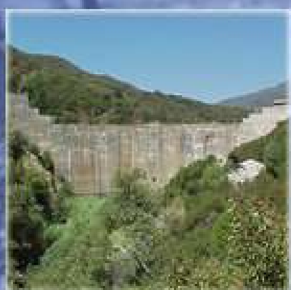
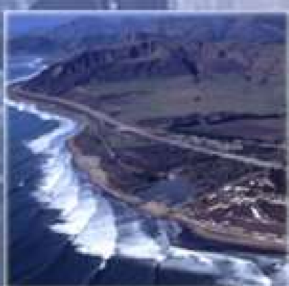
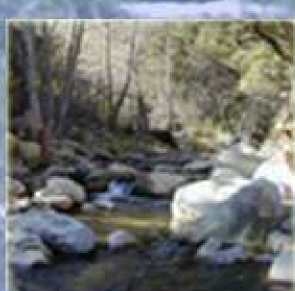
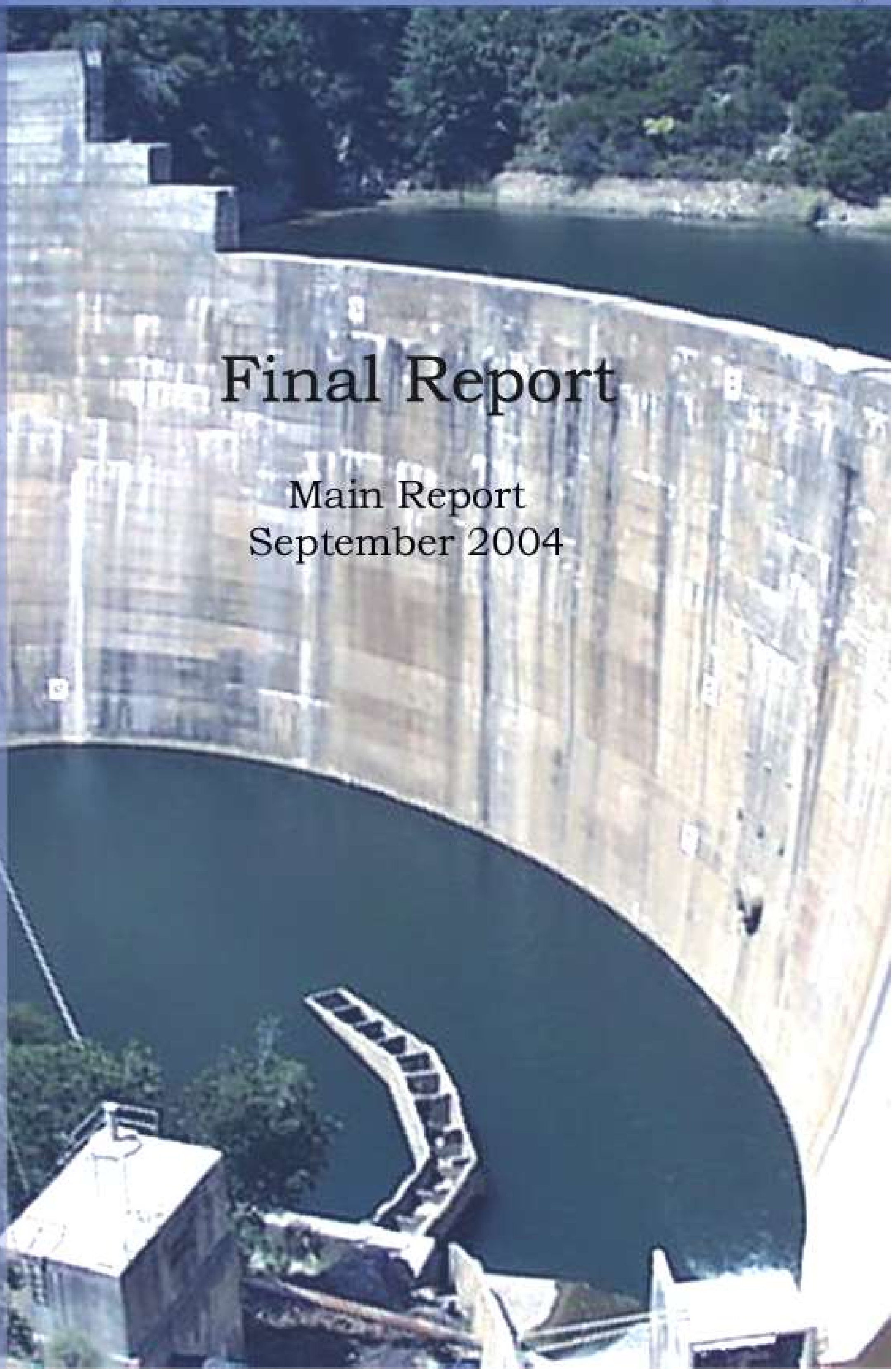
Matilija Dam

Ecosystem Restoration Feasibility Study









Final Report

Main Report
September 2004

DEPARTMENT OF THE ARMY
SOUTH PACIFIC DIVISION, U.S. ARMY CORPS OF ENGINEERS
333 MARKET ST.
SAN FRANCISCO, CALIFORNIA 94105-2195

CESPD-RP-S (1105)

SEP 21 2004

MEMORANDUM FOR Commander, U.S. Army Corps of Engineers (CEMP-SPD), 441 G Street, N.W., Washington, DC 20314-1000

SUBJECT: Transmittal of Final Feasibility Report for Matilija Dam Ecosystem Restoration Feasibility Study, Ventura County, California (PWI #013667)

1. Reference, memorandum, CESPL-DE, dated 16 September 2004, SAB.

2. I concur in the conclusions and recommendations of the District Commander.

JOSEPH SCHROEDEL
BG, USA
Commanding

EXECUTIVE SUMMARY

The Matilija Dam Ecosystem Restoration Feasibility Study is one of the largest dam removal studies in the country, and one of the largest ecosystem restoration studies undertaken by the Army Corps of Engineers west of the Mississippi River.

This report presents the findings of the alternatives analysis and the selection of a recommended plan for the Matilija Dam Ecosystem Restoration Feasibility Study, an effort conducted and coordinated by the Army Corps of Engineers, Los Angeles District, and the Ventura County Watershed Protection District (VCWPD). Many federal, state and local government agencies; environmental resource agencies; interest groups and other stakeholders have provided valuable contributions to the evaluation process that resulted in this report.

The study focuses on ecosystem restoration in the Ventura River Watershed to benefit native fish and wildlife (including the federally listed endangered southern steelhead trout) of the Ventura River and Matilija Creek in the vicinity of Matilija Dam, and improvement to the natural hydrologic and sediment transport regime to support coastal beach sand replenishment from the Ventura River.

Baseline Conditions

Construction of the 190-foot high Matilija Dam was completed in 1947 by the Ventura County Flood Control District (presently VCWPD) to provide water storage for agricultural needs and limited flood control. The dam is currently operated by the Casitas Municipal Water District (CMWD) per a 50-year agreement (1959- 2009). This concrete arch dam is located about 16 miles from the Pacific Ocean and just over half a mile upstream from the Matilija Creek confluence with the Ventura River.

Problems associated with the dam became evident within a couple of decades after construction and include: large volumes of sediment deposited behind the dam and the loss of the majority of the water supply function and designed flood control capability; the deteriorating condition of the dam; the non-functional fish ladder and overall obstruction to migratory fishes; the loss of riparian and wildlife corridors between the Ventura River and Matilija Creek; and the loss of sediment transport contributions from upstream of the dam, with resulting erosion to downstream reaches of the Ventura River, the estuary and the sand-starved beaches along the Ventura County shoreline.

Sedimentation behind the dam has rapidly reduced the ability to store a significant amount of water for future use. It is estimated that approximately 6 million cubic yards of sediments (silts, sands, gravels, cobbles and boulders) have accumulated behind the dam. A relatively small and shallow lake remains behind the dam, presently estimated to be about 500 acre-feet or seven percent (7%) of the original capacity. This lake is expected to disappear by approximately year 2020 as sedimentation continues. Currently Matilija Dam is subject to overtopping during storm flows. The flows however carry mostly suspended fine sediments; the coarser sediments remain trapped behind the dam. By approximately year 2040, the reservoir basin is expected to have reached an equilibrium condition and be completely filled with sediment totaling over 9 million cubic yards. Once this has occurred, full sediment loads from the subwatershed upstream of the dam will be transported downstream.

Ecosystem Concerns

The Ventura River Watershed provides important riparian and wetland habitat for a wide variety of native wildlife species, including many sensitive species and several threatened and endangered species.

Matilija Dam has had many adverse effects on stream ecology and wildlife over the last 55 years. Sediment trapped by the dam has deprived downstream reaches of sand and gravel sized materials necessary to sustain a suitable substrate for spawning, including the creation of riffle and pool formations, sandbars, and secondary channels. These conditions help promote habitat diversity capable of supporting many sensitive wildlife species such as the southern steelhead, southwestern pond turtle, the arroyo toad and the California red-legged frog. The dam has blocked upper watershed natural river flows and therefore has altered natural stream and habitat dynamics. Water that has been impounded and subsequently released downstream is typically of poorer quality, affected by higher temperature, lower dissolved oxygen, and potentially higher nutrient loads. The cumulative adverse effects of Matilija Dam on downstream ecology will continue for at least 100 years, long after the reservoir is completely filled with sediment.

Historically southern steelhead, a species of migratory trout, were common inhabitants of California coastal streams as far south as San Diego. In the last 50 years there has been a dramatic decline from historic estimates of returning adults. This decline has been attributed in large measure to the numerous dams and diversions that have blocked steelhead access into historic habitat in the tributaries of major river systems, and the degradation to quality of habitat in rivers due to agricultural influence and urbanization. In 1997, the southern steelhead was listed as federally endangered. The Ventura River system once supported approximately 4,000 to 5,000 spawning southern steelhead. Current population estimates are less than 100 adult individuals for the Ventura River system. The steelhead habitat upstream from Matilija Dam was historically the most productive spawning and rearing habitat in the Ventura River system. It is estimated that about fifty percent (50%) of this remaining prime habitat was lost due to the construction of the dam.

This study evaluates and recommends the removal of Matilija Dam, an action that would provide an historic restoration opportunity for the Ventura River ecosystem and steelhead fishery. With the removal of the dam, steelhead and other aquatic species (fish, including the Arroyo chub- a California State species of special concern, and amphibians) would regain access to approximately 17.3 river miles of high quality spawning and rearing habitat. Without removal of the dam, fish passage cannot be restored as even a fish ladder facility could not provide a viable solution for a dam of this size.

Another physical barrier to fish passage along the Ventura River is the Robles Diversion Dam (owned by the Bureau of Reclamation and leased to CMWD), less than two miles downstream of Matilija Dam. This facility diverts water from the Ventura River to Lake Casitas, the remaining significant surface water supply for the Ventura River Watershed and surrounding areas. This diversion dam has impacted steelhead migration, spawning and rearing throughout the lower Ventura River. The restoration of fish passage at the facility has been pursued by CMWD. A fishway is currently under construction and will be completed in 2005. New operating criteria as established by the Biological Opinion (NOAA, 2003) will increase the current downstream releases of 20 ft^3/sec from the diversion dam to approximately 50 ft^3/sec for a specified period after storm events to provide minimum flows for steelhead passage at Casitas Springs/Foster Park, where surface flows are prone to disruption as a result of water extraction operations.

Matilija Dam has contributed to streambed erosion in the riverine system. Where erosion of the streambed has been most severe and the active channel has become entrenched, the adjacent alluvial deposits in the floodplain are now abandoned. Flood flows up to the 100-year event can remain in the main channel and do not inundate the floodplain. Native habitats dependent on an active floodplain as a result are significantly impacted and drastically altered. The greatest influence of Matilija Dam to riverine sediment supply and transport are within the 8.5 river miles between the structure and San Antonio Creek. In this stretch of the river, the majority of sediment supply is from the North Fork Matilija Creek. Without the dam in place however, Matilja Creek would be the largest sediment contributor in these reaches. Immediately downstream of Matilija Dam, about 4 feet of erosion has occurred since 1971. Bedrock control limits the amount of erosion. In the reach downstream of Robles Diversion Dam, there has been up to 10 feet of erosion, as there is detention of sediment at that facility. However, if Matilija Dam were removed, degradation would not be a significant problem in this reach. Downstream of San Antonio Creek, a reach between river mile 2 and 5.5 (measured from the river mouth) has experienced up to 10 feet of erosion. This is attributed to a combination of sediment supply deficits resulting from the presence of Casitas Dam and Matilija Dam, as well as debris basins in San Antonio Creek watershed, and channel constriction by bridges.

Beach erosion, attributed to the influence of human activities including the construction of dams, has also been a problem along most of the local coastline. Over the last 50 years, Emma Wood State Beach, west of the mouth of the Ventura River, has eroded approximately 150 feet, indicating an erosion rate of 2 to 3 ft/yr. Surfer's Point just downcoast of the river mouth, once a sandy beach, is now mostly cobble. Loss of upper sand beach zones has caused a loss of spawning habitat for the California grunion, and to foraging and breeding habitat for the federally listed threatened western snowy plover. The extent of coastal dunes on both sides of the river mouth has been diminishing over the years as a result of the loss of protective beachfront and erosion by wave action. Coastal dunes and their habitats, which once supported the silvery legless lizard, a California-State species of special concern, are diminishing and will eventually be lost entirely.

The overtaking of native riparian habitat by invasive and exotic species however has been problematic in the watershed. Giant reed (*Arundo donax*) has become the dominant vegetation type within significant portions of the reservoir basin, and is continuing to spread into the remaining areas, including some portions of Matilija Creek riparian habitat upstream of the reservoir basin. This plant out-competes and displaces the native vegetation and seriously degrades the habitat quality of the area. Giant reed provides no food for wildlife, and at best, very poor habitat for some nesting birds or shelter/shade for native amphibians. Without an intensive removal program, giant reed and other exotic plant species will diminish the ability of the Ventura River to support sensitive species that rely on native willow, cottonwood, and other native riparian species. These include resident and migratory birds, such as least Bell's vireo and southwestern willow flycatcher. The reservoir basin acts as a source of giant reed propagules for the lower watershed as these materials are washed downstream during significant storm events. Downstream of Matilija Dam, clumps of giant reed have colonized in parts of the floodplain within the Ventura River. With time, these clumps will begin to spread, significantly reducing the value of riparian habitat and in turn the native species that depend on that habitat.

Water Supply and Water Quality Concerns

The natural streamflow in the Ventura River and associated subsurface alluvial groundwater is impacted by several major water extraction operations in the watershed: Matilija Dam, Casitas Dam, Robles Diversion Dam, Foster Park diversion facility and other smaller water extractors. Annually the extraction operations in the Ventura River mainstem are approximately 18,000 ac-ft (NOAA, 2003). Matilija Dam provides an average of 590 ac-ft/yr (Reclamation, 2003) to Robles Diversion Dam. The effects of these extractions limit the duration and magnitude of river flow necessary for successful steelhead migration, and in addition, adversely affect in-stream habitat characteristics. During the summer/fall period when natural flows are low, fish and aquatic organisms that become isolated as a result of receding stream flows are subjected to predation, impaired water quality, and desiccation once flows cease.

Discharges into the Ventura River, including point source contributions from a wastewater treatment facility, and non-point source contributions from agricultural and urban development have affected the water quality of the river. The California Regional Water Quality Control Board has classified the Ventura River as a Category I (impaired) watershed and has approved the river's status on the 303(d) list and TMDL priority schedule for pollutants including DDT, copper, silver, zinc, algae (eutrophication) and trash.

Flow Conditions

Although Matilija Dam has a negligible impact on peak flows of large events (greater than 10-yr return periods), it can attenuate the more typically occurring moderate-sized storms, as CMWD can draw down the existing reservoir at the dam prior to the winter storm season. In conjunction, Robles diversion facility, though limited in effective storage capacity, can divert up to 500 ft^3/sec to Lake Casitas. These reductions in peak flows adversely impact steelhead and their habitat in the Ventura River (NOAA, 2003). Steelhead depend on peak flows to attract the fish to enter the river and migrate upstream. The migration is facilitated by the higher flows as natural stream barriers become alleviated. The peak flows flush out finer sediments that may overlay spawning gravels as well as provide a new source of spawning sediment. Additionally, peak flows remove algae and assist in naturally thinning less-established riparian vegetation, including annual types. As a result, well-established perennial species would have less competition for soil nutrients and water allowing mature and more shady habitat to flourish.

The removal of Matilija Dam would effectively cease all peak flow attenuation. Even though a similar situation would inevitably occur under future without project conditions, the benefit would not be available until after year 2040.

Alternatives

A full array of structural and non-structural measures were formulated to address identified problems and opportunities, including measures related to dam removal, no dam removal, mechanical and natural sediment transport, stabilization of deposited sediments, levee and bridge modifications, protection of existing water supply facilities, recreation, and exotic and invasive species management. These measures were combined to formulate, evaluate, and compare alternative plans to each other. Screening criteria was used to select a recommended plan.

The plan formulation process resulted in a final array of seven alternatives: six action alternatives and the No Action plan. Criteria used in the evaluation include impacts related to sediment deposition and turbidity, flooding, beach nourishment, changes to the dam site topography, biological and cultural resources, water supply, and air quality noise and traffic. Features common to each alternative include removal of Matilija Dam; restoration of fish passage; reestablishment of natural hydrologic and sediment transport processes from the upper Matilija Creek watershed; management of the sediment trapped behind the dam; removal of exotic and invasive species, particularly giant reed (Arundo donax) from the reservoir basin, upstream of the basin, and in the downstream reaches of the Ventura River, and non-native predatory species from the dam lake and immediately downstream of the dam, particularly largemouth bass, sunfish, catfish and bull frogs; and mitigation measures for impacts to flooding and to water supply. Recreation measures include trails and associated facilities.

The No Action alternative assumes that the dam will remain in-place for the future 50-year period of analysis. The dam will be monitored for safety purposes, but no modifications to the structure are assumed to be necessary. An additional 3 million cubic yards of sediment will accumulate behind the dam over the next 35 years, resulting in about 9 million cubic yards of sediment trapped behind the dam by 2038. The existing reservoir (lake) will disappear by 2020. Downstream sediment transport will be restored after the in-filling of the dam reservoir basin, although downstream sediment aggradation will take about 100 years before pre-dam streambed elevations are restored. Downstream water diversion operations may be adversely affected due to increased sedimentation at the Robles Diversion Dam. Giant reed (Arundo donax) will continue to overtake existing native species. Casitas Municipal Water District will restore fish passage above Robles Diversion Dam with the anticipated completion of the fishway, although steelhead will not have access to prime spawning and juvenile rearing habitat above Matilija Dam. No maintained recreation trails will exist around Matilija Dam.

Alternative 1 is full dam removal in one phase and mechanical removal of the trapped sediment. The marketable portion of the trapped sediment (3.0 million cubic yards) is processed and sold on-site as aggregate. The portion that is not marketable, comprised of fine-grained sediment approximately underlying the limits of the existing lake (2.1 million cubic yards), is slurried downstream to a 118-acre disposal site located in the vicinity of the Highway 150 Bridge prior to removal of the dam. Additional fine-grained residual sediment remaining after the completion of the aggregate processing operation (770,000 cubic yards) will be trucked to the same disposal site. To convey creek flows and to protect the aggregate operation, a 60-foot wide channel (base width) will be constructed along the right side (looking downstream) of the reservoir basin. The bottom of the channel would be similar to the pre-dam channel bottom to allow natural gradients easily accessible by fish. The channel would be protected on the left side (looking downstream) with soil cement along the side slope extending 13 feet above the channel bottom and 5 feet below. The channel capacity would contain a 100-yr storm event. The soil cement, constructed utilizing on-site aggregate, will be removed following completion of the aggregate sale operation.

Alternative 2a is full dam removal in one phase and natural (fluvial) transport of a portion of trapped sediment. The fine sediment deposited beneath the existing lake (2.1 million cubic yards), is slurried downstream to a 118-acre disposal site located in the vicinity of the Highway 150 Bridge prior to removal of the dam. The remainder of the trapped sediment is allowed to be eroded downstream by storm events and natural fluvial processes. To convey flows, a shallow pilot channel not exceeding 10 feet deep would be excavated through the reservoir basin

Alternative 2b is full dam removal in one phase and natural (fluvial) transport of all of the trapped sediment. The trapped sediment is allowed to be eroded downstream by storm events and natural fluvial processes. To convey flows, a shallow pilot channel not exceeding 10 feet deep would be excavated through the reservoir basin.

Alternative 3a is incremental removal of the dam and natural (fluvial) transport of a portion of trapped sediment. The dam demolition will be conducted in two phases. In Phase 1, the fine sediment deposited beneath the existing lake (2.1 million cubic yards) is slurried downstream to a 118-acre disposal site located in the vicinity of the Highway 150 Bridge, followed by the removal of the dam structure to elevation 1000. To convey flows, a shallow pilot channel (not exceeding 10 feet deep) would be excavated through the reservoir basin. Phase 2 removal of the remaining portion of the dam will begin once the sediment level in the reservoir has, by natural fluvial erosion, reached an equilibrium condition with the modified dam height resulting from Phase 1.

Alternative 3b is incremental removal of the dam and natural (fluvial) transport of all of the trapped sediment. The dam demolition will be conducted in two phases. In Phase 1, the dam is removed to elevation 1030. All materials excavated for the removal of this portion of the dam are placed upstream in the reservoir basin. To convey flows, a shallow pilot channel not exceeding 10 feet deep would be excavated through the reservoir basin. Phase 2 removal of the remaining portion of the dam will begin once the sediment level in the reservoir has reached an equilibrium condition with the modified dam height resulting from Phase 1.

Alternative 4a is full dam removal in one phase and long-term storage of a portion of the trapped sediment within the reservoir basin. The fine sediment deposited beneath the existing lake (2.1 million cubic yards), is slurried downstream to a 118-acre disposal site located in the vicinity of the Highway 150 Bridge prior to removal of the dam. A 100-foot wide channel (base width), following a pre-dam alignment, is excavated in the reservoir basin to an elevation similar to pre-dam levels. The channel, lined with riprap stone protected side slopes extending 11 feet above channel bottom and 5 feet below, will have a design capacity to convey the 100-year flood event. Excavated materials will be permanently stockpiled in storage areas located within the reservoir basin.

Alternative 4b is full dam removal in one phase and short-term storage of a portion of the trapped sediment within the reservoir basin. The fine sediment deposited beneath the existing lake (2.1 million cubic yards), is slurried downstream to a 118-acre disposal site located in the vicinity of the Highway 150 Bridge prior to removal of the dam. A 100-foot wide channel (base width), with a pre-dam alignment, is excavated through the reservoir basin to the pre-dam invert (streambed) elevation. The channel side slopes in the lower half of the reservoir basin would be lined with soil cement, approximately 7 feet high. The revetment height would be overtopped by flows exceeding 12,500 ft^3/sec (10-yr storm event). Excavated materials are stockpiled in storage areas located within the reservoir basin. Soil cement revetment would offer a higher level of protection in portions of the basin where trapped sediment, or the adjacent stockpiled sediment, contain more fines content. All soil cement would be removed from the site following sufficient removal by erosion of the trapped sediment. The removal would be performed in stages.

Comparison and Evaluation of Alternative Plans

Removal of Matilija Dam would cause erosional trends in the Ventura River to reverse and become depositional trends, and finally a balanced condition (equilibrium) to occur. The deposition would re-create a riverine morphology, in terms of channel and riverbed materials characteristics, more similar to pre-dam conditions. The time to reach equilibrium is different for the alternatives. Alternatives 1 and 4a would reach equilibrium in 50 years, while Alternatives 2a, 2b, 3a, 3b within 10 years, and Alternative 4b within approximately 20 years. For the future without-project conditions (No Action Alternative), equilibrium would occur within approximately 100 years. Erosional trends are still likely to continue, though at a slower rate depending on the action alternative, between river mile 5 and 3. The main cause for this is channel constriction by bridges and the presence of Casitas Dam and San Antonio Creek Watershed debris basins.

Sediment delivery to the ocean, and resulting benefits to beach nourishment, would occur sooner for the action alternatives as compared to the No Action Alternative. Time frames would be similar as those described for the establishment of riverine equilibrium. Over a period of 50 years, increases in sediment delivery volumes would be approximately one-third greater than the No Action Alternative for sand, gravel, and cobble-sized sediment. The Beach Erosion Authority for Control Operations and Nourishment (BEACON) has estimated that a cubic yard of sand roughly equates to a square foot of dry sand on the beach. Detrimental effects related to the restoration of increased sediment transport to the shoreline include the short-term impacts of fine sediments on local crustaceans, and the potential increase in future dredging at the Ventura and Channel Islands Harbors due to longshore transport of increased sediments from the Ventura River. Since the increase in volumes of fines and sands are relatively small when compared to the No Action Plan, the detrimental impacts are not considered significant for this study.

The associated effects of releasing trapped sediment downstream, i.e. increased riverine sediment deposition and turbidity levels, will cause short-term adverse impacts to riparian communities, aquatic wildlife and habitats. The impacts however are considered beneficial overall since the system would recover with time.

The process of returning the river to pre-dam conditions will increase the flood risk to infrastructure that has developed along the river corridor since the construction of the dam. As a result, flood control improvements are necessary. Alternatives 2a, 2b, 3a, 3b, and 4b will require more flood protection ("higher level") than Alternatives 1 and 4a ("lower level") since trapped sediments from the dam will be released downstream. Both levels of protection assume purchase of the Matilija Hot Springs property, purchase and removal of Camino Cielo structures, removal and replacement of the Camino Cielo Bridge and restoration of the channel width at the current location, and extension of the Santa Ana Bridge with local channel widening. Improvements also include constructing new and raising existing levees and floodwalls. Locations will include Meiners Oaks (up to 3 feet maximum above the river bank for the "lower level" and 5 feet for "higher level"), Live Oak Acres (up to 2 feet maximum above the existing levee for the "lower level" and 6 feet for "higher level") and Casitas Springs (up to 2.5 feet maximum above the existing levee for the "lower level" and 5 feet for "higher level"). The levee and floodwall at Meiners Oaks will be new features. The source for earth fill materials for the levees is assumed to be from Matilija Dam reservoir basin.

Impacts to water supply due to elevated sediment levels (both coarse- and fine-grained) at the Robles Diversion Dam and Foster Park would require some mitigation. At the Robles diversion facility, a sediment bypass (consisting of four radial gates) would be constructed at the existing sediment basin to allow increased sediment loads to be flushed downstream of the facility. This would be required for all of the action alternatives. The radial gate system would allow for diversion operations to be maintained at a wider range of river flows. Additional modifications would also be necessary to the existing weir (timber crib) structure.

For two of the alternatives (2b,3b), even with a high-flow sediment bypass in place, the impacts from fine sediment in the initial years (and potentially longer in case of a drought period) would overwhelm the facility by clogging the fish screen in the diversion canal and causing operations to cease for the respective season while maintenance cleanout could be performed. These alternatives would necessitate replenishment of the losses to Lake Casitas safe yield by purchase of replacement water from an outside purveyor.

For Alternative 2a and 3a, it is expected that turbidity impacts at Lake Casitas will likely result in water quality problems including prolonged duration of algal bloom production and potential increases in water treatment efforts. Because of the uncertainties related to level and duration of impacts, especially in a drought scenario (where low flows could still transport turbid loads), a desilting basin to settle out fines prior to conveyance to Lake Casitas would be included.

For Alternative 4b, turbidity impacts at Robles Diversion Dam are expected to be much less than Alternative 2a or 3a due to the presence of channel protection (soil cement revetment) in a portion of the reservoir basin where sediments contain higher levels of fines. The soil cement revetment will assure that flow levels less than the 10-year event will not allow erosion of the protected finer materials. Turbidity levels associated with these levels of flow events would therefore be similar to existing conditions. Even during a drought situation, turbidity levels would not be aggravated. For flow events larger than the 10-year event, the soil cement revetment would be overtopped, and flows would have access and cause erosion of the finer materials. The increase in turbidity levels would be of limited duration and would likely be within the natural variability of existing conditions levels. Eventual staged removal of the revetment will cause increases in turbidity levels to possibly higher limits for a temporary period. The removal time frame would be based on monitoring and adaptive management and would not coincide in periods of on-going drought when Lake Casitas levels would be lower than normal.

For Alternative 4b, as part of a locally preferred betterment, a desilting basin has been included. At Foster Park, two additional groundwater wells would be constructed to offset the losses from interruption of surface water diversion operations when turbidity levels are above the maximum limit of 10 NTU. The wells would only be necessary for Alternatives 2a, 2b, 3a, 3b and 4b. At this time, the wells are also included for Alternatives 1 and 4a due to the susceptibility to erosion and loss of fines associated with one of the slurry disposal areas.

Alternative 1 has the highest impacts to the community in terms of truck traffic resulting from aggregate sale operations.

Selection of the Recommended Plan

NER Plan

The table below presents the benefits and costs associated with the action alternatives.

The benefits associated with the alternatives are presented in non-monetary terms (Habitat Units). Ecosystem restoration benefits for this study have been prepared using a modified HEP analysis. The Average Annual Habitat Units (AAHU) have been computed over a 50-year period. Alternative 4b provides the most net benefits to the ecosystem based on the HEP analysis with an overall increase of 731 AAHU when compared to the baseline conditions (No Action Alternative). The outputs for Alternative 2a, 2b, 3a, and 3b however are in a relatively close second position with benefits of 678 AAHU. There is a more distinct separation with the next lower value associated with Alternative 1 (609 AAHU), followed by Alternative 4a (554 AAHU).

Costs shown for the alternatives in the table below do not include recreation measures or betterments under the locally preferred plan.

Alternative 4b has the lowest average annual cost per AAHU. From a cost effectiveness perspective, an alternative is cost effective if there are no other alternatives that provide the same output at a lower cost. Therefore Alternative 4b is the most cost effective alternative. An incremental cost analysis is not necessary since there are no changes in output levels to be compared and levels to be selected except for the No Action Alternative. It is recommended that Alternative 4b be considered as the NER plan.

Locally Preferred Plan

In a consensus decision, the Sponsor and the majority of the stakeholder participants of the Plan Formulation Group have identified Alternative 4b as the preferred plan. In addition however to the NER plan, a desilting basin will be included as an additional feature to Alternative 4b. The desilting basin is considered an associated feature with costs completely borne by the Sponsor.

Recommended Plan

Since the completion of the Public Draft Report, costs have been updated to reflect technical review comments. In particular, cost estimates for the levees at Meiners Oaks, Live Oak and Casitas Springs have been revised based on further review of the necessary fill quantities for the structures. This increase in levee costs does not affect the selection of the Recommended Plan. The table below remains valid for screening purposes.

Alternative 4b with the addition of a desilting basin as an associated feature has been chosen as the recommended plan. The total project cost is $123,7700,000. This includes recreation costs ($1,000,000) and the betterment feature (desilting basin) at the Robles diversion facility ($5,700,000). The total habitat area that would be restored is 2,814 acres.

