



SACRAMENTO COUNTY  
AMERICAN RIVER  
PARKWAY PLAN 2008



County of Sacramento  
Municipal Services Agency  
Planning and Community Development Department



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*Project Management Team staff and UCAC members at the final Update Citizen's Advisory Committee Meeting on June 19, 2006.*



# TABLE OF CONTENTS

1.	INTRODUCTION .....	9
2.	GOALS AND POLICIES .....	15
	Goals.....	15
	Policies .....	15
	1.0 Parkway Concept .....	15
	3.0 Resources of the Parkway .....	16
	4.0 Water Flows, Water Quality and Flood Control ...	19
	5.0 Recreational Use of the Parkway .....	22
	6.0 Non-Recreational Use of the Parkway .....	28
	7.0 Land Use .....	29
	8.0 Public Access .....	32
	9.0 Public Safety .....	34
	10.0 Area Plans .....	38
	11.0 Implementation .....	45
3.	RESOURCES OF THE PARKWAY .....	49
	Terrestrial Resources .....	51
	Aquatic Resources .....	60
	Human Historical Resources .....	69
	Interpretive Resources .....	73
	Aesthetic Values .....	77
4.	WATER FLOWS, WATER QUALITY AND FLOOD CONTROL	77
	Water Management .....	79
	Flood Control and Levee Protection .....	84
	Wild and Scenic Rivers Act .....	89
5.	RECREATIONAL USE OF THE PARKWAY .....	93
	Permitted Recreational Activities and Facilities .....	93
	Nature Appreciation .....	93
	Recreational Enjoyment .....	94
	Trails Recreation .....	97
	Recreational Participation in	
	Group Sports and Athletics .....	97
	Aquatic Recreation .....	98
	Prohibited Activities and Facilities .....	99
	Group Activities .....	101



6.	NON-RECREATIONAL USE OF THE PARKWAY .....	105
	Commercial Activities .....	106
	Caretakers.....	107
	Agriculture .....	107
	Public Utilities .....	108
	Local Drainage .....	108
	Architectural Standards for Structures .....	108
7.	LAND USE .....	109
	Visual Impacts .....	111
	Uses and Facilities within the Parkway .....	112
	Uses and Facilities adjacent to the Parkway.....	114
	Open Space Preserve .....	116
	Nature Study Area .....	116
	Protected Area .....	117
	Limited Recreation .....	118
	Developed Recreation .....	118
	Recreation Reserve .....	119
	Tables 7-1-7-3 .....	120
8.	PUBLIC ACCESS AND TRAILS .....	125
	Public Access .....	128
	Roads, Transit and Staging Areas .....	129
	Trails.....	130
	Bicycle Commuting .....	132
	Access for Persons with Disabilities .....	133
	Bridge Crossings .....	133
	Informational and Directional Signage .....	135
9.	PUBLIC SAFETY .....	141
10.	AREA PLANS .....	149
	Discovery Park Area .....	150
	Discovery Park .....	151
	Discovery Park East .....	153
	Tiscornia Park .....	153
	Jibboom Street East .....	154
	Woodlake Area.....	156
	Cal Expo Area .....	159
	Paradise Beach .....	164
	Campus Commons Area .....	166
	Howe Avenue .....	168
	Watt Avenue .....	170
	SARA Park Area .....	172
	Gristmill .....	172
	Rio Americano Area.....	173
	Arden Bar Area .....	175



