. The Corps of Engineers assumes that a total of about 14,200 acres would be transferred and held in public trust by other government agencies.

1/ For purposes of our HEP analysis, we determined that 3,135 acres of wildlife cover would be adversely impacted by the project.

State Highway 49 would be relocated, and a two-lane bridge constructed across the river canyon at River Mile 23. Also, on the North Fork the Ponderosa way would be relocated and Ponderosa Bridge would be raised to avoid inundation.

400-Year Protection (Flood control only dam; Corps of Engineers' NED Plan)

The 400-year NED flood control dam would be located at the same site as the 200-year alternative, i.e., slightly downstream of the existing Auburn Dam site, about 3.7 miles downstream from the North and Middle Fork American River confluence. This dam also is designed not to preclude future expansion to a large multipurpose structure. It features a curved alignment concrete gravity design constructed with roller compacted concrete. At full capacity, the reservoir would inundate approximately 19.5 miles of the North Fork and Lake Clementine and 20.5 miles of the Middle Fork, and 5,450 acres of land. The reservoir would temporarily store (1-12 days) up to 894,000 acre-feet to a maximum elevation of 942 feet mean sea level. The dam extends from stream bed elevation base foundation at 500 feet mean sea level to 998 feet at the top. The dam rises 548 feet from stream bed elevation with a 400 feet wide base to a 20 feet wide crest. It would be about 2,700 feet in length.

EXISTING CONDITIONS

Vegetation

The Auburn portion of the project area occupies a transition zone between the middle elevation foothill grassland, hardwood woodland-hardwood forest communities, and the higher montane, largely evergreen mixed- and conifer-dominated forest communities. Elevations in the Auburn area range from approximately 450 feet at the base of the proposed dam to 3,000 feet at the highest portion of the area. The area covers about 100 square miles (64,000 acres) along the steep canyons of the North and Middle Forks of the American River. This area includes a wide range of physiographic and microclimatic environments, and a highly diverse and complex vegetation mosaic.

A broad range of vegetation types is involved, including dry grasslands and savannas, moist meadows, emergent wetlands, talus slopes, springs, seeps, open water habitats, fire adapted closed-cone pine and chaparral shrub communities, tall closed canopy valley and montane riparian forests, and upland hardwood forests, hardwood woodlands, conifer forests and mixed evergreen forests. The original Environmental Impact Statement for the multipurpose dam (Kennedy Engineers 1971) briefly describes some of the vegetation characteristics in the study area. Several local planning documents also discuss the natural setting of the area in general (Placer County 1981, 1980, 1979 and City of Auburn and Placer County 1979).

Forest dominants in the Auburn area vary among deciduous broad-leaved trees, evergreen broad-leaved trees, evergreen coniferous trees, and combinations thereof. The extensive site to site variation in species composition, site dominance, and vegetation density within the area reflects the complex interplay of physical factors such as elevation, slope, aspect, soil type, water availability, and site history. Extreme physiographic gradients of slope, aspect, and elevation that exist in the river canyons undoubtedly contribute to the vegetation diversity. One noticeable general trend is that the deciduous hardwood dominants of the valley and lower foothill uplands and woodlands (largely deciduous oaks) are, in the Auburn area (elevation of 500 to 3000 feet), almost completely replaced by evergreen hardwood and conifer forest species.

In the lower to mid-elevations, evergreen hardwoods (mainly live oak) typically dominate, with some coniferous trees like digger and ponderosa pine scattered about. The deciduous blue oak is also a common element in this region, but rarely assumes dominance except in the deeper soils of open flats and gently rolling hills. At progressively higher elevations, conifers of various species begin to assume increased importance and dominance.

All "phases" of the sierran-mixed evergreen forest community discussed by Barbour (1987) can be found in the Auburn area. These include the mixed hardwood, canyon live oak, black oak, and Douglas fir-hardwood phases of this evergreen forest community. In addition, the mixed conifer phase of the mid-montane conifer forest community can be found in the more mesic mid- and higher-elevation sites of the area. To evaluate the anticipated impacts to fish and wildlife of the various flood control proposals by means of the Service's Habitat Evaluation Procedures (HEP) analysis, seven broadly inclusive terrestrial vegetation cover types and one riverine cover type (wildlife habitats) were recognized: evergreen hardwood forest (north slope-black oak), evergreen hardwood woodland (south slope-oak woodland), conifer forest, chaparral, grassland-savannah, upland scrub, rocky/ruderal and riverine (montane) riparian (which includes riparian forest and palustrine scrub-shrub, and freshwater marsh and other habitats within the maximum high water mark (Table 3). Wetlands are included within the riverine riparian zone. Table 3 also includes a relatively non-vegetated category termed rocky/ruderal

Table 3. Existing Conditions - approximated wildlife cover-type acreages within the 490- to 1135 foot elevation of the American River canyon.

ELEVATION ZONES (feet)

Upland	490-530	530-580	580-640	640-720	720-880	880-920	920-950	950-1135	Total
North Slope Oak	18	59	122	299	403	941	274	2013	4129
South Slope Oak	19	44	115	288	426	995	258	206	4206
Grass Land	12	9	22	26	28	47	9	65	218
Pine Forest	5	4	11	29	86	151	55	400	741
Chapparral	7	9	12	28	59	168	49	363	695
Upland Scrub									
Rocky/Ruderal	10	9	30	50	34	43	6	42	224
Subtotal	71	134	312	720	1036	2345	651	4944	10213
Wetland									
Montane Riparian	72	71	187	320	212	331	44	315	1552
Subtotal	72	71	187	320	212	331	44	315	1552
Total	143	205	499	1040	1248	2676	695	5259	11765

upland to account for barren, disturbed, eroded acreages that are of little value to wildlife.

Evergreen Hardwood Forest (north slope oak forest).

This dense canopy cover type typically occupies the north-facing slopes and deep-shaded canyons of the proposed Auburn area. Due to the steep and meandering nature of the North and Middle Fork American River Canyons, this vegetative cover transitions into northwest and northeast facing slopes. On the North Fork, average slopes on the canyon walls between riverbed elevation 520 to 1,000 feet were near 32 percent. On the Middle Fork between riverbed elevation 600 to 1,000 feet average slopes on the canyon walls were 31 percent. The dense canopy cover and variety of more mesic species on these north facing slopes is primarily due to the narrow, steep nature of these canyons. These topographic features and orientation provide greater shading and moisture retention than in less steep, more broadly defined canyons. The most typical and extensive stands of this forest cover type occur on the north-facing slopes of the North Fork drainage (Figure 4). Canopy cover ranges from 50 to 100 percent, and canyon and interior live oaks are the most frequent dominants. Tree heights range between 50 and 100 feet with an occasional conifer exceeding 200 feet.

FIGURE 4. Northslope Oak Woodland

Evergreen hardwood forest (north slope-oak woodland) includes all the sierran phases of the mixed evergreen forest of Barbour (1987), including dense canopy areas of the mixed hardwood, canyon live oak, Douglas fir-hardwood, and black oak phases. It also includes dense canopied stands of blue oak woodland and interior live oak phases recognized by him. Component tree stratum species include and vary among interior live oak, canyon live oak, black oak, California bay, Douglas fir, ponderosa pine, and occasional madrone. Tan oak, a species commonly found in mixed evergreen forests of the Coast Range and north and south of our study area, was noticeably absent from our study sites.

Approximately 4,129 acres of this habitat cover type occurs between the 490-to 1135-foot elevation inundation zone (Table 3).

Isolated pockets of comparable dense-cover, hardwood-dominated, evergreen woodland and forest occur as far down river as Goethe Park (elevation 60 feet) on the lower American River. It also occurs well above the highest elevations surveyed in the Auburn area, eventually merging at higher elevations with the dense canopy mixed conifer phase where hardwoods may codominate with conifers.

The composition and density of understory species varies greatly depending upon site conditions. Densely shaded sites may support sparse understory with ground cover often consisting of forest litter or bare soil. Sites of moderate canopy shading, open areas, wind throws and canopy gaps typically support young forest trees, woody shrubs and vines such as poison oak, deer brush, styrax, coffee berry, buckeye, ceanothus, manzanita, clematis, and pipevine and a variety of grasses and forbs. Occasional elderberry shrubs can be found, usually closely associated with drainages or steep draws. Lower elevation sites may even support essentially grassland understory. In some sites, such as steep mesic draws and drainages (both intermittently and permanently wet), understory shrubs may become so dense that they form virtually impenetrable barriers to human movement. These sites often support trees of the largest basal areas.

Evergreen hardwood woodland (south slope-oak woodland).

This evergreen, largely oak-dominated habitat type typically occurs on drier, southwest- to south- facing slopes with shallow to moderately deep soils (Figure 5). Although highly variable in tree density and species composition, many of the species of trees and shrubs found in the hardwood forest cover type also occur in this cover type. It, however, differs from the former by its distinctly woodland character with an open to moderately open canopy (30 - 50 percent closure). Canopy components vary greatly depending upon the aspect, exposure, elevation, and soils, but interior and canyon live oaks are again the most common dominants.

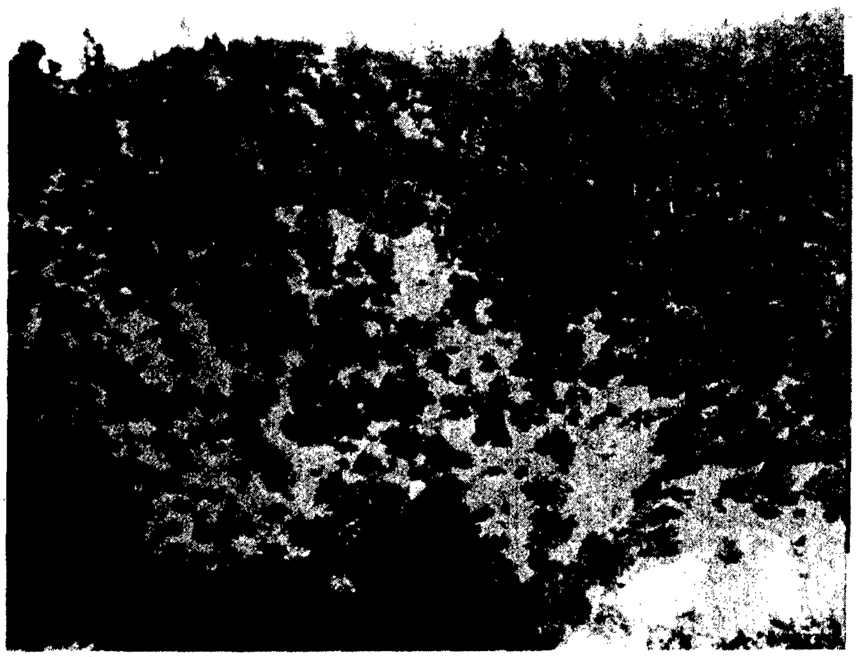


FIGURE 5. Southslope Oak Woodland

Isolated occurrences of this cover type can be found as far down as the Sacramento Bar on the lower American River where interior live oak dominates the canopy. With increasing elevation, moisture, and shading, the canopy dominance typically shifts to canyon live oak. Between the 490- to 1135-foot elevation zone, approximately 4,206 acres occur (Table 3).

Understory Evergreen Hardwood

Understory structure within the evergreen woodland varies to a greater extent than that of the evergreen hardwood forest (Figure 6). In mesic situations, stands may support moderate densities of understory shrubs and thus consist of an essentially three-layered community. In dryer sites, with moderately deep soils, the community may consist of essentially two layers, the tree canopy and an extensive grassland understory. In the lower elevations this two-layered "phase" may grade into the savannah or grassland cover type in the more exposed flats and gently rolling hills with deeper soils.

Conifer forest.

Conifer forest vegetation within the Auburn area corresponds to the mixed conifer phase of mid-montane conifer forest of Barbour (1987). In the lower elevations and western portions of the Auburn area, this cover type is diffuse in occurrence and highly limited in extent. Ponderosa and digger pines are the conifer species most frequently encountered in this region. They typically occur as scattered individuals mixed with plants of the chaparral, hardwood woodland and hardwood forest communities. Those conifer stands that can be recognized and mapped as a distinct cover type generally consist of small clusters of a few ponderosa or digger pine trees, covering only a few acres.

With increasing elevation and proceeding from west to east in the study area, conifers and the conifer forest cover type increase in coverage and importance, though stand dominants and species composition vary noticeably. The few stands of the mixed conifer cover type within the potential inundation zone do not include California white fir, incense cedar, sugar pine or Jeffrey pine as dominants, codominants, or even significant elements. North facing slopes at elevations within the potential inundation zones often support mixed stands where Douglas fir and ponderosa pine are subdominant.

Ponderosa pine (to a lesser extent) and Douglas fir seem to be common components providing cohesiveness to the mixed conifer type within this study area as noted by Barbour (1987). However, conifer forest, for purposes of this study, was more broadly defined including monotypic and mixed stands of digger pine, knobcone pine (Figure 7), and ponderosa pine, as well as more typical mixed conifer stands where dominance may be shared or

FIGURE 6. Understory, Evergreen Hardwood

FIGURE 7. Conifer Forest

shifted between ponderosa pine and Douglas fir. Consequently, the conifer forest cover type of this study provides a wide range and amplitude of habitat conditions for wildlife but a consistent cover dominance by conifer species.

Approximately 741 acres of this habitat cover type exists between the 490- to 1135-foot elevation (Table 3).

Chaparral

The chaparral cover type is composed mainly of evergreen woody shrubs that typify many of the dry, well drained, shallow soils of foothill and lower mountain slopes of the Sierra Nevada and elsewhere throughout the state (Cooper 1922, Oosting 1953, Hanes 1977, Munz and Keck, and Munz 1973). Chaparral vegetation is notable for high tolerance to drought, having many adaptations to fire; capable of "passing endlessly through cycles of burning and regrowth," and being the most valued watershed cover of any vegetation in the State (Hanes 1977, Vogl 1981, Keeley and Zedler 1978). The dominant species in this cover type share consistent features of thick, hard leaf morphology and shrubby growth. Even the oaks and other associated evergreen hardwoods that exist elsewhere as well developed trees, occur in chaparral vegetation as shrub or small tree forms.

The dominant woody species of the chaparral in the study area include chamise, manzanita, ceanothus, toyon, and shrubby forms of the interior and canyon live oaks and infrequently, shrubby forms of the deciduous blue oak. On the most exposed south facing slopes with shallow and or unusual soils, chamise typically dominates to the virtual exclusion of all other plant species (Figure 8). White leaf manzanita, which is the common manzanita in the study area, rarely occupies monotypic stands, but whenever it does, it typically grows at the upper edge of the chamise in small stands of one to a few acres.

The chaparral vegetation type is most abundant and best developed on the south facing slopes in the Middle Fork canyon. Its occurrence often corresponds to unusual soil types such as limestone, serpentine, gabbro or other unusual, highly mineralized soils. Most stands consist of very dense, virtually impenetrable thickets with little understory vegetation. Where an understory can exist, such as along drainages, steep draws or in deeper soils, it typically consists of annual grasses and a few forbs. Approximately 695 acres of chaparral occur in the 490- to 1135- foot elevation zone (Table 3).

FIGURE 8. Chaparral

Grassland/Savanna

Although grassland is considered a distinct cover type, annual grasses and their common forb associates exist as the most pervasive ground cover elements throughout the Auburn study area. In areas where tree cover falls below about 30 percent and shrub cover shows a corresponding drop, the ubiquitous grassland matrix begins to show a distinct presence and importance in the vegetation (Figure 9). Consequently, boundaries between grassland and adjoining woody vegetations frequently grade imperceptibly into one another. Approximately 218 acres of this cover type occur in the 490- to 1135- foot elevation zone (Table 3).

Freshwater marsh

Freshwater marsh habitats in the potential inundation zones exist mainly as isolated occurrences along most of the side drainages of the American River and including several notable locations along the mainstem American River and its forks. Freshwater marshes also may occur at the lower edges of moist meadows and at numerous springs and seeps wherever water perennially accumulates at depths of less than 5 feet. Freshwater marsh is characterized by emergent vegetation including dense stands of tules, cattails, rushes, sedges, and lesser amounts of smartweed and wateredge forbs.

Along the mainstem American River, only 14 acres of freshwater marsh were identified (using 1":400' aerial photographs), with the largest occurrences around the margins of Clementine Reservoir. Over much of the study area, however, ground level habitats were often obscured in the aerial photographs by the often extensive tree canopies, especially in areas of steep topography. In addition, actual ground surveys were highly limited to only a few areas because of time and funding constraints, the enormity of the area, and, in many cases, sheer inaccessibility. Thus, the multitude of perennial, intermittent and ephemeral side drainages generally noted for the area, as well as many springs and seeps, indicates that the actual acreage of freshwater marsh and other wetland habitats within the potential inundation areas of the various alternatives is undoubtedly much greater. Our analysis included freshwater marsh in the riverine habitat cover type.

Montane riparian

For our analysis, palustrine scrub-shrub, emergent marsh, riparian forest and other features between the 490- to 1135-foot elevation zone were included in the montane riparian habitat cover type (Table 4).

FIGURE 9. Grassland/Savannah

Montane riparian habitat in the Auburn area was most commonly observed along the mainstem American River below the confluence of the Middle and North Forks and along the margins of both forks as well as commonly along many of the lesser side drainages in the study area (Figure 10). Interestingly, the Middle Fork includes the majority of the vegetated riparian habitats along the mainstem river. Other important features of the riparian corridor of the mainstem river and forks include large sandy flats and moving sand bars that contribute importantly to the dynamics of riparian vegetation and extensive areas of exposed gravels, cobbles and rocky outcrops. About 1552 acres of montane riparian habitat occur in the 490- to 1135 foot elevation zone (Table 4).

Although both forks above the confluence are regulated to a certain extent by several relatively small- to medium-sized hydropower and irrigation impoundments along several drainages and on the mainstem Middle Fork, the riparian habitats and ecological conditions of the river corridor retain characteristics of a relatively natural foothill and middle elevation riparian system. The highly dynamic and seasonally variable flow conditions characteristic of foothill and mountain streams contribute to the highly dynamic and variable successional conditions of the riparian vegetation.

Consequently, various riparian vegetation types and ages exist along the mainstem river corridor above and below the confluence, including palustrine forest, dense thickets and thin stringers of palustrine scrub-shrub habitats, areas of frequently inundated grasses and ruderal herbs, and even emergent marshes on backwaters and on isolated ponds. Comparable habitats occur along most of the perennial and even some of the ephemeral side drainages.

Palustrine scrub-shrub

This vegetation type includes areas of dense willow scrub vegetation that typically occur along mountain and foothill streams, as well as broad variations of seasonally inundated habitats diffusely covered by woody shrubs and interstitial grasses and herbs (Figure 11). In many areas, narrow stringers of young cottonwoods and alders occur, and with time these should develop into tall canopy riparian forest if they survive the periodic inundation and erosion. Approximately 485 acres of this cover type occur in the elevation 490- to 1135-feet (Table 4).

Palustrine forest

Well developed palustrine forest is highly limited within the main river corridor as a consequence of the narrow canyon and relatively natural terrestrial dynamism of the river in this region (Figure 12). River flows in the North Fork

FIGURE 10. Riverine Riparian

FIGURE 11. Palustrine Scrub-Shrub

FIGURE 12. Palustrine Forest

characteristically show unregulated and extreme seasonal flow conditions and highly erosive forces. However, the Middle fork includes more flow control dams than the North Fork. This may in part account for some of the differences in the riparian vegetation between the two forks. Additional acreage of this cover type likely occurs along most of the unsurveyed side drainages of the Auburn Canyon area. A total of 151 acres of riparian forest was mapped on both forks between elevation 490 to 1135 feet (Table 4).

EROSION AND SLOPE STABILITY

Based on existing reports (Corps of Engineers 1990c, McClelland and Leiser 1990, DWR 1991, U.S. Bureau of Reclamation 1971) on slope stability and slippage potential, as well as field survey observation and examination of aerial photographs showing past and present conditions, soil and slope slippage and erosion is a critically significant factor affecting the vegetation of the canyons. According to the Environmental Impact Statement prepared by Kennedy Engineers for the U.S. Bureau of Reclamation (1971), for the original proposed multipurpose dam, all of the soils in the project area are subject to erosion with some soils on both sides of each fork of the river subject to severe erosion. A large majority of the slopes in the study area exceed 25% (Kennedy Engineers 1971, vol. I) and based on our field efforts many of the slopes in the canyon subject to inundation are 35-40% slopes. Soils in most of the more level areas of the project, pose severe permeability problems; and almost all of the soils in the area are of low fertility. Further the Kennedy Engineers (1971) concluded that there is no known vegetative cover type that can resist the continuous rise and fall of the water level. Soil types and characteristics and the slope and vegetative characteristics of the various soil types are summarized in our sediment and soil loss evaluation (Appendix B).

McClelland and Leiser (1990) briefly discuss the landslide and erosion potential for the American River canyons noting that landslides will be a forseeable consequence of periodic inundation. Soil saturation has been identified as one of the most common causal factors in landslides and soil slippage (Corps of Engineers 1990c; Gray and Leiser 1982, cited in McClelland and Leiser, 1990; Dr. Michael Singer, Professor of soil science, U.C. Davis, pers. comm. Nov. 1990). In the American River canyons, the stability and shear strength of the soft rock and soil slopes (regolith) that commonly lies upon bedrock, deteriorates extensively with partial or complete saturation (Corps of Engineers 1990c). Interestingly, however, the Corps of Engineers (1990c) state that the repeated filling and lowering of the water behind the dry dam will not result in significant erosion and landsliding.

Recent evaluation of the soils and slope stability in the inundation area by the Department of Water Resources indicated that up to 35 percent of the soils are likely stable. About 15 percent of the soils could mobilize at the drawdown rates proposed for the 200-year and 400-year flood control scenarios (DWR 1991). Although DWR's study provides new information that appears plausible, a great deal of additional field sampling and laboratory testing is needed along with precise reservoir drawdown modeling before definitive conclusions can be reached. For this reason, the Service is adhering to our original impact assessment conclusions which are described herein.

The major soil types found in the proposed inundation zone of the American River canyons have low to moderate shear strength, and thus are inherently susceptible to erosion and slippage. Ranking of soil suitability in Table 5 is taken from Kennedy Engineers (1971, vol. II). Under the "Water Retention" category, nine of the eleven soil categories have been rated 9, which indicates there is a "severe hazard" of soil erosion. The Sites-Josephine soil was given a ranking of 7 and the Aiken-Cohasset was given a ranking of 8. Rankings under the "Topsoil" category vary. Nine of the eleven soil categories rank between 2 and 4 ("fair", "fair to poor", and "poor"). The other two categories (Maymen-Rock Land and Rock Land) are given rankings of 10 ("unsuitable"). Figures 13 and 14, (Kennedy Engineers 1971, vol. I and II), illustrate areas of various soil types and potential slope stability hazards, respectively. Based on the above discussions of high to extreme soil instability and erosion hazard for virtually all of the canyon areas subject to inundation, we concluded that the extent of soil erosion, slope failures and the resultant losses in vegetation cover will be extensive. While this contrasts directly with the conclusions by the Corps (1990c) their concerns may primarily focus on significance relative to future capacity and function of the reservoir area behind the dry dam, damage to the dam itself, or the deceptively small acreages of individual slides and erosion sites, not the cumulative extent of vegetation change or fragmentation over the life of the project.

TABLE 5

SOIL MAPPING UNITS AND INTERPRETIVE GROUPINGS

L. BRITTAN, U.S.D.A., SOIL CONSERVATION SERVICE, WESTERN PLACER COUNTY, CALIFORNIA, MARCH 8, 1971

MAP SYMBOL	SOIL NAME / LAND USE	CAMP AREAS	EXCAVATION	LAWNS & GOLF COURSES	PATHS & TRAILS	PICNIC AREAS	PLAY-GROUNDS	WATER RETENTION	ROAD FILL	TOPSOIL	SAND & GRAVEL
AK-AB / BD	Auburn Argonaut Association 2-15% Slopes										
	AUBURN	7	9	9	5	7	9	9	2	4	10
	ARGONAUT	9	9	9	5	7	7	9	3	4	10
AK-AB / EF	Auburn-Argonaut Association Rocky 15-50% Slopes, eroded										
	AUBURN	9	9	9	7	9	9	9	2	4	10
	ARGONAUT	9	9	9	7	9	9	9	1	4	10
AK-EP / EG2	Auburn-Exchequer Association 15-75% Slopes										
	AUBURN	9	9	9	9	9	9	9	4	4	10
	EXCHEQUER	9	9	9	9	9	9	9	4	4	10
RI-AK / DF	Bloomer-Auburn Association 15-50% Slopes										
	BLOOMER	9.	7	9	7	9	9	9	4	2	9
	AUBURN	9	9	9	7	9	9	9	2	4	10
SQ-JP / CD	Sites-Josephine Association 5-15% Slopes										
	SITES	9	7	9	5	7	9	7	3	2	10
	JOSEPHINE	7	7	7	5	7	9	7	3	2	10
SQ-JP-MH / EF2	Sites-Josephine-Mariposa Assoc. 15-50% Slopes, eroded										
	SITES	9	7	9	7	9	9	9	3	2	10
	JOSEPHINE	9	7	7	7	9	9	9	3	2	10
	MARIPOSA	9	9	9	9	9	9	9	3	4	10
JP-MH-MQ / EG	Josephine-Mariposa-Maymen Assoc. Rocky, 15-75% Slopes										
	JOSEPHINE	9	7	9	9	9	9	9	3	2	10
	MARIPOSA	9	9	9	9	9	9	9	3	4	10
	MAYMEN	9	9	9	9	9	9	9	2	4	10
AI-CS / BE	Aiken-Cohasset Association 5-30% Slopes										
	AIKEN	8	7	9	6	8	8	8	3	3	10
	COHASSET	8	7	7	6	8	8	8	3	3	10
MH-JP / DF	Mariposa-Josephine Association 15-50% Slopes										
	MARIPOSA	9	9	9	9	9	9	9	2	4	9.
	JOSEPHINE	9	7	9	9	9	9	9	2	2	9
MH / G	Mariposa 50-75% Slopes										
	MARIPOSA	9	9	9	9	9	9	9	4	4	10
MQ-RL / G	Maymen-Rock Land Association 50-75% Slopes										
	MAYMEN	9	9	9	9	9	9	9	2	10	10
	ROCK LAND	9	9	9	9	9	9	9	2	10	10
RL	Rock Land										
	ROCK LAND	9	9	9	9	9	9	9	4	10	9

NOTE: Soil Mapping Units exclude the gravel bars in the riparian zones.

RANK OF SOIL SUITABILITY:

1. Good
2. Fair
3. Fair to Poor
4. Poor
5. Slight Hazard
6. Slight to Moderate Hazard
7. Moderate Hazard
8. Moderate to Severe Hazard
9. Severe Hazard
10. Unsuitable

FIGURE 13. SOILS OF THE AUBURN AREA

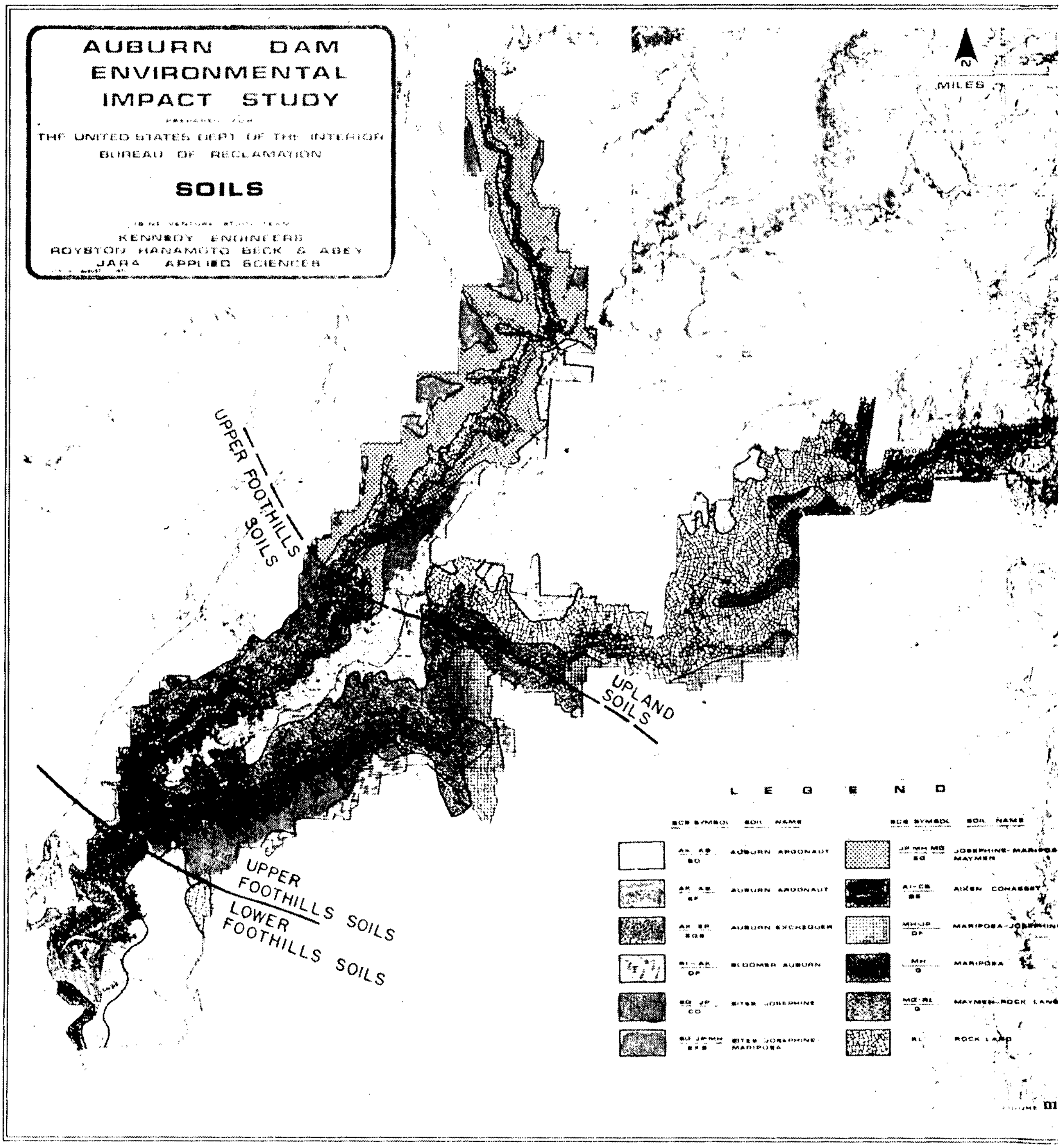
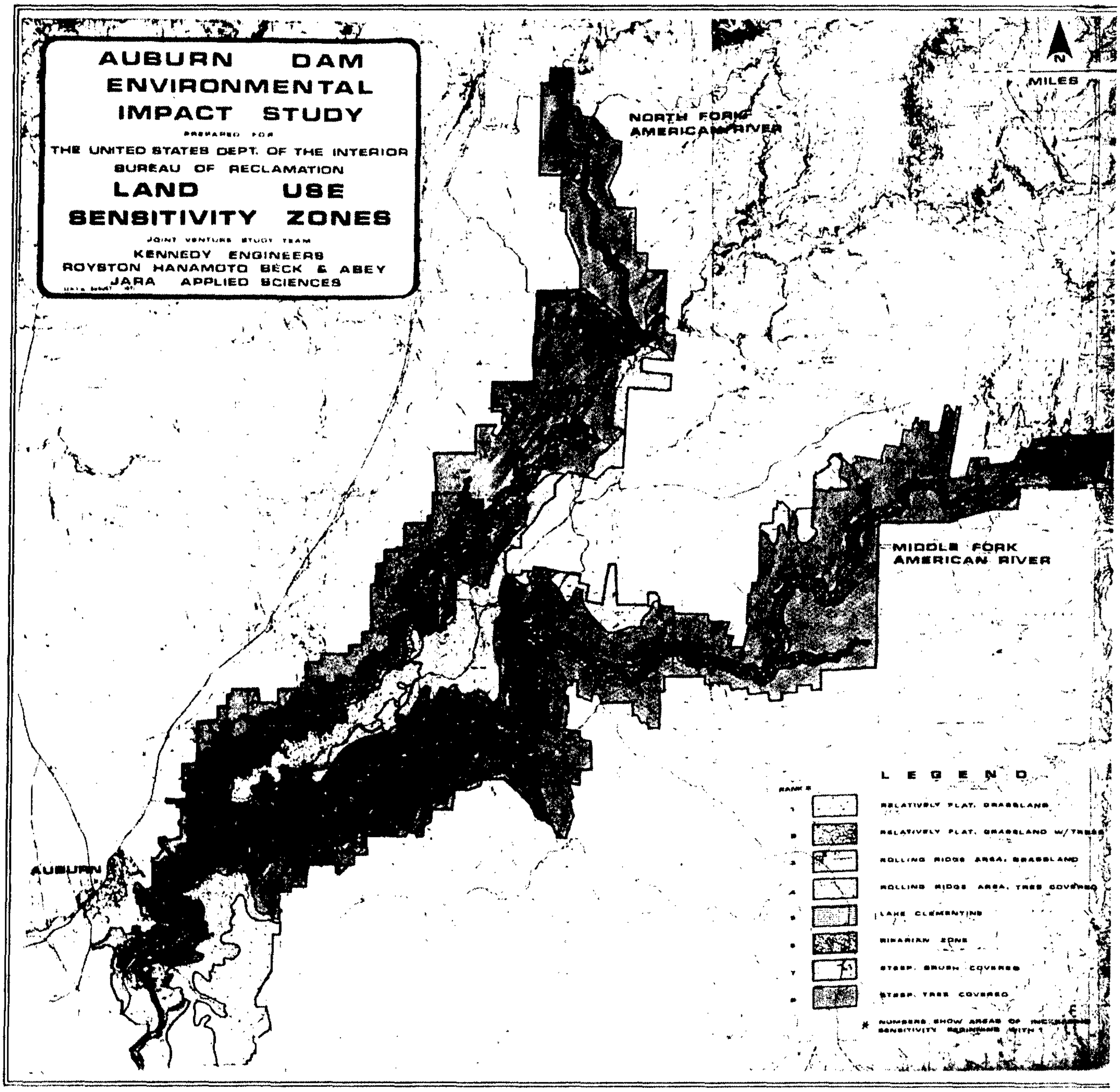


FIGURE 14. AREAS OF POTENTIAL SLOPE INSTABILITY IN THE AMERICAN RIVER CANYON



EXISTING CONDITIONS

Fish

The North Fork American River supports a variety of warmwater species including smallmouth bass, bullhead and sunfish, on a year-round basis. Although a few trout are present, summer/fall water temperatures are generally too warm for suitable summer rearing. Instream mining operations and effects of the authorized Auburn Dam Project are the most apparent disturbances along the river.

The Middle Fork American River, in contrast, supports both warmwater and coldwater species year-round. Cooler temperatures resulting from the Middle Fork American River Project support brown and rainbow trout for about 10 miles below the dam. Habitat is more suitable for warmwater species below this point.

North Fork

Below the Colfax-Iowa Hill Bridge, the North Fork flows through steep-sided canyons with 30-60 percent or greater slopes. Riffles are generally small in area and interspersed between series of deep pools and cascades.

A total of 58 riffles and 64 pools occur from the Colfax-Iowa Hill Bridge downstream 25 miles to the Auburn Dam site (Appendix D). Forty-three of the fifty-eight riffle areas (77 percent) are in an 8 mile stretch between Shirttail Creek and Lake Clementine. The majority of these riffles had significant areas with a combination of gravels from 0.25 - 3.0 inch diameter and underlying cobbles suitable for trout and smallmouth bass spawning (Reiser and Bjornn, 1979; FWS 1983, 1984). Sediments covered less than 25 percent of these gravel areas.

The average riffle is 196 feet long, 82 feet wide and 4 feet deep. The average pool is 246-foot-long, 77-foot-wide and 14-foot-deep.

All 25 miles surveyed contain suitable rearing habitat for resident fish. However, low summer flows and high water temperatures in the North Fork reduce habitat suitability for coldwater species.

Historical background on fish resources of the North Fork is limited. California Department of Fish and Game records of stream surveys from 1934-1938 prior to Folsom Dam construction indicated that a variety of warm and coldwater species were observed (Table 6). Post-Folsom Dam surveys in 1965 also included smallmouth bass (Micropterus doloieui) in addition to those found in the 1930's, and densities of approximately 100 trout per mile were observed.

Lake Clementine begins about 3.5 miles above the Auburn Dam site and extends 5 miles upstream. Similar fish species occur in the North Fork and in Lake Clementine. The Department of Fish and Game periodically stocks rainbow trout in Lake Clementine. The most recent records for angler use estimate about 5,000 angler-days annually are spent on Lake Clementine (Kennedy Engineers, 1971). Access to lower Lake Clementine is limited due to parking and boat launching space constraints.

Below Lake Clementine, there are fewer riffles and increased sediment deposition is evident. Below the Middle Fork confluence, gravel sizes decrease and sand bar deposits increase. The three-fourth mile stretch of channel above the Bureau's coffer dam site is covered by sand deposits which accumulated during operation of the coffer dam.

Throughout the reach from Colfax-Iowa Hill to Auburn Dam site, fringes of riparian vegetation overhang the channel. Willow, alder and blackberry are predominant. Large gravel bars are also sparsely vegetated with these species. The steep canyons and narrow channel likely have a much greater influence on water temperature than the overhanging vegetation. Daily incidence of direct sunlight exposure on the river is greatly reduced by the steep and closely adjoining canyon walls.

Table 6. North Fork American River California Department of Fish and Game Stream Surveys 1934-1938

Sacramento sucker	Castastomus occidentalis
Sacramento squawfish	Pytocheilus grandis
rainbow trout	Salmo gairdneri
hardhead	Mylopharodon conocephalus
Chinook salmon	Oncorhynchus tshawytscha
brown trout	Salmo trutta

Disturbance of channel substrate is evident along most of the river channel, due apparently to numerous instream mining operations. Tailing piles and diversions are common. Surveys (FWS 1989) indicate that low flows and high temperatures in the summer favor greater abundance of warmwater species. Smallmouth bass, riffle sculpin, Sacramento sucker, Sacramento squawfish and brown bullhead were found in significant numbers in pools and riffles, whereas trout were scarce (Table 7).

Table 7. Fish Sampling Survey North Fork American River September 20-28, 1989

Warmwater Species	Colfax-Iowa Hill Bridge	Yankee Jim Bridge	Ponderosa Bridge	Totals
smallmouth bass	15	6	4	25
Sacramento squawfish		2		2
riffle sculpin	2	1		3
Sacramento sucker	3			3
brown bullhead			3	3
green sunfish			1	1
Coldwater Species				
rainbow trout		1		1
	----	----	----	--
Totals	20	10	8	3

Sport fishing is concentrated at the major access points along the river (e.g., at the Colfax-Iowa Hill Bridge, Yankee Jim bridge, Ponderosa Bridge and other vehicle access roads).

Middle Fork

From Oxbow Reservoir/Ralston Afterbay downstream to the confluence, the Middle Fork flows through steep-sided canyons of 30 percent or greater slopes. Riparian vegetation comprised of willows, alder, blackberry and some cottonwood overhangs the channel in many places. Similar to the North Fork, the steep canyon walls and narrow stream channel likely influence water temperature more than the overhanging vegetation. Construction of the Placer County Water Agency's Middle Fork American River project in 1962, above and including Oxbow Reservoir, provided much cooler water temperatures during the summer and fall, thereby improving habitat suitability for resident coldwater species.

Overall, 66 riffles and 67 pools occur in this segment of the Middle Fork. The average riffle is 132-foot-long, 106-foot-wide and 6-foot-deep. Riffle areas in the uppermost portion (upper 3 miles) above Kanaka Rapids generally contained cobbles and boulders (10-160 inches diameter) unsuitable for trout and smallmouth bass spawning. Below Kanaka rapids, wide beds of gravel of 0.25 to 3.0 inches in diameter and larger, with less than 25 percent fines covering the surface, were common. There are also numerous smaller gravel areas in shallow pools, along channel margins and on inside bends. Suitable spawning habitat for trout and smallmouth bass is present from below Kanaka Rapids to the confluence.

Evidence of gold dredging activity and substrate disturbance (tailing piles and turbidity) is common throughout the river segment. Twenty-one active dredges were observed during a two-day float. The greatest activity and substrate disturbance is in the upper five miles from Oxbow Reservoir to Cache Rock where 15 dredges were observed. Since the survey was conducted at the beginning of the dredging season, dredging activity probably increases greatly through the summer.
Historical records of fish resources in the Middle Fork are also limited. California Department of Fish and Game records of stream surveys done in 1938 prior to Folsom Dam construction indicate a variety of species present (Table 8). In addition, records indicate that rainbow and brown trout were stocked from 1930-1949 and then again in the mid-1960's (post-Folsom Dam).

Table 8. Middle Fork American River California Department of Fish and Game Stream Survey 1938

Sacramento pike	Pytocheilus grandis
hardhead	Mylopharodon conocephalus
roach	Hesperoleucas symmetricus
black minnows	Pimephales promelas
sucker	Castastomus occidentalis
salmon	Oncorhynchus tshawytscha

Compared to the North Fork, the Middle Fork has a much greater relative abundance of coldwater species vs. warmwater species (Table 9).

Table 9. Fish Sampling Survey Middle Fork American River September 20-28, 1989

Warmwater Species	Below Oxbow	0.5 mi. below Oxbow	Fords Bar	Mammoth Bar	Total
Sacramento hitch	0	18	0	0	18
Sacramento sucker	0	8	0	2	10
Sacramento squawfish	1	10	0	0	11
riffle sculpin	0	0	0	2	2
Coldwater Species					
brown trout	0	0	4	0	4
rainbow trout	0	1	2	0	3
unidentified	0	0	3	0	3
Totals	1	37	9	4	51

In summary, the North Fork American River from the Auburn Dam site to the Colfax-Iowa Hill Bridge contains about 20 miles of free flowing stream habitat and 5 miles of reservoir habitat (Lake Clementine) suitable for warmwater fish production. Major disturbances appear to have been caused by instream mining and the washed out Auburn coffer dam. In contrast, the Middle Fork American contains about 24 miles of free-flowing stream habitat suitable for both warmwater and coldwater fish, the coldwater habitat being a consequence of the Middle Fork American River project. Instream mining appears to be a major disturbance factor in this reach.

Wildlife

The proposed Auburn Dam site, lying along the western slope of the Sierra Nevada, occurs in a region of high wildlife species diversity (Verner and Boss 1980). Although seven broad vegetation cover types were chosen for studying the Auburn area, this belies the enormously complex and diverse vegetation patterns and wildlife habitats of the area. Many highly significant macro- and microhabitat features occur throughout the study area including seeps, springs, small ponds and pools, rock study area including seeps, springs, small ponds and pools, rock outcrops, talus slopes, cliffs, crevices, and caves all of which contribute significantly to the diversity and abundance of plant and animal life within the study area.

Much of the Auburn study area is characterized by steep often densely vegetated slopes. The canyon bottoms are especially important to wildlife as these areas generally provide surface moisture and associated vegetative cover critical to virtually all wildlife species found in the area. Densely vegetated streams provide relatively secure access to limited surface water for large game species such as deer, bear, and other game and nongame mammals, birds, reptiles and amphibians.

The dense network of drainages and subdrainages, and adjoining dense streamside vegetation throughout the study area, provide for increased mobility and safe passage corridors for species such as deer, bear, coyotes, raccoon, fox, and many species of reptiles and amphibians.

The large numbers of roadways, both dirt and paved, in the study area, have undoubtedly adversely affected movements of some species. Large terrestrial species such as deer, bear, coyote, and gray fox may be affected to a lesser extent than small mammals, reptiles and amphibians. However, increased numbers of roads, especially paved roads with higher vehicle speeds, have undoubtedly resulted in increased road mortalities of all species. Large game species such as the black-tailed deer and black bear are commonly noted by the general public as residing in the canyons of the study area. However, a multitude of interesting and valuable (both ecologically and economically) game and nongame wildlife species also occur in the study area, including several of highly limited range and/or which are legally protected.

Black-tailed deer commonly occur within the study area and most are resident animals with densities of 10 to 30 per square mile (Kennedy Engineers 1971). Although cover and browse conditions for deer vary greatly from excellent to poor throughout the area, in general, conditions are good to very good (Biswell 1974). The availability of adequate surface water with closely adjoining tall vegetation cover may also be an important feature contributing to the relatively high deer populations in the study area. The occurrence of many densely vegetated perennial and ephemeral drainages, springs, seeps and dense cover at localized sites and along the main river undoubtedly contribute important habitat features for deer and most other terrestrial wildlife. Such habitats are critically important to the more obscure, but no less ecologically significant amphibians, reptiles and small nongame mammals.

The relatively high deer populations (indicated by the extent of visibly browsed shrubs and forbs) and the extensive mosaic of fire adapted vegetation types, including chaparral and closed cone pines (mainly in the Middle Fork Canyon) indicate the important and dynamic role fire plays in maintaining high habitat values in the region (Biswell 1974). Periodic natural fires, although thought of as highly destructive, serve to establish important vegetation mosaics and maintain habitat conditions upon which many wildlife species thrive. Fires quickly thin dense, often monotypic stands of trees and shrubs which often provide low forage availability and, in the case of overly mature stands, may impede movement of larger bodied game and nongame species. Fires permit seed regeneration of many important wildlife browse, forage and cover species that otherwise may decline with advancing maturity. Fires also serve to stimulate sprouting in species such as chamise, and several species of manzanita and ceanothus, thus producing increased, highly palatable browse for wildlife.

A recent study by the U.S. Fish and Wildlife Service (1989) evaluated the applicability of using controlled burning as a mitigation tool to improve forage conditions for black-tailed deer. Results of the study indicate that controlled burning on Bureau of Reclamation lands in the Auburn area only partially accomplished interim mitigation goals for impacts to deer habitat associated with construction at the damsite. Reasons for poor success included lack of rotational burning and/or an inadequate reburn frequency, failure to restrict livestock grazing on burned sites, improper burn procedures and conditions, and, on crush and burn areas, failure to fertilize and reseed with suitable cover species. In most cases, monotypic stands of chamise out competed other more favorable vegetative cover types and reduced the overall values for wildlife.

Evergreen Hardwood Forest (north slope-oak forest)

This extensive cover type provides good to excellent habitat for a broad variety of species. The more dense and older trees exist in undisturbed drainage bottoms, where habitat can be characterized as essentially riparian forest. In these areas many cover-dependent species occur such as ringtail cat, gray fox, deer, bear, owls, wild turkey, mountain quail and many species of songbirds. The dense cover provided in the drainage bottoms provides highly suitable nest and denning areas especially where rocky ledges and overhangs exist. The older trees often provide many holes and cavities for nesting and denning. Ground litter often is very thick in the drainage bottoms, including many downed logs, and fallen leaves. This abundant cover provides highly valuable habitat where many mammals, amphibians, reptiles and invertebrates of the forest floor find cover and food. Species such as shrews, salamanders, wood rats, and ground foraging birds occur in abundance in these sites. The California spotted owl (Strix occidentalis), a category 2 Federal candidate species, can be found in these areas wherever conditions provide suitable tree densities with large basal areas, and ample ground litter.

Evergreen Hardwood Woodland (south slope-oak woodland)

This relatively dry open habitat provides high values for a broad variety of wildlife species, many of which also occur in the north-slope forest. The woodland provides woody ground cover and litter, but not nearly as much as the drainage bottoms of the north-slope forest type. Consequently, many of the highly cover-dependent species of the moist forest do not occur in the woodlands of the south-facing slopes. Nonetheless, this habitat, which includes many drought-tolerant older trees and shrubs, provides ample cover and food for species such as deer, bobcat, coyote, gray fox, pocket gopher, gray squirrel, turkey, turkey vulture, California quail, bandtail pigeon, and many species of songbirds, including scrub jay, acorn woodpecker, downy woodpecker, various warbler species, western and mountain bluebirds, California thrasher and various species of vireos and sparrows. The large amount of open sunny exposures and rocky outcrops provide good to excellent habitat for many species of snakes and lizards such as western fence lizard. The tree canopies and grassland openings provide ample insects for foraging bats and insect and seed eating birds. Likewise, grassy openings with nearby tree and shrub cover provide excellent habitat for many species of upland game such as cottontail rabbit, quail, and turkey.

Conifer forest

The broad variety of conifer forest habitat types supports a diversity of wildlife species. In the drier conifer types such as knobcone and digger pines, wildlife species of the nearby chaparral often overlap, including gray fox, coyote, deer, wood rat, wrentit, scrub jay, thrasher, brush mice, badger and bobcat. The more mesic ponderosa pine and incense cedar stands often include good to excellent habitat for many forest and montane species such as gray squirrel, red fox, porcupine, mountain lion, raccoon, beaver, deer mouse, California vole, mink and many forest birds including Townsend's solitaire, pine siskin, gnatcatcher, nuthatch, western wood peewee, various thrushes, warblers, and grosbeak.

Chaparral

This highly drought-tolerant and fire-adapted vegetation varies greatly in its habitat quality for wildlife. Dense stands with little ground vegetation and virtually complete canopy closure offer relatively low wildlife value for many large, highly mobile species when compared to the other, adjoining vegetation types in the study area. Recently burned stands, however, when they consist of ample open areas with plentiful soft young browse, provide good to excellent deer forage and many seed and mast bearing forbs and shrubs. Consequently, wildlife values in these areas can be very high, supporting species such as wrentit, quail, turkey vulture, high deer populations, mountain lion, bobcat, coyote, gray fox, many species of small mammals and reptiles, and a multitude of song birds.

Unfortunately, most of the chaparral areas of the Auburn canyon are essentially "managed" to avoid or prevent periodic burns, especially in areas close to homesites. Thus, the natural fire regime to which the vegetation and wildlife is adapted has been altered (mainly protracted) by policies of fire avoidance and prevention. Any fires that do start are quickly extinguished. Thus the fire-dependent chaparral is indirectly allowed to mature to decadent, essentially monoculture stands of one or two dominant shrubs with relatively low wildlife values.

Grassland/Savannah

This habitat, which occurs throughout the study area, varies greatly in its wildlife component depending upon the location (mainly elevation), size of the grassland patch, adjoining vegetation types and successional condition. In general, grasslands offer important foraging sites for deer, bear, certain raptors such as red-tailed hawk, golden eagle, and many species of small mammals, reptiles, and amphibians. This habitat type is particularly important for upland game, including brush rabbits and cottontail, mourning dove, quail, and turkey. Grasslands are particularly important to songbirds such as western meadowlark, loggerhead shrike, northern oriole, various woodpeckers and sapsuckers, goldfinch, California and rufous-sided towhee, and several species of sparrow. Amphibians and reptiles commonly found in this habitat include horned lizard, western fence lizard, common kingsnake, gopher snake, rattlesnake, alligator lizard, western spadefoot toad, and western toad.

Montane Riparian

The montane riparian areas in the Auburn Canyon are especially important for wildlife as they often support the highest diversity of habitats as compared to any other cover type. The vegetation along the main river corridor includes large areas of flowing, open water habitat; rocky shoreline; sand and gravel bars; river-edge willow and shrub thickets; many stands of tall moist forest of varied ages; higher terrace grasslands and mixed riparian thickets. The river corridor also includes several emergent freshwater marshes in isolated backwater sites and at the mouths of many of the tributary streams. In addition to the main river channels and major tributaries, there are hundreds of minor tributary streams and water courses which provide valuable habitat for wildlife. Although most of these have flow on a seasonal basis, a dense canopy of vegetation remains year-round, providing important wildlife habitat along the stream margins. These frequently serve as a natural corridor for wildlife movement up or down the steep slopes.

This variety of habitats, lying close to surface water, creates a particularly productive situation for wildlife. Many species of water and shorebirds can be found in the river corridor of the North and Middle Forks including the dipper, sandpiper, great blue heron, killdeer, bufflehead, bittern, egret, mallard, merganser, goldeneye, and wood duck.

The availability of surface water in close proximity to ample vegetative cover along the shoreline provides habitat features critically important to many large mammals such as deer, bear, bobcat, raccoon, and ringtail cat. Many amphibians and some reptiles are particularly limited in distribution by the availability of surface water in close proximity to dense vegetation. Thus, the existing river and stream corridors provides excellent habitat for a variety of amphibians including foothill yellow-legged frog, western toad, slender salamander, Ensatina, California newt, and the arboreal salamander. Reptiles that may be found along the river corridor include the western pond turtle, several species of garter snakes, gopher snake, night snake, western whiptail and common kingsnake. These species rely heavily upon the existing shoreline vegetation, rocks and litter for escape cover when moving to and from the water, as well as for food and overwintering sites.

ENDANGERED, THREATENED, CANDIDATE SPECIES AND SPECIES OF SPECIAL MANAGEMENT CONCERN[1/]

The large area, highly complex topographic features, and corresponding high diversity of natural environments in the Auburn area provide suitable habitat for at least one Federally and state-listed endangered species, the bald eagle, the Federally-listed threatened valley elderberry longhorn beetle, and high potential for about 21 other species of various protected and administratively recognized categories of concern.

SPECIES ACCOUNTS

Bald Eagle FE, SE
<u>Haliaeetus leucocephalus</u>

Surveys for the endangered bald eagle were be conducted by Corps staff and include a summary of existing information on the occurrence of the species in the American River Watershed study area. Information from the surveys and literature review were included in the Corps biological assessment.

1/

Abbreviations for species status are as follows:

<u>Federal</u>
FE - Federal Endangered
FT - Federal Threatened
FC_1 - Federal Candidate, Category 1
FC_2 - Federal Candidate, Category 2
FP - Federal Fully Protected
<u>State</u>
CE - State Endangered
CT - State Threatened
CSC - DFG species of special concern
CCE - State Candidate for listing as endangered
CCT - State Candidate for listing as threatened
CFP - DFG "fully protected species"

Our limited information on bald eagle use within the watershed study area consists mostly of available field notes, personal communications and correspondence with local Audubon members or other birders. According to information from Ted Beedy, a local biologist and ornithologist, the bald eagle occurs as a winter visitor within the Watershed study area (pers. comm. 1989). The most consistent observations have been around Folsom Reservoir, Lake Natoma and, to a lesser extent, along the lower American River. David Johnson (local Audubon member, pers. comm. 1989) reports that bald eagles are not observed very frequently or consistently in the lower American River even during the winter, but that around Folsom Reservoir as many as 10-12 wintering bald eagles have been observed.

Sightings of bald eagles throughout the region likely occur in relatively isolated areas with minimal human disturbance and probably in or near the American and Sacramento Rivers and the larger drainages and riparian areas such as Fisherman's Lake, Dry Creek or the Fremont Weir where prey such as water birds, shore birds, or dead or dying fish could be easily located by a foraging eagle.

Although there are no recent reports of bald eagles nesting in the watershed study area, Detrich (pers. comm. 1986) reports that bald eagles historically nested along the Sacramento River near Sacramento during the Gold Rush era. Therefore, at least during and prior to this period, it is reasonable to presume that Bald eagles historically nested all along the Sacramento and American rivers and many of the major stream corridors draining the eastern portions of the study area.

The California Winter Bald Eagle Surveys 1979-1982 (Detrich 1981 and 1982) and 1989 (Nixon, 1989) do not include the lowland portions of the watershed in the sites reported for wintering bald eagles. However, the surveys did include Folsom Lake where the numbers of eagles reported ranged from one to seven during the 1979-1982 winter surveys. Three adults and one juvenile were reported at Folsom Lake during the 1989 winter survey. Incidental sightings along the lower American River by other observers may have included some of the Folsom birds foraging down the river (Beedy, pers. comm. 1989, American River Committee 1988).

Swainson's Hawk CT
Buteo swainsoni

Both foraging and nesting habitat for Swainsons hawk exists throughout the valley portions of the American River Watershed study area up to and including the Lake Natoma and Folsom Reservoir areas. Suitable habitat in the Auburn area however, appears to be greatly limited by the steep terrain and only diffuse availability of large grasslands suitable for foraging. Locally high levels of human activities in many of the areas of level terrain and grasslands also may limit suitability for this species in the Auburn area. Consequently, it appears that only a few sites in the Auburn portion of the study offer suitable habitat for Swainson's hawk, mainly in areas of more level terrain with large expanses of grassland on the upper portions of the canyons.

Bank Swallow CT
Riparia riparia

The river and stream corridors in the Auburn area do not offer bank conditions suitable for the bank swallow. Sand bars and cut banks typical of a meandering valley stream/river are not a common feature of steep canyon portions of the Auburn area. This is a consequence of the steep canyon hydrology, relatively narrow stream channel conditions, and much reduced meander dynamics of the river within the canyons and ravines. Steep cut-bank habitat for the bank swallow is just not available in the Auburn area.

California Spotted Owl FC2
Strix occidentalis occidentalis

The spotted owl is found in extensive stands of mature and "old-growth" forests throughout mountainous regions of the American west. Timber harvest has resulted in extensive loss of spotted owl habitat. In July 1990, the U.S. Fish and Wildlife Service declared as threatened the northern subspecies (S. o. caurina), which occurs in northwestern California, Oregon, and Washington. The so-called Mexican subspecies (S. o. lucida), which occurs in Arizona, New Mexico, and Colorado, was the subject of a recent petition to the Service requesting consideration for threatened status. The California subspecies (S. o. occidentalis), which occurs in the Sierra Nevada range and mountainous areas of southern California, is currently listed as a Category 2 candidate.

Breeding habitat for spotted owls usually occurs in multi-storied stands of large coniferous trees. These stands typically exhibit considerable decadence, which may provide owl nesting cavities and habitat for the small mammals which are the spotted owl's primary prey. Hardwoods are often present as a component in foraging habitat.

Research is currently underway on the status of the California spotted owl. U.S. Forest Service and University of California researchers have confirmed the presence of spotted owls in the American River watershed. Monitoring of radio-telemetered owls during autumn and winter months has revealed downslope migration to winter ranges as low as 885 feet elevation (average minimums of 1900 feet) in the Auburn/Placerville area (Laymon 1989). Although the birds winter in pine-oak woodlands in this area, the key components of winter habitat remain poorly defined. Urbanization, logging, and firewood cutting may be affecting this wintering habitat. The proposed flood control dam could adversely affect owl use of the Auburn Canyon area since the occurrence of wintering owls has been documented at elevations below the maximum flood depth of the dry dam.

Snowy Plover FC2
Charadrius alexandrinus nivosus

This rare species is considered a candidate for endangered or threatened listing under the Endangered Species Act because of the recent dramatic decline in numbers and range. This bird typically is found along large sandy beaches and flats in coastal areas and inland flats. It may occur along some of the larger sandy beaches and flats in the lower American River and Natomas areas, but probably not in the Auburn Canyon area.

Tricolored Blackbird FC2
Agelaius tricolor

This year-round resident songbird once was common and numerous throughout the Central Valley and the coastal areas from Sonoma County south. The species is a Category 2 candidate for Federal listing as endangered or threatened under the Endangered Species Act because of dramatic declines in range and numbers. In the Auburn Canyon area, suitable habitats are highly limited to a few isolated freshwater marshes and brushy riparian thickets along the river or side drainages. These areas probably provide only limited habitat because of their small size and lack of large areas of adjoining pasture land. The most suitable area for the species in the Auburn study area appears to be the open grasslands and pastures well above the river canyon near the town of Cool.

Black Shouldered Kite CFP
<u>Elanus caeruleus</u>

This fully protected raptor is a year-round resident throughout the coastal and valley lowlands throughout much of California. It seems particularly partial to agricultural areas or open grasslands and pastures. The Auburn Canyon area offers very little in the way of suitable habitat for this species because of the steep canyon slopes covered with dense woodland, forest or chaparral habitat. Like the tricolored blackbird, the most likely area for this species is the grassland and pasture areas near the town of Cool.

Red legged frog FC2, CSC
<u>Rana aurora</u>

At one time, this species was the common frog of the Central Valley wetlands, ponds and waterways. It historically occurred in a wide variety of settings including humid forests, woodlands, grasslands and streamsides, especially where emergent and streamside vegetation provide cover (Stebbins 1985).

Intensive collecting for frog legs during the late 1800's and early 1900's undoubtedly contributed to its decline in the Central Valley. The introduced bullfrog also has had a major effect on the distribution of the species. The dramatic reductions in range and abundance of this frog prompted the U.S. Fish and Wildlife Service to place it under review (54 FR 554) for possible listing under the Endangered Species Act of 1973, as amended. It is also a species of concern to the California Department of Fish and Game because of its greatly reduced range.

Potential habitat for the red legged frog occurs throughout the lowland portions of the watershed study area and up to and including wetland habitat within the Auburn area. Potential habitat in the Auburn area would include backwater areas and isolated permanent and seasonal ponds with emergent vegetation, as well as any of the more shaded and isolated ponds, canals and drainages (permanent or seasonal) within the canyon region. Sites of particular potential include those that support emergent vegetation and lack bullfrogs or other large aquatic predators. Although agricultural drainage canals, sloughs and channels of the region may offer some suitable habitat for this species, they may be of low potential because of frequent, periodic clearing and dredging. Irrigation ditches and channels may also offer potential habitat, although the typically high flow conditions may reduce the suitability for this frog.

Foothill Yellow Legged Frog CSC
Rana boylei

This species is a frog of woodland or forest streams, springs and rivers where it typically occupies the margins and immediate vicinity of permanent water. Rocky and/or cobbly bottoms and woody litter seem particularly important as cover when disturbed. However, mud bottoms also are used. During the summer as the smaller streams dry, individuals may congregate in considerable numbers around whatever semipermanent pools may remain (Stebbins 1985, Wright and Wright 1975).

In the Auburn area, most of the unnamed side drainages and the multitude of larger tributaries such as Shirttail Creek, Owl Creek, and Canyon Creek appear to provide extensive areas of suitable habitat for this species. Several occurrences were noted during our surveys of the canyon area including sites near the mouths of Slaughter Ravine, Live Oak Canyon, and Squaw Gulch.

Valley Elderberry Longhorn Beetle FT
Desmocerus dimorphus californicus

As part of the American River Watershed Investigation the Service submitted a report to the Corps on the occurrence and inferred potential distribution of elderberry shrubs (Sambucus spp.) in the Auburn Canyon area (exclusive of areas around Lake Natoma and Folsom Reservoir) (USFWS, 1989). Reconnaissance level surveys were made for the valley elderberry shrubs and evidence of valley elderberry longhorn beetles at accessible sites along both forks of the river. A series of maps were then prepared describing known occurrence and inferred potential distribution of elderberry shrubs. Relative abundance of elderberry shrubs was rated as low, medium or high.

The Corps conducted similar surveys for the Lake Natoma and Folsom Reservoir areas independently. Information obtained in these surveys and reports will be the basis for the Corps' biological assessment to meet requirements of the Endangered Species Act.

Elderberry shrubs were diffusely distributed along the main river corridor, typically occurring on higher sandy flats and alluvial terraces. Shrubs and young plants were observed from the highest elevation inundation point on the river (1135 feet) and at most locations downstream to near the proposed dam site. Individual plants and clumps of plants occurred primarily in association with the sandy alluvia of riverine or stream drainages. Although elderberry plants rarely were observed on the upper drainage slopes, they definitely can occur well above the riparian zone.

Brief examination of selected stems failed to show evidence of emergence holes, however larvae have been confirmed in plants in this general area. Until additional information is known about the elevational and ecological tolerances of the beetle (both larvae and adults) it should be presumed that bushes in the Auburn study area offer suitable habitat for the species.

Yate's Snail FC2
Ammonitella yatesi

This cave dwelling snail is known only from limestone and dolomite caves and under "moss laden" limestone ledges and non-calcareous rock talus within the Mother Lode region of the Sierra Nevada foothills. Only a few locations have been recorded in Calaveras, El Dorado, and Fresno counties (Pilsbry 1939, Smith 1957) at elevations ranging from 2000 to 3000 feet elevation.

Although the recorded elevations for this species are above the anticipated inundation zone for the study, the presence of seemingly suitable limestone and dolomite outcrops in the Middle Fork canyon may offer opportunities for this species. Although the Cool Cave area has been extensively quarried, a number of adjoining areas have not been extensively altered and should be carefully surveyed. This species may also occur within areas that may be affected directly or indirectly (growth inducement or accommodation) if road access is improved by widening or rerouting any of the main roads in the region.

El Dorado Morning Glory CE, FC2
alystegia stebbinsii

This perennial herb of the morning glory family typically occurs in dry, open chaparral or open oak scrub habitats on soils derived from Jurassic gabbro parent materials at elevations between 800-1600 feet. It may also occur on soils derived from ultramafic parent materials such as serpentine. Several areas of suitable soils/parent materials occur in the Auburn Canyon area primarily in areas covered by chaparral or open oak woodland or rocky grassland. Plants also may occur within areas that may be affected directly or indirectly (growth inducement or accommodation) if road access is improved by widening or rerouting any of the main roads in the region.

References: Brummit 1974, Stebbins, G.L. 1977.

Pine Hill Ceanothus CSC, FC2
Ceanothus roderickii

This perennial shrub of the buckthorn family occupies habitats similar to those of the El Dorado morning glory; dry, open chaparral, and oak scrub habitats with often rocky soils derived from Jurassic gabbro or other ultramafic parent materials including serpentine. In addition, this woody shrub may also be found in isolated stands of ponderosa pine on these same soils.

Plants typically occur in microsites that lack dense grass or woody vegetation.

References: Boyd 1985; Dibble 1979; Knight 1968.

Pine Hill Flannel Bush CSC FC2
Fremontodendron decumbens

This woody shrub of the cacao family occupies habitats similar to those of the El Dorado morning glory and Pine Hill Ceanothus: dry, open chaparral, ponderosa pine and oak scrub habitats with often rocky soils derived from Jurassic gabbro or other ultramafic parent materials including serpentine. This woody shrub may benefit from periodic natural or controlled fires (Boyd 1985). Plants typically occur in microsites that are rocky and lack dense grass or woody vegetation.

References: Boyd 1985; Lloyd 1965; Stebbins, G.L. 1977.