The efforts for the Matilija Dam Ecosystem Restoration Recommended Plan encompass a watershed scale and would restore essential physical and natural processes responsible for creating and sustaining habitats and ecosystem functions that support a wide variety of native species, including listed species. The Plan would also benefit current weak stocks of southern steelhead by providing the species access to historically high quality spawning and rearing steelhead habitat.

ALTERNATIVES SCREENING TABLE: ECONOMIC OUTPUTS (FY 2004 Price Levels)							
	Alt. No. 1	Alt. No. 2A	Alt. No. 2B	Alt. No. 3A	Alt. No. 3B	Alt. No. 4A	Alt. No. 4B
Average Annual Habitat Units (AAHU)	2002	2071	2071	2071	2071	1947	2124
Gains beyond No Action[1] (AAHU)	609	678	678	678	678	554	731
Gross Project Costs							
First Costs	$98,879,834	$92,554,052	$114,026,494	$96,807,677	$115,298,299	$97,563,070	$92,088,077
Interest During Construction (Phase 1 only)	$5,376,043	$5,032,113	$6,199,558	$5,101,088	$5,961,246	$8,223,981	$5,006,779
Phase 2 Adjustment for Alt.3 Const. to base year				-$251,618	-$391,290		
Monitoring and Adaptive Management	$4,943,992	$4,627,703	$5,701,325	$4,840,384	$5,764,915	$4,878,153	$4,604,404
Cultural Resources	$988,798	$925,541	1,140,265	$968,077	$1,152,983	$975,631	$920,881
Total Gross Investment[2]	$110,188,667	$103,139,409	$127,067,641	$107,465,608	$127,786,153	$111,640,835	$102,620,140
Annual Costs							
Annual Cost of Total Gross Investment	$6,627,674	$6,203,672	$7,642,917	$6,463,886	$7,686,135	$6,715,019	$6,172,439
Annual Cost of Maintenance (O&M)	$289,265	$433,256	$319,910	$436,483	$319,526	$283,785	$325,594
Total Annual Costs (AAC)	$6,916,938	$6,636,928	$7,962,827	$6,900,369	$8,005,660	$6,998,805	$6,498,033
IV. Average Annual cost per AAHU	**$11,357.86**	**$9,788.98**	**$11,744.58**	**$10,177.54**	**$11,807.76**	**$12,633.22**	**$8,889.24**

[1]No Action Alternative has 1393 AAHU.
[2]Total Gross Investment does not include recreation costs (all alternatives) and betterment costs for desilting basin (Alternative 4b).

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APPENDICES (Under Three Separate Covers)

1. INTRODUCTION

Study Authority

The Matilija Dam Ecosystem Restoration Feasibility Study is prepared in response to the Resolution of the U.S. House of Representatives Committee on Transportation and Infrastructure (Docket 2593), adopted 15 April 1999, which reads as follows:

> "Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That the Secretary of the Army is requested to review the report of the Chief of Engineers on the Ventura River, Ventura County, California, published as House Document 323, 77th Congress, 1st Session, and other pertinent reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at this time, in the interest of environmental restoration and protection, and related purposes, with particular attention to restoring anadromous fish populations on Matilija Creek and returning natural sand replenishment to Ventura and other Southern California beaches."

Study Purpose

The purpose of this feasibility study is to evaluate opportunities for reestablishing natural ecosystem functions and riverine processes that have been degraded as a result of the construction of Matilija Dam. This study evaluates the effect of Matilija Dam on the ecosystem and the natural dynamic riverine, estuarine and coastal processes, and formulates restoration features designed to improve the potential for long-term survival of native aquatic, wetland and terrestrial complexes as self-regulating, functioning systems.

Specifically this study focuses on identification of the Federal interest in (1) ecosystem restoration for terrestrial and aquatic habitat to benefit native fish and wildlife (including the federally listed endangered southern steelhead trout) to the Ventura River and Matilija Creek in the vicinity of Matilija Dam; and (2) improvements to the natural hydrologic and sediment transport regime to support Ventura River's coastal beach sand replenishment. Enhancement of recreational use along the Ventura River and Matilija Creek compatible with the ecosystem restoration outputs will also be considered.

Study Scope

The scope of the feasibility study includes the identification of problems and needs, and objectives and constraints, the evaluation of the historical, existing and future baseline conditions (also know as the "without-project conditions"). Alternative measures are formulated to address the study problems, needs and objectives. These measures are combined to form alternative plans.

For each alternative plan, the "most likely" future conditions are forecast with the plan in place ("with-project conditions"). The most important effects (impacts) of each alternative plan are evaluated on the basis of a without and with-project condition comparison, and the differences are identified. These differences are then assessed and appraised. The evaluation process continues by qualifying which plans merit further consideration and which ones to drop. This is followed by a comparison of the identified most important effects among all the alternative plans, utilizing a more formal and analytical approach to insure that the plans are responsive to the needs of the public, and finally a recommend plan is identified.

An Environmental Impact Statement/Environmental Impact Report (EIS/EIR) is being prepared to address the environmental review requirements of both the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). The purpose of the EIR/EIS document is to identify the environmental effects of the proposed environmental restoration alternatives.

Study and Report Process

The Los Angeles District Corps of Engineers completed the reconnaissance phase of the General Investigation study process in June 2001. The reconnaissance phase 905(b) study determined that there was a Federal interest in participating in a cost-shared feasibility phase study to evaluate ecosystem restoration improvements to the Ventura River in the vicinity of Matilija Dam, in Ventura County. The reconnaissance phase effort included the development of a feasibility-level Project Management Plan (PMP) and the execution of a Feasibility Cost Sharing Agreement (FCSA) between the Los Angeles District Corps of Engineers and the Ventura County Watershed Protection District (VCWPD).

This Public Draft report is one of a series of deliverables leading to the Final Matilija Dam Ecosystem Restoration Feasibility Study Report. This draft report presents a summary of the process and products that are a result of the study process to date, including the inventory and forecast of without project conditions, the identification of problems and opportunities, the formulation, evaluation and comparison of alternative plans, and the selection of a Recommended Plan. The report includes a draft Environmental Impact Statement/ Environmental Impact Report (EIS/EIR) and technical appendices.

The total timeframe for the review of the public draft report is 45 days. A public meeting will be held during the review to present the report findings and provide an opportunity to solicit comments on the study and the Recommended Plan. Comments raised at the public meeting and comments submitted in writing will be addressed in the final feasibility report.

Study Participants and Coordination

The Los Angeles District Corps of Engineers and the Ventura County Watershed Protection District (VCWPD) are responsible for conducting and coordinating this Feasibility Study. The VCWPD is the local sponsor. The VCWPD and the California Coastal Conservancy shared the fiscal contributions to the feasibility study. The VCWPD has provided invaluable in-kind services by way of their own staff, including GIS mapping, some biology surveying and assessment tasks, meeting coordination, and dissemination of information to interested parties; and by way of their contracted services with the U.S. Bureau of Reclamation (BOR), efforts including survey and mapping, geotechnical field investigations, and hydrology, hydraulics and sedimentation studies.

An organizational structure was developed during the preparation of the PMP with the intent to outline the efforts by members of the Steering Committee/Task Force, VCWPD, and the Corps in addressing feasibility activities. The organizational structure also includes non-Federally funded efforts that may provide products and information useful to the feasibility study. These groups include the Legislative/Lobbying and Funding Group, Research Program Group, and Recreation Access Group. The Corps chairs all groups that pertain directly to the feasibility study, while other groups are chaired by the local sponsor, the County of Ventura, the Bureau of Reclamation, and the Matilija Coalition. The organizational chart is presented in Figure 1-1.

Other organizations that have participated in the study process to date include the following agencies and groups:

Federal Agencies
U.S. Fish and Wildlife Service
U.S. Bureau of Reclamation
U.S. Forest Service, Los Padres National Forest
U.S. Geological Survey
National Marine Fisheries Service
National Park Service
National Fish and Wildlife Foundation

Local Committees/Groups
Casitas Municipal Water District
Matilija Coalition
Matilija Environmental Science Area (MESA)
Friends of the Ventura River
American Rivers
Surfrider Foundation, Ventura Chapter
Southern California Wetlands Recovery Project
Fixing Stream Habitats Technical Assistance Program (FiSHTAP)
BEACON
California Trout
Aspen Environmental Group
Southern California Steelhead Coalition

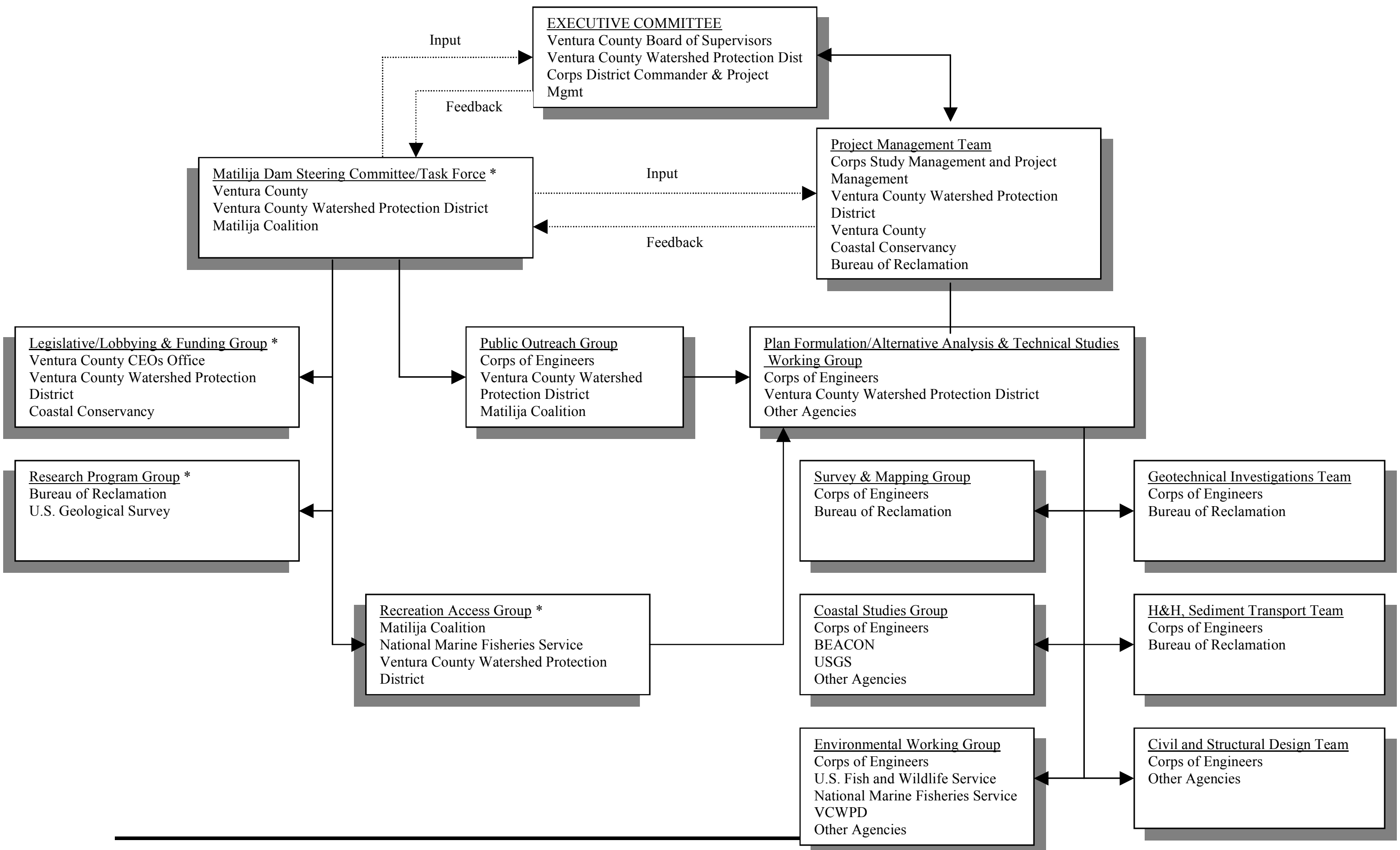
State Agencies
California Coastal Conservancy
California Department of Fish and Game
California Regional Water Quality Control Board

County of Ventura Agencies
County Board of Supervisors
Public Works
Watershed Protection District
County Executive Office
Environmental and Energy Resources Department

City Governments
Ventura
Oxnard
Ojai
Port Hueneme

Universities
University of California Cooperative Extension
California State University, Northridge

FIGURE 1-1: MATILIJA CREEK FEASIBILITY STUDY ORGANIZATIONAL STRUCTURE



* Denotes Non- Feasibility Study Groups

Prior Studies and Reports

The following reports were reviewed as a part of this study:

1. House of Representatives Document No. 323, 77th Congress, 1st Session Report of the Chief of Engineers on the Ventura River Basin - April 1941:

   This letter report was submitted to Congress in response to the study authority described in the first section of this chapter. In general, the Chief's Report cites local interests desires, including construction of flood control channel protection along 15 miles of the Ventura River and several dams for combined flood control and water conservation. Dam sites include Matilija Creek and Coyote Creek. The Corps could not justify support of the dams due to the inability of the structures to provide flood control on the lower Ventura River.

   The report recommendations included construction of a levee for flood control along the east bank of the lower Ventura River to protect the city of Ventura, and a debris basin and channel in Stewart Canyon to protect the city of Ojai. The 1944 Flood Control Act authorized construction of the projects. The 2.6 mile-long Ventura River earthen levee with one-foot grouted stone slope protection was completed by the Corps in December 1948. Local interests maintain the project.

   The Stewart Canyon Debris Basin and channel was constructed by the Corps in January 1963, and consists of an earthfill 40-foot high debris basin with a storage capacity of 300,000 cubic yards, and a 4,500-foot long box and open rectangular concrete lined channel that extends from the basin through the City of Ojai to a natural channel south of the city.

2. Matilija Dam Removal Appraisal Report – April 2000: A reconnaissance level investigation focusing on the feasibility of removing Matilija Dam, prepared by the BOR. Supplemental environmental evaluation and some cost estimates prepared by USACE, Los Angeles District.

3. Planning Aid Memorandum for the Proposed Matilija Dam Removal Project Appraisal Study, Ventura County, California – 2000: Prepared by the U.S. Fish & Wildlife Service (USFWS) for the USBR's Appraisal Study.

4. Sediment Loads in the Ventura River Basin, Ventura County, California, 1969-81 – Dated 1988: Focuses on the sediment transport in the Ventura River, from 1969 to 1981; prepared by the U.S. Geological Survey, in cooperation with the California Department of Boating and Waterways.

5. Coastal Benefits and Impacts of Dismantling Matilija Dam – 2000: Prepared by James A. Bailard and published in the proceedings of the Sand Rights Conference. The report focused on the benefits of the sediment currently trapped behind the dam as beach nourishment, if the dam were removed.

6. Report on the Reconnaissance Investigation, Ventura River Watershed – June 1964: Prepared for the Ojai Soil Conservation District by Boyle Engineering.

7. Ventura River Steelhead Survey – 1997: Prepared by M. H. Capelli for the California Department of Fish and Game. The report focused on the existing steelhead migration and potential restoration in the Ventura River.

8. Ventura Watershed Analysis – 1997: Prepared by S. Chubb for the Forest Service, Los Padres National Forest. The report focused on steelhead restoration.

9. Survey Report for Beach Erosion Control, Ventura County, California – 1980: Prepared by the U.S. Army Corps of Engineers, Los Angeles District.

10. Ventura River State of the Watershed Report (Final)- May 2002: Prepared by the California Regional Water Quality Control Board. Presents an overview of the watershed, its infrastructure, history, and data from a number of surface water sampling programs and general observations on surface water quality.

11. Ventura River Estuary Enhancement- Existing Conditions- October 1992: Prepared by Wetlands Research Associates, Inc. Presents historical changes, existing biological resources, hydrology, and public access.

2. WITHOUT-PROJECT CONDITIONS

General

Without-project conditions address an inventory of historic and existing conditions and a forecast of future without-project conditions. The information presented under these baseline conditions will be used to formulate, evaluate and compare alternative measures that address study problems and opportunities. The period of analysis for this study is 50 years in the future, and the base year is 2003. The timeframe between 2003 and 2053 is used for baseline and alternative studies to allow for a consistent basis for comparison between no action and with-project conditions.

Study Area Description

The study area is located in Ventura County, California approximately 70 miles northwest of Los Angeles, and encompasses the area above and around Matilija Dam and Reservoir and downstream of the dam along Matilija Creek and the Ventura River to the Pacific Ocean.

Ventura River Watershed

The Ventura River Watershed, located in the western portion of Ventura County, comprises an area of approximately 223 square miles of which almost half is within the Los Padres National Forest. The Ventura River drains the coastal watershed and has several major tributaries including Matilija, North Fork Matilija, San Antonio, Coyote Creek and Cañada Larga. Matilija Creek is one of the largest tributaries to the Ventura River. The majority of the rivers in the system are natural bottom.

The watershed topography is characterized by rugged mountains in the upper basins transitioning to relatively flat valleys in the lower downstream areas. Over 75 percent of the Ventura River Watershed is classified as rangeland covered with shrub and brush and 20 percent of the basin is classified as forested. In general, the highest sediment-producing parts of the watershed are those covered in shrub and brush and are located in the upper parts of the watershed where slopes are greater and annual rainfall is larger.

Nearly 45 percent of the watershed can be classified as mountainous, 40 percent as foothill, and 15 percent as valley area. The maximum elevation in the watershed is 5,457 feet above sea level in the Santa Ynez Mountains. The major subwatersheds in the Ventura River Watershed are presented in the following table.

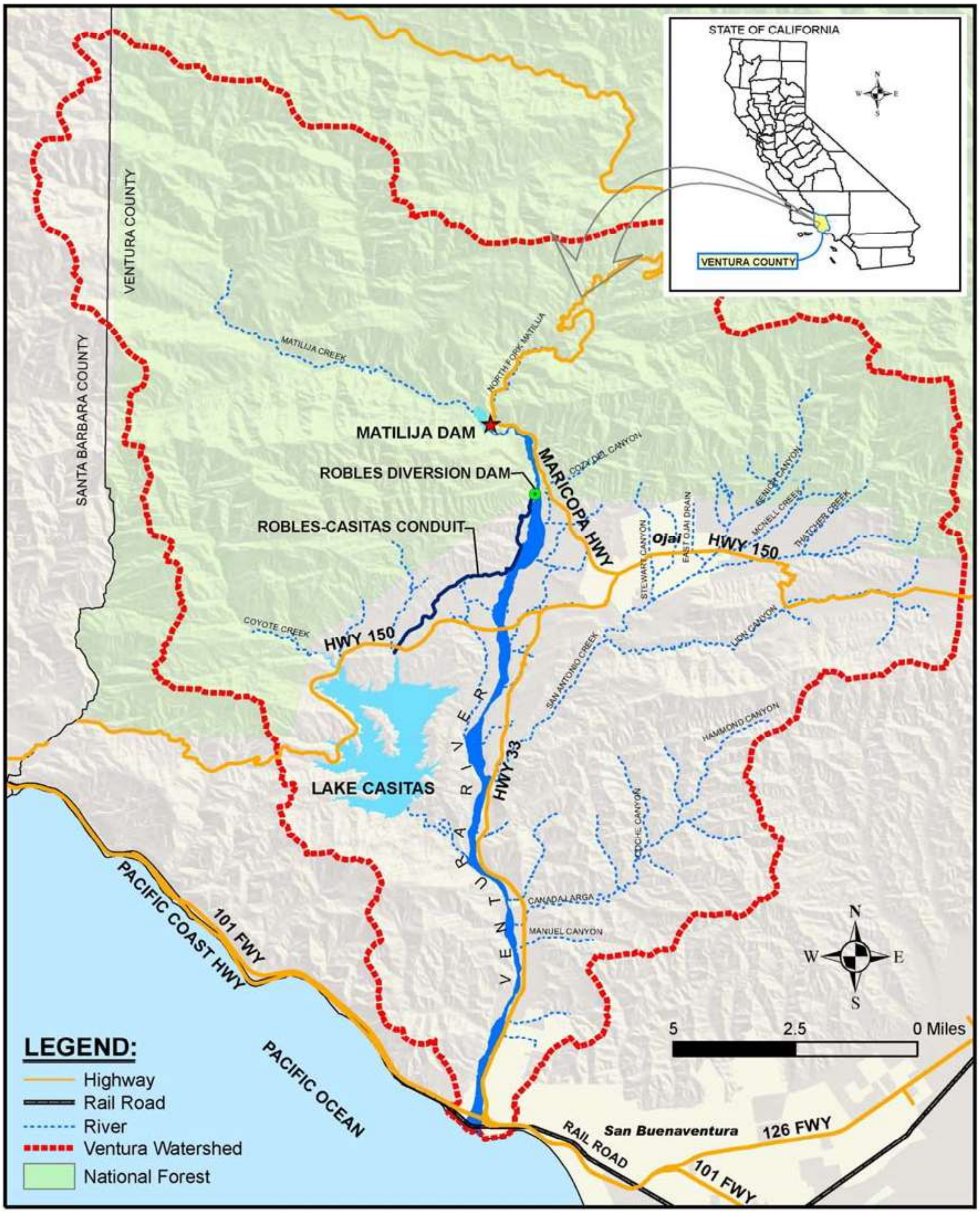


Figure 2-1: Study Area

Table 2-1: Major Sub-watersheds in the Ventura River Watershed

Local Area Basin Name	Drainage Area (sq. mi.)	Max Length of Watershed (ft)	Min Elev. of Watershed (ft)	Max Elev of Watershed (ft)	Mean Annual Precip. (in)
Matilija at Matilija Dam	54.6	83,363	1009	5457	23.5
North Fork Ventura River – Matilija	16.2	40,554	1009	5007	22.1
Ventura River D/S of Willis Canyon	7.4	22,090	697	4279	20.2
Ventura River at Live Oak Creek	11.6	45,685	291	2310	17.8
San Antonio Creek	51.0	79,331	290	5411	18.3
Santa Ana Creek at Lake Casitas	9.5	38,211	529	4646	18.7
Coyote Creek above Lake Casitas	13.4	36,127	561	4770	21.1
Drainage area that includes Lake Casitas	15.3	31,470	515	2343	18.2
Ventura River area to Foster Park	9.3	25,313	196	1303	17.3
Cañada Larga area	19.3	50,752	196	2788	17.9
Lower Ventura River area	15.5	35,470	0	2118	16.9
Entire Ventura River Basin	223.1		0	5457	19.9

The Ventura Watershed lies within the western Transverse Ranges in California, an active tectonic region that contributes some if the highest sediment yields in the United States. The range is composed almost entirely of highly folded and faulted, unmetamorphosed marine sedimentary rocks of Cenozoic and late Mesozoic age, elevated out of the ocean primarily on the Santa Ynez fault along the northern base of the range. Steep slopes in the upper portion of the watershed produce a large portion of sediment supplied to the Ventura River. Mass wasting from erodible, colluvial soils on hillsides, including slides, slumps, debris flows and earthflows, is a common mechanism by which sediment i
s transported to the river channels. Sediment production in the area is also impacted by the occurrence of forest fires which clear the normally dense vegetation and greatly increase the erodibility of land surfaces.

The average annual rainfall for each drainage basin is shown in Table 2-1 above. In general, the higher elevations receive more rain. The average annual rainfall for the drainage basin upstream of Matilija Dam is 23.9 inches per year while the average annual rainfall near the mouth of the Ventura River is approximately 16.9 inches per year. The average for the entire watershed is approximately 20 inches per year. There is extreme seasonal variation in the rainfall and over 90 percent of the rainfall occurs between the months of November and April.

Western Ventura County contains natural visual resources in the form of mountains, canyons, native vegetation, beaches, lakes, wetlands, rivers, and creeks. Additionally, man-made visual features, such as parks, golf courses, harbors, homes, levees, oilfields, and other structures have contributed to the aesthetic quality of the county, both in positive and negative respects.

Two reservoirs lie within the watershed, Lake Casitas and Matilija Reservoir. Both reservoirs serve the purpose of water supply, though to a much lesser extent for the Matilija Reservoir. Matilija Reservoir was also constructed for flood control function. Casitas Dam is located on Coyote Creek about 2 miles upstream of the confluence of the creek with the Ventura River.

There are four debris basins that collect sediment from drainages before entering the mainstem Ventura River. McDonald and Dent Canyons basins are on direct tributaries of the Ventura River. There is a basin on San Antonio Creek, and one on Stuart Canyon, a tributary to San Antonio Creek.

Matilija Creek

Matilija Creek drains steep foothills and mountains of the Santa Ynez Mountains as it flows to the Matilija Reservoir. This portion of the study area is within the Los Padres National Forest. The steep slopes are characterized by dense vegetation on the north facing slopes and sparse vegetation on the south facing slopes. The contributory sub-watershed to Matilija Creek is an area of about 55 square miles comprised in large part (90 percent) of the pristine Matilija Wilderness. About 30 miles of the upper reaches of Matilija Creek and its tributaries are designated as Wild and Scenic Rivers. About 10 percent of the contributory watershed is composed of relatively short streams that flow northward off the north slope of the Santa Ynez Mountains, and southeast draining Rattlesnake Canyon, which is about 1-½ miles long. About 2-½ square miles of the contributory watershed is semi-developed land with cabins and other residences.

Upstream of the dam, Matilija Creek is a steep cobble bed stream that is well confined between canyon walls. Matilija Creek gradually becomes less steep and experiences active channel migration as it cuts through the delta to reach Matilija Reservoir. Study Reaches 8 and 9 include a total of about 32 miles of channels. The only studies that were conducted in Reach 9, in the Los Padres National Forest, were for steelhead habitat assessment, to investigate the general quality and extent of potential habitat if the dam is removed. This information is used in the Habitat Evaluation Procedure (HEP). The studies identified about 17.3 miles of channels that could become accessible to steelhead again if fish passage modifications were made to the Robles Diversion Dam and fish passage was restored at Matilija Dam.

Table 2-2: Upper Matilija Creek Basin		
Channel	**Total Length (mi)**	**Potential Accessible Habitat for Fish Passage (mi)**
Matilija Creek Main/Middle Fork	15	8.2
Upper North Fork Matilija	10	4.9
Murietta Creek	4	1.9
Old Man Creek	3	2.3
Total:	**32**	**17.3**

Matilija Dam is located approximately 16 miles north of the coast on Matilija Creek, which flows downstream from the dam for approximately 0.6 miles before it joins with North Fork Matilija Creek and becomes the mainstem Ventura River. Matilija Dam was constructed in 1946-1947 by the Ventura County Watershed Protection District (VCWPD, formerly the Ventura County Flood Control District) to provide water storage for agricultural needs and for limited flood control. The structure is a concrete arch dam with an average height of 190 feet and a crest length of 616 feet. The structure is situated in a non-symmetric, wide U-shaped canyon. The streambed base is approximately 340 feet wide. The Matilija Reservoir presently has between 20-35 acres of wetlands and up to 50 acres of open water habitat. These habitats support numerous species of vegetation and wildlife, some of which are non-native.

Matilija Dam is founded on the Matilija Formation, which is comprised by massive sandstone beds interbedded with thin, closely fractured sandstone beds and minor siltstone, mudstone and weak shale layers. The Matilija Formation is very resistant, and forms steep slopes, strike ridges, and craggy topography. Local relief can be up to many hundreds of feet. Rockslides and landslides occur on very steep slopes. Bedding plane failure can occur where shale partings are present and dip out of natural slopes and artificial cuts. Matilija Dam lies in a seismically active area.

While no major faults have been mapped within the reservoir and dam area (Dibblee, 1982), there are many faults close to the site. The closest fault is the 90-mile long active Santa Ynez fault, which passes about two miles north of Matilija Dam and is the largest transverse fault west of the San Andreas Fault. Rock falls, boulder rolls, and landslides can be triggered by moderate to strong earthquakes (Weber, et al., 1973).

Downstream of the dam, Matilija Creek joins North Fork Matilija Creek to form the Ventura River. The 1.5 miles immediately downstream of the dam is a very steep reach with mostly boulders as bed material.

Lower North Fork of Matilija Creek

The Lower North Fork of Matilija Creek, and Matilija Creek mainstem form the headwaters for the Ventura River. This fork of Matilija Creek is located about 0.7 miles downstream of the dam and is about 12 miles long. The north fork, in general, follows the alignment of Highway 33 as it winds into the Los Padres National Forest. The downstream portion of the north fork is a narrow riparian corridor. About 4.3 miles from the confluence of the Matilija Creek mainstem, a road crosses at Wheeler Gorge Campground and obstructs fish passage. The Ventura River North Fork was initially excluded from the study area. However, a steelhead habitat assessment was performed and was not included in the HEP analysis.

Ventura River

The Ventura River flows in a southerly direction through several constricting canyons and wider floodplain areas for a total of about 16 miles to the Ventura River Estuary and the Pacific Ocean. The floodplain is seldom wider than 0.5 miles. The estuary is approximately 1.25 miles wide. There are eight major bridge crossings between Matilija Dam and the ocean.

The Robles Diversion Dam is located approximately 1.5 miles downstream of the Matilija Creek confluence on the Ventura River. The Ventura River exits a steep canyon as it enters a wide depositional plain about a mile upstream from Robles Dam. This dam diverts water from the Ventura River to Lake Casitas via the 4.5 miles-long Robles-Casitas Diversion Conduit.

From Robles Diversion Dam to the confluence with San Antonio Creek, the Ventura River is a slightly sinuous braided stream that experiences active channel migration. From San Antonio Creek until the estuary, the river is relatively more confined and has fewer channels.

The Ventura River Estuary begins about 0.6 miles from the Pacific Ocean, where tidal influence begins. The estuary, encompassing an area of approximately 100 acres, provides a diverse mix of habitats including freshwater marsh, salt marsh, and riparian. The estuary is protected from tidal action by a sand bar during seasons of low flow. The sand bar is removed when high flows pass through the estuary and then is created again by the supply of sand from littoral transport. Coastal processes influenced by the study area extend from Point Conception to Point Mugu.

There are three major levees along the Ventura River. The most upstream levee is near the Santa Ana Bridge. It protects the Live Oak community along the west bank. The Casitas Springs Levee is along the east bank and protects the town of Casitas Springs. The Ventura Levee is along the east bank and protects the City of Ventura.

Population and Land Use Characteristics

Ventura County covers approximately 2,010 square miles and is 90 percent rural. The Los Padres National Forest covers about half of the county. Ventura County supports slow growth and has therefore protected large areas from future development. The larger urban areas within the Ventura River Watershed include the City of Ojai, southeast of Matilija Creek, and the City of Ventura in the lower reaches of the Ventura River. Most of the land in the Ventura River Valley is privately owned. The land-use designations in the developed areas vary widely from rural to residential to industrial. Human-impacted areas include activities related to grazing and livestock, agriculture, oil production, and recreation. Little, if any, development is expected over the lifetime of the project in the Matilija Creek watershed.