Harrington Access Area ..... 176

William B. Pond Recreation Area ..... 176

River Bend Park ..... 179

Sarah Court Access ..... 182

Ancil Hoffman County Park ..... 184

Rossmoor Bar Area ..... 187

San Juan Bluffs ..... 191

Sacramento Bar Area ..... 193

Sunrise Recreation Area ..... 195

    Lower Sunrise ..... 195

    Upper Sunrise ..... 197

Sunrise Bluffs ..... 199

Sailor Bar Area ..... 201

Lake Natoma Area ..... 204

11. IMPLEMENTATION ..... 213

    Jurisdictional Responsibilities - Section 1.0 ..... 215

    Community Involvement - Section 2.0 ..... 221

    Planning and Development Process - Section 3.0 ..... 222

    Public Hearing Process - Section 4.0 ..... 226

    County Department of Regional Parks—

    Permit Process for the Parkway - Section 5.0 ..... 229

    Implementation Measures - Section 6.0 ..... 230

    Expenditures and Funding - Section 7.0 ..... 234



# CHAPTER 4

# WATER FLOWS, WATER QUALITY, AND FLOOD CONTROL

The lower American River is a highly managed river system that has experienced dramatic changes in hydrology, geomorphology, and riparian habitat value over the last 150 years due to natural and human-induced processes. The lower river's flows are controlled by releases from Folsom Reservoir and Lake Natoma and its channel is confined by state and federal levees in the first 12 miles, moving upstream from the mouth of the lower American River. The Parkway is a managed floodway that protects Sacramento from seasonal flooding and supports recreational use along with natural habitat areas.

## WATER MANAGEMENT

### Water Flow Policies

- 4.1** It is the intent of this Plan that available water flows protect the lower American River ecosystems and recreational resources. These resources include water quality, appropriate water temperatures, waterway recreation, aesthetics, riparian vegetation, fisheries and other aquatic species, wildlife and other river-dependent features and activities. Flow policies shall include the minimum flows in the flow regime consistent with Lower American River Flow Management Standard (LARFMS) as identified in the 2006 Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game and Water Forum draft technical report or in substantial conformance with that standard.
- 4.2** Flow releases from Folsom Reservoir and Lake Natoma should be managed to minimize fish isolation and redd stranding.
- 4.3** New surface water diversions that deplete flows in the lower American River, whether by execution of a new contract or new water right, to serve entities in counties outside the American River Watershed are inconsistent with this American River Parkway Plan.

### WATER FLOWS

Flows on the lower American River are controlled by the operation of Folsom Dam and Reservoir. Folsom Reservoir, Folsom Dam, Lake Natoma, and Nimbus Dam are a unit of the Central Valley Project (CVP) constructed by the U.S. Army Corps of Engineers (Corps) and operated by the U.S. Bureau of Reclamation (Reclamation). Folsom Reservoir provides flood protection for the Sacramento area, water supplies for







*The Parkway provides a vibrant riparian ecosystem.*

irrigation, domestic, municipal, and industrial uses, hydropower, extensive water-related recreational opportunities, water quality control in the Bay-Delta, and maintenance of flows stipulated to protect fish, wildlife, and recreational considerations.

Lake Natoma serves as an afterbay to Folsom Reservoir, regulating fluctuating discharges and allowing dam operators to coordinate power generation and flows in the lower American River channel during normal reservoir operations.

Operation of Folsom and Nimbus dams has dramatically altered the lower American River and its adjacent habitats by causing an overall decline in extremes

of flow and temperature compared with historical conditions. Current lower American River flows and temperatures are different than pre-dam conditions because river flows are managed by Reclamation to meet multiple objectives. In general, the timing of peak river flows has shifted from spring to early winter and summer water temperatures have declined significantly as summer flows increased, which can result in impacts to target fish species. In addition, when Folsom Reservoir and Lake Natoma must steeply increase and then decrease their releases in a short time period to accomplish an objective, for example, to meet Delta water quality needs, this can result in fish stranding and isolation.

Reclamation operates under a State water right permit and fish protection requirements that were adopted in 1958 as State Water Resources Control Board (SWRCB) Decision 893. Biological, legal and institutional conditions have changed substantially since the SWRCB adopted this decision. The SWRCB and many diverse stakeholders involved in various American River actions have agreed that the conditions specified in D-893 are not sufficiently protective of the beneficial uses of the lower American River, including its support of priority fish species and aquatic habitat.

There are three key areas to managing the river to protect priority fish species, particularly Chinook salmon and steelhead, and river habitat:

- Improvements related to water temperatures and flow,
- Actions or projects to restore, maintain, and improve fish habitat, and
- Reducing the impact of water supply diversions.

In the lower American River, improvements related to flow and water temperatures are believed to have the greatest potential for improving the health of Chinook salmon, steelhead, and habitats.