El Dorado Bed Straw CSC, FC2
Galium californicum
subsp. sierrae

This perennial herb of the Madder or Coffee family occurs in similar habitats as the Pine Hill ceanothus and flannel bush, and the El Dorado morning glory; open, dry chaparral, oak/pine woodland, on olivine schist and/or Jurassic gabbro derived soils. It may also occur on other unusual soils such as serpentine or limestone and on more mesic north facing slopes. Plants also may occur within areas that may be affected directly or indirectly (growth inducement or accommodation) if road access is improved by widening or rerouting any of the main roads in the region.

References: Dempster and Stebbins 1968, Dempster 1977.

Bogg's Lake Hedge-Hyssop CE, FC2
Gratiola heterosepala

The proposed Auburn flood control facility occurs well above the known range for this species (0-300 feet elevation). In addition, the proposed reservoir area and surrounding steep canyons provide little opportunity for the vernal pools and seasonal wetlands that this species requires.

Layne's Butterweed CSC FC2
Senecio layneae

This perennial herb of the sunflower family occurs in similar habitats as the Pine Hill ceanothus and flannel bush, and the El Dorado morning glory: open, dry chaparral, oak/pine woodland, on olivine schist and/or Jurassic gabbro derived soils. It may also occur in grasslands and on other unusual soils such as serpentine.

References: Boyd 1985, Gray 1884, Greene 1883, Niehaus 1977a.

Red Hills Soaproot FC2
Chlorogalum grandiflorum

This perennial herb of the lily family occurs in similar habitats as the Pine Hill ceanothus and flannel bush, and the El Dorado morning glory: open, dry chaparral, oak/pine woodland, on olivine schist and/or Jurassic gabbro derived soils. It typically occurs in grassy openings and may also occur on other unusual soils such as serpentine. Plants also may occur within areas that may be affected directly or indirectly (growth inducement or accommodation) if road access is improved by widening or rerouting any of the main roads in the region.

References: Biosystems 1984; Hoover 1938, 1940; Niehaus 1977b.

Bisbee Peak Rush-Rose FC2
Helianthemum suffrutescens

This perennial sub-shrub occurs in similar habitats as the Pine Hill ceanothus and flannel bush, and the El Dorado morning glory: open, dry chaparral, oak/pine woodland, on olivine schist and/or Jurassic gabbro derived soils. It may also occur on other unusual soils such as serpentine.

References: Munz and Keck 1973.

El Dorado County Mule Ear FC2
Wyethia reticulata

This perennial broad-leaved herb occurs in similar habitats as the Pine Hill ceanothus and flannel bush, and the El Dorado morning glory: open, dry chaparral, oak/pine woodland, on olivine schist and/or Jurassic gabbro derived soils. It may also occur on other unusual soils such as serpentine.

References: Baad 1979, Greene 1884, Weber 1946.

Stebbins' Phacelia FC2
<u>Phacelia stebbinsii</u>

This annual herb grows on rocky soils, among rocks and rubble on metamorphic rock benches, mostly in association with oak/pine woodland. Plants typically flower May to July and should be identified during the flowering period. The species occurs mostly on northern exposures at elevations of 3000-4800 feet, well above the anticipated inundation zone of the proposed Auburn flood control dam. Consequently this species is not likely to be found in the project inundation area. However, plants may occur within areas that may be affected by the project directly or indirectly (growth inducement or accommodation) if road access is improved by widening or rerouting any of the main roads.

References: Constance and Heckard 1970, Heckard 1979.

Pleasant Valley Mariposa FC1
<u>Calochortus clavatus</u>
var. <u>avius</u>

This perennial herb of the lily family occurs in rocky outcroppings in semi-open areas associated with pines, oaks, and incense cedar. It may also be found on volcanic soils, reddish soils, slate outcroppings, and Josephine silt loams and in association with mountain misery. The known elevational range is 2500-5300 feet, well above the probable inundation areas for the project. There are some taxonomic questions regarding the distinctiveness of this variety.

References: Fiedler 1985a,b; 1986, 1987; Overton 1981; Ownbey 1940.

Saw-toothed Lewisia --, FC2
<u>Lewisia serrata</u>

This perennial fleshy leaved herb occurs in oak-pine woodland and open conifer forest on steep rock faces and ledges, and above waterfalls. The known elevations recorded are from 3000-4700 feet, well above the potential inundation zone for the project. However, plants may occur within areas that may be affected by the project directly or indirectly (growth inducement or accommodation) if road access is improved by widening or rerouting any of the main roads.

Nissenan Manzanita --, CCT
<u>Arctostaphylos nissenana</u>

This perennial chaparral shrub is known from the Middle Fork canyon (near the North Fork of the Middle Fork) above the potential inundation area. Known elevations are 1200-3400 feet along exposed ridges and slopes. Although not known from the potential inundation area, the plants could be affected by the project directly or indirectly (growth inducement or accommodation) if road access is improved by widening or rerouting any of the main roads.

References: Howell 1936, Knight 1966, McMinn 1939, Merriam 1918.

WITHOUT THE PROJECT

MAJOR ASSUMPTIONS (based on Corps of Engineers guidance of May 17, 1990 and April 1991 Draft Feasibility/Environmental Impact Statement).

Under the without-project, Federal government agencies (Corps or USBR) would not participate in flood control efforts. The USBR's multipurpose Auburn Dam would not be constructed, and the Auburn Dam would be deauthorized.

VEGETATION

Under without-project conditions, vegetation within the project area would not change significantly during the 100-year period of analysis. Lands within the project area would remain in Federal ownership, in State ownership or a combination Federal/State program. The lands would be administered and managed similarly as they are today by the California Department of Parks and Recreation.

Existing communities adjacent to the project area (Auburn, Weimar, Colfax, and Foresthill on the North Fork; and Cool, Greenwood, Garden Valley, Georgetown, and Volcanoville on the Middle Fork) would expand, and moderate development up to the project boundaries would occur. However, without improved access to these areas (Highway 49) and improved water supply, residential and commercial development of the area would occur at a slower rate. Development nearer to Highway 50 in the Placerville, Lotus, Coloma areas would occur at a faster rate due to better access roads and shorter commute distance to Sacramento.

Even without large-scale development of the area, adverse effects to existing vegetation would occur due to continued moderate changes. Impacts include increased sediment load, increased runoff of contaminants, and increased permitted and unpermitted public use of lands (mountain top/gentle slope foothill woodland and forest cover types). The impacts, however, would be subtle and individually more difficult to see.

FISH

North Fork

There would be a decline in habitat suitability for both smallmouth bass and rainbow trout and other fish species in the North Fork without the project. Habitat conditions for trout are already marginal in the summer and conditions would worsen. Increased water diversions, construction activities, public use, mining and other activities resulting from development would increase sediment loading, decrease pool depths, reduce pool to riffle ratios, reduce instream cover, increase turbidity, increase temperature, and increase water level fluctuation. These changes would be subtle and occur over several years. The rate of degradation would depend on rate and type of development. There are no specific management plans to mitigate these impacts or enhance the fishery in place. Increase in water temperature, turbidity and sediment deposition would occur in the earliest stages and be more easily detected.

Because conditions are already marginal for trout, trout populations would likely decline much earlier than smallmouth bass and other species. Increased water diversions represent the greatest threat and potential adverse impact on the North Fork. Since flows are basically uncontrolled, few options remain for ensuring minimum summer flows. Thus, any additional water diversions during low flow periods or in dry and critical years would have major adverse effects on instream habitat and fish populations.

Additional mountain community diversions in the upper drainages could have a major adverse effect on the fish resources of the North Fork. Overall, we expect a measurable reduction in habitat suitability for smallmouth bass and trout and other species.

Middle Fork

Habitat quality for smallmouth bass and rainbow trout and other fish in the Middle Fork would also decline in the future. Development of lands adjacent to the Middle Fork would bring increased water diversion, construction activity, public use, mining, and other activities which would adversely impact the instream habitat and fish populations. However, there are more options available with the Middle Fork than with the North Fork due to the regulations provided with the upstream reservoirs. Water diversion impacts would be reduced compared to the North Fork because of the existing minimum instream flow requirements pursuant to Placer County Water Agency's FERC license. Additional mitigative measures may be possible to offset future water diversions. Other adverse impacts, e.g., increased sediment loading and increased turbidity might not be easily mitigable by upstream projects. The impacts, however, would be significant.

WILDLIFE

Wildlife resources in the project area would not change significantly without-the-project. Since little change in vegetation and management of the area would occur, wildlife inhabiting the project area would continue as under existing conditions.
However, wildlife species in areas outside the project area would be adversely impacted by development of the region. The impact would be significant, but, would occur at a reduced rate without the additional water supply and improvement of Highway 49. Local communities adjacent to the Auburn Canyons would grow slowly with the emphasis on rural residential homes and few large subdivision or commercial buildings.

ENDANGERED SPECIES

Conditions for listed, candidate species and other species of concern within the project area are not expected to change significantly without the project. Little change is expected in vegetation management within the area. However, outside the publicly held lands, habitat losses would accrue as urban growth in surrounding communities continues. Losses to urbanization would primarily consist of rural single family homes on small acreages, with little additional growth in subdivisions or large commercial developments.

Habitat conditions for riparian associated listed and candidate species likely would continue to decline as a result of increased water diversions, poorly controlled public use, and mining activities.

WITH THE PROJECT

200-Year Dry Dam Alternative

Vegetation

The impact assessment provided herein is based on consideration of four possible long term impact scenarios resulting from dam construction, reservoir operation, Ponderosa Way relocation and Highway 49 relocation. The impacts with these scenarios (over the life of the project) range from no loss of habitat to total loss of habitat. Since considerable direct impacts would occur with construction of the dam, Ponderosa Way and Highway 49, the no impact scenario was dropped from consideration. Preliminary analysis of operation effects on soil and vegetation and evidence from past flooding events led us to believe that the total loss of cover may not necessarily occur soon after project operations begin. However, we were uncertain about the end result of cumulative impacts occurring over the 100-year period. Thus, the focus of our analysis was on two intermediate impact scenarios. The analysis examines direct impacts associated with the dam, Ponderosa Way and Highway 49 construction and operational impacts that will occur with future flood events. The analysis was separated into two parts. Direct impacts from the dam construction, aggregate processing, Ponderosa Way and Highway 49 relocation were analyzed in one HEP application. These impacts were more readily defined in terms of location, timing and severity. A separate HEP analysis was done for the operational impacts because of the complexity in defining impacts due to inundation, soil loss, sedimentation and other factors. Lack of adequate data and similar historical experience posed difficult hurdles in developing the expected timing and severity of impacts due to flooding events.

In our February 1991 draft CAR (Pg 90 et. al.,) we included discussion on indirect impacts of growth inducement due to State Highway 49 relocation. At that time the project design included a road alignment that greatly decreased driving time and access into the cool, Pilot Hill, Garden Valley and Georgetown areas. Following our report, the Corps changed the Highway 49 relocation design and proposed an in-kind elevated bridge replacement that according to the Corps would not be growth inducing. To further complicate expected futures analysis, we understand that the State of California proposes to conduct a route adoption study that would look at improving the State Highway 49 relocation to higher standards than proposed by the Corps later in the planning process. This, in effect, constrains the Service's analysis since we are not impowered in the State planning process. Basically, it divorces the Service from assessing and recommending mitigative measures for the likely growth inducing, improved, Highway 49 across the Auburn Canyon. Reluctantly, we have dropped the indirect impact assessment for this report.

Predicting the short- and long-term and direct and indirect environmental effects of public projects is not only necessary for insuring wise public policy and management decisions, it is legally required pursuant to State and Federal law (The National Environmental Policy Act, Fish and Wildlife Coordination Act, California Environmental Quality Act, and State and Federal Endangered Species Acts). Evaluating the potential impacts on biological resources of large scale public projects, such as the extensive American River Watershed project, requires long term predictions of very complex ecological systems, systems that clearly are many orders more complex than economic systems, and yet economists, although noted for their many assumptions and use of "soft" data, are heavily relied upon for public policy decisions.

One of the most frequently used analytical procedures to predict long-term changes in fish and wildlife habitat is to develop a predictive model. Such models can be very simple, based largely on the knowledge and experience of a professional biologist and amount to nothing more than "best guesses". Or they can be highly complex computer models that require extensive empirical data and a complicated analytical framework (USFWS 1980, Verner et al. 1986). Impact analyses for most public projects frequently fall somewhere in between, usually closer to the "best guess" end of the range.

In the context of the American River Watershed Investigation, the principal function of impact prediction at this time is to provide Congress, the Corps of Engineers, local sponsors and the public a reasonable projection and quantification of the likely ecological impacts and mitigation costs of various project features. The main project feature and principal focus of impact assessment in the Auburn area is a unique dry dam flood control facility, and its potential impacts on the plant and animal communities in the North and Middle Fork American River Canyons. The typical impact assessment approach requires two critical parts: 1) an assessment of existing habitat conditions; and 2) a projection (hypothesis or speculation) of future habitat conditions with and without the project (USFWS 1980). The difference in impacts to the fish and wildlife resources with-and without-the-project is presumed to represent the effects of the project and the magnitude of impacts requiring mitigation.

Predictive models for assessing the impacts of flood control reservoirs have only recently been developed (Whitlow and Harris 1979, Brody and Pendleton 1987, Pearlstine et al. 1985). These models typically take the form of predicting vegetation changes as an indication of impacts to wildlife and fish. But, as noted by Whitlow and Harris (1979) few of the models have been tested and refined sufficiently to assign confidence limits. These same fundamental limitations apply to virtually all wildlife and ecological models in use today (Verner et al. 1984).

The accuracy and reliability of impact predictions is profoundly affected by the level of detail available for each of the analytical parts noted above. Some of the most critical functional variables relative to the vegetation and habitat conditions include reliable estimates of plant species tolerance to inundation, demographics of the various plant populations found in the area (at least for the dominant trees and shrubs), reproductive requirements, and response rates. Virtually all of these parameters not only vary extensively within the study area because of the immense area involved, but, most of the life history data are simply not available (Appendix C). The critical absence of demographic and life history information for plants has been repeatedly noted in the ecological literature.

Based on review of existing information on ecological modeling and studies for flood control facilities (refer to Appendix C), methods and models for evaluating the biological impacts of dry dams are simply not available. A suitable model framework for a dry dam not only requires many of the same biological and other data used in the above typical flood control reservoir and ecological models, but, because of its substantially different operation and highly intermittent inundation regime, it also requires additional types of data and an altogether new modeling approach.

Clearly, a predictive model for the dry dam is not available and development of such a model has not been possible because of the time constraints and funding for the project. These same constraints have also limited the Service's ability to provide reliable baseline biological and other data necessary to allow projections of impacts. Based on review of existing dry dam facilities in California and elsewhere (Appendix C), we find that comparative data on similar facilities in California is not available and most comparisons are severely limited because of substantial differences in scale of the facilities, the regional ecology and hydrologic regime. Regionally distinct facilities such as greentree facilities in the mid-west and southeast, and the Central Valley bypass system, although affording limited impact data, are largely not comparable because of gross differences, regional ecological contexts, and hydrological regimes. Furthermore, review of existing published and other information on flood tolerance of virtually all of the plant taxa in the Auburn area, even the dominant tree and shrub species, is inadequate for reliable predictions. Limited funding and the resulting short time period allocated for habitat sampling did not permit collection of critical data on population structure and site to site variation for the tree and shrub dominants in the study area. And, as mentioned above, life history information for virtually all of the component tree and shrub species are not available. Consequently, any prediction of future conditions will be largely based on professional judgements and experience.

The preferred Service approach in instances where there is a lack of critical information upon which to base a quantitative estimate of impact is to err in favor of protecting fish and wildlife resources and assume a worse case impact. A worse case scenario would assume that the design event (200-year or 400-year) occurs soon after the project is constructed and is continuous for a period of several weeks and all habitat inundated is permanently lost and subsequent events prevent any habitat recovery. As stated earlier, based on preliminary analysis this seems an unlikely scenario. Both the Department of Fish and Game and the Service felt that evaluating a linear decline of habitat values with total loss occuring over the 100-

year project life would be useful information and should be examined. We completed such an evaluation for both the 200-year and 400-year alternatives. Again, after further consideration, we do not believe the linear decline is the most likely scenario that would occur, thus we have dropped it from consideration and appended it for general perspective in this report (Appendix F). Based on results of the gradual decline scenarios and other limited information available, we believe that impacts would occur in a different manner than presented in the straight linear loss scenario (Appendix F). Preliminary data suggests that vegetation cover would respond in different ways based on the frequency, length and seasonality of inundation events. The extent of vegetation, wildlife habitat and wildlife population losses would depend on inundation event variables. Because storm events are typically cyclical, some recovery of vegetation, wildlife habitat and populations would be expected during non-flooding periods. Vegetative recovery would gradually be reduced however as erosion, soil loss and slope stability problems reduced suitable acreage capable of supporting existing vegetative communities. This approach constitutes our selected impact scenario.

SELECTED IMPACT SCENARIO

Basis for Analysis

For this analysis, we relied on project information provided by the Corps of Engineers including their hydrologic, geologic and land use data, existing literature on habitat and wildlife in the Auburn Canyons, existing data developed by the Bureau of Reclamation for the authorized Auburn Dam project, information provided in a special vegetation impact report by McClellan Consultants and Dr. Andrew Leiser, and information gathered during our field studies.

We used this information to assess the direct project impacts that would result from activities such as gravel borrow, haul road construction, dam construction, Ponderosa Way, and Highway 49 relocation. These direct impacts are relatively easy to assess with some degree of confidence since they typically result in a clearly defined temporary or permanent loss of habitat acreage. The validity of direct impact assessment is primarily limited by the quality and quantity of project design information. We also used the information to assess the operational and land use change impacts. These are much more difficult to assess and validity of the assessment is greatly affected by the amount and type of supportive operational, local planning and biological data available for analysis. We relied on the Corps land use data to predict future with - and without - project conditions in the proposed mitigation area which lies along the South Fork American River within the watershed but outside the project area. Our land use analyis methodology is presented in Appendix E.

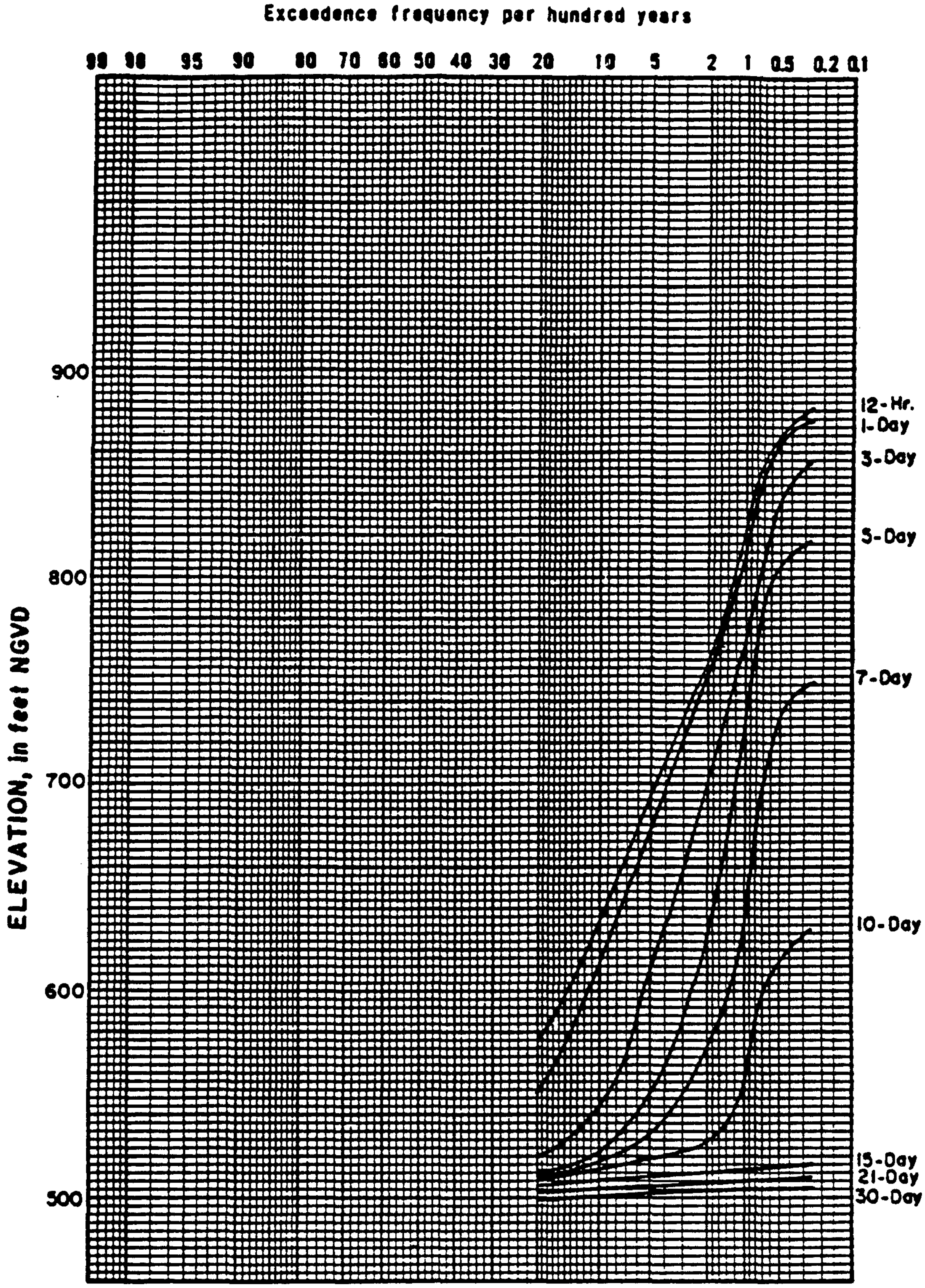
Development of the assessment methodology for the operational impacts took considerable effort. After review of available data, we concluded there were at least four important elements of information that would allow us to assess operational impacts with some degree of confidence. These four elements were 1) the Corps predicted inundation regime; 2) effects of the Auburn Coffer Dam operation on the geological character of the Auburn Canyons (soil and slope stability); 3) existing vegetation sensitivity to inundation; and 4) other physical effects of inundation on wildlife habitat and species in the Auburn Canyons.

PREDICTED INUNDATION REGIME

The Corps provided us with predicted elevation-frequency-duration probability data for the 200- and 400-year dry dam operations (Figures 15-16). These data predicted the amount of time water reached a given elevation for a series of 12 hours through 30 day events. The Corps also provided similar data representing seasonal occurrences, since the probability of inundation events changes greatly with each season. However, these probability data did not reflect probability of clustered recurring events, during a single season or over the life of the project, conditions which are more representative of regional weather patterns and more biologically meaningful.

Based on the Corps predicted data, we developed a series of tables that show frequency of 1 through 15 day inundation events in 5 elevation bands that range from 490 to 880 feet for the 200-year dry dam and 490 feet to 880 feet for the 400-year dry dam. We decided not to consider inundation above the 880 feet elevation because it was so infrequent.

Because the dry dam is designed to permit continual regulated flow through the dam, the duration of inundation would vary with volume, frequency and duration of storm events. Conceptually, then, for the unlikely 100 or 200 year events for each project alternative, the uppermost elevations would be under water for less than one day and lower elevations would experience inundation for perhaps as much as a month. Because the number of flood events varies with elevation it was necessary to devise a means of analyzing inundation durations relative to vegetation in specific elevation bands. This requires that some reasonable reference point be selected to represent the inundation duration for the entire band. Since the midpoint of a given band theoretically represents conditions halfway between the greatest duration and frequency of inundation and the lowest, the band midpoint was selected as a reasonable indication of the inundation-duration for each band for each flood event.

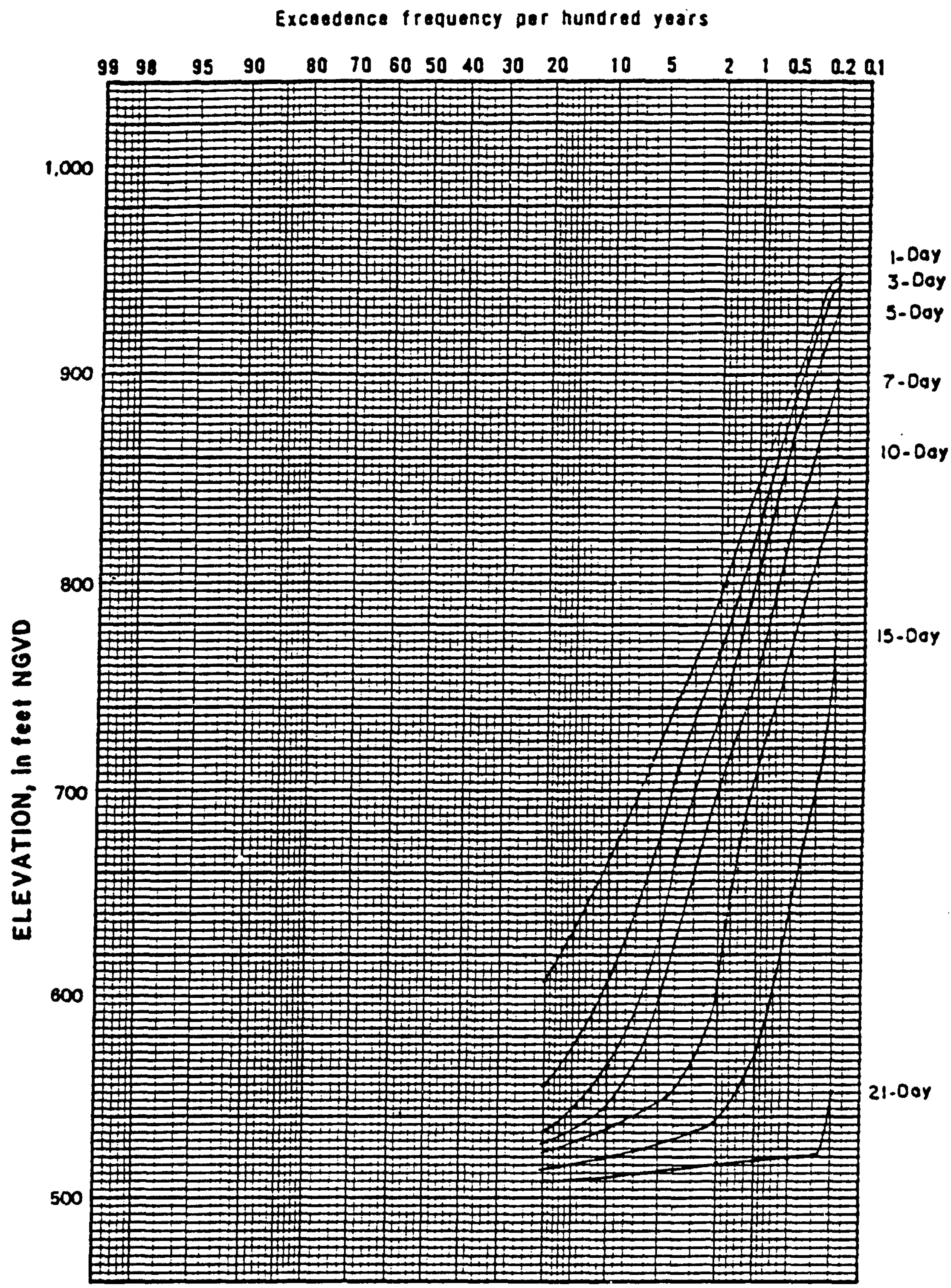


NOTES:
1. Dam located at River Mile 20.1 designed to control a 200-Yr. flood with 400,000 ac.-ft. of flood control space in Folsom Lake and a 115,000 cfs objective release.
2. Top of inactive pool - elevation 490.
3. Curves define the duration of time elevation is equalled or exceeded.

FIGURE 15

ELEVATION-FREQUENCY-DURATION
AUBURN DRY DAM ALTERNATIVE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO, DISTRICT



NOTES:

1. Dam located at River Mile 20.1 designed to control a 400-Yr. flood with 400,000 ac.-ft. of flood control space in Folsom Lake and a 115,000 cfs objective release.
2. Top of inactive pool - elevation 490.
3. Curves define the duration of time elevation is equalled or exceeded.

FIGURE 16

ELEVATION-FREQUENCY-DURATION
AUBURN DRY DAM ALTERNATIVE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO, DISTRICT

SOIL AND SLOPE STABILITY

Soil Erosion and Vegetation Loss Methodology

As stated in our earlier discussion on erosion and slope stability on page 39, high to extreme soil instability and erosion hazards exist for much of the canyon areas subject to inundation. Therefore, we concluded that the extent of soil erosion, slope failures and the resultant losses in vegetation cover could be substantial.

After examining aerial photographs of portions of the North and Middle Fork Canyons before and after the coffer dam operations, we concluded that the extent (acreage) of soil erosion, slope failure, and vegetation change could be delineated and quantified using the photographs. By comparing a large segment of the Canyons prior to the coffer dam (1970) with the same area immediately following the coffer dam failure (1986), vegetation change was assessed (Table 10). A similar approach was used by the Corps (1990c), in assessing slope stability and landslide volumes. Further details on our methodology are included in Appendix C.

MAJOR ASSUMPTIONS

Using this approach to quantify soil erosion, slope slippage, vegetation loss and change requires the following general assumptions:

1) The difference in conditions prior to the coffer dam and several months after the failure include some component of inundation effect and that portion can be separated from other effects and quantitatively determined.

2) The acreages of slide and erosion areas and the resulting vegetation units for a 4-mile segment of the Canyons, in this case from just upstream of the coffer dam to about a mile up the North and Middle forks, would be generally representative of the erosion and slide potentials for the entire 34 miles of canyon subject to inundation. Once again, the 34 miles reflects inundation of the 200-year scenario and does not account for the infrequent inundation of 40 miles that would occur with the 400-year scenario.

SOIL AND SLOPE STABILITY LOSS RESULTS

Comparing the pre- and post-coffer dam data, it was evident that significant increases in sliding and erosion occurred within the former coffer dam area. However, we reemphasize that most of the erosion and slippage changes noted in the canyon below 700' elevation were probably the result of the failure of the coffer dam and the rapid draw down of the water. We have compensated for these drawdown effects in our estimation of erosion losses attributable solely to inundation by using an assumed correction factor. There were significant increases in erosion faces and slide areas as well as covertypes indicative of sliding and slips (upland scrub, and thinly grass/ruderal covered slopes). In addition, there were indications of multiple slips and erosion from former slides that resulted in conversions of one erosion cover type to another. For example, several sites of upland scrub continued to erode becoming bare soil, as well as more open and grass covered.

Large areas of erosion and soil slippage associated with inundation and the coffer dam failure were evident from the aerial photographs in all bands except 800-900', and 900-1,135'. Soil slippage and erosion in these bands appeared to be primarily associated with road cuts and other construction activities and not translational slippage from below. In the 800'-900' band, there also appeared to be recovery of a few former eroded slopes. We assume this was the case because inundation induced sliding did not appear to have caused several of the specific erosion areas identified in this elevation zone.

There were significant losses in acreage of intact (uneroded) upland vegetation and conversions to eroded slopes and lower quality cover types indicative of soil slippage and slides (e.g. upland scrub, thinly covered grass slopes) in all zones below 800 feet. From the waterline to 600', 39.68 acres of former upland vegetation were lost or converted to erosion types of vegetation. Within the 600'-700' band, 37.19 acres were lost or converted. Within the 700'-800' elevation band, 6.92 acres were lost or converted to lower quality cover types. Changes in elevation bands above this level, although partially created by inundation induced sliding from below were not counted in our analysis because inundation did not actually reach above 715 feet. However, project related inundation will affect these elevations; presumably at the same rate as in the upper band in which measurements were taken. It is interesting to note that the bare soil/sand/rock/ cover type was the only one that increased in acreage in every band (Appendix B).

TABLE 10

ACREAGE CHANGES FOR INTACT UPLAND VEGETATION IN THE AMERICAN RIVER CANYON FOR A 4.05 MILE SEGMENT OF THE RIVER

Elevation Zone	Pre-Coffer Dam Intact Upland Vegetation.	Post-Coffer Dam Intact Upland Vegetation.	Net Difference Representing Losses to Upland Vegetation From Erosion	Net Difference with Correction Factor to Eliminate Scour Acreages	Net Erosion Rate Per Measured River Mile (÷4.05)	Net Erosion Rate Per Inundation Event
River to 600'	82.31 ac	42.63 ac	-39.68 ac	-3.97 ac (10%)	-.98 ac	-.49 ac[2]
600-700'	170.76	133.57	-37.19	-7.44 ac (20%)	-1.84 ac	-1.84 ac
700-800'	180.53	173.61	-6.92	-6.92 (100%)	-1.71 ac	-1.71 ac
800-900'	210.37	213.35	---[1]	---	---	---
900'+	453.45	448.27	---[1]	---	---	---

1 Losses (or gains) in these zones were unrelated to inundation since the water never reached these elevations.
2 Only 2 events were counted as inundating this zone.

VEGETATION LOSS FROM INUNDATION

Since few specific data on tolerance to inundation were available for virtually all of the woody plant species in the canyons, a number of assumptions were necessary to proceed with projecting inundation impacts on the vegetation.

MAJOR ASSUMPTIONS

1) In estimating loss of woody plants, no distinction is made between losses due to changes in soil nutrient or chemical conditions, plant growth, reduced seed production, chronic weakening or increased disease, toppling or windthrow, and reduced regeneration due to increased numbers of competing species more tolerant of inundation. There are no data distinguishing these various loss factors and any distinction would have required numerous additional assumptions for each one. Therefore, in the interest of simplicity, we lumped all of these factors and assumed that the mortality rates developed and discussed below, represented all of these causal mechanisms.

2) The response of the woody species was assumed to be uniform within each cover type based on the assumed tolerance of the dominants for that cover type. Selection and mapping of the cover types and their descriptions is provided in the existing condition report section. For example, it was assumed that the tolerance of dominant species such as interior live oak and Douglas fir, were representative of the specific cover types in which they were dominant.
3) Vegetation mortality rate for each cover type was assumed to be a uniform gradient of increasing survival with decreasing duration of inundation.

4) Mortality rates were assumed to differ seasonally, with lower mortality during winter and highest mortality during the late spring and early summer periods.

5) Specific expected mortality rates were based on the extremely limited published data (not subjective ratings) for the few species for which it was available from Walters et al., (1980 a,b), and Whitlow and Harris (1979). From these limited data, linear mortality regressions were developed.

Recognizing that these regressions 1) were based on highly limited field data; 2) differed from available subjective ratings in Walters et al. 1980 a,b and Whitlow and Harris 1979; 3) differed from recent limited observations and subjective judgements by McClelland and Leiser (1990); 4) assumed a linear relationship with inundation duration; 5) included no seasonal differences and thus, appeared to represent only spring-summer period mortality rates for these species; we felt that they probably were not reasonable predictors of the actual mortality that could be expected for the species or the vegetations represented. Therefore, a separate schedule of mortality rates was developed for each vegetation cover-type based on subjective interpolation of presumed mortality from the regressions and the available species specific subjective ratings in Walters et al. 1980a,b. The schedules also include assumptions regarding seasonal differences in inundation sensitivity (Appendix B).

OTHER PHYSICAL INUNDATION EFFECTS ON HABITAT AND SPECIES

Although we were not funded or given adequate time to collect field data on these other physical impacts, we are reasonably certain they would occur to some degree. These other impacts include loss of litter, duff, and other organic material covering the soil surface. All floatable materials would be carried to a new location and redeposited downslope or at some point downstream. The windrows along reservoir and stream banks are good examples of this effect. Terrestrial microbial organisms, invertebrates, insects above and below ground and in the organic top layer would be adversely affected and population recovery times remain unknown. Numerous terrestrial fauna that are dormant or in underground burrows, or relatively immobile and thus, unable to escape rising waters will be lost. It is clear that inundation will have a significant impact on the biological integrity of the affected zone. Habitat suitability variables in the HEP analysis were adjusted to account for these impacts. We were able to accomplish this by reducing average values of litter depth, organic material and other variable measures within the species models to reflect these inundation impacts. Methodology details for this element are explained in the HEP report (Appendix B).

Overall operation impact assessment was accomplished by integrating the information developed from each of the 4 elements of 1) predicted inundation regime; 2) effects of the Auburn Coffer Dam operation on the geological and vegetative character of the Auburn Canyons (soil and slope stability); 3) existing vegetation sensitivity to inundation; and 4) other physical effects of inundation on wildlife habitat and species in the Auburn Canyon, using an interlinked computer spreadsheet. For each inundation event of one day or longer an increment of soil slippage and erosion loss (in acres) was allocated. Then, based on the remaining, intact acreages of each vegetation cover type at specific target years, habitat suitability values were modified based on the number of inundation events, their durations and seasons of occurrence. From these data, average annual habitat units were tracked over the 108 year period of analysis for the without and with-project conditions. Specific details regarding the spreadsheets and interlinking of the data are provided in the HEP report.

Construction impacts associated with relocation of Ponderosa Way would result in the loss of north slope oak woodland (1.6 acres), south slope oak woodland (1.3 acres), Chaparral (.9 acres), and grassland (.1 acres) (Table 11).

Construction impacts associated with relocation of Highway 49 at the rivermile-23 site would result in the loss of north slope oak woodland (10.7 acres), south slope oak woodland (8.3 acres), grassland (1.9 acres), and conifer forest (6 acres) (Table 11).

Construction impacts associated with work at and near to the dam site such as foundation work, regarding, filling of prior Bureau abutment sites and new road construction would result in the loss of north slope oak woodland (25.3 acres), south slope oak woodland (5.4 acres), grassland (131.4 acres), and montane riverine cover (25.1 acres) (Table 11).

Construction impacts associated with aggregate removal, from the Cool Quarry and transport to the dam site and processing would result in the loss of north slope oak woodland (3 acres), south slope oak woodland (6.2 acres), grassland (24.1 acres) and chaparral (3.1 acres) (Table 11).

Inundation impacts from operation of the 200-year level Dry Dam would result in the gradual loss (-) of north slope oak woodland (-326 acres), south slope oak woodland (-305 acres), gain (+) of savanna grassland (+234 acres), loss of chaparral (-41 acres), conifer forest (-36 acres), montane riverine (-447 acres), and gain of rocky/ruderal (+742 acres), and upland scrub (+180 acres) Table 12). Total wildlife cover acreage losses and gains due to Ponderosa Way relocation, Highway 49 relocation, dam site construction, aggregate handling, and Dry Dam operations are shown in Table 13. Figure 17 shows an approximated without-with project habitat comparison.

Table 11. 200-Year Dry Dam Alternative - Highway 49 Relocation and Dam Construction Impacts

Upland	Ponderosa Way	HWY 49	Dam Site	Aggregate	Total
North Slope Oak	1.6	10.7	25.3	3.0	40.6
South Slope Oak	1.3	8.3	5.4	6.2	21.2
Grassland	0.1	1.9	131.4	24.1	157.5
Pine Forest	0.0	6.0	0.0	0.0	6.0
Chaparral	0.9	0.0	0.0	3.1	4.0
Upland Scrub	0.0	0.0	0.0	0.0	0.0
Rocky/Ruderal	0.0	0.0	0.0	0.0	0.0
Subtotal	3.9	26.9	162.1	36.4	229.3
Wetland					
Montane Riparian	0.0	0.0	25.1	0.0	25.1
Subtotal	0.0	0.0	25.1	0.0	25.1
Total	3.9	26.9	187.2	36.4	254.4

Table 12. 200-Year Dry Dam Alternative - Wildlife Cover Acreage Operation Loss Summary (Without-With Project) 2002-2102

Cover Type	Without Project (Acres)	With Project (Acres)	Loss* (-) Gain (+) (Acres)
North Slope Oak	901	575	-326
South Slope Oak	892	587	-305
Grassland	97	331	+234
Pine Forest	135	99	-36
Chaparral	115	74	-41
Upland Scrub	0	180	+180
Rocky/Ruderal	133	875	+742
Subtotal	2,273	2,721	-708 +1156
Wetland			
Montane Riparian	862	415	-447
Subtotal	862	415	-447
Total	3,135	3,135	3,135

Total Wildlife Cover Acreage Loss = - 1155

*Loss represents the difference comparing without and with project acreages remaining at the end of project life (100 years). Loss is due to operation (inundation effects only).

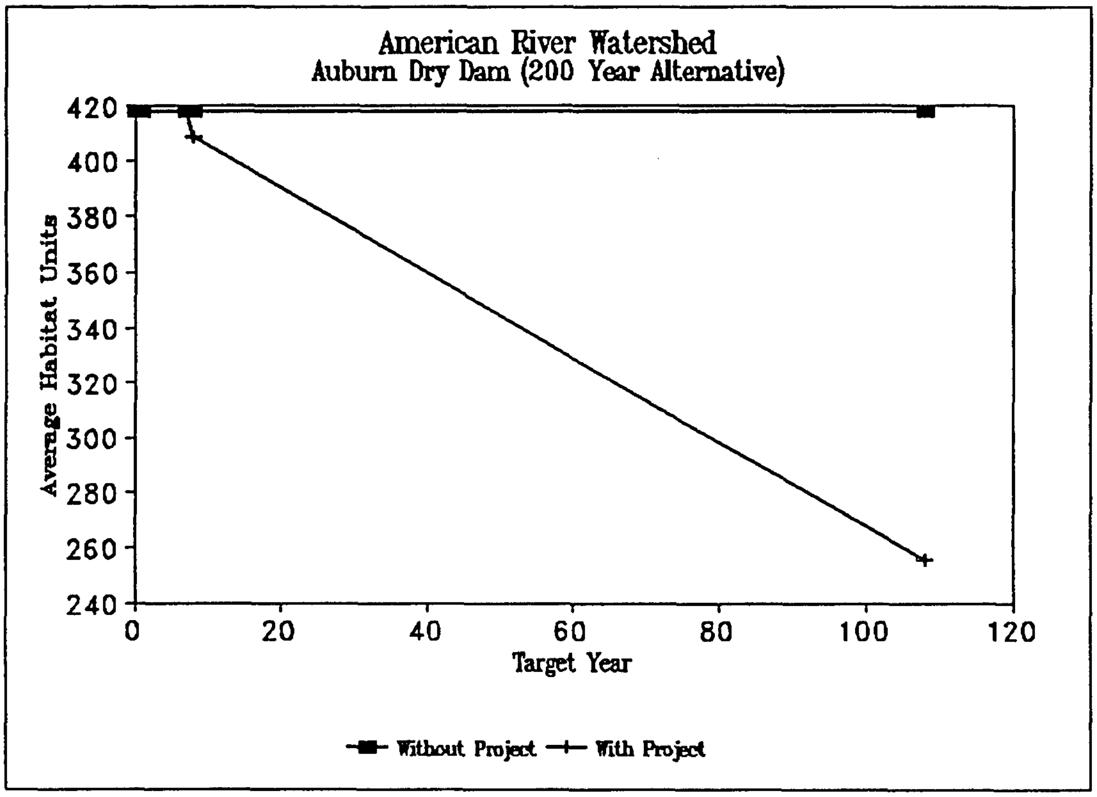


Figure 17 Changes in Average Habitat Units under With- and Without- Project Scenarios - 200 Year Dry Dam Alternative. The area between the curves represents the project induced losses requiring compensation.

Table 13. 200-Year Dry Dam Alternative - Wildlife Cover Acreage Losses (with Project *) Construction, and Operation Impacts 1994-2102

Upland	Construction (Acres)	Operation (Acres)	Loss (-) Gain (+) (Acres)
North Slope Oak	-40.6	-326	-366.6
South Slope Oak	-21.2	-305	-326.2
Grassland	-157.5	+234	-157.5
Pine Forest	-6.0	-36	+234.0
Chaparral	-4.0	-41	-42.0
Upland Scrub	-0.0	+180	-45.0
Rocky/Ruderal	0.0	+742	+742.0
Subtotal Loss	-229.3	-708	-937.3
Gain	0.0	+1156	+1156.0
Wetland			
Montane Riparian	-25.1	-447	-472.1
Subtotal Loss	-25.1	-447	-472.1
Total Loss	-254.4	-1155	

Total Wildlife Cover Acreage Loss = -1409.4

*With project losses represent the difference comparing with and without project acreages remaining at the end of project analysis period (108 years). Total loss reflects wildlife cover acreages converted into on-wildlife value cover.

FISH

With the project, about 17 miles of the stream habitat in each of the Middle and North Fork American Rivers, including Lake Clementine, would be completely submerged for as much as two weeks during storm events. Temporary inundation would have moderate adverse impact on fish resources over existing and without-project conditions, except for the loss of 447 acres of wetlands, because (1) inundation presently occurs during flood flows, and (2) this condition would be only temporary. The loss of 447 acres of wetland habitat due to temporary submergence would be significant. Sedimentation and scouring would occur upstream and downstream of the dam respectively. These adverse impacts would also be significant.

North Fork

Inundation of up to 17 miles of the North Fork would have little adverse impact on Lake Clementine fish resources with Clementine Dam remaining in place. Since the habitat and fish populations are of the reservoir type, inundation would have less adverse effect than on riverine habitat. At planned flood control capacity, the existing lake will be covered by about 154 feet of water. The inundation of the 7-mile segment from upper Clementine to the Big John Hill area will impact the valuable smallmouth bass and trout spawning habitat in the North Fork. However, since the inundation period would be from December through February prior to the bass and trout spawning and incubation period, eggs and fry are at low risk. More significant impacts in this river segment would occur due to sloughing of canyon walls into the river and resultant sediment deposition over spawning riffles. Some stranding of fish in side channels or pools may also occur as waters recede. The least impacts on fish resources will occur in the 5-mile segment below Lake Clementine. Fishery values in this segment of the stream have already been reduced as a result of the coffer dam operation and other Auburn Dam project activities. Most of the settling of suspended sediments would likely occur in this section.

Middle Fork

In a large storm event, inundation of 17 miles of the Middle Fork for 15 days or longer would impact several miles of important spawning riffles and rearing habitat for trout below the Oxbow Reservoir and also spawning and rearing habitat for smallmouth bass. As stated in the North Fork discussion, there will be few inundation impacts on spawning and incubation activities because the storm events typically occur prior to spawning season. However, sediment deposition and stranding in side channels and pools during flow recession would cause significant impacts.

Overall, the level of impacts would be determined by the frequency, duration, and intensity of events. Sloughing of canyon walls and sediment deposition due to inundation during spawning or incubation periods are probably the two most apparent adverse impacts that would affect fish populations.

<u>WILDLIFE</u>

Inundation of wildlife habitat would have a detrimental impact on the diverse assemblage of wildlife species in the project area. Construction of the dam would permanently displace wildlife using the immediate dam site area. Temporary inundation of wildlife habitat caused by operation would result in the loss and/or displacement of wildlife. Many species immobile, dormant or slightly mobile such as reptiles and some small mammals would be lost as flood waters rise in the reservoir. Larger mammals (black-tailed deer, black bear, etc.), some small mammals, and most bird species that escape the rising waters would move into adjacent areas. However, these areas are normally at carrying capacity; therefore, losses would occur. Although habitat conditions would be poorer in areas inundated the longest, some wildlife would return to the reservoir area as flood waters recede.

The permanent loss or degradation would, however, reduce the existing carrying capacity of the area. Under with-project conditions, the conversion and degradation of about 1,409 acres of wildlife habitat would adversely affect large mammals (black-tailed deer, black bear), small mammals, upland game birds (California and mountain quail, wild turkey), passerine birds, and reptiles. Others would enjoy some interim benefit, as many of the plant species unable to tolerate inundation are replaced by grassland and short-lived shrub species.

The gradual overall loss of habitat diversity will result in a substantial reduction in wildlife habitat value and the lowered ability of the area to maintain the diversity and abundance of wildlife.

ENDANGERED SPECIES

Pursuant to Section 7 of the Endangered Species Act of 1973, as amended, the effects of the 200-Year Dry Dam (Selected Plan) on Federally listed species were addressed in our Biological Opinion of November 27, 1991 (Appendix G). At issue were the effects on the Federally listed threatened valley elderberry long horn beetle (Desmocerus californicus demorphus) (beetle) and its elderberry (Sambucus species) habitat. The Biological Opinion stated that "construction and operation of the proposed 200-year American River Watershed Investigation project alternative, including the mitigation for the beetle, as described in this Biological Opinion, is not likely to jeopardize the valley elderberry longhorn beetle and is not likely to result in destruction or adverse modification of its critical habitat. Although critical habitat has been designated for the beetle, none will be affected by the proposed project".

To offset adverse impacts to the beetle and its habitat, the Corps has developed a mitigation plan that includes the following measures:

1. Acquisition of fee-title to 2,700 acres of lands along the South Fork American River.

2. Planting of 32,336 elderberry shrubs within the mitigation

area.

3. Maintaining and monitoring the mitigation area for the life of the project.

4. Revegetating areas of landslides caused by operation of the Dry Dam.

It is important that the Corps and others clearly understand the conclusions and implications of this Opinion. The Opinion as rendered, places clear conditions for mitigative measures to offset impacts to the beetle and its elderberry habitat. The measures proposed in the Corps' mitigation plan were developed in coordination with the Service during the Section 7 consultation process. These measures were specifically designed for the beetle and its habitat. No consideration was given or effort placed on developing mitigative measures that would offset impacts to habitat or species other than the beetle and its habitat.

Additional mitigation recommendations for habitat and species not Federally listed that are impacted by this project, are addressed under provisions of the Fish and Wildlife Coordination Act. The analysis of impacts on non-federally listed species results and recommendations presented in this Auburn Area Substantiating Report and reiterated in our Final Coordination Act Report are independent of and in addition to any requirements stated in the Biological Opinion.

400-YEAR DRY DAM ALTERNATIVE

Impacts resulting from the 400-year Dry Dam alternative would be of similar nature as the 200-year Dry Dam alternative except they would be greater in extent. Construction impacts would be similar, but operation (inundation) impacts would increase. Because the probability of flood events greater than 200-year level is so small (less than 0.5 percent), we did not include events that would occur above that elevation level in our analysis. However, the 400-year Dry Dam, by design, operates in a different manner than the 200-year dam that increases flooding frequency, thus accelerating and increasing inundation impacts.

VEGETATION

Operation of the 400-year level Dry Dam (inundation impacts) would result in the gradual loss (-) or gain (+) of north slope oak woodland (-623 acres), south slope oak woodland (-596 acres), savannah grassland (+401 acres), chaparral (-74 acres), pine forest (-74 acres), montane riparian wetlands (-739 acres), rocky/ruderal (+1327 acres), and upland scrub (+378 acres) (Table 14). Total wildlife cover acreage losses and gains due to dam site, Ponderosa Way, and Highway 49 relocation, and Dry Dam operations are shown in Table 15. Figure 18 compares the vegetation conditions with and without the 400-year Dry Dam.

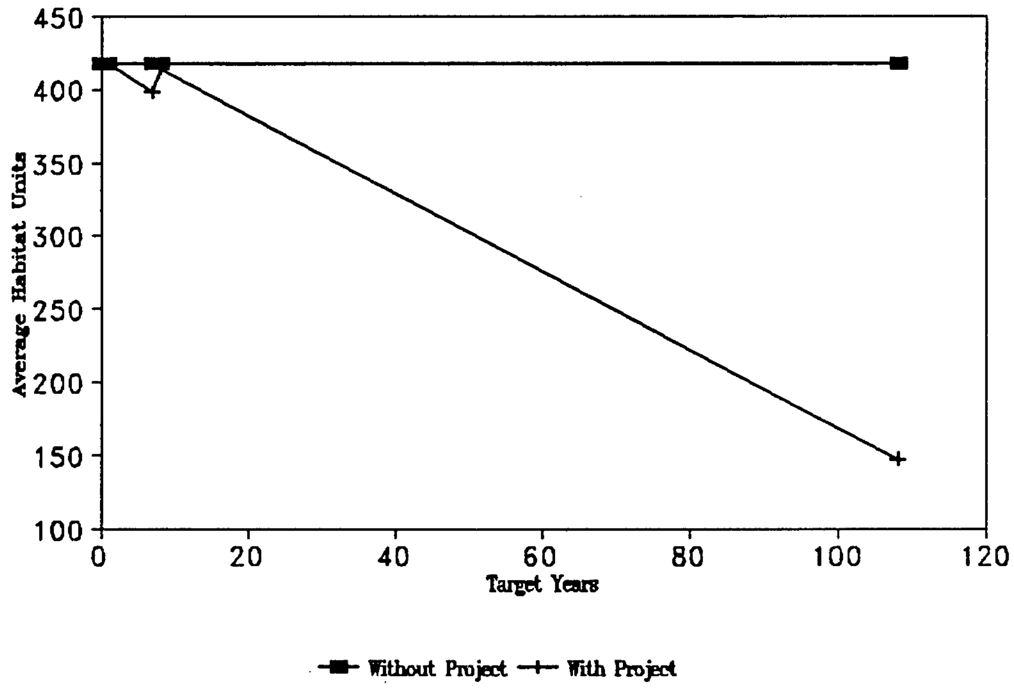


Figure 18 Changes in Average Habitat Units under With- and Without- Project Scenarios - Auburn Dry Dam - 400 Year Alternative. The area between the curves represents the habitat losses requiring compensation.

Table 14. 400-Year Dry Dam Alternative - Wildlife Cover Acreage Operation Loss Summary (Without - With Project) 2002-2102

Upland	Without Project (Acres)	With Project (Acres)	Loss(-)* Gain(+) (Acres)
North Slope Oak	901	278	-623
South Slope Oak	892	296	-596
Grassland	97	498	+401
Pine Forest	135	61	-74
Chaparral	115	41	-74
Upland Scrub	0	378	+378
Rocky/Ruderal	133	1,460	+1,327
Subtotal Loss	2,273	3,012	-1,367
Gain			+2,106
Wetland			
Montane Riparian	862	123	-739
Subtotal Loss	862	123	-739
Total Gain	3,135	3,135	3,135

Grand Total Wildlife Cover Acreage Loss = -2106

*Loss represents the difference comparing with and without project acreages remaining at the end of operation analysis period (100 years). Loss is due to operation (inundation effects only). Grand total loss reflects conversion of wildlife cover to non-wildlife value cover.

Table 15. 400-Year Dry Dam Alternative - Wildlife Acreage Changes (With-Project)* 1994-2102

Upland	Construction (Acres)	Operation (Acres)	Loss (-) Gain (+) (Acres)
North Slope Oak	-40.6	-623	-663.6
South Slope Oak	-21.2	-596	-617.2
			-157.5
Grassland	-157.5	+401	+401.0
Pine Forest	-6.0	-74	-80.0
Chaparral	-4.0	-74	-78.0
Upland Scrub	0.0	+378	-378.0
Rocky/Ruderal	0.0	+1,327	+1,32 .0
Subtotal Loss	-229.3	-1,367	-1,596.3
Gain	0.0	+2,106	+2,106.0
Wetland			
Riparian Riparian	-25.1	-739	-764.1
Subtotal Loss	-25.1	-739	-764.1
Gain			
Total Loss	-254.4	-2106	

Grand Total Wildlife Cover Acreage Loss - 2,360.4

With project losses represents the difference comparing with and without-project acreages remaining at the end of project analysis period i.e., construction and operations (108 years). Total loss reflects wildlife cover acreages converted into non-wildlife value cover.

FISH

Approximately 20 miles of the stream habitat in each of the Middle and North Fork American Rivers, including Lake Clementine, would be completely submerged for periods of time (less than two weeks) with this alternative. Intermittent, temporary inundation would have less adverse impact over existing and without-project conditions than permanent inundation, except for the loss of 739 acres of wetlands, because (1) some level of inundation presently occurs during flood flows, and (2) this condition would be temporary. The loss of 739 acres of wetland habitat due to temporary submergence will be significant. Sedimentation and scouring would occur upstream and downstream of the dam respectively. Fish niches and territories are likely to be highly disrupted due to sudden increases in depth up to 100 feet or more above normal flood stages. We have no information on how this will affect populations. These adverse impacts would also likely be significant.

North Fork

Inundation of up to 20 miles of the North Fork would have little adverse impact on Lake Clementine fish resources with Clementine Dam remaining in place. Since the habitat and fish populations are of the reservoir type, inundation will have less adverse effect than on riverine habitat. At planned flood control capacity, the existing lake will be covered by about 227 feet of water. The inundation of the 10-mile segment above upper Clementine to the Indian Creek area will impact the valuable smallmouth bass and trout spawning habitat in the North Fork. However, since the inundation period will be from December through February, prior to the bass and trout spawning and incubation period, egg and fry stages are at low risk. More significant impacts in this river segment will occur due to sloughing of canyon walls into the river and resultant sediment deposition over spawning riffles. Some stranding of fish in side channels or pools may also occur as waters recede. The least impacts on fish resources will occur in the 5-mile segment below Lake Clementine. Fishery values in this segment of the stream have already been reduced as a result of operation of the coffer dam and other Auburn Dam project activities. Most of the settling of suspended sediments would likely occur in this section.

Middle Fork

In a large storm event, inundation of 20 miles of the Middle Fork for 15 days or longer would impact several miles of important spawning riffles and rearing habitat for trout below the Oxbow Reservoir and also spawning and rearing habitat for smallmouth bass. As stated in the North Fork discussion, there would be few inundation impacts on spawning and incubation activities because the storm events typically occur prior to spawning season. However, sediment deposition over spawning beds and stranding in side channels and isolated pools during flow recession would cause significant impacts.
Overall, the level of impacts would be determined by the frequency, duration, and intensity of events. Sloughing of canyon walls and sediment deposition over spawning habitat are probably the two most apparent adverse impacts that would affect fish populations.

<u>WILDLIFE</u>

The conversion and degradation of about 2,360 acres of wildlife habitat would have a detrimental impact on the diverse assemblage of wildlife species of the project area. Construction of the dam and other permanent new features would permanently displace wildlife using the area. Temporary inundation of wildlife habitat would result in the loss and/or displacement of wildlife. Many species such as reptiles and some small mammals would be lost as flood waters rise in the reservoir. Larger mammals (black-tailed deer, black bear, etc.), some small mammals, and most avian species would move into adjacent areas to escape the rising waters. However, these adjacent areas are normally at carrying capacity; therefore, losses would occur. Although habitat conditions would be poorer in areas inundated the longest, some species would return to the reservoir area as flood waters recede.

The cumulative permanent losses and degradation would, however, reduce the existing carrying capacity of the area. Under with-project conditions, the conversion and degradation of about 2,360 acres of wildlife habitat would adversely affect large mammals (black-tailed deer, black blear), small mammals, upland game birds (California and mountain quail, wild turkey), passerine birds, and reptiles. Some species would derive interim benefit, as many of the plant species unable to tolerate inundation are replaced by grassland and short-lived shrub species.

The overall loss of habitat diversity would result in a substantial reduction in wildlife habitat value and the lowered ability of the area to maintain the existing diversity and abundance of wildlife.

ENDANGERED SPECIES

The effects of the 400-year project alternative on Federally listed and candidate species have not been addressed pursuant to Section 7 of the Endangered Species Act of 1973, as amended. The Corps did not consult with the Service on the 400-Year Dry Dam Alternative since it is no longer considered as the Selected Plan.

DISCUSSION

Our recommendations are based on the Fish and Wildlife Service's Mitigation Policy (Federal Register 46:15, January 23, 1981) which provides internal guidance for establishing appropriate mitigation for projects under our purview. Under this policy, resources are divided into four resource categories to assure that recommended mitigation is consistent with fish and wildlife values involved. The resource categories cover a range of habitat values from those considered to be unique and irreplaceable to those believed to be of relatively low value to fish and wildlife. This policy does not apply to Federally listed endangered or threatened species. Impacts assessment and

<u>mitigative measures for Federally listed species are determined independently under provisions within the Endangered Species Act, as amended.</u>

Resource category determinations are based on the importance of the habitat to selected evaluation species. These species may or may not be the same as those used for the HEP analysis. The resource category of a habitat does dictate the compensation goal for that habitat in the HEP process. During impact assessment, specific habitat types that may be impacted by the project are identified. Evaluation species which utilize each habitat type are selected for impact analysis. 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 as designated by the Director of the Fish and Wildlife Service, such as anadromous fish and migratory birds. Habitat value determinations are based on the importance of the habitat types found in the project area to the selected evaluation species and the relative scarcity of the habitat types.

In this evaluation, all species were selected for both their high consumptive (fishing and hunting) and nonconsumptive (aesthetic, birdwatching, ecological, etc.) values to the public.

The evaluation species selected to determine the values of the fishery/aquatic habitat in the North and Middle Fork American Rivers and Lake Clementine are rainbow trout and smallmouth bass. Although only a moderate fishery exists for these species due to the limited access in the canyons, they represent a scarce resource in declining free-flowing aquatic habitat. Most flowing streams in this region and in the State of California have been dammed, their waters diverted, and their aquatic resources degraded. Although streamflow in many segments of the American River is controlled by dams, this section of the river retains its free-flowing stream character. Because of its scarcity and uniqueness to this region, and its value to the aquatic resources, we recommend that no net loss of in-kind habitat value occur in the Montane Riparian wetlands.

The evaluation species selected to determine the values of the wildlife/riverine habitat include the calliope hummingbird, willow flycatcher, dusky shrew, northern oriole, downy woodpecker, American dipper, screech owl, and others. The ruderal grassland, scrub-shrub, riparian forest, emergent marsh, and rock/sand/gravel bar habitats along the riverine corridor provide essential habitat for these species. Without the corridor, some species such as the American dipper will be lost. The river corridor functions as an important resting area for of California, we recommend that no net loss of in-kind habitat value occur.

The evaluation species selected to determine upland habitat (north slope-oak woodland, south slope-oak woodland, pine forest, chaparral, and grassland) values include northern alligator lizard, mountain quail, western flycatcher, gray fox, bandtailed pigeon, scrub jay, nuthatch, gray squirrel, and other species.

The American River canyons have an abundance of wildlife species rarely seen in other, nearby, more-developed locations. There is a great deal of variation in habitat values within the cover types that we identified. Much of the chaparral is decadent and overgrown, and some areas may benefit from fire management. However, our data indicates that dense chaparral provides high values for many avian species. Even in the present condition, numerous songbirds are still present. The north and south slope-oak woodlands are alive with activity, and active and remnant nests are common. Meadowlark, bluebirds, wrentits, goldfinch, and other birds frequent the open grassy areas within the woodlands. The ephemeral streams and smaller water courses that drain the steep canyon northfacing slopes sustain salamanders, alligator lizards, flycatchers and other wildlife that favor more moisture-prone areas.

Human settlement along the slopes of the Western Sierra foothill region throughout California has led to significant decline in hardwood forest acreage[1/]. Between 1945 and 1973, as many as 890,000 acres were lost due to rangeland clearing. An additional 100,000 acres were cleared for reservoirs, roads, powerlines, and residential development between 1953 and 1973 (Bolsinger 1980). After 1973, residential and commercial development became the leading cause of oak hardwood forest losses with road and freeway construction and rangeland clearing accounting for the majority of remaining losses. Hardwood forest dominated by blue oak was the major forest type lost. An estimated 279,000 acres are now in areas currently being developed for residential, commercial and industrial use. Consequently, of the estimated 10,027,000 acres of hardwood forest existing prior to 1945 about 1,185,000 (12%) have been lost to development (Bolsinger 1988). This represents an average acreage loss of 0.3% per year. At this rate all of California's hardwood forest would be lost by the year 2285 (300 years).

Based on our investigation, we find the American River canyons to be extremely important ecological areas, containing a diverse mosaic of wildlife habitats, buffered from urban disturbance, and with undammed river corridors. Since these types of canyon habitats are scarce and of high value on a local and regional basis, we recommend that no net loss of in-kind habitat value

1/ See FWS 1991. Office report by Jody Brown titled, "Status and Trends of Harwood Forest in the Western Sierra Foothills." Special report prepared for American River Watershed Investigation. Office of Fish and Wildlife Enhancement, Sacramento, California 5 pp.

habitats are scarce and of high value on a local and regional basis, we recommend that no net loss of in-kind habitat value occur.

Of the 20,000 acres considered for Corps project planning, about 6,000 acres within the temporary inundation zone would be retained or acquired. The Corps expects that about 14,200 acres would be transferred to other government agencies. Based on our recent mitigation site surveys, there appears to be little realistic opportunity for mitigation on these lands. In fact, there are few opportunities on any of the proposed Corps project lands or on the existing Bureau of Reclamation lands. The most apparent degraded areas (which would conceivably have the greatest potential for habitat improvement) are the existing Auburn Dam construction site, construction haul roads, and around the Cool limestone quarry. Since plans for construction site and haul road restoration were not made available, we did not consider these sites as restorable in our mitigation analysis. We did, however, examine mitigation opportunities at the Cool limestone quarry. There are about 3.7 acres of land along the Middle Fork American River below the main quarry that are suitable for seasonal wetland restoration (Figure 19). However, because the site lies within the flood inundation zone, it is of limited value for mitigation. Extensive efforts in restoration plantings could easily be negated by a large flood event, and it is likely that minimal wildlife benefits would accrue during the life of the project.

In our February 1991 draft Coordination Act Report, we evaluated the potential of the Knickerbocker site near the town of Cool for mitigation. After further consideration, we determined the site would not meet our basic goal to replace in-kind wildlife value losses. In addition, since wildlife values are already relatively high and the lands are assumed to remain in Federal government ownership under the without-project scenario, this would not be an acceptable site (Figures 20 and 21).