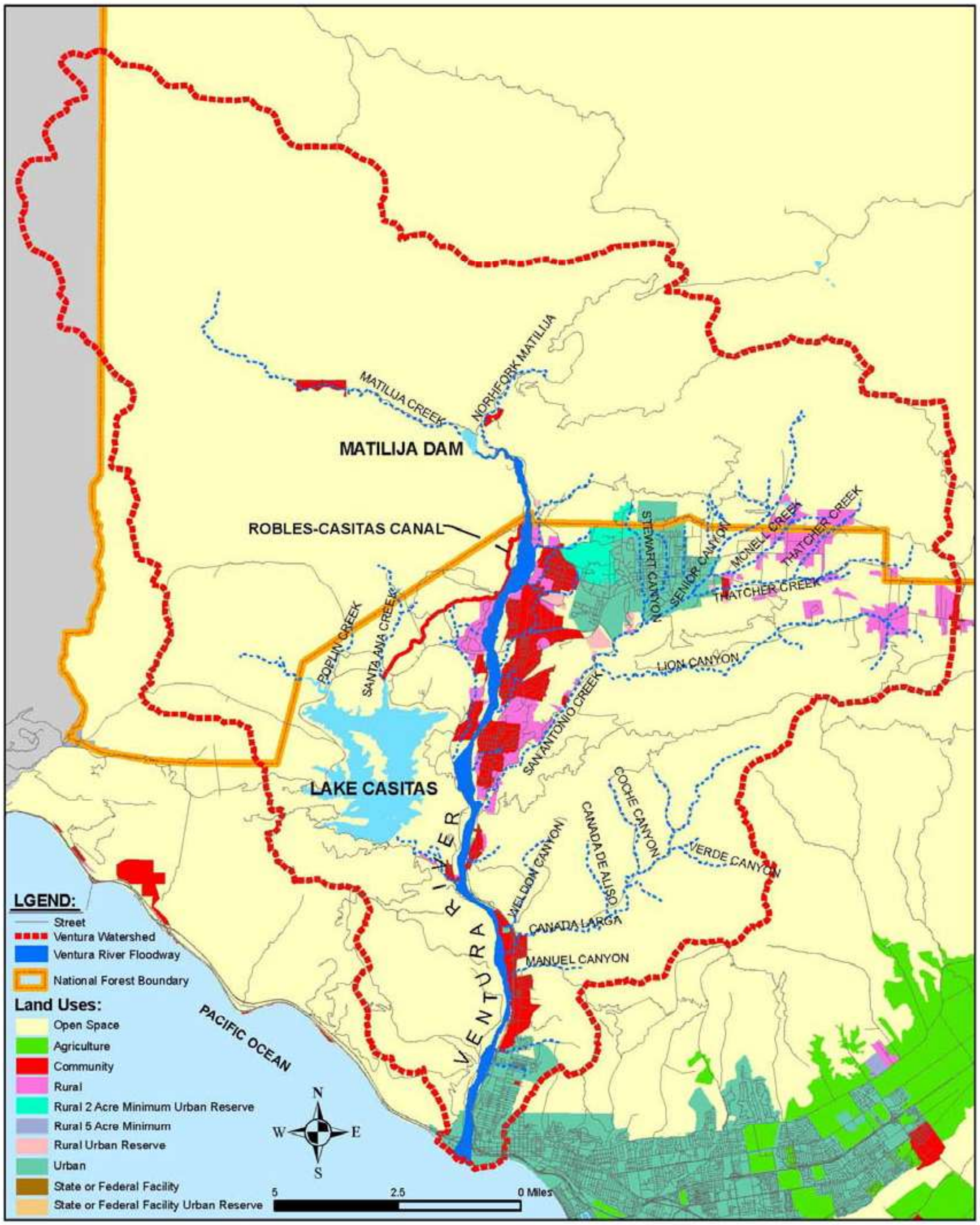


Figure 2-2: Land Use

Although much of the watershed is undeveloped, pockets of urbanized areas are found throughout the middle and lower watershed, particularly the cities of Ojai and Ventura. The bulk of the watershed falls within unincorporated Ventura County and includes the communities of Casitas Springs, Foster Park, Oak View, Valley Vista, Mira Monte, Meiners Oaks, Upper Ojai and Live Oak Acres.

Other jurisdictions in the watershed include the Los Padres National Forest, Casitas Municipal Water District (CMWD), Teague Memorial Area, Ojai Area Plan (74,000 acres of unincorporated portions of Ojai and Ventura River Valleys), and the Ventura County Fire Protection Department. The river and floodplain at the mouth are owned by the state and the City of Ventura. The Ventura County Watershed Protection District holds flowage easements along portions of the Ventura River.

The General Plans of the region indicate few planned residential or commercial areas in the immediate vicinity of Matilija Creek and the Ventura River; therefore, little change in population or housing is expected in the immediate vicinity of Matilija Creek or the Ventura River.

Build-out of the residentially designated areas in the City of Ojai General Plan and the residential areas in the Meiners Oaks, Mira Monte, Oak View and Live Oak Acres communities in the Ojai Valley Area Plan could occur during the life of the project. Residential build-out is likely to occur in Casitas Springs. Some mobile home parks are likely to be replaced (with multiple-family dwellings at the Las Encinas Mobile Home Park, and industrial development at the Magnolia Mobile Home Park).

The City of Ventura Downtown Specific Plan is scheduled to improve the areas adjacent to the lower reaches of the Ventura River through upgrading of existing uses or replacement of existing uses with more attractive, more space-efficient land uses.

The 2002 estimate of the Ventura County population is over 780,000. The Southern California Association of Governments estimates that the City of Ojai will grow by 1,500 people by the year 2025 and that the population of the City of Ventura will increase by 27,000 by the year 2025.

Recreation

There are many outdoor recreational pursuits available within and adjacent to the study area. Most recreation access at Matilija Creek is in the upper portions of the watershed several miles above Matilija Dam within the Los Padres National Forest. The U.S. Forest Service manages the national forest. The access point for trails in the Matilija watershed lead to the Matilija Wilderness area and into the larger Los Padres National Forest. For the current and future without-project conditions, it is assumed that recreational opportunities would not be available around Matilija Dam. The dam would continue to act as a barrier to the linkage of existing trails in the national forest and the Ventura River Valley.

The Ojai Valley Trail runs the length of the Ventura River Valley and follows the abandoned Southern Pacific right-of-way along the west side of State Route 33 from Ojai to the northern end of Foster Park. The trail serves bicyclists, equestrians and pedestrians in the watershed. The equestrian trail terminates at Foster Park, but a bike and pedestrian trail continues downstream along the estuary to the mouth of the Ventura River and south along the shoreline. Damage to this path has occurred in recent years due to the receding shoreline in the area and additional exposure to wave erosion during storm events. The reduction in sediment transport from the Ventura River Watershed to the coastal area, due to the construction of Matilija and Casitas Dams, are one of the primary causes of the localized shore erosion.

The Ojai Valley Land Conservancy has several multi-use trails on their property adjacent to the Ventura River. Some trails start in the Meiner's Oaks area and crosses the river and heads west. CMWD owns and operates the Casitas Lake Recreation Area. Body-contact water recreation is prohibited, but boating, camping, and fishing are allowed. The average daily recreational visitor usage in the mid-1990s was almost 3,000. 80 percent of the shoreline is closed to the public. Ventura County operates Foster Park, which provides day use and camping facilities. Emma Wood State Beach, the Ventura River Group Camp and the City of Ventura's Seaside Wilderness Park are located adjacent to the estuary. Birdwatchers and others enjoy the use of the Ventura River Estuary. The adjacent shoreline area is heavily used by residents and tourists and is a large source of income for the local community. Surfer's Point is a popular local surf spot.

The recreation features in the watershed are not anticipated to change for the future without-project condition. Opportunities for enhancement of existing recreation facilities, particularly linking existing trails, were investigated as part of this feasibility study.

Study Reaches

Matilija Creek and the Ventura River were divided into a total of nine sub-reaches for this study. The reaches were used to identify physical changes along the river, such as different slopes or channel widths; manmade features, such as bridge crossings, dams or levees; or significant habitat changes, such as the Ventura River and the estuary. The reaches are used extensively for the hydrologic, hydraulic and sediment transport studies, and the environmental Habitat Evaluation Procedure (HEP). General features by reach are presented in Table 2-3.

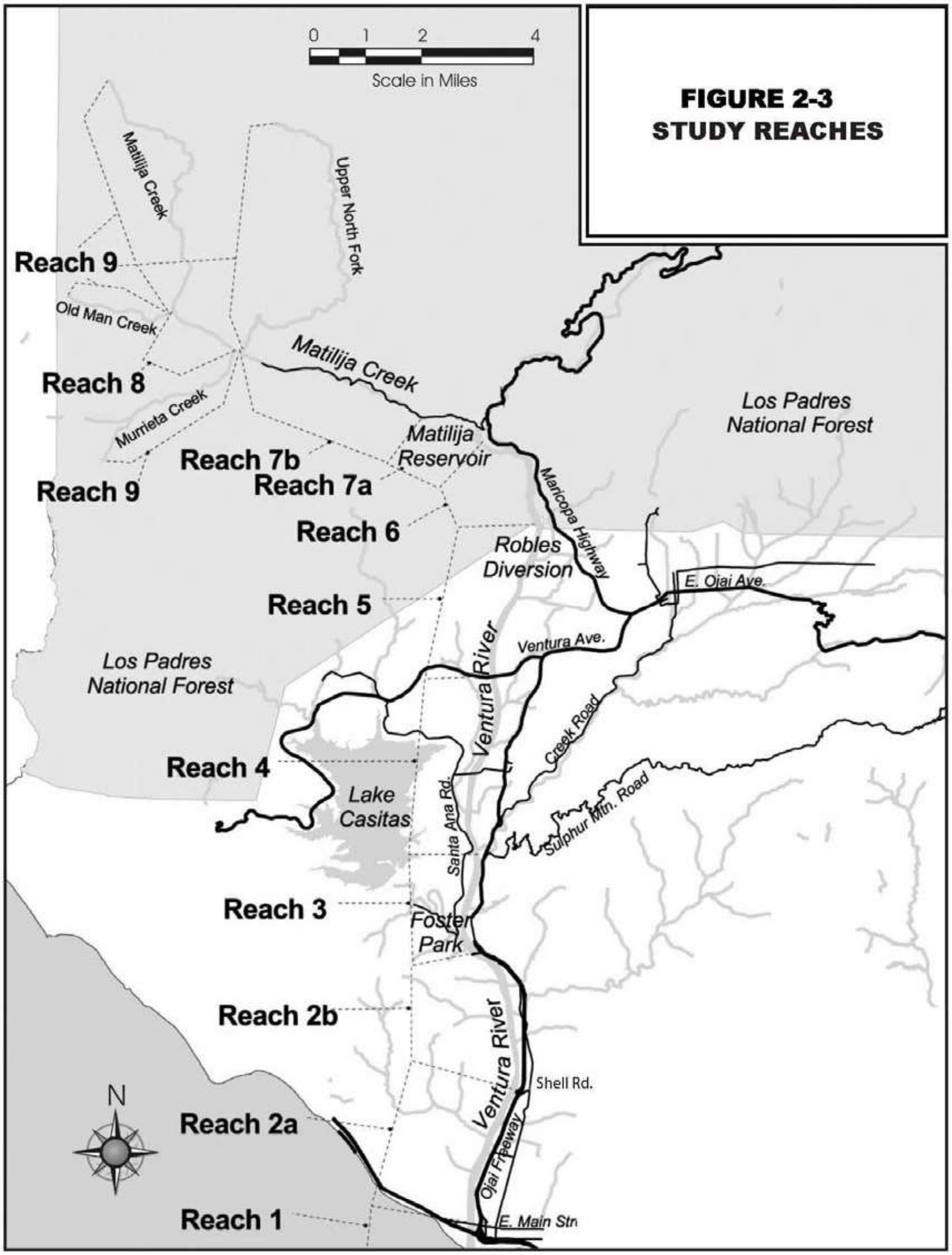


Figure 2-3: Study Reaches

Table 2-3 – Major Reaches of Matilija Creek and the Ventura River

Rch #	Reach Boundaries	River Mile	Geomorphic Description	Slope (%)	Avg. Chnl Width (ft)	Physical Structures/Nearby Communities	Tributaries
9	Matilija Creek Headwaters/Tributaries	30-18.1	Includes Upper North Fork Matilija Creek, Murrieta Creek, Old Man Creek, and Matilija Creek above Old Man confluence. Entire area is within the Los Padres National Forest		<100		Upper North Fork, Murrieta, Old Man, Upper Matilija
8	Matilija Creek Mainstem	18.1–17.5	From "Upstream Channel" area to Old Man Creek confluence, above historic Matilija Dam Reservoir limits.		800		
7b	"Delta" and "Upstream Channel" areas of sediment deposition	17.5–16.8	Upstream from "Reservoir area" characterized by silty sands and coarse gravels and cobbles for the "Delta" and coarse sediments in upstream. About 3.8 MCY of deposition.		1100 Max (700-800 Avg)		
7a	Matilija "Reservoir" area	16.8–16.5	From Dam to the upstream end of Reservoir influence. Mostly clays and silts, totaling 2.1 MCY.		350- 850		
6b	Downstream of Matilija Dam to North Fork Matilija Creek and Kennedy Canyon	16.5–15	Narrow, steep and sinuous bedrock canyon reach with perched <300 ft wide alluvial terrace (RM 16.5-16); opens to narrow linear valley (RM 16-15); alluvial fans and low alluvial terraces flank channel.	>2	100	Matilja Dam (RM 6.46); Matilija Road Bridge (RM 15.9)	North Fork Matilija Creek (RM 15.8)
6a	Kennedy Canyon to Robles Dam	15-14.2	Wide river channel and valley (1650 ft); channel slope changes significantly relative to Reach 6b	2-1.5	200		
5	Robles Dam to Meiners Oaks	14.2–12.3	Depositional reach where valley widens	1.5-1.3	200-400	Robles Diversion Dam (RM 14.2)	
4	Meiners Oaks to San Antonio Creek	12.3–7.9	Braided channel			Baldwin Road Bridge (RM 11.3); Santa Ana Bridge (RM 9.4); Live Oak Levee (RM 10.3-9.4)	San Antonio Creek Tributary (RM 7.9)
3	San Antonia Creek to Foster Park	7.9–6.1	Relatively more confined less braided channel	1-0.6	200	Casitas Springs Levee (RM 7.9-6.8); Foster Park Diversion Structure (RM 6.3)	
2	Foster Park to the Estuary	6.1–0.6	Estuary periodically flushed by floods		Widens rapidly at RM 2.5	2 Bridge Crossings: Casitas Vista Road (RM 5.95), Shell Road (RM 3.2). Upper terminus of Ventura River Levee (RM 2.4)	Cañada Larga Tributary (RM 4.6)
1	Estuary to Mouth of Ventura River	0.6–0.0	Temporary channel naturally cut through sand delta			3 Bridge Crossings: Main St. (RM 0.6), Highway 101 (RM 0.45), Southern Pacific Railroad (RM 0.2). Beginning of Ventura River Levee (RM 0)	

Historic Watershed Use

Agricultural, industrial, and urban development of the Ventura River Watershed has degraded the natural environment by adding system-wide stresses such as increased point and non-point pollution, loss of habitat, groundwater depletion, increased water use, over-harvesting of wildlife, invasion of exotic plants and wildlife, and structural alterations of waterways (Chubb, 1997; Moore, 1980; CRWQCB-LA, 2002; Capelli, 1999). Throughout the Ventura River system, flood control and other waterway alterations have reduced riparian and coastal habitat, altered stream flows, limited access of species (such as the steelhead) to critical habitat, and altered the sediment transport of the rivers and the coastline. Existing wetlands and riparian habitats have been degraded in quality by fragmentation, water quality degradation, and introduction of exotic plants and wildlife. The remaining coastal and riparian habitat is extremely valuable, especially as habitat for a variety of fish and wildlife and for several federal and state-listed threatened and endangered species.

The plight of the endangered southern steelhead trout is representative of the ecosystem degradation of the Ventura River Watershed. A 1946 California Department of Fish and Game (CDFG) report stated that the Matilija Creek system supported a minimum of 2,000 to 2,500 fish in normal years, and this represented approximately half of the total run in the Ventura River system. The historical (pre-dam) estimates of steelhead population made by CDFG personnel are based on direct, historic observations, according to a National Marine Fisheries Service (NMFS – NOAA Fisheries) 2003 Biological Opinion for the Robles Diversion Fish Passage Facility. About half of the primary spawning and rearing habitat in the Ventura River Watershed is located in the upper reaches of Matilija Creek, upstream of the Matilija Dam, thereby making it inaccessible to steelhead (Chubb, 1997).

The NMFS estimated that the current Ventura River steelhead run size is less than 200 adults (Busby et al. 1996). This is the most recent estimate of the Ventura River steelhead population. However, in light of the continued pressures exerted upon the population and the paucity of recent sightings in the drainage, NOAA Fisheries fears the Ventura River steelhead population is likely less than 100 adult individuals at the current time.

Historical accounts do not differentiate between steelhead and rainbow trout, creating difficulty in determining the extent and magnitude of early anadromous runs. Newspaper articles of the late 1800s repeatedly mention the large angler catches from throughout much of the length of the mainstem Ventura River. River flows were apparently adequate to support both resident and anadromous fish throughout most of the Ventura River reaches except during drought years. Approximately half of the river basin perennial and seasonal flowing streams may have once supported anadromous steelhead.

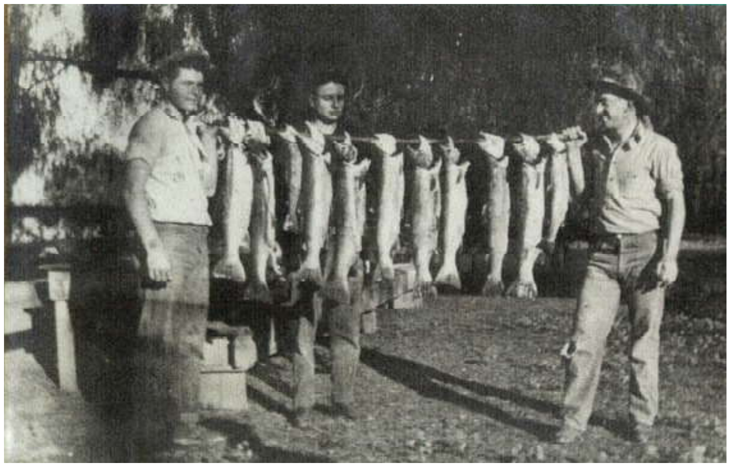


Figure 2-4 - Fishermen with Steelhead: Upper Ventura River , circa 1920

Chumash Indians have inhabited the Ventura River basin for over 4,000 years. The Chumash were hunter-gatherer-fisher people and likely had minimal impact on the landscape and resources. Several large villages were located in the lower coastal portion of the watershed. The primary use of the upper watershed was in dispersed hunting and fishing camps. Prior to the late 1700s, Chumash were known to burn sage scrub and grasslands but not chaparral. It is thought that some of the fires would have escaped into chaparral, perhaps altering vegetation patterns and fire intensities or intervals.

Cattle grazing and vineyard productions were the most noticeable alterations associated with the Spanish missions in the 1700s and the Spanish rancheros in the early 1800s. Vineyards and intensive farming rapidly spread throughout the lower Ventura River basin. During this period, grazing may have been heavy within portions of the watershed reducing grassland fuel loads. With the decline of the Chumash population, prescribed burning was no longer practiced. Historical accounts of 1793 describe chaparral stands as continuous, heavy, and decadent. It is not clear how fire patterns were affected during this period.

Homesteading began in earnest in the late 1800s, as did small hard rock mining operations and oil exploration. Grazing may have declined around the turn of the century, which may have contributed to fuels build up and later major fires. During this period, ranches and small communities began to divert surface waters from the mainstem Ventura River. As the number and volumes of these diversions increased, impacts on steelhead increased by reducing available instream water and habitat and by the high mortality of young fish diverted into unscreened water conveyance systems. Aquatic vegetation was impacted in the 1920s during the development of oilfields through discharge of oilfield wastes into the river.

As more people migrated into the area and populations grew, over-fishing became a problem. Steelhead were likely taken as bycatch in commercial seining operations within the ocean and the lagoon (Ventura Free Press, 1876). Recreational and subsidence fishing also had a noticeable impact; local newspaper accounts boasted about the taking of "trout" in a couple hours of fishing (Ventura Free Press, February 9, 1878). Matilija Creek and other easily accessible drainages were the first to suffer the consequences of severe over fishing.

Increasing agricultural and municipal water demands expanded water diversions and changes to surface water supply became evident in the 1940s. Many water diversions were impediments to upstream and downstream fish migration. Most water diversions were unscreened, causing a loss of countless steelhead juveniles and smolts. From the few accounts that are available, steelhead appeared to begin their most precipitous decline in the late 1950s. The Matilija Dam, completed in 1948, with the Robles Diversion Dam and Casitas Dam completed in 1958, effectively cut-off steelhead access to greater than 50 percent of their historical spawning habitat. These dams also captured much of the supply of sand and gravels, beginning a process that has drastically altered downstream channels, floodplains, and the coastline.

Road building, maintenance, and use has also had an effect on stream corridors. Many of the present day access roads were built around the turn of the century. Highway 33 was constructed in the 1930s. Lengthy highway sections run parallel and impinge upon the North Fork Matilija Creek corridor, greatly influencing riparian habitat, the floodplain, channel morphology, and water quality.

During the 1950s, the area's principal economic development centered around agriculture, oil and gas production, commercial, service and recreational activities. The agricultural industry included both irrigated and dry farming. Oranges, lemons, walnuts, avocados, deciduous fruits, irrigated hay and pasture, and vegetables were the principal irrigated crops. Dry farmed crops included hay, barley, beans, nuts, deciduous fruits and grapes. Three major and several minor oilfields were in production.

Southern Pacific Milling sand and gravel operations in the floodplain were initiated during the 1960s. Between 1962 and 1964, the 101 Freeway was constructed across the Ventura River delta between the Southern Pacific Railroad tracks and Main Street Bridge. Construction of the 101 Freeway subjected the area to increasing pressures from urbanization, although the river and the Ventura River levee, constructed by the Corps in the lower 2.6 miles of river in 1948, acted as a relatively stable urban-rural boundary.

Cultural Resources

Cultural resources studies were conducted for the study area extending one mile on either side of the Ventura River, one mile on either side of Matilija Creek and from the coast at Ventura to approximately 3.5 miles upstream of Matilija Dam. Investigations included a search of existing records and literature and a field survey of portions of the study area.

A records and literature search of the study area was conducted through the South Central Coastal Information Center (SCCIC) at California State University, Fullerton. The records search indicated that over 121 cultural resources field studies have been conducted within the study area. Previous surveys cover approximately 15-20 percent of the study area. No surveys or historic resources have been previously recorded at, or within, the Matilija Dam basin.

Twenty-five prehistoric archeological sites are known to be present within the study area boundary. Four isolated artifacts have also been recorded. These sites include village and small campsites, shell midden, and other resource-processing sites. The artifactual and ecofactual materials contained within the archeological deposit of these sites are a record of Chumash prehistory. Presumably, some of the sites contain information that would contribute to the understanding of regional prehistory and are therefore eligible for listing on the National Register of Historic Places (NHRP). Many of the sites found in the records search may no longer be in existence. Recent development may have obliterated, or to some degree disturbed, some of them.

The record search revealed the presence of 21 historic archeological sites. These include features such as the ruins of the Mission Period San Miguel Chapel, remains of historic adobes, and other miscellaneous evidence of historic period settlement and activities. Several historic buildings dating from 1782 through the 1950s are also recorded within the study area. The present status of the buildings and historic archeological sites is based on records search information only. Some of these structures and sites may no longer exist.

With a lack of project-related disturbance, cultural resources along Matilija Creek and the Ventura River would not be adversely affected by project construction activities.

The Corps archeology staff conducted field surveys of the basin behind Matilija Dam. A prehistoric/historic archeological site was discovered at a higher elevation in the vicinity of the basin. The site (COE#1) consists of prehistoric milling features and historic foundation and wall features. Based on work completed so far, COE#1 is eligible for listing on the National Register of Historic Places (NRHP). There is also a historic road segment (COE#2) that leads to the site. COE#2 is potentially eligible for listing on the NRHP. Based on H&H studies it appears that future sediment deposition may affect these sites. Since these sites are located at higher elevations in the reservoir basin, it is questionable whether without-project impacts would occur. If the sites were threatened by future sediment accumulation in the basin, the decision would have to be made whether to protect the site or allow partial or complete burial. In either case, complete documentation protocol of the sites would be required.

The most visible of historic structures, Matilija Dam, was evaluated by the Corps for potential listing on the National Register of Historic Places, primarily due to its age. The Dam is not eligible for listing because of the previous notching activities. Documentation to this effect will be sent to the California State Historic Preservation Office (SHPO). SHPO concurrence would mean that no further historic preservation considerations would be required for the dam.

Groundwater Supply and Use

The Ventura River groundwater basin, including Matilija Creek, is divided into an upper and lower cell. There is a groundwater constriction, just upstream of the San Antonio Creek confluence (Reach 4), which forces the upper cell's water to the surface. The water quality in the upper cell is generally good while the lower cell is considered unsuitable for use possibly due to oilfield operations or saltwater intrusion. An estimate of groundwater storage in the upper cell is slightly more than 20,000 acre-feet.

Groundwater in the vicinity of the dam site occurs predominantly within alluvial deposits with an average thickness range of 60 to 100 feet and a maximum thickness of 200 feet. These deposits are typically bounded by relatively impermeable Tertiary bedrock. Although the bedrock formations are poor aquifers, movement of groundwater within faults and fractures in bedrock in the Matilija Dam area is evidenced by several local, cool-water, sulfurous, metal-free springs.

Historic groundwater levels (pre-dam) for the area immediately downstream from the Matilija Dam site indicate that the groundwater table in this area has remained at nearly the same level before and after dam construction. Groundwater data from the only well within 2 miles of the Matilija Dam Reservoir indicates fluctuations from 14.3 feet to 40.8 feet to groundwater from 1973 to 1990, with an average depth of 22.4 feet. Groundwater conditions are not expected to change for the future without-project condition.

There are over 300 private wells along the Ventura River and its tributaries. The greatest concentration of wells is in the Oak View, Live Oak Acres, and western Mira Monte area where there is significant residential development. A high number of wells are also located along San Antonio Creek.

The Meiners Oaks County Water District is an independent special district formed in 1949 that provides water to residential, commercial, and agricultural customers (about 1,200 connections) in the Meiners Oaks area via four wells.

CMWD supplements Lake Casitas water supplies with water supplied from the Mira Monte Well.

Increased sediment loads from the Matilija watershed could impact future groundwater extraction along the Ventura River after the dam fills with sediment.

Water Quality

The California Regional Water Quality Control Board, Los Angeles Region 4 (RWQCB) prepared a report on surface water quality for the Ventura River Watershed (May 2002). Limited data is available for the Matilija Creek subwatershed. Available data for bacterial indicators, conventional water quality parameters, and minerals were well within limits proposed in a pending Basin Plan. Total coliform was generally below 1,000/100 ml and pH levels were between 8.1-8.4. Dissolved Oxygen concentrations were always over 7 mg/l and generally did not exceed 100 percent saturation. Turbidity levels were low even during winter months. There are no 303(d)-listed impairments in Matilija Creek.

The RWQCB classifies the lower reaches of the Ventura River as a Category I (impaired) watershed (from Weldon Canyon to the Estuary) and has approved the river's status on the 303(d) list and TMDL priority schedule for pollutants including DDT, copper, silver, zinc, selenium, algae (eutrophication) and trash. The water quality problems are generally non-point source related.

Water temperatures were developed from USGS measurements at the USGS stream gage in the Ventura River near Foster Park. The average water temperature for the months of February and March, when most floods occur, is 56° F. Steelhead in the Ventura River have been reported at temperatures as high as 82.4° F.

Environmental Studies

A multi-agency task force chaired by the Corps and the VCWPD conducted biological resources studies for this study and managed the preparation of the draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR). The Environmental Working Group (EWG) is comprised of almost 20 members from various Federal, State, local and private institutions, and consultants. Without-project conditions work efforts included: the review of existing literature and recent vegetation and wildlife field studies; detailed vegetation mapping and additional species surveys of the study area, from the headwaters to the mouth of the Ventura River; field studies for verification of the mapping; the preparation of a GIS database; a steelhead habitat assessment; the creation of a habitat valuation tool called a modified Habitat Evaluation Procedure (HEP) to measure and quantify changes between existing condition habitats and future without-project condition habitats; and the preparation of a summary draft EIS/EIR. The U.S. Fish & Wildlife Service (USFWS) worked with Federal and State agencies to prepare a Planning Aid Report (PAR) and Coordination Act Report (CAR) that assisted in the formulation process and the development of the EIS/EIR.

Existing vegetation communities for Reaches 1-7 were mapped based on field studies conducted in May and June 2002. Limited mapping and field surveys were conducted in Reaches 8 and 9 to determine the quality of the existing aquatic habitat for potential restoration of fish passage. Reaches 8 and 9 are not expected to change significantly in the future without-project condition since these reaches are within Los Padres National Forest. Reaches 1-7 were broken down into three major vegetation communities that include the historic Matilija Reservoir area, the mainstem riverine system of the Ventura River and the Ventura River Estuary. Vegetation surveys were delineated by habitat communities and transferred onto geo-referenced and ortho-rectified photography using a GIS database. This information was used in combination with the baseline condition sediment transport studies for the HEP analysis.

Biological Resources

The diversity of aquatic and upland community types that occur within the study area provide habitat for a wide variety of resident and migratory wildlife species, including several special status species. Of particular importance are the habitat types associated with the Ventura River and its estuary that are known to provide habitat for several special status species including critical habitat for the federally endangered southern steelhead (*Oncorhynchus mykiss*) and tidewater goby (*Eucyclogobius newberryi*).

Surveys documented nearly 275 vertebrate species from the estuary and vicinity alone. In addition, wildlife surveys conducted by the USFWS (2000) and by a Corps contractor (2002) described over 160 vertebrate species from locations throughout the study area. An appendix to the draft EIS/EIR presents a list of wildlife species that has been compiled from existing literature and recent field studies within the study area.

Recent fish and wildlife surveys performed in the Matilija Reservoir area detected 124 vertebrate species, including 6 fish, 5 amphibians, 7 reptiles, 93 birds and 13 mammals. The report also notes the high densities of many non-native vertebrate species, such as crayfish, bullfrogs, largemouth bass, and green sunfish in the reservoir area. These exotic species are considered detrimental to the survival of many native fish and amphibians.

There are 35 special status wildlife species that are known or expected to occur in the study area. Of these species, three are fish, two are amphibians, four are reptiles, 27 are birds, and two are mammals.