### ***Water Forum***

The Water Forum is a diverse group of business and agricultural leaders, citizens groups, environmentalists, water managers, and local governments in the Sacramento Region that have joined to fulfill two co-equal objectives: provide a reliable and safe water supply for the region's economic health and planned development to the year 2030; and preserve the fishery, wildlife, recreational, and aesthetic values of the lower American River.

In 2000, Water Forum members approved a comprehensive Water Forum Agreement, consisting of integrated actions necessary to provide a regional solution to potential water shortages, environmental degradation, groundwater contamination, threats to groundwater reliability, and limits to economic prosperity. The Water Forum Agreement allows the region to meet its needs in a balanced way through implementation of seven elements. One of these elements is an improved flow standard for the lower American River

### *Updated and Improved Flow Management Standard*

A flow management standard for the LAR has been developed by the Water Forum in cooperation with the U.S. Bureau of Reclamation and state and federal resource agencies. In 2006, agreement was reached on the flow management standard, which includes a flow regime, water temperature objectives, river monitoring and a river management group to implement the standard.

Work is now proceeding to develop a water right petition and related documents to be brought to the State Water Resources Control Board on behalf of the Bureau of Reclamation and the Water Forum. The intent of the petition is to modify the Bureau of Reclamation's Folsom Reservoir water right permit to include the flow standard as part of the operating criteria.

The improved flow standard includes:

- water flows, temperature, ramping flow rate and flow fluctuation criteria;
- the establishment of a river management group consisting of water resource managers, biologists, and interested stakeholders for Folsom Reservoir and lower American River operations; and
- a monitoring and evaluation program to report the resultant hydrologic and biologic conditions.

### Water Quality Policies

- 4.4** Water quality in the lower American River shall be maintained to provide for beneficial uses of the river, including: municipal and domestic water supply; industrial service water supply; irrigation; water contact and non-contact recreation; freshwater habitat; migration of aquatic organisms; spawning, reproduction, and/or early development of fish; and wildlife habitat.
- 4.5** Local, regional, state and federal agencies with jurisdiction over water quality of the American River should work together to maintain and protect a high level of water quality, manage and monitor discharges, and enforce existing water quality regulations.
- 4.6** Due to the unique urban setting of the lower American River, urban run-off containing a variety of contaminants has the potential to further degrade the river and Parkway resources. Therefore, agencies responsible for protecting water quality should take steps to minimize such contaminants.
- 4.7** Parkway Managers should educate users on the proper disposal of litter within the Parkway.
- 4.8** Parkway concessionaires shall undertake programs and actions to educate their customers regarding the proper disposal of litter in the Parkway, with emphasis on the need to utilize refuse containers at sites where customers enter and exit the water.

Historically, water quality conditions in the lower American River were typically well within acceptable limits for water quality objectives and beneficial uses identified for the lower American River, despite the contribution to the river of pollutants and other contaminants from urban run-off and stormwater discharges. However, the lower American River's water quality has reflected the influence of the same





historical activities that have affected the river's physical features, such as mining, dam and levee construction, agricultural development, and urbanization.

Protection of water quality in the lower American River is administered by local and state agencies. The Central Valley Regional Water Quality Control Board is the state agency responsible for permitting and enforcement of water quality. Responsible agencies and jurisdictions that discharge into the lower American River, either directly or through another jurisdiction's system, include: Sacramento County; the cities of Sacramento, Citrus Heights, Folsom and Rancho Cordova; Sacramento State University and the California State Exposition and Fair (Cal Expo).

Under the federal Clean Water Act, states are required to develop a list of water quality limited segments. The waters on this list do not meet water quality standards and the law requires that states develop plans to address water quality limited segments. The lower American River appears on California's list of water quality limited segments for mercury, which is primarily a legacy of historical mining activity, and for toxicity, which results in part due to contaminants from urban run-off. All municipal stormwater and applicable non-stormwater discharges are permitted through National Pollutant Discharge Elimination System (NPDES) Stormwater Permits issued by the Regional Water Quality Control Board. The County of Sacramento and the cities of Sacramento, Citrus Heights, Rancho Cordova and Folsom are co-permittees under permit # CAS082597. The permit specifies the stipulations under which stormwater may be discharged, including requirements such as public education, construction and industrial site inspection and discharge, and creek and river monitoring. The existing permit is up for renewal in January of 2008. Most construction and industrial discharges are also permitted through the Statewide General Industrial and Construction Stormwater Discharge Permits.