Finding no mitigation opportunities within project lands and needing to compensate for direct construction and long-term operation impacts, we investigated potential in-kind mitigation sites in other nearby areas. Since our goal was

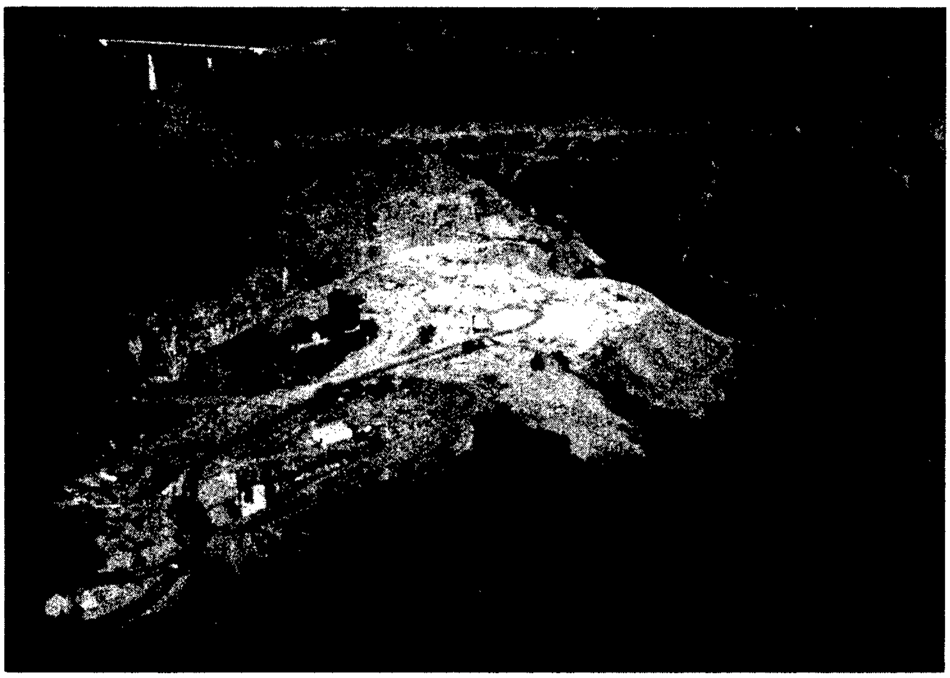


FIGURE 19. CONSIDERED COMPENSATION AREA AT COOL LIMESTONE QUARRY

FIGURE 20. PROJECT AREA--KNICKERBOCKER SITE

FIGURE 21. PROJECT AREA--KNICKERBOCKER SITE

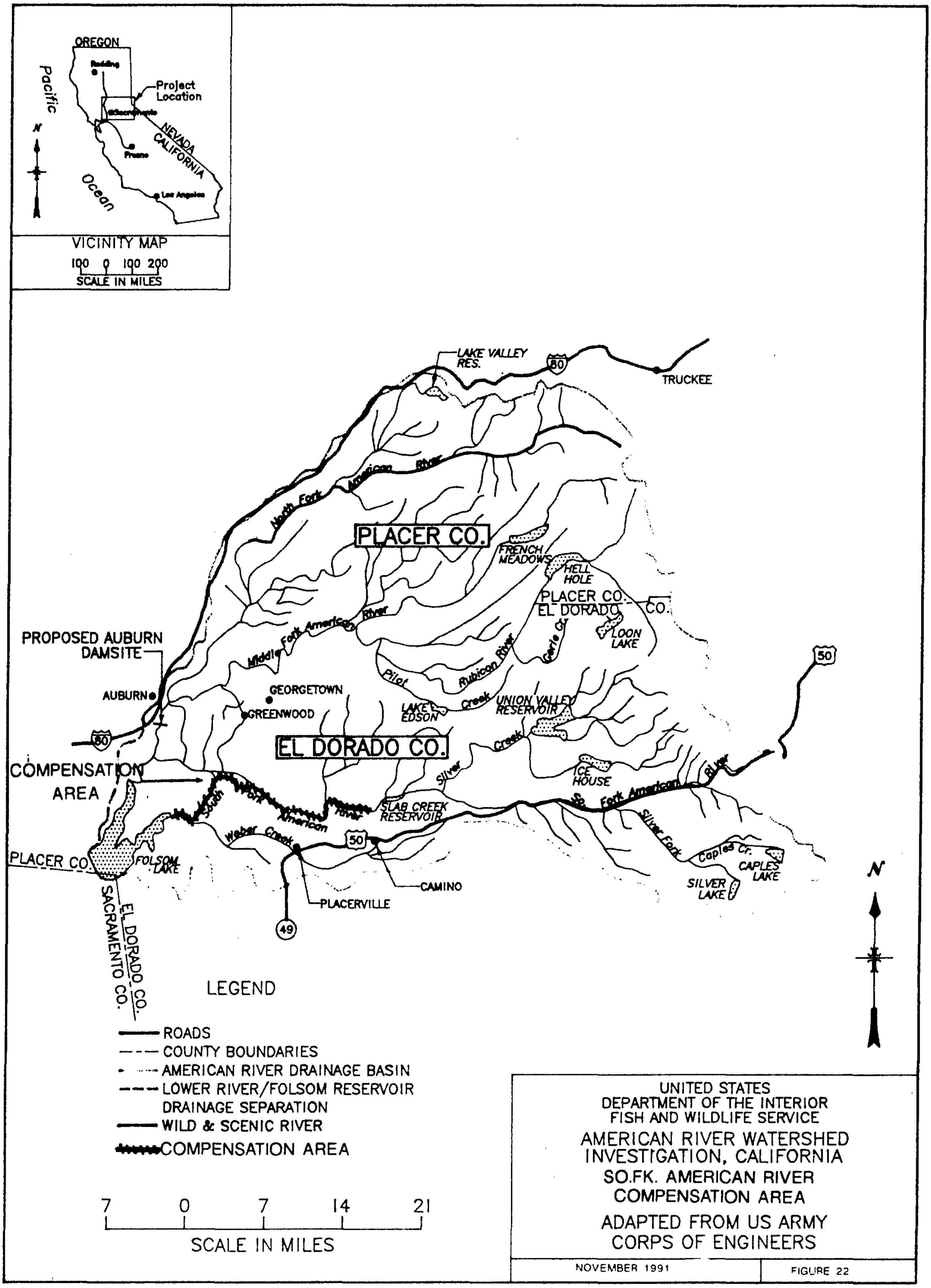
in-kind compensation, we looked for free-flowing riverine canyons with the same general elevation zones as those being affected in the North and Middle Fork American River canyons. A logical first choice was the South Fork American River since we believed the South Fork would have topographic and ecological features similar to those found in the North and Middle Fork canyons. During the course of the investigation, we learned that many of the lands in the South Fork canyons are likely to be developed in the near future and their wildlife values largely lost. Therefore, we determined that acquiring these lands and improving similar in-kind habitat would serve as a conceptual mitigation planning scenario for our HEP analysis. At the time we prepared our draft Coordination Act Report, we had minimal information on land use, availability, access and other important data about the South Fork American River. For the draft, we evaluated a potential compensation area that encompassed 4.4 river miles and about 4,000 acres. We also included mitigation credits for the Knickerbocker site and considered a Cosumnes River site. Following submittal of the draft, we have spent additional effort gathering more information about the South Fork American River and it is now our preferred site. We have expanded the defined compensation area to 13.8 river miles and about 8,500 acres. The general location of the compensation area is shown in Figure 22.

At this planning stage, the selected compensation area along the South Fork American River is conceptual. To our knowledge, there have been no attempts made to approach landowners or begin acquisition. The area discussed was chosen to meet HEP analysis needs and criteria. Lands within the compensation area may or may not be available for acquisition.

The compensation area is located within a similar foothill region as the North and Middle Fork American Rivers. It lies along the South Fork American River between the Salmon Falls Bridge at the upper end of Folsom Lake and the El Dorado National Forest Boundary. We divided the compensation area into two river reaches. The lower reach extends from above the confluence of Burnt Shanty Creek to near the town of Lotus. The upper reach extends from near the confluence of Dutch Creek above Coloma to the National Forest boundary. Riverbed elevation is near 425 feet at the Salmon Falls Bridge and increases to near 1,500 feet at the National Forest boundary.

The riverbed gradient is moderate, dropping about 35 feet per mile over the entire length of the compensation area. The river flows through relatively steep sloped canyons (24 percent) in the upper reach and then through less steep canyons (13 percent) in the lower reach.

Combined, the two reaches encompass 13.8 river miles with montane riparian wetland (252 acres) and upland (8,208 acres) wildlife cover totaling 8,529 acres. The area straddles both sides of the



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

AMERICAN RIVER WATERSHED INVESTIGATION, CALIFORNIA

SO.FK. AMERICAN RIVER COMPENSATION AREA

ADAPTED FROM US ARMY CORPS OF ENGINEERS

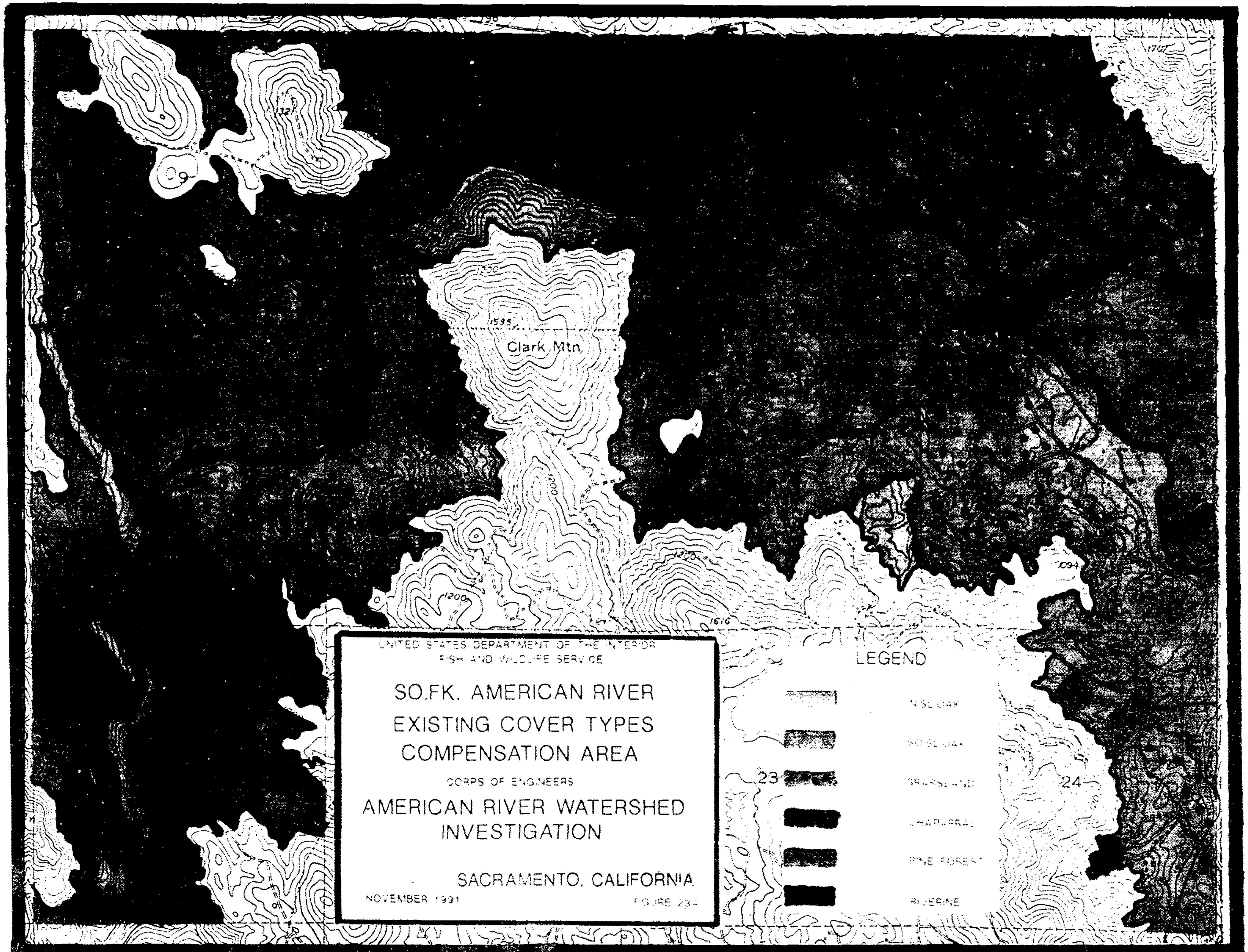
NOVEMBER 1991 | FIGURE 22

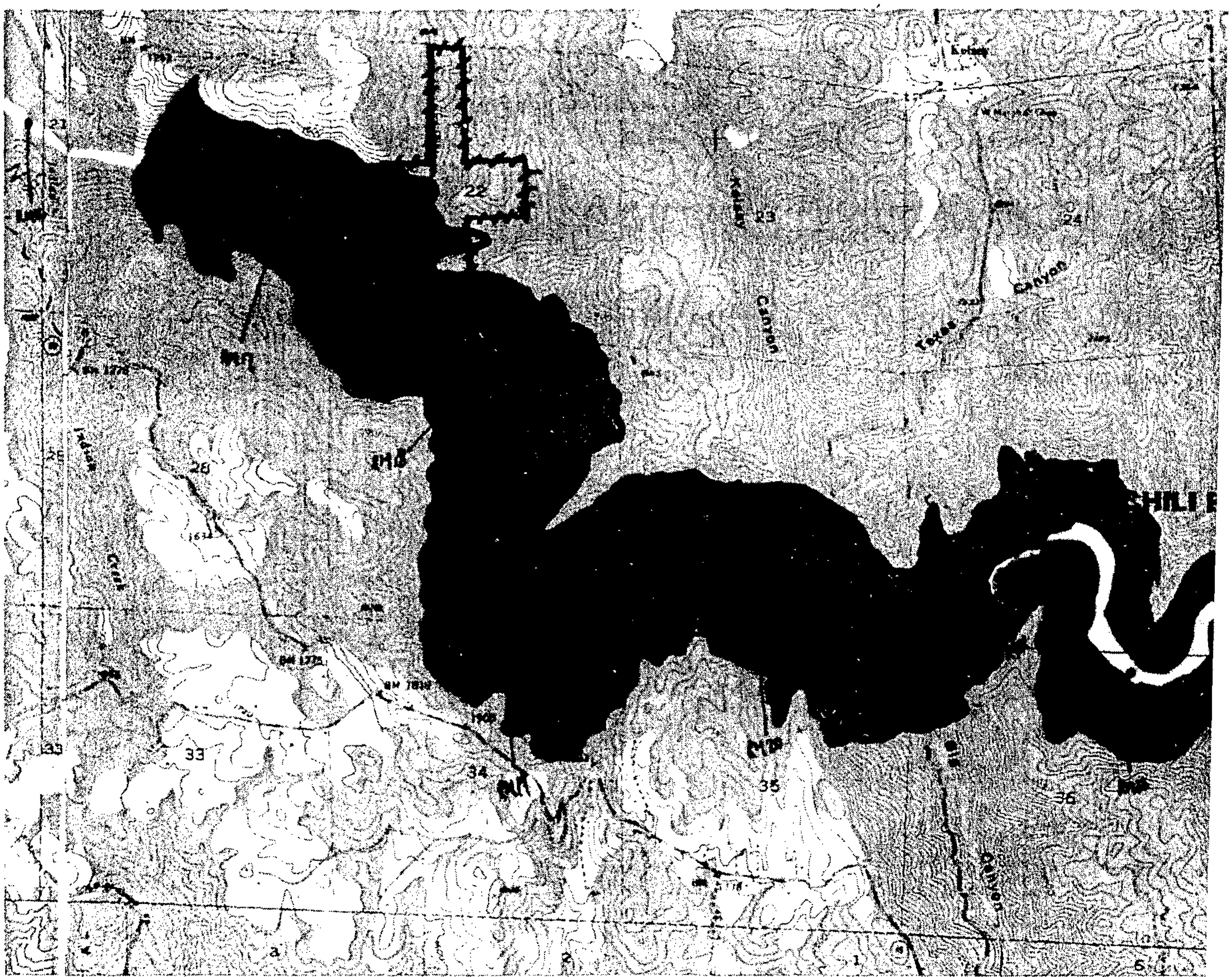
river and extends up to elevations of 1,200 feet or more to the canyon rims.

All of the wildlife cover types impacted at the Auburn canyons occur in this area although in different proportions (Figures 23a and 23b). Acreages of existing cover are shown in Table 16. The condition of wildlife cover varies greatly within the compensation area. A significant portion is relatively pristine whereas other portions are affected by development. Most of the oak woodlands are in good condition with moderate to high values. Compared to the North and Middle Fork canyons, there is proportionally less north slope-oak woodland and proportionally greater south slope-oak woodland due to the less-steep canyon topography of the lower reach (Figure 24). This is demonstrated by graphically comparing topography in the North, Middle and South Fork canyons (Figure 25). It is important to recognize that we based our compensation analysis scenario for the South Fork American River partially on land use changes presently occurring. Large parcels of 100 acres and greater are being divided and sold as 5 acres and greater rural- residential lots for future development. Lands along the river with suitable topography are in demand. Our assumption is that much of the privately owned lands along the river with buildable sites would be developed soon and such development would greatly diminish the existing, relatively high, wildlife habitat values.

It is also important to recognize that acquiring and saving lands along the South Fork American or Cosumnes Rivers or any other free flowing river fails to offset net loss of riverine canyon habitat. The only way to truly accomplish no net loss is to acquire an equivalent number of river miles in a non-free-flowing river canyon of similar topographical and potential ecological composition and restore it. We are unaware of any canyons where this opportunity exists. Thus, after examining the 100-year future for this region, it appears that saving nearby relatively pristine, riverine canyon areas with similar in-kind wildlife habitat values is the next best mitigation alternative if a project is built.

We were not able to gain access to all of the lands within the conceptual compensation area. In part, this was due to lack of time and in part, to land being in private ownership. We were unable to sample chaparral and pine forest cover in the compensation area. Based on our prior field sampling experience, we felt that areas on the South Fork closely resembled other areas sampled on the North and Middle Forks. Therefore, we decided to rely on average sample values obtained in our North and Middle Fork American River surveys. Assumptions regarding these values are explained in our HEP report.


UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
SO.FK. AMERICAN RIVER
EXISTING COVER TYPES
COMPENSATION AREA
CORPS OF ENGINEERS
AMERICAN RIVER WATERSHED
INVESTIGATION
SACRAMENTO, CALIFORNIA
NOVEMBER 1991
LEGEND
Clark Mtn
1595
1200
1616
23
24



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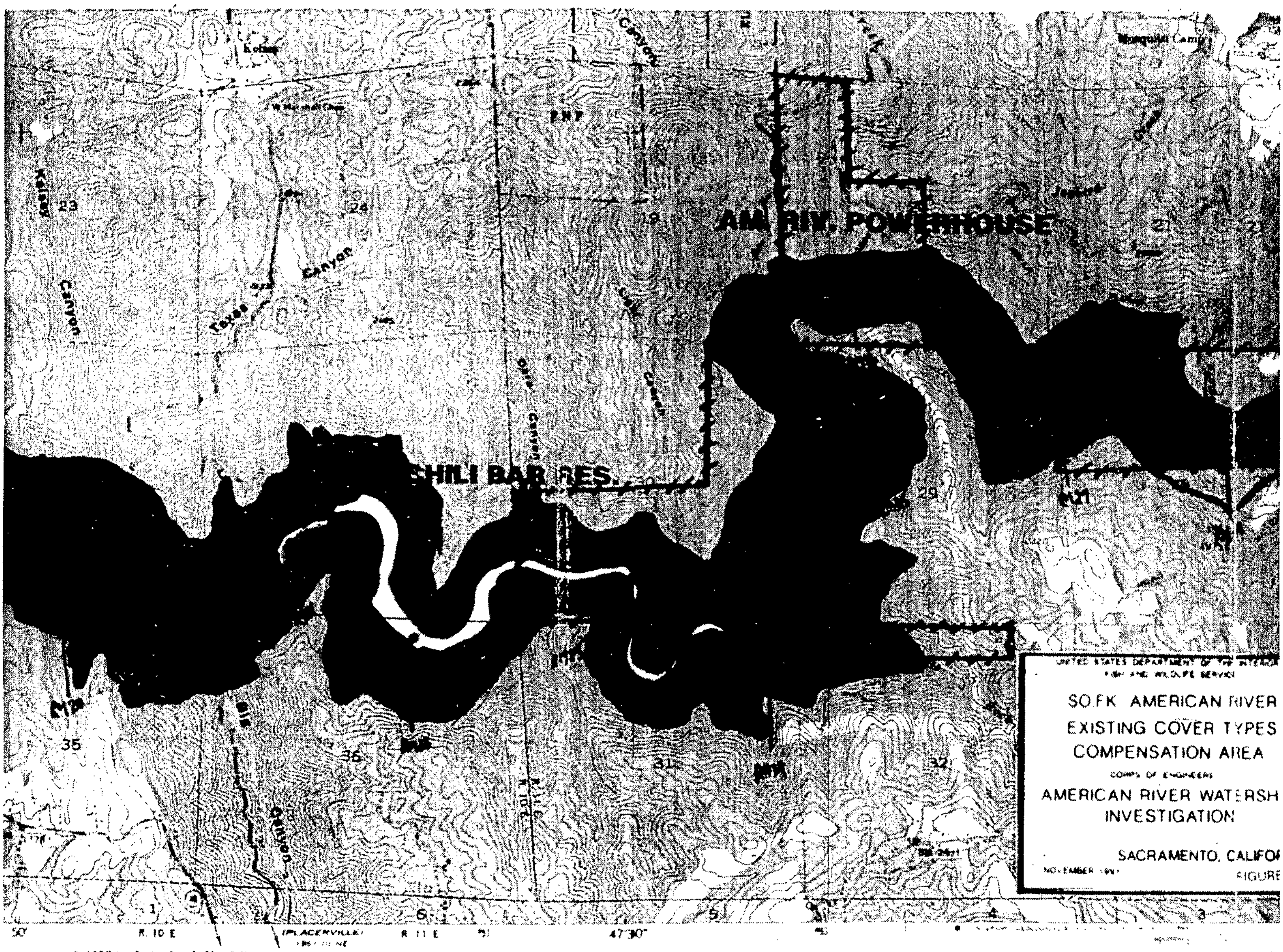

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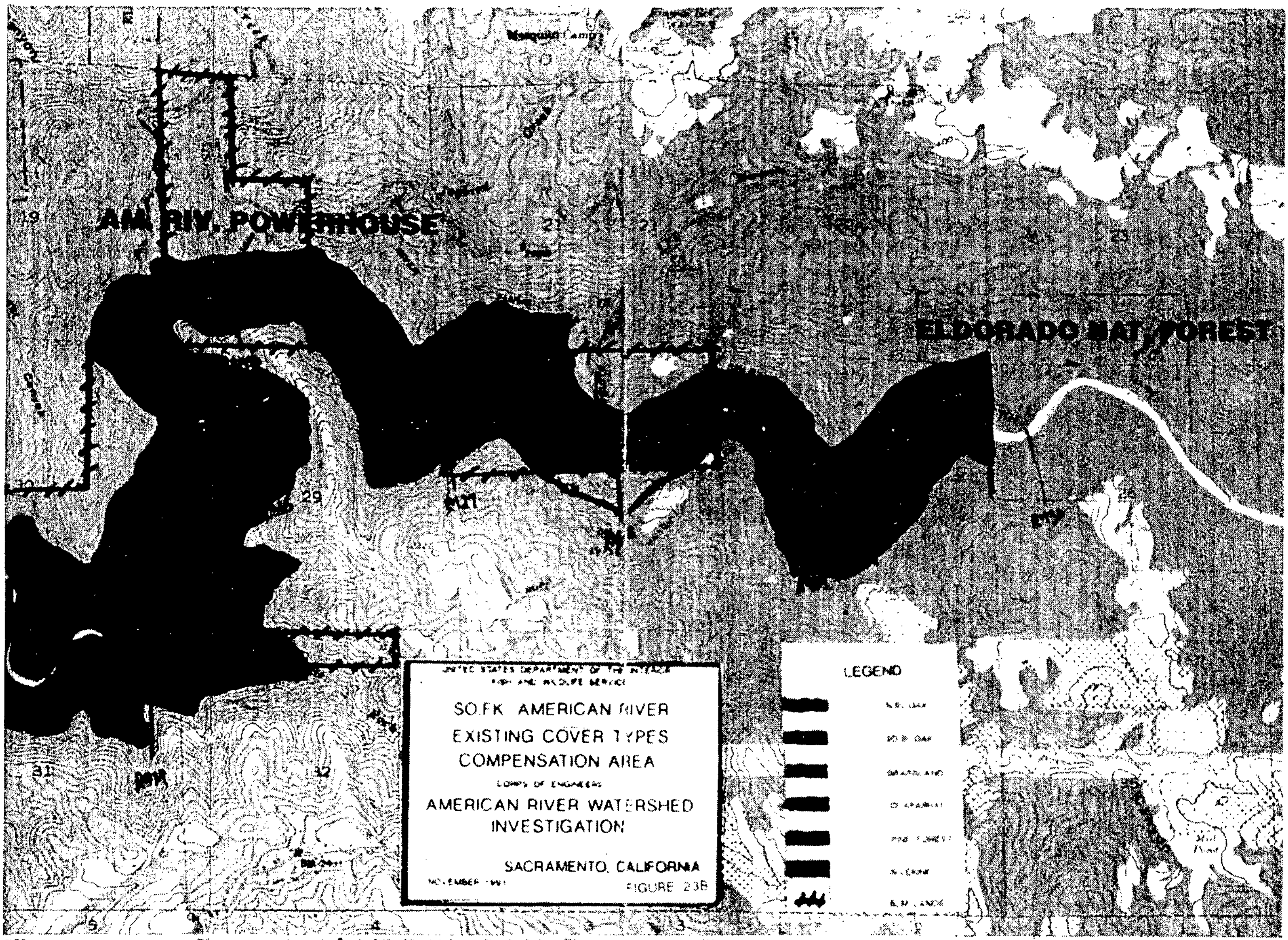
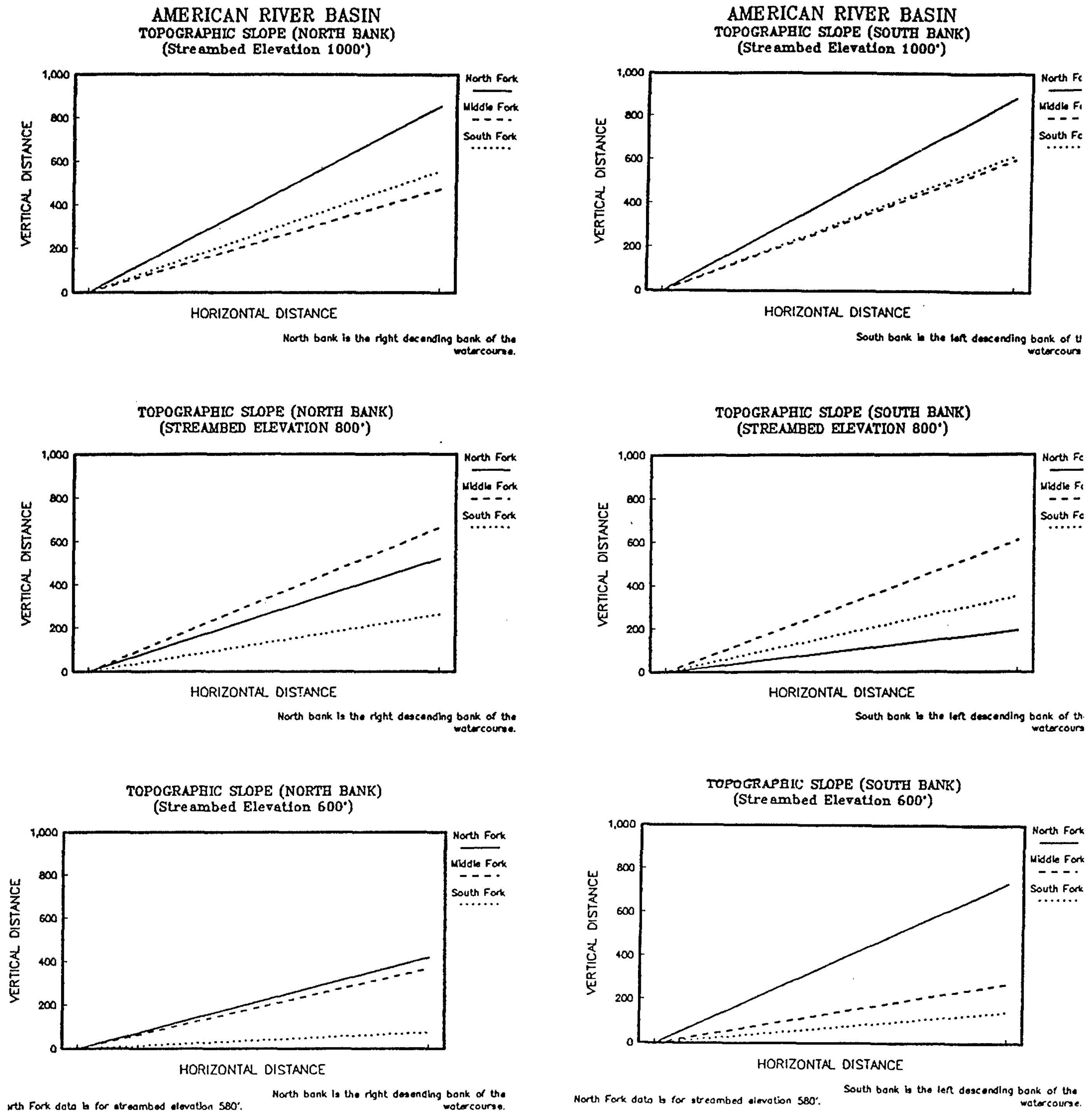

AM. RIV. POWERHOUSE
ELDORADO NAT. FOREST
UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
SO.FK AMERICAN RIVER
EXISTING COVER TYPES
COMPENSATION AREA
CORPS OF ENGINEERS
AMERICAN RIVER WATERSHED
INVESTIGATION
SACRAMENTO, CALIFORNIA
FIGURE 23B
LEGEND

FIGURE 24 SOUTH FORK AMERICAN RIVER--MITIGATION AREA

FIGURE 25



AMERICAN RIVER BASIN
TOPOGRAPHIC SLOPE (NORTH BANK)
(Streambed Elevation 1000')
VERTICAL DISTANCE
HORIZONTAL DISTANCE
1,000
800
600
400
200
0
North Fork
Middle Fork
South Fork
North bank is the right decending bank of the watercourse.
AMERICAN RIVER BASIN
TOPOGRAPHIC SLOPE (SOUTH BANK)
(Streambed Elevation 1000')
South bank is the left descending bank of the watercourse.
TOPOGRAPHIC SLOPE (NORTH BANK)
(STREAMBED ELEVATION 800')
North bank is the right descending bank of the watercourse.
TOPOGRAPHIC SLOPE (SOUTH BANK)
(STREAMBED ELEVATION 800')
South bank is the left descending bank of the watercourse.
TOPOGRAPHIC SLOPE (NORTH BANK)
(Streambed Elevation 600')
North bank is the right desending bank of the watercourse.
North Fork data is for streambed elevation 580'.
TOPOGRAPHIC SLOPE (SOUTH BANK)
(Streambed Elevation 600')
South bank is the left descending bank of the watercourse.
North Fork data is for streambed elevation 580'.

Because of the lack of time and funding, we did not carry out any additional HEP sampling on the additional 4,500 acres of lands added to the compensation area since our draft report. We believe that average habitat values are generally the same throughout the compensation area. For purposes of our HEP analysis, we assumed values are the same and sampling was sufficient. If the project is authorized, we would expect funding and time to conduct additional sampling to validate our assumptions.

Aerial photographs enlarged to 1:12,000 scale and U.S. Geological Survey topographic maps (7 1/2 minute) of 1:24,000 scale were used to identify existing cover types. Both helicopter and on-the-ground surveys were completed to validate our findings. Represented cover types included north slope-oak woodland, south slope-oak woodland (Figure 26), grassland (Figure 27), pine forest (Figure 28), chaparral (Figure 29), and montane riparian (Figure 30). Most likely, upland scrub and rocky/ ruderal cover occurs, but we were not given time to assess their extent.

FIGURE 26. SOUTH FORK AMERICAN RIVER--OAK WOODLAND

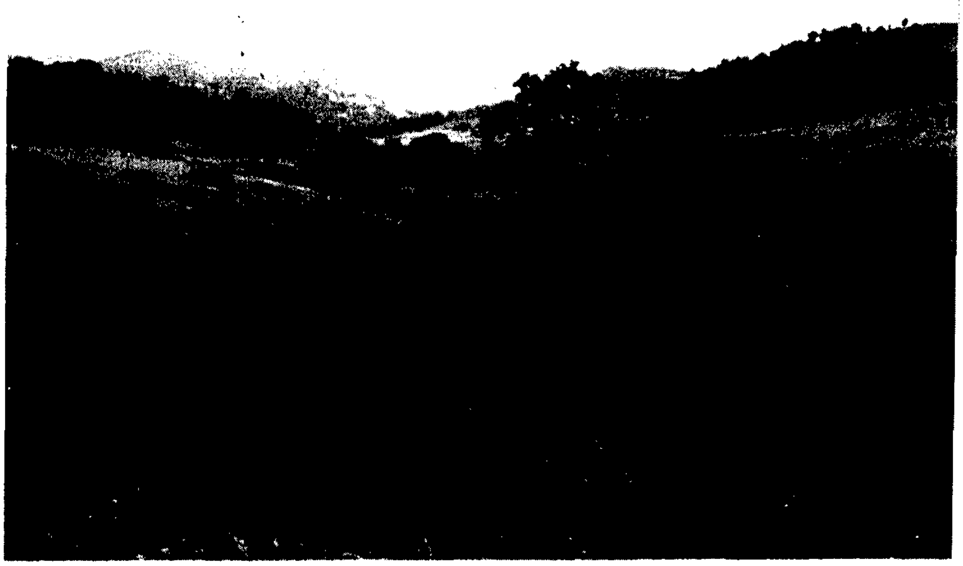


FIGURE 27. SOUTH FORK AMERICAN RIVER--SAVANNAH GRASSLAND

FIGURE 28. SOUTH FORK AMERICAN RIVER--PINE FOREST

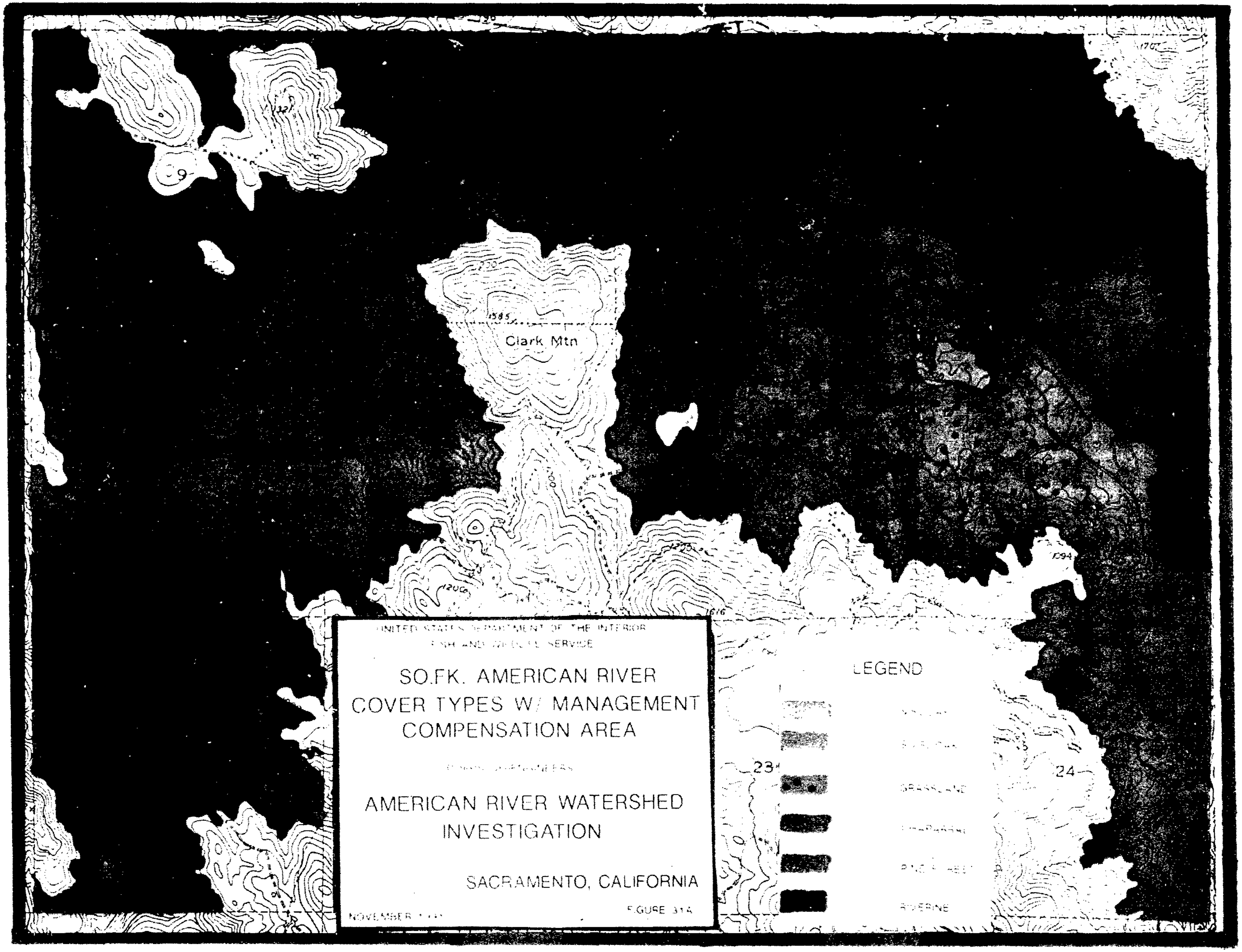
FIGURE 29. SOUTH FORK AMERICAN RIVER--CHAPARRAL

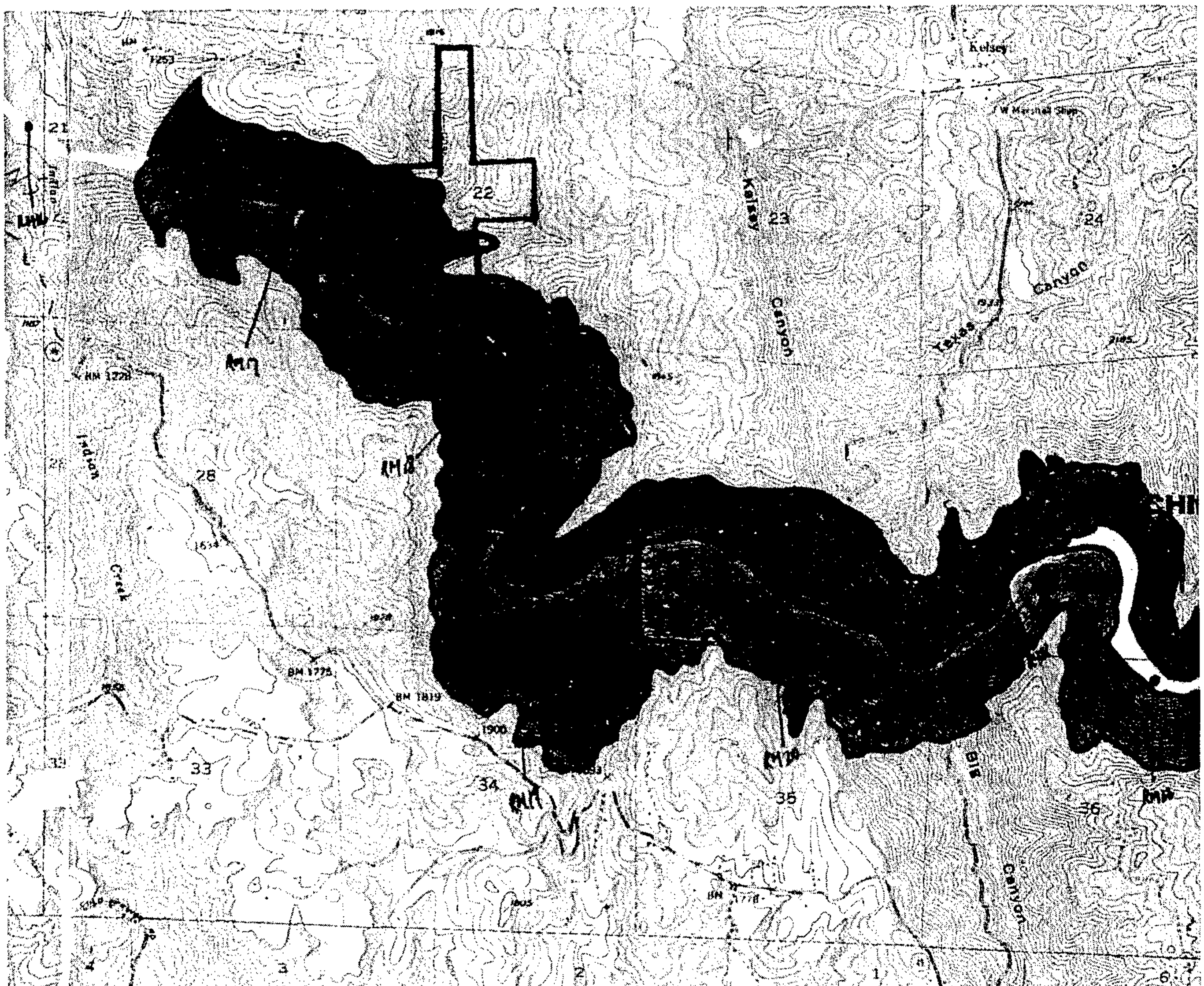
FIGURE 30. SOUTH FORK AMERICAN RIVER--MONTANE RIVERINE

As stated earlier in this report, our acceptance of this compensation site is based in part on the assumption that a significant amount of wildlife cover and values would be lost due to development in our 108-year period of analysis. This permits us to gain wildlife value credits for acquiring and managing the lands. The expected rate and amount of development along with potential wildlife value improvements influence the credit potential. Rapid and extensive development offer greater potential credits since wildlife values would be lost early in a 108-year analysis period. However, in this case, since the compensation lands are already of moderate to high value for wildlife, the management opportunities are relatively limited. This means that increases in wildlife values would probably require more intensive and costly management measures. This contrasts with an area that is highly degraded wherein large increases in wildlife value are possible with less intensive and less costly management.

Because lands in the upper portion of the river canyon are very steep, we assumed they would remain undeveloped. Since they are already of high value, we did not include intensive management as part of their future scenario. Land use information for the Lotus/Coloma area provided by the Corps was used to develop with- and without-project conditions for a 108-year analysis. Details of our methodology and the Corps information are included in Appendix E. Basically, we used the Corps' predicted land use changes in developed and undeveloped areas to derive expected changes in specific wildlife cover types within the compensation area. These acreage changes are reflected in the HEP analysis of without-management conditions on the compensation area over the 108-year period of analysis.

For the with-management compensation area scenario, we examined several management options that would effectively improve existing wildlife values on the compensation area, in a timely, but least costly manner. We considered vegetative restoration, controlled burning, flow release schedule modification, grazing removal and other management techniques. Since there was minimal time for management planning, we made some key decisions and proceeded with a general conceptual plan to be implemented throughout the project life. This conceptual plan includes 1) acquiring lands in fee title, 2) removing cattle grazing, 3) restoring oak woodland and pine forest cover, 4) spawning gravel placement, 5) montane riparian vegetation restoration, 6) controlled burning to maintain grasslands, and 7) improvement of flow release schedules. This conceptual management plan is described in more detail in our HEP report (Appendix B). The compensation area under with-management conditions is displayed in Figures 31a and 31b. Table 16 displays cover type acreages under existing, without-management and with-management conditions.


Clark Mtn
1585
LEGEND
GRASSLAND
RIVERINE
UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
SO.FK. AMERICAN RIVER
COVER TYPES W/ MANAGEMENT
COMPENSATION AREA
AMERICAN RIVER WATERSHED
INVESTIGATION
SACRAMENTO, CALIFORNIA
FIGURE 31A



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Topography from aerial photographs by multiplex methods

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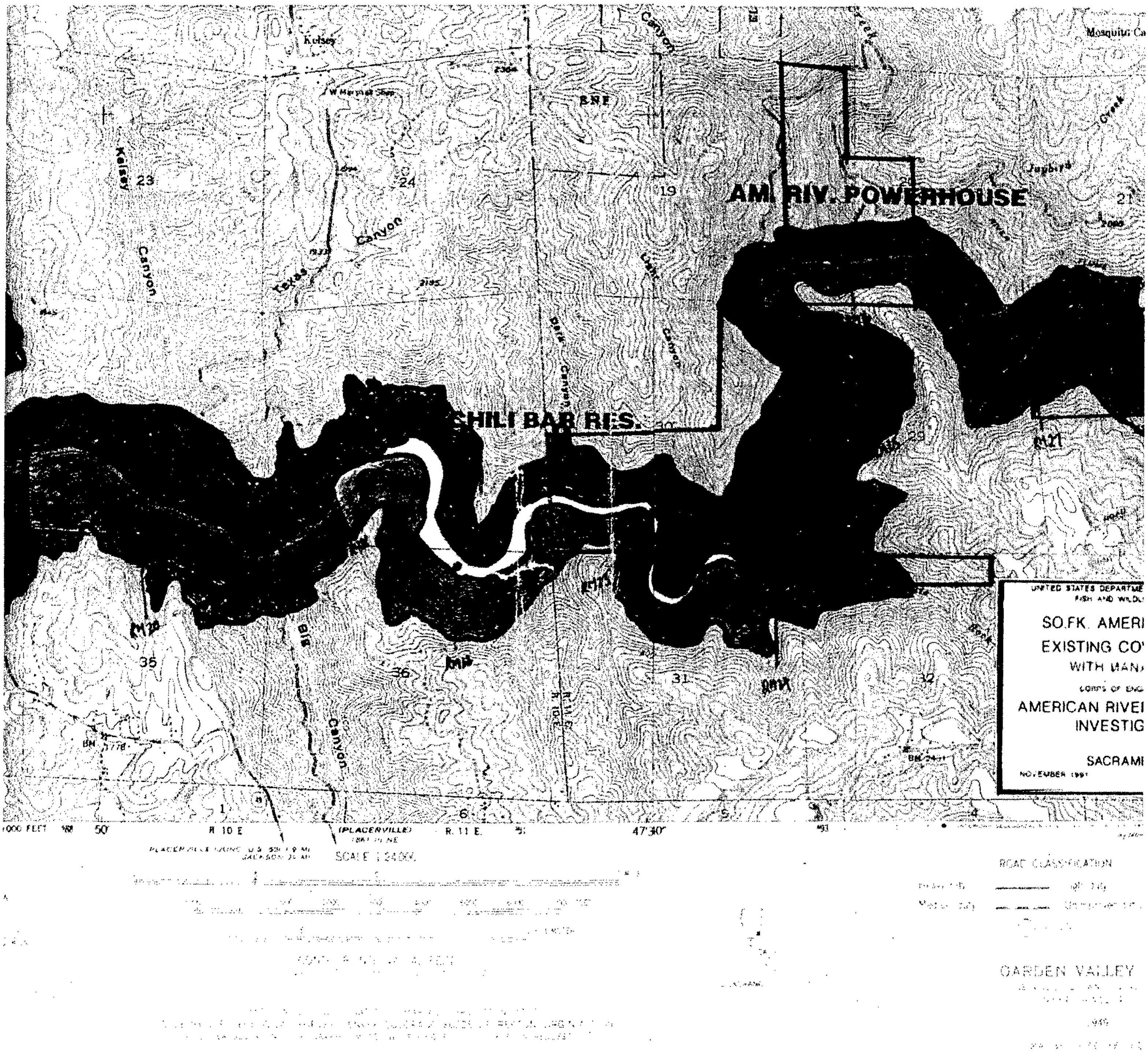
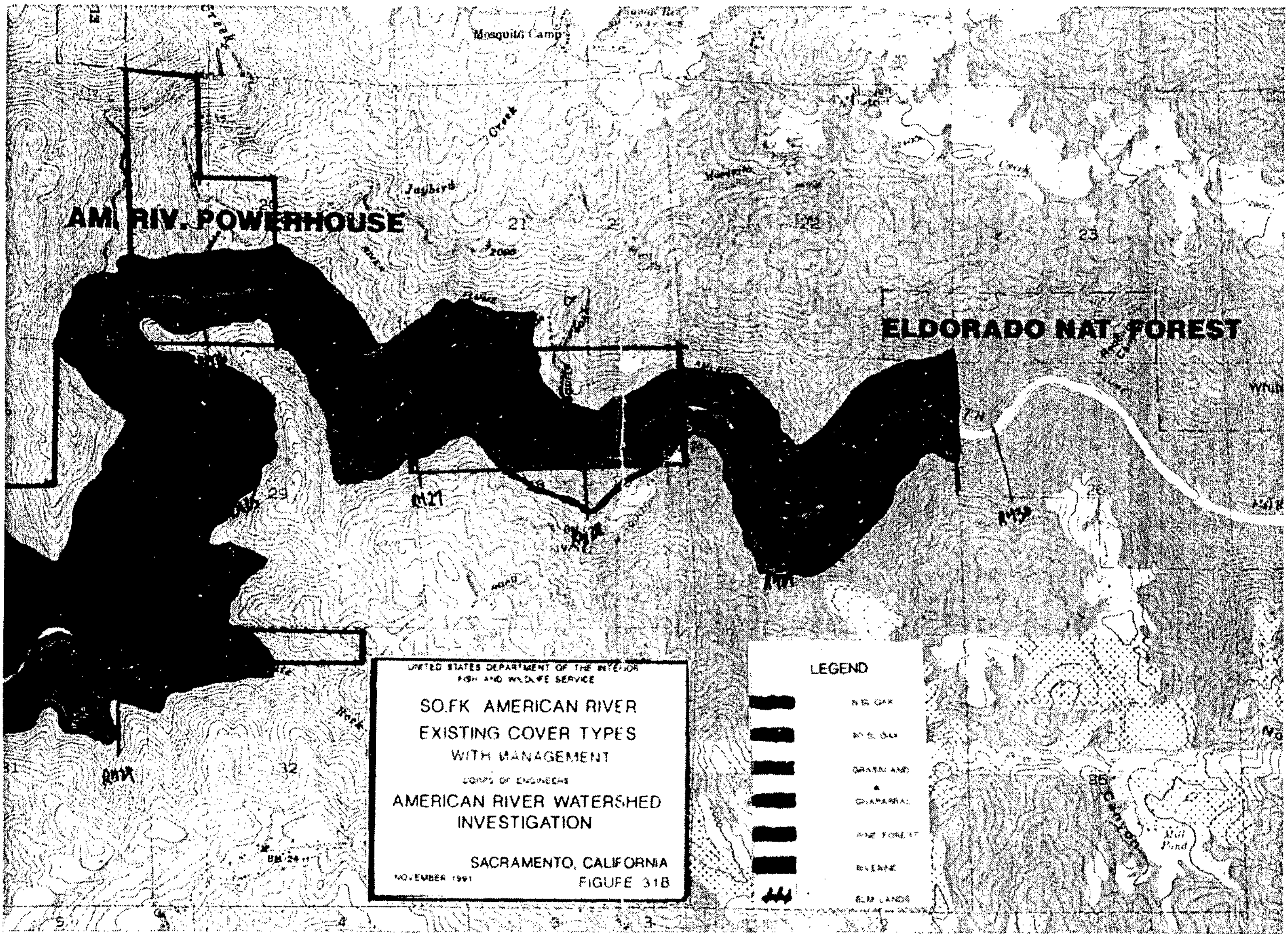

AM. RIV. POWERHOUSE
CHILI BAR RES.
Kelsey
Canyon
Texas
Canyon
UNITED STATES DEPARTMENT
FISH AND WILDLIFE
SO.FK. AMERI
EXISTING CO
WITH MAN
CORPS OF ENG
AMERICAN RIVE
INVESTIG
SACRAM
NOVEMBER 1991
R 10 E
R 11 E
(PLACERVILLE)
SCALE 1:24000
GARDEN VALLEY



ROAD CLASSIFICATION

GARDEN VALLEY CALIF.

Table 16. 200-Year or 400-Year Dry Dam - Alternatives Conceptual Compensation Site Under Existing, Without- and With-Management Conditions

Upland	Existing	Without Management	With Management
North Slope Oak	1332	1201	1332
South Slope Oak	3560	1180	5708
Grassland	2864	203	573
Pine Forest	285	0	428
Chaparral	167	0	167
Upland Scrub	0	0	0
Rocky/Ruderal	0	0	0
Developed	0	5624	0
Subtotal	8208	8208	8208
Wetland			
Montane Riparian	252	0	252
Reservoir	69	69	69
Developed	0	252	0
Subtotal	321	321	321
Total	8529	8529	8529

Mitigation

200-Year Dry Dam Alternative

Based on the results of our HEP analysis, to mitigate the loss of 937 acres of uplands and 472 acres of montane riparian wetlands resulting from dam construction and ongoing operation impacts during project life, 51,996 acres of riverine canyon habitat along the South Fork American River would be needed for wildlife habitat management. These estimates are based on the relative composition of the montane riparian and upland cover types existing in the compensation area. If the project becomes authorized and compensation site(s) selected are significantly different than the conceptual site chosen, then further analysis is needed to ensure that lost habitat values are replaced and in-kind mitigation goals met. Lands should be acquired in fee title and easements and rights-of-way acquired in perpetuity.

Acreages of the various cover types for the 200-year or 400-year alternatives under existing, without- and with-management conditions are shown in Table 16. Wildlife cover types under with-management conditions are shown in Figures 31a and 31b.

Management of fee title lands would focus on wildlife value goals. Public access, recreational activities and other uses would be limited to those compatible with meeting wildlife goals. If any lands are acquired by easement, then management measures would be negotiated with the landowner(s) so that both parties are fully satisfied with easement conditions. On fee title lands, some level of signing, controlled access, and enforcement would likely be necessary.

The approximate 52,000 acre compensation area would be developed into the same proportional wildlife cover as found in the conceptual 8,500 acre compensation area. Therefore, about 96 percent of the cover would be upland and 4 percent wetland. There would be north slope-oak (16 percent), south slope-oak (70 percent), grassland (7 percent), pine forest (5 percent) and chaparral (2 percent) in the upland. There would be montane riparian (79 percent) and reservoir (21 percent) in the wetland. Management options applied and estimated costs for the 8,500 acre conceptual area along the South Fork American River are displayed in Table 17. The average cost per acre for this level of development would be about $3,228. Equivalent level of development on a 52,000 acre compensation area would be approximately $167,843,000.

To mitigate the increased sedimentation and resultant stream habitat degradation in the lowest elevation zones of the North and Middle Forks, (490-800 feet), stream habitat should be improved above Lake Clementine on the North Fork and above streambed elevation 800 feet in the Middle Fork. Preparation of a long-term fishery management plan in consultation with the Department of Fish and Game and the U.S. Fish and Wildlife Service will be required prior to placement of structures such as log barriers, downfall trees, and rock gabions or similar instream devices to create pools and instream cover. Cost of plan development with the Fish and Wildlife Service as lead planning agency is estimated at $50,000. Cost of implementing the plan is estimated at $150,000.

Table 17. Estimated Development Costs for the South Fork American River Compensation Area*

Management Option	Estimated Cost
North Slope Oak Restoration	2,205,000
South Slope Oak Restoration	17,942,000
Pine Forest Restoration	696,000
Grassland Control Burning	234,000
Removal Cattle Grazing **	
Riparian Vegetation Restoration	121,000
Spawning Gravel Placement	1,748,000
Flow Schedule Improvement ***	
Subtotal	22,946,000
20 percent contingency	4,589,000
Total	27,535,000

* These costs represent only costs for developing the 8,529 acre conceptual compensation area. Calculation of total costs to fully meet the mitigation requirements for the 200-year or 400-year plans are included in Table 18. See Appendix F for additional details.

** We assumed fee title acquisition, therefore grazing removal would be cost free.

*** Any flow schedule changes would need to be negotiated with those entities possessing water rights at the upstream reservoirs. Therefore cost estimates are not available at this time.

Although a significant portion of the North and Middle Fork canyons in the 500-800 feet elevation zone would be lost (1409 acres), more than 50 percent of the lands will remain with some wildlife values. Since these lands would be subjected to periodic inundation, best management practices would be necessary to optimize remaining wildlife values. For this reason, a wildlife management plan should be developed and implemented throughout the project life. The Corps, U.S. Fish and Wildlife Service and California Department of Fish and Game should cooperatively develop and implement the plan. Estimated plan development and implementation cost would be approximately $200,000. Average annual operation and maintenance of plan measures is included in the operation and maintenance cost estimates in Table 18.

Additionally, to mitigate the impact of sloughing of canyon walls and resultant river sedimentation, slipouts should be stabilized by revegetating with indigenous species, and sediment be removed from the channel and the streambed recontoured to normal gradient. Work should be done promptly after sloughing. Planning and implementation of slipout repair should be coordinated with the California Department of Fish and Game and the Fish and Wildlife Service.

A long-term monitoring program throughout the project life would be needed in the North and Middle Fork canyons to evaluate the effectiveness of the remedial measures such as slope stabilization, and revegetation. Monitoring would also be needed to gather more information about inundation impacts and possible measures to reduce those impacts. The Corps, Fish and Wildlife Service and the California Department of Fish and Game should cooperatively develop a monitoring plan along with the fisheries plan. The average annual monitoring cost would be about $50,000 (Table 18).

Table 18. 200-Year Dry Dam Alternative - Mitigation Cost Summary

Measure		Cost
1.	Fisheries Management Plan Development and Implementation for the North and Middle Fork American Rivers	$200,000
2.	Wildlife Management Plan Development and Implementation for the North and Middle Fork American River	$200,000
3.	Fish and Wildlife Management Plan Development and Implementation for South Fork American River Compensation Area (51,996 acres)	$167,843,000
	Subtotal	$168,243,000
4.	Long Term Monitoring Costs (100 years)	
	A. North and Middle Fork American Rivers	$5,000,000
	B. South Fork American River	$5,000,000
	Subtotal	$10,000,000
5.	Operations and Maintenance Costs	
	A. North and Middle Fork American River	$10,000,000
	B. South Fork American River	$10,000,000
	Subtotal	$20,000,000
	C. Average Annual O&M Cost	$200,000
6.	Summary of all costs	$198,243,000

400-Year Dry Dam Alternative

To mitigate the loss of 764 acres of canyon riverine wetlands and 1,596 acres of canyon uplands resulting from dam construction and ongoing operation impacts during project life, 78,341 acres of riverine canyon habitat along the South Fork American River would be needed for wildlife habitat management. As with the 200-year Dry Dam Alternative, these estimates are based on the relative composition of riverine wetland and upland cover types present in the selected compensation area. If compensation sites eventually chosen are significantly different, then further analysis is needed to ensure that lost habitat values are replaced and in-kind mitigation goals met. Estimated development costs for the 400-year Dry Dam alternative using the South Fork American River compensation area are shown in Table 19. Lands, easements and rights-of-way costs are not included in these estimates. Lands should be acquired by fee title and easements and rights-of-way should be acquired in perpetuity.

Land management constraints described for the 200-year Dry Dam alternative also apply to this alternative.

Long term monitoring recommendations stated for the 200-year Dry Dam alternative also apply to this alternative. Estimated monitoring costs are the same ($100,000 annual) and so are the operations and maintenance cost estimates (200,000 annual).

Table 19. 400-Year Dry Dam Alternative - Mitigation Cost Summary

Measure		Cost
1. Fisheries Management Plan Development and Implementation for the North and Middle Fork American Rivers		$200,000
2. Wildlife Management Plan Development and Implementation for the North and Middle Fork American River		$200,000
3. Fish and Wildlife Management Plan Development and Implementation for South Fork American River Compensation Area (78,341 Acres)		$252,885,000
	Subtotal	$253,285,000
4. Long term monitoring costs (100 years)		
A. North and Middle Fork American Rivers		$ 5,000,000
B. South Fork American River		$ 5,000,000
	Subtotal	$10,000,000
5. Operations and Maintenance Costs		
A. North and Middle Fork American River		$10,000,000
B. South Fork American River		$10,000,000
	Subtotal	$20,000,000
C. Average Annual O&M Cost		$200,000
6. Summary of all costs		$283,285,000

RECOMMENDATIONS

For the 200-YEAR PROTECTION PLAN, the Fish and Wildlife Service recommends that:

1. To assure adequate evaluation of impacts on fish and wildlife resources of any future expansion of the dam, the authorizing document for the flood control only dam include a statement that any alteration of flood control only facilities, or project purpose, be authorized by additional legislation, and that evaluation studies be conducted prior to such authorization. Studies required are (1) an impact analysis on the biological resources of the Auburn area, lower American River, Sacramento-San Joaquin Delta, San Francisco Bay, and water service areas; and (2) a detailed reanalysis of water allocation for fish and wildlife.

2. To mitigate the loss of 1,409 acres of riverine canyon and upland wildlife habitat due to direct project-related impacts in and near the North and Middle Fork American River Canyons, 51,996 acres along the South Fork American River be acquired and managed for wildlife and fisheries, in perpetuity. Costs for this are estimated at $172,843,000 for development and monitoring and $100,000 annually for operation and maintenance.

3. To mitigate the increased sedimentation and resultant stream habitat degradation in the lowest elevation zone (490-800 feet), stream habitat be improved above Lake Clementine and above streambed elevation 800 feet in the Middle Fork. Preparation of a long-term fishery management plan in consultation with the California Department of Fish and Game and the U.S. Fish and Wildlife Service will be required prior to any revegetation, placement of structures such as log barriers, downfall trees, and rock gabions or similar instream devices to create pools and instream cover. Cost of plan development with the Fish and Wildlife Service as lead planning agency is estimated at $50,000. Cost of implementing the plan is estimated at $150,000. Annual operation, maintenance and replacement costs for equipment, structures and labor is estimated at $50,000. Long term monitoring annual cost is estimated at $25,000.

4. To minimize any additional impacts on the remaining wildlife lands in the project inundation zone, a wildlife management plan be developed cooperatively by the Corps, U.S. Fish and Wildlife Service and the California Department of Fish and Game, and implemented throughout the project life. Plan development cost is estimated at $200,000. Average annual operations and maintenance would be $50,000. Long term monitoring annual cost is estimated at $25,000.

5. To mitigate the impact of sloughing of canyon walls and resultant river sedimentation, slipouts be stabilized by revegetating with indigenous species, and sediment be removed from the channel and the streambed recontoured to normal gradient. Work should be done promptly after sloughing. Planning and implementation of slipout repair should be coordinated with the California Department of Fish and Game and the Fish and Wildlife Service.

For the <u>400-YEAR PROTECTION PLAN</u>, the Fish and Wildlife Service recommends that:

1. To assure adequate evaluation of impacts on fish and wildlife resources of any future expansion of the dam, the authorizing document for the <u>flood control only dam</u> include a statement that any alteration of flood control only facilities, or project purpose, be authorized by additional legislation, and that evaluation studies be conducted prior to such authorization. Studies required are (1) an impact analysis on the biological resources of the Auburn area, lower American River, Sacramento-San Joaquin Delta, San Francisco Bay, and service areas; and (2) a detailed reanalysis of water allocation for fish and wildlife.

2. To mitigate the loss of 2360 acres of riverine canyon wetlands and uplands resulting from dam construction and ongoing operation impacts during project life in the North and Middle Fork American River Canyons, 78,341 acres along the South Fork American River be acquired and managed for wildlife and fisheries, in perpetuity. Costs for this are estimated at $257,885,000 for development and monitoring and $100,000 annually for operation and maintenance.

3. To mitigate the increased sedimentation and resultant stream habitat degradation in the lowest elevation zone (490-800 feet), stream habitat be improved above Lake Clementine and above streambed elevation 800 feet in the Middle Fork. Preparation of a long-term fishery management plan in consultation with the Department of Fish and Game and the U.S. Fish and Wildlife Service will be required prior to placement of structures such as log barriers, downfall trees, and rock gabions or similar instream devices to create pools and instream cover. Cost of plan development with the Fish and Wildlife Service as lead planning agency is estimated at $50,000. Cost of implementing the plan is estimated at $150,000. Annual operation, maintenance and replacement costs for equipment, structures and labor is estimated at $50,000. Long term monitoring annual cost is estimated at $25,000.

4. To minimize any additional impacts on the remaining wildlife lands in the project inundation zone, a wildlife management plan be developed cooperatively by the Corps, U.S. Fish and Wildlife Service and the California

Department of Fish and Game and implemented throughout the project life. Plan development and implementation costs are estimated at $200,000. Average annual operations and maintenance would be $50,000. Long term monitoring annual cost is estimated at $25,000.

5. To mitigate the impact of sloughing of canyon walls and resultant river sedimentation, slipouts be stabilized by revegetating with indigenous species, and sediment be removed from the channel and the streambed recontoured to normal gradient. Work should be done promptly after sloughing. Planning and implementation of slipout repair should be coordinated with the California Department of Fish and Game and the Fish and Wildlife Service.

REFERENCES

Auburn Dam Environmental Impact Study. Volumes 1-6. Prepared for U.S. Department of the Interior, Bureau of Reclamation. Sacramento, California.

Baad, M.F. 1979. Wyethia reticulata status report. California Native Plant Society, Berkeley, CA. Unpubl. Rept.

Barbour, M.G. 1987. California Upland Forests and Woodlands, pp. 132-164.

Biosystems Analysis, Inc. 1984. Study of sensitive plant species on the BLM Red Hills Management Area, Tuolumne County, California. Unpubl. Rept. U.S. Bureau of Land Management, Sacramento, CA.

Biswell, H.H. 1974. The potential for controlled burning to mitigate wildlife losses on the Auburn Reservoir Area. Contract Report number SFWB 38246, U.S. Fish and Wildlife Service, Sacramento, Calif. 65 pp.

Boyd, R. 1985. The response to fire of three rare plant species from the Pine Hill Ecological Reserve. Calif. Dept. Fish and Game, Sacramento, CA. Unpubl. Rept.

Brummit, R.K. 1974. A remarkable new species of Calystegia (Convolvulaceae) from California. New Bull. 29:499-501.

California Department of Parks and Recreation 1979. Resource Inventory Report: Auburn-Folsom Project. Dept. Parks and Recreation, Sacramento, CA 187 pp.

California Department of Water Resources. 1982. A preliminary study of flood control alternatives on the lower American River. Central District Report. Sacramento, California. 66 pp.

City of Auburn and Placer County. 1979. Auburn Area General Plan. City of Auburn and Placer County Planning Commissions, Auburn, CA. 86 pp.

Constance, L. and L.R. Heckard 1970. Two new species of Phacelia (Hydrophyllaceae) from California. Brittonia 22: 25-30.

Cooper, W.S. 1922. The broad-sclerophyll vegetation of California. Publ. 319. Carnegie Inst. Wash. D.C. 145 pp.