Matilja Watershed

Before construction of the dam, the Matilija Reservoir area (Reach 7) was a riparian habitat riverine system with relatively steep slopes similar to the upstream reaches of Matilija Creek. By 1948, the filling of the reservoir led to a transition from riparian to open-water habitat. Other wetland habitats have developed in the original reservoir footprint as the reservoir has filled in with sedimentation over time.

Figure 2-5 – Matilija Creek (pre-dam construction)

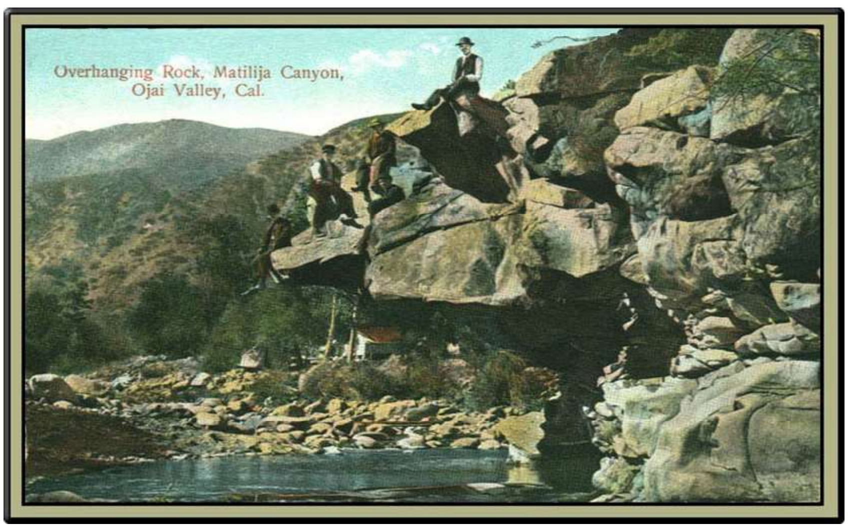


Figure 2-6 – Pre-Dam Photo of Matilija Creek

Currently, the depositional area in the former reservoir footprint is described as a riverine upper perennial wetland. Mulefat, with cottonwood and willow saplings establish on sandbars in suitable areas, and bulrush and cattails establish in pools and the perimeter of the reservoir. Scrub/Shrub and Forested Wetlands occupy the remainder of the former reservoir footprint. The reservoir has between 20-35 acres of shoreline riparian habitat (wetlands) and up to 50 acres of open-water habitat. These aquatic habitats support numerous species of vegetation and wildlife, some of which are non-native.

The giant reed is a significant problem in this area. Giant reed (*Arundo Donax*) is an invasive exotic plant that has rapidly spread through and degraded riparian ecosystems of Southern California. Giant reed readily invades riparian channels, especially in disturbed areas, is very competitive, and is difficult to control. This plant out-competes and displaces the native vegetation and seriously degrades the habitat quality of the area. It grows in wet areas and uses prodigious amounts of water to fuel its incredible rate of growth. Under optimal conditions giant reed can grow more than three inches per day. All evidence indicates that giant reed provides no food for wildlife, and, at best, only very poor habitat for some nesting birds or shelter/shade for native amphibians.

Giant reed is rapidly spreading throughout much of the wetlands in the original reservoir area, and is expected to completely dominate the area in the near future. Smaller isolated giant reed stands may be in the Matilija headwaters. Aerial photo studies conducted by the VCWPD in 2002 revealed that giant reed infestation in the original reservoir has increased from 5 percent vegetation cover in the 1969 delta area (approximately 5,000 feet upstream of the dam) to nearly 100 percent cover in the 2001 delta area (approximately 1400 feet upstream of the dam). The HEP analysis assumed that the giant reed in the Matilija Reservoir area will continue to spread and fully displace native riparian vegetation by year 50.

Matilija Creek in the reaches upstream of Matilija Reservoir's influence has high quality spawning and rearing habitat. Sections of the middle to upper Matilija Creek are thought to have been the primary spawning habitat, representing over half of the historically used habitat (Moore, 1980). About 21.6 miles of prime steelhead habitat could be available if Matilija Dam was removed and fish passage was restored at the Robles Diversion structure. This includes an estimated 4.3 miles of habitat on the Lower North Fork of Matilija Creek and 17.3 miles of habitat above Matilija Dam.

Ventura River Watershed

The riparian vegetation along the Ventura River is directly related to the hydro-geomorphic factors. The river's steep banks can scour and erode when the there is a rapid change in water surface elevation from flooding. Major storms can produce sediment-laden flows that dislodge significant portions of the riparian vegetation and alter the stream channel. Where gradients are low, alluvial material is deposited, thereby providing areas where emergent vegetation can become established. If the interval between stream-altering flows is several years, rapidly growing riparian vegetation can become mature and well established. The general pattern of riparian vegetation in the study area is, therefore, to exist in a state of constant succession.

The riverine system includes the active channel and floodplain. The active channel system is subdivided into an upper and lower perennial wetland (with high/low gradients and with well limited/developed floodplains, respectively), and intermittent wetlands (channel that contains water only part of the year). The floodplain riparian and wetland vegetation includes mature riparian forest of Fremont cottonwoods, willows, California black walnut, and California sycamores. The floodplain has shrub vegetation that is early successional or stunted due to environmental conditions (i.e., repeated scour/deposition or moisture regime). Herbs, mulefat, and immature cottonwoods and willows typically dominate the lower terraces of the floodplain. The upper terraces typically include alluvial scrub vegetation such as California sagebrush, white and black sage, buckwheat and laurel sumac. The vegetation typical of these subsystems is described in detail in the EIS/EIR.

The uppermost terraces of the floodplain do not require a permanent source of water or seasonal flooding. Vegetation within this system includes grasslands, oak grasslands, chaparral, California sagebrush, and coastal sage scrubs (e.g., black sage, white sage, and buckwheat).

Clumps of giant reed have colonized the floodplain within the Ventura River. Within active channels, scouring action removes giant reed, as well as native woody vegetation before maturation. However, in lower flood terraces that may be washed over by floodwaters but not necessarily scoured, vegetation can survive. The future without-project condition and the HEP analysis assumes that established clumps of giant reed will out compete and displace native vegetation significantly lowering the value of the riparian habitat in the HEP analysis.

The Ventura River anadromous steelhead population continues to be severely depressed. There have been only a few scattered reports of anadromous adult steelhead in the Ventura River since the 1960s. Southern steelhead have adapted to their unpredictable climate by retaining the flexibility to remain landlocked through many years or generations before returning to the ocean when conditions allow (Titus et al., 1994). Both anadromous and resident trout have adapted to periodic flood extremes and droughts through upstream movements. Smolts move downstream with receding storm flows from April through June (Shapovalov and Taft, 1954).

Ventura River Estuary

The Ventura River Estuary is a coastal lagoon and associated wetlands formed in the delta of the Ventura River. U.S. Highway 101, Main Street, Southern Pacific Railroad tracks, oil and gas pipelines, and electrical transmission lines cross the estuary. Seaside Wilderness Park and portions of Emma Wood State Park are also part of the estuary area. The estuary and associated wetlands is about 100 acres and lies directly west of the city limits of Ventura. The estuary is generally protected from tidal action by a sand bar during seasons of low flow. The sand bar disappears during storm events and rebuilds over time through renewed supply of sand from littoral transport. Strong ocean storms may also breach the sand bar. During periods when the river mouth is closed, water levels behind the barrier can rise up to 6 feet. Frequencies and durations of inundation influence vegetation distribution.

The Ventura River Estuary includes subtidal and intertidal habitats. The estuary is home to the Federally endangered species the tidewater goby (*Eucyclogobius newberryi)*. Intertidal vegetation includes cattails and bulrush, and scrub/shrub and forested wetlands. Scrub/shrub vegetation includes saltbush, picklewood and mulefat. Forested wetlands can have large mature trees with an understory of small trees and schrubs.

Along the eastern floodplain terrace between U.S. Highway 101 and the Southern Pacific Railroad tracks, VCWPD aerial photo studies show that almost all the native vegetation was removed during the February 1969 flood, and native willow scrub vegetation had recovered to at least 90 percent cover by 1983. A few giant reed clumps were also present, making up between 5 to 10 percent of the overall cover. By 2001, in the absence of any extensive flood events to remove surface vegetation, the giant reed has expanded to comprise over 75 percent of the overall cover.

Figure 2-7 – Ventura River Estuary

A review of 1928-1992 aerial photography showed that the river channel in the estuary has narrowed and its spread reduced by blockage or fill. An extensive sand dune and sandbar system in the adjacent floodplain has diminished in size. The Ventura River mouth has also moved farther west due to development in the area and construction of a levee, built by the U.S. Army Corps of Engineers in 1948, to protect the City of Ventura.

Steelhead Habitat Needs

Steelhead use flowing reaches to spawn. They are not limited to perennial waters and may use intermittent reaches to avoid crowding and potential predators (Carroll, 1985; Everest, 1973). Riffles provide the predominant spawning habitat. Good spawning habitat should have a high percentage of gravels (greater than 20 percent), no more than 15 percent fine sediments, and channel morphology offering good oxygen and silt-carrying velocities. Soon after hatching, steelhead fry swim up through the gravel and disperse downstream into shallow slow water stream margins (Bisson et al., 1981). Low gradient riffles, runs, and glides provide the primary rearing habitat into the early summer. The quality of rearing habitat is largely determined by the continuation of water flow of moderate temperatures and the availability of cobble and small woody debris for use as cover from predators and protection from high water velocities. Instream cover is in low abundance throughout much of the upper Ventura River Basin, a situation common to most Southern California coastal streams. Smaller sized wood is of importance to rearing juveniles, although it is still an uncommon element in this region.

Migrating steelhead can generally navigate upstream against flows up to 6 feet per second and leap over 4-6 foot heights (Evans and Johnston, 1972). Deep water (greater than half of the vertical jump) is necessary to gain the leaping momentum. Resting pools are necessary in long sections of high velocity flows. During low flows, boulder cascades, bedrock slides, and low gradient riffles may become barriers to upstream fish movement. Steelhead may become stranded on their upstream migration if flows rapidly decline. The presence of good deep pools is essential during this period, as fish may need to wait out the period between storms. Swimming and jumping abilities are size dependant (Evans and Johnston, 1972), so only larger individuals may be able to reach the upper reach spawning beds.

Restoration of fish passage above Matilija Dam would allow for an estimated 17 miles and 422 acres of pristine riverine habitat to become accessible to steelhead above Matilija Dam, and is considered the most valuable remaining reaches of rearing and spawning habitat for the entire Ventura River Watershed.

River Flow and Water Diversions

Streamflow in the Ventura River, as is typical in Southern California, can vary seasonally as well year to year. Perennial flow may be typical in some reaches of the river, while other reaches may be typically intermittent. Flows are perennial from the headwaters of the mainstem downstream to Robles Diversion Dam. From Robles Diversion Dam to the confluence with San Antonio Creek, the flow is intermittent. During summer months, there may be very little flow. At Casitas Springs, the groundwater rises due to a geologic discontinuity and feeds a perennial reach. The tributaries of San Antonio Creek and Live Oak Creek also contribute surface flows. At Foster Park there is some disruption in perennial flow due to groundwater extraction and surface diversion. Further downstream flows are perennial to the estuary. Contributions to flow in this lower reach are from treated effluent discharge from the Ojai Valley Sanitary District Wastewater Treatment Plant (CRWQCB-LA, 2002).

In a “normal” water year (15-40 inches of rainfall), there are adequate peak flows to allow steelhead and rainbow trout to migrate upstream until a barrier is met. Several successive winter storms could allow for multiple spawning migrations and could assist with the movements of steelhead smolts downstream to the ocean. However, an average of one out of five years is well below normal precipitation (less than 15 inches over the year), severely limiting steelhead spawning migrations and trapping smolts. Low flow barriers become more significant during the dry years, not only for limiting upstream spawning steelhead, but also for limiting movements of steelhead juveniles and wild resident trout into late summer refuge habitats.

There are several major structures that impact streamflow in the Ventura River Watershed: Matilija Dam, Casitas Dam, Robles Diversion Dam, Foster Park diversion structure, the City of Ventura groundwater pumping wells, and the Ojai Valley Sanitary District Wastewater Treatment Plant. The three dams and the Foster Park diversion structure affect the sediment regime and fish migration as well.

Future surface and groundwater water demands are not anticipated to increase in the area based on strict population growth initiatives and existing water supply limitations. Therefore, steelhead recovery, broader ecological values and the operation of the Robles fishway are not anticipated to change based on future water demand.

Matilija Dam

Matilija Dam was constructed in 1946-1947 by the VCWPD to provide for water storage for agricultural needs and for limited flood control. The structure is a concrete arch dam with an average height of 190 feet and a crest length of 616 feet. The dam varies in thickness from 35 feet at the base to 8 feet thick at the crown arch. More then 60,000 cubic yards of concrete was used for dam construction, with a minimum compressive strength of 3,000 pounds per square inch and maximum aggregate size of 3 inches. The concrete work for dam construction was placed in 5-foot lifts, and vertical contraction joints are spaced about every 40 feet. Project features included an overflow spillway, a plunge pool with a submerged 6-foot thick concrete apron extending about 75 feet downstream from the dam, a fish ladder and collection system, outlet works and a water supply pipeline. The dam has been notched three times over its life to its current configuration; therefore the current spillway width is 535 feet. The dam in its current configuration is shown in Figure 2-9.

The original construction of Matilija Dam featured two outlet pipes: a 36-inch diameter outlet for the water supply pipeline and a 48-inch diameter outlet pipe for river discharge. Casitas Municipal Water District (CMWD) operates the outlet works controls. The outlet works have been modified after the 48-inch pipe was abandoned due to sediment buildup behind the dam. Modifications include an additional 42-inch diameter outlet pipe for river discharge and a new intake structure and an additional 36-inch valve for river discharge.

A reinforced concrete fish ladder was installed during the initial construction of the dam. The fish ladder leads up the left abutment to a fish trap and holding tank. Originally, water flowed from the outlet works to the fish ladder and cascaded into the plunge pool. Fish were collected in the trap, loaded into a truck and hauled to an area upstream of the dam. Over the years, the fish ladder has been damaged by debris falling over the spillway crest during high flows and remains inoperable to this day. It is assumed that the dam will block fish passage to Matilija Creek for the 50-year future without-project condition.

The Matilija Reservoir and Dam had an initial capacity of 7,000 acre-feet at the spillway crest. The reservoir was first completely filled with water in 1952. Since its construction the reservoir capacity has decreased significantly due in part to the dam notching and also due to the large debris sedimentation in the reservoir following significant storm and fire events. The reservoir capacity is presently estimated to be less than 500 acre-feet, or about 7 percent of the original capacity. It is estimated that approximately 6,000,000 cubic yards of sediment (silts, sands, gravels, cobbles and boulders) is trapped in the reservoir. There is little, if any, incidental flood storage currently available in the Matilija Reservoir.

Figure 2-8 – Matilija Dam in 1948

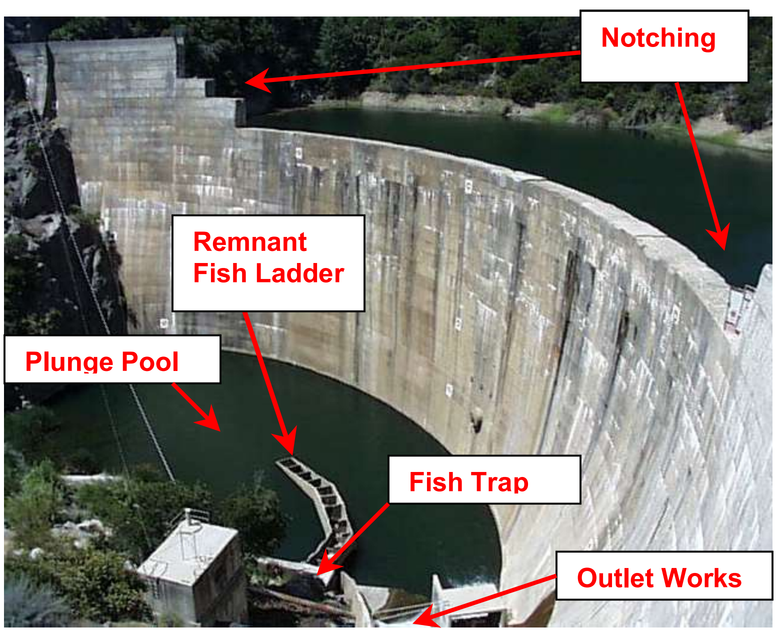


Figure 2-9 – Matilija Dam , 2001

Structural Dam Safety Evaluation

Matilija Dam has been exposed to adverse internal and external conditions that have affected its operation and safety since its construction in 1946-47. Concrete in the dam has experienced excessive deterioration due to *alkali-silica reaction (ASR)*. This is a reaction between the alkali in the cement and certain siliceous constituents that may be present in the aggregate. This deterioration is evidenced by expansion, cracking, and disintegration of the concrete in the upper 40 feet of the dam. Concrete core sampling and testing performed in past studies have shown a decrease in the concrete compressive strength for the upper portions of the dam, although testing also showed higher than specified compressive strengths 40 feet from the top of the dam and far fewer cracks than the upper portions of the dam. The deterioration, however, is expected to spread to the lower portions of the dam as pressures confining the ASR are relieved through chemical expansion. Thus, the material properties of the concrete in the dam are expected to continue to degrade for the remaining life of the structure. Due to sedimentation filling in approximately 93 percent of the original reservoir, loads acting on Matilija Dam have increased dramatically since its original design. The estimated earthquake-induced ground accelerations have increased from the original design ground acceleration of 0.1g to an updated peak horizontal ground acceleration (PHGA) of 0.7g for the Maximum Credible Earthquake. The ASR has increased the internal stresses within the structure and acts in combination with the other static and dynamic loads.

To lower and widen the spillway in order to maintain adequate factors of safety, the dam was notched three times. In 1965, a 280-foot wide by 30-foot high segment was removed from the centermost portion of the dam where damage was the greatest. A second notching was performed in 1977, whereby another 78 feet in width was removed. The notched portion of the dam serves as the spillway. The notching has decreased the maximum pool level and has thus decreased the loads and stresses acting on the dam.

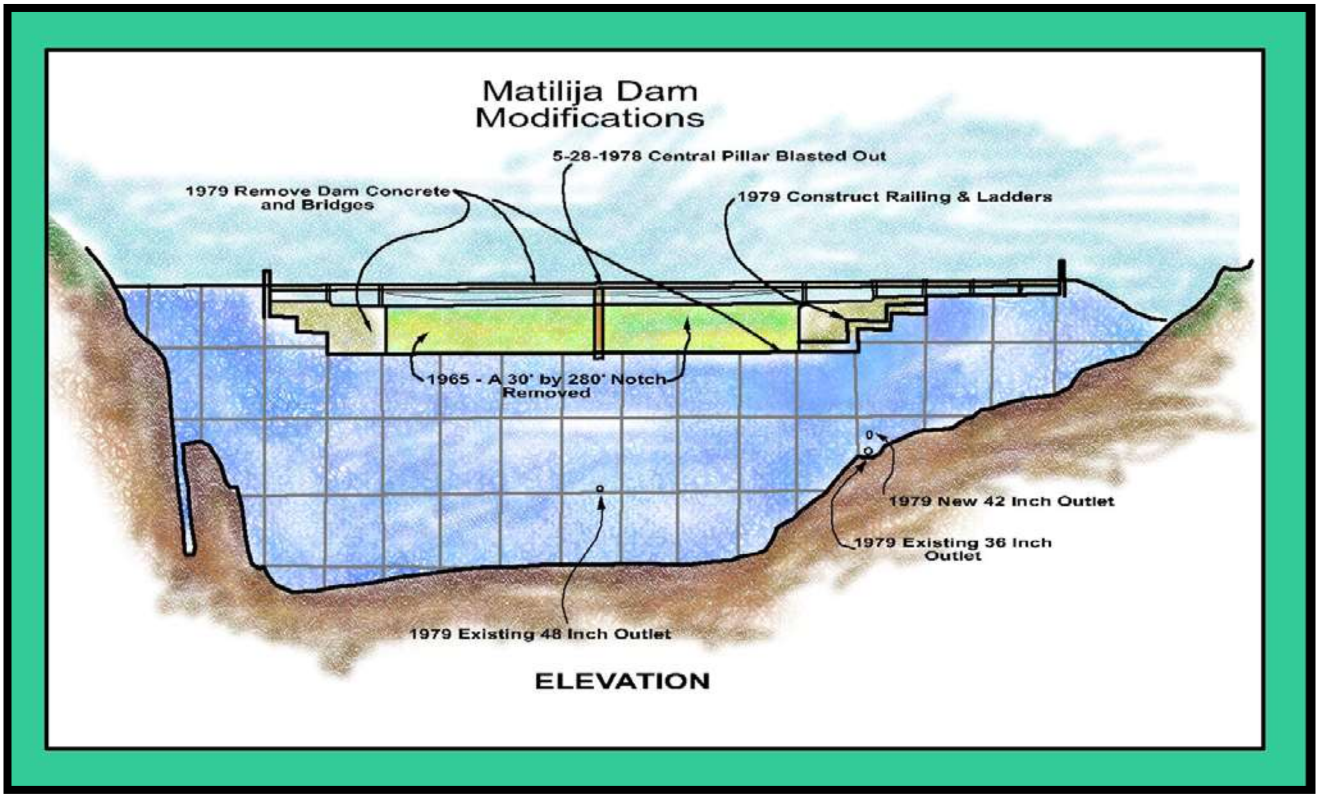


Figure 2-10: Historic Notching of Dam

The California Department of Safety of Dams (DSOD) considers most dams in Southern California to be high hazard dams due to their proximity to populations. Matilija Dam is categorized as a high hazard dam by DSOD, with potentially substantial consequences in the remote event of a dam failure including loss of life, the disruption of critical facilities and access, major damages to public and private property, and extensive mitigation required for environmental damages. This classification in no way implies that there are structural deficiencies that render the dam unsafe. Recent analyses conducted by consultants to the VCWPD have shown that Matilija Dam is adequately stable. The reports recommend continued operation with periodic inspection and future concrete sampling and testing. The dam marginally meets current safety criteria for arch dams when applying U.S. Army Corps of Engineers criteria to the previous study results.

Monitoring and Management of Matilija Dam

For the current and future baseline condition assumptions, it is assumed that the dam will remain in place as it exists today and that no additional notching will be necessary for the next 50 years. However, since the quality of concrete will decrease, and the loading due to sedimentation will increase, modifications still may be required in order to maintain an adequate level of safety for the dam. The scope of such modifications is dependent upon the actual rate of concrete deterioration and sediment deposition. The VCWPD has stated that there are no plans for modifying the Dam from its current configuration. There will be continued inspection and monitoring, including periodic concrete sampling and testing, serving as indicators of Matilija Dam's remaining life.

Federal and State laws, rules and regulations do not currently require the dam owner, the VCWPD, to undertake any corrective actions to restore fish passage at this dam. The existing lease agreement that CWMD has with the VCWPD also does not require that fish passage or other restoration measures be enacted as part of the lease agreement, or in compliance with the Endangered Species Act of 1973 (ESA).

The VCWPD states that it is unlikely that measures could be taken on their own to restore fish passage and sediment transport at the Matilija watershed without the involvement of the Federal government due to the size, complexity and cost of dam removal. Removing Matilija Dam is a key component of a long-term plan to manage and implement multi-purpose projects to address Ventura River Watershed issues, such as ecosystem degradation, flooding, and management of surface and ground water supplies for domestic and environmental purposes in other portions of the Ventura River Watershed.

Robles Diversion Dam

Robles Diversion Dam is located on the Ventura River about 1.5 miles downstream from the confluence of Matilija Creek and North Fork Matilija Creek and approximately 2 miles downstream of Matilija Dam. The Robles Diversion Dam is owned by the U.S. Bureau of Reclamation (USBR) and operated by the CMWD. The structure was built by the USBR in 1958 and diverts surface water from the Ventura River to Casitas Reservoir via the 4.5- mile long Robles-Casitas Canal. The major components of the dam are: an earth and rockfill structure and an upstream sediment basin to trap coarse-grained material during storm events; a series of three 7-foot high concrete by-pass gates to allow for the capture or release of Ventura River flows for diversion to the Robles-Casitas Canal; fish screens at the canal to prohibit fish from entering the water diversion canal; and turbidity control systems to lower turbidity levels of waters before entering Lake Casitas. The Robles Diversion Dam currently obstructs about 6.3 miles of steelhead spawning and rearing habitat from Robles Dam to Matilija Dam and the Lower North Fork of Matilija Creek.

The maximum diversion from the Ventura River to Casitas Reservoir is approximately 500 cubic feet per second (ft^3/s) through the Robles Canal. Water diversion is subject to operating criteria established in the 1959-1960 water year and a March 2003 Biological Opinion (BO), prepared by the National Marine Fisheries Service (NMFS - NOAA Fisheries), addressing effects on steelhead. The BO is prepared based on the construction and operation of a new fishway at the facility, in accordance with Section 7 consultation of the ESA.

In general, when the natural flow of the Ventura River at the Robles Diversion Dam is less than 20 ft^3/s, the entire flow will be passed down river and when the natural flow is greater than 20 ft^3/s, no less than 20 ft^3/s will be passed down river. On average, diversions from the facility to Lake Casitas average 13,000 ac-ft/yr for the relatively wet period of 1991 to 2001.

Robles Diversion Dam is subject to large amounts of sediment deposition during floods, and significant sediment removal is necessary following a major flood event. However, large floods govern the majority of sediment transport in the Ventura River, and Robles Diversion Dam does not significantly affect these flows during these events.

Figure 2-11 – Robles Diversion Dam Sediment Basin

Figure 2-12 – Robles Diversion Dam Sluice Gates

Robles Fishway

A fish passage facility is nearing completion at the Robles Diversion Dam to allow migratory steelhead to bypass this facility. The NMFS biological opinion describes the principal components of this fishway as:

- A 360-foot long fishway with "step pools" by which migrating fish can traverse the 7-foot high Robles Diversion Dam;
- An auxiliary water supply pipeline, which would allow the ladder to operate during flows ranging from 50 to 1,500 cfs;
- A flow control structure for metering water through the fishway;
- A fish guidance device and upstream outlet designed to prevent "fallback" of fish successfully migrating through the facility;
- A self-cleaning fish screen to prevent adult and juvenile downstream migrating steelhead from being inducted into the Robles Diversion Canal and Casitas Reservoir;
- A series of grade stabilizers downstream to ensure adequate pool depth at the entrance to the fishway; and
- A monitoring and counting technology to determine the fishway performance and the number of fish utilizing the facility.

The fishway would allow for a total average of 22 days of fish passage annually, and would also prevent juvenile downstream migrant steelhead from being inducted into the Robles Diversion Canal and the Casitas Reservoir. It is anticipated that steelhead spawning and rearing habitat in the lower reaches of Ventura River would also benefit from regulated water bypasses during the January through June spawning and migratory season.

The USBR and CMWD will be responsible for the operations of the Robles Fishway. The passage facility will be operated during the steelhead's natural upstream migration and downstream emigration period (January through June), and only operated when there is sufficient flow to allow migration of fish from the Robles Diversion Dam to the mouth of the Ventura River. The number of times and days each year that the facility will operate depends on the timing and duration of winter storms.

The initial operating criteria for the facility generally provides for a minimum flow of 50 cfs for 10 consecutive days for each storm event and 30 cfs for the rest of the timeframe during the January through June migratory season. The higher flows through the ladder following storm events allow for the fish to migrate from the ocean through the lower reaches of the Ventura River, to the fishway. NOAA fisheries, in conjunction with BOR and CDFG, developed this criterion in order to develop a release schedule that mimics the natural recession rate of Ventura River storm events and thus eliminates sudden, unnatural reductions in downstream flow.

At inflow ranges of 10 to 671 cfs, fish will move up and downstream through the diversion structures via the fishway, fish bypass channel and the diversion headworks gate. The fishway is designed to meet established fish passage criteria at flows of 20 cfs. Passage may be possible at lower flows. The fishway will also function in higher flow conditions, greater than 671 cfs. The fishway's operating criteria, ensuring the success of its functioning, and monitoring and adaptive management is directed by the terms and conditions expressed in the BO between NMFS and the USBR. The BO is considered a binding agreement in regard to the future operation of the fishway.

Careful consideration has been given to the operation of this fishway to ensure that there are no adverse impacts to water storage at Casitas Dam. Drought provisions include tying the operation of the fishway to naturally occurring river flows and limiting operation under certain conditions.

Casitas Dam

Casitas Dam, which dams the Santa Ana and Coyote Creeks, was built in 1958 by the U.S. Bureau of Reclamation to provide water for agricultural, municipal and industrial use. It can serve up to approximately 60,000 customers. The facility also provides recreational activities including boating, camping, and hiking. The dam is owned and operated by the Casitas Municipal Water District (CMWD). The structure is located on Coyote Creek about 2 miles above the junction of the creek and the Ventura River. The dam, earth and rockfill, is 285 feet high with a reservoir capacity of 250,000 acre-feet. Prior to Casitas Dam, Coyote Creek contributed 18 percent of flow at Ventura River. After construction, significant flow downstream of the Casitas Dam in Coyote Creek only occurred during wet years in which the spillway was passing water. As a result, Coyote Creek contributed approximately only 5 percent of the flow in the Ventura River during the period 1971-1980. Casitas Dam also traps effectively all the sediment that enters into it. Casitas Dam is a barrier to fish passage. Some steelhead spawning and rearing occurs downstream of the dam (NMFS, 2002). This feasibility study does not contain an evaluation specifically related to Casitas Dam. Discussion of this dam is included because of its connection to Robles Diversion Dam.

Foster Park Diversion

The Foster Park Diversion (Reach 3, RM 6.3), owned by the City of Ventura, was constructed in 1906 by the Ventura Power Company, and is located approximately 1,200 feet north of Foster Park Bridge. The diversion is approximately 10 miles downstream of Matilija Dam. The structure is a submerged weir extending across Coyote Creek and Ventura River. The depth of the structure is about 65 feet. The structure was constructed to raise the groundwater table and thereby supply municipal pumps located upstream. The operation is a combination of surface diversion and subsurface wells. On average, surface diversions are 2,500 acre-feet per year (ac-ft/yr) and groundwater pumping is 3,900 ac-ft/yr (Reclamation, 2003). No surface water is diverted if high suspended sediment concentrations are present in the river (greater than 10 NTU). The Foster Park Diversion does not affect sediment transport in the Ventura River.

The structure is at most only partially exposed and is not considered to be a physical impediment to either up or downstream migration of steelhead. However, in the past the surface intake was unscreened and would induct fish into the intake; this intake was fitted with a fish screen about 25 years ago, and has been operated to prevent the induction of juveniles, or large downstream migrants (Capelli, 2002).

Seasonal dewatering of the reach of the river between the Casitas Vista/Foster Park Bridge and Casitas Springs may occur as a result of both the surface diversion and the series of pumps immediately upstream from the Foster Park Diversion. Adult steelhead are able to spawn in this reach of the river, which normally retains a small surface flow as a result of rising groundwater (Capelli, 2002).