Infrequently, lower American River water samples have exceeded the maximum limit for single samples for fecal coliform organisms (as indicators of potential pathogens, such as *Cryptosporidium*, *Giardia*, and viruses). There are many potential sources of fecal coliform organisms, including septic systems, human waste, domestic animals and wildlife. The exact pathogens can only be determined through testing.

In addition, the lower American River provides extensive recreational opportunities for urban residents. Recreational use of the lower American River is protected by law under the National Wild and Scenic Rivers Act and appropriate use of the Parkway is encouraged by the County of Sacramento and recognized by this Plan. However, recreational use also has the potential to place additional stress on natural resources. At times, use by anglers, boaters, swimmers, scuba divers, hikers, equestrians, and others strain river resources, native biota, and habitat. Such activities can lead to higher nitrate levels, the accumulation of garbage in the stream and riparian zone; and other sources of pollution associated with recreational use. Creating greater public awareness of the potential impacts of recreational use on water quality is an important strategy to reduce pollution.

Educating all Parkway visitors about the proper disposal of litter is one important strategy to reduce potential impacts on water quality. The Parkway Manager should educate visitors about the need to dispose of litter and other materials in appropriate containers. In addition, concessionaires operating in the Parkway under agreement with the County of Sacramento can also play a vital role in Parkway stewardship by educating their customers and encouraging proper disposal of their customers' litter. Conditions in their operating agreements should emphasize that sites under the direct control and/or influence of the concessionaire be free of litter at the close of each business day.



It is also important to note that illegal use of the Parkway places additional stress on natural resources and can have a detrimental affect on water quality. Enforcing prohibitions against illegal activity is an important component of protecting Parkway resources.

## STANDARDS AND MONITORING

In 1998, the Water Quality Control Plan for the Sacramento-San Joaquin River Basins was approved by the SWRCB, defining water quality objectives and standards for the waters of the Sacramento and San Joaquin river basins (including the lower American River). The lower American River has numerous beneficial uses, defined by state law as uses that may be protected against quality degradation. The Central Valley Regional Water Quality Control Board has defined the following existing and potential beneficial uses for the lower American River:

- Municipal and domestic water supply,
- Industrial service water supply,
- Irrigation;
- Power,
- Water contact, canoeing and rafting, and other non-contact recreation;
- Warm and cold freshwater habitat;
- Migration of aquatic organisms (includes striped bass, sturgeon, shad, salmon, steelhead);
- Spawning, reproduction, and/or early development of fish; and
- Wildlife habitat.

Since 1992, the Sacramento Coordinated Monitoring Program (CMP), a partnership of the Sacramento Regional County Sanitation District with the City and County of Sacramento has conducted water quality monitoring to characterize water quality conditions in the lower American River and Sacramento River. Before 1990, water quality monitoring was not conducted in the lower American River in a consistent or comprehensive manner. The CMP coordinates with, and participates in, other regional monitoring programs, including those managed by the Sacramento River Watershed Program (SRWP), the U.S. Geological Survey, and the California Regional Water Quality Control Board. Since 1992, the CMP has collected water samples from sites within the greater Sacramento County area to provide water quality data, including two sites on the LAR: one at Nimbus Dam and one at Discovery Park near the lower American River's confluence with the Sacramento River. The SRWP water quality-monitoring program includes three sites on the LAR: at the Fairbairn water treatment plant, at J Street, and at Discovery Park. Water and other environmental samples are collected on a regular basis throughout the year and analyzed from these locations by the SRWP as well as by its coordinating partners, such as the CMP.