Dempster, L.T. 1977. Galium californicum subsp. sierrae status report. California Native Plant Society, Berkeley, CA.

Unpubl. Rept.Dempster, L.T. and G.L. Stebbins. 1968. A cytotaxonomic revision of the fleshy-fruited Galium species of the Californias and Southern Oregon (Rubiaceae). Univ. Calif. Publ. Bot. 46:1-57.

Detrich, P. 1981. California Winter Bald Eagle Survey 1979-1981. U.S. Fish and Wildlife Service, Endangered Species Office, Sacramento, California. 15 pp. + appendices.

__________. 1982. California Winter Bald Eagle Survey 1982. National Wildlife Federation, Raptor Information Center, Washington, D.C. 8 pp. + appendices.

__________. 1986. The status and distribution of the bald eagle in California. Masters degree thesis. California State University, Chico, California.

Dibble, J. 1979. Ceanothus roderickii status report. California Native Plant Society, Berkeley, CA. Unpubl. Rept.

Fiedler, P. 1987. Life history and population dynamics of rare and common mariposa lilies (Calochortus Pursh: Liliaceae). Journ. Ecol. 75:977-995.

__________. 1986. Concepts of rarity in vascular plant species, with special reference to the genus Calochortus Pursh. (Liliaceae). Taxon 35(3):502-518.

__________. 1985a. An investigation into the nature of rarity in the genus Calochortus Pursh. (Liliaceae). PhD. Thesis, Univ. Calif. Berkeley.

__________. 1985b. Heavy metal accumulation and the nature of edaphic endemism in the genus Calochortus (Liliaceae). Am. Journ. Bot. 72:1712-1718.

Gray, A. 1884. Synop. Flora N. America. 1:2:390.

Greene, E.L. 1884. Bull. Calif. Acad. Sci. 1:9.

Greene, E.L. 1883. New western compositae. Bull. Torrey Bot. Club 10:87.

Hanes, T.L. 1977. California Chaparral, pp. 417-469 in M.G. Barbour and J. Major (eds.) Terrestrial Vegetation of California. John Wiley and Sons, New York. 1002 pp.

Heckard, L.R. 1979. Phacelia stebbinsii status report. California Native Plant Society, Berkeley, CA. Unpubl.

Hoover, R.F. 1938. New Californian plants. Leafl. West. Bot. 2:128-129.

Hoover, R.F. 1940. A monograph of the genus Chlorogalum. Madrono 5:137-147.

Howell, J.T. 1936. Concerning Arctostaphylos nissenana. Leafl. West. Bot. 1(2):233-234.

Johnson, David. 1989. Personal communications. Member of Sacramento Chapter National Aububon Society.

Keeley, J.E. and P.H. Zedler 1978. Reproduction of chaparral shrubs after fire: a comparison of sprouting and seeding strategies. Amer. Midland Natur. 99:142-161.

Kennedy Engineers, Royston, Hanamoto, Beck and Abey, Jara Applied Sciences, Inc. 1971.

Knight, W. 1968. A new California Ceanothus. Four Seasons 2(4):23-24.

Knight, W. 1966. The nature and distribution of Arctostaphylos nissenana (Merriam). Four Seasons 1(4):1-16.

Laymon, S.A. 1989. Altitudinal migration movements of spotted owls in the Sierra Nevada, California. The Condor 91:837-841.

McMinn, H.E. 1939. An Illustrated Manual of California Shrubs. Univ. Calif. Press, Berkeley, CA. pp. 388-391.

Merriam, C.H. 1918. Proceedings of the Biological Society of Washington. 31:102.

Munz, P.A. and D.D. Keck. 1973. A California Flora and Supplement. Univ. Calif. Press, Berkeley, CA. P. 174.

Munz, P.H. and D.D. Keck. 1973. A California Flora and Supplement. Univ. California Press, Berkeley, CA. 1681 pp. and supplement 224 pp.

Niehaus, T. 1977a. Senecio laynae status report. California Native Plant Society, Berkeley, CA. Unpubl. Rept.

Niehaus, T. 1977b. Chlorogalum grandiflorum status report. California Native Plant Society, Berkeley, CA. Unpubl. Rept.

Oosting, H.J. 1953. The Study of Plant Communities. W.H. Freeman and Company, San Francisco, CA. 389 pp.

Overton, W.C. Jr. 1981. Unpubl. notes on Calochortus clavatus var. avius. On file U.S. Fish & Wildlife Service, Sacramento, CA.

Owenby, M. 1940. A monograph of the genus Calochortus. Ann. Missouri Bot. Garden. 27(4):371-553 and plates. Pilsbry 1939.

Placer County. 1981. Foresthill General Plan and Environmental Impact Report. Placer County Planning Commission, Auburn, CA. 93 pp.

__________________, 1980. Weimar, Applegate, Clipper Gap General Plan and Environmental Impact Report. Placer County Planning Commission, Auburn, CA. 55 pp.

__________________, 1979. Bowman General Plan. Placer County Planning Commission. Auburn, CA. 56 pp.

Reiser, D.W. and T.C. Bjorn. 1979. Habitat requirements of anadromous salmonids. (General Technical Report PNW-96.) USDA Forest Service. Portland, OR 54 pp.

Smith, F. 1977. A short review of the status of riparian forests in California. Pp. 1-3 in A. Sands (ed.), Riparian forests in California, their ecology and conservation. Division of Agricultural Sciences, University of California. Davis, CA. 122 pp.

Stebbins, G.L. 1977a. Calystegia stebbinsii status report. California Native Plant Society, Berkeley, CA. Unpubl. Rept.

Stebbins, G.L. 1977b. Fremontodendron decumbens status report. California Native Plant Society, Berkeley, CA. Unpubl. Rept.

Stebbins, R.C. 1985. A Field Guide to Western Reptiles and Amphibians. Houghton Mifflin Co. Boston, Mass. 279 pp.

U.S. Bureau of Reclamation. 1971. Auburn Dam Environmental Impact Study, 6 Vols. Prepared by Kennedy Engineers. U.S. Bureau of Reclamation, Sacramento, CA

__________________________. 1988. American River Service Area draft Environmental Impact Statement.

U.S. Fish and Wildlife Service. 1984. A supplemental Detailed Report on the Auburn-Folsom South Unit - lower American River alternatives Central Valley Project.

______________________________. 1984. Life History Information on Juvenile Chinook Salmon in the lower American River study period January-June 1983. Prepared by Division of Ecological Services, Sacramento, California. February 1984.

__________________________. 1989. Service prepared maps of Valley elderberry shrub (Sumbucus spp.) distribution for the American River Watershed Study. Copies of maps in official files. Sacramento, California.

______________________________. 1989. Reports dated May and September 1989 on Middle and North Forks American River fishery surveys. Memos to American River Watershed File. Division of Fish and Wildlife Enhancement, Sacramento, California.

______________________________. 1991. American River Watershed Investigation Special Office Report. Status and trends of of blue oak/diggger pine and montane riparian habitat types within the Western Sierra range. Division of Fish and Wildlife Enhancement. Sacramento, California, 13 pp.

______________________________. 1989. Auburn Interim Wildlife Mitigation Program. Memorandum dated October 3, 1989, to Regional Director, U.S. Bureau of Reclamation, Sacramento, CA, from Field Supervisor, U.S. Fish and Wildlife Service, Sacramento, CA. 24 pp.

U.S. Geological Survey, 1986. Water Resources Data California, Water Year 1986. Volume 4. Water discharge record for North Fork American River below Auburn Damsite, near Auburn, California.

Walters, M.A., R. O. Teskey, and T.M. Hinckley, 1980a. Impact of Water Level Changes on Woody Riparian and Wetland Communities: Vol. VII. Mediterranean Region, Western Arid and Semi-Arid Region. U.S. Fish and Wildlife Service FWS/OBS-78/93. 47 pp.

Whitlow, T. H. , R. W. Harris, and A. T. Leiser. 1979. Use of vegetation to reduce levee erosion in Sacramento-San Joaquin Delta. Davis, CA. Prepared for: California Department of Water Resources, Sacramento, CA. 46 pp. + appendices.

Verner, J. and A.S. Boss (Tech. Coord.), 1980. California wildlife and their habitats: western Sierra Nevada. Gen. Tech. Rep. PSW-37, Pacific Southwest Forest and Range Exp. Stn., U.S.D.A. Forest Ser., Berkeley, CA. 439 pp.

Weber, W. 1946. A taxonomic and cytological study of the genus Wyethia. Amer. Midl. Naturalist 35:400-452.

Wright, A.H. and A.A. Wright. 1975. Handbook of Frogs and Toads (3rd Ed.). Cornell Univ. Press. Ithaca, N.Y. 640 pp.

________________. 1987. Planning Aid Letters to U.S. Army Corps of Engineers Sacramento District dated July 20 and December 18 as part of reconnaissance level investigation. Division of Ecological Services, Sacramento, California. 25 and 30 pps.

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

AMERICAN RIVER WATERSHED INVESTIGATION

AUBURN AREA

APPENDICES

SUBSTANTIATING REPORT

VOLUME II

REGION ONE

NOVEMBER 1991

APPENDIX A

The Scientific and Common Names of Plant Species Discussed in the Text

Common Names	Scientific Names	Area of Occurrence[1] Nat.	L. Am.	Aub.
Alkali bulrush	*Scirpus olneyi*	X	X	
Alkali heath	*Frankenis grandiflora* var. *campestris*	X		
Alkali weed	*Cressa truxellensis*	X	X	
Asparagus	*Asparagus* sp.	X	X	X
Baltic rush	*Juncus balticus*	X	X	X
Bigleaf maple	*Acer macrophyllum*		X	X
Blackberry	*Rubus procerus*	X	X	X
Black oak	*Quercus kelloggii*			X
Black sage	*Salvia mellifera*		X	X
Bladderwort	*Utricularia* sp.	X	X	X
Blue oak	*Quercus douglasii*	X	X	X
Blue wild rye	*Elymus glaucus*	X	X	X
Boisduvalia	*Boisduvalia* sp.	X	X	
Boxelder	*Acer negundo* ssp. *californicum*	X	X	X
Brome	*Bromus* sp.	X	X	X
Brass buttons	*Cotula coronopifolia*	X	X	
Brodiaea	*Brodiaea Dichelostemma* and *Triteleia* sp.	X	X	X
Buckrush	*Ceanothus cuneatus*		X	X
Buckeye	*Aesculus californica*		X	X
Buckwheat	*Eriogonum* sp.	X	X	X
Bulrush	*Scirpus acutus*	X	X	
Burrow bush	*Hymenochlea salsola*	X	X	
Busk monkeyflower	*Displacus aurantiacus*		X	X
Buttonwillow	*Cephalanthus occidentalis*	X	X	X
California bay	*Umbellularia californica*		X	X
California melic	*Melica californica*	X	X	X
California sagebrush	*Artemisia californica*	X	X	X
Canyon live oak	*Quercus chrysolepis*	X	X	X
Cat's ear	*Hypochoeris glabra*	X	X	X
Cattails	*Typha latifolia* and *T. angustifolia*	X	X	X
Chain fern	*Woodwardia fimbriata*		X	X
Chamise	*Adenostoma fasciculatum*			X
Clematis	*Clematis* sp.	X	X	X
Clover	*Trifolium* sp.	X	X	X
Cocklebur	*Xanthium strumarium* var. *canadense*	X	X	X
Coffeeberry	*Rhamnus californicus* ssp. *tomentella*	X	X	X

[1] Nat. = Natomas, L. Am = Lower American, Aub. = Auburn

(cont.)

		Area of Occurrence		
		Nat.	L. Am	Aub.
Common reed grass	*Phragmites communis*	X	X	
Cottonwood	*Populus fremontii*	X	X	X
Creek dogwood	*cornus stolonifera*		X	X
Digger pine	*Pinus sabiniana*		X	X
Douglas-fir	*Pseudotsuga menziesii*			X
Downingia	*Downingia* sp.	X	X	
Duckweed	*Lemna minor*	X	X	X
Elderberry	*Sambucus* spp.	X	X	X
Elodea	*Elodea canadensis*	X	X	X
Fat hen	*Atriplex patula*	X	X	X
Fescue	*Festuca* spp.	X	X	X
Fiddleneck	*Amsinckia* spp.	X	X	X
Filaree	*Erodium* spp.	X	X	X
Flannel bush	*Fremontodendron californicum*			X
Fleshy jaumea	*Jaumea carnosa*	X	X	
Flowering dogwood	*Cornus nuttallii*			X
Foxtail	*Hordeum* spp.	X	X	X
Giant reed	*Arundo donax*	X	X	
Goldfields	*Lasthenia californica*	X	X	
Gooseberry	*Ribes* sp.		X	X
Hairgrass	*Deschampsia danthonioides*	X	X	X
Hazelnut	*Corylus cornuta* var. *californica*			X
Horned pondweed	*Zanichellia palustris*	X	X	
Horsetail	*Equisetum* spp.	X	X	X
Horseweed	*Conyza canadensis*	X	X	X
Incense cedar	*Calocedrus decurrens*			X
Interior live oak	*Quercus wislizenii*		X	X
Iodine bush	*Allenrolfea occidentalis*	X		
Knit grass	*Gastridium ventricosum*	X	X	X
Lady fern	*Athyrium filix-femina*		X	X
Barley	*Hordeum* spp.	X	X	X
Lupine	*Lupinus* spp.	X	X	X
Manzanita	*Arctostaphylos* spp.		X	X
Grindelia	*Grindelia* spp.	X	X	X
Marsh pennywort	*Hydrocotyle verticillata*	X	X	
Meadowfoam	*Limnanthes* sp.	X	X	X
Mistletoe	*Phoradendron* sp.	X	X	X
Mountain mahogany	*Cercocarpus betuloides*		X	X
Mousetail	*Myosurus minimus*	X		
Mugwort	*Artemisia douglasiana*	X	X	X
Mulefat	*Baccharis viminea*	X	X	X
Mustard	*Brassica*	X	X	X
Navarretia	*Navarretia* sp.	X	X	X
Nettles	*Urtica* sp.	X	X	X
Needlegrass	*Stipa* spp.	X	X	X
Oregon ash	*Fraxinus latifolia*	X	X	X
Owl's clover	*Orthocarpus* spp.	X	X	X
Pepper grass	*Lepidium* sp.	X	X	X
Pickleweed	*Salicornia* sp.	X		

(cont.)

		Area of Occurrence Nat.	L. Am	Aub.
Pogogyne	*Pogogyne douglasii*	X	X	
Poison-oak	*Toxicodendron diversilobum*	X	X	
Ponderosa pine	*Pinus ponderosa*			X
Pondweed	*Potamogeton* sp.	X	X	X
Popcorn flower	*Plagiobothrys* sp.	X	X	X
Poppy	*Eschscholzia californica*	X	X	X
Redbud	*Cercis occidentalis*		X	X
Rush	*Juncus* sp.	X	X	X
Salt grass	*Distichlis spicata*	X	X	
Sand-spurry	*Spergularia* sp.	X	X	
Sedge	*Carex* sp.	X	X	X
Seep-weed	*Suaeda* spp.	X		
Serviceberry	*Amelanchier* sp.			X
Snowberry	*Symphoricarpos* sp.			X
Spice bush	*Calycanthus occidentalis*			X
Spike rush	*Eleocharis macrostachya*	X	X	X
Saltbush	*Atriplex* spp.	X	X	X
Sugar pine	*Pinus lambertiana*			X
Sycamore	*Platanus racemosa*	X	X	X
Tanoak	*Lithocarpus densiflora*			X
Thistle	*Silybum marianum*	X	X	X
Toyon	*Heteromeles arbutifolia*		X	X
Tule	*Scirpus* sp.	X	X	X
Umbrella sedge	*Cyperus eragrostis*	X	X	X
Valley oak	*Quercus lobata*	X	X	X
Valley saltbush	*Atriplex polycarpa*	X	X	
Verbena	*Verbena* spp.	X	X	
Walnut	*Juglans* spp.	X	X	
Water fern	*Azolla filiculoides*	X	X	X
Water lily	*Nuphar polysepalum*	X	X	X
Water milfoil	*Myriophyllum* sp.	X	X	X
White alder	*Alnus rhombifolia*	X	X	X
White fir	*Abies concolor*			X
White thorn	*Ceanothus cordulatus*			X
Wild grape	*Vitis californica*	X	X	X
Wild oats	*Avena* spp.	X	X	X
Wild rose	*Rosa californica*	X	X	X
Willow	*Salix* sp.	X	X	X
Woolly marbles	*Psilocarphus brevissimus*	X	X	
Yellow waterweed	*Ludwigia peploides*	-	X	

Table A. Wildlife Species of the American River Watershed Study Area

Common Name	Scientific Name	Habitats[a]
	BIRDS	
Red-throated loon	Gavia stellata	O
Common loon	Gavia immer	O
Pied-billed grebe	Podilymbus podiceps	O,M
Horned grebe	Podiceps auritus	O,M
Eared grebe	Pidiceps nigricollis	O,M
Western grebe	Aechmophorus occidentalis	O
American white pelican	Pelecanus erythrorhynchos	O,M
Double-crested cormorant	Phalacrocorax auritus	O,M
American bittern	Botaurus lentiginosus	M
Great blue heron	Ardea herodias	M,R
Great egret	Casmerodius albus	M,R
Snowy egret	Egretta thula	M
Cattle egret	Bubulcus ibis	M,A
Green-backed heron	Butorides striatus	M,R
Black-crowned night heron	Nycticorax nycticorax	M,R
White-faced ibis	Plegadis chihi	M,A
Tundra swan	Cygnus columbianus	M,A
Greater white-fronted goose	Anser albifrons	M,A
Snow goose	Chen caerulescens	M,A
Ross' goose	Chen rossii	M,A
Canada goose	Branta canadensis	M,A,C
Wood duck	Aix sponsa	M,R
Green-winged teal	Anas crecca	M,O
Mallard	Anas platyrhynchos	M,O
Norther Pintail	Anas acuta	M,O
Blue-winged teal	Anas discors	M,O
Cinnamon teal	Anas cyanoptera	M,O
Northern shoveler	Anas clypeata	M,O
Gadwall	Anas strepera	M,O
Eurasian wigeon	Anas penelope	M,O
American wigeon	Anas americana	M,O
Canvasback	Aythya valisineria	M,O
Redhead	Aythya americana	M,O
Ring-necked duck	Aythya collaris	M,O
Greater scaup	Aythya marila	M,O
Lesser scaup	Aythya affinis	M,O
Common goldeneye	Bucephala clangula	M,O
Barrow's goldeneye	Bucephala islandica	M,O
Bufflehead	Bucephala albeola	M,O
Hooded merganser	Lophodytes cucullatus	M,O
Common merganser	Mergus merganser	O
Ruddy duck	Oxyura jamaicensis	M,O

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (continued)	
Turkey vulture	Cathartes aura	C,W,A,F
Osprey	Pandion haliaetus	O
Black-kshouldered kite	Elanus caeruleus	C,W,A
Bald eagle	Haliaeetus leucocephalus	O
Northern harrier	Circus cyaneus	A,G,M
Sharp-shinned hawk	Accipiter striatus	W,G,R,F
Cooper's hawk	Accipiter cooperii	W,G,R,F
Northern goshawk	Accipiter gentilis	W,G,F
Red-shouldered hawk	Buteo lineatus	R
Swainson's hawk	Buteo swainsoni	A,R,G
Red-tailed hawk	Buteo jamaicensis	A,R,G,W,C,F
Ferruginous hawk	Buteo regalis	A,G
Rough-legged hawk	Buteo lagopus	A,G
Golden eagle	Aquila chrysaetos	G,W
American kestrel	Falco sparverius	A,G,R,F
Merlin	Falco columbarius	A,G
Peregrine falcon	Falco peregrinus	M,A,G,F
Prairie falcon	Falco mexicanus	G,A,M
Ring-necked pheasant	Phasianus colchicus	A,R
Wild turkey	Meleagris gallopavo	G,W,F
California quail	Callipepla californica	O,W,C,R,F
Mountain quail	Oreortyx pictus	W,C,F
Virginia rail	Rallus limicola	M
Sora	Porzana carolina	M
Common moorhen	Gallinula chloropus	M,O
American coot	Fulica americana	M,O
Sandhill crane	Grus canadensis	A,M
Black-bellied plover	Pluvialis squatarola	G,M,A
Lesser golden plover	Pluvialis dominica	G,M,A
Snowy plover	Charadrius alexandrinus	M
Semipalmated plover	Charadrius semipalmatus	M
Killdeer	Charadrius vociferus	M,A,G
Mountain plover	Charadrius montanus	A
Black-necked stilt	Himantopus mexicanus	M,A
American avocet	Recurvirostra americana	M,A
Greater yellowlegs	Tringa melanoleuca	M
Lesser yellowlegs	Tringa flavipes	M
Solitary sandpiper	Tringa solitaria	M
Willet	Catoptrophorus semipalmatus	M
Spotted sandpiper	Actitis macularia	M,R
Whimbrel	Numenius phaeopus	M
Long-billed curlew	Numenius americanus	M,A,C

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (continued)	
Marbled godwit	Limosa fedoa	M
Red knot	Calidris canutus	M
Western sandpiper	Calidris mauri	M
Least sandpiper	Calidris minutilla	M
Baird's sandpiper	Calidris bairdii	M
Pectoral sandpiper	Calidris melanotos	M
Dunlin	Calidris alpina	M
Short-billed dowitcher	Limnodromus griseus	M
Long-billed dowitcher	Limnodromus scolopaceus	M
Common snipe	Gallinago gallinago	M
Wilson's phalarope	Phalaropus tricolor	M,O
Red-necked phalarope	Phalaropus lobatus	M,O
Bonaparte's gull	Larus philadelphia	M,O
Mew gull	Larus canus	M,O
Ring-billed gull	Larus delawarensis	M,O,A
California gull	Larus californicus	M,O,A
Herring gull	Larus argentatus	M,O,A
Thayer's gull	Larus thayeri	M,O,A
Glaucous-winged gull	Larus glaucescens	M,O,A
Caspian tern	Sterna caspia	O
Forster's tern	Sterna forsteri	O
Black tern	Chlidonias niger	M,O
Rock dove	Columba livia	G,A
Band-tailed pigeon	Columba fasciata	W,C,F
Mourning dove	Zenaida macroura	A,W,C,G,F
Yellow-billed cuckoo	Coccyzus americanus	R
Greater roadrunner	Geococcyx californianus	C
Common barn-owl	Tyto alba	A,G
Western screech-owl	Otus kennicottii	W,R,F
Great horned owl	Bubo virginianus	W,R,F
Northern pygmy-owl	Glaucidium gnoma	W
Burrowing owl	Athene cunicularia	G,A
Long-eared owl	Asio otus	R
Short-eared owl	Asio flammeus	O,A,M
Northern saw-whet owl	Aegolius acadicus	W,F
California spotted owl	Strix occidentalis	W,F
Lesser nighthawk	Chordeiles acutipennis	C,R,F
Common nighthawk	Chordeiles minor	C,R,F
Common poorwill	Phalaenoptilus nuttallii	C,R
Vaux's swift	Chaetura vauxi	R,C,F
White-throated swift	Aeronautes saxatalis	R,C,W,F
Black-chinned hummingbird	Archilochus alexandri	R,C
Anna's hummingbird	Calypte anna	R,C,U,F

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (CONTINUED)	
Costa's hummingbird	*Calypte costae*	R,C
Rufous hummingbird	*Selasphorus rufus*	R,U
Allen's hummingbird	*Sleasphorus sasin*	R,U
Belted kingfisher	*Ceryle alcyon*	R,O
Lewis' woodpecker	*Melanerpes lewis*	W,G,F
Acorn woodpecker	*Melanerpes formicivorous*	W,G,F
Yellow-bellied sapsucker	*Sphyrapicus varius*	W,R,A
Red-breasted sapsucker	*Sphyrapicus ruber*	W,R,F
Nuttall's woodpecker	*Picoides nuttallii*	W,R,F
Downy woodpecker	*Picoides pubescens*	W,R,F
Hairy woodpecker	*Picoides villosus*	W,F
Northern flicker	*Colaptes auratus*	W,R,G,F
Olive-sided flycatcher	*Contopus borealis*	W,R,F
Western wood-pewee	*Contopus sordidulus*	W,R,F
Willow flycatcher	*Empidonax traillii*	R
Hammond's flycatcher	*Empidonax hammondii*	R,W,F
Dusky flycatcher	*Empidonax oberholseri*	R,W,C,F
Gray flycatcher	*Empidonax wrightii*	R
Western flycatcher	*Empidonax difficilis*	R,F
Black phoebe	*Sayornis nigricans*	R,M
Say's phoebe	*Sayornis saya*	G
Ash-throated flycatcher	*Myiarchus cinerascens*	W,R
Western kingbird	*Tyrannus verticalis*	G
Horned lark	*Eremophila alpestris*	G
Purple martin	*Progne subis*	G
Tree swallow	*Tachycineta bicolor*	R,A,G,F
Violet-green swallow	*Tachycineta thalassina*	R,A,G,F
Northern rough-winged swallow	*Stelgidopteryx serripennis*	R,A,G
Bank swallow	*Riparia riparia*	R
Cliff swallow	*Hirundo pyrrhonota*	R,A,G,O
Barn swallow	*Hirundo rustica*	R,A,G,O
Scrub jay	*Aphelocoma coerulescens*	W,R,F
Yellow-billed magpie	*Pica nuttalli*	G,R
American crow	*Corvus brachyrhynchos*	W,G,R
Plain titmouse	*Parus inornatus*	W,R,F
Bushtit	*Psaltriparus minumus*	W,R,F
Red-breasted nuthatch	*Sitta canadensis*	W,F
White-breasted nuthatch	*Sitta carolinensis*	W,F
Brown Creeper	*Certhia americana*	W,F
Rock wren	*Salpinctes obsoletus*	Ro
Canyon wren	*Catherpes mexicanus*	Ro
Bewick's wren	*Thryomanes bewickii*	R,W,C,F

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (continued)	
House wren	Troglodytes aedon	R,W,F
Winter wren	Troglodytes troglodytes	R
Marsh wren	Cistothorus palustris	M
American dipper	Cinclus mexicanus	R
Golden-crowned kinglet	Regulus satrapa	W,R,F
Ruby-crowned kinglet	Regulus calendula	W,R,F
Blue-gray gnatcatcher	Polioptila caerulea	R,C,F
Western bluebird	Sialia mexicana	G,W,C
Mountain bluebird	Sialia currucoides	G,W
Townsend's solitaire	Myadestes townsendi	W,F
Swainson's thrush	Catharus ustulatus	R,W,F
Hermit thrush	Catharus guttatus	R,W,C,F
American robin	Turdus migratorius	G,R,W,C,U,F
Varied thrush	Ixoreus naevius	R,W,F
Wrentit	Chamaea fasciata	R,C
Northern mockingbird	Mimus polyglottos	R,C,U
California thrasher	Toxostoma redivivum	C,R
Water pipit	Anthus spinoletta	G
Cedar waxwing	Bombycilla cedrorum	W,F
Phainopepla	Phainopepla nitens	R,W,F
Loggerhead shrike	Lanius ludovicianus	G,A
European starling	Sturnus vulgaris	G,A,U,W,C
Solitary vireo	Vireo solitarius	W,R,F
Hutton's vireo	Vireo huttoni	W,R,F
Warbling vireo	Vireo gilvus	W,R,F
Orange-crowned warbler	Vermivora celata	C,R,W,F
Nashville warbler	Vermivora ruficapilla	R,W,F
Yellow warbler	Dendroica petechia	R,F
Yellow-rumped warbler	Dendroica coronata	R,W,U,F
Black-throated gray warbler	Dendroica nigrescens	W,F
Townsend's warbler	Dendroica townsendi	W,F
Hermit warbler	Dendroica occidentalis	W,F
MacGillivray's warbler	Oporornis tolmiei	W,R,F
Common yellowthroat	Geothlypis trichas	M,R
Wilson's warbler	Wilsonia pusilla	M,r,C,F
Yellow-breasted chat	Icteria virens	R
Western tanager	Piranga ludoviciana	W,R,F
Black-headed grosbeak	Pheucticus melanocephalus	W,R
Blue grosbeak	Guiraca caerulea	R,G
Lazuli bunting	Passerina amoena	R,G,W,F
Rufous-sided towhee	Pipilo erythrophthalmus	C,U,F
Brown towhee	Pipilo fuscus	C,U,F
Rufous-crowned sparrow	Aimophila ruficeps	C,R
Chipping sparrow	Spizella passerina	C,R,W,F

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	BIRDS (continued)	
Vesper sparrow	Pooecetes gramineus	G
Lark sparrow	Chondestes grammacus	G,W
Sage sparrow	Amphispiza belli	C
Savannah sparrow	Passerculus sandwichensis	G,R
Fox sparrow	Passerella iliaca	R,C,F
Song sparrow	Melospiza melodia	R,M
Lincoln's sparrow	Melospiza lincolnii	R,M
Golden-crowned sparrow	Zonotrichia atricapilla	G,U,C
White-crowned sparrow	Zonotrichia leucophrys	G,U,C
Dark-eyed junco	Junco hyemalis	G,W,C,F
Red-winged blackbird	Agelaius phoeniceus	M,R,G,A
Tricolored blackbird	Agelaius tricolor	M,R,G,A
Western meadowlark	Sturnella neglecta	G,F
Yellow-headed blackbird	Xankthocephalus xanthocephalus	M
Brewer's blackbird	Euphagus cyanocephalus	M,A,U,G
Brown-headed cowbird	Molothrus ater	R,M,G,A
Northern Oriole	Icterus galbula	W,F
Purple finch	Carpodacus purpureus	R,W,F
House finch	Carpodacus mexicanus	R,W,A,U,F
Pine siskin	Carduelis pinus	W,F
Lesser goldfinch	Carduelis psaltria	R,G,W,F
Lawrence's goldfinch	Carduelis lawrencei	R,G,W,C,F
American goldfinch	Carduelis tristis	R,G,W,C,F
Evening grosbeak	Coccothraustes vespertinus	W,F
House sparrow	Passer domesticus	U
	AMPHIBIANS	
Foothill Yellow legged frog	Rana boylei	R,M,F
California newt	Taricha torosa	R,G,W,F
Tiger salamander	Ambystoma tigrinum	R,G
California slender salamander	Batrachoseps attenuatus	R,G,W
Arboreal salamander	Aneides lugubris	W
Western spadefoot	Scaphiopus hammondi	G
Western toad	Bufo boreas	R,G
Pacific treefrog	Hyla regilla	R,G
Bullfrog	Rana catesbeiana	M
Ensatina	Ensatina eschschottzi	R,W,M,F

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland, (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	REPTILES	
Western pond turtle	Clemmys marmorata	M,R,F
Western fence lizard	Sceloporus occidentalis	C,W,G,F
Gilbert's skink	Eumeres gilberti	G,W,Ro
Western skink	Eumeres skiltonianus	G,W,Ro
Western whiptail	Cnemidophorus tigris	W,R
Southern alligator lizard	Gerrhonotus multicarinatus	G,C,W,F
Ringneck snake	Diadophis punctatus	W,G,C,F
Sharp-tailed snake	Contia tenuis	W,G,C,F
Coachwhip	Masticophis flagellum	G,W
Racer	Coluber constrictor	C,G,F
Gopher snake	Pituophis melaneoleucuc	G,W,R,M,A,F
Common kingsnake	Lampropeltis getulus	G,W,R,M,F
Long-nosed snake	Rhinocheilus lecontei	G,W
Giant garter snake	Thamnophis gigas	M,R,O,W
Common garter snake	Thamnophis sirtalis	A,M,G
Western terrestrial garter snake	Thamnophis elegans	M,G,F
Western aquatic garter snake	Thamnophis couchi	M,G,O,F
Night snake	Hypsiglena torquata	C,R
Western rattlesnake	Crotalus virdis	C,G,R,W,F
Coast horned lizard	Phrynosoma coronatum	G,Ro,W,C,A
	MAMMALS	
Trowbridge shrew	Sorex trowbridgei	R,W
Virginia opossum	Didelphis virginiana	R,F
Vagrant shrew	Sorex vagrans	R,G,M
Ornate shrew	Sorex ornatus	R,M
California myotis	Myotis californicus	Widespread in many habitat
Red bat	Lasiurus borealis	Widespread in many habitat
Hoary bat	Lasiurus cinereus	Widespread in many habitat
Pallid bat	Antrozous pallidus	Widespread in many habitat
Brazilian free-tailed bat	Tadarida brasiliensis	Widespread in many habitat
Big free-tailed bat	Tadarida macrotis	Widespread in many habitat
Desert cottontail	Sylvilagus audubonii	G,M,R
Brush rabbit	Sylvilagus bachmani	C,W,R
Broad-footed mole	Scapanus latimanus	G,W,A
Yuma myotis	Myotis yumanensis	Widespread in many habitat

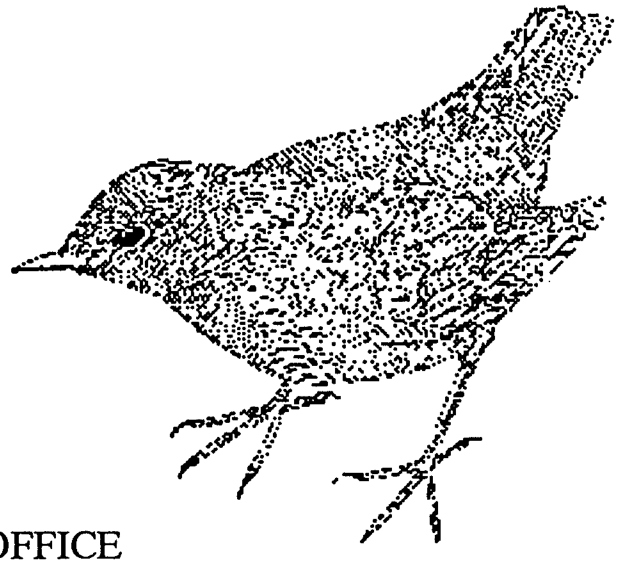
[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland, (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

Common Name	Scientific Name	Habitats[a]
	MAMMALS (continued)	
Western pipistrelle	*Pipistrellus hesperus*	Widespread in many habitat
Big Brown Bat	*Eptesicus fuscus*	Widespread in many habitat
Townsends big-caved bat	*Plecotus townsendi*	Widespread in many habitat
Black-tailed hare	*Lepus californicus*	G,M
California ground squirrel	*Spermophilus beechevi*	G,M,R,C
Beaver	*Castor canadensis*	R,M,F
Western harvest mouse	*Reithrodontomys megalotis*	G
Deer mouse	*Peromyscus maniculatus*	G,F
California vole	*Microtus californicus*	G,F
Muskrat	*Ondatra zibethicus*	M,F
Black rat	*Rattus rattus*	U,A,F
Norway rat	*Rattus norvegicus*	U,A,F
House mouse	*Mus musculus*	U,A,F
Coyote	*Canis latrans*	C,W,G,F
Red Fox	*Vulpes vulpes*	G,W,F
Gray fox	*Urocvon cinereoargenteus*	G,W,R,F
Ringtail	*Bassariscus astutus*	R,F
Raccoon	*Procvon lotor*	R,F
Mink	*Mustela vison*	R,M,F
Western spotted skunk	*Spilogale gracilis*	R
Striped skunk	*Mephitis mephitis*	R,W
River otter	*Lutra canadensis*	R
Black-tailed deer	*Odocoileus hemionus*	C,W,G,R,F
Western gray squirrel	*Sciurus griseus*	W,R,F
Botta's pocket gopher	*Thomomy's bottae*	R,G,W
Brush mouse	*Peromyscus boylei*	C,W,F
Pinyon mouse	*Peromyscus truei*	W,Ro,F
Dusky-footed woodrat	*Neotoma fuscipes*	C,W,R,F
Porcupine	*Erethizon dorsatum*	C,F
Long-tailed weasel	*Mustela frenata*	Widespread in many habitat
Badger	*Taxidea taxus*	G,A,W
Mountain lion	*Felis concolor*	R,W,C,Ro,F
Bob cat	*Lynx rufus*	R,G,W,C,F

[a] Major wildlife habitats of the American River Watershed Study Area include: riparian (R), freshwater marsh (M), grassland, (G), oak woodland (W), mixed evergreen forest (F), chaparral (C), agricultural areas (A), open water (O), urban (U), and rocky areas (Ro).

APPENDIX B

APPENDIX
B



UNITED STATES DEPARTMENT
OF
THE INTERIOR

FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE ENHANCEMENT OFFICE
SACRAMENTO, CALIFORNIA

HABITAT EVALUATION PROCEDURE
AMERICAN RIVER WATERSHED PROJECT
AUBURN AREA
PLACER COUNTY, CALIFORNIA

by

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Fish and Wildlife Biologist
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Monty Knudsen
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November 1991

DISCLAIMER

This is the completed Habitat Evaluation Procedures report for the Corps of Engineers American River Watershed Investigation, Auburn Area. It has been approved by the U. S. Fish and Wildlife Service. It does not necessarily represent official positions or approval of cooperating agencies, and it does not necessarily represent the views of all individuals involved in the process. This analysis is subject to modifications as dictated by new findings and changes in project designs or underlying assumptions.

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PURPOSE OF REPORT

The results of the Habitat Evaluation Procedures analysis of the proposed Auburn dry dam portion of the American River Watershed Investigation are presented in this report. The study was conducted using a team of biologists and environmental professionals from the U.S. Fish and Wildlife Service, California Department of Fish and Game, California Department of Water Resources, and U.S. Army Corps of Engineers. A team approach was used to design and conduct the study. The team discussed and/or made decisions regarding study goals, evaluation elements, field sampling sites, study assumptions, and mitigation goals, management actions, and compensation plans.

This report is a technical evaluation; and, therefore, intended for an audience with a thorough understanding of Habitat Evaluation Procedures. The results of this evaluation are intended for use of the participating agencies. The goal of the analysis is to describe the impacts of the proposed project and to determine the amount of mitigation necessary to compensate for those impacts.

PURPOSE OF THE STUDY

The objectives in this HEP study are to provide an assessment of the environmental impacts of two alternative measures and related activities designed to provide 200-year and 400-year level of flood protection for Sacramento, respectively. The objectives are as follows:

1. Determine baseline habitat conditions for selected evaluation elements in the project impact and potential mitigation areas.

2. Qualitatively and quantitatively assess project impacts on fish and wildlife habitat from an ecological perspective.

3. Determine mitigation alternatives for avoidable and unavoidable impacts.

4. Develop appropriate mitigation plans for Auburn impact areas.

5. Determine acreage needed to fully compensate for project induced impacts.

INTRODUCTION

PROJECT DESCRIPTION

The U.S. Army Corps of Engineers American River Watershed Investigation is directed at resolving flood protection problems in the Sacramento metropolitan area. To that end, they are examining flood control features in the American River canyon at Auburn, in the Lower American River between Folsom Dam and the Sacramento River, and in the Natomas area.

For purposes of our analysis, we divided the Corps of Engineers' American River Watershed Project into these three areas, the Natomas area in Sacramento, Yolo, and Sutter Counties, the lower American River area within Sacramento County, and the Auburn area in Placer and El Dorado Counties. This report deals only with the Auburn area of the project.

Table 1. Physical features - Auburn Dam Alternatives.

Components	200-Year Alternative Plan	400-Year NED Plan
Storage capacity	545,000 Acre Feet	894,000 Acre Feet
Type of dam	Flood control only	Flood control only
Flood storage pool elevation	865 feet	942 feet
Surface acres (maximum pool)	4,000	5,450
Permanent storage	none (could be expanded to 2.3 million Acre feet)	none (could be expanded to 2.3 million Acre feet)
Highway 49 relocation	yes	yes

Two flood control alternatives are being investigated upstream of Folsom Reservoir on the upper American River (Table 1). Each alternative involves construction of a dam and temporary inundation of the river canyons. Construction on the dam would begin in 1994 and continue for about 7 years. The period of analysis is 108 years.

200-YEAR PROTECTION (FLOOD CONTROL ONLY DAM)

The 200-Year flood control dry dam would be located slightly downstream of the existing Auburn Dam site, about 3.7 miles downstream from the North and Middle Fork American River confluence. The dam is of a curved alignment concrete gravity design constructed with roller compacted concrete. At full capacity, the reservoir would inundate approximately 16.5 miles of the North Fork, including Lake Clementine, and 17.5 miles of the Middle Fork, and 4,000 acres of land. The reservoir is designed to store temporarily (1 to 12 days) up to 545,000 acre-feet of water during storms.

The dam extends from elevation 490 feet mean sea level (msl) (channel bottom) to approximately elevation 930 feet msl. The 434-foot-high, 2,700-foot-long, 15-foot-wide (at crest) dam includes a vertical upstream face and a sloped downstream face. The dam is designed not to preclude future expansion to a large multipurpose structure (2.3 million acre-foot reservoir).

All lands (19,000 acres) within the temporary inundation zone would be retained (if in Federal ownership) or acquired (if not in Federal ownership). Lands outside of the inundation zone and in Federal ownership would be transferred to other agencies for management. The Corps of Engineers assumes that a total of about 14,200 acres would be transferred and held in public trust by other government agencies.

State Highway 49 would be relocated, and a two-lane bridge constructed across the river canyon at River Mile 23. Also, on the North Fork, Ponderosa Way would be relocated and Ponderosa Bridge would be raised to avoid inundation.

400-YEAR PROTECTION (FLOOD CONTROL ONLY DAM; CORPS OF ENGINEERS' NED PLAN)

The 400-Year NED flood control dam would be located at the same site as the 200-Year alternative, i.e., slightly downstream of the existing Auburn Dam site, about 3.7 miles downstream from the North and Middle Fork American River confluence. This dam is also designed not to preclude future expansion to a large multipurpose structure. It features a curved alignment concrete gravity design constructed with roller compacted concrete. At full capacity, the reservoir would inundate approximately 19.5 miles of the North Fork and Lake Clementine and 20.5 miles of the Middle Fork, and 5,450 acres of land. The reservoir would temporarily store (1-12 days) up to 894,000 acre-feet to a maximum elevation of 942 feet mean sea level. The dam extends from base foundation at 450 feet mean sea level to 998 feet at the top. The dam rises 548 feet from a 400 feet wide base to a 20 feet wide crest. It would be about 2,700 feet in length.

Project designs include relocation of state highway 49, and the construction of facilities to excavate and transport aggragate rock to the dam site at river mile 20.5. Each alternative would affect 6,506 acres of canyon habitats.

Finding no mitigation opportunities within projecct lands and needing to compensate for direct construction and long-term operation impacts, we investigated potential mitigation sites in other nearby areas. Since our goal was in-kind compensation, we looked for free flowing riverine canyons with the same general elevation zones as those being affected in the North and Middle Fork American River canyons. A logical first choice was the South Fork American River since we believed the South Fork would have topographic and ecological features similar to those found in the North and Middle Fork canyons. During the course of the investigation, we learned that many of the lands in the South Fork canyons are likely to be developed in the near future and their wildlife values largely lost. Therefore, we determined that acquiring these lands and improving similar in-kind habitat would serve as a mitigation proposal for our HEP analysis.

The compensation area is located within a similar foothill region as the North and Middle Fork American Rivers. It lies along the South Fork American River between the Salmon Falls Bridge at the upper end of Folsom Lake and the El Dorado National Forest boundary. The compensation area includes two river reaches. The lower reach extends from above the confluence of Burnt Shanty Creek to near the town of Lotus. The upper reach extends from near the confluence of Dutch Creek above Coloma to the National Forest boundary. Riverbed elevation is near 425 feet at the Salmon Falls Bridge and increases to near 1,500 feet at the National Forest boundary. The riverbed gradient is moderate, dropping about 35 feet per mile over the length of the area. The river flows through relatively steep sloped canyons (24%) from the El Dorado National Forest Service Boundary past the town of Coloma and then through less steep canyons (13%) from Coloma to the Salmon Falls Bridge at the upper end of Folsom Reservoir. A 13.8 mile reach of canyon with riverine (252 acres) and upland (8,208 acres) of wildlife cover was selected as a compensation area. The compensation area straddles both sides of the river and extends up to elevations of 1200 feet or more to the canyon rims.

All of the wildlife cover types impacted at the Auburn dam site occur in the compensation area. The condition of wildlife cover varies greatly within the compensation area. A significant portion of the area is relatively pristine whereas other portions are affected by development. Most of the oak woodlands are in good condition with moderate to high wildlife values. Compared to the North and Middle Fork American canyons there is proportionally less north slope oak woodland habitat than southslope due to the gentler slopes. Most of the grasslands are very open and are typical of moderately grazed canyon lands that were cleared of native trees many years ago. Burning at regular intervals is commonly practiced to maintain grasslands for grazing. Most of the tributary streams draining into the South Fork meander for several miles from the higher elevations. Narrow bands of riparian vegetation line these streams. Seasonal marshes occur along spring seeps which flow from the canyon walls. The remaining woodlands vary from broad continuous thickets to sparse isolated thickets. In many cases, grazing has greatly reduced recruitment of young tree seedlings.

Table 2. Summary of changes in Auburn area habitat types under 400-Year alternative.

Starting Acres	Habitat Types	Ending Acres	Change
892.00	S. Slope	295.95	-596.05
901.00	N. Slope	278.31	-622.69
115.00	Chaparral	41.09	-73.91
135.00	Pine Forest	60.82	-74.18
862.00	Mont Riparian	122.69	-739.31
133.00	Rocky/Ruderal	1460.26	1327.26
97.00	Grassland	497.56	400.56
0.00	Upland Scrub	378.32	378.32
3135.00		3135.00	0.00

Table 3. Summary of changes in Auburn area habitat types under 200-Year alternative.

Starting Acres	Habitat Types	Ending Acres	Change
892.00	S. Slope	586.71	-305.29
901.00	N. Slope	574.76	-326.24
115.00	Chaparral	73.55	-41.45
135.00	Pine Forest	98.93	-36.07
862.00	Mont Riparian	415.37	-446.63
133.00	Rocky/Ruderal	874.69	741.69
97.00	Grassland	330.56	233.56
0.00	Upland Scrub	179.59	179.59
3135.00		3135.00	0.84

Net acreage losses from the two alternatives differ. The 400-Year dry dam, because of a more frequent inundation pattern, would cause a net loss of 2,106.14 acres of canyon habitats (Table 2). Whereas, the 200-Year dry dam would yield a net loss of 1,155.68 acres (Table 3).

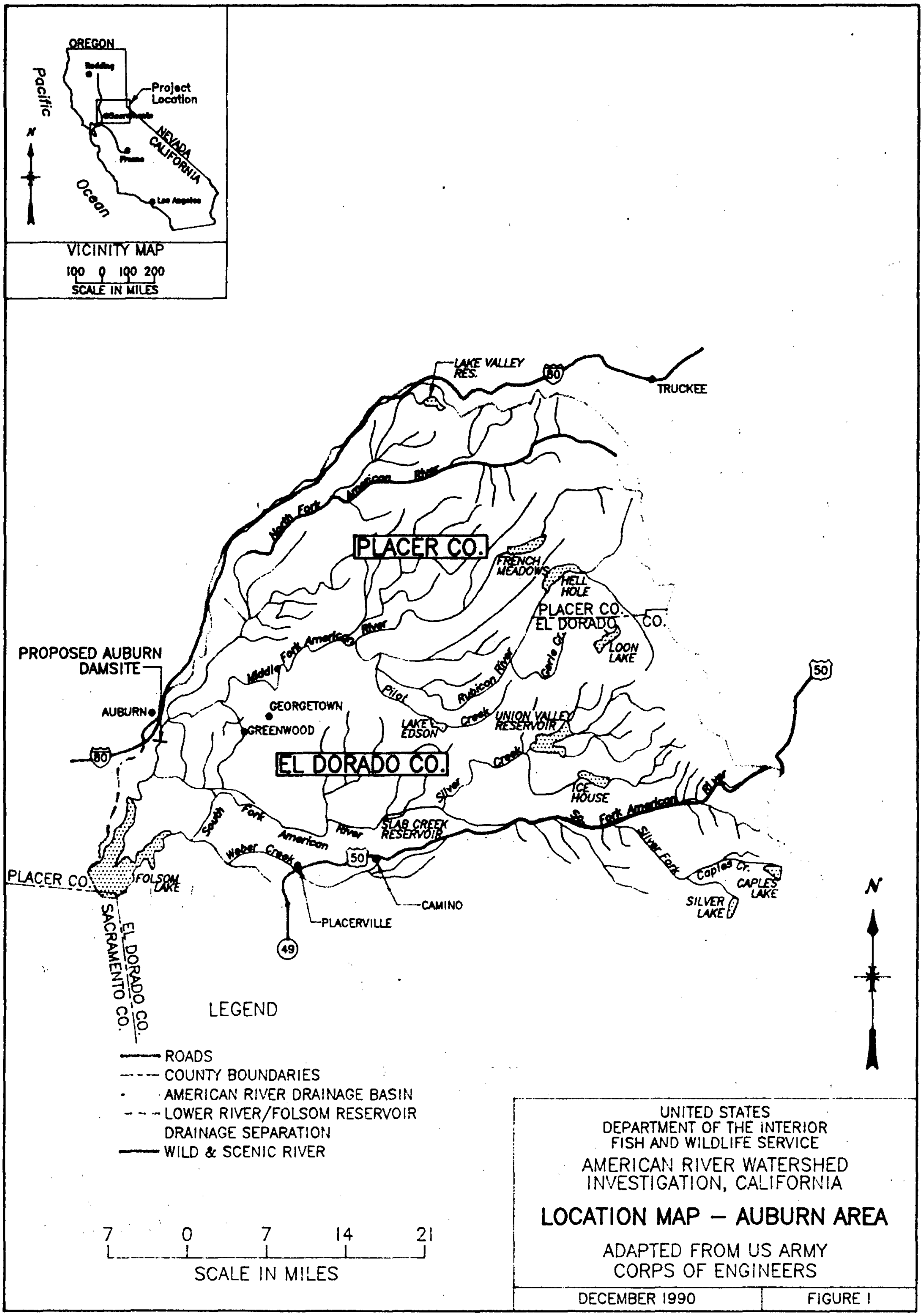
STUDY AREA

Impact Area

This analysis encompasses portions of the North and Middle Forks of the American River plus adjacent lands (Figure 1).

Originating in the Sierra Nevada, the North and Middle Forks of the American River join just upstream of the city of Auburn. From the North Fork and Middle Fork confluence, the river flows past the rapidly growing city of Auburn and the Auburn Dam site before entering Folsom Lake. The Auburn Dam site is located in a narrow, deep, steep-sided canyon, with distinct north slope and south slope habitats, about 3 miles downstream of Auburn and 30 miles northeast of the city of Sacramento.

The North Fork American River watershed is generally mountainous with elevations varying from about 500 feet at the base of the dam to more than 8,000 feet at the extreme upper elevations of the basin (at the peaks bordering Lake Tahoe). The watershed, extending from the foot to the crest of the Sierra Nevada, is essentially a tilted fault block sloping from east to west. The Auburn Dam project area lies in the western portion of the fault block near where it dips beneath the sediments of the Central Valley. The principal streams in the watershed, the North and Middle Forks of the American River and the Rubicon River, originate along the eastern edge of the basin above the 7,000-foot level. The combined drainage area above the Auburn Dam site exceeds 980 square miles.


OREGON
Project Location
NEVADA
CALIFORNIA
Pacific
Ocean
N
VICINITY MAP
100 0 100 200
SCALE IN MILES
LAKE VALLEY RES.
80
TRUCKEE
North Fork American River
PLACER CO.
FRENCH MEADOWS
HELL HOLE
PLACER CO.
EL DORADO CO.
LOON LAKE
Middle Fork American River
Pilot Creek
Rubicon River
PROPOSED AUBURN DAMSITE
AUBURN
GEORGETOWN
GREENWOOD
LAKE EDSON
UNION VALLEY RESERVOIR
50
EL DORADO CO.
Silver Creek
ICE HOUSE
So. Fork American River
South Fork American River
SLAB CREEK RESERVOIR
Weber Creek
Silver Fork
Caples Cr.
CAPLES LAKE
SILVER LAKE
PLACER CO.
FOLSOM LAKE
CAMINO
PLACERVILLE
49
SACRAMENTO CO.
EL DORADO CO.
N
LEGEND
ROADS
COUNTY BOUNDARIES
AMERICAN RIVER DRAINAGE BASIN
LOWER RIVER/FOLSOM RESERVOIR DRAINAGE SEPARATION
WILD & SCENIC RIVER
7 0 7 14 21
SCALE IN MILES
UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
AMERICAN RIVER WATERSHED INVESTIGATION, CALIFORNIA
LOCATION MAP – AUBURN AREA
ADAPTED FROM US ARMY CORPS OF ENGINEERS
DECEMBER 1990
FIGURE 1

Within the project area, the North Fork flows about 23 miles from the Colfax-Iowa Hill Bridge through a steep bedrock walled canyon to the Auburn Dam site at River Mile 20.1. Within this 23 mile stretch the river drops at a rate of about 33 feet per mile for 9 miles through a series of Class IV and V rapids (Watson, 1985) strewn with large boulders and cobbles to the Ponderosa Way Bridge. In this reach, riffle areas are small but gravels are clean. Most of the riffle areas (77 percent of the total observed) occur between Shirttail Creek and Lake Clementine. The 3.5 mile reach from Ponderosa Way Bridge to Lake Clementine has Class III rapids with more gravel bars and occasional bedrock outcrops.

Lake Clementine, formed by the North Fork Dam, was constructed by the Corps of Engineers in 1937 for sediment storage. The 5-mile-long reservoir has a storage capacity of 14,600 acre-feet. Spillway elevation is at about 715 feet (mean sea level). Waters of the North Fork flow over the spillway crest and continue downstream for about 2.5 miles at a somewhat lesser rate of drop (31 feet per mile) to the confluence of the North and Middle Forks. The North Fork flows along the 3.5 mile reach below the confluence and continues at a relatively lower gradient (31 feet per mile) over sand and gravel bars, and randomly distributed boulder clumps. Sand and sediment deposits significantly increase toward the damsite. Much of the deposits resulted from the 1986 storm event and the Bureau of Reclamation's coffer dam operation.

Runoff in the North and Middle Forks is from rain and snowmelt. Nearly 50 percent of the annual rainfall occurs during a 60-day winter period. Summers by contrast receive less than 1 percent of the annual precipitation, resulting in natural low summer flows. U.S. Geological Survey records (1941 to 1986, Station #11427000) show an average annual flow of 856 cubic feet per second (cfs), a maximum flow of 65,400 cfs, and a minimum flow of zero on the North Fork American River at the North Fork Dam just above the Middle Fork confluence. About one-mile downstream of the Auburn Dam site on the North Fork, U.S. Geological Survey records (1972 to 1986, Station #11433800) indicate an average annual discharge of 2,262 cfs, a maximum discharge of 66,700 cfs, and a minimum discharge of 51 cfs. Flows recorded at the downstream station reflect operation of the coffer dam and restricted flows through a bypass tunnel. Thus, the coffer dam has reduced peak flows to Folsom Reservoir since 1972 when it was constructed.

The Middle Fork American River flows downstream through steep walled rocky canyons past the Placer County Water Agency's Ralston Afterbay Dam/Oxbow Powerhouse for about 1/2 mile where it is joined by the northern arm of the Middle Fork. The Middle Fork continues dropping at a rate of about 27 feet per mile for about 5 miles to Kanaka Rapids. Large cobble substrate and boulders are common in this reach with less than 25 percent of their surfaces covered with sediments. The gradient remains about the same in the next 10 mile reach from Kanaka Gulch to

Ruck-A-Chuckey Rapids. There are smaller boulders in this reach and gravels are clean (less than 25% sediment coverage).

Below Ruck-a-Chuckey Falls, the gradient lessens to about 9 feet per mile downstream for about 10 miles until it joins the North Fork. Long and wide riffles and pools alternate in this reach. Pools are deep averaging about 16 feet.

U.S. Geological Survey records (Station #11433500, years 1911 to 1986) located on the Middle Fork American River near Auburn (614 square miles drainage area) shows an average annual flow of 1,342 cfs, a maximum flow of 253,000 cfs and minimum flow of 20 cfs.

MITIGATION AREA

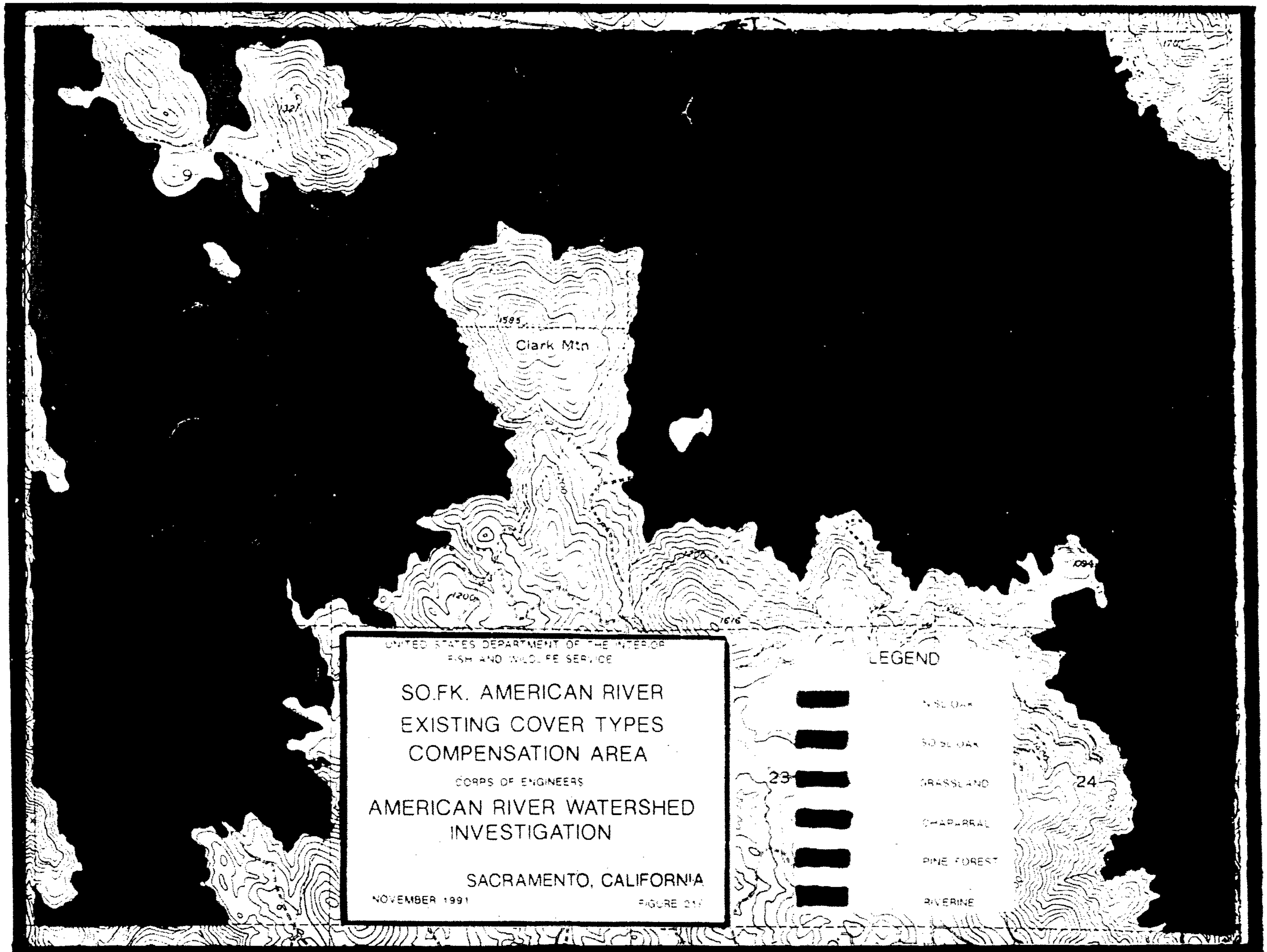
SOUTH FORK AMERICAN RIVER COMPENSATION AREA

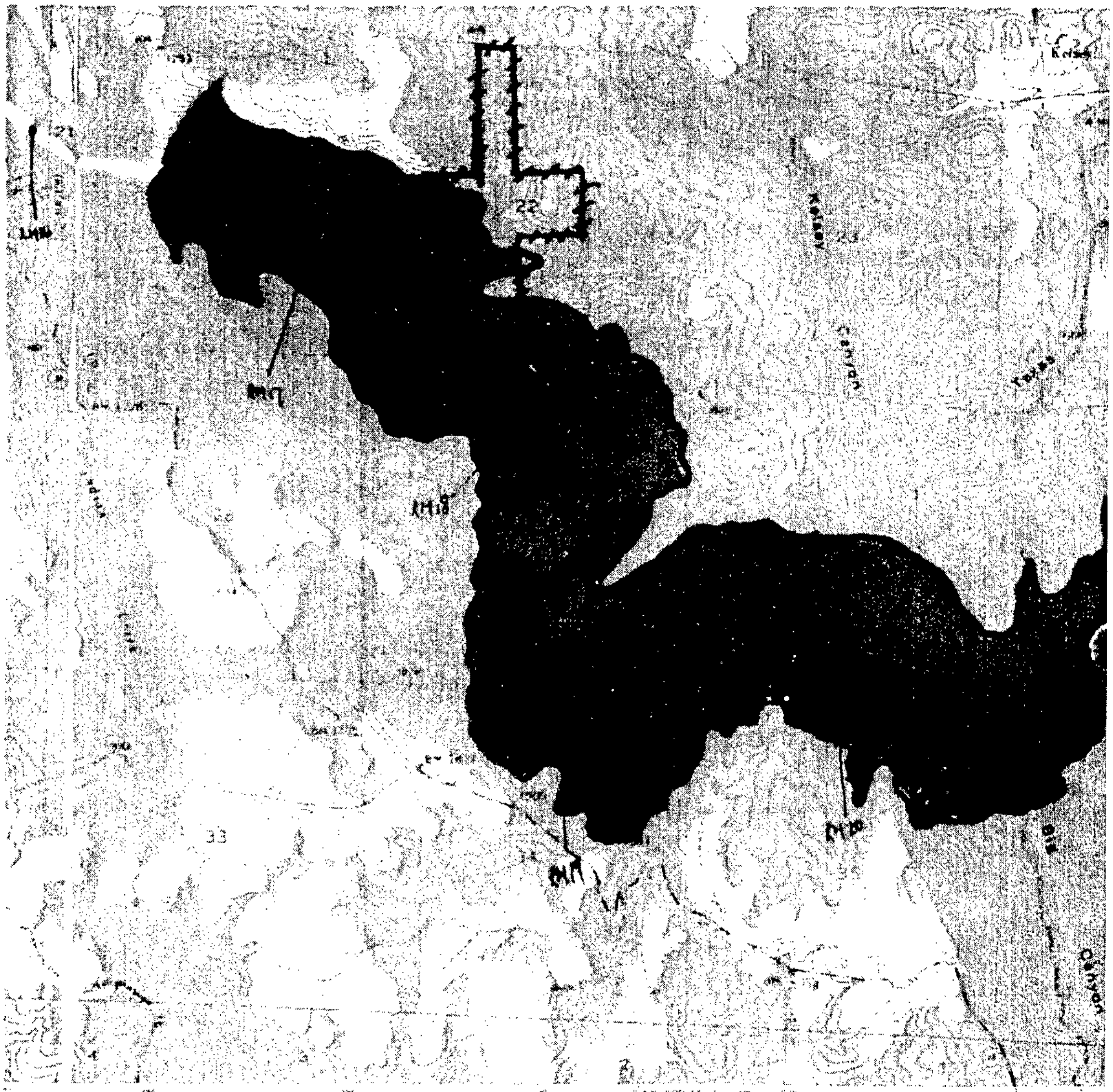
The South Fork American River compensation area selected for the HEP analysis is located within the same foothill region as that of the dry dam impact zone of the North and Middle Fork American Rivers (Figure 2). Riverbed elevation is near 425 feet at the Salmon Falls Bridge and increases to near 1500 feet elevation at the uppermost limit of the study reach. The riverbed gradient is moderate dropping about 35 feet per mile over the length of the area. The river flows through relatively steep sloped canyons (24%) from the El Dorado National Forest Service Boundary past the town of Coloma and then through less steep canyons (13%) from Coloma to the Salmon Falls Bridge at the upper end of Folsom Reservoir. A 13.8 mile reach of canyon with riverine (252 acres) and upland (8,208 acres) of wildlife cover was selected as a compensation area. The compensation area straddles both sides of the river and extends up to elevations of 1200 feet or more to the canyon rims.

Table 4. South Fork Compensation site acreages.