Figure 2-13 – Foster Park Diversion Structure

Water Rights

Since 1959, per a 50-year agreement (1959 to 2009) between the VCWPD and CMWD, Matilija Dam has been used to temporarily store winter runoff for release to the Ventura River and diversion to Robles Diversion Dam, where it is diverted to Casitas Reservoir. The general operating criteria for Lake Casitas is to maintain outflow equal to inflow when diversions are not taking place at Robles Diversion Dam. The yields of Matilija Reservoir to Lake Casitas have gradually decreased as a result of sedimentation at Matilija Dam, from approximately 1,900 acre-feet per year to an average of 590 acre-feet per year (BOR, 2003). Impounded water at Matilija Dam serves as an occasional source of water for fire fighting efforts. CMWD also considers it a potential source of water for emergency water supply, if ever needed. This study assumes that the lease agreement would not be renewed by the VCWPD after the 2009 expiration date since infilling of the reservoir will continue with about 150 ac-ft of storage remaining in 2010, and less than 50 ac-ft remaining by 2020.

Prior to the agreement with CMWD, VCWPD supplied water directly from Matilija Dam to end users in eastern Ojai via the Matilija Conduit, an underground pipeline. The Matilija Conduit is currently non-operational and no longer provides a direct connection as a water supply pipeline to the Ojai area customers. Instead, CMWD provides water directly from Lake Casitas to the agricultural and ranching end users in eastern Ojai.

Wastewater Treatment

The Ojai Valley Sanitary District Wastewater Treatment Plant was constructed in 1963 with 1.4 million gallons per day (mgd) capacity and expanded in 1982 to its current dry weather capacity of 3 mgd and wet weather (short duration) capacity of 7.0 mgd. It was upgraded to tertiary treatment in 1997 to help mitigate nuisance growth of aquatic plants and low dissolved oxygen occurring downstream of the discharge. Based on their release data from 1990 to 2001, the plant released treated effluent at an average rate of 1.5 mgd (2.36 ft^3/s) into the Ventura River from the outfall located approximately 3000 feet upstream from the confluence of Cañada Larga. No modifications to existing operations are anticipated for the future without-project condition.

Hydrologic, Hydraulic and Sediment Transport Studies

The BOR developed the hydrologic, hydraulic and sediment transport (H&H) modeling used for the without-project conditions analyses and the alternatives studies. Hydrologic studies investigate the rainfall and runoff patterns in a watershed and are used for the hydraulics and sediment transport studies for the without-project conditions and the analysis of alternative plans. Information for this analysis relies on historical rain gage and field data, topographic mapping, land use and vegetative coverage, and the frequency and impacts associated with brush fires.

Hydrologic Studies

A flood-frequency analysis was performed for the entire length of the Ventura River. The magnitude and frequency of discharges for the 10-, 20-, 50-, 100-, and 500-year events were developed using data from stream gages and the seven largest storms on record. A separate analysis was performed to obtain the flood magnitudes for more frequent 2- and 5-year return period events. Table 2-4 presents the peak flows used for the hydrologic study.

Table 2-4 – Peak Flows for Ventura River at Existing Stream Gauge Sites

Flood Flows at Selected Locations (ft^3/s)						
Return Period (yr)	Upstream of Confluence with N. Fork Matilija Creek	Downstream of Confluence with N. Fork Matilija Creek	Baldwin Rd.	Casitas Springs	Casitas Road Bridge	Shell Chemical Plant
2	3,060	3,250	3,380	4,130	4,520	5,080
5	7,090	7,580	7,910	9,820	11,060	12,250
10	12,500	15,000	16,000	35,200	36,400	41,300
20	15,200	18,800	19,800	44,400	46,400	52,700
50	18,800	24,000	24,800	56,600	59,700	67,900
100	21,600	27,100	28,300	66,600	69,700	78,900
500	27,900	35,200	36,700	89,000	93,100	105,500

Flow duration curves were developed from stream gage data. Over 60 percent of the time, the flow is less than 10 ft^3/s in the Ventura River at Foster Park, and approximately 80 percent of the time the flow is less than 10 ft^3/s in the Ventura River at Meiners Oaks. The river has no flow at least 30 percent of the time at Meiners Oaks. It was determined that flood duration is very short and large flows occur infrequently. For example, the 2–yr flood value is only exceeded 0.2 percent of the time in the Ventura River

The 10-year record of storm events from the 1990s were used for the development of the flood hydrograph to simulate the baseline conditions and alternative conditions. This decade of hydrographic information was repeated five times to simulate the 50-year pattern and magnitude of future condition storm events for the hydraulic and sediment transport models. The flow records from the 1990s were used since gage data was available in 15-minute increments and the short-term peak flows could be modeled more accurately. The Ventura River Watershed has highly variable flow hydrographs. It is a coastal watershed with a steep streambed slope and conveys river flow at high velocities. This type of a watershed is termed “flashy.” This term implies that the river stage rises and falls abruptly within a hydrologic event.

The cyclic variations in peak flow magnitudes and frequency are shown in Figure 2-14. From the 1930s to the mid 1940s the floods were relatively frequent. From mid 1940s until the late 1960s, the floods were less frequent and of smaller magnitude, except for the large flood of 1969. From the 1970s until the present, floods have occurred relatively frequently and several have been very large with the largest flood of record occurring in 1978.

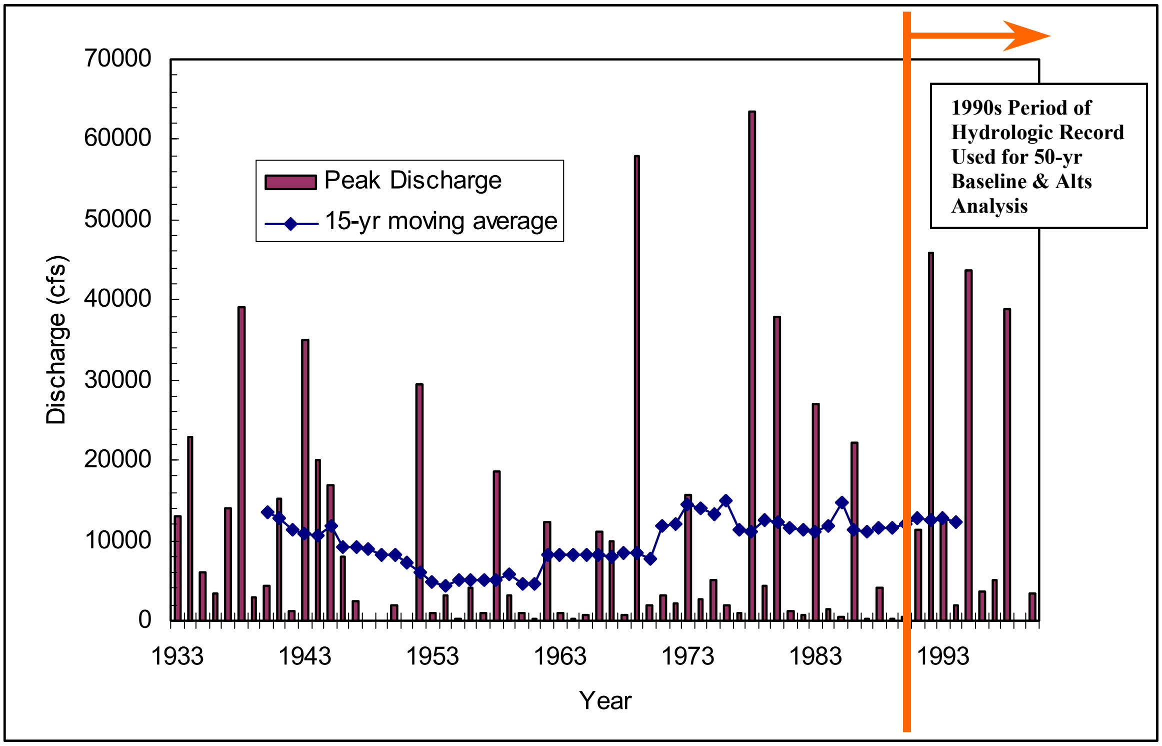


Figure 2-14 – Peak Discharge History in the Ventura River

Hydraulic Studies

The BOR developed digital terrain models and ortho-rectified photographs for the project reaches based on an aerial survey flight on October 10, 2001. Microstation CADD and InRoads software programs were used to develop design surfaces from this data and to create the geometry for the hydraulic model. Cross sections were constructed at intervals of approximately 500 feet along the study reaches from just upstream of the sediment deposition behind Matilija Dam to the mouth of the Ventura River. In addition, eight bridges were field surveyed to more accurately model bridge geometry throughout the project reach.

The Army Corps of Engineers computer program HEC-RAS 3.0 was initially used to simulate the hydraulics for each flood. Results were generated for each cross section along the study area. The hydraulic model was calibrated based on observed data at the Foster Park gage. This study assumes that existing condition and future without-project condition discharges would remain the same based on current and future land use comparisons. Overflows were computed for the 2, 5, 10, 20, 50, 100, and 500-year return periods using the hydraulic model. Overflow figures are presented in the H&H appendix and show inundation areas along the Ventura River.

Sediment Transport Studies

Without-project conditions sediment transport modeling was prepared using HEC6 and later using the BOR sediment transport model GSTAR. These one-dimensional models were used to quantify potential deposition or erosion within the channel for a large range of floods under current and future morphologic conditions.

Sediment yield data from previous studies and the historical depositional and trap efficiency history of Matilija Dam were utilized in estimating sediment yields for the Matilija and Ventura River Watersheds. The sediment routing from Matilija Dam to the mouth of the Ventura River was simulated in two separate models. The first was from below Matilija Dam to upstream of the confluence of San Antonio Creek, and the second was from that confluence to the mouth of the Ventura River due to inflowing sediment loads from San Antonio Creek.

Sediment transport simulations also included the modeling of individual storms such as the 10-yr, 50-yr, and 100-yr return period events. Alternative simulations were modeled using the BOR sediment transport model GSTAR. Results were compared to specific HEC6 model runs for validation purposes.

Sediment Deposition at Matilija Dam

Historic sediment monitoring information, initiated in 1947, was used to calibrate the sediment transport modeling. The earliest sedimentation in the reservoir developed mainly at the upstream end and in the channel region immediately upstream of the dam. By 1954, the BOR estimated that Matilija Reservoir was filling in at a rate of 79 acre-feet per year (127,000 CY/YR). The 1965 notching of the dam reduced the storage capacity of the reservoir from 7,000 acre-feet to about 4,600 acre-feet (7.4 MCY) after considering the storage volume already lost due to sedimentation.

Large storm events in the Matilija watershed are the primary source of sediment that has deposited upstream of the damsite. The 1969 storm season alone deposited about 1.6 MCY of sediment (1,000 acre-ft), spread uniformly over the entire length of the reservoir. An additional 3 MCY of sediment has deposited behind the dam since the late 1960s. Most of the sediments were transported during larger storm events, such as those in 1978, 1992, 1995 and 1998.

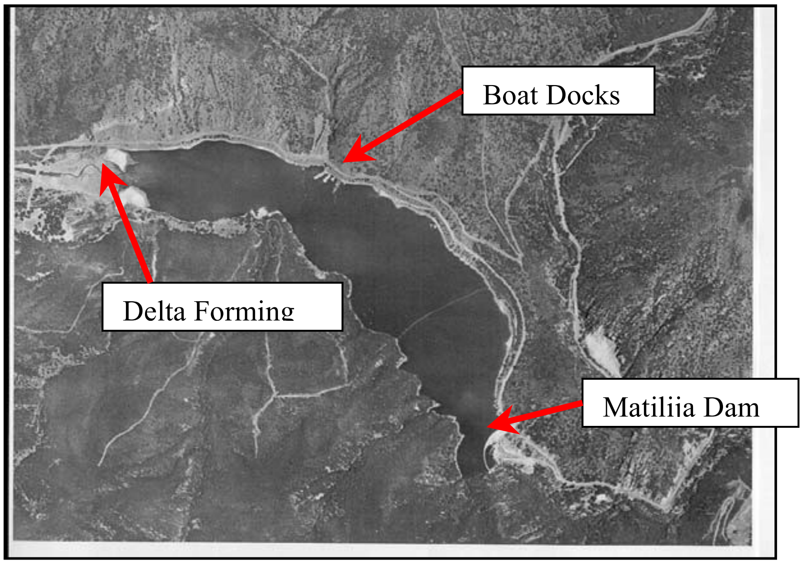


Figure 2-15 – Aerial View of Matilija Dam and Reservoir, 1960 (Photo: EDR, Inc)

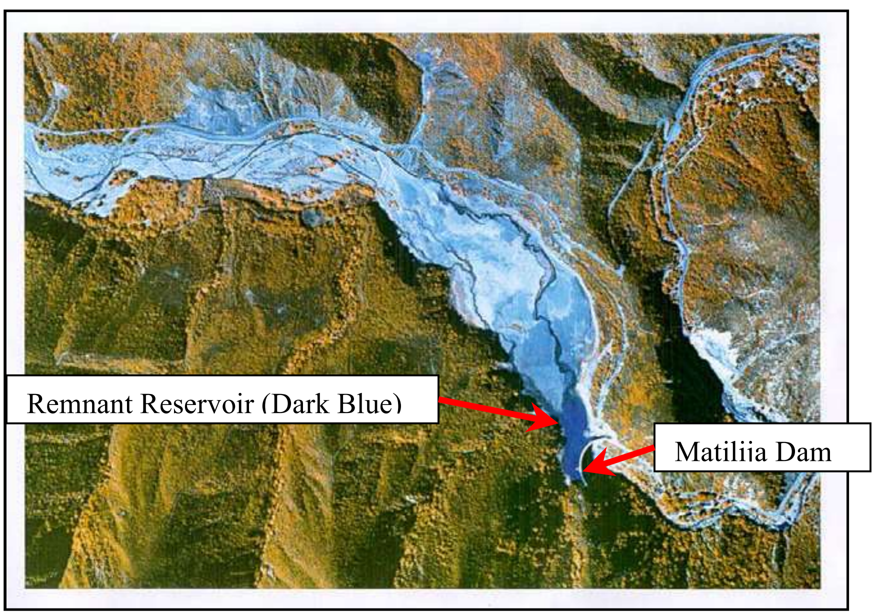


Figure 2-16 – Aerial View of Matilija Dam and Reservoir, 1978 (Photo: EDR, 1978)

Several methods were considered to estimate the historic, current and future sediment trapping efficency of Matilija Dam. From 1947 to 1964, it is estimated that the dam trapped about 95 percent of the total sediments from the watershed. Today, it is estimated that the trapping efficiency has dropped to approximately 45 percent of the total sediment load from Matilija Creek, although the trap efficiency for sand sizes and greater is still practically 100 percent. Field verification and analysis of borehole samples indicate that coarser grain sizes are being deposited in the delta or the upstream end of the reservoir. It is believed that a large percentage of the fine materials (silts and clays) pass over the top of Matilija Dam during storm events.

This study estimates that an additional 3.5 million cubic yards of sediment will deposit behind the dam in the next 35 to 40 years, and more material will pass over the dam as the structure becomes less efficient in trapping material during storm events. As Matilija Reservoir continues to fill with sediment, an equilibrium will eventually be reached whereby the sediment will fill the reservoir completely, and the resulting sediment surface will form a constant slope from a point close to the crest of the dam (at the upstream face) to a point upstream where the slope intersects the grade of the approaching natural stream slope. The equilibrium slope is estimated to be 50 percent of the natural stream slope profile for this study or approximately 1.1 percent. The upper limit of the deposition would increase from the current distance of about 1.2 miles from the dam to about 1.8 miles. Sediment trapping efficiency would decrease as time progresses, allowing more sediment to pass over the dam.

Table 2-5 – Projected Deposition with Dam in Place

Year	Dam Crest Elevation	Reservoir Storage (ac-ft)	Est. Trap Efficiency (%)	Est. Deposited Volume (yd3)
2003	1095	500	45	5,800,000
2010	1095	150	27	6,900,000
2020	1095	45	10	7,800,000
2030	1095	14	5	8,600,000
2040	1095	4	0	9,300,000
2050	1095	1	0	9,300,000
2060	1095	0	0	9,300,000

The reservoir is predicted to have less than 50 ac-ft of storage by 2020. Aerial photography from 2001 shows the delta to be within 1200 feet of the dam face. The average rate of delta progression, estimated by comparing aerial photos taken in 1973, 1985, and 2001, is 46 ft/yr. This indicates that the delta would reach the dam face in approximately 25 years. However, it is expected that the delta progression rate will slow and the delta will reach the dam face at the same time the equilibrium condition of the reservoir is obtained, in 35 to 40 years.

Currently, the Matilija Creek subwatershed contributes approximately 24 percent of the total sediment load of the Ventura River Watershed at Foster Park. As Matilija Reservoir fills, the Matilija Creek subwatershed will contribute more sediment until its contribution stabilizes at approximately 37 percent of the total watershed sediment load at Foster Park.

Geotechnical Investigations of Deposited Sediments

The BOR (2002) has identified three primary sediment zones impounded behind the dam, based on sediment gradation data that overlay pre-dam alluvium. These zones make up the historic extent of the Matilija Reservoir, and have been designated with the names “Reservoir Area,” “Delta Area” and “Upstream Channel Area.”

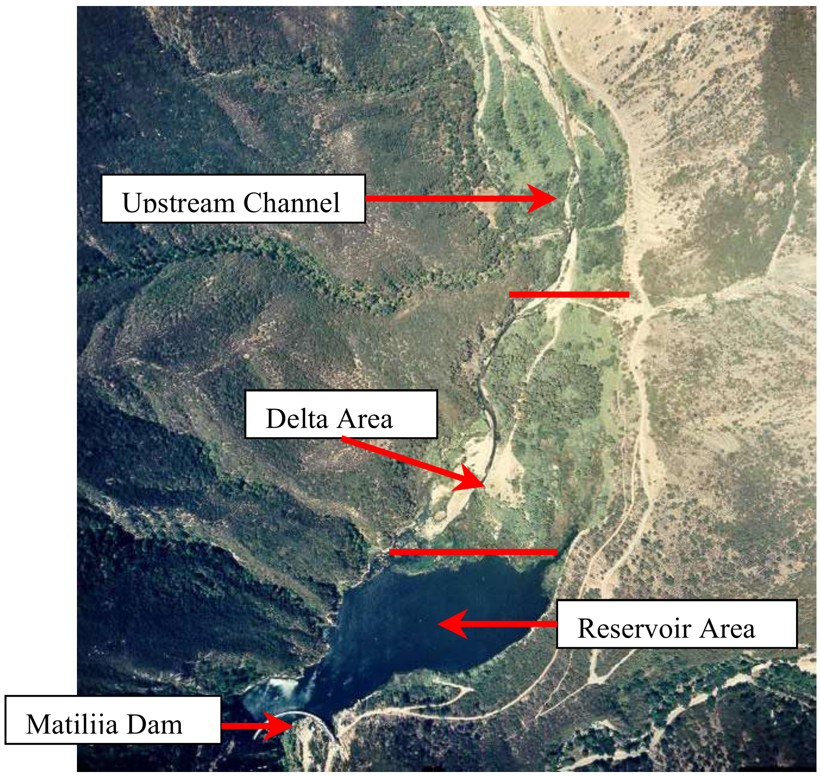


Figure 2-17 - Sediment Deposition Areas

Field investigations were performed to characterize the make up and quantity of material that has deposited behind the dam since the completion of construction in 1948. The primary sources of geotechnical data for the feasibility study are the field investigations conducted from July to September 2001 by the BOR. These investigations consisted of 15 drill holes, eight of which were drilled from a barge; the remaining seven were drilled on land using a truck-mounted drill rig. A total of 98 samples were tested for gradation, Atterberg limits, and moisture content. Hazardous and Toxic Waste (HTW) sampling was also conducted. Sediment toxicity analyses were conducted on 39 samples, and analyses were conducted on two methane gas samples.

In addition to the investigations described above, The USBR conducted a sediment gradation surface study of the “Upstream Channel Area” in June 2002. Cobble/gravel/boulder bars in the braided stream deposit were mapped and investigated to determine percentages of sand, gravel, cobbles, and boulders. More detailed information related to all of these studies is included in the Geotechnical appendix.

Boring logs were visually assessed and lab results were used to determine the percentage of silt, sand, and gravel in the three deposition zones behind the dam. Weighted averages of silt, sand, and gravel were then determined for both the "Delta Area" and "Upstream Channel Area."

Table 2-6: Approximate Quantity of Materials behind Matilija Dam (cubic yards)

Material Type	Reservoir	Delta	Upstream Channel	Total
Silt	1,823,000[2]	667,000	104,000	2,594,000
Sand	297,000[2]	1,408,000	234,000	1,939,000[3]
Gravel Plus[1]		395,000	962,000	1,357,000
Total	2,100,000	2,470,000[1]	1,300,000[1]	5,890,000[1]

[1] These values include material gravel size and coarser (cobbles and boulders).
[2] Reservoir sediments are estimated to be in excess of 90 percent fines. These values represent estimated minimum quantity of silt and maximum quantity of sand.
[3] Volume of sand available for potential beach placement should not include volume of sand from "Reservoir Area." Beach suitable volume is 1.8 million cubic yards.

The "Reservoir Area" encompasses the area from the upstream face of the dam to approximately 1,400 feet upstream of the dam. The limits of the "Reservoir Area" are approximated by the location of the open water (pool). Sediments in this zone are typically silts. The total volume of sediment in this area is estimated to be 2.1 million cubic yards.

Pressurized natural gas (methane) was also encountered in several locations at various depths. Samples of the natural gas were tested and confirmed its presence to be the byproduct of organic material decay. Therefore, the presence of methane is not expected to affect overall project costs or construction activities related to sediment removal measures, although venting may be necessary.

(Photograph on right from Matilija Coalition)

Figure 2-18 – Matilija Reservoir Area (Partially Drained on Right, 2003)

The “Delta Area” extends from the upstream edge of the open water to approximately 1,500 feet upstream (between 1,400 feet to 2,900 feet upstream of the dam). The total volume of sediment in this zone is estimated to be 2.5 million cubic yards. The materials are predominately silty sand, especially in the downstream portions of the zone, but tend to become coarser in the upstream direction with more gravel and cobble content. The total volume of sediment in the “Delta Area” is estimated to be 2.5 million cubic yards.

The “Upstream Channel Area” extends from the upstream edge of the “Delta Area” to the upstream limit of sedimentation behind the dam (from 2,900 feet to approximately 6,000 feet upstream of the dam). The total volume of sediment in this reach is estimated to be 1.3 million cubic yards.

Drilling conditions were generally difficult in the “Upstream Channel Area” due to the very coarse nature of the deposited cobbles and boulders. Therefore, samples obtained by drilling operations were compared to the data obtained from the sediment gradation surface studies.

The sediments impounded behind Matilija Dam, except for the “Reservoir Area,” are highly heterogeneous, that is, there is a large variation in grain size, and the materials can be very mixed. From the upstream limit of “Upstream Channel Area” to the downstream limit of the “Delta Area,” the materials grade from very coarse to very fine; however, there are also significant quantities of fines in some samples in the “Upstream Channel Area” and coarse materials in samples in the “Delta Area.” The geotechnical borehole logs of investigation show that there are no large unmixed deposits of clean sand behind Matilija Dam.

There are approximately 1.7 million cubic yards of beach-compatible sand behind Matilija Dam, and 2.7 million cubic yards of sediment that would meet the minimum gradation requirements for beach placement (sands and gravels). However, due to the heterogeneity of the deposited sediments, twice that volume would need to be excavated and transported to get this sand to the beach via mechanical means (trucking, slurry, or conveyor systems), unless very expensive processing systems were used to separate out the desired materials.

Hazardous and Toxic Waste Sediment Assessment

Sediment toxicity analyses were performed to determine whether problems might arise with mechanical disposal of some or all of the deposited sediments in different locations, including several upland sites and for beach nourishment. Results showed that none of the impounded sediments exceed Puget Sound Dredge Disposal Analysis limits for the 81 constituents used to screen for beach disposal of the material. In a few instances, the more rigorous NOAA sediment quality assessment criteria were exceeded by some samples for some constituents. Historical research and regulatory database research determined no deleterious past use of the reservoir's contributory watershed: no metals mining or prospecting, no industrial development or agriculture, and extremely limited commercial/recreational development. DDT was detected in some samples and was likely used for mosquito control. There are no indications through testing or research to date that any of the impounded sediments qualify as "hazardous waste," the upland disposal criteria. Details are presented in the Geotechnical appendix.

Ventura River Morphology (Deposition and Erosion Patterns)

The river and creek beds are mostly dominated by cobbles though there is a large range of sediment sizes. Throughout the entire area sampled, there were sands interspersed between the larger rocks. Results of the streambed sediment sampling indicate that the particle size generally increases upstream with river mile (RM) distance. Near the ocean (RM 0), the average material diameter is approximately 3 inches; just downstream of Matilija Dam (RM 16.5), it increases to over 12 inches. This is consistent with typical sediment distribution in natural river channels where materials tend to be coarser in the upstream reaches where the slopes are steeper and flows have more velocity. Sampling upstream of the dam was limited to one location. Correlation with downstream material diameter trends is not possible due to the presence of the dam.

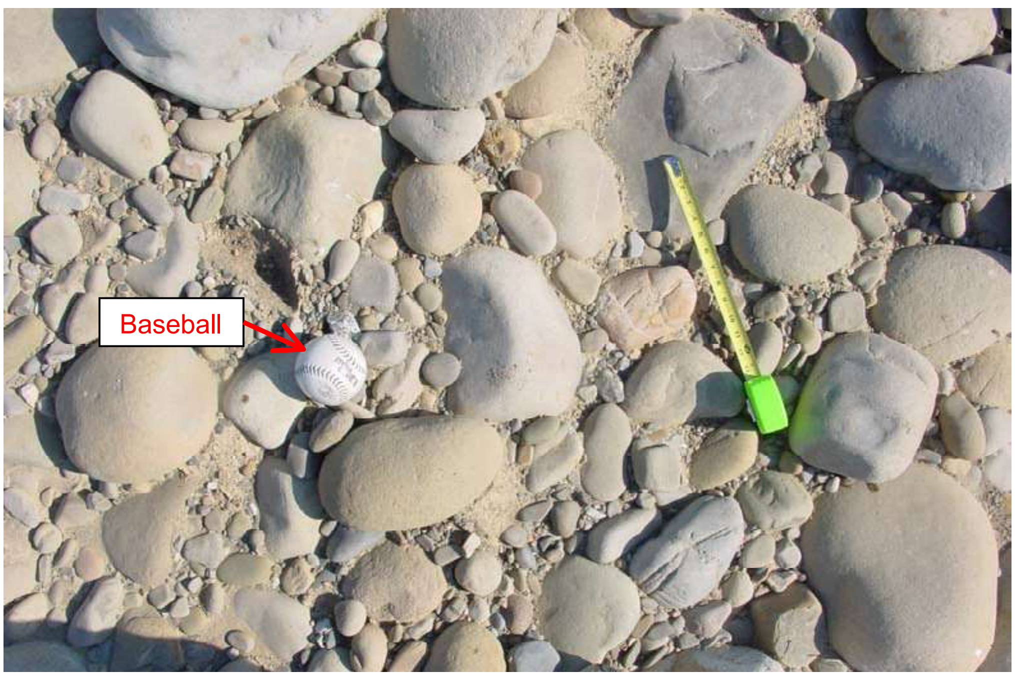


Figure 2-19 – Typical Surface Bed Material (Sample Site #8, RM 2.5)

The Ventura River has experienced significant erosion in the past 30 years based on comparisons between the 1971 and 2001 surveys. The water leaving Matilija Dam is sediment starved and picks up sediment from the downstream river channel to replenish itself. Erosion has occurred throughout most of the Ventura River, with the exception of a few locations.

The BOR performed streambed sediment sampling and analysis in October 2001. The data obtained from this study was used for sediment transport calculations under existing conditions and to monitor changes in the river for the analyses alternatives. A total of 18 bed material samples were collected, spaced approximately every mile, from the mouth of the Ventura River to 1.5 miles upstream of Matilija Dam. Two additional samples of beach sand were collected along the shoreline near the mouth of the Ventura River.

It is expected that the Ventura River erosional rate will slow significantly throughout the Ventura River. This conclusion is based on the comparison of selected historical and current cross-section measurements, sediment routing, and computation of the required depth for full armoring. In the future, storm flows downstream of Matilija Dam will not be as sediment starved as trapping behind the dam gradually decreases. Therefore, sediment loads will gradually increase in the Ventura River as less sediment is trapped behind Matilija Dam, and less sediment will erode from the Ventura River streambed to replenish itself. Historic erosion is summarized by reach, and future changes based on the sediment transport model outputs are presented below.

Reach 6b: This reach immediately below Matilija Dam has experienced about 4 feet of erosion since 1971. There will be no significant changes in this reach until coarse sediment begins to pass over the top of the dam in about 40 years. It will take much longer before sediment that is coarse enough to cause bed aggradation starts to pass over the dam. It is estimated that it will take about 100 years before pre-dam channel elevations may be obtained in this reach.

Reach 6a: The confluence between Matilija Creek and the Robles Diversion Dam is generally a depositional reach. The main source of sediment is currently the Lower North Fork of Matilija Creek and some smaller tributaries, with a total drainage area of about 18 square miles. The Matilija Creek watershed behind the dam has a drainage area that is almost three times as large (55 square miles). There is no expected change to the current deposition patterns at Robles for about 40 years until more coarse-grained material passes over Matilija Dam. The current average volume of sediment removed from the basin above the Robles Diversion Dam is about 13,300 cy/yr. That average volume of deposition is expected to double within 50 to 70 years when equilibrium of the sediment supply and transport in the reservoir and reach upstream of Robles is expected to occur.

Reach 5: There has been some significant erosion immediately downstream of Robles Diversion Dam (RM 13 – 14). This is likely due to the detention of sediment by that structure. There will be no significant aggradation in the reach until the coarse sediment starts to pass over the dam. The reach will then slowly start to aggrade, finally reaching equilibrium in 70 to 100 years.

Reach 4: This reach has remained relatively stable since 1971 and should continue to do so in the future for at least the next 50 years according to the sediment modeling. The lower portion of the reach is relatively well armored by bedrock.

Reach 3: This reach is not well armored, but there are several bedrock controls that will likely prevent further erosion. The Foster Park Diversion (RM 6.3) will not limit the riverbed degradation upstream of this location. Some aggradation is expected to occur at the Casitas Springs Levee area with the majority of the deposition occurring in the upper portion of the reach. For long-term simulations, the aggradation in this reach is more dependent upon the sediment loads entering from San Antonio Creek than the sediment loads released at the dam.