There are a number of federal and state laws, regulations, and regional plans that have established water quality standards applicable to the lower American River or that could expand the role of resource agencies in water quality standards and permitting of facilities that discharge into surface waters, including the lower American River. These include the federal Clean Water Act, the Endangered Species Act, the Magnuson-Stevens Fishery Conservation and Management Act, the California Toxics Rule, Biological Opinions by NOAA Fisheries and the USFWS, California SWRCB water quality plans, policies and regulations, the Bay-Delta Water Quality Plan, and the state's Porter-Cologne Water Quality Control Act.

## OPPORTUNITIES FOR REDUCING CONTAMINANTS IN URBAN RUN-OFF

In recent years, improved knowledge of hydrology, greater environmental awareness and tighter regulatory limits have led to innovations in reducing urban run-off that make use of natural and planned features.



Some of these promising approaches include: use of permeable paving materials to allow run-off to soak into groundwater; bio-filtration techniques, such as landscaped swales (shallow vegetated depressions) that filter sediments and pollutants from run-off and encourage infiltration to groundwater; treatment through water polishing wetlands or settling basins; diverting low flows which have the most concentrated contaminants, sometimes called “dry weather” flows, to the sanitary sewer system for treatment; source control; and treatment through proprietary treatment devices or sand filters. These solutions can be incorporated into land use, flood control and water resources planning through early involvement and collaboration on a watershed basis. It is the intent of this American River Parkway Plan that innovative approaches such as water polishing wetlands inside the Parkway not be used as a justification for directing additional discharges into the Parkway, which could have an impact on aquatic or terrestrial resources. The intent is that these approaches be used as methods to reduce contaminants from existing discharges into the lower American River.

## FLOOD CONTROL AND LEVEE PROTECTION

### Flood Control Policies

- 4.9** Flood management agencies should continue to maintain, and improve when required, the reliability of the existing public flood-control system along the lower American River to meet the need to provide a high level of flood protection to the heavily urbanized floodplain along the lower American River consistent with other major urban areas. This effort is expected to include raising and strengthening the levees as necessary to safely contain very high flows in the river (up to 160,000 cubic feet per second) for a sustained period.
- 4.10** Flood control projects, including levee protection projects and vegetation removal for flood control purposes, shall be designed to avoid or minimize adverse impacts on the Parkway, including impacts to wildlife and wildlife corridors. To the extent that adverse impacts are unavoidable, appropriate feasible compensatory mitigation shall be part of the project. Such mitigation should be close to the site of the adverse impact, unless such mitigation creates other undesirable impacts.
- 4.11** Where feasible, multi-use buffers should be created on the land side of the levees, including additional access points from public streets that enhance levee operation and maintenance activities, improve flood fight capabilities, provide opportunities to relocate or expand levees or supporting stability berms if required, and support recreational opportunities.
- 4.12** Vegetation in the Parkway should be appropriately managed to maintain the structural integrity and conveyance capacity of the flood control system, consistent with the need to provide a high level of flood protection to the heavily urbanized floodplain along the lower American River and in a manner that preserves the environmental, aesthetic, and recreational quality of the Parkway.
- 4.13** Flood control berms, levees and other facilities should be, to the extent consistent with proper operation and maintenance of these facilities, open to the public for approved uses, such as hiking, biking and other recreational activities.
- 4.14** Public facilities and private encroachments that inappropriately constrain the operation and maintenance of the flood-control system should be redesigned or relocated.



## Flood Control Policies

- 4.15** The flood control system should be maintained in a condition that ensures adequate flood fighting capability, consistent with the demands of protecting a heavily developed floodplain.
- 4.16** Bank scour and erosion shall be proactively managed to protect public levees and infrastructure, such as bridges, piers, power lines, habitat and recreational resources. These erosion control projects, which may include efforts to anchor berms and banks with rock revetment, shall be designed to minimize damage to riparian vegetation and wildlife habitat, and should include a revegetation program that screens the project from public view, provides for a naturalistic appearance to the site, and restores affected habitat values
- 4.17** Projects to address bank stabilization and erosion that are threatening privately-owned structures shall secure appropriate permits. The engineering of these projects should give preference to biotechnical or non-structural alternatives, where feasible, over alternatives involving revetments, bank re-grading, or installation of river training structures. Use of rubble, gunite, bulkheads and similar material in these projects is prohibited.
- 4.18** It is recognized that flood control agencies have the authority to take action(s) to prevent or respond to flood emergencies occurring in or adjacent to the Parkway. In the event that these action(s) have an adverse impact on biological resources in excess of the estimated impacts of the projected flood damage to such resources, the agency(ies) undertaking the emergency work will implement feasible compensatory mitigation measures pursuant to Policies 3.1 and 3.2. Nothing in this Policy shall be construed to interfere with the existing authority of flood control agencies to prevent or respond to an emergency situation occurring in or adjacent to the Parkway.