North Slope Oak	South Slope Oak	Grass-land	Montane Riverine	Pine Forest	Chaparral
1332	3560	2864	252	285	167
		Total = 8529			

All of the wildlife cover types impacted at the Auburn dam site occur in the compensation area although in different proportions. Acreages of existing cover are shown in Table 4. The condition of wildlife cover varies greatly within the compensation area. A significant portion of the area is relatively pristine whereas other portions are affected by development. Most of the oak woodlands are in good


Clark Mtn
1585
1200
1616
1094
23
24
UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
SO.FK. AMERICAN RIVER
EXISTING COVER TYPES
COMPENSATION AREA
CORPS OF ENGINEERS
AMERICAN RIVER WATERSHED
INVESTIGATION
SACRAMENTO, CALIFORNIA
NOVEMBER 1991
LEGEND
N.SL. OAK
SO.SL. OAK
GRASSLAND
CHAPARRAL
PINE FOREST
RIVERINE


Kelsey
Canyon
Canyon
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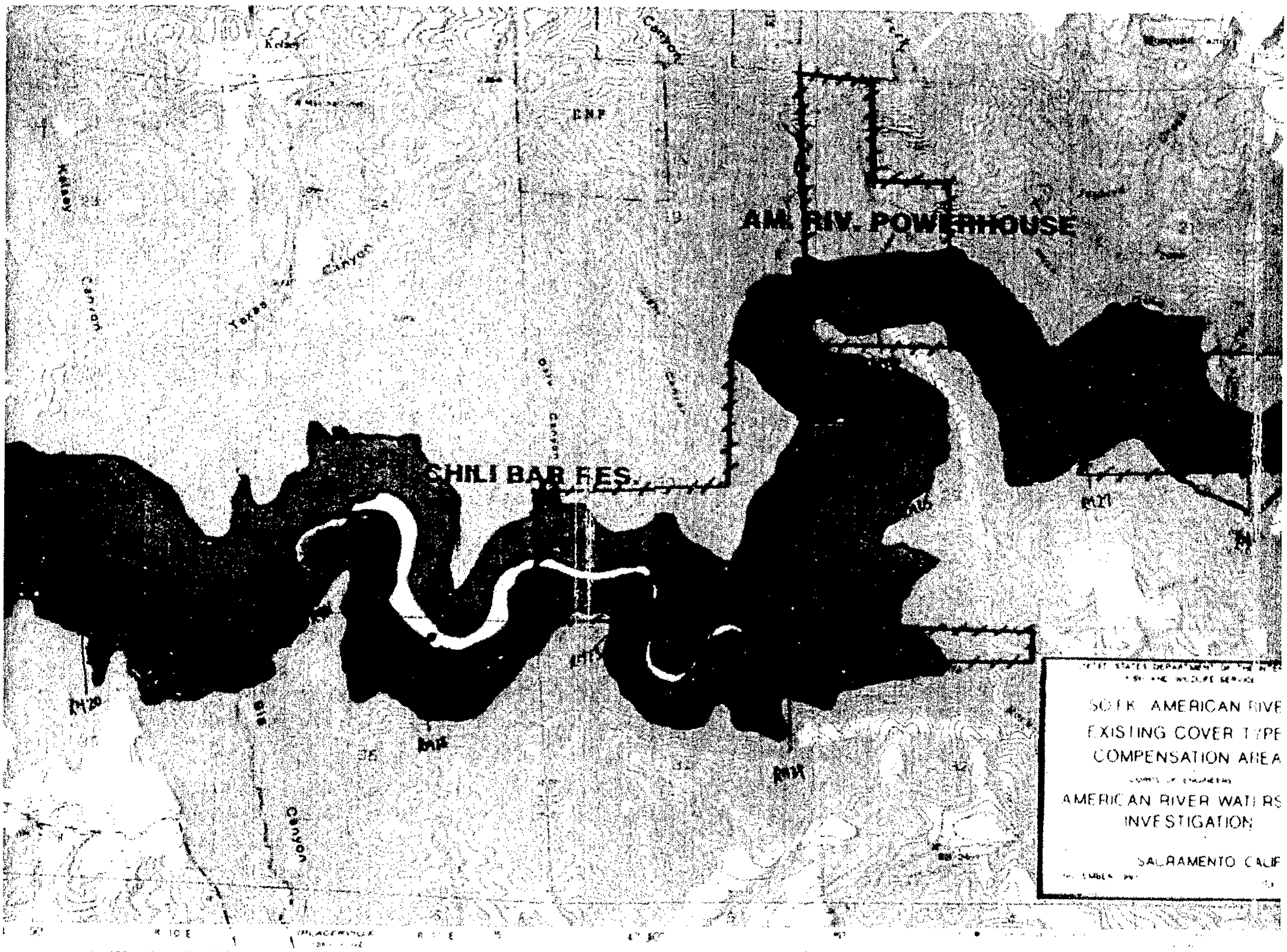
AM. RIV. POWERHOUSE
CHILI BAR RES.
Texas Canyon
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EXISTING COVER TYPE
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INVESTIGATION
SACRAMENTO CALIF

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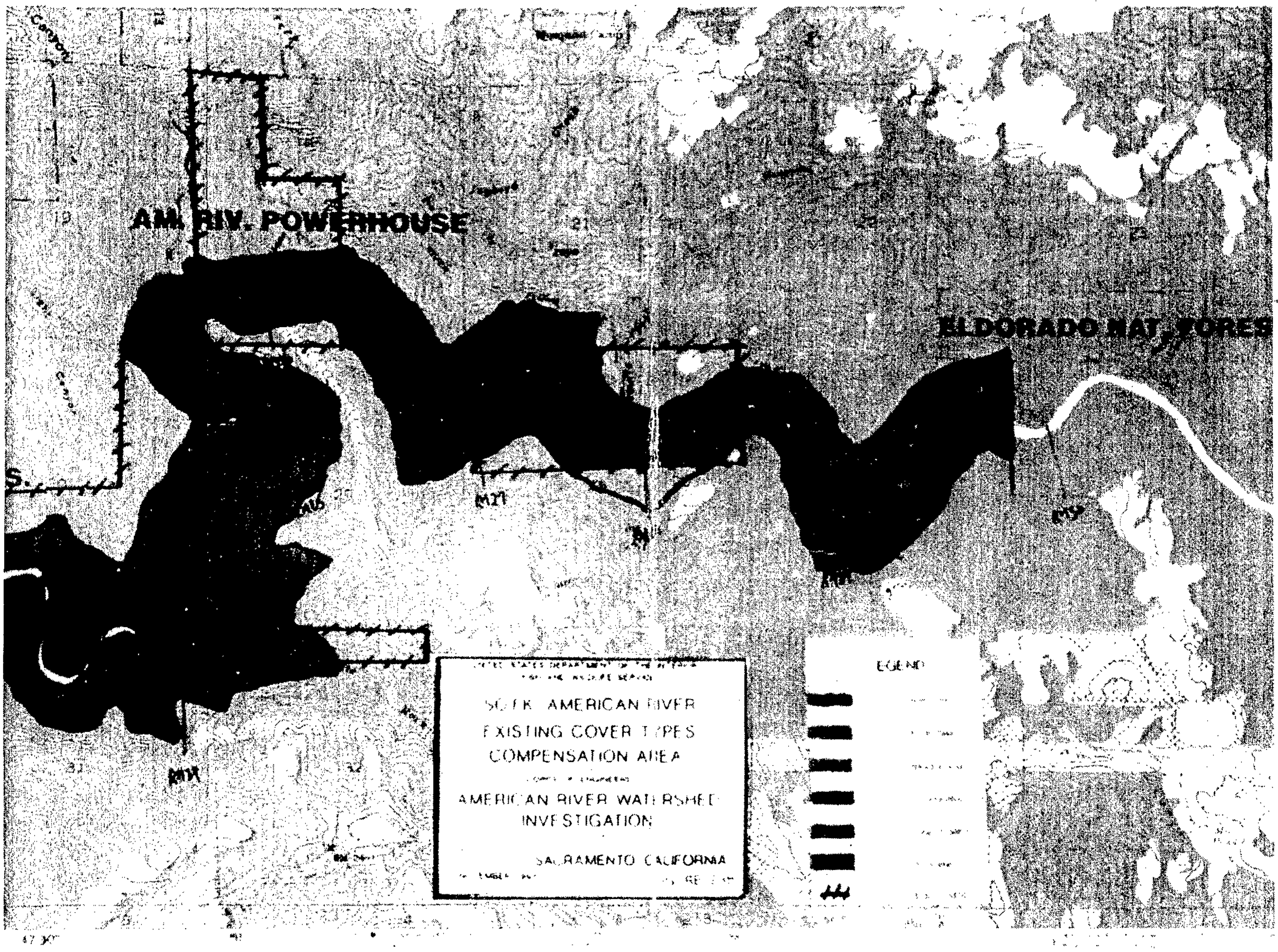
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COMPENSATION AREA
AMERICAN RIVER WATERSHED
INVESTIGATION
SACRAMENTO CALIFORNIA
LEGEND

3

condition with moderate to high wildlife values. Compared to the North and Middle Fork American canyons there is proportionally less north slope oak woodland habitat than southslope due to the gentler slopes. Most of the grasslands are very open and are typical of moderately grazed canyon lands that were cleared of native trees many years ago. Burning at regular intervals is commonly practiced to maintain grasslands for grazing. Most of the tributary streams draining into the South Fork meander for several miles from the higher elevations. Narrow bands of riparian vegetation line these streams. Seasonal marshes occur along spring seeps which flow from the canyon walls. The remaining woodlands vary from broad continuous thickets to sparse isolated thickets. In many cases, grazing has greatly reduced recruitment of young tree seedlings.

METHODOLOGY

HABITAT EVALUATION PROCEDURES (HEP)

HEP was used to quantify (1) baseline wildlife habitat values throughout the study area, (2) impacts from the proposed project, and (3) gains in habitat values on the mitigation areas with management. Impacts were determine for operation of project facilities, namely, the effects of inundation on canyon habitats and wildlife values. In addition, impacts were determined for construction of the dam and related facilities. Project-induced accelerated development of adjacent lands, analysed in previous iterations, was deleted from this final analysis and report.

GENERAL HEP PRINCIPLES.

HEP is a habitat-based evaluation methodology developed for use in impact assessment and mitigation planning. The method is based on the assumption that habitat quality and quantity can be numerically described in terms of habitat units. HEP uses evaluation species or species life history elements in a species-habitat approach to impact assessment. Habitat quality for a given evaluation species is determined through use of a Habitat Suitability Index (HSI) model. Habitat types are delineated for the study area, and evaluation species are selected for the habitat types. HSI values quantify the value of the habitat types to the evaluation species. The HSI value multiplied by acres of available habitat type equals Habitat Units (HU), and HU's are the numerical basis of the HEP analysis.

Impact assessments are performed by quantifying HSI values at several points in time over the life of the project. These points in time are known as "Target Years," and they are selected for years in which changes in habitat conditions can be reasonably defined. In every HEP analysis, there must be, at a minimum, a Target Year 0 (TY0), which represents the baseline conditions, Target Year 1 (TY1), which is the first year habitat conditions are expected to deviate from baseline conditions, and an ending Target Year, which defines the life of the project. For this analysis, the life of the project is 100 years which ends at Target Year 108 (TY 108, construction during target years 1 through 7 with operation begun in target year 8).

Evaluation species' HSI's and habitat acreages are required for all Target Years. HSI's and acreages are predicted for Target Years in which a change in value or area is expected to occur. Acreages at TY0 are termed "baseline" and are quantified through use of aerial photographs and/or vegetation maps and ground-truthing. Impact assessment is conducted by annualizing the habitat conditions and impacts over the life of the project by comparing HU's from two secnarios. These scenarios are (1) Future-With-Project and (2) Future-Without-Project. For each scenario, HU's are determined for each Target Year, and the HU's are averaged over the life of the project in an annualization process. Impact assessments are calculated using the annualized average HU's. These average HU's are known as Average Annual Habitat Units (AAHU), and the net impact of a proposed project is calculated by subtracting the Future-Without-Project AAHU's from Future-With-Project AAHU's ($AAHU_{with}$ - $AAHU_{without}$). This process is performed for impact assessment on project lands and for management actions on mitigation lands because each is in essence, a "project."

Table 5. Thomas' (1979) life form categories and descriptors.

Guild Number	Breeds	Feeds
1	In Water	In Water
2	In Water	Ground, bushes, trees, water
3	On Ground around water	Ground, bushes, trees, water
4	On Ground	On Ground
5	On Ground	Bushes, trees or air
6	In Bushes	Ground, water or air
7	Bushes	Trees, bushes, air
8	Deciduous trees	Trees, bushes, air
9	Deciduous trees	On Ground
10	On very thick branches	On Ground or in Water
11	Own or natural cavity	Trees, bushes, ground, air
12	Other excav/nat cavity	Ground, water or Air
13	Underground burrow	On ground or under it
14	Underground burrow	Air or water

EVALUATION SPECIES

Evaluation species are the basis of HEP analyses, and they were selected for this study based on several criteria. Evaluation species were selected to represent specific wildlife guilds (Table 5) within given habitat types in an effort to represent the significant biological and environmental attributes of the project area and mitigation areas. Table 6 lists the evaluation species, the habitat types they were selected to represent and their respective guilds.

The criteria considered in selecting the evaluation species for this study were:

1. The species must have a relatively high probability of occurring in the study area.

2. The species will likely be negatively impacted by the project.

3. Sufficient data must be available to assign, with some degree of confidence, a relationship between the HSI model, habitat quality, and some measure of a species' response (i.e., biomass, density, reproductive success, etc.).

Table 6. Evaluation species models used in Auburn HEP and the habitat types in which they were applied, and the guild category to which each belongs.

HABITAT TYPES†

N.S.
SlopeSlope
BlackBlueChap-PineSavnhMont
EVALUATION ELEMENTOakOakparralForestGrslndRiverGuild

EVALUATION ELEMENT	N. Slope Black Oak	S. Slope Blue Oak	Chap-parral	Pine Forest	Savnh Grslnd	Mont River	Guild
N. Alligator Lizard	10						13
Mtn Quail	14						5
Blk-capped Chickadee	8						12
MacGill.'s Warbler	15						7
Western Flycatcher	3						12
Grey Fox	11			11			13
California Quail		5					5
Band-tailed Pigeon		19					5
West. Fence Lizard		6	6		6		13
Rufous-sided Towhee		7		7			4
Scrub Jay		17					8
Desert Cottontail		18					13
Brush Rabbit			20				13
California Thrasher			22				4
Wrentit			25				7
Calliope Hummingbird						27	8
W. Grey Squirrel				16			10
Pygmy Nuthatch				12			12
Western Wood Peewee				13			8
Western Bluebird					32		6
Mourning Dove					34		9
Willow Flycatcher						29	12
Dusky Shrew						26	4
Northern Oriole						4	8
Downy Woodpecker						2	10
American Dipper						30	3
W. Screech Owl						28	12
W. Meadowlark					31		4
Turkey					33		10
Bobcat			24				13
W. Rattlesnake			23				13

† - *numbers in table body are model numbers in Auburn Micro-HSI Library*

4. The baseline habitat conditions at the study site are indicative of the habitat conditions for the evaluation species.

5. Each evaluation species utilizes the habitat type(s) they were selected to represent.

6. The species occupies an ecological niche/guild that represents significant environmental values in the study area.

7. The species has the potential to respond to management activities in the potential mitigation areas.

8. The species is not able to adapt well to alternate habitat types.

9. A model has been constructed for the species and is complete and/or published.

10. The model is suitable for this project, requiring little or no major modification.

Wildlife species lists for the Auburn area were developed from a variety of sources, including the California Wildlife Habitat Relationships System, reports on the Bureau of Reclamations multipurpose dam, etc. These lists were used to develop the species guild matrices and select the evaluation species using the above criteria. These lists are not included in this report in an effort to reduce the size of the document, however, this information is on file with the Sacramento Fish and Wildlife Enhancement Field Office, U.S. Fish and Wildlife Service.

HABITAT SUITABILITY INDEX MODELS

HSI models were used for each evaluation species. These included HSI models published by the Service's National Ecology Research Center and unpublished HSI models developed by environmental consultants, the Soil Conservation Service, the Sacramento Field Office and the Pacific Gas & Electric Company for the western Sierra Nevada mountains. Some of the selected models were modified and used successfully in previous HEP studies, e.g., yellow warbler from the Bureau of Reclamation's San Joaquin Conveyance Study. These models were modified by the HEP team as necessary. Each HSI model had its own assumptions which affected the HEP study design and analysis. These assumptions usually included geographic area applicablility, minimum habitat size, and cover type applicablility. Micro-HSI versions of the HSI models used in the study are included in Appendix B-2.

HEP METHODS EMPLOYED FOR THE STUDY

Habitat values for the evaluation species were determined from field sampling and study area site map interpretation. Suitability indices for the evaluation species were calculated by averaging the field data from sample points throughout the entire study area, and a single baseline Habitat Suitability Index value for each evaluation species was calculated for the study area using Micro-HSI (Version 2.1) software. Since the compensation area is not within project lands, data was also gathered in the appropriate habitat types and used to develop baseline HSI value for the mitigation area.

The HEP accounting software (Version 2.1) was used to calculate the AAHU's for the Future-With-Project and for the Future-Without Project scenarios. The results of this analysis are presented as the HEP Form C's and these forms are not included in the report to reduce document size. HEP software was used to determine the net change in AAHU's (Form D) between the Future-With-Project and Future-Without-Project scenarios. Comparison of net changes in AAHU's from project activities with net changes from proposed management activities yield HEP Form H's and the area required to compensate for project-induced losses. These forms are incorporated into the RESULTS section.

Table 7. Description of the habitat types used in the Auburn HEP.

Habitat Type	Description
North Slope	North slope black oak - madrone woodland
South Slope	South slope blue oak - digger pine woodland
Pine Forest	Conifer dominated woodland
Chaparral	Chamise and chaparral species
Grassland	Foothill grassland, sparse oak savanna
Montane River	Canyon bottom and side slope riverine and riparian areas
Upland Scrub	Severely degrade chaparral
Rocky/Ruderal	Rock based area with sparse grasses from scouring

IMPACT ASSESSMENT

CONSTRUCTION IMPACTS

Table 8. Baseline Habitat Acreages in Construction Areas for 200-Year and 400-Year Dry Dam Alternatives.

HABITAT	ACREAGE
North Slope	40.60
South Slope	21.20
Chaparral	4.00
Pine Forest	6.00
Grassland	157.50
Montane Riverine	25.10
	254.40

Direct construction impacts were evaluated in this iteration. They were analysed separately from the operational or inundation impacts for three reasons. One, the physical area affected by each alternative was the same. Two, integration of this information into the inundation analysis would have required more effort than time or budgets allowed. Three, the results obtained from this approach would not differ from those gained through integration and total reanalysis. The basic assumption underlying the construction impact analysis is that these are permanent impacts. Table 8 presents not only existing habitat type acres, but also those lost to construction activities. Temporary construction impacts were considered negligible, or would occur in areas impacted by previous construction related impacts.

OPERATIONAL/INUNDATION IMPACTS

Worst Case Scenario

The preferred Service approach in situations where critical information is lacking upon which to base a quantitative estimate of impact is to err in favor of protecting fish and wildlife resources and assume a worst case effect. In this situation, the logical worst case is to assume a gradual loss of all but the most flood tolerant shrubby riparian vegetation along the river and reservoir edge up to the highest possible impact level regardless of frequency, duration, worst case discussion or season. However, this worst case seemed unreasonable given the substantial difference in inundation regime between the proposed dry dam and a comparable multipurpose reservoir (U.S. COE 1990).

Anticipated General Effects of a "Dry" Dam on the Vegetation

Based on review of available information on inundation effects on vegetation (Appendix C) and the foregoing discussion, the following general impacts to the vegetation in the American River canyon are expected to occur with the construction and operation of the Auburn dry dam:

1) Intermittent inundation behind the "dry" dam of the frequency and durations projected by the Corps of Engineers (1990a,b) is expected to reduce seed establishment of many of the upland species either directly by diminishing viability or prolonging dormancy as a result of "water-logging", and/or "indirectly" by removing or reducing the seed bank or reducing survival of seedlings through increased competition with other species more tolerant of periodic inundation or disturbance. Reduced survival in the seedling and early sapling stages of the longer-lived sclerophyllous upland species and the deciduous hardwoods and conifers will produce the greatest vegetative changes in the local ecosystem. The resulting changes may not become readily apparent for several to many years because of the uncertainty of when inundation will occur, the actual inundation recurrence intervals, the elevations inundated and the durations that actually occur. Furthermore, without a carefully designed and intensive monitoring plan, the gradual changes that are likely to occur with intermittent inundation may not be readily detectable on a year to year basis.

2) Those plant species expected to be most tolerant of inundation would be those with rapid life cycles, such as annual forbs and grasses, and those that grow in the lower drainage bottoms or along perennial stream courses where they tap into the ground water and experience frequent inundation during high flow periods (e.g. riparian species). Table 9 provides a listing of the relative tolerance of the various dominant woody species found in the Auburn area. These were derived from Walters et al. (1980), Chapman et al. (1982), and Whitlow and Harris (1979). However, as

Table 9. Relative Tolerance of Dominant Woody Species Found in Auburn Canyon Area.

		Tolerance[1]	% Mortality[2, 3]
SPECIES COMMONLY FOUND IN EVERGREEN HARDWOOD FOREST, WOODLAND, CONIFER FOREST, & SAVANNA GRASSLAND			
TREES	Interior live oak*	IM	100% @ 7 days
	Canyon live oak*	ND	Assumed similar to interior live oak
	Dougas fir*	IM	0% @ 1 wk, 15% @ 2 wk, 50% @ 4 wk
	Black oak	ND	Assumed similar to douglas fir
	Blue oak	IM	29% @ 47 days, 50% @ 76 days, 66% @ 87 days
	Ponderosa pine*	IM	Assumed similar to douglas fir
	Madrone*	ND	" " " 2
	Buckeye*	IN	50% @ 35 days, 100% @ 70 days
	California Bay*	IM	Assumed similar to douglas fir
	Incense cedar*	IN	50% @ 65 days, 100% @ 129 days
SHRUBS			
	Red bud	IM*	0% @ 1 wk, 15% @ 2 wk, 50% @ 4 wk 2
	Mountain mahogany (not native)	IM	Assumed similar to red bud
	Curlleaf Mountain mahogany	T	
SPECIES OF RIPARIAN HABITATS			
TREES	Fremont cottonwood	VT	100% @ 7 days (seedling)
	Box elder	VT	50% @ 94 days
	Sycamore	VT	68% @ 60 days
	Bigleaf maple	IM	100% @ 60 days
	Oregon ash	T	40% @ 50 days, 100% @ 60 days
	White alder	VT	" " "
SHRUBS	Salix spp.	VT	0% @ 60 days 50% @ 80 days
	Coyote bush*	VT	" " "
	Seep willow	VT	" " "
	Button bush	VT	5% @ 100 days
SPECIES OF CHAPARRAL HABITATS (including Knobcone and Digger pine)			
	Scrub oak*	ND	Assumed similar to interior live oak
	Chamise*	ND	" " "
	Manzanita*	ND	" " "
	Buck brush*	ND	" " "
	Deer brush*	ND	" " "
	Scrub oak*	ND	" " "
	Toyon*	ND	" " "
	Yerba Santa	ND	" " "
	Coffee berry*	ND	" " "
	Chaparral pea	ND	" " "
	Mountain misery	ND	" " "
	Knobcone pine*	ND	" " "
	Digger pine*	ND	" " "

* Evergreen, often winter active species.

1 Tolerance ratings taken from Walters et al 1980

2 Most of the specific mortality rates listed were for flooding during the spring and summer periods (the peak growing periods for typical winter decidious species). These rates may be different for winter flooding of evergreen winter active species noted with an asterisk.

3 For several species, the specific mortality data do not appear to correspond to the tolerance rating from Walters et al. 1980 a & b, (e.g. Interior live oak, Douglas fir, Fremont cottonwood, Buckeye). Available data indicate less tolerance.

ND: No data

VT: Very tolerant. Species that can withstand flooding for periods of two or more growing seasons.

T: Tolerant. Species that can withstand flooking for most of one growing season.

noted in Appendix C, the tolerance ratings in Walters et al. (1980 a, b) and Whitlow and Harris (1979), represent only crude relative values of tolerance and intolerance to inundation and many lack adequate empirical basis (Whitlow and Harris 1979).

3) Over the 100 year life of the project, the proposed Auburn "dry" dam will inexorably and dramatically change the composition and structure of the vegetation in the American River canyon. This will occur as a result of a complex of factors including, soil and slope slippage and erosion, differential tolerance of the vegetation components to the periodic inundation, and other incidental human activities such as road construction and facility maintenance. Because of the differential frequency and occurrence of inundations across the elevation gradient, the lower elevations (500-700 feet) will reveal the effects sooner and more dramatically. The upper elevations will experience fewer and less frequent events; and thus, exhibit fewer dramatic vegetative changes. Although, in general, the animal components will shift in composition as the vegetation changes, the periodicity of inundation will contribute a substantial overriding influence on the animal community.

4) Changes in the species composition, and physical structure and appearance of the vegetation will result in loss of natural biological diversity. Changes in the vegetation and wildlife, at all but the lowest elevations, are likely to occur as subtle, almost imperceptible losses of certain species over time, and increases in other more inundation or disturbance tolerant species. The rates of change will correspond to the frequency and duration of inundation. However, as a consequence of the above notable lack of fundamental empirical data, any projected quantification of the effects of periodic inundation on native plant and animal communities in the canyons will necessarily be based largely on personal experience and professional judgement.

Computer Modeling

One frequently employed analytical procedure used to predict long-term changes in fish and wildlife habitat is to develop a predictive computer model or models (USFWS 1980, Verner et al. 1986). In the context of this project, the principle function of such a model, would be to provide a reasonably accurate method for quantifying and tracking the ecological impacts of the dry dam on the existing plant and animal communities in the American River canyons for purposes of identifying mitigation needs and costs.

Most modeling approaches for impact analyses typically involve an assessment of existing habitat conditions coupled with a projection (hypothesis or speculation) of future habitat conditions with and without the project (USFWS 1980). The difference in impacts to the fish and wildlife resources with and without the project is presumed to represent the effects of the project and the magnitude of impacts requiring mitigation.

One of the multitude of assumptions in this approach is that fish and wildlife resources are dependent on, and functionally related to habitat conditions (USFWS 1980, Verner et al. 1984). With respect to terrestrial habitats, it is further assumed that vegetation conditions are a primary determinant of the carrying capacity for the various wildlife species. Thus, to accurately model the relationships among habitat and animals, both the supply of habitat resources and the life requirements of each species must be known (Moen 1973, USFWS 1980). In addition, projections of future conditions relies upon many assumptions regarding responses in the plant communities and other future actions which may affect conditions in the area.

Predictive computer models for assessing the impacts of typical water storage and greentree reservoirs have only recently been developed (Whitlow and Harris 1979, Brody and Pendleton 1987, Pearlstine et al. 1984, 1985). But, as noted by Whitlow and Harris (1979), even these have not been adequately tested and refined sufficiently to assign confidence limits. These same fundamental limitations apply to most wildlife and ecological models in use today (Verner et al. 1984).

A comparable model framework for the dry dam must address a broad variety of baseline data that differ substantially from the data required for existing reservoir models. The completely different, highly intermittent inundation regime requires a substantially modified analytical method. Such a framework must then accurately integrate all the functional variables and then, using a stochastic function, project a hypothetical distribution of future inundation events to generate a prediction of what happens to the various plant communities in the inundation zone over the life of the project. Some of the most critical functional variables include variations in plant species inundation tolerances, demographics, population structure, reproductive requirements, and response rates. Virtually all of these parameters not only vary extensively within the study area, but most of the data are simply not available. Substantial effort over many years would be required to develop the data. Clearly, development of a comprehensive predictive computer model of this type for the dry dam is not only well beyond the scope of available biological data, but also beyond the modeling capability and time and funding provided for this entire project. However, a less comprehensive predictive model was attainable.

Selected Approach - Integrated Inundation Analysis

Based on the above discussions, and recognizing the limits discussed above, our analysis focused on four broad issues: 1) the likely physical characteristics and temporal inundation regime (seasonal, as well as long-term event distribution), of a peak flow detention facility in the Auburn area; 2) the extent of soil stability and sliding on the canyon slopes; 3) the sensitivity of the vegetation (hence wildlife habitat) to the periodic flooding resulting from the facility; and 4) the overall effect of inundation on wildlife in the canyons.

Because of the inherent limitations associated with assessing wildlife populations (USFWS 1980) and the virtual complete lack of information on the erratic and periodic inundation effects of dry dams on wildlife communities, the approach taken in this study uses a projection of impacts on vegetation (hence wildlife habitat) as the primary indicator of impacts to the terrestrial biota. Thus, specific numbers of wildlife affected are not a part of the analysis.

Impacts to the terrestrial habitat were based on the three remaining parameters of soil stability, vegetation mortality and inundation regime. The use of these three factors in our analysis requires the general assumption that the three are functionally related and that rates of slope erosion and sliding as well as vegetation mortality can be predicted based on individual inundation events.

Inundation Regime

The projected inundation-duration regime of a 200- and 400-year "dry" dam in the American River canyon was developed by the Corps of Engineers, Sacramento District (reports of June 1990, August 1990, respectively). The analyses took the form of probability distributions for the frequency, durations, and elevations of flooding behind the dam depicted in annualized exceedence graphs (Figures 3 and 4 and Tables 10 and 11 for the 200- and 400-year dams respectively). In addition, because of substantial seasonal differences in probability of flooding, the frequency-duration-elevation data were also broken into seasonal segments for the 200- and 400-year dams, representing the periods December through February, March, April, May, June through September, October and November (Tables 12 and 13). Specific details and supporting data for these analyses can be found in the above referenced reports.

It should be noted at this point that the probability projections provided by the Corps indicate only the probability of the occurrence of individual events at specific elevations for regularly spaced recurrence intervals. These probabilities do not indicate the clustering of events during a single season or over the life of the project, conditions which are more representative of the regional weather patterns and more biologically meaningful. In the absence of a stochastic analysis, we, therefore, distributed individual

Table 10. 200 Year Dam - Project Number of Event types per 100 Year Period (based on Corps of Engineers inundation-duration submittal of June 1990.

INUNDATION DURATION

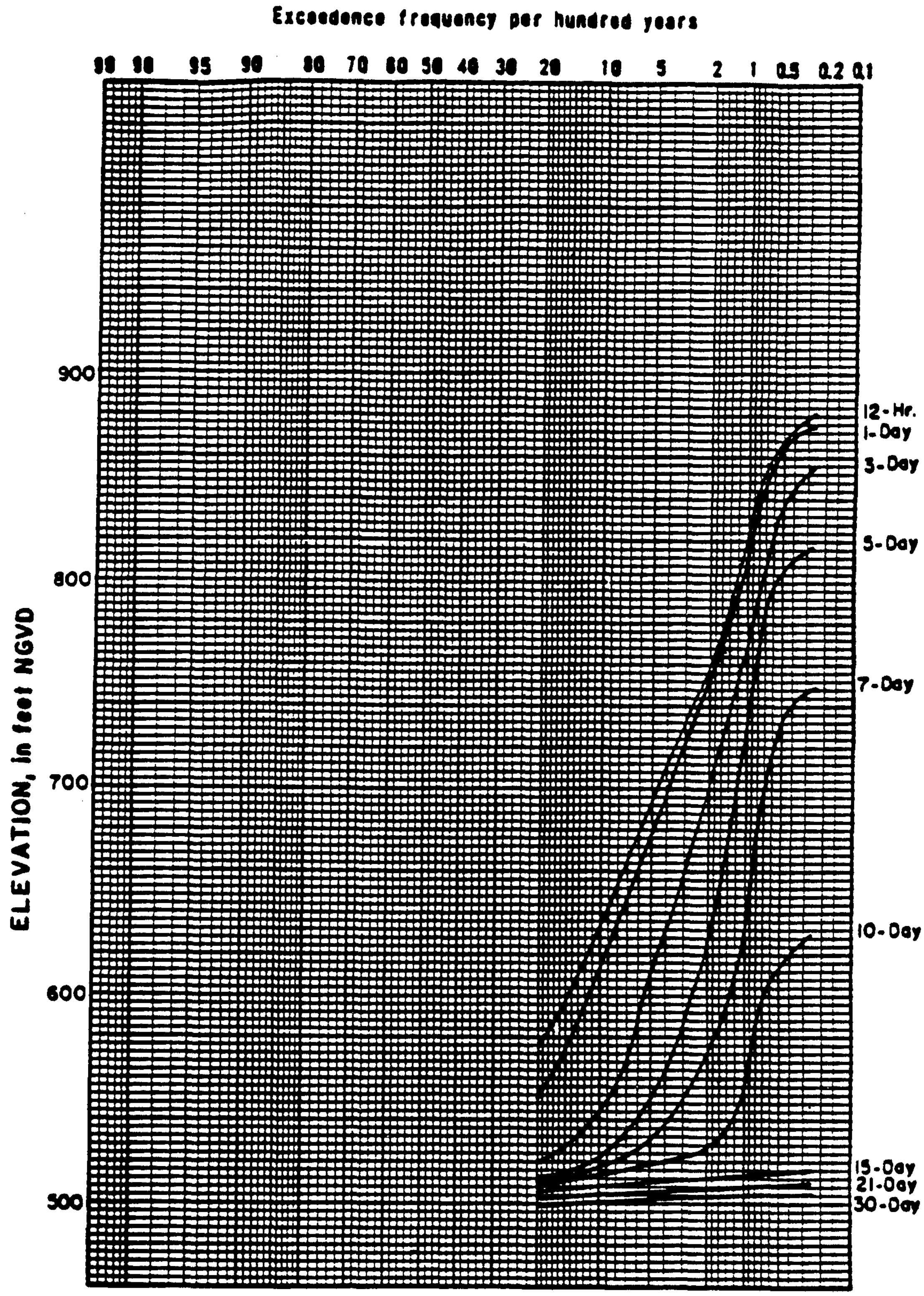
Elevation	1 Day	3 Days	5 Days	7 Days	10 Days	Cumulative Number[1] of Events per 100 Yrs
825	1.0[2]	-0.55	0.00	0.00	0.00	1.00
820	1.0	-0.60	0.00	0.00	0.00	1.00
800	1.1	0.60	0.00	0.00	0.00	1.00
780	1.4	-0.90	0.70	0.00	0.00	2.00
760	1.8	1.00	0.90	0.00	0.00	4.00
740	2.5	1.40	1.00	0.40	0.00	4.00
720	3.0	1.60	1.00	0.60	0.00	5.00
700	4.0	2.00	1.20	0.70	0.00	7.00
680	5.0	2.50	1.40	0.80	0.00	9.00
660	6.0	3.00	1.60	0.90	0.00	11.00
640	8.0	3.70	1.80	1.00	0.00	15.00
620	9.5	4.60	2.20	1.50	0.40	16.00
600	12.0	5.50	2.80	1.30	0.70	2.00
580	14.0	6.50	3.20	1.80	0.80	25.00
560	18.0	8.00	4.00	2.50	1.00	33.00
540	24.5	11.00	6.00	4.00	1.20	46.00
520	70.0	24.00	11.00	8.50	5.00	118.00
500	95.0	90.00	80.00	75.00	60.00	397.00
490	Base elevation permanently flooded					

[1] Only events of 1 day or longer were used in the woody plant mortality analysis. This could underestimate effects of the much higher frequency, but short duration events that likely will occur over the life of the project. Many of these events will occur several times during each flood season and a moderate percentage are likely to occur during peak growing periods when plants are most intolerant.

[2] Percent exceedence assumed to be equal to the number of events/100 years (life of project). Probabilities >= 0.8 % rounded to the nearest 1.

flood events evenly over the life of the project corresponding to their recurrence intervals. This reduces the number of events clustered in one season and the number of consecutive wet years. It also minimizes clusters of dry periods and consecutive dry years.

The hypothetical routings and probability curves developed by the Corps from historical data from 1942 to 1986 (submittal of 6 September 1989), indicate that there is less than a 0.2 percent chance of a 200 year event occurring in the next 40 years. We assumed, however, that at least one 200 year event will occur during the life of the project, thus maximum possible inundation of the Auburn canyon (for a 200 year event and 400-year dam) would occur up to elevation 950 feet. The same event with a 200-year dam would reach just slightly over 880 feet elevation. Inundation for at least 7 days would occur up to about 750 feet for the 200-year dam, and to about 900 feet for the 400-year dam.

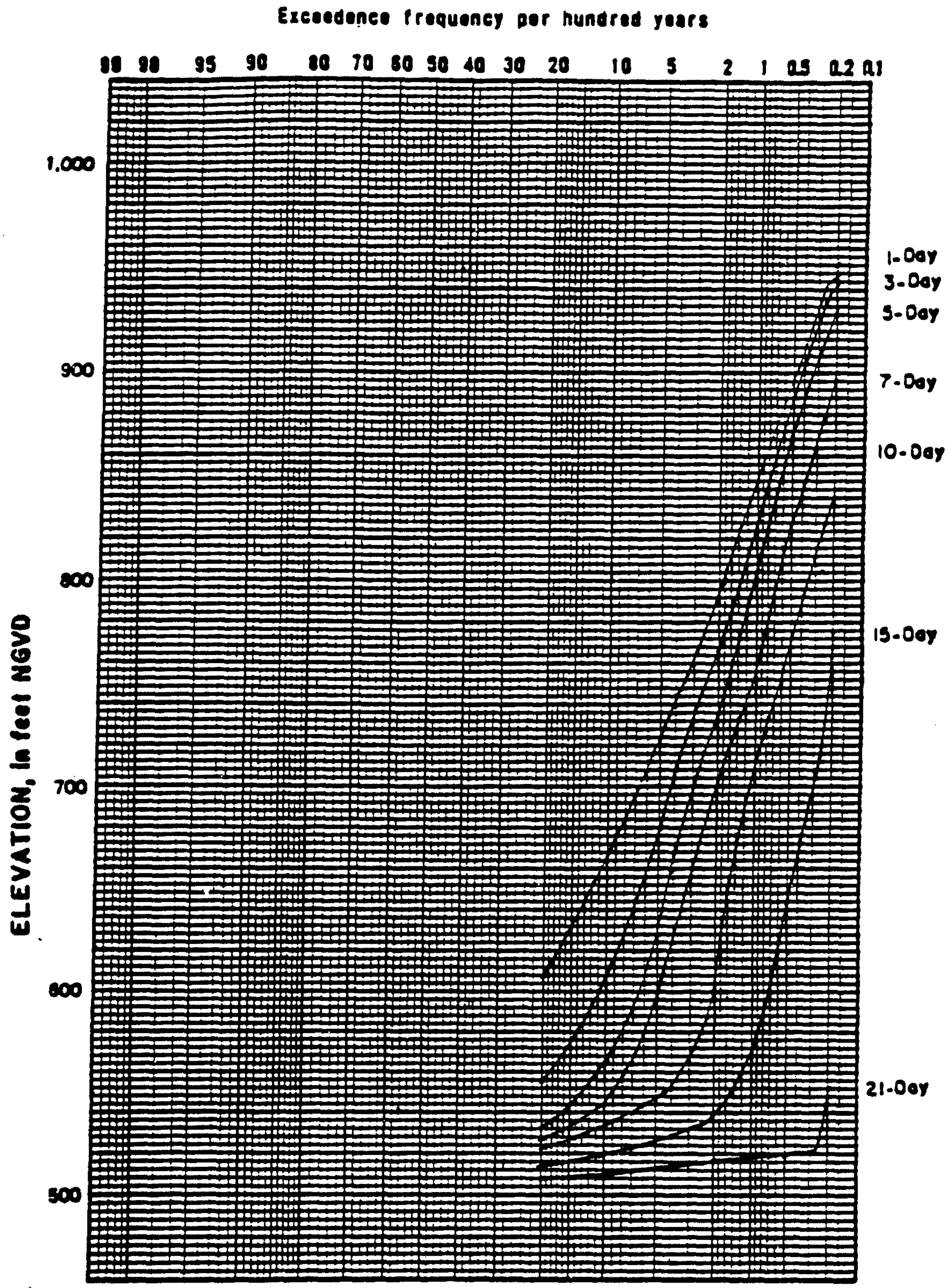


NOTES:
1. Dam located at River Mile 20.1 designed to control a 200-Yr. flood with 400,000 ac.-ft. of flood control space in Folsom Lake and a 115,000 cfs objective release.
2. Top of inactive pool - elevation 490.
3. Curves define the duration of time elevation is equalled or exceeded.

FIGURE 3.

ELEVATION-FREQUENCY-DURATION
AUBURN DRY DAM ALTERNATIVE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO, DISTRICT



NOTES:
1. Dam located at River Mile 20.1 designed to control a 400-Yr. flood with 400,000 ac.-ft. of flood control space in Folsom Lake and a 115,000 cfs objective release.
2. Top of inactive pool - elevation 490.
3. Curves define the duration of time elevation is equalled or exceeded.

FIGURE 4.

ELEVATION-FREQUENCY-DURATION
AUBURN DRY DAM ALTERNATIVE

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO, DISTRICT

Table 11. 400 Year Dam. Projected number of event types per 100 years (Based on Corps of Engineers inundation-duration submittal of August 1990)

	INUNDATION DURATION							
Elevation	1-Day[2]	3-Day	5-Day	7-Day	10-Day	15-Day	21-Day	Cumulative[1] Number of Events
945	0.25[2]	0	0	0	0	0	0	0
900	0.50	0.42	0.32	0	0	0	0	0
880	0.65	0.55	0.45	0.26	0	0	0	0
860	0.88	0.70	0.55	0.33	0	0	0	1
840	1.10	0.90	0.70	0.42	0	0	0	2
820	1.40	1.10	0.85	0.55	0.20	0	0	3
800	1.80	1.40	1.20	0.68	0.36	0	0	4
780	2.50	1.70	1.25	0.80	0.45	0	0	5
760	3.10	2.20	1.60	1.00	0.55	0.20	0	7
740	4.20	2.80	2.00	1.20	0.70	0.22	0	9
720	5.40	3.50	2.50	1.60	0.90	0.25	0	12
700	6.80	4.20	3.00	2.00	1.20	0.30	0	17
680	8.50	5.00	3.60	2.50	1.30	0.36	0	19
660	11.00	6.00	4.10	3.00	1.50	0.42	0	25
640	13.50	7.00	4.80	3.60	1.70	0.50	0	29
620	17.50	8.80	5.50	4.00	1.90	0.60	0	37
600	23.00	11.00	6.50	5.00	2.00	0.70	0	47
580	36.00	14.00	8.00	6.00	2.60	0.90	0	67
560	60.00	19.00	11.00	8.00	3.50	1.20	0	102
540	80.00	40.00	16.00	11.50	7.00	2.00	0.2	156
520	94.00	80.00	53.00	40.00	30.00	10.00	0.5	307
500	98.00	97.00	94.00	93.00	91.00	81.00	70.0	624
490	Base elevation Permanently Flooded							

1 Only events of 1 day or longer were used in the woody plant mortality analysis. This could underestimate effects of the much higher frequency, but shorter duration events that likely will occur over the life of the project. Many of these events will occur several times during each flood season and a moderate percentage are likely to occur during peak growing periods when plants are most intolerant.

2 Percent exceedence. Assumed to be equal to the numbers of events/100 years (life of project). Probabilities >= 0.8% rounded to nearest 1.

The Corps' seasonal analyses for the proposed 200- and 400-year Auburn "Dry" Dam alternatives, indicates that the upland portions of the canyons would be inundated most frequently and to the greatest height during December to February, with more infrequent occurrences expected from March through May and October to November. Inundation above the 550 foot level between June through September is least likely, although some possibility does exist and probably will occur during the anticipated 100 year life of the proposed project. The total number of individual seasonal events for the life of the project was then calculated by relative proportions based on specific seasonal probabilities (Tables 12 and 13), and allocated to the total number of annualized events listed in Tables 12 and 14. The results are presented in Tables 14 and 15.

Because the dry dam is designed to allow water to continually pass through the dam, the duration of inundation would vary with elevation, and the frequency and durations

Table 12. Seasonal elevation-duration-exceedence frequency (per 100 years) f 200-Year Dry Dam Alternative *Source: Corps of Engineers, 1990a*

DECEMBER - FEBRUARY

Elevation (feet)	Duration (days) 1	3	7	10
870	0.40			
850	0.70	0.33		
800	0.90	0.75		
750	1.50	0.98	0.20	
700	2.95	1.40	0.70	
650	5.10	2.35	0.90	
600	8.30	4.00	1.20	0.70
550	12.25	6.10	1.20	1.05
520	37.00	10.90	6.50	3.45

MARCH

Elevation (feet)	Duration (days) 1	3	7	10
870				
850				
800	0.20			
750	0.35	0.20		
700	0.65	0.35		
650	1.30	0.55		
600	2.30	1.00	0.20	
550	5.30	1.80	0.55	
520	13.00	5.00	1.60	0.65

APRIL

Elevation (feet)	Duration (days) 1	3	7	10
870				
850				
800				
750				
700				
650				
600	0.20			
550	1.05	0.20		
520	6.50	1.00	0.20	

MAY

Elevation (feet)	Duration (days) 1	3	7	10
870				
850				
800				
750				
700				
650				
600				
550				
520	3.00	0.25		

JUNE - SEPTEMBER

Elevation (feet)	Duration (days) 1	3	7	10
870				
850				
800				
750				
700				
650				
600				
550				
520	1.00	0.20		

OCTOBER

Elevation (feet)	Duration (days) 1	3	7	10
870				
850				
800				
750				
700				
650				
600	0.20			
550	0.60			
520	1.50	0.65		

NOVEMBER

Elevation (feet)	Duration (days) 1	3	7	10
870				
850				
800				
750	0.25			
700	0.40	0.25		
650	0.60	0.40		
600	1.00	0.60		
550	1.80	1.00	0.35	
520	5.00	2.00	0.70	0.40

of storm events. Conceptually, then, for the unlikely 100 or 200 year events, the upper most elevations would be under water for less than one day and lower elevations would experience inundation for perhaps as much as a month. Because the number of flood events varies with elevation it was necessary to devise a means of analyzing inundation durations relative to vegetation in specific elevation bands. This requires that some reasonable reference point be selected to represent the inundation duration for the entire band. Since the midpoint of a given band theoretically represents conditions halfway between the greatest duration and frequency of inundation and the lowest, the band midpoint was selected as a reasonable location upon which to base the inundation-duration for each band for each flood event.

Erosion and Slope Stability

Based on existing reports (Army Corps of Engineers 1990, McClelland Engineers 1990, Kennedy Engineers 1971) on slope stability and slippage potential, as well as examination of aerial photographs, soil and slope slippage and erosion is expected to be a significant, more critical issue affecting the vegetation of the canyon than inundation, since plant tolerance to inundation is largely irrelevant if soil slippage becomes significant (Whitlow and Harris 1979, McClelland Engineers 1990).

According to the Environmental Impact Statement prepared by Kennedy Engineers (1971), for the original proposed multipurpose dam, all of the soils in the project area are subject to erosion with soils on both sides of each fork of the river subject to severe erosion. A large majority of the slopes in the study area exceed 25% (Kennedy Engineers, 1971, vol. I) and based on our field efforts many of the slopes in the canyon subject to inundation were 35-40% slopes. Soils in most of the more level areas of the project, pose severe permeability problems; and almost all of the soils in the area are of low fertility (Kennedy Engineers, 1971, vol. I). Kennedy Engineers (1971, vol. 1) further conclude that there is no known vegetative cover type that can resist the continuous rise and fall of the water level. Soil types and characteristics are listed in Table 16. Table 17 summarizes the vegetative characteristics of the various soil types. Figure 5 shows the distribution of the various soil types in the canyons and Figure 6 shows the relative slope instability areas.

Table 13. Seasonal elevation-duration-exceedence frequency (per 100 years) f 400-Year Dry Dam

DECEMBER - FEBRUARY

Elevation	Duration (days)					
(feet)	1	3	5	7	10	15
945	0.22					
900	0.48	0.40	0.32			
850	0.90	0.75	0.62	0.37		
800	1.10	0.90	0.78	0.70	0.35	
750	2.48	1.60	1.00	0.85	0.60	0.20
700	4.90	2.85	2.00	1.28	0.90	0.30
650	8.00	4.43	3.00	2.10	1.00	0.50
600	13.00	7.20	4.40	3.20	1.30	0.70
550	21.20	12.25	8.60	6.25	3.00	0.80
520	40.00	25.00	20.00	16.00	13.30	7.00

MARCH

Elevation	Duration (days)					
(feet)	1	3	5	7	10	15
945						
900						
850	0.20					
800	0.40	0.30	0.27			
750	0.75	0.50	0.40	0.25		
700	1.40	0.85	0.60	0.42	0.20	
650	2.50	1.40	0.90	0.70	0.35	
600	5.40	2.40	1.40	1.20	0.45	
550	14.00	5.80	3.00	2.00	1.00	0.40
520	20.00	9.00	7.00	5.50	4.70	2.00

APRIL

Elevation	Duration (days)					
(feet)	1	3	5	7	10	15
945						
900						
850						
800						
750						
700						
650	5.00					
600	1.20	0.30				
550	4.00	1.20	0.20			
520	10.00	4.00	2.20	1.00	0.50	

MAY

Elevation	Duration (days)					
(feet)	1	3	5	7	10	15
945						
900						
850						
800						
750						
700						
650						
600	0.20					
550	1.20	0.50				
520	6.00	2.20	1.00	0.40		

JUNE - SEPTEMBER

Elevation	Duration (days)					
(feet)	1	3	5	7	10	15
850						
800						
750						
700						
650						
600						
550						
520	2.20	1.20	0.50			

OCTOBER

Elevation	Duration (days)					
(feet)	1	3	5	7	10	15
850						
800						
750						
700						
650						
600	0.30					
550	1.00	0.35				
520	2.50	1.20	0.20			

NOVEMBER

Elevation	Duration (days)					
(feet)	1	3	5	7	10	15
850						
800	0.30	0.20				
750	0.47	0.40	0.30			
700	0.70	0.50	0.40	0.30		
650	1.10	0.67	0.50	0.40	0.25	
600	1.90	1.00	0.70	0.60	0.35	
550	3.50	1.90	1.20	0.95	0.50	0.30
520	7.50	3.10	2.20	1.90	1.50	1.00

Source: Corps of Engineers, 1990b

Table 14. Projected Number and Seasonal Distribution of Events for the 200-Year Dry Dam at Auburn

1 - Day Events

Elevation	Dec-Feb	Mar	Apr	May	Jun-Sep	Oct	Nov	Total #s
825	1							1
820	1							1
800	1							1
780	1							1
760	1							1
750	2							2
740	2							2
720	2	1						3
700	2	1					1	4
680	3	1					1	5
660	4	1					1	6
650	4	2					1	7
640	5	2					1	8
620	7	2					1	10
600	9	2					1	12
580	10	3					1	14
560	11	4					2	17
550	12	5	1				3	21
540	14	7	1				3	25
530	22	11	3			1	4	41
520	39	14	7	3	2	1	4	70
500	55	17	9	4	2	1	6	94

3 - Day Events

Elevation	Dec-Feb	Mar	Apr	May	Jun-Sep	Oct	Nov	Total #s
825	1							1
820	1							1
800	1							1
780	1							1
760	1							1
750	1							1
740	1							1
720	2							2
700	2							2
680	2	1						3
660	2	1						3
650	2	1						3
640	3	1						4
620	4	1					1	6
600	4	1					1	6
580	5	1					1	7
560	6	1					1	8
550	6	2					1	9
540	6	3					2	11
530	8	4					2	14
520	13	6	2				3	24
500	51	19	9	2	2	1	5	89

Source: Corps of Engineers Seasonal Inundation - duration submittal of June 1990

5 - Day Events

Elevation	Dec-Feb	Mar	Apr	May	Jun-Sep	Oct	Nov	Total #s
825	1							1
820	1							1
800	1							1
780	1							1
760	1							1
750	1							1
740	1							1
720	1							1
700	1							1
680	1							1
660	2							2
650	2							2
640	2							2
620	2							2
600	2							2
580	2	1						3
560	3	1						4
550	4	1						5
540	4	1					1	6
530	4	2					1	7
520	7	3					1	11
500	48	19	3				9	79

7 - Day Events

Elevation	Dec-Feb	Mar	Apr	May	Jun-Sep	Oct	Nov	Total #s
825								0
820								0
800								0
780								0
760								0
750								0
740								0
720								0
700								0
680								0
660	1							1
650	1							1
640	1							1
620	1							1
600	1							1
580	2							2
560	2	1						3
550	2	1						3
540	3	1						4
530	5	1						6
520	7	2						9
500	55	15					2	72

Source: Corps of Engineers Seasonal Inundation - duration submittal of June 1990

10 - Day Events

Elevation	Dec-Feb	Mar	Apr	May	Jun-Sep	Oct	Nov	Total #s
825								0
820								0
800								0
780								0
760								0
750								0
740								0
720								0
700								0
680								0
660								0
650								0
640								0
620								0
600								0
580	1							1
560	1							1
550	1							1
540	1							1
530	2							2
520	4	1						5
500	43	8					5	56

15 - Day Events

Elevation	Dec-Feb	Mar	Apr	May	Jun-Sep	Oct	Nov	Total #s
825								0
820								0
800								0
780								0
760								0
750								0
740								0
720								0
700								0
680								0
660								0
650								0
640								0
620								0
600								0
580								0
560								0
550								0
540								0
530								0
520								0
500								0

Source: Corps of Engineers Seasonal Inundation - duration submittal of June 1990

Table 15. Projected Number and Seasonal Distribution of Events for the 400-Year Dry Dam at Auburn

1 - Day Events

Elevation	Dec-Feb	Mar	Apr	May	Jun-Sep	Oct	Nov	Total #s
860								0
840	1							1
820	1							1
800	1							1
780	2							2
760	3							3
750	3							3
740	4							4
720	4	1						5
700	5	2						7
680	7	2						9
660	7	3					1	11
650	7	4					1	12
640	9	4					1	14
620	11	5	1				2	19
600	14	6	1			1	2	24
580	21	9	1			1	4	36
560	37	15	2			1	5	60
550	43	17	4	1		1	4	70
540	44	18	5	3		3	7	80
530	40	19	7	3	1	3	7	80
520	43	21	11	6	2	3	8	94
500	46	21	11	6	2	3	9	98

3 - Day Events

Elevation	Dec-Feb	Mar	Apr	May	Jun-Sep	Oct	Nov	Total #s
860								0
840	1							1
820	1							1
800	1							1
780	2							2
760	2							2
750	2	1						3
740	2	1						3
720	3	1						4
700	3	1						4
680	4	1						5
660	4	1					1	6
650	4	2					1	7
640	4	2					1	7
620	6	2					1	9
600	7	3				1	1	12
580	8	3	1			1	1	14
560	10	5	2			1	1	19
550	17	8	2			1	3	31
540	19	10	5	2		1	3	40
530	30	16	6	3		1	4	60
520	42	18	7	4	2	2	5	80
500	53	19	9	5	3	2	6	97

Source: Corps of Engineers Seasonal Inundation - duration submittal of June 1990

5 - Day Events

Elevation	Dec-Feb	Mar	Apr	May	Jun-Sep	Oct	Nov	Total #s
860								0
840								0
820								0
800	1							1
780	1							1
760	1							1
750	1							1
740	2							2
720	2							2
700	2	1						3
680	2	1						3
660	3	1						4
650	3	1						4
640	4	1						5
620	5	1						6
600	5	2						7
580	5	2					1	8
560	8	2					1	11
550	9	6					1	16
540	10	4	1				1	16
530	22	8	2	1			2	35
520	34	12	3	1			3	53
500	61	21	5	1		1	5	94

7 - Day Events

Elevation	Dec-Feb	Mar	Apr	May	Jun-Sep	Oct	Nov	Total #s
860								0
840								0
820								0
800								0
780								0
760	1							1
750	1							1
740	1							1
720	2							2
700	2							2
680	2	1						3
660	2	1						3
650	2	1						3
640	3	1						4
620	3	1						4
600	4	1						5
580	5	1						6
560	6	2						8
550	7	2					1	10
540	8	3					1	12
530	17	6	1				2	26
520	26	10	2				2	40
500	65	21	3	1			3	93

Source: Corps of Engineers Seasonal Inundation - duration submittal of June 1990

10 - Day Events

Elevation	Dec-Feb	Mar	Apr	May	Jun-Sep	Oct	Nov	Total #s
860								0
840								0
820								0
800								0
780								0
760								0
750								0
740								0
720	1							1
700	1							1
680	1							1
660	1							1
650	2							2
640	2							2
620	2							2
600	2							2
580	2							2
560	2	1						3
550	3	1						4
540	6	1						7
530	14	4					1	19
520	21	7					2	30
500	64	21	1				5	91

15 - Day Events

Elevation	Dec-Feb	Mar	Apr	May	Jun-Sep	Oct	Nov	Total #s
860								0
840								0
820								0
800								0
780								0
760								0
750								0
740								0
720								0
700								0
680								0
660								0
650								0
640								0
620								0
600								0
580								0
560	1							1
550	1							1
540	2							2
530	5	1						6
520	6	3					1	10
500	49	24					8	81

Source: Corps of Engineers Seasonal Inundation - duration submittal of June 1990

Table 16. Common soil types found in the Auburn project area.

1) Steep, brush covered slopes occur on:

   a) AK-EP / EG2 b) SQ-JP-MH / EF2 c) RL d) JP-MH-MQ / EG

   e) MQ-RL / G f) MH-JP / DF g) AI-CS / SE h) AK-AB / EF

   i) MH / G j) RI-AK / DF

2) Steep, tree covered slopes occur on:

   a) SQ-JP-MH / EF2 b) RL c) JP-MH-MQ / EG d) MG-RL / G

   e) MH-JP / DF f) SQ-JP-MH / EF2 g) SQ-JP / CD

Table 17. Summary of the vegetation characteristics associated with various soil types.

1) AK-AB EF Auburn-Argonaut rock, 15-50%
This soil type occurs on moderately steep and steep foothills, is of shallow, rocky, and medium texture, and the vegetation found here consists of grass oak.

Auburn: Depth to bedrock: 10-30".
Argonaut: Permeability of subsoil is very slow, runoff is rapid, erosion is high, drainage is good, and rock outcrops are common.

2) AK-EP EG2 Auburn Exchequer, very rocky, 15-75% eroded
This soil is shallow to very shallow, very rocky, and loamy soils are underlined by metabasic, igneous rock. It is found in steep to very steep canyons and mountain slopes along the American River. The vegetation found here consists of oak, brush, annual grass, and spotted stands of conifers. The soil depth is shallow.

Auburn: Well drained with rapid to very rapid runoff and high erosion hazard.
Exchequer: Very shallow silt loams and low fertility.

3) MQ-RL G Maymen-Rock Land association, 50-75% slope
This soil is very shallow, containing very rocky soils on very steep canyon walls of the American River. The vegetation found here consists of brush and scattered conifers.

Maymen: Thin soils, very rapid runoff, high erosion hazard, and low water capacity.
Rock Land: Large, monolithic rock exposures.

4) SQ-JP-MH EF2 Sites-Josephine-Mariposa, rock, 15-50% slopes eroded
This type consists of deep, moderately deep, and shallow rocky, loamy soils. It is found on strongly sloping to steep mountain slopes. The vegetation found here consists of conifer forest, brush, and open areas of grass. Steep slopes, slow permeability, and, in places, shallow soil depth are consistent with this soil type.

Sites : Slow permeability, good depth with water holding capacity for growing trees. Depth to bedrock: 24-48".
Josephine: Depth to bedrock: 24-40" or more, rock outcrop common.
Mariposa: Depth to bedrock: 15-30". Rapid runoff, high erosion hazard, and low fertility.

5) JP-MH-MQ EG Josephine-Mariposa-Maymen, rock, 15-75% slopes
This type consists of loamy, rocky, moderately deep and shallow soil formations in bedded slates and schists. It occupies steep to very steep mountains, uplands and canyon slopes of the American River. The vegetation found here consists of conifer-forest and brush. Steep slopes that are shallow with rocky profiles are found here.

Josephine: Depth to bedrock: 30-50". Occurrence common on north face slopes; moderately good producers; rock outcrop common.
Mariposa: Shallow, depth to bedrock is 15-30", and rock outcrops are common.
Maymen: Thin, depth to bedrock is usually <10", rock outcrops are common, runoff rates are very rapid, and there is a dense cover of brush.

6) AI-CS BE Aiken-Cohasset, 5-30% slopes.
This type contains thick, friable, granular medium acid loams, that are sometimes cobbly, blocky or hard. The vegetation found here consists of pine, cedar, and black oak.

Cohasset: A timber producing soil, but it tends to erode badly when cleared.

7) SQ-JP CD Sites-Josephine, 5-15% slopes.
This type contains deep and moderately deep, loamy soils. It occupies moderately sloping to strongly sloping mountain uplands. The vegetation here consists of pine-mixed forest and brush.

Sites: Depth to bedrock: 36-60". Slowly permeable, good depth and water-holding capacity for growing trees.
Josephine: Depth to bedrock: 30-50".

Table 17 continued.

8) RL	The large areas here contain a thin mantle of cobbly soil that supports some grasses and forbs. The bedrock is hard and not easily broken and runoff is very rapid.
9) RI-AK / DF	Bloomer-Auburn, 15-50% slope This type contains moderately deep, rocky soils underlain by metamorphosed rock.
10) MH / G	Mariposa The vegetation types found here consist of pine, fir, cedar, oak, manzanita, and clover. The soil types are very shallow, and are found on rocky slopes (30 to 50%) (steeper in some areas).
11) MH-JP / DF	Mariposa-Josephine, 15-50% slope The vegetation types found here consist of pine, fir, cedar, oak, manzanita, and clover. The soils have been moderately eroded, and 25-50% of the surface soil has been removed by erosion. The erosion hazard high and rock outcrops are common

(Kennedy Engineers, 1971, vol. II).

FIGURE 5 SOILS OF THE AUBURN AREA

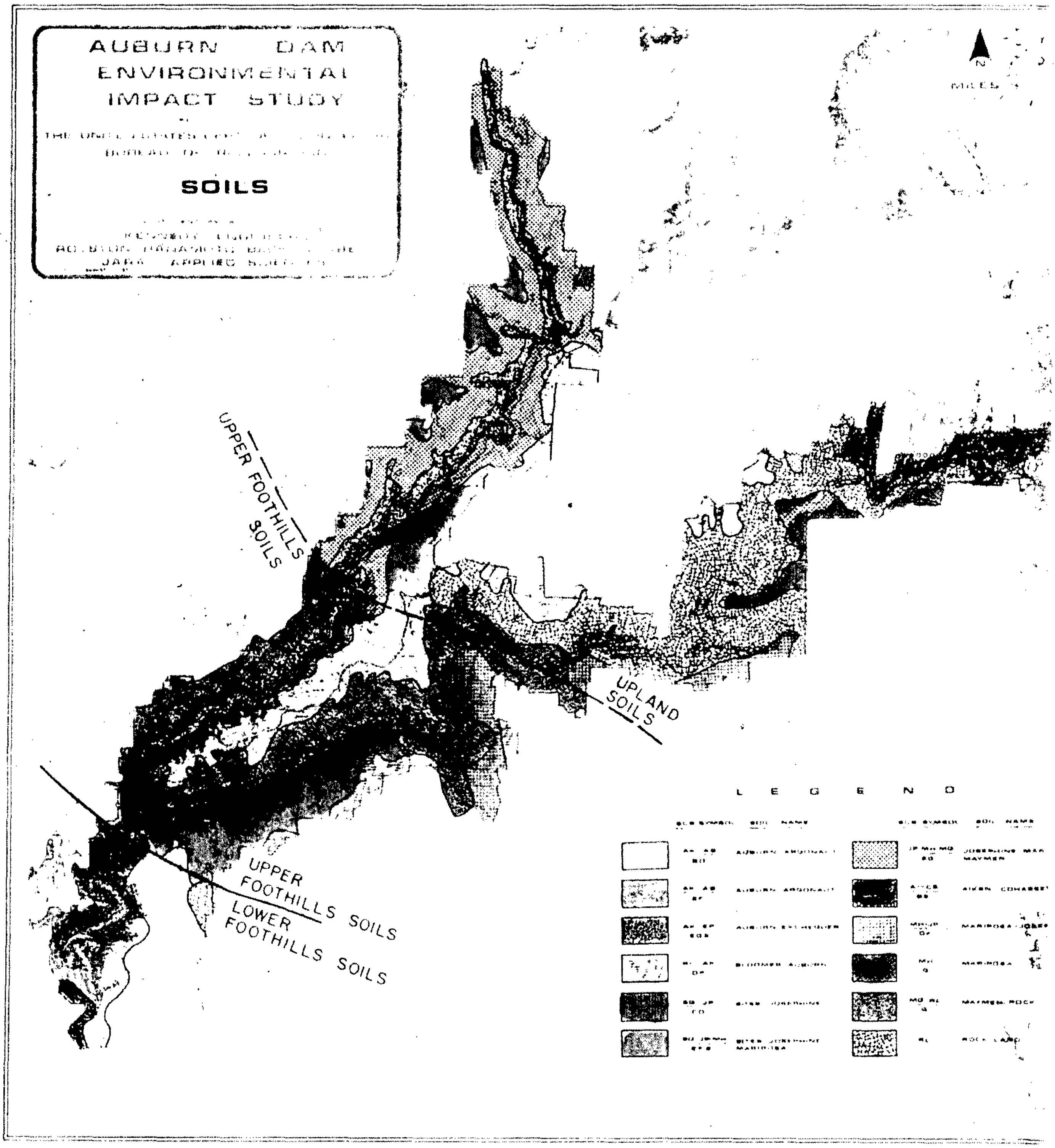
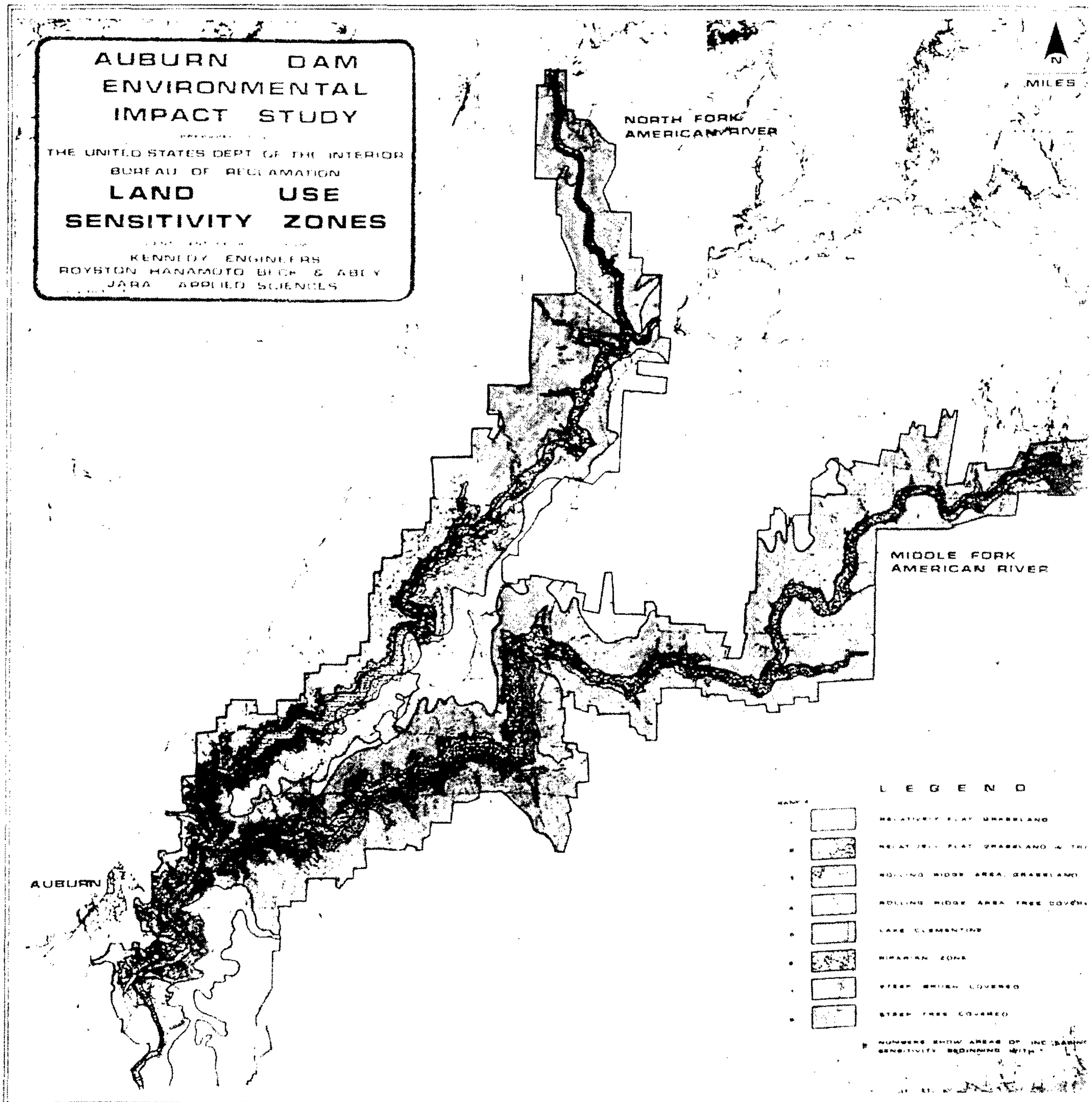


FIGURE 6 AREAS OF POTENTIAL SLOPE INSTABILITY IN THE AMERICAN RIVER CANYON



McClelland and Leiser (1990) briefly discuss the landslide and erosion potential for the American River canyon, noting that landslides will be a foreseeable consequence of periodic inundation. Soil saturation has been identified as one of the most common causal factors in landslides and soil slippage (Corps of Engineers 1990c; Gray and Leiser 1982, cited in McClelland and Leiser, 1990; Dr. Michael Singer, Professor of Soil Science, U.C. Davis, pers. comm. Nov. 1990). In the American River canyon, the stability and shear strength of the soft rock and soil slopes (regolith) that commonly lies upon bedrock, deteriorates extensively with partial or complete saturation (Corps of Engineers 1990c). Interestingly, however, both McClelland and Leiser (1990) and Corps of Engineers (1990c) state that the repeated filling and lowering of the water behind the "dry" dam will not result in significant erosion and landsliding.