Reach 2: This reach has experienced the most erosion of any reach on the Ventura River. The most significant erosional areas have been in the vicinity of the Shell Road Bridge (RM 3.2), between RM 2 – 4. At the Shell Road Bridge, survey data taken between 1975 and 1994 indicates that approximately 10 feet of bed erosion has occurred, as well as narrowing of the channel. Downstream of Shell Road Bridge, at RM 3, degradation has lowered the active channel by almost 16 feet since 1971. On the upstream side of Baldwin Road Bridge (Reach 4, RM 11.27), historical survey data indicates that there was approximately 10 feet of erosion between 1971 and 1993. Since 1993, the channel bottom has remained relatively stable. There is bedrock (between RM 6 to RM 5) where the river is constricted through a narrow canyon. The sediment model indicates that there will be an additional 4 feet of erosion in this reach over the next 50 years.

Table 2-7 – Average Sediment Deposition by Reach for Without-project Conditions

	Yr 1	Yr 3	Yr 10	Yr. 50	50 yr min/max deposition range per reach (ft)
	Avg. Deposition/Erosion by Reach (ft)				
Reach 6b	0.0	0.0	0.1	1.0	0.0 to 4.0
Reach 6a	0.0	0.0	0.1	0.7	0.0 to 2.0
Reach 5	0.0	0.0	0.0	0.1	-1.0 to 1.0
Reach 4	-0.2	-0.4	-0.5	-0.5	-1.0 to 1.0
Reach 3	0.1	0.3	0.6	2.5	0.0 to 4.0
Reach 2	-0.1	-0.1	-0.2	-0.1	-4.0 to 2.0
Reach 1	0.3	0.7	0.8	1.4	0.0 to 2.0

Reach 1 (Estuary and Shoreline): In the last eighty years, sand supplies from the Ventura River Watershed have been markedly reduced due to dam construction, watershed improvements, and riverbed sand and gravel mining. Prior studies estimated that the Ventura River delivers roughly 70 percent of its former natural yield of sands to the ocean (BEACON, 1989). The sediment transport modeling for this study shows a delivery of about 83 percent of the former equilibrium condition of sand transported to the ocean. Overall, watershed changes have resulted in beach erosion. This trend will likely continue in the future.

Figure 2-20 – Erosion at Surfer's Point Near Mouth of the Ventura River

As Matilija Dam fills with sediment, pre-dam sediment yields will be restored to the Ventura River and the shoreline, although it would take some time for the sand to eventually reach the beaches. Since the downstream reaches of Matilija Creek and the Ventura River have been starved of coarse-grained sediment from the Matilija watershed for over 55 years, it would take about 100 years before the Matilija watershed's sediment delivery to the ocean equals pre-dam conditions. The estimate of current and future equilibrium sediment delivery is presented in Table 2-8.

Table 2-8 – Current & Equilibrium Sediment Delivery

	yd^3/yr of Sediment Delivered				
Type	Fines	Sand	Gravel	Cobbles	Total
Current	311,000	136,000	9,400	530	457,000
Equilibrium Estimation	373,000	164,000	11,300	630	548,000

<u>Habitat Evaluation Procedure</u>

The EWG established a HEP subgroup that included representatives from the California Department of Fish & Game, National Marine Fisheries Service (NMFS), USFWS, University of California's Cooperative Extension, Casitas Municipal Water District (CMWD), the Matilija Coalition, the Southern California Wetlands Recovery Project, VCWPD and the Corps. The modified HEP is an evaluation tool used to measure the relative value of biological resources of concern in quantitative, non-monetary terms.

The HEP subgroup used previous studies and guidance, and best professional judgment to quantify habitat values. A numerical value between 0.0 and 1.0 (lowest to highest value) was selected and then multiplied by the habitat acres from the vegetation mapping to obtain the Habitat Units (HUs) for each habitat type on a reach-by-reach basis for the existing conditions.

Future without-project condition HEP outputs were measured considering changes due to additional sedimentation and the spread of the giant reed above Matilija Dam, the construction of a fishway at Robles Diversion Dam five years from the start of the analysis, sedimentation in the upper reaches of the Ventura River (Reaches 1-6) based on results of the sediment transport model, and the spread of giant reed along these reaches. Aerial photography and GIS data was also used for this analysis.

Three riparian ecosystem components were used to quantify HEP values: riparian habitat, steelhead habitat and natural processes. Details are presented in the HEP appendix to the EIS/EIR. The habitat value was calculated using these formulas:

Habitat Value = Riparian Habitat Value + Steelhead Habitat Value +Natural Processes

Riparian Habitat Value = ((2*(percent Native Vegetation Cover+ percent Giant Reed Cover)) + Listed Species + Adjacent Land Use Character))/6

Steelhead Habitat Value = ((Habitat Value Score)*((Fish Passage)*(other steelhead factors))$^{1/2}$)$^{1/2}$

Natural Processes = (Natural Hydrological Regime + Natural Sediment Regime)/2

Riparian Habitat Component

The HEP analysis resulted in riparian habitat values ranging from average to good quality. The presence of giant reed was the primary factor that lowered the quality of the habitat.

As the reservoir fills with sediment, wetland areas behind the dam will first increase, but will then decrease as the filled land behind the reservoir begins to dry. Riparian habitat will replace the lake and wetlands areas. Giant reed will continue to spread throughout the area once occupied by the open water and associated wetland habitat behind the dam. Colonization will also extend to new areas upstream of the original reservoir.

Matilija Dam creates an impassible barrier to upstream migration on Matilija Creek and its tributaries. The area above the dam will continue to have no value to steelhead throughout the period of analysis. If that barrier could be removed, however, significant additional environmental outputs could be achieved, as passage to miles of high quality habitat would be possible.

The quality of riparian habitat downstream of Matilija Dam will continue to decline throughout the period of analysis. This assessment is largely based on the reasonable assumption that the giant reed will continue to expand in the floodplain terraces areas where it is currently established. Without vegetation management, exotic and invasive species will continue to persist and out compete native species and/or prevent establishment of trees and shrubs that are important for wildlife. For riparian habitats in the study area, it is reasonable to expect that significant increases in riparian habitat quality (environmental outputs) could be achieved from removing exotic and invasive species from the study area and revegetating the areas with native species.

Steelhead Habitat Component

On the whole, steelhead habitat was evaluated as below average for most of the mainstem Ventura River because it is substantially impaired in relation to its historical condition. Perennial flows were not a factor in the rating criteria. Only Reach 3 was rated as having an average migrating, spawning and rearing habitat.

Downstream of Matilija Dam; steelhead habitat is expected to remain of the same quality in Reaches 1 through 5. The construction of the Robles Fishway is estimated to be operational by the fifth year of the period of analysis. The fishway will create beneficial passage for upstream migrating adults and downstream migrating juvenile southern steelhead. This will also make approximately 6.3 miles of additional spawning and rearing habitat available in portions of North Fork Matilija Creek.

The HEP team assigned a passage value of 0.5 through the Robles fishway, which reflects its inability to provide complete passage. The maximum habitat values above Robles do not exceed 0.6 (out of 1.0) in the HEP analysis for the future without-project condition, largely because of the constraints on passage opportunities at Robles due to the nature and function of the structure. Sustainability of the fishway is addressed in the NMFS BO operating criteria. Adjustments may be made to operations of the fishway based on the monitoring and adaptive management also described in the BO.

Natural Processes Component

The HEP value in terms of natural processes for the reservoir is considered very low due to the extreme alteration of hydrologic regime and the unnatural alteration to the sedimentation regime. The environment has transformed from a pre-dam riverine system to an open water and delta system following the construction of Matilija Dam.
As the reservoir behind Matilija Dam continues to fill with sediment, open-water habitat will continue to decrease to the detriment of any aquatic reservoir inhabitants. Additional wildlife benefits may result from the future without-project condition when Matilija Dam ultimately fills with sediment, thereby eliminating suitable habitat for exotic predators such as bullfrogs and largemouth bass.

The influence of agricultural, industrial, and urban development, including dam and levee construction, groundwater extraction, surface flow diversion and discharges, and sand and gravel operations, have adversely affected the natural processes of the Ventura River.

Most of the reaches have received very poor values. There are many segments of the river that have been significantly eroded since the construction of Matilija Dam, Robles Diversion and Casitas Dam. Segments of the Ventura River have become so entrenched that flows, including the 100-year event, will remain in the active channel. Only Reach 6 received close to an average value due to the limited adverse impacts and the beneficial influence of North Fork Matilija Creek.

Table 2-9 Summary Baseline Conditions HEP Outputs

REACH	STEELHEAD HABITAT			RIPARIAN HABITAT			NATURAL PROCESSES			TOTAL HU's
	Avg. Habitat Value	Acres	Avg. Habitat Units	Avg. Habitat Value	Acres	Avg. Habitat Units	Avg. Habitat Value	Acres	Avg. Habitat Units	
1	0.42	45	18.93	0.60	74	43.67	0.10	95	9.50	72.09
2	0.42	167	69.51	0.54	377	202.95	0.10	451	45.07	317.53
3	0.60	54	32.09	0.55	104	57.81	0.10	142	14.22	104.12
4	0.40	135	53.47	0.54	348	187.57	0.10	417	41.72	282.75
5	0.35	83	28.93	0.59	549	324.45	0.12	593	73.52	426.90
6	0.57	50	28.41	0.70	58	41.10	0.42	79	32.72	102.22
7	0.00	93	0.00	0.53	109	60.69	0.19	162	28.65	89.34
8	0.00	129	0.00	-	-	-	-	-	-	-
9	0.00	200	0.00	-	-	-	-	-	-	-
Tot. Acres		956			1619			1939		
50-Yr Avg.	0.46		38.56	0.58		131.18			35.06	204.79

Existing Floodplain Features and Issues

The hydraulic and sediment transport analyses include an investigation of the existing and future without-project condition flood threat along Matilija Creek and the Ventura River. The flooding analysis assumed no difference between the existing and future without-project condition potential flood threat. Studies included investigations of the 10, 50, 100 and 500-year flood events. Figures 2-21 and 2-22 present the overflows for the 50- and 100-year events. The existing Ventura, Casitas Springs, and Live Oak Levees were included in the analysis and assessed for potential overtopping as a result of the 10, 50, 100 and 500-year flood events. Details are presented in the H&H appendix.

Currently, properties with structures at risk include Matilija Hot Springs, Camino Cielo, Meiners Oaks, Live Oak, and Casitas Springs. Matilija Hot Springs has some lower grounds that would flood with an event greater than the 50-yr. Some properties within the Camino Cielo area are within the 100-yr floodplain. The Meiners Oaks area is just above the 100-yr floodplain. The levee at Live Oak is greater than the 100-yr event. However, the Santa Ana Bridge, a severe constriction, can create a backwater effect upstream, causing overtopping of the levee. A maintenance program to prevent the buildup of channel bed elevations is currently in effect. The levee at Casitas Springs does not provide 100-yr flood protection.

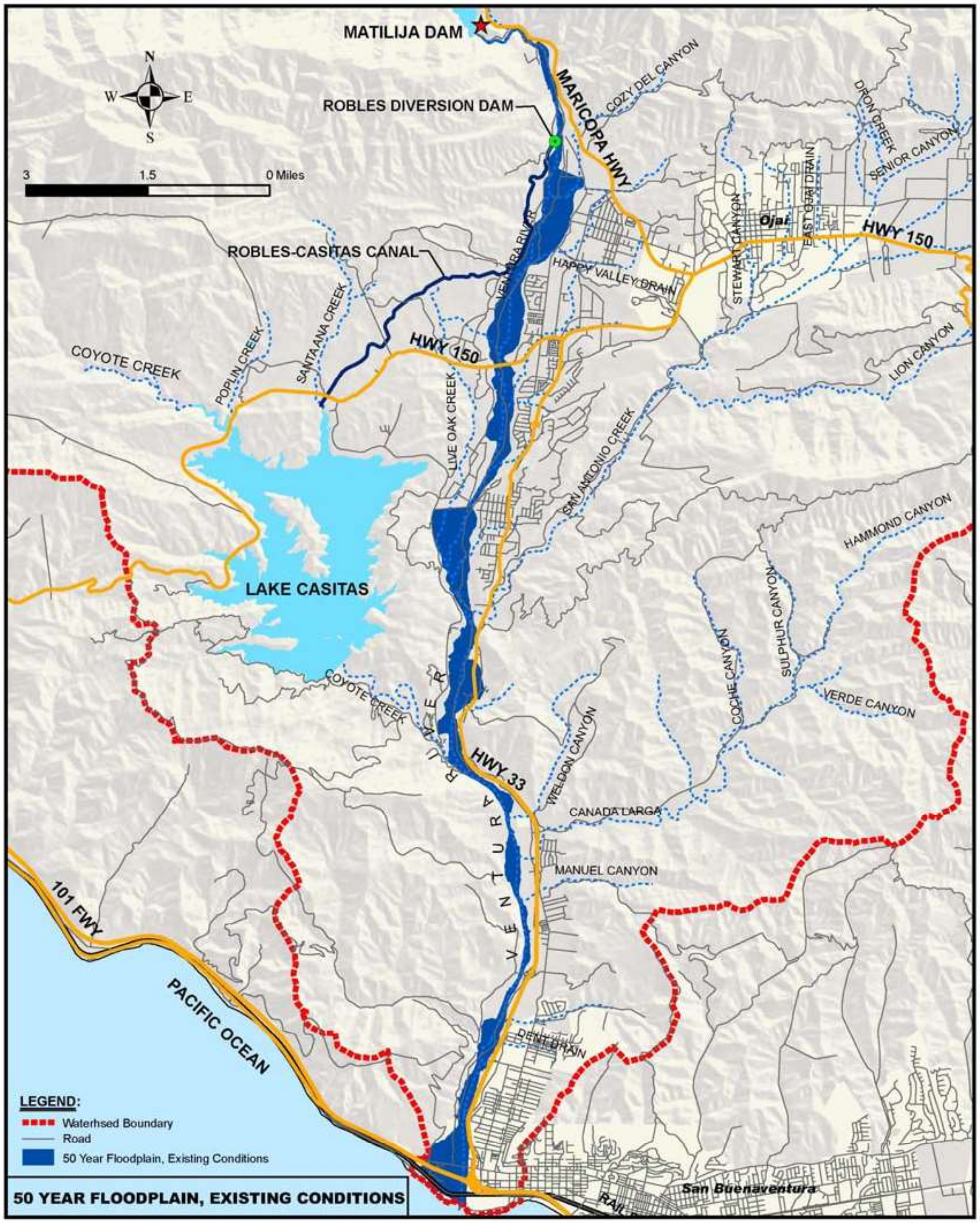


Figure 2-21 - 50-yr Floodplain

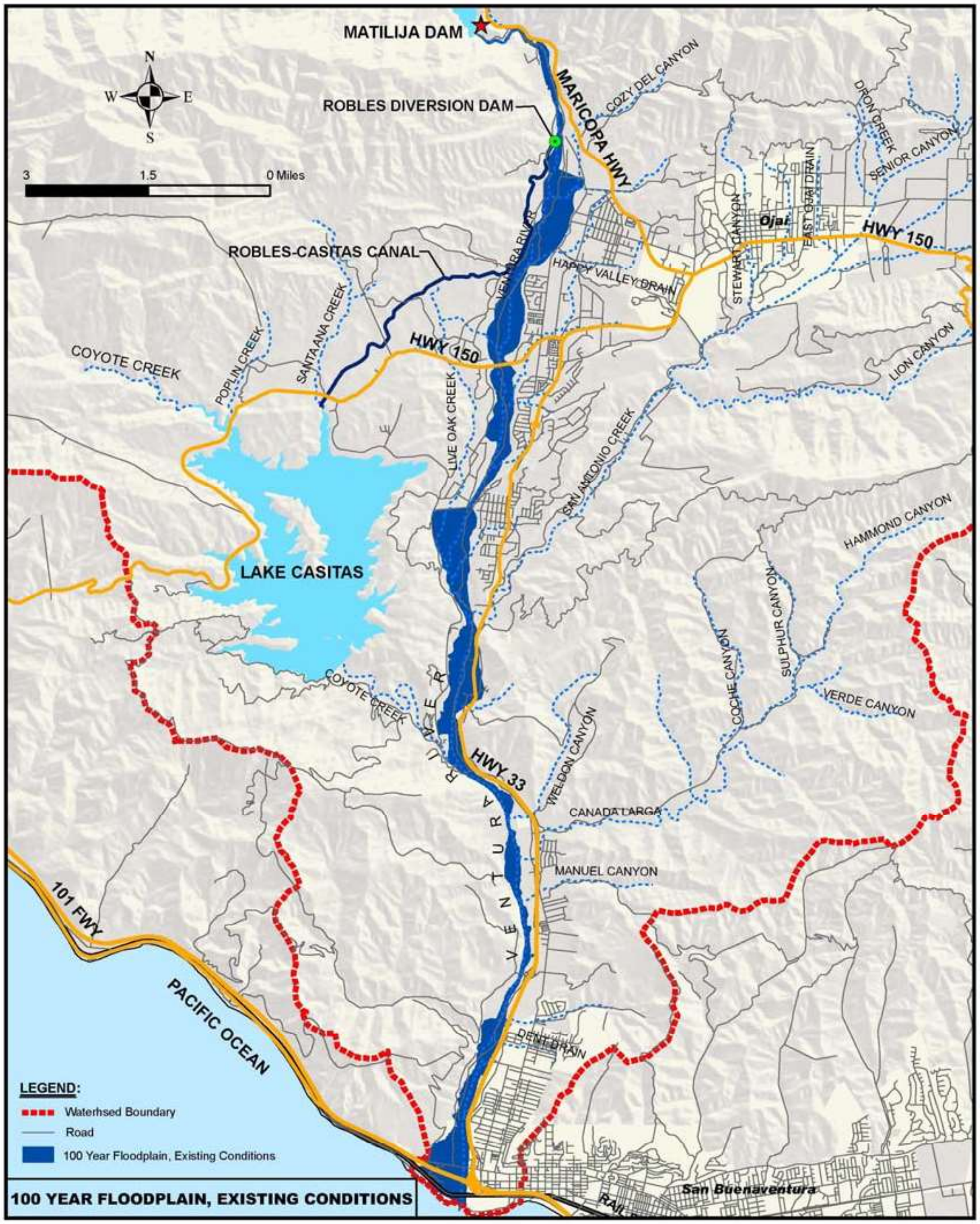


Figure 2-22 - 100-yr Floodplain

An economic analysis of potential flood damage was also prepared based on floodplain mapping generated by the hydraulic and sediment transport modeling. All lands within the floodplain were studied to determine the potential economic structural and non-structural (crop) damages. Details are presented in the Economic Appendix.

No flood damages occur within the Matilija subwatershed. Matilija Dam has a negligible impact on the peak flows of large floods (greater than 10-year return periods). The remaining reservoir area, with about 500-acre feet of storage, will quickly fill during a major storm and provides virtually no attenuation of floods.

Figure 2-23 – Matilija Dam During Recent Storm

For the Ventura River, the non-damaging discharge varies by reach. For Reaches 1, 2 and 4, the non-damaging discharge is less than 10-years for non-structural damages (crops). For Reaches 3 and 5, a 45-year, non-damaging discharge is assumed.

Crop damages occur in Reaches 2, 3, 4 and 6 of the Ventura River for the 500-year event, and Reaches 2, 4, and 6 for more frequent flood events (less than 100-yr-10 yr). The most significant flood damages to crops occur in Reach 2 and begin at the 10-year event.

Table 2-10 Potential Crop Damages (2003 Price Levels)

Flood Event	Damage Estimates ($)	# Acres Impacted
10-yr	$ 68,000	42
50-yr	$137,000	92
100-yr	$197,000	125
500-yr	$283,000	174

Structure and content damages occur in Reaches 1-5, with the most damages occurring in Reach 3. Structure and content damages per event are estimated to be about $3.8 million for the 50-year event, $5 million for the 100-year event, and $18.3 million for the 500-year event. For the 50-year event, flooding impacts 170 structures. The majority of those structures are single-family residences (144), and most are located in Reach 3 in the Casitas Springs community. For the 100-year event, the structures impacted by flooding increases to 215, with 149 of those single-family residences. For the 500-year event, there are 442 structures impacted by flooding.

Figure 2-24 – Upstream/Downstream Views of Casitas Springs Levee in Feb 1998 Storm Event (<20 Year Event)

The Equivalent Annual Damages (EAD) is a calculation that includes the probability of the flood events occurring in any given year and total damages for those events. The net present value for the EAD was estimated to be $163,000 for structural and crop damages ($148,000 for structural damages alone). Only $1.8 million in equivalent annual damages would be prevented by modification of existing flood control features to provide a 100-year level of protection. The relatively low average annual damage potential is not considered sufficient to justify Federal interest in flood protection measures alone.

3. PLAN FORMULATION

Problems and Opportunities

The list of public concerns presented in the *Coordination, Public Views and Comments* chapter was used as a guide for the baseline conditions analysis. These concerns are also the basis of the problem and opportunity statements presented in this section, in addition to other problems that have been identified during the baseline condition studies. Some of the problems and opportunities are applicable to both baseline conditions and future with-project conditions for potential dam removal or modification measures. The ♦ symbol designates problem statements and the ◘ symbol designates opportunity statements.

♦ **Degraded river habitat and upstream physical barriers in the Ventura River watershed have caused a significant decline in anadromous fish populations, particularly the endangered southern steelhead trout.**

The Ventura River watershed has historically supported one of the largest runs of the southern steelhead trout on the south coast.

Agricultural, industrial, and urban development in the Ventura River watershed has degraded the natural environment by adding system-wide stresses such as increased point and non-point pollution, loss of habitat, diversion and extraction of water, increased water use, increased raising of livestock, and structural alterations of waterways.

The Ventura River watershed is classified as impaired and is on the State's 303(d) list for pollutants (including DDT, copper, silver, zinc, algae (eutrophication) and trash) and the TMDL priority schedule.

Construction of Matilija Dam, Casitas Dam and Robles Diversion Dam has blocked access to historical upstream spawning and rearing habitats.

Poor water quality in the Ventura River, including increased water temperatures, low dissolved oxygen levels, and potentially high nutrient loads may adversely affect steelhead habitat.

◘ ***Increase anadromous fish populations by improving quality of mainstem Ventura River habitat and access to headwater spawning grounds that were historically highly productive.***

Construction of a fish ladder structure at Robles Diversion Dam would allow fish passage upstream to the base of Matilija Dam and also to the North Fork Matilija Creek, at least 4.5 creek miles. Local interests are pursuing this measure at this time.

Fish passage upstream of Matilija Dam would open at least 17.3 miles of pristine waters within the Matilija Wilderness.

Removal of Matilija Dam would restore fish and wildlife migratory corridor benefits.

Removal of Matilija Dam would return natural flows and sediment processes from Matilija Creek to the Ventura River. Water quality could potentially benefit in the Ventura River, including reduced temperatures and increased dissolved oxygen levels.

♦ **Significant erosion of the streambed has occurred in the Ventura River.**

The presence of Matilija Dam, Robles Diversion Dam, and Casitas Dam has decreased the sediment loads in the Ventura River system. Storm flows, especially from Matilija Dam, are sediment starved and pick up sediment in the downstream river channel. Various reaches of the river have been subject to degradation.

Some segments of the Ventura River have become so entrenched that flows including the 100-year event will remain in the active channel, effectively abandoning adjacent floodplain areas and potentially have a detrimental impact on the habitat.

Infrastructure could be potentially damaged in the future. At Shell Road Bridge, for example, erosion in the vicinity and downstream of the structure ranges from 10 to 16 feet below the 1971 thalweg elevation.

◘ ***Restore natural sediment transport and replenishment of riverine system.***

♦ **The coastline of Ventura County is subject to significant erosion.**

The Ventura River was once a major contributor of sediment supply for the beaches of Ventura County. Sediment yields have been greatly reduced as a result of the construction of Matilija Dam, the Robles Diversion Dam and Casitas Dam that trap sediment.

Beach erosion along the local coastline has impacted native habitats of sensitive species.

To protect against high erosion rates, the Ventura County Watershed Protection District has implemented costly coastal armoring measures. Damage to coastal infrastructure (roads, utilities, existing coastal armoring structures) and associated repair and mitigation costs (new coastal armoring structures) have been significant.

Coastal tourism is one of California's largest industries. Erosion can reduce the recreational value of the beaches.

◘ ***Restore natural sediment transport to the ocean from Matilija Creek benefiting coastal beaches and ecosystems.***

♦ **The reservoir behind Matilija Dam has been subject to substantial sedimentation, almost six million cubic yards, since its construction.**

Ventura River Watershed lies in an active tectonic region that contributes some of the highest sediment yields in the United States.

Matilija Dam serves a limited water supply use function and provides little protection against major floods. From an original storage capacity of 7,000 acre-feet, it is estimated that the current capacity of Matilija Dam is less than 500 acre-feet. The dam provides no practical attenuation of the peak flow for large flood events (return interval greater than 10 years).

Based on its current rate of sedimentation, it is estimated that the reservoir pool capacity will be less than 50 acre-feet by year 2020. It is estimated that by 2040, the reservoir will have reached equilibrium and will contain more than nine million cubic yards of sediment.

◘ ***Provide beach nourishment and coastal erosion protection along the Ventura coastline utilizing trapped sediment behind Matilija Dam.***

♦ **Exotic and invasive species are replacing native species in Matilija Reservoir, and downstream of the dam along the Ventura River and within portions of the Ventura River estuary.**

The Ventura River Watershed provides important riparian and wetland habitat for a wide variety of native wildlife species, including many sensitive species and several threatened and endangered species.

Upstream of Matilija Dam, the invasive giant reed (Arundo donax) has overtaken the majority of the original reservoir upstream of the reservoir pool (open water habitat). Downstream of the dam clumps of giant reed are colonizing the floodplain and the estuary.

◘ ***Eradicate exotics and invasive plant species within the Ventura River corridor and estuary, as well as non-native vertebrate species associated with the existing Matilija Reservoir.***

Local groups, such as the Ventura County Resources Conservation Agency, have made recommendations and plan eradication measures to control giant reed in Ventura County.

Revegetation with native species would occur.

A long-term monitoring and maintenance plan could measure the success of the eradication program.

♦ **The existing reservoir (open water habitat) supports many non-native vertebrate species that are considered detrimental to the survival of many native fish and amphibians.**

Non-native species include crayfish, bullfrogs, largemouth bass, and green sunfish.

The reservoir will eventually fill with sediments, and the open water and associated wetland habitats will decline.

Continued infilling of the reservoir will further reduce the non-native species habitat, potentially reducing their populations.

◘ ***Eradicate non-native vertebrate species associated with the existing Matilija Reservoir.***

♦ **Dam safety has been a concern for Matilija Dam since shortly after its construction.**

Matilija Dam has been subject to concrete deterioration due to alkali-silica reaction. The central portion of the dam has been notched twice to lower the spillway crest, thereby decreasing the maximum pool and alleviating loads and stresses acting on the structure.

Periodic dam safety studies have been performed on Matilija Dam since 1965. In addition, a surveillance program is also in effect, and includes surveys and instrumentation.

It is believed that Matilija Dam will remain in service, in its existing configuration, for at least an additional 50 years. Continued inspection and concrete sampling and testing will serve to monitor Matilija Dam's remaining life.

◘ ***Reduce or eliminate threat of dam failure by modification or removal of Matilija Dam.***

♦ **There is no recreation access at Matilija Dam and reservoir.**

Matilija Dam and reservoir are not accessible to the public.

There are no recreation trails that connect the Ventura River corridor south of the dam and the Los Padres National Forest land to the north of the dam via Matilija Creek.

Prior to the construction of Matilija Dam, the area drew many residents and tourists for recreational activities and enjoyment of the natural beauty of the region.

◘ ***Provide recreation access through the Matilija Dam and the reservoir area to establish connectivity between the Ventura River and Los Padres National Forest recreation trails along Matilija Creek.***

Potential extension of the Los Padres National Forest boundaries, as supported by the U.S. Forest Service, could provide additional recreation potential along Matilija Creek.

Objectives and Constraints

The problems and opportunities identified in this study are used to describe specific planning objectives that represent desired positive changes in the without-project conditions and provide focus for the formulation of alternative plans. The primary objectives for this study were developed by the Corps, the Sponsor, resource agencies and stakeholders based on public input, meetings, and identification of the problems and needs. The primary ecosystem restoration study objectives are:

- Improve aquatic and terrestrial habitat along Matilija Creek and the Ventura River to benefit native fish and wildlife species, including the endangered Southern California steelhead trout.
- Restore the hydrologic and sediment transport processes to support the riverine and coastal regime of the Ventura River Watershed.
- Create recreational opportunities along Matilija Creek and the downstream Ventura River system.

Constraints have been identified through the study process, particularly during meetings with the Sponsor, resource agency representatives and other stakeholders.

► Maintain the current level of flood protection along the Ventura River downstream of Matilija Dam.

► Minimize adverse impacts to local communities associated with the removal of the trapped reservoir sediment.

► Minimize disturbances to cottonwood – willow and marsh communities throughout the study area.

► Limit effects of potential deposition within the Ventura River estuary and associated wetlands from increased sediment yield resulting from Matilija Dam trapped sediments.

► Protect or limit adverse impacts to prehistoric/historic archeological sites in the vicinity of the original Matilija Dam Reservoir from construction activities.

- Limit adverse impacts to normal water supply quantity, quality and timing of delivery to Casitas Reservoir via Robles Diversion Dam.

- Limit impacts to water quality in Lake Casitas by turbid flows resulting from the release of Matilija Dam trapped finer sediments.

- Limit impacts to Robles Fish Passage Facility and opportunities of fish migration at the facility.

National Objectives

The "*Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies,*" also known as Principles and Guidelines (P&G) identifies a single Federal objective emphasizing National Economic Development (NED). The P&G is one of the most important sources of Corps planning guidance.

"The Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements."

Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation.

Ecosystem restoration has become one of the primary missions of the Corps Civil Works program. Current Corps policy (Engineering Regulation (ER) 1105-2-100) establishes an additional national objective to contribute to National Ecosystem Restoration (NER). The NER objective is to contribute to the Nation's ecosystems through restoration, with contributions measured by changes in the amounts and values of habitat. The Habitat Evaluation Procedure (HEP), prepared by the Environmental Working Group (EWG), is the analysis used for this study to identify NER outputs. Primary ecosystem restoration benefits associated with the final array of alternative plans considered for this study are presented in non-monetary outputs (habitat units). The NER plan is the alternative with the greatest net ecosystem restoration benefits.

Four accounts are presented later in this chapter to organize and summarize important considerations used to compare and evaluate alternative plans. The accounts are NED, Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE). The four categories, known as the System of Accounts and suggested by the U.S. Water Resources Council, address long-term impacts, defined in such a manner that each proposed plan can be easily compared to the no action plan and other alternatives.

Formulation of Measures and Alternative Plans

Multiple iterations of formulation and screening of measures and alternatives were conducted during the plan formulation process. These activities involved the multi-agency members represented in the Plan Formulation Group (PFG), the Environmental Working Group (EWG), and various technical groups formed to address specific issues related to dam fate, sediment management, ecosystem, fish migration barriers, water supply, flood control, air quality, noise, and traffic.