## FEDERAL/STATE FLOOD CONTROL SYSTEM

The lower American River traverses a large floodplain covering over 100,000 acres east of the Sacramento River. Most of this floodplain has been extensively developed for urban use. These urban developments, which have a structural value in excess of \$30 billion, are protected from flooding by Folsom Dam and the levee system running along the east side of the Sacramento River, the north and east sides of the Natomas Basin, and the north and south sides of the lower American River. These facilities are part of a much larger Federal/State flood control system in the Sacramento Valley administered by the U. S. Army Corps of Engineers (Corps) and the California Reclamation Board (Reclamation Board).

Along the lower American River, the Federal/State levees extend from the mouth of the river to high ground about 13 miles to the east. The south side levee and the lower portions of the north side levees were constructed prior to the

*Discovery Park and I-5 during the winter. No parking indeed.*



completion of Folsom Dam. These levees were designed to contain floods capable of producing peak flows up to 180,000 cubic feet per second (cfs) with three feet of freeboard between the water surface and the top of the levee. Toward this end, the north side levees were set back a considerable distance from the river channel. After the completion of Folsom Dam in 1956, the last segment of the Federal/State levee system was constructed along the north side of the river between Cal Expo and the Carmichael Bluffs. Relying on the regulating effect of the dam, this levee was placed relatively close to the river and the newly confined channel was designed to contain flows up to 115,000 cfs with at least five feet of freeboard, or 152,000 cfs with at least three feet of freeboard on both sides of the river. In the mid-1970's, private developers constructed the south bank levee upstream of the Mayhew Drain to allow development of the adjoining floodplain. This levee was designed to contain a flow of about 130,000 cfs with three feet of freeboard.

The flood of 1986 generated record rainfall and run-off in the American River watershed and exposed many deficiencies in the flood control system along the lower American River. In the aftermath of the flood, Sacramento's local elected officials formed the Sacramento Area Flood Control Agency (SAFCA) to work with the Army Corps and the Reclamation Board to provide the Sacramento area with at least a 200-year level of flood protection. In pursuit of this goal, SAFCA and its federal and state partners have developed a program of flood control improvements that includes:

- increasing the low-level discharge capacity of Folsom Dam so that dam operators can use the storage space in the reservoir more efficiently for controlling large floods;
- insuring that flood operations at Folsom Dam, including advance releases, are consistent with the flood control mission of the dam and public safety. Increasing the height of the dam so that there is more reservoir storage space available for controlling large floods; and
- raising and strengthening the levees along the lower American River so that they can safely convey very high flows in the river (up to 160,000 cubic feet per second) for sustained periods (36 hours or more).

This program of improvements has been approved in a series of actions by Congress and the State Legislature and is being implemented on a step-by-step basis.

Pursuant to its authority under the California Water Code and its obligations under a series of operation and maintenance agreements with the Corps, the Reclamation Board regulates all activities that might affect the performance of the American River levees and the channel between them. This regulatory responsibility extends to the lands in the Parkway upstream of the levee system that are inundated by flows discharged from Folsom Dam within the design of the flood control operation. The State's objective is to preserve the conveyance capacity of the flood control system by regulating encroachments on the floodway including engineered structures and vegetation.