The major soil types found in the proposed inundation zone of the American River canyon have low to moderate shear strength and thus, are inherently susceptible to erosion and slippage. Ranking of soil suitability in Table 18 is taken from Kennedy Engineers (1971, vol. II). Under the "Water Retention" category, nine of the eleven soil categories have been rated a 9, which indicates there is a "severe hazard" of soil erosion. The Sites-Josephine was given a ranking of a 7 and the Aiken-Cohasset was given a ranking of an 8. Rankings under the "Topsoil" category vary. Nine of the eleven soil categories rank between 2 and 4 ("fair, "fair to poor", and "poor"). The other two categories (Maymen-Rock Land and Rock Land) are given rankings of 10 ("unsuitable").

Based on the above discussions of high to extreme soil instability and erosion hazard for virtually all of the canyon areas subject to inundation, we concluded that the extent of soil erosion, slope failures and the resultant losses in vegetation cover will be biologically significant. While this appears to contrast with the conclusions of the Corps (1990c) and McClelland and Leiser (1990), their concerns primarily appeared to focus on significance relative to future capacity and function of the reservoir, damage from the dam itself, or the deceptively small acreages of individual slides and erosion sites, not the cumulative extent of vegetation changes over the life of the project.

After examining aerial photographs of portions of the canyon before and after the coffer dam, we concluded that the areal extent of soil erosion, slope failure, and vegetation change could be detected and quantitatively delineated using available aerial photographs. By comparing a large segment of the canyon prior to the coffer dam with aerial photographs of the same area immediately after the coffer dam failure in 1986, we felt that a reasonable quantification of potential soil erosion and commensurate vegetation change could be developed and related to inundation events. A similiar approach was used by the Corps (1990c) in assessing slope stability and landslide volumes.

Table 18. Soil mapping units and interpretive groupings.

Map Symbol	Soil Name	LAND USE A	B	C	D	E	F	G	H	I	J
AK-AB	Auburn-Argonaut Association										
BD	2-15% Slopes										
	AUBURN	7	9	9	5	7	9	9	2	4	10
	ARGONAUT	9	9	9	5	7	7	9	3	4	10
AK-AB	Auburn-Argonaut Association										
EF	Rocky 15-50% Slopes										
	AUBURN	9	9	9	7	9	9	9	2	4	10
	ARGONAUT	9	9	9	7	9	9	9	1	4	10
AK-EP	Auburn-Exchequer Association										
EG2	15-75% Slopes										
	AUBURN	9	9	9	9	9	9	9	4	4	10
	EXCHEQUER	9	9	9	9	9	9	9	4	4	10
R1-AK	Bloomer-Auburn Association										
DF	15-50% Slopes										
	BLOOMER	9	7	9	7	9	9	9	4	2	9
	AUBURN	9	9	9	7	9	9	9	2	4	10
SQ-JP	Sites-Josephine Association										
CD	5-15% Slopes										
	SITES	9	7	9	5	7	9	7	3	2	10
	JOSEPHINE	7	7	7	5	7	9	7	3	2	10
SQ-JP-MH	Sites-Josephine-Mariposa Association										
EF2	15-50% Slopes, eroded										
	SITES	9	7	9	7	9	9	9	6	2	10
	JOSEPHINE	9	7	7	7	9	9	9	3	2	10
	MARIPOSA	9	9	9	9	9	9	9	3	4	10
JP-MH-MQ	Josephine-Mariposa-Maymen Association										
EG	Rocky, 15-75% Slopes										
	JOSEPHINE	9	7	9	9	9	9	9	3	2	10
	MARIPOSA	9	9	9	9	9	9	9	3	4	10
	MAYMEN	9	9	9	9	9	9	9	2	4	10
AI-CS	Aiken-Cohasset Association										
BE	5-30% Slopes										
	AIKEN	8	7	9	6	8	88	8	3	3	10
	COHASSET	8	7	7	6	8	8	8	3	3	10
MH-JP	Mariposa-Josephine Association										
DF	15-50% Slopes										
	MARIPOSA	9	9	9	9	9	9	9	2	4	9
	JOSEPHINE	9	7	9	9	9	9	9	2	2	9
MH	Mariposa										
G	50-75% Slopes										
	MARIPOSA	9	9	9	9	9	9	9	4	4	10
MQ-RL	Maymen-Rock Land Association										
G	50-75% Slopes										
	MAYMEN	9	9	9	9	9	9	9	2	10	10
	ROCK LAND	9	9	9	9	9	9	9	2	10	10
RL	Rock Land										
	ROCK LAND	9	9	9	9	9	9	9	4	10	9

LAND USES

A - Camp Areas
B - Excav^[^[ations
C - Lawns & Golf Courses
D - Paths & Trails
E - Picnic Areas
F - Playgrounds
G - Water Retention
H - Road Fill
I - Topsoil
J - Sand & Gravel

RANK OF SOIL SUITABILITY

1. Good
2. Fair
3. Fair to Poor
4. Poor
5. Slight Hazard
6. Slight to Moderate Hazard
7. Moderate Hazard
8. Moderate to Severe Hazard
9. Severe Hazard
10. Unsuitable

Major Assumptions. To use this approach to quantify soil erosion, slope slippage, and quantify the resultant vegetation loss and change requires the following general assumptions:

1) It assumes that the difference in conditions before the coffer dam and several months after the failure include some component of inundation effect, and that that portion can be separated from other effects and quantitatively projected.

2) It assumes that the acreages of slide and erosion areas and the resulting vegetation units for a 4 mile segment of the canyon, in this case from the just upstream of the coffer dam to about a mile up the North and Middle forks, would be generally representative of the erosion and slide potentials for the entire 23 miles of canyon subject to inundation.

3) It assumes that the acreages of measured slope slippage, erosion and vegetation loss and change, indicated by the acreage difference between the pre- and post- coffer dam aerial photographs is quantitatively linked to individual inundation events during the period the coffer dam operated.

4) It assumes that if the number of inundation events is known, the delineated acreage of vegetation loss or change per inundation event indicates a rate of loss or change that can be extrapolated to the entire canyon.

Methods and Procedures. Aerial photos of the coffee dam and lower portions of the North and South forks of the American River were obtained from the U.S. Bureau of Reclamation for pre-coffer dam (April 1970, scale approx. 1"= 585') and from the Army Corps of Engineers for the post-coffer dam (August 1986, scale approx. 1"=400'). Elevation increments were determined and delineated on the aerial photographs using clear acetate overlays for the 600', 700', 800' and 900' elevation levels. Slide and erosion areas and vegetation conditions indicative of, and resulting from, these conditions (upland scrub and obvious eroded areas covered by grass/ruderal vegetation) were also marked on the aerial photographs using clear acetate.

To the extent possible, areas selected for evaluation were largely intact vegetation. Erosion and sliding associated with construction of bridges and roadways, etc. were excluded. Thus, although the aerial photographs covered almost 7 miles of the river canyon, only certain segments were considered indicative of sliding and erosion associated with intact vegetation. The evaluated segments comprised only 4.05 miles of the canyon.

The total number of acres of terrestrial habitat per elevation band was determined by planimetering the areas within each band from the aerial photographs. The area of each slide and remaining areas of intact vegetation were then planimetered to quantify the areas of land sliding and erosional loss of vegetation that occurred prior to construction of the coffer dam and after it broke in February 1986. Since we had determined the total number of acres in each band (pre-and post-coffer dam) of palustrine forest, palustrine scrub-shrub, and scour zone, we could then subtract these acres from the total number of acres in each band to obtain the total amount of intact upland vegetation per bank that was affected by landslides and erosion during the coffer dam operation. Once the difference between the pre- and post-coffer dam conditions were calculated, the scour zone and riparian acreages were omitted from the calculation of erosion and sliding losses since only erosion and sliding induced changes in upland areas (above the former scour and riparian zone) were of direct interest. These are presented in Table 19, Columns 1-3.

Table 19. Acreage changes for intact upland vegetation in the American River canyon for a 4.05 mile segment of the river.

Elev.	Pre-Coffer Dam Intact Upland Vegetation	Post-Coffer Dam Intact Upland Vegetation	Net Losses to Vegetation from Erosion	Net Losses with Correction Factor to Eliminate Scour Acres	Net Erosion Rate Per River Mile (÷ 4.05)	Net Erosion Rate Per Inundation Event
upto 600'	82.31	42.63	-39.63	-3.97	0.98	-0.49[1]
600-700	170.76	133.57	-37.19	-7.44	-1.84	-1.84
700-800	180.53	173.61	-6.92	-6.92	-1.71	-1.71
800-900	210.37	213.35	--.--[2]	-.-	-.-	-.-
900+	453.45	448.27	--.--[1]	-.-	-.-	-.-

1 Only 2 events were counted as inundating this zone.
2 Losses (or gains) in the zones were related to inundation since the water never reached these elevations.

Because a high proportion of the erosion and slide losses in the canyon evident in the 1986 photographs were due to failure of the coffer dam and not inundation, it was necessary to take this into account. Subsequent to the coffer dam failure, the lower elevations would have experienced the greatest scouring conditions and for the longest period of time. Since there was no specific information on slide losses in the existing reports, it was necessary to develop additional assumptions. Therefore, we assumed that, below the 600' band, 90 percent of the erosion and sliding conditions evident and delineated in the aerial photographs was the result of hydrological scouring when the coffer dam broke and only 10 percent of the losses would have occurred had the coffer dam remained intact. Between the 600' and 700' bands, it was assumed that scouring produced 80 percent of the slides and erosion conditions and only 20 percent of the losses were attributable to inundation. These were the correction factors applied to the net soil erosion and vegetation loss data developed from the aerial photographs for the 500'-600' and 600'-700' zones, respectively.

Above the 700-foot level, and up to the 800-foot level, all areas of sliding and erosion, contiguous with the approximately 700' level (maximum elevation attained by the water was 715' when the dam broke), appeared to be the result of soil loss from below in the absence of undercutting. This suggested that the initial, at least 15' vertical drop in water level when the dam broke, included minimal downstream movement and scour components. Thus, it seemed reasonable to assume that 100 percent of the erosion and slippage losses above this level were the result of inundation. The appropriateness of this assumption was indicated by personal communication (November 1990) with Dr. Michael Singer, Professor of Soil Science, U.C. Davis, Department of Land, Air, and Water Resources.

The resulting net acreage difference (net difference) was then assumed to represent that portion of the erosion and sliding losses attributable solely to inundation. The resulting accumulated data and calculations are presented in Table 19. Based on the above, the expected rate of habitat loss and conversion within each elevation band is represented by the corrected net difference between pre- and post-coffer dam acreages shown in Table 19, Column 4. Losses or gains above the 800' level were not considered in the calculations since inundation never reached these areas and most of the erosion and slides were not connected with lower levels.

The next step was to determine an expected rate of inundation induced sliding and erosion for the entire river canyon. This was accomplished by measuring the total number of river miles over which the above habitat loss rate occurs to get a rate per river miles. It is important to reemphasize at this point that the areas planimetered from the aerial photographs occurred in segments representing only 4.05 miles of the river canyon, whereas there were nearly 7 miles of river canyon within the aerial photographs. The remaining areas not measured on the photographs included areas of greatly increased sliding and erosion mainly associated with existing bridges and roadways. It was evident that inundation induced sliding and erosion was much greater in areas of bridges and roadways, even when older features had been in place for many years. However, including them would have greatly overestimated the slide and erosion potential for the majority of the canyon where the vegetation is largely intact and roads and bridge features are largely absent. We therefore, divided the total number of acres of erosion and slides and associated cover types within each elevation band by 4.05; this gave us the acres of erosion and slope slippage per elevation band per river mile for areas of relatively intact vegetation. These data are presented in Table 19, Column 5.

Because the net difference in land sliding and erosion within a given elevation band needed to be related to inundation events to provide a loss rate per inundation event, the next calculation involved dividing the net difference in erosion acreage per band by the number of inundation events within each elevation band. This would represent the number of events that occurred during the 14 year period during which the coffer dam operated. This was known from the data provided by the Bureau of Reclamation presented earlier. The net difference in acres of erosion cover types per band per river mile were then divided by the number of events that occurred within each band to yield the expected rate of erosion loss per inundation event per river mile (shown in Table 19, Column 6). Since two events barely reached above the scour zone, these events were not counted and the 600' zone erosion rate is based on two events.

To apply these rates to actual cover types over the life of the project, it was necessary to allocate losses for each cover type and it's conversion to the various erosion cover types (upland scrub, grass/ruderal and bare soil/rock). This required the following additional assumptions:

1) cover type conversions would be distributed proportionately to the amount of each intact upland cover type within each band. Cover type conversions of intact upland vegetation to erosion cover types would occur with each inundation event.

2) shifts among the erosion cover types were also allocated by their relative proportions in the bands and these were further assumed to remain stable over time.

Results. Comparing the pre- and post-coffer dam data, it was evident that significant increases in sliding and erosion occurred within the former coffer dam area. Although, most of the erosion and slippage changes noted in the canyon below 700' elevation were the result of failure of the coffer dam and rapid drawdown of the water, we attempted to remove these effects from our estimation of inundation induced erosion losses using a correction factor described earlier. There were significant increases in erosion faces and slide areas as well as covertypes indicative of sliding and slips (upland scrub, and thinly grass/ruderal covered slopes). In addition, there were indications of multiple slips and erosion from former sites that resulted in conversions of one erosion cover type to another. For example, several sites of upland scrub continued to erode becoming bare soil, as well as more open and grassy.

Large areas of erosion and soil slippage associated with inundation were evident from the aerial photographs in all bands except 800'-900', and 900'-1135'. Soil slippage and erosion in these bands appeared to be associated with road cuts and other construction activities, not with translational sliding from below. In the 800'-900' band, there also appeared to be recovery of a few former eroded slopes. We assume this was the case because inundation induced sliding did not appear to reach several of the specific erosion areas identified in this elevation zone.

There were significant losses in acreage of intact (uneroded) upland vegetation and conversions to erosion slopes and lower quality cover types indicative of soil slippage and slides (e.g. upland scrub, thinly covered grass slopes) in all zones below 800 feet. From the waterline to 600', 39.68 acres of former upland vegetation were lost or converted to erosion types of vegetation. Within the 600'-700' band, 37.19 acres were lost or converted. Within the 700'-800' elevation band, 6.92 acres were lost or converted to lower quality cover types. Changes in elevation bands above this level, although partially created by inundation induced sliding from below, were not counted in our analysis because inundation did not actually reach above 715 feet. It is interesting to note that the bare soil/sand/rock cover type was the only one that increased in acreage in every band.

Plant Tolerance to Inundation

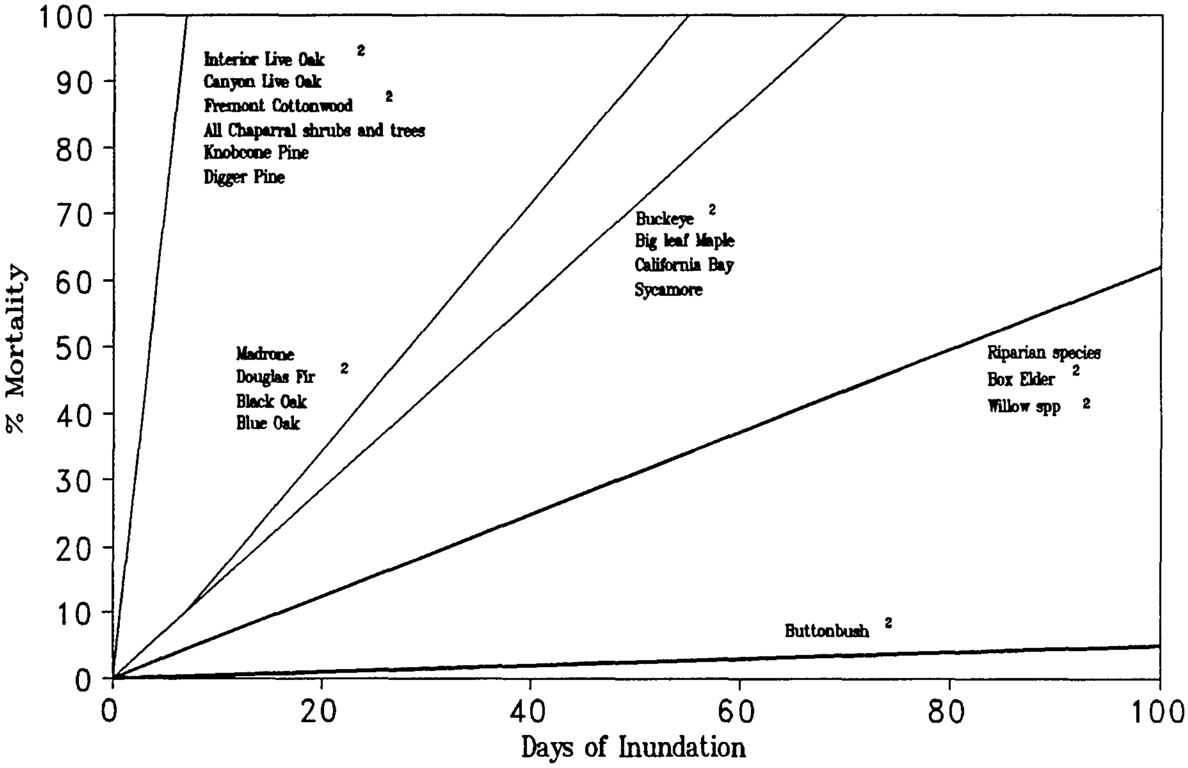
Review of available literature on inundation effects on plants and similar existing flood control structures is presented in Appendix C. Since this review indicated that few specific data were available for the plants in the canyons, a number of assumptions were necessary to proceed with projecting inundation impacts on the vegetation. The following are the major assumptions:

1) In estimating loss of woody plants, no distinction is made between losses due to changes in soil nutrient or chemical conditions, plant growth, reduced seed production, chronic weakening or increased disease, toppling or windthrow, reduced regeneration due to increased numbers of competing species more tolerant of inundation. There are no data distinguishing these various loss factors, and any distinction would have required numerous additional assumptions for each one. Therefore, in the interest of simplicity, we lumped all of these factors and assumed that the mortality rates developed and discussed below, represented all of these causal mechanisms.

2) The response of the woody species was assumed to be uniform within each cover type based on the assumed tolerance of the dominants for that cover type. Selection and mapping of the cover types and their descriptions is provided in the main report. For example it was assumed that the tolerance of dominant species such as Interior live oak and Douglas fir, were representative of the specific cover types in which they were dominant.

3) Vegetation mortality rates for each cover type were assumed to be a uniform gradient of increasing survival with decreasing duration of inundation.

4) Mortality rates were assumed to differ seasonally, with lower mortality during winter and highest mortality during the late spring and summer periods.



[1] Based on data from Walters et al 1980 a, b and assumed linear functions. Mortalities represent flooding during the "growing" season, presumably spring-summer
[2] Denotes species represented by the regression line. The other species listed are presumed to have comparable tolerances.

Figure 7. Linear Mortality Regressions for Various Woody Plants in the Auburn Area.

5) Specific expected mortality rates provided in the extremely limited published data (not subjective ratings) were used to develop expected mortality regressions (Figure 7).

Recognizing that these regressions:

1) were based on highly limited field data;
2) often differed from available subjective ratings in Walters et al. 1980 a,b and Whitlow and Harris 1979 and;
3) differed from recent observations and subjective judgments by McClelland Engineers (1990); it appeared that these regressions may indicate a maximum mortality rate for these species, and not be indicative of the actual modal mortality for the species or the

Table 20. Seasonal inundation survival rates of dominant habitat types in the Auburn area.

INUNDATION DURATION (DAYS)	SURVIVAL RATES December-Feb			March			April			May			June-September			October			November		
	SS	NS	PF	SS	NS	PF	SS	NS	PF	SS	NS	PF	SS	NS	PF	SS	NS	PF	SS	NS	PF
1	1.00	1.00	1.00	1.00	1.00	0.99	0.98	1.00	0.99	0.96	0.99	0.97	0.96	0.99	0.97	1.00	1.00	1.00	1.00	1.00	1.00
3	0.97	0.99	0.98	0.97	0.99	0.98	0.95	0.98	0.96	0.85	0.95	0.96	0.85	0.95	0.96	0.96	0.99	0.98	0.98	0.99	0.98
5	0.97	0.99	0.98	0.95	0.97	0.98	0.90	0.97	0.95	0.80	0.90	0.95	0.80	0.90	0.95	0.94	0.97	0.98	0.97	0.99	0.98
7	0.96	0.98	0.97	0.92	0.95	0.97	0.85	0.95	0.94	0.75	0.85	0.90	0.75	0.85	0.90	0.92	0.95	0.97	0.96	0.98	0.97
10	0.96	0.98	0.97	0.89	0.92	0.96	0.80	0.90	0.93	0.60	0.80	0.80	0.60	0.80	0.80	0.89	0.92	0.96	0.96	0.98	0.97
15	0.95	0.97	0.96	0.85	0.90	0.95	0.70	0.80	0.93	0.50	0.75	0.85	0.50	0.75	0.85	0.85	0.90	0.95	0.95	0.97	0.96

SS = South Slope - Blue Oak Woodland
NS = North Slope - Black Oak/Madrone Woodland
PF = Pine Forest - Conifer Woodland

vegetations they are to represent. Consequently, a separate schedule of mortality rates was developed for each vegetation type. These we based on subjective interpolation of presumed mortality from the regressions and the available species-specific subjective ratings (Table 20). These rates also are broken down to include differences in seasonal sensitivity. Mortality rates were then converted to survival rates.

6) Grass and herbaceous vegetation was assumed to establish and survive at all elevations thus offering some wildlife values during the non-flooded seasons.

Based on these hypotheses and assumptions, the following analytical framework was implemented using interlinked spreadsheets. For each inundation event of one day or longer an increment of soil slippage and erosion loss (in acres) was allocated. Then based on the remaining, intact, acreages of each vegetation cover type at specific target years, habitat suitability values were modified based on the number of inundation events, their durations and seasons of occurrence and appropriate modifications to specific model variables. From these data habitat suitability changes were tracked over the 100-year life of the project and determined for specific target years.

Mathematical Analysis of the Integrated Inundation Methodology

Annual Survival Factors. The seasonal distribution of inundation events within each elevation zone (Table 20) was combined with the survival rate data to create a weighted annual average survival for each cover type in each elevation zone.

The result was a survival rate table for each of the five elevation zones for each alternative (Tables 21 and 22). Each table contains survival rates by habitat type for

Table 21. Weighted average annual survival rates of Auburn area habitat types to inundation of varying duration for 200-Year alternative.

Habitat Type	Inundation Duration (Days) 1	3	5	7	10	15
Zone 1						
SS	0.996	0.968	0.964	0.951	0.946	1.000
NS	1.000	0.989	0.984	0.973	0.968	1.000
PF	0.995	0.978	0.980	0.970	0.968	1.000
Zone 2						
SS	0.999	0.971	0.966	0.947	0.960	1.000
NS	1.000	0.990	0.986	0.970	0.980	1.000
PF	0.997	0.980	0.980	0.970	0.970	1.000
Zone 3						
SS	1.000	0.972	0.970	0.960	1.000	1.000
NS	1.000	0.990	0.990	0.980	1.000	1.000
PF	0.998	0.980	0.980	0.970	1.000	1.000
Zone 4						
SS	1.000	0.970	0.970	0.960	1.000	1.000
NS	1.000	0.990	0.990	0.980	1.000	1.000
PF	0.998	0.980	0.980	0.970	1.000	1.000
Zone 5						
SS	1.000	0.970	1.000	1.000	1.000	1.000
NS	1.000	0.990	1.000	1.000	1.000	1.000
PF	1.000	0.980	1.000	1.000	1.000	1.000

each inundation duration for an average year.

Habitat Variable Values. Variables for each cover type were examined for their susceptibility to inundation effects. For those identified as affected, we used either the survival rate value or a simple percent decrement or increment constant or similar factor to combine with inundation duration event distribution data.

Event Distribution by Target Year For each elevation zone, the total number of events of a given duration were evenly distributed across the 100 year project life. This process was repeated for each inundation duration. The result was a target year by target year distribution of inundation events for each inundation duration, e.g. 1,3,5,7,10 days for the 200 year alternative 1,3,5,7,10 and 15 days for the 400 year alternative. The total number of events in each target year was also calculated. This process was repeated for each of the five elevation zones affected in each alternative.

Soil Loss/Erosion Rates. The soil losses in acres per zone per river mile per event had to be converted to total acres lost per event in each zone. This was done by determining the number of river miles in each zone on the Middle and North Forks of the American River. Total river miles in each zone was determined by extrapolating from an American River Profile prepared by Kennedy Engineers for the multipurpose dam environmental impact statement. These miles were multiplied by the acres of soil lost per zone per river miles per event to yield acres lost per zone per event. Since the elevation zones used in the soil loss rate calculations did not correspond to the zones

Table 22. Weighted average annual survival rates of Auburn area habitat types to inundations of varying durations for the 400-Year alternative.

Elevation/ Habitat Type	INUNDATION DURATION (Days) 1	3	5	7	10	15
Zone 1						
SS	0.994	0.959	0.958	0.945	0.957	0.950
NS	0.999	0.985	0.983	0.971	0.978	0.970
PF	0.994	0.975	0.978	0.969	0.970	0.960
Zone 2						
SS	0.998	0.969	0.965	0.952	0.943	0.950
NS	1.000	0.989	0.985	0.974	0.965	0.970
PF	0.997	0.979	0.980	0.970	0.968	0.960
Zone 3						
SS	0.999	0.971	0.964	0.952	0.960	1.000
NS	1.000	0.990	0.984	0.974	0.980	1.000
PF	0.997	0.980	0.980	0.970	0.970	1.000
Zone 4						
SS	1.000	0.972	0.965	0.947	0.960	1.000
NS	1.000	0.990	0.985	0.970	0.980	1.000
PF	0.997	0.980	0.980	0.970	0.970	1.000
Zone 5						
SS	1.000	0.970	0.970	0.960	1.000	1.000
NS	1.000	0.990	0.990	0.980	1.000	1.000
PF	1.000	0.980	0.980	0.970	1.000	1.000

used in habitat type delineation, a logical process had to be applied to yield useable figures. Our criteria was, in which soil zone did the majority of the habitat zone reside? For example, most of the 580'-640' habitat zone is above 600'; and, therefore, the soil loss factor for 601'-700' was applied to this habitat zone. Table 23presents these data.

Table 23. Soil loss rates used to track changes and losses to wildlife habitat with each project alternative.

	Elevation Zones 490-530'	530-580'	580-640'	640-720'	720-880'
Loss Rate (Acres/event)	4.2	4.2	36.2	36.2	48.22

Table 24. Summary of changes in Auburn area habitat types under 400-Year alternative.

Starting Acres	Habitat Types	Ending Acres	Change
892.00	S. Slope	333.2	-558.80
901.00	N. Slope	317.80	-583.20
115.00	Chaparral	45.00	-70.00
135.00	Pine Forest	64.42	-70.60
862.00	Mont Riparian	122.69	-739.31
133.00	Rocky/Ruderal	1460.26	1327.26
97.00	Grassland	497.56	400.56
0.00	Upland Scrub	378.32	378.32
3135.00		3135.00	0.00

Calculation of Acreage Losses Within Habitat Types. Using the event distribution data described above, the loss and/or conversion of habitat types was tracked in the following manner. For each and every target year, the loss rate per event was multiplied by the number of events in that year. That total loss was then partitioned out as losses/conversions of North Slope, South Slope, Chaparral, Pine Forest and Montane riparian acreages in proportion to their original composition. For example, if North Slope in zone 1 comprised 10% of the total acreage of these affected habitat types, then 10% of the total loss would be debited to that cover type. Conversion to upland scrub, rocky ruderal and grassland was allocated as 28%, 58%, and 14% respectively. This incremental process was applied to each target year with the new acreages carried forward into the next target year. The process was repeated for each elevation zone for each of the project alternatives. Tables 24 and 25 summarizes starting, ending and acres changes produced by this process for each alternative

Table 25. Summary of changes in Auburn area habitat types under 200-Year alternative.

Habitat Variable Changes. Tracking habitat variable changes was by far the most technically complex portion of this analytical approach. Each habitat type was handled separately. Once again, each elevation band was analyzed separately, i.e. for each habitat, five spreadsheets were developed -one for each zone. Within each zone, the 100 project years were arrayed against each of the affected variables. Changes to the variable value were calculated with the following formula:

$$V_i = V_e * (F_1^{E1} * F_3^{E3} * F_5^{E5} * F_7^{E7} * F_{10}^{E10} * F_{15}^{E15})$$

Where

V_i = Variable value at end of the present year

V_e = Variable value at the end of the previous year

F_n = Survival factor for the variable with the habitat under specific inundation duration (n)

E_n = Number of inundation events of n duration during that year

This process was repeated for each zone, in each habitat type, within each alternative. It required linking the event distribution data, the survival rates data and variable values. The same technique was applied to both the 200 years and 400 years alternatives. The major difference between these two alternatives is the event distribution data.

For each habitat type, values within selected target years, TY01, TY08 and TY108 for this analysis, were combined with the corresponding target year acreages (Table 26 and 27) from the soil loss spreadsheet and integrated across the five elevation zones by the Micro-HSI software to yield a single weighted HSI and acreage for each species in each target year. The process was repeated for the second project alternative. The Micro-HSI outputs became the input for the HEP accounting software. Comparison with the without project scenario values yields a net change in Average Annual Habitat Units.

Table 26. 200-Year Dry Dam target year acreage changes based upon inundation modeling.

Habitat Type	0	1	8	108
North Slope	901.0	901.0	886.6	574.8
South Slope	892.0	892.0	878.2	586.8
Chaparral	115.0	115.0	113.0	73.6
Pine Forest	135.0	135.0	133.3	98.8
Grassland	97.0	97.0	104.4	284.5
Montane Riverine	862.0	862.0	841.0	415.4

Table 27. 400-Year Dry Dam target year acreages change in target year based on inundation modeling.

Habitat Type	0	1	8	108
North Slope	901.0	901.0	897.2	317.8
South Slope	892.0	892.0	888.4	333.2
Chaparral	115.0	115.0	113.8	45.0
Pine Forest	135.0	135.0	134.2	64.4
Grassland	97.0	97.0	99.9	497.6
Montane Riverine	862.0	862.0	850.4	122.7

SAMPLING PROCEDURES

Table 28. Criteria used in selection of sampling sites for the Auburn Habitat Evaluation Procedures analysis.

SAMPLING SITE SELECTION CRITERIA
1. Reaches were defined as general areas of homogeneity in terms of habitat types and quality of habitat.
2. Adequate number of sample sites and transects were chosen so the data collected adequately represents the values within the habitat types.
3. Sites were selected for their suitable access, i.e., landowner can be readily identified to gain permission for access.
4. Sites were identified in which data collection could be implemented.
5. Sites were chosen that were representative of direct and indirect project impacts.
6. The number of sites selected was directly related to habitat type acreages impacted.

Field sampling was based on a stratified sampling scheme designed to address the variability in habitat quality (Table 28). Stratification was by habitat type and general habitat quality and sample areas were selected within each habitat. A random number table was used to select the sample points within the selected sample area. The minimum size of a sample plot was either 0.1 hectare plot or a 50-meter transect.

Sampling in the compensation area was severely limited by available time, budgets and accessibility (the area is largely in private ownership). In some instances, e.g., pine forest habitat, baseline habitat values in the mitigation area had to be assumed to be equal to those in the project area, since they were not sampled in the compensation area (Figure 8).

MEASUREMENT OF HABITAT VARIABLES

Data were collected on seven to forty-five different habitat variables per habitat type, and the following section describes the general habitat sampling methodology. Appendix B-2 contains a copy of the field data sheets used in the study.

TERRESTRIAL WILDLIFE HABITAT VARIABLES

Habitat sampling was conducted in May 1989 and September 1990. The majority of habitat measurements were made on 0.1 hectare areas consisting of a 50-meter line transect and contiguous 20-meter belt transect. In riparian areas, line transects were placed perpendicular to water flow. Topographic maps were used to locate the transects on the ground.

Random numbers were used to select a position for a 50-meter line transect. Along the transect, the line intercept method was used to measure variables such as average

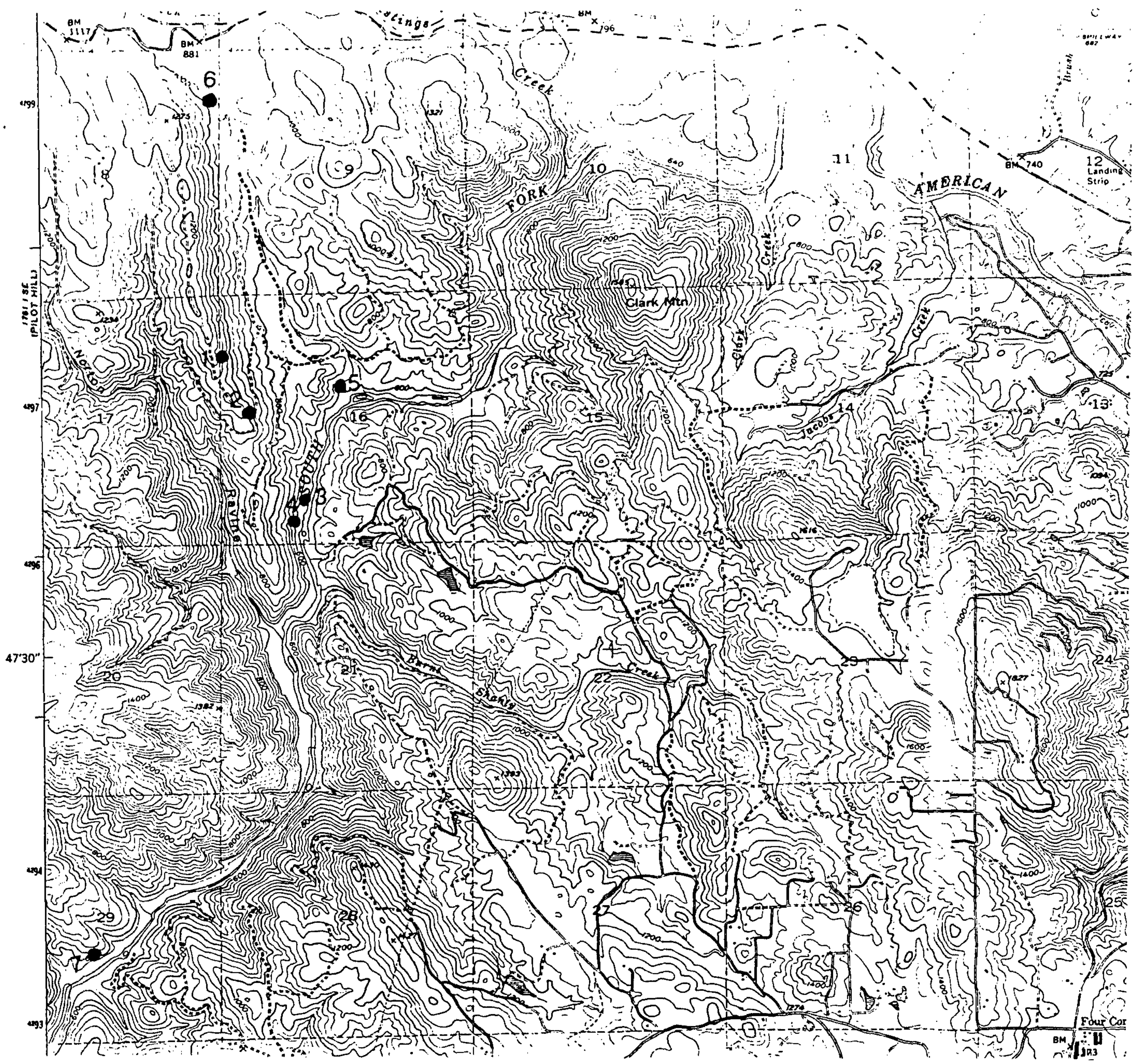


FIGURE 8 HEP FIELD SAMPLING SITES ON SOUTH FORK AMERICAN RIVER

size of ground cover objects and percent cover of various habitat parameters and herbaceous canopy height. Belt transects, 20-meters wide on a randomly selected side of the transect, were used to establish densities variable values e.g., number of nest sites per hectare and average values for shrub and tree canopy height.

Distance variables were measured in the field or from topographic maps and/or aerial photographs. Maps and photographs were used when field crews were unable to locate the parameter or the distance was beyond line of sight. These variables measured in the field included distance to water, escape cover, or feeding areas. Variables most often measured from maps or photographs included distance to nesting areas or foraging areas or distance from human activity.

DATA GAPS

Data gaps and problems occurred for various reasons: (1) gaps occurred when required information was not collected in the field; (2) they also occurred in one instance as an oversight in field data form development, i.e., a single variable for a single model was accidentally excluded; (3) problems in the data occurred when sampling protocols were not followed.

Problems of the first type were dealt with by either excluding that sample site from the average for that variable value, or if it occurred in a habitat type sampled only once, the optimum value for that variable was assigned to it. An optimum value was also assigned to the variable accidentally left off field data forms. These artificial values were maintained throughout the analysis to provide consistency and reduce bias.

Deviations from the sampling protocol were a challenge. The most difficult one to deal with was when a true point-intercept method of recording the first item touched by the sampling pin was abandoned for recording each and every forb and grass encountered by the sampling pin on it on the way to the ground. This was handled via a subjective evaluation of the available data and interpreting its value. This was done when no other data source was available.

HSI DETERMINATION

Average values for the habitat variables were calculated for each habitat type, and Habitat Suitability Index values were determined from the habitat variable averages for each habitat type using the Micro-HSI software. Compensation plans were developed using the mitigation goal of no net loss of in-kind habitat values.

Decisions regarding trade-offs can be made for each habitat type. Trade-offs refer to the ability to trade Habitat Units for a given evaluation species among habitats. For example, loss of Habitat Units for the American kestrel in grasslands could be compensated in a trade-off by mitigating with the appropriate amount of Habitat Units in palustrine forest. No trade-offs for the evaluation species were acceptable for any habitats in this analysis.

MITIGATION PLANNING

Compensation via acquisition and management is necessary when the other mitigation actions, e.g., impact avoidance, modified project design, etc., leave all or a portion of project-induced impacts unmitigated. Although project design has been modified, unmitigated impacts remain, requiring some type of management/ mitigation action.

A management plan (e.g., Future-With-Management) was developed for the mitigation area. The management actions and assumptions for the mitigation areas are presented in detail in the following section and in Tables 29 and 30.

The South Fork American River site was selected as a compensation site because 1) it is threatened with development in the near future, 2) it resembles the American River canyon lands to be adversely impacted by each of the project alternatives, 3) there is potential for enhancing wildlife values, and 4) it is within or adjacent to the project area.

The South Fork American River compensation area selected for the HEP analysis is located within the same foothill region as that of the dry dam impact zone of the North and Middle Fork American Rivers. Riverbed elevation is near 425 feet at the Salmon Falls Bridge and increases to near 1500 feet elevation at the uppermost limit of the study reach. The riverbed gradient is moderate dropping about 35 feet per mile over the length of the area. The river flows through relatively steep sloped canyons (24%) from the El Dorado National Forest Service Boundary past the town of Coloma and then through less steep canyons (13%) from Coloma to the Salmon Falls Bridge at the upper end of Folsom Reservoir. A 13.8 mile reach of canyon with riverine (252 acres) and upland (8,208 acres) of wildlife cover was selected as a compensation area. The compensation area straddles both sides of the river and extends up to elevations of 1200 feet or more to the canyon rims.

All of the wildlife cover types impacted at the Auburn dam site occur in the compensation area although in different proportions. Acreages of existing cover are shown in Table 31. The condition of wildlife cover varies greatly within the compensation area. A significant portion of the area is relatively pristine whereas other portions are affected by development. Most of the oak woodlands are in good condition with moderate to high wildlife values. Compared to the North and Middle Fork American canyons there is proportionally less north slope oak woodland habitat than southslope due to the gentler slopes. Most of the grasslands are very open and are typical of moderately grazed canyon lands that were cleared of native trees many years ago. Burning at regular intervals is commonly practiced to maintain grasslands for grazing. Most of the tributary streams draining into the South Fork meander for several miles from the higher elevations. Narrow bands of riparian vegetation line these streams. Seasonal marshes occur along spring seeps which flow from the canyon walls. The remaining woodlands vary from broad continuous thickets to sparse isolated thickets. In many cases, grazing has greatly reduced recruitment of young tree seedlings. Along the South Fork river channel, sparsely vegetated gravel bars, large boulder outcrops, and alluvial sand bars are common. Scrub-shrub and palustrine forest vegetation occur in narrow (50-100 foot) bands along the waters edge.

The management plan and assumptions were used to develop/predict changes in acreage with- and without- management (Table 32).

Table 29. Management plan for South Fork American River compensation site.

Grassland -	Remove cattle grazing. Carryout a burning program every 3 years on 20 percent of the grasslands (573 acres). Implement an oak woodland restoration program on 75 percent (2,148 acres) of the grasslands. Revegetate to accomplish a moderate density oak woodland. Implement a pine forest restoration program on 5 percent (143 acres) of the grassland.
Wetland Seasonal -	No management needed. Allow natural succession. This wetland cover type not considered in this analysis.
Montane Riverine -	Remove cattle as for the grassland. Implement a revegetation program to accelerate recovery of the wetland cover species. Implement an improved flow release schedule to expand the riparian band. Implement a gravel placement program to improve quality and quantity of riffles in the reach.
Oak Woodlands -	The existing oak woodlands within or adjacent to cattle grazing areas would benefit from grazing removal. The oak woodland restoration program on 75 percent (2,148 acres) of the grasslands would gradually increase the acreage proportion of southslope oak woodlands. There appears to be little opportunity to increase north slope oak woodland since none of the steep sloped canyon areas are under grazing or other similar agricultural practices.
Chaparral -	Allow natural succession. Field data show burning not advantageous to evaluation species.
Pine Forest -	Include a pine forest restoration program on 5 percent (143 acres) of the existing grasslands.

Table 30. Assumptions for predicting future scenarios for South Fork American River Compensation site.

Baseline

1. Existing habitat types are:

   Compensation Area: 8,529 acres

a.	North slope - Black oak/madrone woodland	1,332 acres
b.	South slope - Blue oak woodland	3,560 acres
c.	Savana grassland	2,864 acres
d.	Conifer pine forest	285 acres
e.	Chaparral [illegible]	
f.	Montane riverine	252 acres

2. Goal of evaluation is to replace in-kind natural habitat values.
3. Lands are being used for a variety of practices including grazing, rural ranchettes and open space.
4. Areas in grassland are suitable for oak woodland and pine forest restoration.
5. The quality of Montane riverine habitat is capable of improvement by substrate, water regime and grazing removal measures.

Future with Management -
Target Year

0 Baseline conditions exist. The site is characterized by rural grazed ranch lands, relatively undisturbed oak woodlands with moderate to high wildlife values and natural riverine corridor also with moderate to high wildlife values.

1 Acquire lands. Remove cattle. Burn chaparral. Burn grassland. Implement oak woodland and pine forest restoration program. Implement gravel placement and revegetation program for montane riverine habitat improvement.

4 Repeat grassland burn of selected areas avoiding oak woodland and pine forest management areas. Every three years additional burns to follow.

11 Replanted south slope oak woodland occupies 2,148 acres. Oaks are 20 feet in height and canopy cover 5%. Replanted pine forest occupies 143 acres. Pines are 25 feet high and canopy cover is 10% due to high density planting. Riparian vegetation is more dense and tree crown cover is about 10% average. Average decidous tree canopy greater than 15 feet. Stand width remains less than 300 feet. Riffle pool ratios are approximately 50:50.

30 Oaks are 35 feet in height and canopy cover is about 25%. Pines are 50 feet and canopy cover 30 percent. A few snags are appearing. Fifty percent of understory developed. Riparian vegetation is becoming very dense with tree crown cover about 50%. Average deciduous tree canopy is greater than 20 feet. Stand width remains less than 300 feet. Riffle pool ratios remain at 50:50.

50 Oaks are 50-60 feet in height and canopy cover is 50 percent. Pines are 60-80 feet in height and canopy cover 75 percent. About 1-2 snags per acre occur. Seventy-five percent of the understory is developed. Riparian vegetation is at maximum density with tree crown cover about 90 percent and average canopy greater than 25 feet. Stand width remains less than 300 feet. Riffle pool ratio remains at 50:50.

108 All upland cover types reach optimum value. Riverine only attains 90 percent of optimum value due to remaining problems in flow schedule.

South Fork American River Compensation Area
Future Without Management

0 Baseline conditions exist. Site characterized by rural grazed grasslands, relatively undisturbed oak woodlands with moderate to high wildlife values.

1 Lands are acquired and conversion for non-wildlife purposes begins to occur.

10 Approximately 61 percent of the land (2,337 acres) is developed for non-wildlife purposes by this time.

15 Approximately 83 percent (3,186 acres) of the land is developed for non-wildlife uses by this time.

Table 31. South Fork Compensation site acreages.

North Slope Oak	South Slope Oak	Grass-land	Montane Riverine	Pine Forest	Chaparral
1332	3560	2864	252	285	167

Total = 8460

Table 32. South Fork American River compensation site - changes in wildlife habitat type acreages.

Without Management -

Habitat Type	0	1	10	15	20	108
South slope oak	3560	3560	2108	1584	1180	1180
North slope oak	1332	1332	1252	1223	1201	1201
Savanna grassland	2864	2864	1241	655	203	203
Pine forest	285	285	111	48	0	0
Chaparral	167	167	65	28	0	0
Montane Riverine	252	252	164	133	108	108
Developed/Bare	0	0	3519	4789	5768	5768
GRAND TOTAL	8460	8460	8460	8460	8460	8460

With Management

Habitat Type	0	1	4	6	11	30	50	108
South slope oak	3560	5708	5708	5708	5708	5708	5708	5708
North slope oak	1332	1332	1332	1332	1332	1332	1332	1332
Savana grassland	2864	573	573	573	573	573	573	573
Pine forest	285	428	428	428	428	428	428	428
Chaparral	167	167	167	167	167	167	167	167
Montane Riverine	252	252	252	252	252	252	252	252
Developed/Bare	0	0	0	0	0	0	0	0
GRAND TOTAL	8460	8460	8460	8460	8460	8460	8460	8460

RESULTS

Our mitigation goal is to assure that recommended compensation is consistent with the fish and wildlife values involved. Resources cover a range of habitat values from those considered to be unique and irreplaceable to those believed to be of low value to fish and wildlife resources (Table 33). The American River canyon, and its associated habitat types, to be impacted by the Auburn portion of the American River Watershed

Table 33. Fish and Wildlife Service Compensation/Mitigation goals and resource categories.

	COMPENSATION/MITIGATION PLANNING	
Resource Category	Habitat-Species	Goal
1	High value, unique on a national or ecoregion basis	No loss of existing habitat value
2	High value, relatively scarce or becoming scarce on a national or ecoregion basis	No net loss of in-kind habitat value
3	High to medium value and relatively abundant on a national basis	No net loss of habitat value
4	Medium to low value habitat	Minimize loss of value

project were placed in Resource Category 2 (see Substantiating Report for a thorough discussion). The goal for these resources, therefore, is to prevent any net loss of in-kind habitat value.

Resource Category 2 designation requires no net loss of in-kind habitat value (Table 34). In-kind mitigation in the HEP process requires using the compensation acreage for the species with the largest acreage requirement. The goal of the HEP team in this HEP application was to model the natural system, specifically the canyon, from an ecological perspective and to regain all the elements of that system in the mitigation. To accomplish this goal, each and every evaluation element must be mitigated. Using the mitigation requirement of the species with the highest acreage requirement insures this goal. An equal compensation goal involves averaging project losses against management gains, i.e., the losses of one species can be offset by gains provided to one or more other species. This was not appropriate for this analysis given the Resource Category into which the American River Canyon habitats were placed. In addition, this treatment of the data (in-kind) prevented trading off habitat losses for multi-cover

Table 34. Compensation goal and replacement objectives.

Compensation Type	Species	Replacement
In-Kind	Same species	Equal for individual species
Equal	Same or different species	Equal for sum of all species
Relative	Same or different species	Equal for weighted sum of all species

evaluation species (i.e., species that occur in more than one habitat type) with gains in other habitat types. For example, losses in wetland habitat for the muskrat would not be offset or replaced by gains in grassland habitat.

RESULTS OF THE HEP ANALYSIS

CONSTRUCTION IMPACTS

Results of the field evaluation of the habitat conditions are shown in Table 35. A total change of -441.19 AAHU's would occur with the project in the construction areas (Table 36). Once again, construction of the project would result in net loss of habitat values for all evaluation species combined (Table 36). HSI values for baseline conditions varied from 0.00 to 1.0 for species in the construction impact areas. For all species combined, the average HSI value was approximately 0.55 for the existing habitats in this area. This value indicates, very generally, that the total available habitat within the project impact area is about average in its capacity to support the evaluation species. The in-kind compensation needs for these direct impacts are shown in Table 37. These impacts would result in a net loss of 254.4 acres of canyon habitats.

Table 35. Baseline Habitat Suitability Index Values and Acres for Auburn Dam Construction Sites (Form B).

Form B: Habitat Units

Study Name: Auburn Integrated Inundation
Action: PA 9 (without project) Construction Area
Target Year: 0

Evaluation ID#	Species Name	Area of Habitat	Habitat Suitability Index	Habitat Units
1	N. Alligator Lizard	40.60	0.55	22.33
2	Mountain Quail	40.60	0.00	0.00
3	Blk-capped Chickadee	40.60	0.30	12.18
4	MacGill's Warbler	40.60	0.88	35.73
5	Western Flycatcher	40.60	0.59	23.95
6	Grey Fox	46.60	0.99	46.13
7	California Quail	21.20	0.50	10.60
8	Band-tailed Pigeon	21.20	0.47	9.96
9	W. Fence Lizard	182.70	0.51	93.18
10	Rufous-sided Towhee	27.20	0.68	18.50
11	Scrub Jay	21.20	0.51	10.81
12	Desert Cottontail	21.20	0.40	8.48
13	Brush Rabbit	4.00	1.00	4.00
14	Calif. Thrasher	4.00	1.00	4.00
15	Wrentit	4.00	0.52	2.08
16	Calliope Hummingbird	25.10	1.00	25.10
17	W. Grey Squirrel	6.00	0.97	5.82
18	Pygmy Nuthatch	6.00	0.59	3.54
19	W. Wood Pewee	6.00	0.63	3.78
20	Western Bluebird	157.50	1.00	157.50
21	Mourning Dove	157.50	0.77	121.27
22	Willow Flycatcher	25.10	0.26	6.53
23	Dusky Shrew	25.10	0.98	24.60
24	Northern Oriole	25.10	0.69	17.32
25	Downy Woodpecker	25.10	0.60	15.06
26	American Dipper	25.10	0.94	23.59
27	W. Screech Owl	25.10	0.75	18.83
28	W. Meadowlark	157.50	0.80	126.00
29	Turkey	157.50	0.60	94.50
30	Bobcat	4.00	0.75	3.00
31	W. Rattlesnake	4.00	0.76	3.04

Table 36. Net Change in Average Annual Habitat Units With- and Without-Construction Impacts. (Form D).

Form D: Net Change in AAHU's Date: 12/12/1991

Study Name: Auburn Integrated Inundation
Action: PA 10 (with project) Direct Constrc Impct
Compared To: PA 9 (without project) Construction Area
Period of analysis: 108

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	N. Alligator Lizard	0.10	22.33	-22.23
2	Mountain Quail	0.00	0.00	0.00
3	Blk-capped Chickadee	0.06	12.18	-12.12
4	MacGill's Warbler	0.17	35.73	-35.56
5	Western Flycatcher	0.11	23.95	-23.84
6	Grey Fox	0.21	46.13	-45.92
7	California Quail	0.05	10.60	-10.55
8	Band-tailed Pigeon	0.05	9.96	-9.92
9	W. Fence Lizard	0.43	93.18	-92.75
10	Rufous-sided Towhee	0.09	18.50	-18.41
11	Scrub Jay	0.05	10.81	-10.76
12	Desert Cottontail	0.04	8.48	-8.44
13	Brush Rabbit	0.02	4.00	-3.98
14	Calif. Thrasher	0.02	4.00	-3.98
15	Wrentit	0.01	2.08	-2.07
16	Calliope Hummingbird	0.12	25.10	-24.98
17	W. Grey Squirrel	0.03	5.82	-5.79
18	Pygmy Nuthatch	0.02	3.54	-3.52
19	W. Wood Pewee	0.02	3.78	-3.76
20	Western Bluebird	0.73	157.50	-156.77
21	Mourning Dove	0.56	121.27	-120.71
22	Willow Flycatcher	0.03	6.53	-6.50
23	Dusky Shrew	0.11	24.60	-24.48
24	Northern Oriole	0.08	17.32	-17.24
25	Downy Woodpecker	0.07	15.06	-14.99
26	American Dipper	0.11	23.59	-23.48
27	W. Screech Owl	0.09	18.82	-18.74
28	W. Meadowlark	0.58	126.00	-125.42
29	Turkey	0.44	94.50	-94.06
30	Bobcat	0.01	3.00	-2.99
31	W. Rattlesnake	0.01	3.04	-3.03
				-444.19

Table 37. In-Kind Compensation Requirement for Direct Construction Impacts using the South Fork American River Compensation Area (Form H).

Area Needed For In-Kind Compensation
(Form H Results)

Study Name:	Auburn Integrated Inundation	
Plan Alternative:	PA 10 (with project)	Direct Construction Impacts
Compared To:	PA 9 (without project)	Construction Area
Management Plan:	MP 10 (with project)	S.Fork Band W/Mgmt
Compared To:	MP 11 (without project)	S.Fork No Mgmt, W/Develpmnt
Candidate Management Area Size:	8460.00	

Net Change In AAHU's

Evaluation Species ID#	Name	Plan Alternative	Management Plan	Area Needed For Compensation
1	N. Alligator Lizard	-22.23	91.20	2,061.73
2	Mountain Quail	0.00	67.20	
3	Blk-capped Chickadee	-12.12	305.24	336.02
4	MacGill's Warbler	-35.56	579.48	519.19
5	Western Flycatcher	-23.84	120.00	1,680.87
6	Grey Fox	-45.92	529.89	733.15
7	California Quail	-10.55	1,702.82	52.42
8	Band-tailed Pigeon	-9.92	1,624.11	51.66
9	W. Fence Lizard	-92.75	2,618.29	299.67
10	Rufous-sided Towhee	-18.41	2,647.48	58.83
11	Scrub Jay	-10.76	2,502.77	36.38
12	Desert Cottontail	-8.44	1,820.76	39.22
13	Brush Rabbit	-3.98	152.99	220.17
14	Calif. Thrasher	-3.98	152.99	220.17
15	Wrentit	-2.07	79.55	220.17
16	Calliope Hummingbird	-24.98	131.88	1,602.70
17	W. Grey Squirrel	-5.79	339.18	144.49
18	Pygmy Nuthatch	-3.52	206.11	144.63
19	W. Wood Pewee	-3.76	221.24	143.87
20	Western Bluebird	-156.77	0.00	LOSS
21	Mourning Dove	-120.71	120.80	▸8,453.63◂
22	Willow Flycatcher	-6.50	55.67	987.06
23	Dusky Shrew	-24.48	118.93	1,741.71
24	Northern Oriole	-17.24	113.45	1,285.50
25	Downy Woodpecker	-14.99	0.00	LOSS
26	American Dipper	-23.48	39.56	5,021.78
27	W. Screech Owl	-18.74	174.13	910.39
28	W. Meadowlark	-125.42	156.89	6,762.91
29	Turkey	-94.06	128.65	6,185.59
30	Bobcat	-2.99	114.74	220.17
31	W. Rattlesnake	-3.03	131.57	194.57

OPERATIONAL/INUNDATION IMPACTS

Results of the field evaluation of the 200-Year and 400-Year protection alternatives under baseline conditions are shown in Table 38 (existing conditions are the same, regardless of the project alternative analysed). HSI values for baseline conditions varied from 0.0 to 1.0 for species in the project impact area. For all species combined, the average HSI value was approximately 0.73 for the existing habitats in the area. This value indicates in very general terms that the total available habitat within the project impact area is well above average in its capacity to support the evaluation species.

The South Fork American River compensation site has good potential for mitigating project impacts. Habitat value here are lower than in the project area; the average HSI was 0.52 (Table 39). HSI values varied from 0 to 1.0 for habitats in the compensation area. These values indicate that the habitat within the compensation site combined was about average in its capability to support all the evaluation species. These low values provide "more room for improvement", and hence, require fewer acres than a site with better pre-existing values.

Changes in AAHU's with the 200-Year flood control project alternative are compared in Table 40 for the future with the project (no habitat management) versus the future without the project. This alternative would produce a cumulative loss of -2,461 AAHUs. This value indicates that construction of the flood control project without a compensation plan for habitat losses would result in a net loss in habitat value for all evaluation species combined. Conversely, adoption of the scenario - the future with habitat management on the South Fork American River compensation areas versus the future without management of the compensation areas - would result in a net gain of 17,047 AAHU's with the proposed compensation plan (Table 41).

The 400-Year alternative would have substantially greater impacts than the 200-Year alternative. Changes in AAHU's with the 400-Year flood control project alternative are compared in Table 42 for the future with the project (no habitat management) versus the future without the project. The total change in AAHUs would be -3,938 (Table 42). This value indicates that construction of the flood control project without a compensation plan for habitat losses would result in a combined net loss in habitat value for all evaluation species. Conversely, adoption of the scenario - the future with habitat management of the South Fork American River compensation area versus the future without management of the compensation area - would result in a net gain of 17,047 AAHU's (Table 41).

Table 43 shows the in-kind compensation needed in acres for the 200-Year flood control alternative. Adoption of this alternative would result in the loss of 1,155.68 acres of habitat. Management of 43,533 acres of the South Fork American River mitigation site, as outlined in the Assumptions section, would be needed for compensation. In addition to these operational impact acreage compensation

Table 38. Auburn Form B. Baseline Habitat Suitability Index values and acres for evaluation elements used in the HEP analysis of the Auburn 200-Year and 400-Year dry dam alternatives.

Study Name: Auburn Integrated Inundation
Action: PA 1 (without project) Without Dry Dam
Target Year: 0

Evaluation ID#	Species Name	Area of Habitat	Habitat Suitability Index	Habitat Units
1	N. Alligator Lizard	901.00	0.55	495.55
2	Mountain Quail	901.00	0.00	0.00
3	Blk-capped Chickadee	901.00	0.83	747.83
4	MacGill's Warbler	901.00	0.88	792.88
5	Western Flycatcher	901.00	0.59	531.59
6	Grey Fox	1036.00	0.99	1025.64
7	California Quail	892.00	0.50	446.00
8	Band-tailed Pigeon	892.00	0.47	419.24
9	W. Fence Lizard	1104.00	0.95	1048.80
10	Rufous-sided Towhee	1027.00	0.69	708.63
11	Scrub Jay	892.00	0.51	454.92
12	Desert Cottontail	892.00	0.40	356.80
13	Brush Rabbit	115.00	1.00	115.00
14	Calif. Thrasher	115.00	1.00	115.00
15	Wrentit	115.00	0.52	59.80
16	Calliope Hummingbird	862.00	1.00	862.00
17	W. Grey Squirrel	135.00	0.97	130.95
18	Pygmy Nuthatch	135.00	0.59	79.65
19	W. Wood Peewee	135.00	0.63	85.05
20	Western Bluebird	97.00	1.00	97.00
21	Mourning Dove	97.00	0.77	74.69
22	Willow Flycatcher	862.00	0.26	224.12
23	Dusky Shrew	862.00	0.98	844.76
24	Northern Oriole	862.00	0.69	594.78
25	Downy Woodpecker	862.00	1.00	862.00
26	American Dipper	862.00	0.94	810.28
27	W. Screech Owl	862.00	0.75	646.50
28	W. Meadowlark	97.00	0.84	81.48
29	Turkey	97.00	0.60	58.20
30	Bobcat	115.00	0.75	86.25
31	W. Rattlesnake	115.00	0.86	98.90

requirements, an additional 8,454 acres would be needed (for construction impacts) for complete compensation of project impacts (Table 37).

Tables 44 shows the in-kind compensation needed in acres for the 400-Year protection alternative. Adoption of this alternative would result in the loss of 2,106.14 acres of habitat. Management of 69,887 acres of the South Fork American River site, as outlined in the Assumptions section, would be needed for compensation. In addition to the operational impact acreage compensation requirements, an additional 8,454 acres would be needed (for construction impacts) for complete compensation of project

Table 39. South Fork American River Compensation Site Form B.

Study Name: Auburn Integrated Inundation
Action: MP 11 (without project) South Fork Mitigation
Target Year: 0

ID#	Evaluation Species Name	Area of Habitat	Habitat Suitability Index	Habitat Units
1	N. Alligator Lizard	1332.00	0.76	1012.32
2	Mountain Quail	1332.00	0.56	745.92
3	Blk-capped Chickadee	1332.00	0.54	719.28
4	MacGill's Warbler	1332.00	0.00	0.00
5	Western Flycatcher	1332.00	1.00	1332.00
6	Grey Fox	1617.00	0.77	1245.09
7	California Quail	3560.00	0.24	854.40
8	Band-tailed Pigeon	3560.00	0.20	712.00
9	W. Fence Lizard	4363.00	0.18	785.34
10	Rufous-sided Towhee	3845.00	0.50	1922.50
11	Scrub Jay	3560.00	0.21	747.60
12	Desert Cottontail	3560.00	0.07	249.20
13	Brush Rabbit	167.00	1.00	167.00
14	Calif. Thrasher	167.00	1.00	167.00
15	Wrentit	167.00	0.52	86.84
16	Calliope Hummingbird	252.00	1.00	252.00
17	W. Grey Squirrel	285.00	0.97	276.45
18	Pygmy Nuthatch	285.00	0.59	168.15
19	W. Wood Pewee	285.00	0.63	179.55
20	Western Bluebird	2864.00	0.00	0.00
21	Mourning Dove	2864.00	0.77	2205.28
22	Willow Flycatcher	252.00	0.28	70.56
23	Dusky Shrew	252.00	0.94	236.88
24	Northern Oriole	252.00	0.58	146.16
25	Downy Woodpecker	252.00	0.00	0.00
26	American Dipper	252.00	0.35	75.60
27	W. Screech Owl	252.00	0.00	0.00
28	W. Meadowlark	2864.00	1.00	2864.00
29	Turkey	2864.00	0.82	2348.48
30	Bobcat	167.00	0.75	125.25
31	W. Rattlesnake	167.00	0.86	143.62

mpacts (Table 37).

Table 40. 200-Year Dry Dam - Net Change in AAHUs (Form D).