Measures that address the study objectives were considered, discussed, combined in different manners and screened during this process. Initial screening was accomplished by evaluating the measures against habitat, fish passage, and riverine and beach nourishment impacts. The criteria is defined as follows:

Habitat: The ability of the measure to maintain or improve/restore the natural processes that support aquatic ecosystems (e.g. spawning/rearing habitat) and riparian systems (e.g. floodplain vegetation). Also included are the measure's applicable beneficial or adverse impacts to the hydrologic regime (including sedimentation/erosion), long-term water quality and connectivity.

Fish Passage: The ability of the measure to restore fish passage at Matilija Dam. Consideration is also given to the measure's effectiveness either under a wide range of flow conditions or under a limited range of flows (as for a fish ladder). This criterion assumes that fish passage at Robles Diversion Dam is not a constraint.

Riverine and Coastal Nourishment: The ability of the measure to restore the natural hydrologic and sediment transport regime to downstream Ventura River reaches and the renourishment of local beaches. Consideration included whether the measure removes all, a portion of, or none of the trapped sediment for potential re-introduction into the riverine/coastal system, as well as whether the measure allows for re-introduction to the riverine/coastal system of new sediment from the watershed upstream of Matilija Dam.

Measures were combined to form alternatives, which were iteratively refined and screened with the intent to make plans complete, effective, efficient, and acceptable. Initial alternatives screenings were conducted with preliminary engineering design and construction cost estimates, developed with limited sediment modeling information and, therefore a preliminary HEP evaluation. Anticipated sediment deposition trends were assessed based on a comparison of the alternatives designs. Natural (fluvial) sediment transport alternatives, particularly those that included removal of the entire dam in one-phase were anticipated to have the most downstream beneficial and adverse impacts related to sediment deposition and turbidity as these alternatives were the most extreme in nature.

Modifications to design, cost estimates, and HEP evaluations were discussed and incorporated into the formulation and screening process as new information, including more refined sediment transport modeling results, became available. Some measures, or combinations thereof, were revisited as the study progressed and more refinements were made. Various combinations of alternative measures were considered throughout the formulation process.

The following sections present measures that were considered in the formulation process, summarized by category. The evaluation of each measure and screening outcome is summarized. For ease of discussion, the combinability of the measures into alternatives has been limited. The following premises were made during the formulation process: a fishway will be constructed at Robles Diversion Dam; all measures will not impede fish passage at Robles Diversion Dam; and the sites identified for sediment hauling, concrete recycling, and metal debris salvaging will still be in service when construction operations are under way.

The measures considered address no dam deconstruction, dam deconstruction, and actions independent of dam fate.

Measures Addressing Fate of Matilija Dam

<u>No Dam Deconstruction</u>

Restoration of Matilija Dam Water Supply – This measure would restore the water supply function of Matilija Dam, with a reservoir that is the approximate size of the 1960 condition (limited due to prior notching of the dam). The notched portions of the dam would not be restored. Since trapped sediments behind the dam would be removed to restore water storage capacity, this measure would need to be combined with other mechanical sediment transport measures. Sluicing sediment downstream by utilizing existing conduits through the structure would not be economical, primarily due to the exorbitant quantity and expense of importing water. The dam itself would potentially require significant structural modification due to the increase in loading conditions, requiring consultation with the California Department of the Safety of Dams (DSOD). The existing operation of the dam for water supply would be impacted during restoration operations. To meet study objectives, this measure would also need to be combined with the construction of a fish ladder to the top of dam. There are significant issues related to this prospective feature. The Sponsor (VCWPD) has indicated that they have no interest in pursuing either full or partial restoration of Matilija Dam. This decision was supported by the consensus of the stakeholder group. There would be very high costs associated with this measure when combined with other measures, such as mechanical sediment removal. The position of the EWG is that a fish ladder would not be an effective measure due to the necessary height for this feature (see "Construct New Fish Ladder" below). This measure was not carried forward.

Construct New Fish Ladder – This measure would leave the dam and trapped sediment in place. Construction of a fish ladder at Matilija Dam was not supported by the EWG, particularly the National Marine Fisheries Service and the California Department of Fish and Game. A memorandum (2003) was prepared by the EWG to state concerns regarding the likelihood of success of a large fish ladder structure at Matilija Dam. Amongst other factors, including compromising higher environmental outputs associated with an overall ecosystem restoration plan, no success has been reported for dams over 180 feet in height. This measure was not carried forward.

***Fish Tunnel Bypass to the North Fork of Matilija Creek* –** This measure would leave the dam and the majority of trapped sediment in place. A 600-foot long bypass tunnel would be excavated through a mountain face, connecting Matilija Creek upstream of the dam to the adjacent Lower North Fork of Matilija Creek, which currently merges to form the Ventura River about a half a mile downstream of Matilija Dam. The tunnel would be a 72-inch diameter pipe with lighting, and would divert some or all of the flows from upstream of dam to allow for fish passage. Maintenance would be required to remove sedimentation in the tunnel. Sedimentation at the upstream end of the tunnel would be problematic as too much sedimentation would bury the inlet or loss of sedimentation levels around the opening would strand it. Attraction flows to fish are questionable, and steelhead would likely still migrate to the bottom of Matilija Dam. This measure was not supported by the EWG and was not carried forward.

***Trap and Truck Fish* -** This measure assumes that the dam would remain in-place. A new temporary holding facility would be constructed for steelhead migrating up Ventura River to the base of Matilija Dam. The steelhead would be collected at the holding facility and trucked above the dam to an appropriate release site. Although this measure has some benefit to fish migrating upstream, it is not considered effective in assisting the migration of potentially significant numbers of fish. Some consideration was given to a similar trap and hold method for downward migrating fish, but it was not possible to design such a feature for the wide variety of storm events. The steelhead would likely not survive the drop from the top of the dam notch to the pool below, about 165 feet in height. In addition, trapping and trucking is traumatic to the fish with potential life-threatening consequences and is strongly opposed by the EWG. Therefore, this measure was not considered forward.

Dam Deconstruction

***Dam Deconstruction by Controlled Blasting* -** A Bureau of Reclamation (BOR) Appraisal Report (2000), prepared prior to this feasibility study, summarized results of field-testing for different methods of dam removal. The BOR tested these removal methods at one of the Matilija Dam abutments where prior notching had already occurred. The information in the appraisal report was used for this comparison of dam removal measures. Dam removal by controlled blasting allows the removal to happen relatively quickly. Excavation of sediments behind the dam would be necessary to access the back face of the structure for removal operations. The dam would be removed in 15-foot increments (lifts) by placing explosives at proper distances along horizontal planes of the dam face. Most of the dam would be removed in 11 of these 15-foot increments. The abutment may take some additional blasting.

Minimal processing would occur on-site to prepare the concrete rubble for removal by truck hauling. Concrete blocks would be prepared for hauling using a hoe-ram, with a maximum diameter of about 2 feet and all reinforcement cut flush with the concrete. The material, estimated to be about 77,000 cubic yards, would be hauled to a concrete recycling center, assumed to be Hanson Aggregates located about 28 miles away from the dam. Non-recyclable debris would be hauled to the Toland Landfill.

There would be temporary adverse impacts related to noise (from blasting and trucking), and associated traffic and air quality impacts due to the trucking of the material.

This measure is more time and cost effective than other deconstruction measures, and is therefore carried forward for more detailed analysis.

Dam Deconstruction by Diamond Wire Cutting - This measure was also addressed in the BOR appraisal report, but was found to be much more expensive and time consuming. Diamond wire cutting would be accomplished in smaller lifts. Each cut section would be secured with bolts and removed by a crane and loaded onto a truck for final processing and disposal. This method was not very effective due to the large size of the reinforcement used for the construction of the dam. Due to the significant increase in costs and the slow production rate, this measure was not carried forward.

Dam Deconstruction by Expansive Chemicals - This measure was also presented in the appraisal report. This method was the least effective and most costly of the three methods included in the appraisal report because of difficulties with the size of the reinforcement in the dam. It required relatively difficult cutting of the reinforcement before sections of the dam face could be removed. Therefore, this measure was not carried forward.

Dam Deconstruction by Hoe-Ram - This measure was also presented in the appraisal report. The method would not be as economical as blasting for a large structure, and would have limited control in maintaining horizontal and vertical breaklines. The hoe-ram is also less effective in poorer quality concrete, which would be a factor in the upper portions of the dam. The use of the hoe-ram for deconstruction is practical however in conjunction with controlled blasting.

Full Dam Removal – This measure would remove the dam (above the streambed) in one phase by controlled blasting. Full dam removal is combinable with mechanical or natural sediment transport modes, as well as on-site stabilization methods. This measure was carried forward in the formulation process.

Incremental (Staged) Dam Removal - The dam would be removed in 15-foot horizontal increments by controlled blasting. The analysis considered removal of the dam in two phases. The second phase would begin once storm events naturally transported the trapped sediments that are deposited at a higher elevation than the interim height of the dam created by first phase incremental removal. No additional increments of removal, such as three or four phases, were considered. Increasing removal phases would result in increasing the length of time for complete dam removal.

This measure offers some better control of the release of downstream sediments over a more extended period of time, potentially reducing downstream flooding and water supply impacts. The detriments are that restoration of fish passage to the Matilija watershed is dependent on the timeframe for the removal of the accumulated sediment behind the dam. If large storms occurred, the timeframe would be relatively short in comparison to the length of time it would take for sediments to erode during a drought cycle. This measure also does little to control the release of fines to the downstream reaches, so water supply activities could still be adversely affected by this measure. It is possible to combine this measure with the mechanical removal of fines from the 'Reservoir Area.' Incremental dam removal was supported by some of the Plan Formulation Group participants and was therefore carried forward in the formulation process.

Partial Dam Removal and Restoration of Water Supply Function – This measure would remove a portion of the dam in horizontal lifts by controlled blasting. The same issues are true for this measure as for the full restoration of Matilija Dam for water supply. This measure does not meet the objectives for this ecosystem restoration study alone, and would have to be combined with mechanical removal of sediments and restoration of a fish ladder. DSOD would have to be consulted about the structural integrity of a partial dam for water supply use. The costs are very high for this option and the Sponsor does not support the restoration of Matilija Dam as a water supply facility. Therefore, this measure was not carried forward.

Partial Dam Removal - This measure is similar to the previous measure, although the remainder of Matilija Dam is not being used for water supply. This measure would have to be combined with other measures including construction of a fish ladder and mechanical removal and/or natural transport of sediments. This measure was not supported by the PFG and, therefore was not carried forward.

Partial Dam Removal (with "V" Notch) - This measure cuts a vertical (V-notch) section in center of dam from top to bottom, with stabilization of the remaining sections of the dam structure. Some sediment would be removed/displaced to facilitate notching, including grading in the reservoir. The remainder of the trapped sediment would be removed over time by natural transport. There were significant concerns related to the structural integrity of the remaining dam structure. The dam is a concrete arch structure, and the structural integrity would likely be compromised with a vertical notch from top to bottom (loss of arch-action). This measure was not carried forward.

Measures to Address Trapped Sediment Behind Matilija Dam

Mechanical Transport of Sediment

Sale/Disposal of Sediment Measures

Truck All Sediment to a Processing Center - This measure assumed the transport of all trapped sediment (5.9 million cubic yards) to a local construction aggregate company (Vulcan Materials Co. or Hansen Aggregate Co.) located about 30 miles southeast from the dam site in Saticoy. Trucking would be the only method of delivery accepted at the sites. No claim for credit would be made for the disposed sediment. This measure was dismissed based on the very high costs associated with the transport of this significant volume of material, for the lengthy trucking distance, the excessive number of truck trips, and the significant and long-term traffic, noise and air quality impacts in the local communities. The same is true for trucking only sediments from the 'Delta Area' and the "Upstream Channel Area'- totaling 3.8 MCY.

Truck 'Reservoir Area' Sediment to a Disposal Site - The 'Reservoir Area' sediment (2.1 million cubic yards), comprised primarily of silts and clays, would be transported by truck to a designated off-site disposal area. There are inherent construction processing/handling problems associated with trucking this sediment (composed primarily of silts and clays) to an off-site disposal. This fine sediment lies primarily under the existing reservoir and is completely saturated. Excavation and handling of this wet sediment would be very cumbersome due to its cohesive and sticky nature. Following excavation, a significant drying operation would be necessary to facilitate handling of this sediment prior to transport from the dam site by truck. An option to drying the fine sediment would be to use liners in the truck beds. This however would increase the number of truck trips substantially, and was therefore not further considered. The high handling cost of the drying process together with the trucking impacts related to traffic, air quality and noise in the local community were reasons for dismissing this measure from further consideration.

The Sponsor investigated 14 areas for possible use as a *permanent disposal site*. Sites consisted of either open space or agricultural areas, and are in close proximity to the Ventura River. Distance downstream from Matilija Dam ranges from 2.5 to 13.5 miles. The size of the land parcels vary based on use and ownership. The Sponsor also queried land owners on their willingness to sell. An area located in the vicinity of the Highway 150 Bridge has been identified as a primary candidate for the designated disposal site. The area is comprised of four separate sites, located both upstream and downstream of the bridge, totaling 118 acres. The distance downstream of Matilija Dam varies from 3.6 to 6.3 miles.

Alternate uses for the "Reservoir Area' sediment, such as for *agriculture* and *landfill cover*, were also assessed. Based on Sponsor queries to local farmers, there was very limited demand, and only for small quantities. Similarly for landfills, though there was some potential interest for use, the option was not considered to be cost effective due to the demand for only limited quantities, the long distances to the sites, as well as the high costs in processing and hauling the materials. In addition there would be associated impacts to the local community. These alternate uses were not considered further.

Sell Coarse Sediment from the Dam and Truck to End-Users - This measure assumes the sale of marketable construction–grade aggregate from the dam site over a 10-year timeframe. There is approximately 3.0 MCY of marketable aggregate in the 3.8 million cubic yards of deposited sediments in the "Delta" and "Upstream Areas." This material would be stockpiled and sold on-site. Constant regrading would occur on an annual basis and sediments would be protected from downstream storm erosion. The residual non-marketable fine materials, 770,000 MCY, would be separated and either hauled by truck to a landfill or to the designated disposal site to limit downstream turbidity impacts.

This measure assumed no costs for the truck transport of this material since the construction contractor is selling directly to end users. The likely primary transportation routes associated with the sale of aggregate identified by the local sponsor are: Highway 33 to Highway 101 to local roads, and Highway 33 to Highway 150 to Highway 126 to local roads. The second route directly impacts Ojai since Highway 150 traverses the town.

Impacts to air quality, noise and traffic associated with this measure are being assessed for the EIS/R. There was interest from members of the PFG in pursuing this measure, even with the potential adverse impacts to the local community for up to 10 years. Therefore, this measure was carried forward in the formulation process.

A *dedicated haul route* along the Ventura River alignment that would connect to Highway 33 to Highway 101 was also considered. The expense of constructing the road, and opposition from the EWG, was reason for the dismissal of this feature.

The sale of materials from an *off-site disposal/processing area* would provide an alternative to selling the materials from the dam site. The town of Ojai could potentially be less impacted by truck traffic if the sale of materials is from the designated disposal site (temporary use), or a different designated site, with the only entry/exit route is the southern portion of Highway 33 and Highway 101. Adverse impacts including noise, air quality and traffic impacts are compounded by trucking at both the dam site and from the sale of materials to end users from the disposal/processing site (i.e double handling). In addition, the off-site disposal/processing area would also require a substantial amount of space for the processing/temporary stockpiling of materials. For capacity reasons, it is likely that this would have to be a separate site from the disposal site needed for the permanent storage of 'Reservoir Area' sediment identified by another measure. Sale of materials from off-site was not carried forward.

Use Conveyor System to Transport "Reservoir Area" Sediment to Disposal Site - This measure is similar to "Truck 'Reservoir Area' Sediment to a Disposal Site" except that a conveyor belt system is used in lieu of trucking. Due to the inherent difficulties and higher costs in excavation/handling/drying these materials, this measure was not carried forward.

This measure was also combined with the conveyor system to Surfer's Point (described below under Beach Nourishment Measures). The main belt to the coast would incorporate an off-line *"spur"* to the disposal site. For the same reasons described above, this measure was not carried forward.

Use Conveyor System to Transport ≤ 9" Sediment to a Temporary Downstream Processing Site - This measure is similar to the trucking option for sale of materials from an off-site disposal/processing area. This measure was considered in combination with transporting 'Reservoir Area' sediment to a disposal site by either a conveyor or a slurry pipeline system. Traffic, air quality and noise impacts could be improved by using a conveyor belt from Matilija Dam when compared to trucking, although impacts to the local communities would still be significant. This measure would also require some sorting of material at the dam and at the disposal site. Sale of the material to end-users would also have similar impacts as those described in the trucking measure. This measure was not carried forward for detailed analysis.

Slurry 'Reservoir Area' Sediment to a Downstream Disposal Site – The 'Reservoir Area' sediments would be slurried via pipeline to a disposal site. The remainder of the trapped sediment could be transported naturally or mechanically depending on the combination of measures. The slurry mix would need to be placed behind a constructed containment dike. Appropriate measures would be necessary to protect the dike against flood events should the disposal location be within the floodplain.

A minimum of 4,500 acre-feet (ac-ft) is needed to slurry the fines. Sources of water considered include Casitas Municipal Water District (CMWD); pumping groundwater; pumping seawater; using supply stored behind Matilija Dam; City of Ventura supplies or entitlements; and state water pipeline. CMWD has indicated that it cannot accommodate the sale of water for any potential future Matilija Dam removal project due to the limitations on the district's safe yield. Groundwater may be a potential source, but initial studies indicated that the aquifer capacity would not suffice for the need. The use of seawater would be a costly option due to the 17 miles of pipeline required to get the water to the dam, and the need for a desalination plant. The EWG objected to the use of seawater because of the potential adverse impacts to the environment if a leak were to occur in the system. There are only 500 acre-feet of water behind Matilija Dam, not enough for the slurry. The most promising source is the City of Ventura, which currently has a surplus of 5,000 to 6,000 ac-ft of CMWD water. The City has an entitlement of 8,000 ac-ft/yr from CMWD, and must annually purchase 6,000 ac-ft of water from the water district. The State pipeline is also a more expensive option.

In relative costs, a slurry system would be less expensive than a conveyor system. The alignment would require real estate right-of-way (temporary easements). There would need to be a road constructed adjacent to the slurryline for O&M. The alignment footprint, approximately 25 feet wide, would initially require the removal of native vegetation.

This measure could be combined with other dam removal and sediment management measures, and was carried forward for more detailed analysis.

Slurry all Less than ≤¼" Sediment to Downstream Processing Site/Disposal Site - Consideration was given to slurrying only ¼-inch and finer sediment (comprising approximately 4.5 MCY of total trapped sediment) to a temporary downstream processing site. The costs of obtaining the substantial quantity of water necessary, the potential multiple processing and disposal sites, together with the limited commercial aggregate value of the smaller grain sized sediment and the need to separate it from the fines, was reason for dismissal of this measure.

Beach Nourishment Measures

Truck Coarse Sediment to Surfer's Point – This measure would utilize trucking to transport the 3.8 million cubic yards of sediment from the 'Delta Area' and the 'Upstream Channel Area' to Surfer's Point, located about 16 miles downstream of Matilija Dam near the mouth of the Ventura River. Continuous operations would truck these sediments through Ojai and down Highway 33 to Surfer's Point. This is a lengthy operation, with significant impacts to the local community from traffic, air quality and noise. There would be significant costs associated with this alternative, much higher than other mechanical and natural transport measures. Although this measure would directly benefit beach nourishment, the effort would largely provide only temporary benefits to the local coastline as the high energy coastal environment would transport the majority of this material downcoast. Any replenishment benefits from re-introducing the Matilija Dam trapped sediments to the Ventura River system would be foregone. Other less expensive offshore borrow sites could be utilized as a source of beach compatible material when compared to the trucking option. The high costs associated with this measure, as well as the adverse impacts and effectiveness of the action provided justification for this measure to be dismissed from further consideration.

Consideration was also given to limiting the hauling efforts to only cobble–sized sediment. This larger sized material would be more erosion resistant in the high energy wave environment at Surfer's Point. However, even 0.5 MCY of cobbles from the dam site would require about 25,000 truck trips. This refinement of the original measure was not carried forward for reasons of cost effectiveness, compounded with similar (though smaller in scale) environmental impacts related to truck hauling as described above.

Use Conveyor System to Transport Coarse Sediment to Surfer's Point - This measure is similar to "Truck Coarse Sediments to Surfer's Point" except that a conveyor system is used in lieu of trucking. The more than 16-mile long conveyor belt system would be constructed along the general alignment of the Ventura River. Materials to be conveyed would be pre-sorted on-site. The system would be designed to accommodate materials no larger than 9 inches. This measure would be very expensive, both for initial construction of the system, and for operations and maintenance. There would need to be a road constructed adjacent to the conveyor for O&M. The alignment would require extensive real estate right-of-way (temporary easements). The alignment footprint, approximately 30 feet wide, would initially require the removal of native vegetation. Operation of the conveyor system would be required over a period of years. Noise impacts to downstream communities would have to be mitigated, requiring limited daily and seasonal operational timeframes and electric motors for the system. Preliminary costs were very high for this measure, and combined with other impacts, the decision was made to dismiss it from further consideration.

Slurry all ≤ ¼" Sediment to Nearshore - This measure would slurry only ¼-inch and finer sediment (comprising approximately 4.5 MCY of total trapped sediment) to the nearshore environment. The remaining 1.4 MCY of coarser material would remain at the dam site and be would be graded to conform to natural topographic contours. Approximately 9,300 ac-ft of water would be necessary to slurry sediment to the nearshore environment. This quantity of water would have to come from multiple and expensive freshwater sources if it was determined to be available. Pumping seawater was also considered, but the action was met with resistance from the EWG. Extensive temporary right-of-way would have been needed for the 16-mile long alignment, and native vegetation would be temporarily impacted. Permits would also need to have been negotiated for impacts of fines and turbidity to the near- and offshore environment. To limit the introduction of fine sediment to the ocean, a separate feature to slurry the 'Reservoir Area' to a disposal site (via a "spur" off of the main line) was also considered. Preliminary costs for either feature were high. This measure was dismissed from further consideration.

Slurry ≤ ¼" Sediment (except 'Reservoir Area' Sediment) to Floodplain Downstream of Robles Facility- This measure would be combined with "Slurry 'Reservoir Area' Sediment to a Downstream Disposal Site" (2.1 MCY). Approximately 2.4 MCY of ¼-inch and finer sediment from the 'Delta Area' would be slurried to an open area in the floodplain downstream of the Robles Facility. The intent of this action would be to preclude fine sediment impacts to the Robles facility and to allow the placed materials to be subsequently available to erosion by flows and eventual transport to the ocean. The preliminary costs for this action were high largely due to the need to procure a substantial quantity of water and the need for additional real estate. This measure was dismissed from further consideration.

Natural Sediment Transport

Natural Transport of all Trapped Sediments - This measure would be combined with full or incremental dam removal measures. All the trapped sediment (5.9 MCY) will be transported downstream by natural (fluvial) processes. A shallow pilot channel would be excavated through the sediment to concentrate all streamflow. This measure would have the most extreme downstream flooding and water supply impacts and would require the most mitigation measures. This measure is included in the final array of alternative plans.

Natural Transport of all 'Delta Area' and 'Upstream Channel Area' Sediment – This measure would be combined with full or incremental dam removal and the slurry of 'Reservoir Area' sediments (2.1 MCY) to a disposal site. A shallow pilot channel would be excavated through the sediment to concentrate all streamflow. The fluvial transport of the remaining trapped sediments would still require a high level of protection for potential downstream flooding impacts, but potential adverse impacts to water supply are significantly reduced based on much lower turbidity levels. This measure is included in the final array of alternative plans.

On-Site Sediment Stabilization

Long-Term Transport Period – This measure would be combined with the full dam removal measure. Sediment would be stabilized within the original reservoir basin limits by the creation of multiple storage sites. The storage of sediment in upland side canyons was also considered but not pursued because the majority of land adjacent to the reservoir basin was part of the National Forest. For 'Reservoir Area' sediment, both on-site stabilization and off-site disposal via slurryline was considered. The slurryline to a downstream disposal site was preferred as this option rendered cost savings compared to on-site excavation/drying/storage of the fine sediment.

The northern side of the reservoir basin (left side, looking downstream) was chosen for locating the majority of the storage sites. This would allow for easier access for construction operations from the adjacent Matilija Road. This also allowed for slope protection to be confined to only the northern side of the channel. The southern side of the channel would be confined by the canyon slope. Refinements added another storage site on the south side of the canyon upstream limit of the 'Reservoir Area.'

A channel would be excavated to convey storm flows through the basin and to restore fish passage to the upstream pristine Matilija wilderness areas. Excavated materials ('Delta' and 'Upstream Channel' areas) would be placed into the storage sites. The channel would offer a 100-year level of protection from storm erosion. Riprap stone, grouted stone, and soil cement were all considered for slope protection. The larger materials on-site (boulders) were not sufficient in quantity. If riprap stone is used, a local quarry located a few miles from the dam site has the capability of supplying the required quantity, size and quality. The riprap stone and soil cement (using on-site aggregate) were comparable in cost. Riprap was preferred for long-term stabilization. The use of grouted stone slope protection or a reinforced concrete channel was discarded early due to concerns expressed by the EWG.

Various channel widths and alignments were evaluated for this measure to address fish passage and channel stability. Eventually, a channel with a 100-foot base width was selected to better allow for alternating alluvial bars, pools and a thalweg meander to form, conditions more diverse and favorable to fish and aquatic habitat. The channel follows the general alignment and slope of the pre-dam channel in the canyon. The side slopes would be terraced to allow for vegetation to grow and provide some shade to the channel.

This measure minimizes the risk to with-project downstream flooding and water supply impacts. This measure is included in the final array of alternative plans.

Short-Term Transport Period - This measure has some similarities to the "*Long-Term Transport Period"* measure, although stored sediments would be exposed to more frequent erosion, and hence fluvial transport downstream, during storm events. The storage sites would occupy a similar footprint as described in the previous measure and the channel configuration would also be similar for flow conveyance and fish passage. Several levels of protection were investigated for the channel to be excavated in the basin, from a capacity containing only the annual to the 10-year storm event. Several structural measures were discussed for stabilization, including the use of riprap stone and soil cement. Soil cement was preferred for short- term stabilization.

This measure seeks to limit impacts to downstream water supply, though does not limit risks to downstream flooding. This measure is also included in the final array of alternative plans.

Pool and Riffle System - This measure would require removal of most of the existing dam to the bed elevation, and a system of stabilizing structures to be constructed across the full width of the Matilija canyon. The stabilizing structures would be stair-stepped in the downstream direction with a one-foot drop at each structure to enable fish passage. The footprint of the Pool and Riffle system would span the entire canyon downstream of the dam and only a portion of the basin upstream of the dam.

The Pool and Riffle System would render the topography substantially different than pre-dam conditions. The Environmental Working Group expressed the most objections to this measure, and could not propose any changes to the preliminary design that would make this measure more environmentally acceptable. The chief objection was that the structure provides only marginal habitat and had shortcomings in functioning properly for steelhead given the dynamic nature of Matilija Creek. Therefore, this measure was dismissed from further analysis.

Additional Measures

Downstream Flood Protection - The formulation of the final alternative plans included dam removal measures. Since there is some increased risk to downstream flooding based on existing conditions, and to a lesser degree future without-project conditions, flood protection measures were added to the initial measures. These include modification to all the existing levees and construction of new levees or floodwalls, some bridges, and the acquisition of some properties. Improvements were based on offering a 100-year level of protection even though there is currently not a 100-year level of protection with all of the existing levees. During screening, leading up the final array of alternatives, levels of improvements were offered at two levels: “low level” or “high level” depending on the risk involved in the release of sediments downstream by mechanical or natural transport or stabilized sediments in-place.

The earthwork quantity necessary to construct new or modify existing levees is estimated to not exceed approximately 200,000 cubic yards for the improvements requiring greater protection (“high level”). It is assumed that the required fill may be obtained from the materials removed from Matilija Dam. There would be some trucking impacts to the community, regardless of the alternative chosen, associated with hauling materials from the dam site to the levee improvement areas downstream. The raising of any levees would also require purchase and placement of additional riprap stone protection. These measures are included in the final array of alternatives.

Downstream Water Supply Protection – The previous measures that included mechanical transport of fines or stabilization of sediments have direct benefits related to the protection of the existing downstream water supply facilities. In particular, the slurry of fines to a downstream disposal site is used to decrease potential turbidity impacts to

CMWD Robles Diversion Dam operations and ultimately to Lake Casitas. Sediment deposition is also a concern for CMWD. Measures that stabilize Matilija Dam sediment either on-site, or transport the materials off-site, reduce the amount of potential deposition in the Robles facility sediment basin and other appurtenance features.

Additional measures include increasing the storage capacity of the sediment debris basin at the Robles facility; modifying the facility to include a sediment bypass structure (radial gates) to allow sediment-laden flows to pass downstream; constructing a desilting basin to limit the potential increase in fines diverted through flows into the Robles-Casitas Canal and to Lake Casitas; and the potential purchasing of water from other sources if water diversions are temporarily interrupted from significant sedimentation impacts. Water diversions will be impacted if greater than 40,000 CY of sediment is deposited in the existing Robles facility sediment basin, causing interruptions to diversion operations to Lake Casitas. Diversion operations cannot be resumed until the sediment is cleared from the sediment basin, a regulated maintenance operation that cannot occur during the wet season. Flows with turbidity that are diverted into the canal can cause water quality problems at Lake Casitas.

Foster Park water diversions may also be impacted by sediment deposition and turbidity levels. Measures were investigated to provide alternate water sources including the purchase of water and construction of additional groundwater pumping wells.

Removal of Exotics/InvasiveSpecies - This measure includes the removal of non-native species identified in the U.S. Fish and Wildlife Service Coordination Act Report (CAR). The predominant species of concern is giant reed (*Arundo donax*). Giant reed has overwhelmed native riparian vegetation in many Southern California watersheds and provides little habitat value. The plant is very difficult to eradicate and requires active monitoring to ensure success. The total estimate of acreage affected by giant reed in the study area is about 250 acres. Giant reed could be removed by combining mechanical removal with application of herbicides.

Other suggested removal programs considered for this measure include reservoir area species such as bullfrogs, crayfish and green sunfish. This measure is combinable with other structural ecosystem restoration measures and will be considered in the final array of alternative plans.

Recreation Trails and Facilities - There is interest in providing recreational trails around the vicinity of the dam to establish a link between the Ventura River and the Matilija Wilderness. The U.S. Forest Service manages the wilderness area. There is currently no recreation offered in the vicinity of the dam. This measure could be combined with measures that remove the dam and is therefore considered in the final array of alternatives.