Engineered structures may include the levee system itself; bridge abutments and piers for highway, railroad and pedestrian bridges; buried and armored utility crossings; and recreation or urban developments, including buildings, hardened roadbeds, and retaining walls. These structures can confine the floodway, as in the case of the narrowing of the levee system upstream of the Cal Expo area, or act as a flow obstruction that may cause locally adverse hydraulic conditions. Vegetation represents a degree of hydraulic roughness, potentially impeding the flow of water and raising water surface elevations. Vegetation in the lower American River has been affected by many factors, including deposition of hydraulic mining debris, removal for infrastructure and recreational development, wildland fire, invasion by non-native species, thinning and clearing for maintenance of engineered structures, and re-vegetation/habitat restoration projects. Vegetation management needs are identified based on historical data, field observations, professional judgment, and hydraulic modeling.





By agreement with the State, the American River levees are maintained by local districts. Reclamation District 1000 maintains the north (right bank) levee of the American River in the Natomas Area. The American River Flood Control District maintains the remainder of the north levee and the south levee extending from the Mayhew Drain to the mouth of the river. The County of Sacramento maintains the privately constructed levee extending from Mayhew Drain to Grist Mill on the south side of the river (left bank). This levee is currently being incorporated into the Federal/State system. The local levee maintaining agencies act as first responders in carrying out the State's responsibilities to regulate public use of the levees for hiking, biking, landscaping or other non-flood control purposes.

## EROSION CONTROL

Erosion of the berms and banks supporting the levees along the lower American River is an ongoing threat to the stability of the flood control system that has been heightened by the need to convey very high flows through the system for sustained periods as part of the program to provide a high level of flood protection to the urbanized floodplain.

This threat is further aggravated by the legacy of hydraulic mining in the watershed, the operation of Folsom Dam,

and the urbanization of the protected floodplain. Hydraulic mining practices discharged massive amounts of sediment to the lower river causing a significant rise in the river bottom and surrounding floodplain. Regulation of these practices and the subsequent construction of Folsom Dam drastically reduced the rate of sediment transport and caused the lower river to scour the sediment deposits, steadily lowering the depth of the channel bottom until it reached more stable hard pan. This was accomplished shortly after the completion of Folsom Dam. Since then, the river has proceeded to widen its channel by scouring the sediments comprising its banks and berms.

Throughout the lower portion of the Parkway, this pattern of erosion has produced a relatively narrow low flow channel that is confined by steep, often unstable banks that rise to an elevated, irregularly inundated floodplain. This erosion can threaten the stability of levees that have been placed relatively near the channel, such as on the north side of the river (right bank) upstream of Cal Expo and on much of the south side of the river (left bank). Because these levees are hemmed in by urban subdivisions, flood managers must halt the erosion. The Parkway Manager also has an interest in protecting threatened berms that support remnant stands of cottonwood forest and provide recreational access to the river. The consequence of failing to protect these berms is evident on the south side of the river (left bank) just upstream of the Capital City Freeway. There, the high flows generated by the flood of 1986 removed a sizeable berm that once buffered the nearby levee, provided shaded riverine aquatic habitat and supported an informal recreational trail. In the aftermath of the flood, emergency repair crews restored the waterside slope of the levee by placing engineered rock extending from the top of the levee to the river channel, creating a large gap in the riparian corridor occupying this portion of the Parkway.



*Fair Oaks Bluff oak tree—roots exposed.*

Erosion is also a problem in some portions of the Parkway upstream of the levee system. Here, erosion threatens private structures that have been allowed to locate close to the river channel, rather than the stability of the levee system that protects the urbanized floodplain. Therefore, the policies governing the engineering and aesthetic aspects of these private erosion control projects are more restrictive.

## EROSION CONTROL PROGRAM

A major focus of flood management along the lower American River is the development and implementation of an anticipatory erosion control program based on identifying and treating eroding sites before they become a critical threat to the levee system and ideally before the riparian corridor is lost. This program emphasizes early interventions, relying on methods of protection that minimize habitat impacts and reduce future costs. Toward this end, potential erosion sites must be regularly monitored and evaluated as to the likelihood of an unacceptable loss of material. When necessary to prevent such a loss, appropriate erosion control measures must be designed and constructed. Each project must consider the nature of the erosion threat and the most effective method for controlling erosion with the least damage to riparian vegetation, wildlife, and the aesthetics of the final product. Where there is a conflict between preservation of the natural environment and protecting threatened facilities and structures, it may be appropriate to relocate or acquire and remove the threatened facilities and structures.