Study Name: Auburn Integrated Inundation
Action: PA 2 (with project) 200 Year Dry Dam
Compared To: PA 1 (without project) Without Dry Dam
Period of analysis: 108

ID#	Evaluation Species Name	AAHU's With Action	AAHU's Without Action	Net Change
1	N. Alligator Lizard	365.84	495.55	-129.71
2	Mountain Quail	0.00	0.00	0.00
3	Blk-capped Chickadee	607.99	747.83	-139.84
4	MacGill's Warbler	637.82	792.88	-155.06
5	Western Flycatcher	435.37	531.59	-96.22
6	Grey Fox	848.48	1025.64	-177.16
7	California Quail	372.13	446.00	-73.87
8	Band-tailed Pigeon	349.80	419.24	-69.44
9	W. Fence Lizard	919.81	1048.80	-128.99
10	Rufous-sided Towhee	505.63	708.63	-203.00
11	Scrub Jay	366.41	454.92	-88.51
12	Desert Cottontail	297.70	356.80	-59.10
13	Brush Rabbit	94.50	115.00	-20.50
14	Calif. Thrasher	94.50	115.00	-20.50
15	Wrentit	46.87	59.80	-12.93
16	Calliope Hummingbird	645.42	862.00	-216.58
17	W. Grey Squirrel	114.48	130.95	-16.47
18	Pygmy Nuthatch	71.36	79.65	-8.29
19	W. Wood Pewee	75.55	85.05	-9.50
20	Western Bluebird	187.27	97.00	90.27
21	Mourning Dove	144.19	74.69	69.50
22	Willow Flycatcher	167.81	224.12	-56.31
23	Dusky Shrew	632.51	844.76	-212.25
24	Northern Oriole	445.34	594.78	-149.44
25	Downy Woodpecker	645.42	862.00	-216.58
26	American Dipper	606.70	810.28	-203.58
27	W. Screech Owl	484.07	646.50	-162.43
28	W. Meadowlark	78.38	81.48	-3.10
29	Turkey	98.85	58.20	40.65
30	Bobcat	71.17	86.25	-15.08
31	W. Rattlesnake	81.61	98.90	-17.29
				-2,461.31

Table 41. South Fork American River Compensation Site - Net Change in AAHUs (Form D).

Study Name: Auburn Integrated Inundation
Action: MP 10 (with project) S. Fork American River
Compared To: MP 11 (without project) S. Fork (Upper Unchanged)
Period of analysis: 108

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	N. Alligator Lizard	1012.32	921.12	91.20
2	Mountain Quail	745.92	678.72	67.20
3	Blk-capped Chickadee	959.72	654.48	305.24
4	MacGill's Warbler	579.48	0.00	579.48
5	Western Flycatcher	1332.00	1212.00	120.00
6	Grey Fox	1472.20	942.31	529.89
7	California Quail	2034.03	331.21	1702.82
8	Band-tailed Pigeon	1900.12	276.01	1624.11
9	W. Fence Lizard	3177.61	559.32	2618.29
10	Rufous-sided Towhee	3327.24	679.76	2647.48
11	Scrub Jay	2792.59	289.81	2502.77
12	Desert Cottontail	1917.36	96.60	1820.76
13	Brush Rabbit	167.00	14.01	152.99
14	Calif. Thrasher	167.00	14.01	152.99
15	Wrentit	86.84	7.29	79.55
16	Calliope Hummingbird	252.00	120.12	131.88
17	W. Grey Squirrel	362.40	23.21	339.18
18	Pygmy Nuthatch	220.23	14.12	206.11
19	W. Wood Pewee	236.32	15.08	221.24
20	Western Bluebird	0.00	0.00	0.00
21	Mourning Dove	449.38	328.57	120.80
22	Willow Flycatcher	89.31	33.63	55.67
23	Dusky Shrew	231.84	112.91	118.93
24	Northern Oriole	183.12	69.67	113.45
25	Downy Woodpecker	0.00	0.00	0.00
26	American Dipper	75.60	36.04	39.56
27	W. Screech Owl	174.13	0.00	174.13
28	W. Meadowlark	583.61	426.72	156.89
29	Turkey	478.56	349.91	128.65
30	Bobcat	125.25	10.51	114.74
31	W. Rattlesnake	143.62	12.05	131.57
				+17,047.01

Table 42. 400-Year Dry Dam Alternative - Net Change in AAHUs (Form D).

Study Name: Auburn Integrated Inundation Analysis
Action: PA 6 (with project) 400 Year Dry Dam
Compared To: PA 1 (without project) Without Dry Dam
Period of analysis: 108

Evaluation Species ID#	Name	AAHU's With Action	AAHU's Without Action	Net Change
1	N. Alligator Lizard	294.03	495.55	-201.52
2	Mountain Quail	0.00	0.00	0.00
3	Blk-capped Chickadee	510.43	747.83	-237.40
4	MacGill's Warbler	532.43	792.88	-260.45
5	Western Flycatcher	364.15	531.59	-167.44
6	Grey Fox	717.26	1025.64	-308.38
7	California Quail	315.81	446.00	-130.19
8	Band-tailed Pigeon	296.86	419.24	-122.38
9	W. Fence Lizard	824.28	1048.80	-224.52
10	Rufous-sided Towhee	454.65	708.63	-253.98
11	Scrub Jay	309.23	454.92	-145.69
12	Desert Cottontail	252.65	356.80	-104.15
13	Brush Rabbit	80.14	115.00	-34.86
14	Calif. Thrasher	81.40	115.00	-33.60
15	Wrentit	39.09	59.80	-20.71
16	Calliope Hummingbird	514.31	862.00	-347.69
17	W. Grey Squirrel	99.29	130.95	-31.66
18	Pygmy Nuthatch	60.55	79.65	-19.10
19	W. Wood Pewee	63.41	85.05	-21.64
20	Western Bluebird	266.92	97.00	169.92
21	Mourning Dove	218.54	74.69	143.85
22	Willow Flycatcher	133.72	224.12	-90.40
23	Dusky Shrew	504.02	844.76	-340.74
24	Northern Oriole	354.87	594.78	-239.91
25	Downy Woodpecker	514.31	862.00	-347.69
26	American Dipper	483.45	810.28	-326.83
27	W. Screech Owl	385.73	646.50	-260.77
28	W. Meadowlark	87.80	81.48	6.32
29	Turkey	126.35	58.20	68.15
30	Bobcat	61.21	86.25	-25.04
31	W. Rattlesnake	70.55	98.90	-28.35
				-3,936.85

Table 43. In-Kind Compensation Requirement for 200-Year Dry Dam using the South Fork American River Compensation Site (Form H).

Area Needed For In-Kind Compensation
(Form H Results)

Study Name:	Auburn Integrated Inundation	
Plan Alternative:	PA 2 (with project)	200 Year Dry Dam
Compared To:	PA 1 (without project)	Without Dry Dam
Management Plan:	MP 10 (with project)	S.Fork Band W/Mgmt
Compared To:	MP 11 (without project)	S.Fork No Mgmt, W/Develpmnt
Candidate Management Area Size:	8460.00	

Net Change In AAHU's

Evaluation Species ID#	Name	Plan Alternative	Management Plan	Area Needed For Compensation
1	N. Alligator Lizard	-129.71	91.20	1,2031.90
2	Mountain Quail		0.00	67.20
3	Blk-capped Chickadee	-139.84	305.24	3,875.74
4	MacGill's Warbler	-155.06	579.48	2,263.69
5	Western Flycatcher	-96.22	120.00	6,782.96
6	Grey Fox	-177.16	529.89	2,828.47
7	California Quail	-73.87	1,702.82	367.03
8	Band-tailed Pigeon	-69.44	1,624.11	361.73
9	W. Fence Lizard	-128.99	2,618.29	416.79
10	Rufous-sided Towhee	-203.00	2,647.48	648.70
11	Scrub Jay	-88.51	2,502.77	299.18
12	Desert Cottontail	-59.10	1,820.76	274.60
13	Brush Rabbit	-20.50	152.99	1,133.82
14	Calif. Thrasher	-20.50	152.99	1,133.82
15	Wrentit	-12.93	79.55	1,374.85
16	Calliope Hummingbird	-216.58	131.88	13,893.40
17	W. Grey Squirrel	-16.47	339.18	410.84
18	Pygmy Nuthatch	-8.29	206.11	340.10
19	W. Wood Pewee	-9.50	221.24	363.16
20	Western Bluebird	90.27	0.00	NONE
21	Mourning Dove	69.50	120.80	NONE
22	Willow Flycatcher	-56.31	55.67	8,556.62
23	Dusky Shrew	-212.25	118.93	15,098.45
24	Northern Oriole	-149.44	113.45	11,143.71
25	Downy Woodpecker	-216.58	0.00	LOSS
26	American Dipper	-203.58	39.56	» 43,532.63 «
27	W. Screech Owl	-162.43	174.13	7,891.98
28	W. Meadowlark	-3.10	156.89	167.28
29	Turkey	40.65	128.65	NONE
30	Bobcat	-15.08	114.74	1,111.61
31	W. Rattlesnake	-17.29	131.57	1,111.61

Table 44. In-Kind Compensation Requirement for 400-Year Dry Dam using the South Fork American River Compensation Site (Form H).

Area Needed For In-Kind Compensation
(Form H Results)

Study Name:	Auburn Integrated Inundation	
Plan Alternative:	PA 6 (with project)	400 Year Dry Dam
Compared To:	PA 1 (without project)	Without Dry Dam
Management Plan:	MP 10 (with project)	S.Fork Band W/Mgmt
Compared To:	MP 11 (without project)	S.Fork No Mgmt, With Devlpmnt
Candidate Management Area Size:	8460.00	

Evaluation Species ID#	Name	Net Change In AAHU's: Plan Alternative	Net Change In AAHU's: Management Plan	Area Needed For Compensation
1	N. Alligator Lizard	-201.52	91.20	18,692.61
2	Mountain Quail	0.00	67.20	
3	Blk-capped Chickadee	-237.40	305.24	6,579.79
4	MacGill's Warbler	-260.45	579.48	3,802.41
5	Western Flycatcher	-167.44	120.00	11,804.39
6	Grey Fox	-308.38	529.89	4,923.47
7	California Quail	-130.19	1,702.82	646.83
8	Band-tailed Pigeon	-122.38	1,624.11	637.49
9	W. Fence Lizard	-224.52	2,618.29	725.44
10	Rufous-sided Towhee	-253.98	2,647.48	811.61
11	Scrub Jay	-145.69	2,502.77	492.48
12	Desert Cottontail	-104.15	1,820.76	483.95
13	Brush Rabbit	-34.86	152.99	1,927.48
14	Calif. Thrasher	-33.60	152.99	1,857.91
15	Wrentit	-20.71	79.55	2,202.89
16	Calliope Hummingbird	-347.69	131.88	22,304.28
17	W. Grey Squirrel	-31.66	339.18	789.71
18	Pygmy Nuthatch	-19.10	206.11	783.94
19	W. Wood Pewee	-21.64	221.24	827.45
20	Western Bluebird	169.92	0.00	NONE
21	Mourning Dove	143.85	120.80	NONE
22	Willow Flycatcher	90.40	55.67	13,736.68
23	Dusky Shrew	-340.74	118.93	24,238.85
24	Northern Oriole	-239.91	113.45	17,889.97
25	Downy Woodpecker	-347.69	0.00	LOSS
26	American Dipper	-326.83	39.56	» 69,886.72 «
27	W. Screech Owl	-260.77	174.13	12,669.69
28	W. Meadowlark	6.32	156.89	NONE
29	Turkey	68.15	128.65	NONE
30	Bobcat	-25.04	114.74	1,846.32
31	W. Rattlesnake	-28.35	131.57	1,823.13

SUMMARY AND CONCLUSIONS

The Habitat Evaluation Procedures method was used to quantify the baseline habitat conditions, and determine the impacts to terrestrial and aquatic wildlife habitats, and calculate the compensation required to offset the impacts of the proposed 200-Year and 400-Year dry dam in the Auburn area of the American River canyon, Placer County, California. Difference exists between the two alternatives in acres impacted, therefore, two analyses on direct inundation impacts were completed. In addition, an analysis of the construction impacts was also completed. The study encompasses a vast area, including the direct and operational impact areas and the proposed mitigation site.

Field sampling was conducted from May to June 1989 and in September 1990 by representatives from the U.S. Fish and Wildlife Service, California Department of Water Resources, California Department of Fish and Game, and the U.S. Army Corps of Engineers. Field sampling, impact assessment and management planning was conducted for several habitat types including north slope black oak - madrone woodland, south slope blue oak - digger pine woodland, pine forest, chaparral, grassland and montane riverine. A comprehensive mitigation plan were developed to compensate for the habitat acres and value losses associated with the impacts of the flood control project. Total habitat losses to inundation impacts was 1,156 acres for the 200-Year alternative, whereas the 400-Year alternative would adversely impact 2,106 acres of canyon habitat types. Construction impacts were evaluated for with and without the project. Different levels of flood protection did not yield different construction impacts since the footprint of the dam and the other features are basically the same with either alternative. Construction impacts would produce a project induced loss of 254.40 acres. Preservation/conversion of 8,454 acres of the South Fork mitigation area would compensate for these project induced impacts.

The mitigation plan calls for preservation and management of existing South Fork American River canyon lands which would otherwise be developed. Management of 43,533 acres of lands of this type and configuration would be necessary to meet the compensation goal of no net loss of in-kind value for the 200-Year alternative. The 400-Year alternative would require 69,887 acres for compensation on the South Fork American River site. Full mitigation for general wildlife impacts would be met by combining the mitigation acres required for construction impacts with those necessary for the selected plan.

This analysis of the Auburn dam alternatives forged new territory in tracking and quantifying the impacts of a dry dam. A systematic, theoretical and mathematical model of dry dam operation impacts was synthesized from frequency inundation duration exceedence data (from the Corps of Engineers), site-specific soil erosion data, vegetation inundation tolerance data and Habitat Suitability Index model variable values combined with inundation event distributions. To our knowledge, this is the first dry dam impacts model every designed or implemented for the arid west. Although, like any model, it is based on a wide array of assumptions, we feel the methods and results are biologically meaningful.

REFERENCES

Allen, J.A., J.T. Teaford, E.C. Pendleton and M. Brody. 1988. Evaluation of Greentree Reservoir Management Options in Arkansas. Presented at the 53rd North American Wildlife and Natural Resources Conference, Louisville, KY, March 18-23, 1988. Available through the USFWS National Wetlands Research Center, 1010 Gause Blvd. Slidell, LA 70458.

Allen, H.H. and C.V. Klimas. 1986. Reservoir Shoreline Revegetation Guidelines. Tech. Rept. E-86-13. U.S. Army Corps of Engineers, Waterways Exp. Sta., Vicksburg, Miss. 87 pp.

Allen, H.H. and L.R. Aggus. 1983. Effects of fluctuating reservoir water levels on fisheries, wildlife, and vegetation; summary of a workshop, 24-26 February 1981. Misc. Paper E-83-2. U.S. Army Corps of Engineers, Waterways Exp. Sta., Vicksburg, Miss. 55 pp.

California Dept. Parks and Recreation. 1979. Resource Invventory Report, Vol. 1: Natural Resources. State of California Dept. Parks and Recreation, Sacramento, CA. 188 pp.

Chapman, R.J., T.M. Hinckley, L.C. Lee, and R.O. Teskey. 1982. Impact of water level changes on woody riparian and wetland communities, Vol X. Index and Addendum to Vols. I-VIII. U.S. Fish and Wildlife Service FWS/OBS-82/23. Eastern Energy and Land Use Team, Kearnysville, W.Va.

Comes, R.D. and T. McCreary. 1986. Approaches to revegetate shorelines at Lake Wallula on the Columbia River, Washington-Oregon. Tech. Rept. E-86-2. U.S. Army Corps of Engineers, Waterways Exp. Sta., Vicksburg, Miss. 89 pp.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. FWS/OBS-79/31. U.S. Fish and Wildlife Service, Office of Biological Services, Wash. D.C. 131 pp.

Fenner, P., W.W. Brady and D.R. Patton. 1985. Effects of regulated flows on regeneration of cottonwood. Journ. Range Mgmt. 38(2):135-138.

Harris, R.W., A.T. Leiser, G.W. Forister, and T.H. Whitlow. 1980. Plant Tolerance to Flooding. Progress Report to the U.S. Bureau of Reclamation and U.S. Forest Service. Contract No. A 5fs-16565. Dept. of Environmental Horticulture, University of Calif., Davis. 10+pp.

Holstein, G. 1984. California Riparian Forests: Deciduous islands in an evergreen sea. Pp. 2-22. In: R.E. Warner and K.M. Hendrix (eds.) California Riparian Systems: ecology, Conservation, and Productive Management. Univ. Calif. Press, Berkeley.

Kennedy Engineers. 1971. Auburn Dam EIS, volume I: Introduction and Summary. Prepared for U.S. Bureau of Reclamation, Region 2, Sacramento, California.

_____. 1971. Auburn Dam EIS, volume II: Baseline Environmental Survey. Prepared for U.S. Bureau of Reclamation, Region 2, Sacramento, California.

_____. 1971. Auburn Dam EIS, volume V: Implementation Guidelines. Prepared for U.S. Bureau of Reclamation, Region 2, Sacramento, California.

Kozlowski, T.T. 1984. Flooding and Plant Growth. Academic Press, Inc. Orlando, Fl.

McClelland Consultants, Inc. and A.T. Leiser 1990. Analysis of Potential vegetation mortality resulting from operation of the proposed Auburn flood control dam. Unpubl. contract report to State of Calif. Dept. Water Resources and Reclamation Board. 45 pp + appendices.

Major, J. 1977. California climate in relation to vegetation. In: M.G. Barbour and J. Major (eds.) Terrestrial Vegetation of Califonria. Chapter 2, pp 11-74. John Wiley & Sons, New York.

Major, J. 1961. Use in plant ecology of causation, physiology and a definition of vegetation. Ecology 42(1):167-169.

Mason, H.L. and J.H. Langenheim. 1957. Language analysis and the concept "environment". Ecology 38:325-340.

Pickett, S.T.A. and J.N. Thompson. 1978. Patch dynamics and the design of nature reserves. Biol. Conservation 13:27-37.

Reed, P.B. Jr. 1988. National list of plant species that occur in wetlands: California (Region 0). Biol. Rept. 88 (26.10). U.S. Fish and Wildlife Service, National Wetlands Inventory, Wash. D.C.

Rudolph, R.R. and C.G. Hunter. 1964. Green trees and greenheads. Pp.610-618 In: J.P. Linduska (ed.), Waterfowl Tommorrow, USDI, Wash., D.C.

Taylor, G.G. 1981. Stream Alterations: an introduction. U.S.F.W.S., Office of Biological Services, Eastern Energy and Land Use Team. Kearneysville, WV. 19 pp.

Teskey, R.O. and T.M. Hinckley. 1977. Impact of water level changes on woody riparian and wetland communities, Vol. I. Plant and soil responses. U.S. Fish and Wildlife Service FWS/OBS-77/58. National Stream Alteration Team, Colombia, Missouri.

U.S. Army Corps of Engineers 1990a. Inundation Analysis for the 200 year flood control reservoir at Auburn. Sacramento District. Unpubl. Rept., June 1990.

U.S. Army Corps of Engineers 1990b. Inundation Analysis for the 400 year flood control reservoir at Auburn. Sacramento District Corps of Engineers. Unpubl. Rept., August 1990.

U.S. Army Corps of Engineers 1990c. Reservoir rim and slope stability study. Sacramento District. Unpubl. Rept., June 1990.

U.S. Bureau of Reclamation. 1971. Auburn Dam Environmental Impact Study. Prepared by Kennedy Engineers; Royston, Hanamoto, Beck & Abey; Jara Applied Sciences, Inc. U.S. Dept. of the Interior Bureau of Reclamation, Sacramento, CA. Six Vols.

U.S. Fish and Wildlife Service. 1980. Ecological Services Manual 102. Habitat Evaluation Procedures. USDI-FWS, Division of Ecological Services, Wash. D.C.

Walters, M.A., R.O. Teskey, and T.M. Hinckley. 1980a. Impact of water level changes on woody riparian and wetland communities, Vol. VII. Mediterranean Region. U.S. Fish and Wildlife Service FWS/OBS-78/93. Eastern Energy and Land Use Team, Kearnysville, W.Va.

__________. 1980b. Impact of water level changes on woody riparian and wetland communities, Vol. VIII. Pacific Northwest and Rocky Mountain Regions. U.S. Fish and Wildlife Service FWS/OBS-78/94. Eastern Energy and Land Use Team, Kearnysville, W.Va.

Whitlow, T.H. and R.W. Harris. 1979. Flood tolerance in plants: a state-of-the-art review. Tech. Rept. E-79-2. U.S. Army Corps of Engineers, Waterways Exp. Sta., Vicksburg, Miss. 161 pp. + Appendices.

APPENDIX C

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UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
FISH AND WILDLIFE ENHANCEMENT OFFICE
SACRAMENTO, CALIFORNIA

POTENTIAL VEGETATION AND WILDLIFE IMPACTS OF THE PROPOSED AUBURN "DRY" DAM: A LITERATURE REVIEW AND DISCUSSION OF SIMILAR PEAK FLOW FACILITIES

by
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December 1990

INTRODUCTION AND BACKGROUND

Construction and operation of a proposed "dry" dam flood control reservoir at the Auburn Dam site would result in periodic inundation of substantial portions of the American River Canyon near Auburn. Inundation would adversely affect several miles of both the north and middle forks. In an effort to describe, predict and evaluate the effects of such a dam on the biotic communities of the American River canyon, our analysis necessarily depended heavily upon project design and hypothetical operation information provided by the Corps of Engineers as well as field data (both quantitative and observational) gathered by the Service during HEP sampling in the canyons. We also conducted brief examinations of sites in California with similar vegetation that also are subject to periodic inundation, such as the upper zones of several small multipurpose reservoirs and the area below Keswick dam on the upper Sacramento River (at the suggestion of Dr. Andrew Leiser, Univ. Calif. Davis). In addition, we reviewed available literature on similar existing flood control structures and on the flood tolerance of species indigenous to California and the American River Canyons. This was supplemented by computer searches of information available from libraries and the Service's Wildlife Review database in Fort Collins Colorado. We also contacted researchers knowledgeable in plant tolerance to flooding and the effects of flooding on plant and animal communities.

THE "DRY" DAM CONCEPT

The concept of a peak flow detention dam, "dry" dam or "dry" bed dam to reduce the flood potential to downstream areas is a relatively new approach to large scale flood control efforts, at least in the arid west. In contrast to a typical large multipurpose reservoir, which not only provides some level of flood control, but also stores water for other uses, a peak flow detention dam impounds water only during periods when runoff from the upstream watershed exceeds the dam outlet capacity (Taylor 1981). The frequency, duration, elevation, and areal extent of inundation behind a particular "dry" dam depend on several factors such as: 1) the size, hydrologic and geomorphic characteristics of the watershed in which the dam is placed 2) the vegetative communities within the watershed; 3) characteristics of individual storms, which, at least conceptually, are a function of the climatic regime in which the watershed exists; and, of course; 4) the specific design of the dam.

The outlet structure of a peak flow detention faciltiy, which is typically an ungated opening through the dam, is specifically designed and sized to allow unrestricted passage of specific stream-flow volumes (usually normal or lower flow volumes). Flow volumes exceeding the outlet design capacity are passively detained and back-up behind the dam, temporarily inundating the upstream channel and adjoining terrestrial habitats.

LITERATURE REVIEW

Impacts to Vegetation and Wildlife

Although peak flow detention dams (in comparison to similar sized multipurpose reservoirs), typically inundate a smaller area for relatively brief periods, they nonetheless effect profound changes in stream-edge and upland communities above and below the impoundments (Taylor 1981). In relatively undisturbed watersheds, such as the American River Canyon, both the terrestrial and aquatic environments generally exist in a dynamic equilibrium (Karr and Schlosser 1977). Human modifications to relatively intact, natural watersheds and stream systems introduces completely new physical influences that disrupt the existing or developing dynamic equilibrium of the system. The ensuing extent of disequilibrium (Karr and Schlosser 1977) varies with the location, areal extent, and types of modifications made and the former condition of the system. Despite the existing uses and human influences present in the canyon, the American River canyon remains one of the largest, relatively natural river systems in California.

In most cases studied, river impoundments, in general, result in substantial loss of biological diversity in both the terrestrial and aquatic portions of the system above and below the impoundment. This has been attributed to reduction in the spatial and temporal heterogeneity within the systems (Ward and Stanford 1979). Another forseeable result is the obvious fundamental alteration of the basic nature and frequency of the former habitat patch dynamics (Pickett and White 1977). Of particular concern are terrestrial processes and cycles such as fire regimes, various population cycles (such as insect and vertebrate density fluctuations), that serve to maintain the long-term dynamic equilibrium in the terrestrial communities. Even relatively rare inundation events have the potential to substantially, if not completely, alter these processes.

Interestingly, despite the obvious ecological alterations that occur with peak flow detention dams, little attention has been given to research on the effects on the wildlife communities probably because most dry dams are very small, inundating relatively small acreages and/or occur in mostly lowland areas where increased inundation can be managed to enhance already existing wetland values (USFWS 1981). Review of available literature found virtually no information or data on the impacts to terrestrial wildlife for "dry" dam types of flood control structures. Consequently, the following discussions focus largely on impacts to the vegetation and habitats for wildlife rather that actual effects on wildlife populations.

GENERAL DOWNSTREAM IMPACTS

Because "dry" dams are specifically designed to substantially reduce the downstream peak flow characteristics, substantial changes in the streamside communities below the dam typically result. Specifically, the width of the riparian and scour zones becomes narrowed because of the attenuation of flushing and scouring flows (Taylor 1981). The riparian zone at the upland interface typically reverts to dry land habitat and at the water interface, woody riparian species expand into the former scour zone and increase along the waters edge especially at sand bars and shoals. Species composition (terrestrial and aquatic, as well as plant and animal) within the riparian zone inevitably changes from those characteristic of a highly dynamic fluvial/riparian system to those more indicative of a relatively constant and narrower less variable flow system. The extent of these effects within a given system undoubtedly depends upon the change in magnitude of the peak flow conditions.

GENERAL UPSTREAM IMPACTS

Conceptually, in comparison to a permanent multipurpose reservoir, a peak flow detention dam would fill for relatively brief periods of time and most inundations cover much less than the maximal land area behind the dam. Consequently, losses of vegetation and wildlife habitat are expected to be less than a comparable multipurpose reservoir since a proportion of the vegetation (and supportive habitat for wildlife) would remain alive and productive within the temporary reservoir pool area. Actual impacts of a "dry" dam on the local wildlife populations, however, are expected to be severely disruptive, since most terrestrial wildlife species cannot breathe under water even for a few minutes.

Wildlife

Most of the highly vagile wildlife in the canyons will be forced out of the area as the water rises. Birds will obviously be able to fly to new areas and many of the larger ground dwelling mammals that are active during the flood periods will move out also. However, subterranean species, those aestivating or hibernating will drown. This comprises a large biomass and significant component of the wildlife trophic support level. Many highly significant trophic groups such as reptiles, amphibians, and slow moving rodents likely will be eliminated. Other very important trophic components such as the invertebrates will also decline enormously. Even those animals capable of moving to new areas will be severely stressed and many will die because food and cover resources will not be sufficient to sustain the abnormally higher populations in the escape areas.

Thus the effects of inundation will extend well beyond the upper level of the water.

Although those individuals resident in the higher escape areas will be at a distinct advantage to find food and cover, all individuals will experience dramatically increased competition and stress. Even displacements of only hours or a day or two can dramatically increase competition for cover and food in the escape areas and thus, adversely affect large numbers of animals. These effects are greatly compounded during winter periods when food and cover are already at a premium.

Even when the water recedes, the displaced wildlife will not be able to immediately reclaim their habitats since conditions throughout the inundated area will change dramatically. Former dens will be full of water, debris or collapsed. Even tree holes will be full of water. Much of the flotable ground litter, downed logs, brush piles and food caches will be floted away or relocated. Some food items will be waterlogged, or covered by sediments and largely unuseable.

Predatory species may benefit over the immediate term since many prey species will be displaced, disoriented and readily available. However, the net effect on overall quality and carrying capacity immediately following the inundation event will be a dramatic drop. For some species carying capacity and habitat quality are expected to drop more than 90 percent, for others less, but all will decline significantly. Recovery will not be immediate and for most vertebrate species the lower carrying capacity is expected to last for at least a year or more depending upon conditions in the subsequent seasons. For example, subsequent inundation events, even for short periods will likely disrupt and prolong the recovery process.

Vegetation

The causal factors attending inundation, can affect the occurrence and location of the various vegetation components (individual plant species) in numerous and complex ways. The actual effects of inundation upon a given plant can vary depending upon specific conditions of the plant, soil, water and associated biota (Whitlow and Harris 1979, Walters et al. 1980a,b).

Individual Plants

Conceptually, the effects and responses of individual plants to inundation have been categorized as direct and indirect, short-term and long-term, internal and external, physiological and physical, and primary and secondary (Teskey and Hinckley 1977, Whitlow and Harris 1979, Walters et al. 1980 a & b, McClelland and Leiser 1990). However, these terms do not provide absolute or consistent indication of the relative importance of the various factors or how they interact (Whitlow and Harris 1979, Major 1961, Mason and Langenheim 1957, Daubenmire 1974). For example, soil erosion (a secondary effect according to Whitlow and Harris 1979 and McClelland and Leiser 1990) can completely override all other inundation effects (direct or indirect), and become a direct agent of plant mortality and adverse environmental impact.

One of the more subtle, but fundamental results of inundation, which includes both direct and indirect aspects, can include a complex cascade of effects on the demographics of individual species (e.g. inundation alters the reproductive response of the species that correspondingly results in shifts in the local habitat conditions, that subsequently results in further alterations of the reproductive success of the species). This multifactorial, seemingly inseparable complex of the environment-plant interaction has been discussed several times (Major 1961, Daubenmire 1974, Mason 1947, Mason and Langenheim 1957). Thus, the reality of inundation seems to be that specific causal mechanisms cannot be clearly distinguished or separated (Whitlow and Harris 1979). Nonetheless, the magnitude of impacts on the upstream plant communities should logically relate to the frequency, duration and elevation of inundation behind the dam, as well as the specific physical and ecological characteristics of the communities and fluvial system affected. However, it appears that specific predictions or quantitative conclusions based on information available at this time are necessarily speculative.

Physiological Effects

Detailed discussions of the physiological effects flooding has on plants and soils is provided in Teskey and Hinckley (1977); Whitlow and Harris (1979); Walters et al. (1980a,b); Chapman et al. (1982), and Kozlowski (1984). Inundation frequently acts to reduce photosynthetic efficiency, restrict oxygen uptake, increase accumulation of carbon dioxide, and completely alter the chemical and microbial balance of the soils (Whitlow and Harris 1979, Kozlowski 1984). Consistent, or even irregular but periodic, exposure to these factors can result in chronic weakening of individuals and increased susceptiblity to disease or parasites, or other "indirect" mortality factors, especially for species not formerly exposed to periodic inundation nor specifically adapted to it (Whitlow and Harris 1979). These detrimental conditions become more obvious with repeated exposure and/or over long time periods. Consequently, while individual upland species may not die or show immediate indications from an individual or even several inundation events, continued exposure to inundation, even on a rare or infrequent basis, is expected to greatly increase the likelihood of early death. Clearly, however, the actual impact of inundation on a particular plant community will depend upon a multitude of factors including the age and species affected and many site specific physical features (Whitlow and Harris 1979).

Regeneration

Inundation effects on regeneration can vary extensively. For example species that are adapted to periodic inundation, more frequent soil disturbance or patch disturbance (Pickett and Thompson 1978, Harper 1977, Menges 1989, 1990), may not only survive, but increase in occurrence and dominance. Species responses to inundation are expected to depend in large part upon species-specific life histories (Grime 1979, Grubb 1977, Harper 1977) or inherent adaptations to inundation. In some cases, inundation could provide conditions for invasion of new species such as weedy ruderals like star thistle, certain weedy annual grasses and forbs and other disturbance site species. This appears to have occurred around some of the large sediment and slide deposits that occurred during the operation of the coffer dam or the spring following its washout. These conditions also appear in the understory of the lower elevation woodlands and chaparral that experienced inundation during the operation of the coffer dam.

Increased soil moisture resulting from inundation can increase growth and survival of seedlings. However, seedlings are also among those demographic stages most susceptible to inundation mortality, thus the actual effects will depend upon species specific tolerance to inundation. Annual herbaceous species, because of their ability to rapidly establish and grow, are particularly successful under disturbance or changing conditions such as would occur with periodic inundation. In contrast, regeneration of many upland woody species or their longevity can be constrained by protracted moisture conditions and inundation, even for events that rarely occur. This is most likely to occur with the woody species whose life history patterns are specifically adapted to summer drought and well drained soils and areas never flooded (Whitlow and Harris 1979).

Many plant species (woody and herbaceous) depend upon seeds in the soil for regeneration (Harper 1977, Chap. 4). This is particularly true for chaparral forbs and shrubs (Hanes 1977, Barbour et al. 1980). Inundation will undoubtedly wash many of the seeds away thus reducing the potential for future recruitment. Future recruitment of some species, particularly woody trees and shrubs, will be further reduced if important patch processes such as fire or other natural vegetation gap processes (Grime 1977, Grubb 1977) are affected.

Some woody riparian species may increase in coverage along the river as a consequence of increased availability of moist shoals, and point bars in the pool areas. The maintenance of a relatively "normal" seasonal flow pattern during the non-flooded periods makes this a possibility for riparian species that require specific seasonal flow and flooding patterns such as cottonwood (Fenner et al. 1985). However, these species can also suffer adverse effects during extended inundation, especially if sedimentation becomes excessive. And some notable riparian species, like seedling cottonwoods, demonstrate a substantial seasonal difference in tolerance to flooding than might be indicated by their habitat and life history requirements (Walters et al. 1980 a,b; Fenner et al. 1985).

Inundation Effects on California Plant Species and Communities

Our search of the available published literature (Whitlow and Harris 1979, Allen and Aggus 1983, Allen and Klimas 1986, Chapman et al. 1982, Teskey and Hinckley 1977, and Reed 1988) and data from existing flood control facilities found that most information on inundation tolerance in plants is largely observational and anecdotal data focusing on individual woody plant species from reservoirs and flood control facilities in the midwest and southeast. Teskey and Hinckley (1977), Whitlow and Harris (1979), Walters et al. (1980), Chapman et al. (1982), Allen and Aggus (1983), Allen and Klimas (1986), and Reed (1988), provide little quantitative information on the flood tolerance of indigenous California plants. Specifically, there is a marked absence of information and experimental data on California foothill trees and shrubs that are common and abundant in the upland habitats that would be inundated by the proposed Auburn "dry" dam.

Harris et al. (1975, cited in Walters et al. 1980a), provided some observational information on the "growing season" tolerance of a few native woody plants of California. Walters et al. (1980a,b) and Chapman et al. (1982) which provide the most complete summaries of specific flood tolerance data for plants in the U.S., include limited data for species native to California and only a few of the dominant tree and shrub species in the Auburn area. Most of the information for these few California species involved information gathered ad hoc along newly filled reservoir inundation zones primarily searching for plants that could grow in the reservoir draw-down zones (Harris et al 1975 cited in Walters et al. 1980a, Whitlow and Harris 1979). Much of the literature focused on efforts to revegetate the barren zones of fluctuating reservoirs with non-native species (Whitlow and Harris 1979, Harris et al. 1980, Comes and McCreary 1986, and Allen and Klimas 1986). Reed (1988) and Cowardin et al. (1979) focus on plants indicative of wetland conditions. Impacts of flooding on the indigenous species around the California reservoirs was largely observational and apparently collected as a secondary effort.

McClelland and Leiser (1990), provided more recent short-term observational and anecdotal information on inundation response of several woody species found in the Auburn area. They also provided supplemental observational information on similar species occurring along the scour zone downstream of Keswick Dam. However, the lack of adequate experimental design, unspecified sampling protocols, unreplicated and uncontrolled sample sites, limited quantification, absence of documentation of habitat conditions before and after the reference flood conditions or events, and inappropriate assumptions regarding winter dormancy for most of the affected woody plant species, renders the results of limited usefulness and the conclusions suspect. Many of these same limitations constrain the applicability and usefulness of the data in the literature for California species. This is especially true for the physiologically distinctive, evergreen sclerophyllous species that dominate the American River canyons.

No quantitative data or other information from specifically designed experiments could be found concerning inundation effects on native California sclerophyllous plants (or any other similar Mediterranean climate species). This is not surprising considering that the majority of species comprising these communities, are evergreen sclerophyllous taxa noted for their unusual winter physiological activities and not typically found in periodically inundated soils.

Both of the evergreen hardwood vegetation types (woodland and forest), as well as the chaparral, and conifer associations grow, for the most part, on well drained, nutrient poor soils and under summer drought conditions. It is well documented that the winter physiological activities of these species plays a critical role in their ability to survive and thrive in the hot, dry foothill areas where they grow (Baker et al. 1982, Dement and Mooney 1974, Keeley and Keeley 1977, Morrow and Mooney 1974). Among the more critical physiological processes that occurs during this cool wet period, is nitrogen uptake (Dr. Scott Martens, UCD Botany Dept., pers. comm. November, 1990).

Many of the upland woody species found in the American River canyon depend upon specific soil symbionts for nutrient cycling and breaking of seed dormancy (Poth 1982, Nilsen 1982, Miller 1982, Arianoutsou-Faraggitaki and Margaris 1982, Maser et al. 1978, Hanes 1977). Soil chemicals also play an important role in seedling establishment and site conditions (Muller et al. 1968, Hanes 1977), especially for the ubiquitous annual grasses and forbs. Even short term inundation is likely to alter the chemical concentrations in the soil and change the soil microbiota to a significant degree. Further, increased soil moisture or long term changes in the ground vegetation could alter fire cycles, a major influence in the patch dynamics of foothill chaparral and scrub vegetation (Hanes 1977, Naveh 1975, Christensen 1973). Alterations in such cycles, either protractions or contractions, can result in major shifts in plant and animal species composition (Barbour et al. 1980, Sweeney 1956, Biswell 1974, Keeley 1977, 1982). The magnitude and longevity of the inundation effects however. will likely depend in part, upon the frequency and duration of inundation.

A second Mediterranean climate adaptation is that many of the dominant upland plant species in the American River Canyon become dormant during the hot dry summer period (Harvey and Mooney 1964). Their growing season is, therefore, confined to a much different seasonal schedule than for virtually all of the species discussed in the literature. Peak photosynthesis occurs in the moist winter-spring seasons (Hanes 1977). Chamise peaks in January falling to low levels in July (Hanes 1965). Additional discussions of the winter-spring activity cycles of California's evergreen sclerophyll vegetation can be found in Morrow and Mooney (1974), Harrison et al. (1971), Harrison (1971), Baker et al. (1982), Dement and Mooney (1974), Keeley and Keeley (1977), Mooney and Chu (1974), Mooney and Dunn (1970). Consequently, most of the woody shrub and tree species dominating these areas, unlike the typical winter dormant species reported in the literature, are physiologically active to a certain degree even during the winter period. Thus, flooding during this winter period, even for relatively brief periods of one day or longer is likely to disrupt these critical physiological activities and result in some level of stress, damage or scattered mortality of individuals (which may or may not become evident for several years).

The limited amount of published data for several of the woody species common to the canyon uplands (Walters et al. 1980 a,b; Harris et al. 1975, cited in Walters et al. 1980a) clearly indicates that substantial or almost complete mortality can occur even for comparatively short periods of time (e.g. two weeks or less) during the "growing" period (e.g. Interior live oak, Douglas fir). However, the tolerance ratings for many of these species found in Whitlow et al. (1979), Walters et al. (1980 a,b) appears incongruent with the available data (Table 1). Unfortunately, there is no published or systematic experimental data available on inundation effects (short-term or long-term) during the winter period. This gap in the information greatly impairs the ability to confidently predict future effects of periodic inundation.

Although individuals of several of these evergreen upland species can and do occur scattered and isolated in the typical riverine inundation zone behind the former Auburn coffer dam and along the Sacramento River below Keswick Dam, this zone provides largely unsuitable habitat for these species. Most of the individuals of these species found in the inundation zone are not common elements indicative of the normal inundation zone vegetation. Occurrences of individuals of these, otherwise, upland species may represent ecotypes and/or individuals pre-conditioned or acclimated to the periodic flooded conditions (Whitlow and Harris 1979, Pearlstine et al. 1984). Therefore, many of these individuals likely are more tolerant of inundation and not indicative of the tolerance of the majority of the populations of conspecifics found on the canyon uplands well above the normal inundation zone. It could also be that they are merely interim survivors that, given time, will slowly die out. Only a long term study will be able to determine this.

TABLE 1. Flood tolerance ratings and specific mortality data for various woody plants that occur in the American River Canyon near Auburn (taken from Walters et al. 1980 a & b, Whitlow and Harris 1979).

SPECIES COMMONLY FOUND IN EVERGREEN HARDWOOD FOREST, WOODLAND, CONIFER FOREST, & SAVANNA GRASSLAND

		Tolerance 1	% Mortality 2, 3
TREES	Interior live oak*	IM	100% @ 7 days
	Canyon live oak*	ND	Assumed similar to interior live oak
	Dougas fir*	IM	0% @ 1 wk, 15% @ 2 wk, 50% @ 4 wk
	Black oak	ND	Assumed similar to douglas fir
	Blue oak	IM	29% @ 47 days, 50% @ 76 days, 66% @ 87 days
	Ponderosa pine*	IM	Assumed similar to douglas fir
	Madrone*	ND	" " " 2
	Buckeye*	IN	50% @ 35 days, 100% @ 70 days
	California Bay*	IM	Assumed similar to douglas fir
	Incense cedar*	IN	50% @ 65 days, 100% @ 129 days
SHRUBS	Red bud	IM*	0% @ 1 wk, 15% @ 2 wk, 50% @ 4 wk 2
	Mountain mahogany (not Calif. species)	IM	Assumed similar to red bud
	Curlleaf Mountain mahogany	T	

SPECIES OF RIPARIAN HABITATS

TREES	Fremont cottonwood	VT	100% @ 7 days (seedling)
	Box elder	VT	50% @ 94 days
	Sycamore	VT	68% @ 60 days
	Bigleaf maple	IM	100% @ 60 days
	Oregon ash	T	40% @ 50 days, 100% @ 60 days
	White alder	VT	" " "
SHRUBS	Salix spp.	VT	0% @ 60 days 50% @ 80 days
	Coyote bush*	VT	" " "
	Seep willow	VT	" " "
	Button bush	VT	5% @ 100 days

SPECIES OF CHAPARRAL HABITATS (including Knobcone and Digger pine)

Scrub oak*	ND	Assumed similar to interior live oak
Chamise*	ND	" " "
Manzanita*	ND	" " "
Buck brush*	ND	" " "
Deer brush*	ND	" " "
Scrub oak*	ND	" " "
Toyon*	ND	" " "
Yerba Santa	ND	" " "
Coffee berry*	ND	" " "
Chaparral pea	ND	" " "
Mountain misery	ND	" " "
Knobcone pine*	ND	" " "
Digger pine*	ND	" " "

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* Evergreen, often winter active species.
1 Tolerance ratings taken from Walters et al 1980
2 Most of the specific mortality rates listed were for flooding during the spring and summer periods (the peak growing periods for typical winter decidious species). These rates may be different for winter flooding of evergreen winter active species noted with an asterisk.
3 For several species, the specific mortality data do not appear to correspond to the tolerance rating from Walters et al. 1980 a & b, (e.g. Interior live oak, Douglas fir, Fremont cottonwood, Buckeye). Available data indicate less tolerance.
ND: No data
VT: Very tolerant. Species that can withstand flooding for periods of two or more growing seasons.
T: Tolerant. Species that can withstand flooking for most of one growing season.
IM: Intermediately tolerant. Species that are able to survive flooking for one to three months during the growing season. The root systems will produce few new roots or be dormant.
IN: Intolerant. Species that cannot withstand flooding for short periods of one month or less during their growing season. Root systems typically die.

Effects on Vegetation Composition and Structure

There was a notable absence of information on the impacts of flooding on the plant community or the gross vegetation. For example virtually no information was available on gross compositional changes in the herbaceous or litter layers, soil microbiota, terrestrial (non-wetland) wildlife populations, or broad vegetation attributes such as tree and shrub density, or physiognomy. Contacts with knowledgeable researchers confirmed the dismal lack of empirical data, especially for the arid west and its unusually adapted species (Richard Harris and Charles Klimas, US Army Corps of Engineers, Vicksburg Miss., Dr. Andrew Leiser, UCD, Dr. Robert Holland, Calif. Dept. Fish and Game, Sacramento, Dr. Dean Taylor, BioSystems Analysis, Santa Cruz, Dr. Diana Jacobs, State Lands Commission, Sacramento, pers. comm.).

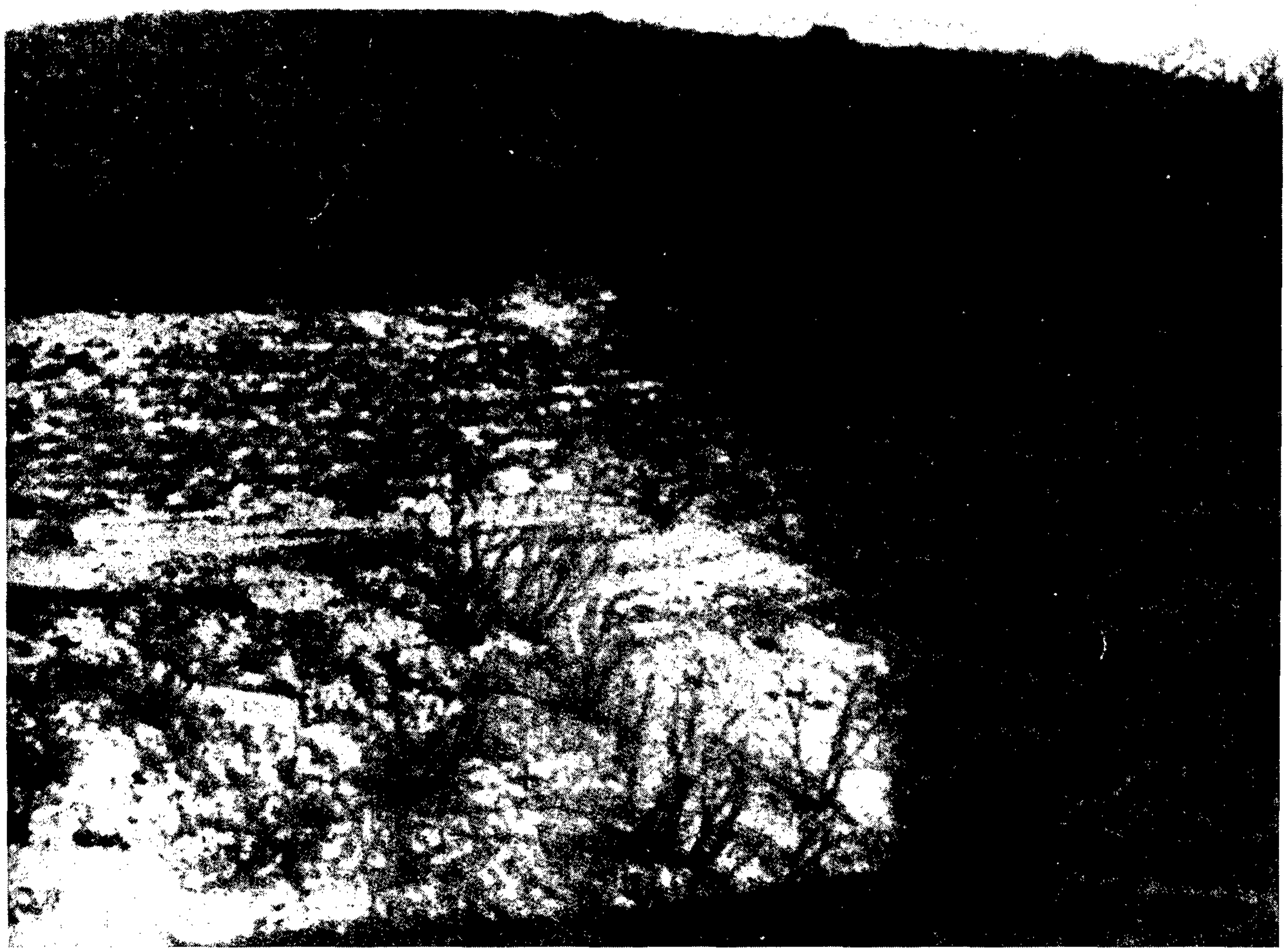
Most plant ecologists concerned with the ecology of California's native vegetation would not intuitively consider researching the potential effects of intermittent inundation on sclerophyllous or even upland plant communities because these types of communities do not characteristically occur in areas subject to periodic inundation. Many researchers probably assume that the basic structure, function and species composition of the community would shift to an unnatural, less diverse and more ruderal condition, a situation which is not particularly fertile for researchers concerned with understanding the function, dynamics and conservation of California's natural plant communities. Similarly, plant ecologists concerned with California's native vegetation and its conservation have shown little interest in researching native plant communities along the drawdown zone of multipurpose reservoirs probably because this zone is typically devoid of virtually all of the indigenous upland vegetation below the highest inundation level, and typically, only a low, forb/grass vestiture of flood tolerant ruderals intermittently exists in the upper portions of the draw-down zone during the low water periods (Figure 1).

The majority of the vegetation to be inundated by periodic filling of the Auburn dry dam is composed of evergreen oak forest, evergreen oak woodlands, chaparral, and small enclaves of foothill conifers such as digger pine, knobcone pine, ponderosa pine, and douglas fir all of which characteristically occur on xeric upland sites. Most of these species are notoriously adapted to a distinctly mediterranean climate with hot dry summers and cool moist winters (Major 1977) and require good to excessive soil drainage (Calif. Dept. Parks and Recreation 1979, U.S. Bureau of Reclamation 1971). Virtually all of the woody species dominating the uplands are evergreen sclerophyllous species notable for their unusual summer dormancy and winter and spring activity peaks. This is most clearly documented for the chaparral and live oak woodland taxa of California's foothill regions (Baker, Rundell and Parsons 1982, Keeley and Keeley 1977, Morrow and Mooney 1974, and Pers. Comm. Drs Michael G. Barbour

Figure 1. Photographs of several California foothill reservoirs showing the complete alterations in the composition and structure of the vegetation communities in the draw-down zones.

A. Draw-down zone of Amador (or Jackson Creek) Reservoir, elevation 500', Amador County, California. Note complete mortality of woody plants and horizontal lines of wave-wash erosion. Photograph date august 1989.

Figure 1. continued



B) Amador (or Jackson Creek) Reservoir elevation 500 feet, Amador County, California. Note the abrupt vegetation boundry at the high water zone and horizontal lines indicating wave wash erosion.

Figure 1. continued

[illegible] arm of Commanche Reservoir, elevation approximately 500 feet, Amador County, California. Note the substantial soil loss even in this relatively gentle draw down area of the reservoir. Photograph taken August 1989.

and Scott Martens Univ. Calif. Davis Botany Dept., Dr. Dean Taylor, Biosystems Analysis, Santa Cruz, CA., Dr. Diana Jacobs, State Lands Commission, Sacramento). Only about 8 percent of the vegetation in the American River canyon is comprised of wetland (riparian) vegetation along the narrow margins of the main river corridor and canyon bottoms of the intervening permanent and intermittent drainages. Thus, the effects of a peak flow detention dam in the Auburn canyon area is expected to have little in common with typical dry dams from elsewhere because of major ecological, climatic, topographic and edaphic differences.

COMPARISON TO SIMILAR FLOOD CONTROL STRUCTURES

Review of available information on similar flood control facilities indicates there are no large dams of this type in California or any similar area in the west. Those dry dams that do exist in the west are substantially smaller in scale, and their ecological context differs significantly from the communities that would be affected by the proposed Auburn facility. In addition, for many of the existing California facilities, the operations are only grossly similar, and therefore, the existing conditions are not directly comparable. Similar sized facilities outside of California not only were substantially different in operation, but the ecological communities affected are not comparable. However, because the most frequent use and application of peak-flow detention structures is in the southern and eastern United States, in flood prone bottomlands, these will be discussed first.

Greentree Reservoirs

Peak flow detention facilities in the south and eastern United States are frequently referred to as "greentree" reservoirs because the flooding occurs more or less in relatively flood tolerant, mostly bottomland areas, where the vegetation is largely adapted to periodic inundation (Rudolph and Hunter 1964, cited in Allen et al. 1988). Most component tree and shrub species of a typical eastern greentree reservoir are well adapted to moist soil conditions, summer rains, periodic inundation and winter dormancy. The hydrological regime of a typical greentree facility and the resultant ecological context is most closely approximated in the bypass system of the Central Valley. However, because of dramatic differences between the climatic regimes and the component plant species, ecologically they have little in common with one another and, neither greentree reservoirs nor the Central Valley bypass system is comparable to the proposed facility at Auburn.

Unfortunately, there has been little systematic effort to document the impacts of any of these facilities on the local plant and animal communities. In the greentree reservoir sites where some basic data were collected (Allen et al. 1988, Pearlstine et al. 1985), the resulting changes to the areas that accompanied increased flooding actually enhanced the indigenous wildlife values by restoring, enhancing and expanding mostly degraded wetlands and preexisting wetlands. The low to moderate amounts of upland conversion that actually took place were considered an improvement and expansion of valuable wetland and lowland floodplain habitats. Thus, conditions for the indigenous wildlife species occurring over most greentree and "dry" dam sites available in the literature, was considered largely an enhancement of already existing wetland values rather than an adverse impact to adjoining upland habitats. These types of situations are logical, justifiable, and consistent with Service mitigation policy. We could not find any example where a greentree reservoir or "dry" dam was located in a steep river canyon with extensive acreages of largely intact, terrestrial (wholly upland) communities, of the size or comparable ecological context of the proposed Auburn "dry" dam. In stark contrast, more than 90 percent of the terrestrial communities in the Auburn area consist of relatively intact, high value, canyonside, upland habitats that do not exist as compositionally distinct plant communities in areas subject to any periodic inundation.

Central Valley Bypass System

The plant communities of the Central Valley bypass system are largely uncomparable with those in the Auburn area, despite similarities in adaptation to the regional mediterranean climate. This is a consequence of the significant ecological differences between the vegetations of the two systems (lowland floodplain plant communities that flood almost annually versus dry canyon and foothill communities that never flood) and, perhaps more importantly, significant differences in the hydrological regimes (prolonged periods of flooding for up to several months in the bypasses versus the Auburn "dry" dam's proposed intermittent and short-term flooding for only days or weeks).

Although the American River canyons are intermittently dotted with narrow stringers of foothill riparian vegetation, the periodic and dynamic flows inherent in the canyons severely limit the development of woody riparian vegetation. Consequently, riparian vegetation in the canyons is typically confined to the narrow intermittent sand bar accumulations along the edge of the river (Figure 2). As stated earlier, riparian or streamside vegetation comprises only about 8 percent of the vegetation acreage in the canyons along the main channels of the middle and north forks.

As discussed previously, the upland plant communities of the American River canyon are strongly adapted to a very dry mediterranean climate with cool moist winters and hot dry

Figure 2. Photograph showing the typical narrow "stringers" of woody riparian vegetation along the river edge in the American River canyon.

Photograph taken near Tamaroo Bar, April 1990. Note dense star thistle in foreground. The star thistle and other ruderal herbs were growing on recently deposited sediments from slides immediately upslope. The sediments had covered and killed several former willow thickets.

Figure 3. Inundation zone of the "dry" dam on the North Fork Feather River near Chester, Plumas County. Note the absence of virtually all woody vegetation in the inundation zone and dominance by ruderal annual forbs and grasses.

A) Photograph shows the inundation area behind the dam. Note the stark absence of woody vegetation with the inundation zone and the abrupt line formed by the tree lined areas. The inundation pool is small because of the adjoining bypass structure at the left side of the photograph

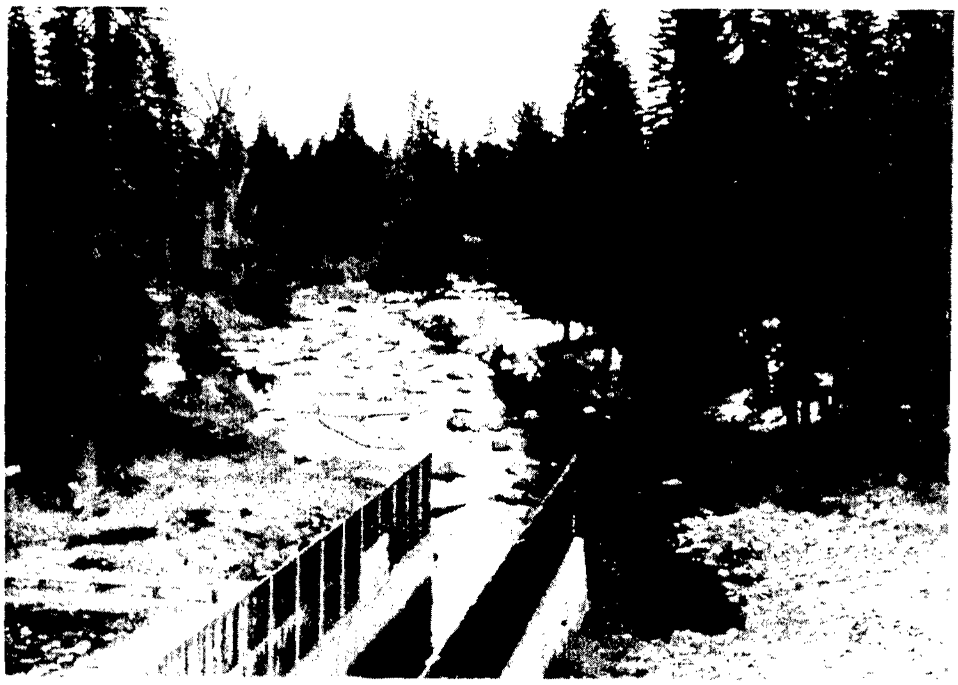
B) Photograph shows the extensive bypass structure which carries high flows away from the river. Note the absence of woody vegetation.

Figure 3. continued

C) Photograph shows the ruderal nature of the vegetation in the inundation area.

D) Photograph shows the abrupt line of trees and shrubs at the upper edge of the inundation zone. The zone corresponds to the approximate elevation of the bypass entrance.

Figure 4 View of the North Fork Feather River just downstream of the "dry" dam. Note the abundance of woody vegetation along the edge of the river.



A) Photograph shows the extensive woody trees and shrubs that line the river below the dam

B) Photograph shows the extensive woody tree and shrub covering along the river below the dam.

Because of the different hydrological regime (spring/summer snow melt flows vs anticipated mid-winter runoff flows at Auburn), the vegetation conditions behind and below this facility may not be comparable to the conditions that would develop behind the proposed Auburn dam. However, details on the operation of this facility were not available as of this writing. Certainly, the much smaller size of the north fork dam greatly under represents the magnitude of effects of a proposed Auburn facility. Another limitation is that the impacts of the facility on the adjoining plant communities have not been systematically monitored. Interestingly, however, despite the inclusion of large trash racks over the outlet structure, this dam annually requires substantial maintenance because of debris and sediment accumulation at the base of the dam. This also indicates the potential for a similar maintenance problem at the proposed Auburn facility, and additional impacts to fish and wildlife.

SOIL CONSERVATION SERVICE DRY DAMS

The Soil Conservation Service also has constructed many small detention dams, or dry bed dams, throughout California and elsewhere. However, none are anything close to the scale or ecological context of the proposed Auburn Dam, or even the North Fork or Merced facilities, and no systematic data have been collected on the resulting ecological effects on the adjoining plant and animal communities.

FORMER AUBURN COFFER DAM

As noted by McClelland and Leiser (1990), the former coffer dam at Auburn was a smaller version of the larger dry dam. Thus, the several winter events that occurred during its 14 year operation (1972 to February 1986) provide some indication of the effects expected from a larger facility. However, any comparison is severely limited for several reasons. First and foremost, adequate baseline data are not available on the conditions of the biota prior to the dam, and post dam information is also severely limited. Detailed data on the condition of the vegetation prior to the coffer dam are simply not available. Of particular concern is the lack of detailed data on changes in the composition of both the woody and herbaceous vegetation layers which not only relates to seed bed conditions for all of the canyon plant species, but conditions for many of the wildlife species.

As noted previously only about 8 percent of the canyon vegetation is comprised of riparian forest or scrub vegetation. However, the existing riparian vegetation, especially in the vicinity of the former coffer dam appears to represent a slight increase over pre-coffer dam conditions. Apparently the placement of the coffer dam resulted in increased sedimentation and sand bar formation in the area immediately upstream of the coffer dam. This allowed increased establishment of stream edged grassland, scrub and forest vegetation including some elements, such as

White alder, not commonly found in this area. However, Service evaluation of riparian vegetation in the inundation zone four years after the coffer dam broke, indicates that it is not of high quality apparently because it is still recovering from extensive sedimentation and possibly protracted inundation conditions that formerly existed with the coffer dam.

Second, the report by McClelland and Leiser (1990), which provides some limited data on individual plants and gross observational judgements regarding the condition of sample segments of the vegetation collected in 1990, represents conditions 4 years after the coffer dam failed. Many of the observational judgements presented in the report conflict with those of the Service regarding gross evidence of flooding impacts on the vegetation and regeneration of many of the upland species. Similar, observational recollections of vegetation effects of the 1964 flood (McClelland and Leiser 1990, page 9) are unsubstantiated and unuseable, since there are no quantitative data.

Third, the short-period of time that the coffer dam was in operation (14 years), 4 inundation events occurred above the normal river inundation zone. During the ensuing four years since the coffer dam has been gone, the vegetation in the former inundation zone has had opportunity to readjust in the absence of any inundation, but results of inundation and the coffer dam break still are clearly evident in the canyon. The vegetation (and individuals) that occur higher up in the former coffer dam inundation zone have experienced only a few mid-winter inundations and for only brief durations of, at most, about one or two days.

During the four inundation events, two were of about one day duration during January and March 1978, both times reaching only about 525 feet, or approximately only 10 feet above the ordinary scour and inundation zone (Figure 5), of the river (estimated at 510-515 feet elevation). The remaining two events were also of short duration during February of 1982 and 1986. The February 1982 event reached about 645 feet but remained there for only a few hours. Inundation to the 600 foot elevation during the February 1982 event was about one day, and to 550 feet for about 2 days. During the peak flood of February 1986, which is estimated as a 67 year event, the water reached a maximum elevation of approximately 715 feet, but the coffer dam broke shortly thereafter. The estimated duration of this winter inundation at the various elevations (interpolated from McClelland and Leiser 1990, figure 5) is only a few hours at 700 feet, less than a day at 650 feet, perhaps slightly over a day at 600 feet, slightly more than 2 days at 550 feet and about 2-1/2 days at 525 feet. Thus, the secondary and indirect, largely observational, evidence presented by McClelland Engineers (1990), gives little insight into the likely ecological and community effects of a large dry dam in this highly variable fluvial system. The vegetation behind the coffer dam has not been

Figure 5. View of the American River Canyon showing the river scour zone above the area affected by the coffer dam break of 1986. The upper limit of the scour zone shown in this photograph occurs approximately 20-30 feet above the thalweg indicating a highly dynamic natural flow regime.

Photograph shows the ordinary scour zone of the river that occurs with relatively natural high flows. Note woody vegetation exists up to the edge of the scour zone.

subjected to many hundreds of repeated inundations, nor of the longer durations, higher levels and later season events anticipated for the large facility.

OTHER FACILITIES

Keswick Dam

The use of the area immediately downstream of Keswick Dam as an indication of likely inundation impacts in the Auburn area suffers many of the same fundamental limitations cited above for the former coffer dam, as well as several others. First, the vegetation along the established inundation zone is comprised of an odd admixture of various vegetation elements that cannot be considered comparable to the intact upland vegetation in the American River canyon. Although a few of the upland taxa in the Keswick inundation area also occur in the American River canyon, the gross species composition of the inundation zone vegetation, as well as the overall physiogonomy and appearance is significantly different than the zonal upland vegetation in the American River Canyon or the nearby uplands at Keswick. It was obvious that the flow conditions and inundation regime created a plant "community" distinctly different in species composition, physiogonomy and appearence than the chaparral and woodland vegetation of the nearby zonal uplands.

Service observations indicate that the vegetation within the Keswick inundation area was distinctly more open, and the sclerophyllous elements appeared substantially reduced in importance and density when compared to the uninundated portions of the surrounding area. In addition, wherever soil was available, the ground layer was dominated by annual forbs or grasses, many of which are indicative of periodic inundation or disturbance. Contrary to the observations by McClelland and Leiser (1990), the Service found few indications of recruitment in the inundation area for virtually all of the sclerophyll tree and shrub species. In contrast, seedlings and young shrubs and trees appeared to be noticeably more common in the non-inundated upland sites.

A significant portion of the ground surface at the Keswick site was barren rock, indicating frequent hydrological scouring. Most of the surviving trees and shrubs in the inundation area were undoubtedly firmly rooted in the rocky substrate and may therefore represent individuals acclimated to the wet conditions or the roots may not experience inundation conditions as intensely as they would in more typical soils. Consequently, collecting a few growth and condition observations during one growing season, from a few individual trees and shrubs in the inundation zone and surrounding uplands cannot be considered adequate evidence that most of the upland tree and shrub species, (and more importantly, the vegetation and upland communities as a whole), will not change significantly with inundation.

CONCLUSIONS

Based on review of information on similar existing facilities and data from the published literature, we conclude that quantitative impacts to the vegetation and wildlife that would become manifest over the long-term life of a dry dam facility in the American River canyon, cannot be reliably extrapolated. Existing evidence in the American River canyon, at other similar facilities in California, or elsewhere in the United States, does not provide an adequate representation of the magnitude or extent of effects that would occur with the proposed Auburn "dry" dam. The available literature on flood tolerance of plants and inundation effects on biotic communities provides virtually no data on species or plant communities found in the project area. Undoubtedly the vegetation in the American River canyon above and below the former coffer dam has been changed substantially by the former facility. However, there is virtually no basis for comparison, and no actual quantification of flooding impacts is available for any similar facility in California or elsewhere in the arid west. Consequently, any projection of the impacts of such a facility on the species composition or vegetation in the American River canyon will require many assumptions and necessarily depend largely upon best professional judgement.

REFERENCES

Arianoutsou-Faraggitaki, M. and N.S. Margaris 1982. Microbial activity after fire in a phryganic east Mediterranean ecosystem. Pp. 321-324. In: C.E. Conrad and W.C. Oechel (Tech Coords.). Proceedings of the symposium on dynamics and management of Mediterranean-type Ecosystems. U.S.D.A. Gen. Tech. Rep. PSW-58. Pac. Southwest For. & Range Exp. Stn., Berkeley, CA.

Allen, J.A., J.T. Teaford, E.C. Pendleton and M. Brody. 1988. Evaluation of Greentree Reservoir Management Options in Arkansas. Presented at the 53rd North American Wildlife and Natural Resources Conference, Louisville, KY, March 18-23, 1988. Available through the USFWS National Wetlands Research Center, 1010 Gause Blvd. Slidell, LA 70458.

Allen, H.H. and C.V. Klimas. 1986. Reservoir Shoreline Revegetation Guidelines. Tech. Rept. E-86-13. U.S. Army Corps of Engineers, Waterways Exp. Sta., Vicksburg, Miss. 87 pp.

Allen, H.H. and L.R. Aggus. 1983. Effects of fluctuating reservoir water levels on fisheries, wildlife, and vegetation; summary of a workshop, 24-26 February 1981. Misc. Paper E-83-2. U.S. Army Corps of Engineers, Waterways Exp. Sta., Vicksburg, Miss. 55 pp.

Baker, G., P.W. Rundel, and D.J. Parsons 1982. Comparative phenology and growth in three chaparral shrubs. Botanical Gazette 143:94-100.

Barbour, M.G., J. Burke, and W.D. Pitts 1980. Terrestrial Plant Ecology. Benjamin/Cummings Publ. Co., Inc., Menlo Park, CA. 604 pp.

Biswell, H.H. 1974. Effects of fire on chaparral. Chap. 10. In: Fire and ecosystems. T.T. Kozlowski and C.E. Ahlgren (eds.). Academic Press, New York.

Brady, M. and E. Pendleton 1987. FORFLO: A model to predict changes in bottomland hardwood forests. U.S. Fish and Wildlife Service, Nat. Wetl. Res. Center, Slidell, LA. 9 pp.

California Dept. Parks and Recreation. 1979. Resource Invventory Report, Vol. 1: Natural Resources. State of California Dept. Parks and Recreation, Sacramento, CA. 188 pp.

Chapman, R.J., T.M. Hinckley, L.C. Lee, and R.O. Teskey. 1982. Impact of water level changes on woody riparian and wetland communities, Vol X. Index and Addendum to Vols. I-VIII. U.S. Fish and Wildlife Service FWS/OBS-82/23. Eastern Energy and Land Use Team, Kearnysville, W.Va.

Christensen, N.L. 1973. Fire and the nitrogen cycle in California chaparral. Science 181:66-68.

Comes, R.D. and T. McCreary. 1986. Approaches to revegetate shorelines at Lake Wallula on the Columbia River, Washington-Oregon. Tech. Rept. E-86-2. U.S. Army Corps of Engineers, Waterways Exp. Sta., Vicksburg, Miss. 89 pp.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. FWS/OBS-79/31. U.S. Fish and Wildlife Service, Office of Biological Services, Wash. D.C. 131 pp.

Dement, W.A. and H.A. Mooney 1974. Seasonal variation in the production of tannins and cyanogenic glucosides in the chaparral shrub Heteromeles arbutifolia. Oecologia 15:65-76.

Fenner, P., W.W. Brady and D.R. Patton. 1985. Effects of regulated flows on regeneration of cottonwood. Journ. Range Mgmt. 38(2):135-138.

Grime, J.P. 1979. Plant strategies and vegetation processes. John Wiley and Sons, New York.

Grubb, P.J. 1977. The maintenance of species-richness in plant communities: the importance of the regeneration niche. Biological Review 52:107-145.

Hanes, T.L. 1977. California chaparral. Chapter 12, Pp 418-469. In: M.G. Barbour and J. Major (eds.). Terrestrial Vegetation of California. John Wiley and Sons. New York, N.Y.

Harper, J.L. 1977. Population Biology of Plants. Academic Press. London. 892pp.

Harris, R.W., A.T. Leiser, G.W. Forister, and T.H. Whitlow. 1980. Plant Tolerance to Flooding. Progress Report to the U.S. Bureau of Reclamation and U.S. Forest Service. Contract No. A 5fs-16565. Dept. of Environmental Horticulture, University of Calif., Davis. 10+pp.

Harris, R.W., A.T. Leiser and R.E. Fissel 1975. Plant tolerance to flooding: summary report. Dept. of Environmental Horticulture, Univ. Calif., Davis.

Harrison, A.T. 1971. Temperature related effects on photosynthesis in Heteromeles arbutifolia M. Roem. Ph.D. dissert. Stanford Univ., Stanford, Calif.

Harrison, A.T., E. Small, and H.A. Mooney 1971. Drought relationships and distribution of two Mediterranean-climate California plant communities. Ecology 52:869-875.

Harvey, R.A. and H.A. Mooney 1964. Extended dormancy of chaparral shrubs during severe drought. Madrono 17:161-163.

Holstein, G. 1984. California Riparian Forests: Deciduous islands in an evergreen sea. Pp. 2-22. In: R.E. Warner and K.M. Hendrix (eds.) California Riparian Systems: ecology, Conservation, and Productive Management. Univ. Calif. Press, Berkeley.

Keeley, J.E. 1977. Fire-dependent strategies in Arctostaphylos and Ceanothus. Pp 391-396. In: Proceedings of the Symposium on Environmental Consequences of Fire and Fuel Management in Mediterranean Ecosystems. U.S.D.A. Forest Service Gen. Tech. Rep. WO-3, Wash. D.C.

Keeley, J.E. 1982. Distribution of lightning- and man-caused wildfires in California. Pp. 431-437 In: C.E. Conrad and W.C. Oechel (Tech Coords.). Proceedings of the symposium on dynamics and management of Mediterranean-type Ecosystems. U.S.D.A. Gen. Tech. Rep. PSW-58. Pac. Southwest For. & Range Exp. Stn., Berkeley, CA.

Keeley, J.E. and S.C. Keeley 1977. Energy allocation patterns of a sprouting and non-sprouting species of Arctostaphylos in the California chaparral. Amer. Midl. Nat. 98:1-10.

Kennedy Engineers. 1971. Auburn Dam EIS, volume I: Introduction and Summary. Prepared for U.S. Bureau of Reclamation, Region 2, Sacramento, California.

_____. 1971. Auburn Dam EIS, volume II: Baseline Environmental Survey. Prepared for U.S. Bureau of Reclamation, Region 2, Sacramento, California.

_____. 1971. Auburn Dam EIS, volume V: Implementation Guidelines. Prepared for U.S. Bureau of Reclamation, Region 2, Sacramento, California.

Kozlowski, T.T. 1984. Flooding and Plant Growth. Academic Press, Inc. Orlando, Fl.

McClelland Consultants, Inc. and A.T. Leiser 1990. Analysis of Potential vegetation mortality resulting from operation of the proposed Auburn flood control dam. Unpubl. contract report to State of Calif. Dept. Water Resources and Reclamation Board. 45 pp + appendices.

Major, J. 1977. California climate in relation to vegetation. In: M.G. Barbour and J. Major (eds.) Terrestrial Vegetation of Califonria. Chapter 2, pp 11-74. John Wiley & Sons, New York.

Major, J. 1961. Use in plant ecology of causation, physiology and a definition of vegetation. Ecology 42(1):167-169.

Maser, C., M.M. Trappe, and R.M. Nussbaum 1978. Fungal-small mammal interrelationships with emphasis on Oregon coniferous forests. Ecology 59(6):799-809.

Mason, H.L. and J.H. Langenheim. 1957. Language analysis and the concept "environment". Ecology 38:325-340.

Mason, H.L. 1946. The edaphic factor in narrow endemism. I. The nature of environmentalinfluences. Madrono 8:209-240.

Menges, E.S. 1990. Population viability analysis for an endangered plant. Conservation Biology 4(1):52-62.

Menges, E.S. 1989. Predicting the future of rare plant populations: demographic monitoring and modeling. Natural Areas Journal 6(3):13-25.

Miller, P.C. 1982. Nutrients and water relations in Mediterranean-type ecosystems. Pp. 325-332. In: C.E. Conrad and W.C. Oechel (Tech Coords.). Proceedings of the symposium on dynamics and management of Mediterranean-type Ecosystems. U.S.D.A. Gen. Tech. Rep. PSW-58. Pac. Southwest For. & Range Exp. Stn., Berkeley, CA.

Moen, A.N. 1973. Wildlife Ecology. W.H.Freeman, San Francisco. 458 pp.

Mooney, H.A. and C. Chu 1974. Seasonal carbon allocation in Heteromeles arbutifolia, a California evergreen shrub. Oecologia 14:295-306.

Mooney, H.A. and E.L. Dunn 1970. Photosynthetic systems of Mediterranean climate shrubs and trees in California and Chile. Amer. Natur. 104:447-453.

Mooney, H.A., A.T. Harrison, and P.A. Morrow 1975. Environmental limitations of photosynthesis on a California evergreen shrub. Oecologia 19:293-301.

Morrow, P.A. and H.A. Mooney 1974. Drought adaptations in two California evrgreen sclerophylls. Oecologia 15:205-222.

Muller, C.H., R.B. Hanawalt, and J.K. McPherson 1968. Allelopathic control of herb growth in the fire cycle of California chaparral. Bull. Torrey Bot. Club. 95:225-231

Naveh, Z. 1975. The evolutionay significance of fire in the Mediterranean region. Vegetatio 29:199-208.

Nilsen, E.T. 1982. Productivity and nutrient cycling in the early postburn chaparral species Lotus scoparius. Pp. 291-296. In: C.E. Conrad and W.C. Oechel (Tech Coords.). Proceedings of the symposium on dynamics and management of Mediterranean-type Ecosystems. U.S.D.A. Gen. Tech. Rep. PSW-58. Pac. Southwest For. & Range Exp. Stn., Berkeley, CA.

Pearlstine, L., H. McKellar and W. Kitchens 1985. Modelling the impacts of a river diversion on bottomland forest communities in the Santee River floodplain, South Carolina. Ecological Modelling 29:283-302.

Pickett, S.T.A. and J.N. Thompson. 1978. Patch dynamics and the design of nature reserves. Biol. Conservation 13:27-37.

Poth, M. 1982. Biological dinitrogen fixation in chaparral. Pp. 285-290. In: C.E. Conrad and W.C. Oechel (Tech Coords.). Proceedings of the symposium on dynamics and management of Mediterranean-type Ecosystems. U.S.D.A. Gen. Tech. Rep. PSW-58. Pac. Southwest For. & Range Exp. Stn., Berkeley, CA.

Reed, P.B. Jr. 1988. National list of plant species that occur in wetlands: California (Region 0). Biol. Rept. 88 (26.10). U.S. Fish and Wildlife Service, National Wetlands Inventory, Wash. D.C.

Rudolph, R.R. and C.G. Hunter. 1964. Green trees and greenheads. Pp.610-618 In: J.P. Linduska (ed.), Waterfowl Tommorrow, USDI, Wash., D.C.

Sweeney, J.R. 1956. Responses of vegetation to fire. Univ. Calif. Publ. in Botany. 28:143-206.

Taylor, G.G. 1981. Stream Alterations: an introduction. U.S.F.W.S., Office of Biological Services, Eastern Energy and Land Use Team. Kearneysville, WV. 19 pp.

Teskey, R.O. and T.M. Hinckley. 1977. Impact of water level changes on woody riparian and wetland communities, Vol. I. Plant and soil responses. U.S. Fish and Wildlife Service FWS/OBS-77/58. National Stream Alteration Team, Colombia, Missouri.

U.S. Army Corps of Engineers 1990a. Inundation Analysis for the 200 year flood control reservoir at Auburn. Sacramento District. Unpubl. Rept., June 1990.

U.S. Army Corps of Engineers 1990b. Inundation Analysis for the 400 year flood control reservoir at Auburn. Sacramento District Corps of Engineers. Unpubl. Rept., August 1990.

U.S. Army Corps of Engineers 1990c. Reservoir rim and slope stability study. Sacramento District. Unpubl. Rept., June 1990.

U.S. Bureau of Reclamation. 1971. Auburn Dam Environmental Impact Study. Prepared by Kennedy Engineers; Royston, Hanamoto, Beck & Abey; Jara Applied Sciences, Inc. U.S. Dept. of the Interior Bureau of Reclamation, Sacramento, CA. Six Vols.

U.S.F.W.S. 1980. Ecological Services Manual 102. Habitat Evaluation Procedures. USDI-FWS, Division of Ecological Services, Wash. D.C.

Verner, J., M.L. Morrison and C.J.Ralph (eds.) 1984. Wildlife 2000: Modeling Habitat Relationships of Terrestrial Vertebrates. University of Wisconsin Press, Madison, WI. 470 pp.

Walters, M.A., R.O. Teskey, and T.M. Hinckley. 1980a. Impact of water level changes on woody riparian and wetland communities, Vol. VII. Mediterranean Region. U.S. Fish and Wildlife Service FWS/OBS-78/93. Eastern Energy and Land Use Team, Kearnysville, W.Va.

___________. 1980b. Impact of water level changes on woody riparian and wetland communities, Vol. VIII. Pacific Northwest and Rocky Mountain Regions. U.S. Fish and Wildlife Service FWS/OBS-78/94. Eastern Energy and Land Use Team, Kearnysville, W.Va.

Whitlow, T.H. and R.W. Harris. 1979. Flood tolerance in plants: a state-of-the-art review. Tech. Rept. E-79-2. U.S. Army Corps of Engineers, Waterways Exp. Sta., Vicksburg, Miss. 161 pp. + Appendices.

APPENDIX D

APPENDIX D

Files

Fish and Wildlife Biologist

CE - American River Watershed Study

On May 1, 2, 17, 22, 1989, I floated the Middle and North Forks of the American River upstream of the proposed Auburn Dam. The purpose of these floats was to make observations of aquatic habitat and fish species.

Middle Fork

The Middle Fork was floated on May 1, 2, 1989, from Oxbow Reservoir (Ralston Afterbay) down to the confluence with the North Fork near the Highway 49 bridge crossing.

Pool, riffle and run areas were identified and length, width, and depth estimated. These characteristics were physically measured at the start to "calibrate" the observer. Time constraints precluded physical measurement of all pools and riffles.

Overall on the Middle Fork, 66 riffles and 67 pools were observed. Some areas at different flows might be placed in a different category (i.e., run to riffle). The average riffle was 132 feet long, 106 feet wide and 6 feet deep. The average pool was 353 feet long, 100 feet wide and 16 feet deep.

Gravel bars below Kanaka rapids (4 miles downstream from oxbow) appear to be best suited for spawning. Generally the riffles had gravels which fell into two rating classes: gravel (0.08-2.5 inches), and cobble (2.5-10 inches). In most cases less than 25 percent of the surface of gravels were covered by fine sediment.

Riffle areas above Kanaka rapids contained larger cobble sized substrate and boulders (10-160 inches). Again, less than 25% of their surface area was covered by fine sediment.

Throughout the entire reach of the Middle Fork there were numerous areas where additional suitably sized spawning gravels occurred, but were not included in the tally. These areas were generally located at the tail end of the pools before the river enters a cascade, along the edge of some runs and on the inside corner of bends. These areas are small compared to the area of adjacent pool or run.

Evidence of dredging, both historic and recent, is evident throughout the river by tailing piles and diversions. Twenty-one active dredges were observed on this 2-day float. The most active area was the upper five miles, Oxbow Reservoir to Cache Rock, where 15 dredges were observed (3 per mile). The lower nineteen miles had only 6 dredges (.3 per mile). This is only the begining of the annual dredging period and the numbers of dredges will likely increase greatly according to the river guides on this trip. These guides reported that by the end of summer the river is full of tailing piles.

Riparian habitat is present along the river and is composed primarily of willow, alder, some cottonwood and blackberries. Horseshoe Bend (Oxbow area dewatered by Tunnel Chute) contains excellent riparian habitat composed of large cottonwoods, willow thickets and alder. Evidently, there is some subsurface flow in the old channel. At Josephine Creek (River Mile 3) large cottonwoods (10-12 in. dbh) were observed at Dardanelles Creek (River Mile 5.5) a distinct change in canyon wall vegetation was noted as chapparal appeared more on the south facing slopes. Little riparian habitat exists between Greenwood Bridge and Ruck-A-Chucky Rapids. The exception is at Ruck-A-Chucky Lake above Ruck-A-Chucky Rapids which supports good riparian growth. The substrate in the downstream half of the lake is all sand. Areas containing notable stand of heavily shaded aquatic cover were noted below Mustache Rapids and below Cherokee Bar.

Fish species observed while floating the river included Sacramento squawfish, suckers and trout. Generally fish were observed throughout the reach. Fish observations so far have been made only from the raft. Snorkeling observations are planned for later in the summer/fall period during lower water levels. Trout fishing (browns, rainbows) is reported to be excellent in the reach we floated. At least one guide works the river on a catch and release basis. He reported smallmouth bass are also caught near the confluence with the North Fork American River.

Prior to this trip I checked California Department of Fish and Game (Region II) files for information on fish species. The earliest record I found was the 1938 California Department of Fish and Game Stream Survey. This survey reported the following species present.

Sacramento pike	(Sacramento squawfish)
hardhead	
roach	(California roach)
black minnows	(Sacramento blackfish?)
sucker	(Sacramento sucker)
salmon	(chinook salmon)

Stocking records from 1930-1949 indicate rainbow (including anadromous stock) and brown trout were planted in the Middle Fork. Memorandums to the file indicate rainbow and brown trout were again recommended for stocking in the mid-1960's (post Folsom Dam). In 1969 Fish and Game conducted a survey of the river which identified 26 pools per mile (40% of surface in pools) upstream of Brushy Canyon and 14 pools/mile (8% of surface in pools) downstream of Brushy Canyon. I assume this is Brushy Mountain Canyon identified at River Mile 19 on the American River Recreation Area Map (Map No. 1).

I previously provided water temperature information I obtained from Jack Rowell (USBR). In addition, I collected the following water temperatures during our trip. Temperatures were taken using a Taylor hand held thermometer approximately 6 inches below the water surface.

48° F @ 9:30 am @ Oxbow Reservoir
49° F @ 11:00 am @ Last Chance Rapids
50° F @ 12:00 pm @ Volcano Creek
52° F @ 2:00 pm @ African Bar 5/1/89
53° F @ 5:00 pm @ Ford's Bar

49° F @ 9:00 am @ Ford's Bar 5/2/89
52° F @ 1:00 pm @ Cherokee Bar

The following wildlife were observed during the float.

common nerganser (*Mergus merganser*)
wood duck (*Aix sponsa*)
mallard (*Anas platyrhynchos*)[1/]
American dipper (*Cinclus mexicanus*)[1/]
Canada goose (*Branta canadensis*)[1/]

red-tailed hawk (Buteo jamaicensis)

turkey vulture (Cathartes aura)

mourning dove (Zenaida macroura)

California quail (Callipepla californica)

turkey (Meleagris gallopavo)[2/]

acorn woodpecker (Melanerpes formicivorus)

western gray squirrel (Sciurus griseus)

mule deer (Odocoileus hemionus)

1/ observed nesting or with juveniles

2/ heard calling/not observed

North Fork

The North Fork was floated on May 17 and 22, 1989 from the Colfax-Iowa Hill Bridge crossing to the beginning of Lake Clementine, and Clementine Dam to the proposed Auburn Dam site.

Pool, riffle, and run areas were again identified and length, width and depth estimated. Time constraints prohibited actual measurements.

A total of 58 riffles and 64 pools were observed. Again lower flows might result in an area being placed in different category (i.e., run to riffle). The average riffle was 196 feet long, 82 feet wide and 4 feet deep. The average pool was 246 feet long, 77 feet wide and 14 feet deep.

Below the Colfax-Iowa Hill Bridge the river flows into a steep bedrock canyon. Riffle areas are present, but small. Generally there are a series of pools and cascades with numerous large in-channel boulders.

The majority of the riffles in the North Fork above Lake Clementine are clean with less than 25% of the surface of the gravel covered by fine sediments. The riffles had gravels which fell into two rating classes: gravel (0.08-2.5 inches), and cobble (2.5-10 inches). Most of the riffle areas (43 or 77% of the total) were observed between Shirttail Creek and Lake Clementine. Below Clementine Dam there were few riffles compared to above reaches. Gravel sizes decrease below the Middle Fork confluence. Sand bar deposits also appear below the Highway 49 bridge crossing. Approximately 2 miles below Highway 49 the gravels are mixed with sand to the extent that as much as 50-75% of their surface is covered. The last three-fourths of a mile of river channel above the old coffer dam site is completely covered by sand deposits.

Once again there are numerous fringe areas of suitably sized spawning gravels along runs and near pools which were not counted. At lower flows more of these areas would likely be counted.

Evidence of dredging, both historic and recent, is evident throughout the river by tailing piles and diversions. Nineteen active dredges were observed on the river above Ponderosa Way (2.3 per mile). Between Ponderosa Way and Lake Clementine no active dredging was observed (4 miles). Only one active dredge was observed in the six mile reach between Clementine Dam and the Auburn Dam site and it was located above Highway 49. It is expected that dredging will increase during the summer months.

There is a good fringe of riparian habitat at the Colfax-Iowa Hill Road bridge crossing which disappears about a quarter of a mile downriver as the river enters a narrow bedrock lined canyon. After about four and one-half miles the canyon walls are less steep and have less bedrock, riparian growth is again present, occasionally dense. Willows, alders, and berries are the dominant plant species along the river. Large gravel bars below Highway 49 are sparsely vegetated.

Fish species observed while floating the river included, Sacramento squawfish, suckers, and smallmouth bass. Three anglers were observed fishing for trout at Highway 49. They had not yet been successful.

Below Clementine Dam the river was snorkeled in pool and riffle areas to attempt fish observation. Above the confluence of the Middle Fork turbidity limited visibility to about 7 feet. Below the Middle Fork visibility increased to about 12 feet. Very few fish were observed, but included:

Sacramento squawfish (Ptychocheilus grandis)
Sacramento sucker (Catostomas occidentalis)
smallmouth bass (Micropterus dolomieui)

Flows on the North Fork are uncontrolled so the best time for observations should be late summer or early fall.

Prior to this trip I checked California Department of Fish and Game (Region II) files for information on fish species.

The earliest record I found was a 1934 California Department of Fish and Game Stream Survey that extended to the confluence of the Middle Fork. It appeared to include the middle portion of the North Fork including some of the area now inundated by Folsom Dam. This survey reported:

sucker	(Sacramento sucker)
pike	(Sacramento squawfish)
trout	(rainbow, brown?)
steelhead	(anadromous rainbow trout)

Another Stream Survey in 1938 identified the following species:

Sacramento pike	(Sacramento squawfish)
hardhead	
sucker	(Sacramento sucker)
rainbow trout	
loch leven trout	(planted in 1933)
king salmon	(chinook salmon)

Stocking records from 1930-1949 indicate that rainbow and brown trout, and smallmouth bass were planted in the North Fork.

A stream survey conducted by Fish and Game on the North Fork, one quarter mile below the Colfax-Iowa Hill Bridge, in September 1965 found the following species:

rainbow trout
brown trout
Sacramento squawfish
Sacramento sucker
smallmouth bass

The memo to file reported an estimated 100 trout/mile or 316 trout/acre in this area. This is approximately where the river enters the steep bedrock lined canyon.

Water temperatures were again collected on the two trips using a Taylor hand held thermometer approximately 6 inches below the surface.

53° F @ 8:30 am @ Colfax-Iowa Hill Bridge
56° F @ 11:00 am @ Canyon Creek 5/17/89
59° F @ 12:30 pm @ Ponderosa Bridge
62° F @ 2:30 pm @ upper end of Clementine Lake

60° F @ 12:00 pm @ base of Clementine Dam
61° F @ 2:45 pm @ Middle Fork confluence 5/22/89
57° F @ 3:00 pm @ below Hwy 49 Bridge 1/
58° F @ 4:00 pm @ Auburn Dam Site

1/ Middle Fork inflow was 55° F on 5/22/89

The following wildlife were observed during the trip:

common merganser
mallard 1/
American dipper 1/
Canada goose 1/
red-tailed hawk

turkey vulture

California quail

mule deer

1/ observed nesting or with juveniles

UNITED STATES GOVERNMENT FISH AND WILDLIFE SERVICE

Memorandum

TO : Files DATE: October 4, 1989

FROM : Fish and Wildlife Biologist

SUBJECT: CE - American River Watershed Study

On September 20, 25, 28, 1989, Fred Walasavage (CE) and I conducted fish sampling on the North and Middle Forks of the American River upstream of the proposed Auburn Dam site. Results of the sampling are:

NORTH FORK AMERICAN RIVER (50 cfs estimated flow)

@ Iowa Hill - Colfax Bridge

Electrofishing, snorkeling and bank observation were made in the riffle area downstream of the bridge and in the pool upstream of the bridge.

Smallmouth bass (3 total @ ~ 250 mm. FL) were observed in the pool. Bank observation of 3 additional bass and 3 Sacramento suckers were also recorded. Visibility in the pool was poor. Depth ranged from 1.5 feet to approximately 10 feet. Pool substrate was a cobble/gravel mix (10-20% embedded) with some bedrock (one bank was solid bedrock). Riparian cover was sparse, composed of willow and cottonwood.

The riffle area below the bridge held smallmouth bass and riffle sculpin. The smallmouth bass (9 total) ranged in size from 65 mm to 270 mm. The riffle sculpin were 45 and 50 mm. Water depth in the riffle ranged from 1 1/2 to 3 feet. Riparian vegetation cover was low. Both sites had active dredging operations. Water temperature was 60°F at 9:30 am.

@ Yankee Jim Bridge

Electrofishing and snorkeling observations were made in a riffle and pool at this site.

Smallmouth bass (2 @ 65 and 80 mm), Sacramento squawfish (2 @ 185 and 310 mm), and riffle sculpin (1 @ 65 mm) were located electrofishing in the riffle. Water depth ranged from .5 to 1.5 feet. Substrate was primarily gravels (10% embedded) with some cobble. Riparian cover was poor and primarily willows.

Snorkeling observations in the pool revealed smallmouth bass (4 ranging between 250 and 300 mm), and a rainbow trout (~ 400 mm). Water depths ranged from 3 to 20 feet deep (bottom beyond our vision). The bottom was bedrock with gravel pockets interspersed in the areas we could see. Riparian vegetation was sparse and composed of willows and cottonwoods. Water temperature was 64°F at 2:30 pm.

@ Ponderosa Bridge

Brown bullhead (3 ranging from 210-250 mm TL), smallmouth bass (4 ranging from 75-265 mm FL), and a green sunfish (1 at 85 mm) were located electrofishing in the riffle. Only the fringe area of the channel was electroshocked about 600 feet upstream of the bridge. Water depth in the area sampled ranged from .5 to 3.0 feet. Substrate was gravel with a few cobbles and boulders (20% embedded). Riparian vegetation was comprised of sparse willows. Good instream cover was present from boulders and bedrock outcrops.

MIDDLE FORK AMERICAN RIVER (100 cfs estimated flow)

@ Oxbow Reservoir

The river channel directly below the dam was sampled electrofishing. A single Sacramento squawfish (52 mm) was in the large cobble/boulder substrate. Normally flows are bypassed from the channel through the powerhouse. Oxbow Reservoir was drained for maintenance work, the release was approximately 100 cfs. Average depth was .5 to 2.5 feet. Ripariar cover was thick low growing willows. Water temperature was 63°F @ 9:30 am.

A second site was snorkeled approximately .5 mile below Oxbow Reservoir. Sacramento squawfish (10 ranging 150-450 mm), Sacramento sucker (26 ranging 300-600 mm), and rainbow trout (1 @ 200 mm) were observed. Water depth ranged from 6-12 feet, visibility was low due to dredging and maintenance work at Oxbow Reservoir upstream. Instream cover was high, riparian vegetation was sparse, primarily willows, cottonwoods and alders. Substrate was boulders and cobbles. Water temperature was 62.5°F @ 11:00 am.

@ Fords Bar

Angling and snorkeling were utilized at this site. Sacramento suckers (12 @ ~ 600 mm) were observed in pool areas. Rainbow trout (2 @ 270, 317 mm), and brown trout (4 ranging 170-279 mm) were caught and released angling. Three other trout were hooked, but not landed. Water depth in the pools ranged from 6 to 12 feet, in the riffles it was 6-30 inches. Substrate in the pool was bedrock with pockets of gravel and sand, instream cover was good. The riffle area was gravel with bedrock outcrops, instream cover was good. Riparian vegetation was good with overhanging branches in some areas. Water temperature was 59°F @ 7:00 am, 61°F @ 10:00 am.

@ Mammoth Bar

A side channel pool was electrofished at this site. Riffle sculpin (2 @ 67, 105 mm), and Sacramento sucker (2 @ 60, 65 mm) were found. There was little instream cover or riparian vegetation. Water depth ranged from 8 to 30 inches. Water temperature was 69°F at 3:30 pm.

Time constraints prohibited further sampling.

Doug

Doug Weinrich

AMERICAN RIVER WATERSHED STUDY
(Aquatic Sampling)

9:30 60°F

LOCATION N.F American River @ Iowa Hill - Colfax Bridge

DATE 09 20 89 **RIFFLE** ✓ **POOL** **RUN**

Record Number	Species	Number of Individuals	Length (mm)	Location	Method 1/
	Smallmouth Bass	1	270		2
	"	1	85		2
	"	1	90		2
	"	1	90		2
	"	1	90		2
	"	1	82		2
	"	1	75		2
	"	1	91		2
	"	1	65		2
	Riffle Sculpin	1	45		2
	Riffle Sculpin	1	50		2
	"				

1/ Method:

1. direct observation
2. electrofish
3. seine

Notes: 35' long
75' wide

18"-3' occasional hole (dredge)

low riparian willows

AMERICAN RIVER WATERSHED STUDY
(Aquatic Sampling)

61°F @ 11:30

LOCATION N.F American River @ Iowa Hill - Colfax Bridge

DATE 09 | 20 | 89 **RIFFLE** [ ] **POOL** [✓] **RUN** [ ]

Record Number	Species	Number of Individuals	Length (mm)	~~Location~~ depth (ft)	Method 1/
	Smallmouth Bass	2	~250	3.0	1
	Smallmouth Bass	1	~250	3.0	1
	Pool - 300'x90'				
	~50 cfs				
	cobble/gravel substrate — some bedrock				
	10-20% embedded				
	Smallmouth Bass	3		} bank observations	
	Sacramento Sucker	3			

1/ Method:

1. direct observation
2. electrofish
3. seine

Notes: Low. cover rip < one bank solid bedrock
other bank Willow and Cottonwood
interspersed in boulder/cobble/bedrock
estimated depth of pool 18-10'

AMERICAN RIVER WATERSHED STUDY
(Aquatic Sampling)

64°F @ 2:20

LOCATION: N.F. American River @ Yankee Jim Bridge

DATE: 09 20 89 RIFFLE: ✓ POOL: RUN:

Record Number	Species	Number of Individuals	Length (mm)	Location	Method 1/
	Smallmouth Bass	1	80		2
	Smallmouth Bass	1	65		2
	Squawfish	1	316		2
	Squawfish	1	185		2
	Sculpin (riffle sculpin)	1	65		2
	6"-18" in deep				
	gravel bottom (few cobbles)				
	10% embedded				
	poor riparian (willow)				

1/ Method:

1. direct observation
2. electrofish
3. seine

Notes:

AMERICAN RIVER WATERSHED STUDY
(Aquatic Sampling)

LOCATION N.F American @ Yankee Jim Bridge

DATE 09 | 20 | 89 **RIFFLE** [ ] **POOL** [✓] **RUN** [ ]

Record Number	Species	Number of Individuals	Length (mm)	Location	Method 1/
	Rainbow trout	1	400		1
	Smallmouth Bass	1	250		1
	"	1	250		1
	"	1	300		1
	"	1	300		1
	160' x 25'				
	3'-20' deep				
	gravel in areas we could see				
	willow/cottonwood riparian [illegible]				
	bedrock channel				

1/ Method:

1. direct observation
2. electrofish
3. seine

Notes:

AMERICAN RIVER WATERSHED STUDY
(Aquatic Sampling)

68°F @ 4:10 PM

LOCATION N.F American River @ Ponderosa Bridge

DATE 09 | 20 | 89   **RIFFLE** ✓   **POOL** ☐   **RUN** ☐

Record Number	Species	Number of Individuals	Length (mm)	depth ~~Location~~	Method 1/
	Bullhead sp.	1	250	3'	2
	"	1	235	"	2
	"	1	210	"	2
	Smallmouth Bass	1	265	"	2
	"	1	135	"	2
	"	1	95		2
	"	1	75		2
	Green Sunfish	1	85		2
	[illegible] riparian (willows)				
	gravel few cobble and Boulders				
	75' x 60' wide				
	good instream cover	by boulders	bedrock outcrops		

1/ Method:

1. direct observation
2. electrofish
3. seine

Notes:

AMERICAN RIVER WATERSHED STUDY
(Aquatic Sampling)

63°F @ 9:30

LOCATION M.F. American River (Below Oxbow Reservoir

DATE 09 | 25 | 89 **RIFFLE** ✓ **POOL** ☐ **RUN** ☐

Record Number	Species	Number of Individuals	Length (mm)	Location	Method 1/
	Sacramento Squawfish	1	52		2
	Instream cover hi				
	Substrate: Boulder - Cobble				
	Riparian (Med) Low willow				
	50'x 30' area sampled				
	ave depth 6" max	3.5'			

1/ Method:

1. direct observation
2. electrofish
3. seine

Notes:

AMERICAN RIVER WATERSHED STUDY
(Aquatic Sampling)

62.5 °F @ 11:00

LOCATION M F American River (.5 mile below Oxbow Reservoir

DATE 09 25 89 **RIFFLE** [ ] **POOL** [✓] **RUN** [ ]

Record Number	Species	Number of Individuals	Length (mm)	Location	Method 1/
	Sacto Squawfish	4	6"	(150 mm)	1
	Sacto Sucker	8	24"	(600 mm)	1
	Sacto. squawfish	6	12-14"	(300-450 mm)	1
	Sacto sucker	18	12-14"	(300-450 mm)	1
	Rainbow trout	1	8"	(200 mm)	1
	Site below N.F of MF. American River				
	Instream cover hi				
	substrate Boulder / Cobble				
	Low Riparian (willow / cottonwood / alder)				
	ave depth 6' max 12' visibility low due to work				
	@ Oxbow Reservoir and dredging operations 6-8' visibility				

1/ Method:

1. direct observation
2. electrofish
3. seine

Notes:

AMERICAN RIVER WATERSHED STUDY
(Aquatic Sampling)

59°F @ 7:00 AM
61°F @ 10:00 AM

LOCATION: M.F. American River @ Fords Bar

DATE: 09 28 89 RIFFLE [ ] POOL [ ] RUN [ ]

Record Number	Species	Number of Individuals	Length (mm)	Location	Method 1/
	Rainbow trout	1	317		4
	Brown trout	1	239		4
	"	1	279		4
	"	1	270		4
	"	1	170		4
	Rainbow trout	1	270		4
	Lost	3			
	Good instream cover				
	Med. riparian some overhang on N. bank				
	riffle area 6-30"				
	pool 5'-6'				
	Gravel substrate, bedrock appears in some areas				
	width 40'-50'				

1/ Method:

1. direct observation
2. electrofish
3. seine
4. angling

Notes:

AMERICAN RIVER WATERSHED STUDY
(Aquatic Sampling)

69°F @ 3:30

OCATION: M.F American River @ Mammoth Bar

ATE: 09 | 25 | 89   RIFFLE [ ]   POOL [/]   RUN [ ]

Record Number	Species	Number of Individuals	Length (mm)	Location	Method 1/
	Sculpin (riffle)	1	105		2
	"	1	67		2
	Sacto Sucker	1	65		2
	Sacto Sucker	1	60		2
	Poor Riparian				
	Gravel - not compact				
	15x30				
	8"-30"				

1/ Method:

1. direct observation
2. electrofish
3. seine

Notes:

APPENDIX E

APPENDIX E

South Fork American River
Compensation Area
FWS Preferred Site

For purposes of our HEP Analysis, we selected 8,529 acre compensation area on the South Fork American River as a potential fish and wildlife management area to mitigate impacts on the North and Middle Fork American Rivers. The site was selected because of presumed threat of development and loss of similar in-kind habitat being impacted by the Auburn Dry Dam. Because of the accelerated planning schedule imposed by the Corps, there was little time to conduct thorough studies of existing habitat, much less details needed for a rigorous and careful HEP analysis.

We relied on the Corps to provide us with land use information needed to predict future changes on the compensation area. The HEP analysis requires an assessment of compensation area changes for the period of analysis (100-years in this case) under without-wildlife management and with-wildlife management conditions. Unfortunately there was not adequate time allotted by the Corps to developing a careful land use analysis along the South Fork American River. Their analysis did not address all of the potential areas along the River. The Corps provided us with a draft land use study on November 9, 1991 (Attachment 1). The study encompassed 4,320 acres on 6-3/4 sections of land in the Lotus, Coloma area along the South Fork American River. Our preferred site included some of the Corps study lands and additional acreage upstream of Coloma.

We used information on land use changes as projected in the Corps study to develop our HEP futures scenario on the compensation area. We excluded government owned lands and only considered private lands. We developed a buildout scenario for the sections studied by the Corps and made the assumption that it would also apply to the sections within our selected area downstream of Coloma. We assumed that no significant growth or land conversion would occur upstream of Coloma due to very steep, relatively unaccessible areas along the canyon rims. These assumptions are reflected in our HEP report.

Table 1. Land-Use Predictions For Non-Government Lands [1]

Scenario	Ty 0 (%)	Ty 10 (%)	Ty 15 (%)	Ty 20 (%)
10-year buildout	640	0	0	0
15-year buildout	640	213	0	0
20-year buildout	2541	1271	635	0
Developed	0(0)	2337(61)	3186(83)	3821(100)
Total Acres	3821	3821	3821	3821

[1] Based on 11/12/91 data provided by Meridith Stevens, Corps economist for range 9E, sections 9, 10, 11, 12, 13, 15, 16, and three fourths of section 21, Coloma 7-1/2 minute topographic quad map.

Attachment 1

November 9, 1991

EXISTING AND PROPOSED LAND USES OF ALTERNATIVE MITIGATION LANDS

Scope and Purpose of Land Use Study. The purpose of this study is to identify existing and projected land uses for the two mitigation land alternatives currently under consideration by the Corps of Engineers (Corps) and the Fish and Wildlife Service (FWS). The limited time available for this study precludes a detailed on-site analysis of the lands involved. However, the study is based on a parcel by parcel analysis of the El Dorado County assessor's records, review of the most current census and land use data available from the county, review of current area plans and zoning, and personal interviews with a number of local agency personnel and individuals with a first-hand knowledge of the area. The period of analysis is based on the 100-year life of the proposed American River Flood Control Project. However, as most of the land use changes are expected within a 20-year time frame (1991 to 2011), the analysis is focused on this time period. It should be noted that land use projections are inherently speculative and are subject to many uncertainties. These include future actions of public agencies with regard to land use decisions and provision of needed infrastructure and economic conditions which dictate the real estate market. Based on Corps direction and the need to prioritize study objectives due to the short-time available, the focus is on Alternative 1.

Project Compensation Areas. Alternative I borders a 7.6 mile-long section of the South Fork American River downstream of the community of Lotus, California (Figure 1). It encompasses 4,320 acres and includes all of Sections 12, 11, 10, 9, 15, 16, and 3/4 of Section 21. It contains 223 separate parcels under the ownership of 192 individuals and government agencies. Government ownership, primarily the Bureau of Land Management, totals ------ acres. Approximately 86 percent of the lands bordering the South Fork American River are in private ownership, with the remainder under government ownership or control. Land uses within the Alternative I study area vary from small lot residential to large residential lots which may or may not have agricultural uses. The study area contains extensive grazing lands. A substantial amount of the agricultural lands are within Williamson Act Agricultural Preserves. Land in the preserves must stay in agricultural use for a minimum of 10 years in exchange for a reduced tax base predicated on agricultural use. Several of the largest agricultural tracts are in nonrenewal status and will be "rolled out" or excluded from the preserves in 1996. There has been significant sales activity and requests for parcel maps providing for smaller lot sizes in the past several years. Land speculation is also evidenced by the large tracts acquired by developers and/or investment groups. There has been a significant decline in sales activity in the current year due to unfavorable economic conditions nationwide. However, this is expected to be a temporary downturn. Although most of the newly created lots and many of the older lots remain vacant, it is anticipated that substantial building activity will occur within the next 10 years.

Alternative 2 encompasses 4,480 acres in three separate locations. This includes Sections 1, 2, and 36 north of Highway 49 and the town of Lotus totaling 1920 acres and used for grazing; 1280 acres in Sections 13 and 19 which have been extensively subdivided; and 1280 in Sections 31 and 30 north of Pilot Hill which have also been split into numerous parcels. Alternative 2 consists of 160 parcels under 80 ownerships. Government ownership totals --------acres. None of the land in agricultural preserves is in a nonrenewal status. With the exceptions of Sections 1, 2, and 36, most of the land is in small to larger size residential parcels. One of the largest subdivisions proposed in western El Dorado County would be located in the vicinity of Section 30.

General Plan Designations and Zoning. Most of Alternative 1 is within the Lotus-Coloma Area Plan boundaries. A small portion of the lands located west of the South Fork of the American River in Alternative 1 is within the Cool-Pilot Hill Area Plan. The lands north of Lotus in Alternative 2 are also within the Lotus-Coloma Area Plan. The remainder of land in Alternative 2 is within the Cool-Pilot Hill Area Plan boundaries. Most of the general plan and zoning in Alternative 1 is for low density residential uses which permits 1 dwelling units per 10-160 acres. Smaller lots are also located in number of areas and allow 1 dwelling unit per 5 to 9.9 acres or less. Parcels less than 4.9 acres require public sewer or water. The Georgetown Public Utility District (GDPUD) currently has requests for annexation to serve water to 5,150 acres of land within portions of Alternative 1 and 2 and adjacent lands.

General Plan Designations. The general plans for the subject areas are outdated and are being revised as part of an overall general plan revision for the county. The plan revision, El Dorado County 2010 General Plan, is not expected to be completed until late 1992. No decisions on land use changes for any of the study area have been made. The following is a listing of general plan designation and zoning categories used in this report.

B - Rural Residential Agriculture - 1 dwelling unit per 10 - 160 acres.

D - Single Family Residential- Low Density - 1 dwelling unit per 5 to 9.9 acres

E - Single Family Residential- Medium Density - 1 dwelling unit per 1 - 4.9 acres

F - Single Family Residential - High Density -5 dwelling units per acre

G- Multiple Family Residential- 20 dwelling units per acre

L - Parks

K - Open space and conservation

M - Public Facility

Zoning

R1A - Single Family Residential - 1 acre minimum
RE5 - Single Family Residential - 5 acre minimum
RE10 - Single Family Residential - 10 acre minimum
RA-20 - Residential Agriculture - 20 acre minimum
RA-40 - Residential Agriculture - 40 acre minimum
RA-80 - Residential Agriculture - 80 acre minimum
AE - Exclusive Agriculture
RF - Recreation Facilities
OS - Open Space

Alternative 1

The following is a more detailed discussion of the 7 Sections of land comprising Alternative 1. The order in which the Sections are discussed is determined by their location, extending from east to west and north to south.

Section 12

640 acres, 14 parcels, 9 owners
GP Designation - predominately B, small portion of D, government lands designated BLM.
Zoning - Majority designated AE and RE 40, small portion RE 10

Current Land Use. About 61% of the land is used for grazing and is under Williamson Act contract or is under government ownership. Ownership along the .8 miles of river frontage is 50% government and 50% private. The smaller lots are a mixture of vacant and improved. The residential lots are generally below 10 acres. A cluster of 4 rural residential lots adjoin the South Fork.

Future Land Use. Government control of the 131 acres is not expected to change. The 255 acres of land under Williamson Act contract cannot be developed for at least 10 years. However, due to development pressure in the area, it can be expected to ultimately develop within the next 20 years. Those portions with the steepest slopes would have low development potential, generally 1 dwelling unit per 20 to 40 acres. More level lands could accommodate higher densities in the range of 1 dwelling unit per 5 to 10 acres. As existing residential parcels are generally 5 acres or less, no further splits are anticipated of these parcels. Within 10-15 years, it is anticipated that all existing vacant residential lots will be developed.

Section 11

640 acres - 21 parcels - 17 owners
GP Designation - Predominately B, small portions of D.
Zoning - Mixture of AE, RF, RE 10 and RA 40

Current Land Uses. Much of the land is vacant. Only a few homes have been constructed, including a small older multi-family complex. All of the 1.8 miles of river frontage is in private ownership. Parcels adjoining the river are relatively large, ranging from 40 to 100 acres. There has been considerable sales activity in this Section in the past several years. Several large-scale development have been proposed, including a golf course and a condominium development. Grading for the golf course was begun, but was halted by the County due to failure by the owner to obtain the necessary permits. A number of requests for 10 acre parcels have been submitted; approval is pending.

Future Land Use. The size and location of the parcels, the favorable topography, and development interest shown in the land indicate a high potential for residential development. The 40 acre parcels have the necessary entitlements for 1 housing units per 40 acres without county approval of a parcel map. However, it i more likely that the parcels will be further subdivided. There is a potential for Single Family Residential-Low and Medium Density development. Public water or sewer would be required for subdivisions of less than 1 dwelling unit per 4.9 acres. The ability of the GDPUD to serve this area is unknown. The time frame for development is estimated to occur within the next 10 to 15 years.

Section 10

640 acres - 7 parcels - 2 owners
GP Designation - BLM, L and B
Zoning - RA 20 and RA 40

Current Land Use. Approximately 58% or 370 acres are in government ownership or control. BLM parcels include the Clark Mountain conservation area, a 40-acre parcels on the west bank of the river and a 40 acre parcel in the northwest quadrant. The remaining 270 acres is privately owned by one developer. The private land is currently used for grazing but is zoned for low density residential. Section 10 contains 1.2 miles of river frontage. Of this, .5 miles is privately owned and .7 miles is owned by the government.

Future Use. Government control of the 370 acres is not expected to change. The private land can be expected to develop in low to medium residential density within the next 10 years.

Section 9

640 acres - 1 parcel - 1 owner
GP Designation - B
Zoning - AE

Current Land Use. The entire section is used for grazing. The owner has applied for nonrenewal of his Williamson Act contract, and the property will be rolled out in 1996. The owner has also applied to the GDPUD for annexation into their water district. The GDPUD has indicated it has the potential to serve the property. The GDPUD is studying the location of pump station on an adjoining section also belonging to this property owner.

Future Land Use. Assuming that water connections are available, and given the favorable topography and location of the site, a medium residential density is possible. As no development can proceed until the roll out date in 1996, it is unlikely that full development of the site could occur within 10 years. However, division of the parcel and infrastructure improvements would be feasible within 10 years. Ultimate buildout would be dependent on the density and type of development.

<u>Section 15</u>

640 acres - 42 parcels - 40 owners
GP Designation - B and D
Zoning - RA20 and RA10

Current Land Use. The Section has been extensively subdivided into a mixture of parcel sizes ranging from 5 to 40 acres. The predominant parcel size is 10 acres. Most of the sale activity and parcel requests have been from 1988 to the present. Only a few homes have been constructed. About .5 miles of river frontage are within this Section. All is in private ownership. Approximately 17 acres have been privately acquired for rafting access. Five parcels ranging from 6 to 16 acres border the river on the east bank. A 29 acre parcel on the west bank is scheduled for roll out of the Williamson Act in 1996.

Future Land Use. Under current zoning, all of the 40 acre parcels can be subdivided into 20 acre parcels. It can also be anticipated that further splits of the parcels will occur. The 29 acres in roll out status are under the same ownership of the land scheduled for roll out in adjoining Section 9. It is probable that the 29 acres will be part of the overall development. Higher densities can be anticipated within the next 10 years. However, it is unlikely that housing would be constructed on all of the vacant lots within that period. A 20-year buildout of Section 15 is more probable. Low to medium density development is probable.

<u>Section 16</u>

640 acres - 4 parcels - 3 owners
GP Designation B
Zoning AE

Current Land Use. All of the land is used for grazing or is vacant. The bulk of the land is designated and zoned for agriculture and is currently under Williamson Act contract. However, a 545 acre parcel, which extends into Section 21, will be rolled out in 1996. Two other parcels are also under a single ownership which totals 400 acres and extends south into Section 21. These parcels are under Williamson Act contract and no application for nonrenewal has been filed. The fourth parcel is only 16.5 acres and is not in an agriculture preserve. All of these parcels border the 1.1 mile of river frontage in this Section. As previously discussed, a pumping station is proposed by GDPUD on a section of the river within the 545 acre parcel. This will require annexation by the water district.

Future Land Use. The application for roll out and request for annexation into the GDPUD indicate the owner's desire for development of the 545 acre parcel. This development would probably be part of the overall plan by the same landowner in Sections 9 and 15. Due to its more remote location, the land in this Section would probably be developed in the final stages of the overall development plan. As no development can proceed until after the roll out date in 1996, it is unlikely that full development of the site could occur within 10 years. However, division of the parcel and infrastructure improvements could occur within 10 years. The other agricultural preserve land could not be developed until at least 2002 and this would require an application for nonrenewal in 1992. This property could remain indefinitely as grazing land. However, as development encroaches to the east and west of this parcel, the potential for development will substantially increase. Development could occur within a 20-year time frame. Densities would probably be low, but with water service and the favorable topography in most portions, medium density would be feasible. The remaining 17 acre parcel could be developed for more intensive river related use or home sites.

<u>Section 21</u>

480 acres - 3 parcels - 2 owners
GP Designation - B
Zoning - AE and RE 40

Current Land Use. The land is currently used for gazing. The 264 acres adjacent to the east bank is under a Williamson Act contract and no notice of nonrenewal has been filed. This is part of the large tract north and west under the same ownership. The 216 acre parcel on the west bank is not under a Williamson Act contract. The current zoning would allow one housing unit per 40 acres. The American River Land Trust is currently negotiating to acquire the 216 acre parcel. Section 21 has 1.3 miles of river frontage and is all in private ownership.

Future Land Use. The 264 acres could not be developed until at least 2012, and this would require a notice of nonrenewal in 1992. The 216 acre parcel could be divided into 40 acre parcels with the existing entitlements. Development of parcels to the north would require infrastructure extensions which could increase the potential for division of this Section into smaller parcels. The steeper topography would limit the density of development in some portions. If the American River Land Trust is successful in acquiring this parcel, the area would remain undeveloped. The development potential of the 264 acres would be similar to that described for Section 16. Division and possible development of this land is possible within a 20-year time frame. Low to medium densities would be feasible where the topography allows.

ALTERNATIVE 2

The following generally describes the 7 Sections comprising Alternative 2.

Section 36, 1 and 2

1920 acres - 6 parcels - 2 owners
GP Designation - B
Zoning - AE

Current Land Use. All of this land is used for grazing and is owned by two members of the Bacchi family. The property is part of the original homestead of the Bacchi family who were early settlers and landowners in El Dorado County. At one time, a portion of the property was offered to the State of California for park use. However, the State was unable to accept this offer. The land is under Williamson Act contracts and no application for nonrenewal has been filed.

Future Land Use. Development of this land could not occur for at least 10 years under Williamson Act provisions. However, the owners have applied for annexation into the GDPUD. This indicates future plans for development. Development of these sections is possible within the next 10-15 years. With public water service and given the favorable topography and location, medium density development would be possible.

Section 19

640 acres - 31 Parcels - 25 Owners
GP Designation - B
Zoning - RE10

Current Land Use. All of this section has been divided into parcels, generally ranging from 10 to 40 acres. Ten acre parcels predominate in the areas accessible by Salmon Falls Road. An estimated 6 parcel maps have been approved or are in process to allow 10 acre lots. Vista Verde Estates is one of the larger subdivisions with 25 improved lots. This subdivision has been halted due to failure to obtain the necessary permits. The preponderance of other subdivided lots throughout this Section remain vacant, with the greatest concentration of housing near Salmon Falls Road.

Future Land Use. There remains an estimated 3 to 4 parcels of 40 acres each which could be subdivided into 10 acre parcels (these are parcels for which no rezones have been requested). Based on current zoning, no further subdivision of existing 10 acre parcels would be allowed. Construction on the existing vacant lots is expected within the next 10 to 15 years.

<u>Section 19</u>

640 acres - 68 parcels - 25 owners
GP Designation - B
Zoning - RE10 and RE10 PD

Current Land Use. Most of this section is occupied by Pilot Hill Crossing. Pilot Hill Crossing extends into Section 14 to the west and encompasses 800 acres. The development provides lots with wells for custom or executive type homes. Most of the lots are vacant and remain in the developer's ownership. Lot sizes vary from 8 to 16 acres and are within the RE10 PD zoning boundaries. A number of other lots varying in size from 10 to 29 acres are within the southeast quadrant of this section.

Future Land Use. All of the vacant lots are expected to be improved or have residential construction within the next 10 years.

<u>Section 31</u>

640 acres, 16 parcels, 10 owners
GP Designation - Includes Pilot Hill Core Area with designations D, F,G,L, M - Surrounding area designated D.

Zoning - RIA, RI20

Current Land Use. A number of small parcels and several small subdivisions are within this section. A number of the lots are vacant. Larger parcels occur on the western boundary and presumably are used for grazing or are vacant.
A & B Development of Hawaii owns some property within this section as well as extensive properties bordering this section. A & B Development is currently proposing Pilot Hill Ranch which would be located on 1,800 acres at the northeast corner of Salmon Falls Road and Rattlesnake Bar Road on Highway 49 in Pilot Hill. The project would consist of 983 residential units, 9 acres of commercial and a 120 acre golf course. Lot sizes would range from 1/4 acre to 10

acres. It is not known whether any of this development extends into Section 31. A small amount of acreage is publicly owned by El Dorado County and the local fire district.

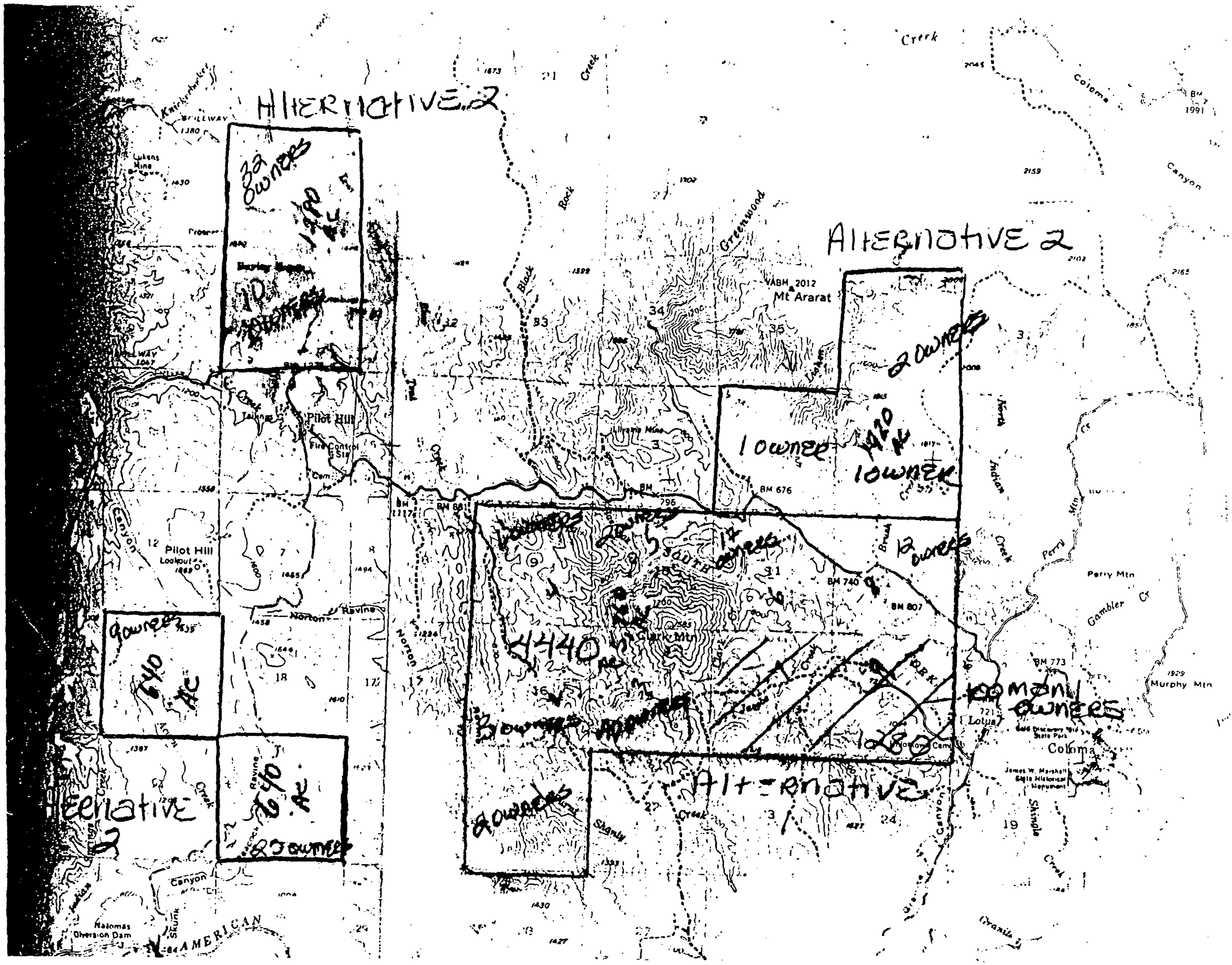
Future Land Use. Most of the lots are expected to have improvements or residential construction within the next 10 years. The larger parcels can be expected to be divided into 1 to 10 acre lots. The highest densities will occur in the Pilot Hill core area. Publicly owned land would remain unchanged.

<u>Section 30</u>

640 acres - 16 parcels - 10 owners
GP Designation - D and K
Zoning - RE5

Current Land Use. A number of small subdivisions and parcels are within this Section and many have housing. The average lot size is 5 acres. The USBR owns about 27 acres previously acquired for the USBR authorized Auburn Dam.

Future Land Use. Most of the vacant lots are expected to have residential construction or housing within the next 10 years. The larger parcels can be expected to be divided into the 5 acre minimums. Publicly owned land would remain unchanged.



Alternative 2
32 owners
1280 AC
10 owners
Alternative 2
2 owners
1 owner
1920 AC
1 owner
12 owners
Many owners
1280
Alternative 1
4440 AC
8 owners
2 owners
9 owners
640 AC
640 AC
8 owners
Alternative 2
Pilot Hill
Pilot Hill Lookout
Norton Ravine
Mt Ararat
Greenwood
Black
Rock
Creek
Clark Mtn
Lotus
Coloma
Perry Mtn
Gambler Cr
Murphy Mtn
Nasomas Diversion Dam
AMERICAN
Shingle
Colome
Canyon

APPENDIX
F

Mitigation Measure
Details and Costs

North and Middle Fork American Rivers

1. Fishery Management Plan

   A. Develop cooperatively with Corps, U.S. Fish and Wildlife Service, and California Department of Fish and Game. Service would be lead agency.

Staff - 1 senior biologist 1 assistant biologist	Biologist Days
Meetings with agencies	20
Reconnaissance field surveys	20
DFG files search	10
Literature review	10
Plan preparation (draft)	20
Plan preparation (final)	10
	90

   B. Plan Implementation - conduct identified studies such as instream flow methodology, and stream habitat mapping. Prepare reports of studies findings. Construct physical features and implement new flow schedules.

      Biologist Days: 267

   C. Estimated Cost would be 357 biologist days @ $561/day = $200,000.

2. Wildlife Management Plan

   A. Develop cooperatively with Corps, U.S. Fish and Wildlife Service and California Department of Fish and Game. Service would be lead agency.

Staff - 1 senior biologist 1 assistant biologist	Biologist Days
Agency meetings	20
Habitat mapping, surveys for wildlife	20
Literature review	10
DFG files search	10
Plan preparation (draft)	20
Plan preparation (final)	10
	90

B. Plan Implementation - conduct studies identified in plan such as wildlife population, distribution and use, also vegetation distribution and age class. Prepare reports. Implement vegetation management measures, construct physical features, carry out long term studies.

	Biologist Days
	267

C. Estimated cost would be 357 biologist days @ $561/day = $200,000.

3. Long Term Monitoring Program

A. A long term (life of project) monitoring effort is needed to evaluate effectiveness of the remedial measures planned to stabilize slopes, repair slumps, minimize erosion, and to remove sediment in the streambed. A plan to address these problems should be developed cooperatively between the Corps, U.S. Fish and Wildlife Service and California Department of Fish and Game. Implementation should be coordinated with these agencies.

B. Cooperative Plan Development - The Corps would be the lead agency. The Service would participate in developing and reviewing remedial plans and monitor implementation.

	Biologist Days
Staff - 1 senior biologist, 1 assistant biologist	
Plan development and plan review meetings	100
Followup site evaluations of slipouts, damages, etc.	2500
Study site monitoring, data collection, reporting	6300

C. Total estimated cost would be 8,900 biologist days @ $561/day = $5,000,000. This is a 100 year intensive monitoring effort intended to evaluate the project's effects from beginning to end. Information gained would permit better management during project life, better assessment of impacts on future projects and hopefully reveal new remedial measures with high likelihood for success.

4. Operations and Maintenance Costs

A. This estimate reflects costs that would accrue during the 100 year project life for operating and maintaining fish and wildlife habitat improvement structures, special signing, fencing, replacement planting, law enforcement, vehicles, equipment, etc.

B. Estimated average annual O&M cost would be $100,000 x 100 years = $10,000,000 band. Use combination planting scheme with mostly interior live oak and canyon live oak with lesser amounts of Douglas fir and California Bay. Include some component of shrub plantings.

250 trees (5 gallon size) @ $10/tree = $2,500

750 shrubs (1 gallon size) @ $2.50 each = $1,875

irrigation system est. ~ $10,000 per acre based on $10,000/ac. per Wildcat San Pablo project

planting labor cost - est. 20 minutes per shrub/tree planting @ 1,000 shrubs and trees per acre = 333 hrs. x $7.00/hr = $2,331.00/acre

TOTAL COST estimate = $2,500 + $1,875 + $10,000 + $2,331 = $16,706 per acre

132 acres x $16,706 per acre = $2,205,192.00

2. South Slope Oak Restoration

A. Convert 2,148 acres of grassland into south slope oak woodland. Use combination planting scheme with mostly interior live oak, and lesser amounts of digger pine and Douglas fir. The density of plantings would be about one half of that planned for the north slope. Thus all per acre costs would be reduced by 50 percent.

Estimated Cost = $16,706 ÷ 2 = $8,353 per acre

2,148 acres x $8,353/acre = $17,942,244

3. Pine Forest Restoration

A. Convert 143 acres of grassland into pine forest. Plant only pine and allow other grass/herbaceous understory to recover. Plant at ratio of 400 - 1 or 2 year old seedlings per acre. Provide 4 foot by 4 foot weed free protective zone around seedlings with plastic or permanent mulch.

400 seedlings x $1.00 each = $400

irrigation system estimate = $\frac{400}{1000}$ x $10,000 = $4,000 per acre

planting labor cost = 10 minutes per planting @ 400 seedlings per acre = 67 hours @ $7.00/hr. = $469 per acre

Total Estimate Cost = $400 + $4,000 + $469 = $4,869 per acre

143 acres x $4,869 per acre = $696,267

4. Grassland Control Burns
   A. Conduct control burning program every 3 years on 573 acres of grassland. This would prevent reversion to ruderal more competitive undesirable species for example star thistle.

   I estimated a cost of $12.00 per acre based on the following:

   Personnel:

   1 crew chief $20.00/hr. x 8 hrs. = $160.00/day = $160
   9 laborers $8.00/hr. x 8 hrs. = $64/day = $576
   5 support pumper trucks w/drivers @ $500/day = $500
   Total crew and equipment cost/day = $1,236/day
   crew burns 100 acres/day so 573 acres would require 5.73 days @ $1236/day = $7,082 per burn season

   100 year analysis ÷ 1 burn every 3 yrs. = 33 burns x $7,082 = $233,706.00

5. Remove cattle grazing

   A. All cattle grazing practice would be eliminated from the compensation area lands. This would be done immediately at the onset of management.

<u>Wetland</u>

1. Riparian Vegetation Restoration

   A. Additional planting of typical riparian tree species such as alder, willow and cottonwood would be done on both sides of the river channel in barren and light density areas that are suitable sites. The emphasis would be to accelerate recovery of sites damaged by cattle grazing, human activity, river crossings and slide areas. In addition, once more stable flow regimes are in place, it may be appropriate to replant higher terraces in some locations. Management goal is to increase density and continuity of the riparian band.

   We assumed that density of plantings would be very light and they would be sporadically planted along the river. This assumes an intense planting effort in the first few years so maturity and increased benefits come soon in the project life.

   trees = willow, cottonwood, alder @ 100 trees per acre
   100 trees (1 gal) @ $2.50 each = $250.00 per acre
   no irrigation system needed
   planting labor cost - est. 20 minutes per tree x 100 trees = 33

hrs.
33 hrs. x $7.00 per hr. = $231.00 per acre
Total cost per acre = $250 + $231 = $481 per acre

Total cost = 252 acres x $481 per acre = $121,212.00

2. Spawning gravel placement

A. Gravel placement only considered for lower reach below Lotus. Assume that there is deficiency in recruitment due to two reservoirs above Lotus. This would be a periodic replacement schedule of once every 3 years to permit natural displacement and monitoring. Gravels to be spread throughout the lower reach (6.5 miles) over the 108-year period of analysis. Much of the placement would be in the upper 3.25 miles of the lower reach assuming that gravels would be distributed by high flows into the remaining lower reach and eventually into Folsom Reservoir.
Total area of streambed in lower reach = 6.5 miles x 5,280 feet per mile x 100-feet wide = 78.8 acres or 381,333 sq. yards = 381,333 cubic yards assuming 1 foot depth for gravels.

Assume one half of area is considered for replacement so 381,333 cubic yards ÷ 2 = 190,666 cubic yards.
190,666 cubic yards ÷ 108 years = 1765 cubic yards per year or 5296 cubic yards per every 3 years.
Estimated cost = 5,296 yards x 33 placements x $10 per yard = $1,747,680