## EROSION CONTROL MEASURES

The following is a brief description of the erosion control measures that could be implemented as part of the anticipatory erosion control program and their applicability to the Parkway.

### *Revetments*

Revetments involve the use of engineered rock to armor eroding banks and levee slopes. Rock slope protection has been widely used in some areas of the lower American River to ensure safe containment of very high flows in the river. When applied to waterside levee slopes, the environmental impacts of this measure can be minimized by covering the revetments with soil and planting the soil surface with native grasses. When applied to berms and banks, the impacts of this measure may be substantial, generating relatively high costs for on-site and off-site mitigation. Rock toe protection is less expensive and less environmentally detrimental than rock slope protection, but may require removal of large woody material from the channel bottom. This measure may be very effective where the primary bank failure mechanism is mass failure due to an over-steep bank above an eroded toe. Access to such steep vegetated banks is difficult in many areas of the lower American River and, where feasible, barge construction of toe protection projects should be considered. Low berm construction is an enlarged version of toe rock protection that permits construction access by reconstructing eroded berms for use as a waterside platform with a soil trench to provide a planting medium. Because this method requires a substantial volume of engineered rock, it can be very expensive.

### *Biotechnical Treatments*

These treatments involve the use of vegetation, woody material, and other organic substances to control erosion. Applications include using woody plants such as willows or other vegetation to stabilize the lower portion of an eroding bank; using fascines, brush clearing, or vegetated geogrids to increase the treated bank's resistance to erosion; and constructing brush boxes employing bundles of woody material anchored to piers installed near the toe of an eroding bank to lessen the erosive effects of boat or wind generated waves. These measures are most effective when deployed with other bank stabilization techniques.

However, because of their relatively low cost and secondary environmental benefits, biotechnical treatments may be widely applicable as preventive measures.

### *Bank Re-grading*

Bank re-grading reduces erosion potential by lessening the steepness of the upper slope and reducing the weight of the slope over the toe of the bank. Although this may create more stable conditions for plantings, impacts are generally high because of the need to disturb existing vegetation and recreational facilities at the top of bank. Bank reconstruction repairs erosion damage with more erosion resistant soil material and is generally most useful in combination with other measures.

### *River Training Structures*

River training structures, such as weirs and dikes, are designed to reduce flow velocities along the bank by pushing flows toward the center of the channel. These structures are adaptable for working around in-stream woody material, although access for construction and keying the structures into existing banks is difficult if the banks are steep and well vegetated. Such structures may raise navigation and recreational safety concerns and would need to be carefully designed to minimize or avoid any safety concerns. Hard points are used to harden bank lines at specific points or intervals to address isolated areas of erosion or bank failure. These structures may produce a more stable bank line if several are used in combination with vegetation.

### *Non-Structural Methods*

Erosion can also be reduced by employing non-structural methods such as removing or relocating structures that are generating erosion or may be subject to erosion-related damage, or increasing the conveyance capacity of the channel in the vicinity of the area of erosion.

## WILD AND SCENIC RIVERS ACT

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### INTRODUCTION

The 23-mile portion of the American River that extends from below Nimbus Dam to the confluence with the Sacramento River has been designated as a Wild and Scenic River under both the State and Federal Wild and Scenic Rivers Acts. The river has a broad channel with riparian vegetation along the banks and is located within the American River Parkway corridor. River flows in this segment are affected by Folsom and Nimbus Dams and impacted by other man-made intrusions at several points along the river.

### STATE WILD AND SCENIC RIVER SYSTEM

The California Legislature passed the State Wild and Scenic Rivers Act (WSRA) in 1972 (PRC Section 5093.50-5093.70). The legislature said that it was the State's intent that "certain rivers which possess extraordinary scenic, recreation, fishery, or wildlife values shall be preserved in their free-flowing state, together with their immediate environment, for the benefit and enjoyment of the people of the State." The lower American River was included in the State Wild and Scenic River System in 1972 when the State Act was passed.