Basis for General Characteristics of Alternative Plans

Based on extensive coordination and interaction with the Plan Formulation Group, the Environmental Working Group and some of the other technical teams, only measures that included the removal of Matilija Dam could reasonably address restoration of access for returning anadromous fish to historic spawning and rearing habitat on Matilija Creek and its tributaries. Other fish bypass measures that did not require dam removal, such as trapping and trucking, construction of a fish ladder, a bypass tunnel for fish passage, and stocking of fish upstream of the dam were considered and dismissed based on their effectiveness, cost, and technical viability. The dam still provides a major impediment to downstream migration in all of those circumstances, except for the bypass tunnel. Steelhead could not survive the drop over the face of the existing dam during higher flow conditions when they would be migrating. Trapping the steelhead while migrating downstream somewhere upstream of the dam was not a viable measure due to the flashy nature of storm flows in the canyon. Therefore, dam removal measures are included in the final array of alternative plans to fully address the restoration of access to the 17 miles of pristine riverine habitat upstream of Matilija Dam.

Restoration of natural sand replenishment will occur in the future No Action alternative, but it is estimated that the dam will trap an additional 3 million cubic yards of sediment over the next 35 years before pre-dam volumes of coarse-grained material will be transported over the dam. Restoration of the 16 miles of sediment-starved reaches along the Ventura River is estimated to take an additional 65 years (as discussed later in this chapter under "*Evaluation of Alternative Plans, Sediment Transport, No Action Alternative*"). Measures were considered to mechanically transport the more coarse-grained sediments from above the dam to areas downstream of the dam, from directly below the dam to the ocean. It was determined that these measures could not be considered without the removal of the dam because of potential dam safety issues. The dam, in the current condition with trapped sediment behind it, is a stable structure that is not expected to required additional improvements for the next 50 years. If the sediment were removed from behind the dam, significant structural improvements would have to be made to the dam to ensure that the structure is safe. Therefore, dam removal was included as a measure in the final array of alternative measures to restore sediment transport to the beaches in far less time (10 to 20 years for the Recommended Plan) when compared to 100 years for the No Action alternative. Furthermore, mechanical removal and placement of sediment downstream along the riverine system or along the coast would provide only a temporary solution, as the mechanism of sediment replenishment from upstream of Matilija Dam would not be possible if the structure were to remain in place.

Alternative Plans

For the final array of action alternatives, features common to each include removal of Matilija Dam (either full or incremental); restoration of fish passage; reestablishment of natural hydrologic and sediment transport processes from the upper Matilija Creek watershed; management of the sediment trapped behind the dam; removal of exotic and invasive species, particularly giant reed (Arundo donax) from the original reservoir basin and in the downstream reaches of the Ventura River, and non-native predatory species from the dam lake and immediately downstream of the dam, particularly large mouth bass, sunfish, catfish, and bullfrogs; and mitigation measures for impacts to downstream flooding and to water supply. Recreation measures include trails and facilities consistent with Corps of Engineers guidance.

A brief discussion of each alternative is presented below. More details are presented in the Engineering Design Appendix. Chapter 4 presents additional information related to the recommended plan.

No Action Alternative

The No Action Alternative assumes that no ecosystem restoration measures are implemented. There would be no action taken to modify Matilija Dam from its current configuration and there would be no removal of trapped sediments from within the limits of the original reservoir. No downstream flood control improvements or other measures to limit downstream impacts attributed to additional sediment deposition or increases to turbidity levels resulting from removal of the dam would be required.

Fish passage would be restored above Robles Diversion Dam on the Ventura River in several years with the construction of the fish ladder, but for only about 4.3 miles from Robles Dam upstream along the Ventura River to the first significant fish passage obstruction on the north fork of Matilija Creek. No fish passage would be restored to the pristine juvenile and rearing habitat reaches above Matilija Dam.

Alternative 1: Full Dam Removal/Mechanical Sediment Transport: Slurry 'Reservoir Area' Sediment to Disposal Site/Sell Coarse from Dam

The dam demolition process for Alternative 1 would be conducted in one phase. Alternative 1 would slurry the 'Reservoir Area' sediment (2.1 million cubic yards) to an offsite disposal area and allow for removal of the dam. Of the remaining trapped sediment (3.8 million cubic yards), sands and gravels would be sold on site as aggregate (3.0 million cubic yards). Residual fine sediment (770,000 cubic yards), remaining after extraction of marketable aggregate, would be trucked to the offsite disposal area. Figure 3-1 presents a schematic diagram showing the primary components of this alternative.

As part of the restoration effort, giant reed would be removed from the limits of the original reservoir basin and upstream in limited areas of Reaches 8 and 9 prior to any earthmoving or dam deconstruction activity. Giant reed removal would also continue in the downstream reaches (1 through 6) as construction activities proceed.

Concrete from the dam removal would be crushed and sold on site as aggregate. Metal debris would be hauled from the site and salvaged. Non-salvageable items would be hauled to the Toland Landfill, 41 miles away, between Santa Paula and Fillmore.

All aggregate would be sold and removed from the reservoir basin by trucking. Truck routes would utilize state highways and local roads.

For the removal of fine sediment by slurry operation, this alternative assumes for cost estimating purposes that the source of water would be pumped from Lake Casitas, utilizing a constructed 8-mile long pipeline. Slurried materials would be deposited within several areas in proximity of the Highway 150 (Baldwin Road) Bridge. The areas, comprising 118 acres in the floodplain, are both upstream and downstream of the bridge and are distant from 3.6 to 6.3 miles downstream of Matilija Dam. Earthen containment dikes, with an average height of 20 feet and partially protected from riverine flows with stone, would be constructed to contain the slurried materials. Following dewatering of the slurried materials, the return effluent would be permitted to return to stream flow. A 404(b)(1) permit would be required. The upstream-most disposal area would be subject to erosion for flow events greater than the 5- to 10-year recurrence interval. Loss of limited levels of fine sediments downstream would likely occur.

To convey flows through the reservoir basin, a 60-foot wide channel with 3:1 (horizontal to vertical) side slopes would be excavated. The channel would maintain an alignment along the southern side of the reservoir (i.e. right side, looking downstream) as adjacent as possible to the canyon wall. The channel would have a streambed elevation similar to the pre-dam streambed elevation, though the alignment would be straighter and slightly steeper. The aggregate sale stockpile would be located on the northern side of the reservoir (i.e. left side, looking downstream). To protect the sand and gravel operation during major storm events, the northern (left) side slope of the channel would be protected with an 8-foot wide soil cement revetment designed to contain a 100-year storm event. The soil cement revetment, constructed utilizing on-site aggregate, would extend 13 feet above the channel invert and 5 feet below. Following completion of the aggregate sale operation, the slope protection would be removed and the material recycled. The streambed channel configuration will subsequently be allowed to migrate naturally within the post-reservoir basin.

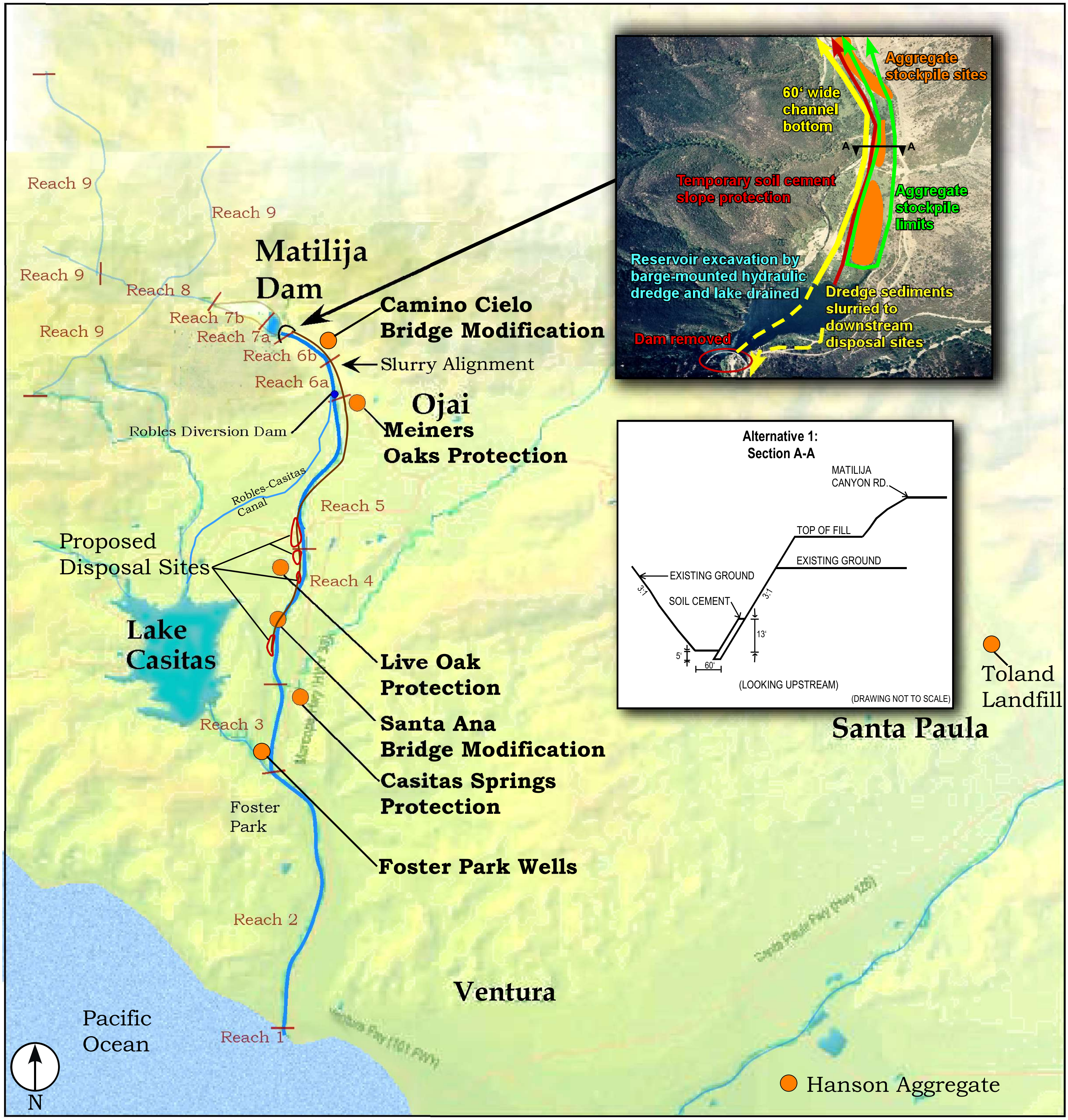
Downstream flood control protection would include purchase of the Matilija Hot Springs facility; purchase and removal of structures at Camino Cielo; removal/restore river channel width and replacement of Camino Cielo Bridge; extension of the Santa Ana Bridge and local river channel widening; and construction of new or raising existing levees and floodwalls at Meiners Oaks (2.8-ft average above the river bank), Live Oak and Casitas Springs (2- and 2.4-ft average, respectively, above the existing levee). The levee and floodwall at Meiners Oaks would be new features.

Modifications for sedimentation impacts at Robles Diversion Dam would include a high-flow bypass (radial sluice gates) structure to allow for evacuation of increased sediment loads at the facility debris basin resulting from removal of Matilija Dam. Modifications to the existing timber overflow weir structure would also be needed.

With the likely loss of fine sediments to riverine flows associated with at least one of the slurry disposal areas, modifications at the City of Ventura water supply facilities at Foster Park for increased turbidity impacts would include the placement of two groundwater supply wells.

This alternative is estimated to take 24 months for dam removal and slurry operations with a total time of 10 years for completion of aggregate sales and re-vegetation activities.

Alternative 1



Alternative 2a: Full Dam Removal/Natural Sediment Transport: Slurry 'Reservoir Area' Sediment Offsite

The dam demolition process for Alternative 2a would be conducted in one phase. Alternative 2a would slurry the 'Reservoir Area' sediment (2.1 million cubic yards) to a designated downstream disposal site, remove the dam, and allow the natural flows to erode the remaining sediment trapped (3.8 million cubic yards) within the original reservoir limits. Figure 3-2 presents a schematic diagram showing the primary components of this alternative.

As part of the restoration effort, giant reed would be removed from the limits of the original reservoir basin and upstream in limited areas of Reaches 8 and 9 prior to any earthmoving or dam deconstruction activity. Giant reed removal would also continue in the downstream reaches (1 through 6) as construction activities proceed.

For the removal of fine sediment by slurry operation, this alternative assumes for cost estimating purposes that the source of water would be pumped from Lake Casitas, utilizing a constructed 8-mile long pipeline. Slurried materials would be deposited within several areas in proximity of the Highway 150 (Baldwin Road) Bridge. The areas, comprising 118 acres in the floodplain, are both upstream and downstream of the bridge and are distant from 3.6 to 6.3 miles downstream of Matilija Dam. Earthen containment dikes, with an average height of 20 feet and partially protected from riverine flows with stone, would be constructed to contain the slurried materials. Following dewatering of the slurried materials, the return effluent would be permitted to return to stream flow. A 404(b)(1) permit would be required. The upstream-most disposal area would be subject to erosion for flow events greater than the 5- to 10-year recurrence interval. Loss of limited levels of fine sediments downstream would likely occur.

Following controlled blasting of the dam, the concrete rubble would be processed as required for transportation to a commercial concrete recycling plant, assumed to be Hanson Aggregates (approximately 28 miles from Matilija Dam). Metal debris would be hauled from the site and salvaged. Non-salvageable items would be hauled to the Toland Landfill, 41 miles away, between Santa Paula and Fillmore.

Downstream flood control protection would include purchase of the Matilija Hot Springs facility; purchase and removal of structures at Camino Cielo; removal/restore river channel width and replacement of Camino Cielo Bridge; extension of the Santa Ana Bridge and local river channel widening; and construction of new or raising existing levees and floodwalls at Meiners Oaks (5-ft average above the river bank), Live Oak and Casitas Springs (6-ft and 5-ft average, respectively, above the existing levee). The levee and floodwall at Meiners Oaks would be new features.

Modifications for sedimentation impacts at Robles Diversion Dam would include a high flow bypass (radial sluice gates) structure to allow for evacuation of increased sediment loads at the facility debris basin resulting from removal of Matilija Dam. Modifications to the existing timber overflow weir structure would also be needed. In addition, a desilting basin would be included off-line to the diversion canal to allow for the settling out of increased suspended fine sediment loads associated with the removal of Matilija Dam prior to re-conveyance to the canal and final delivery to Lake Casitas.

Modifications at the City of Ventura water supply facilities at Foster Park for increased turbidity impacts from suspended fines (silts and clays) would include the placement of two groundwater supply wells.

After a large proportion of the reservoir basin has been eroded, the site will be revegetated. It is estimated that the revegetation could be completed within 10 years of initial construction operations, however this is entirely dependent on the hydrology of storm events. Dam removal and slurrying operations are estimated to take 24 months to complete.

Alternative 2b: Full Dam Removal/Natural Sediment Transport: Natural Transport of 'Reservoir Area' Sediment

As in Alternative 2a, the dam demolition process for Alternative 2b would be conducted in one phase. At the Matilija Dam site, Alternative 2b differs from Alternative 2a only in that the 'Reservoir Area' sediment would not be slurried off-site. Instead only a portion of the 'Reservoir Area' sediment (approximately 0.5 million cubic yards) necessary to ensure safe removal of the dam in one phase would be excavated by clam shell dredging. This dredged sediment would be placed upstream within the basin and allowed to be naturally eroded by fluvial processes with the other trapped sediment. Figure 3-3 presents a schematic diagram showing the primary components of this alternative.

Alternative 2b features associated with giant reed eradication in the reservoir, structural removal of the dam, downstream flood mitigation measures, and modifications at Robles Diversion Dam (with the exception of a desilting basin) and Foster Park diversion are similar to Alternative 2a. In addition however, increased impacts at the Robles Diversion facility resulting in missed water diversion opportunities (for up to 8 years) to Lake Casitas necessitates the procurement of up to 48,000 acre-ft of water for Casitas Municipal Water District from other water purveyor sources.

While removal of the trapped sediment by natural fluvial processes will be variable and dependent on the hydrology, it is estimated that the time for completion including re-vegetation could be within 10 years of initial construction operations. Dam removal would require approximately 24 to 30 months.


Reach 9
Reach 9
Reach 9
Reach 9
Matilija Dam
Reach 8
Reach 7b
Reach 7a
Reach 6b
Reach 6a
Camino Cielo Bridge Modification
Slurry Alignment
Ojai
Meiners Oaks Protection
Robles Diversion Dam
Proposed Desilting Basin Site
Robles-Casitas Canal
Reach 5
Proposed Disposal Sites
Reach 4
Lake Casitas
Live Oak Protection
Santa Ana Bridge Modification
Casitas Springs Protection
Reach 3
Foster Park
Foster Park Wells
Reach 2
Ventura
Pacific Ocean
Reach 1
N
Trapped sediment to be removed by natural processes
Reservoir excavation by barge-mounted hydraulic dredge and lake drained
Dredged sediments slurried to downstream disposal sites
Dam removed
Toland Landfill
Santa Paula
Hanson Aggregate


Trapped sediment to be removed by natural processes
Low flow bypass prevents erosion of fines during non-storm flows and drains lake
Excavated sediments deposited upstream
Sediments behind dam excavated by barge-mounted clam shell
Dam removed
Reach 9
Reach 9
Reach 9
Reach 9
Matilija Dam
Reach 8
Reach 7b
Reach 7a
Reach 6b
Reach 6a
Camino Cielo Bridge Modification
Ojai
Robles Diversion Dam
Meiners Oaks Protection
Reach 5
Reach 4
Lake Casitas
Live Oak Protection
Santa Ana Bridge Modification
Reach 3
Casitas Springs Protection
Foster Park
Foster Park Wells
Toland Landfill
Santa Paula
Reach 2
Ventura
Pacific Ocean
Reach 1
N
Hanson Aggregate

Alternative 3a: Incremental Dam Removal/Natural Sediment Transport: Slurry 'Reservoir Area' Sediment Offsite

The dam demolition process for Alternative 3a would be conducted in two phases. For Phase 1, the 'Reservoir Area' sediment (2.1 million cubic yards) would be slurried to a designated downstream site, and then the dam structure above elevation 1000 feet would be removed. The remaining trapped sediment behind the dam would be allowed to erode by natural fluvial processes. Once the trapped sediment reaches equilibrium with the modified dam height, the remainder of the dam would be removed in Phase 2. Following Phase 2 removal, the remaining trapped sediment would be allowed to erode by natural fluvial processes. Figure 3-4 presents a schematic diagram showing the primary components of this alternative.

As part of the restoration effort, giant reed would be removed from the limits of the original reservoir basin and upstream in limited areas of Reaches 8 and 9 prior to any earthmoving or dam deconstruction activity. Giant reed removal would also continue in the downstream reaches (1 through 6) as construction activities proceed.

For the removal of fine sediment by slurry operation, this alternative assumes for cost estimating purposes that the source of water would be pumped from Lake Casitas, utilizing a constructed 8-mile long pipeline. Slurried materials would be deposited within several areas in proximity of the Highway 150 (Baldwin Road) Bridge. The areas, comprising 118 acres in the floodplain, are both upstream and downstream of the bridge and are distant from 3.6 to 6.3 miles downstream of Matilija Dam. Earthen containment dikes, with an average height of 20 feet and partially protected from riverine flows with stone, would be constructed to contain the slurried materials. Following dewatering of the slurried materials, the return effluent would be permitted to return to stream flow. A 404(b)(1) permit would be required. The upstream-most disposal area would be subject to erosion for flow events greater than the 5- to 10-year recurrence interval. Loss of limited levels of fine sediments downstream would likely occur.

Following controlled blasting of the dam in each phase, the concrete rubble would be processed as required for transportation to a commercial concrete recycling plant, assumed to be Hanson Aggregates (approximately 28 miles from Matilija Dam). Metal debris would be hauled from the site and salvaged. Non-salvageable items would be hauled to the Toland Landfill, 41 miles away, between Santa Paula and Fillmore.

Downstream flood control protection would include purchase of the Matilija Hot Springs facility; purchase and removal of structures at Camino Cielo; removal/restore river channel width and replacement of Camino Cielo Bridge; extension of the Santa Ana Bridge and local river channel widening; and construction of new or raising existing levees and floodwalls at Meiners Oaks (5-ft average above the river bank), Live Oak and Casitas Springs (6-ft and 5-ft average, respectively, above the existing levee). The levee and floodwall at Meiners Oaks would be new features.

Modifications for sedimentation impacts at Robles Diversion Dam would include a high-flow bypass (radial sluice gates) structure to allow for evacuation of increased sediment loads at the facility debris basin resulting from removal of Matilija Dam. Modifications to the existing timber overflow weir structure would also be needed. In addition, a desilting basin would be included off-line to the diversion canal to allow for the settling out of increased suspended fine sediment loads associated with the removal of Matilija Dam prior to re-conveyance to the canal and final delivery to Lake Casitas.

Modifications at the City of Ventura water supply facilities at Foster Park for increased turbidity impacts from suspended fines (silts and clays) would include the placement of two groundwater supply wells.

It is estimated that this alternative would require approximately 18 months to complete the Phase I removal of the 'Reservoir Area' sediment and the dam. While removal of the remaining sediments will be variable and dependent upon the hydrology, it is estimated under wet year conditions that Phase II could be initiated as early as two years after completion of Phase I. Re-vegetation could be completed as early as 10 years after notice to proceed.

Alternative 3b: Incremental Dam Removal/Natural Sediment Transport: Natural Transport of 'Reservoir Area' Sediment

As in Alternative 3a, the dam demolition process for Alternative 3b would be conducted in two phases. For Phase 1, a portion of the 'Reservoir Area' sediment (approximately 300,000 cubic yards) necessary to ensure safe removal of the dam to elevation 1030 would be excavated by clam shell dredging. This dredged sediment would be placed upstream within the basin and allowed to be naturally eroded by fluvial processes with the other trapped sediment. A small pilot channel, no greater than 10 feet deep, would be excavated to initially convey flows through the reservoir basin. Once the trapped sediment reaches equilibrium with the modified dam height, the remainder of the dam would be removed in Phase 2. Following Phase 2 removal, the remaining trapped sediment would be allowed to erode by natural fluvial processes. Figure 3-5 presents a schematic diagram showing the primary components of this alternative.

Alternative 3b features associated with giant reed eradication in the reservoir, structural removal of the dam, downstream flood mitigation measures, and modifications at Robles Diversion Dam (with the exception of a desilting basin) and Foster Park diversion are similar to Alternative 3a. In addition however, increased impacts at the Robles Diversion facility resulting in missed water diversion opportunities (for up to 8 years) to Lake Casitas necessitates the procurement of up to 48,000 acre-ft of water for Casitas Municipal Water District from other water purveyor sources.

While removal of the trapped sediment by natural fluvial processes will be dependent on the hydrology, it is estimated under wet year conditions that the time for completion including re-vegetation could occur within 10 years of initial construction operations.

Alternative 3a

Alternative 3b

Alternative 4a   Full Dam Removal/On-Site Sediment Stabilization: Long-Term Transport Period

The dam demolition process for Alternative 4a would be conducted in one phase.

Alternative 4a would slurry the 'Reservoir Area' sediment (2.1 million cubic yards) to the designated downstream disposal site and allow for removal of the dam. The remaining trapped sediment would be stabilized within the original reservoir basin limits.

A channel with a 100-foot wide base width would be excavated within the original reservoir basin following an alignment similar to the 1947 "pre-dam" alignment. The invert (bottom) of the excavated channel would be to pre-dam elevation and similar gradient. The channel would have a design capacity to convey the 100-year level flood event. Side slopes would be 3:1 (horizontal to vertical). The slope protection, consisting of riprap stone (ungrouted), would extend 11 feet above channel invert and 5 feet below the channel invert to prevent undermining of the revetment. Sediment excavated from the channel would be permanently placed in storage locations within the original reservoir limits. Figure 3-6 presents a schematic diagram showing the primary components of this alternative.

As part of the restoration effort, giant reed would be removed from the limits of the original reservoir basin and upstream in limited areas of Reaches 8 and 9 prior to any earthmoving or dam deconstruction activity. Giant reed removal would also continue in the downstream reaches (1 through 6) as construction activities proceed.

For the removal of fine sediment by slurry operation, this alternative assumes for cost estimating purposes that the source of water would be pumped from Lake Casitas, utilizing a constructed 8-mile long pipeline. Slurried materials would be deposited within several areas in proximity of the Highway 150 (Baldwin Road) Bridge. The areas, comprising 118 acres in the floodplain, are both upstream and downstream of the bridge and are distant from 3.6 to 6.3 miles downstream of Matilija Dam. Earthen containment dikes, with an average height of 20 feet and partially protected from riverine flows with stone, would be constructed to contain the slurried materials. Following dewatering of the slurried materials, the return effluent would be permitted to return to stream flow. A 404(b)(1) permit would be required. The upstream-most disposal area would be subject to erosion for flow events greater than the 5- to 10-year recurrence interval. Loss of limited levels of fine sediments downstream would likely occur.

Concrete rubble from the dam removal would be buried in the storage area fills. Metal debris would be hauled from the site and salvaged. Non-salvageable items would be hauled to the Toland Landfill, 41 miles away, between Santa Paula and Fillmore.

Downstream flood control protection would include purchase of the Matilija Hot Springs facility; purchase and removal of structures at Camino Cielo; removal/restore river channel width and replacement of Camino Cielo Bridge; extension of the Santa Ana Bridge and local river channel widening; and construction of new or raising existing levees and floodwalls at Meiners Oaks (2.8-ft average above the river bank), Live Oak and Casitas Springs (2- and 2.4-ft average, respectively, above the existing levee). The levee and floodwall at Meiners Oaks would be new features.

Modifications for sedimentation impacts at Robles Diversion Dam would include a high-flow bypass (radial sluice gates) structure to allow for evacuation of increased sediment loads at the facility debris basin resulting from removal of Matilija Dam. Modifications to the existing timber overflow weir structure would also be needed.

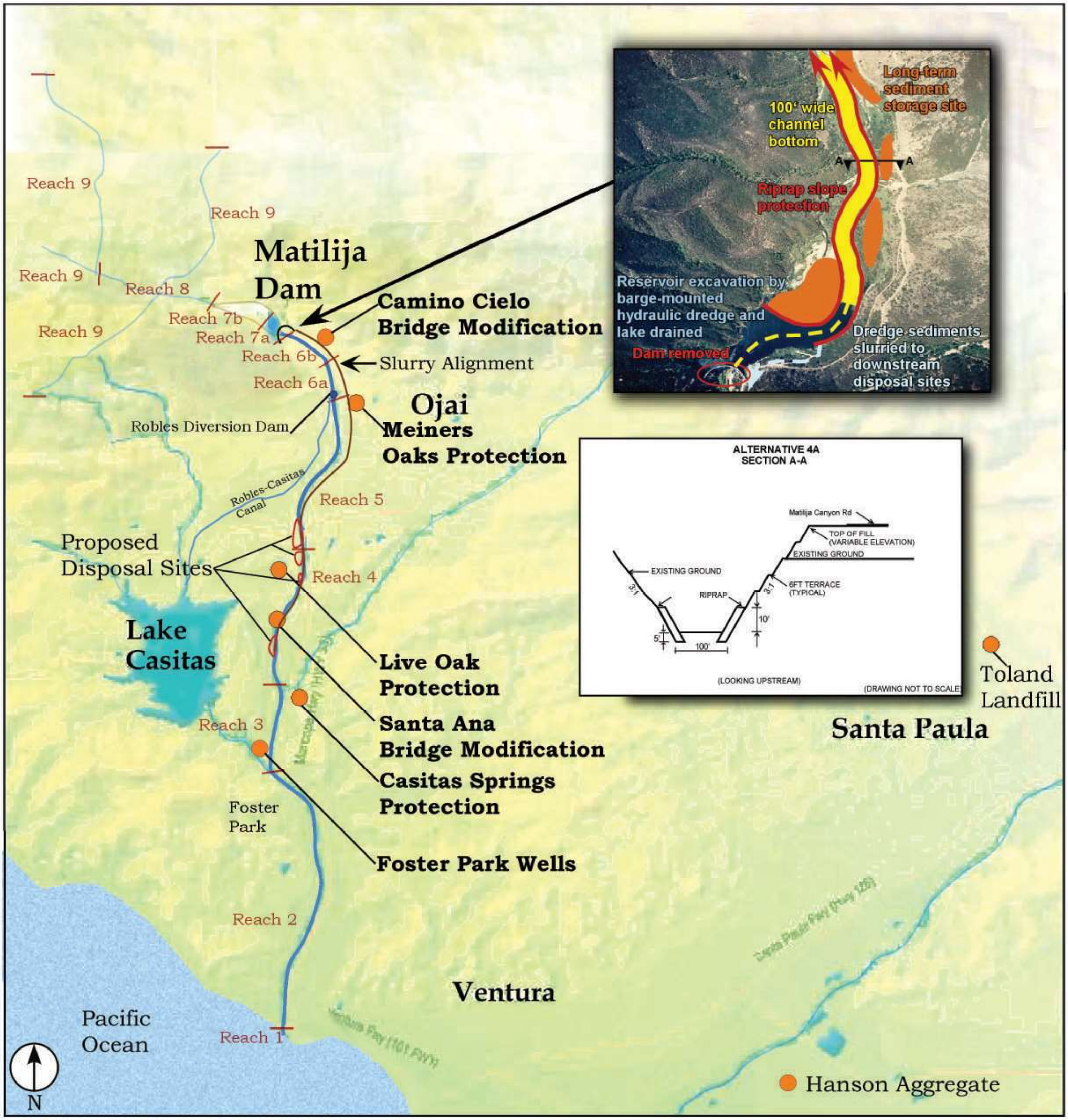
With the likely loss of fine sediments to riverine flows associated with at least one of the slurry disposal areas, modifications at the City of Ventura water supply facilities at Foster Park for increased turbidity impacts would include the placement of two groundwater supply wells.

This alternative is estimated to take 3 years to complete, including slurrying the 'Reservoir Area' sediment, removal of the dam, channel excavation, riprap stone protection placement, and re-vegetation.

Alternative 4b Full Dam Removal/On-Site Sediment Stabilization: Short-Term Transport Period

The dam demolition process for Alternative 4b would be conducted in one phase. Alternative 4b would slurry the 'Reservoir Area' sediment (2.1 million cubic yards) to a designated downstream disposal site and allow for removal of the dam. The remaining trapped sediment would be temporarily stabilized within the original reservoir basin limits.

For the removal of fine sediment by slurry operation, this alternative assumes for cost estimating purposes that the source of water would be pumped from Lake Casitas, utilizing a constructed 8-mile long pipeline. Slurried materials would be deposited within several areas in proximity of the Highway 150 (Baldwin Road) Bridge. The areas, comprising 118 acres in the floodplain, are both upstream and downstream of the bridge and are distant from 3.6 to 6.3 miles downstream of Matilija Dam. Earthen containment dikes, with an average height of 20 feet and partially protected from riverine flows with stone, would be constructed to contain the slurried materials. Following dewatering of the slurried materials, the return effluent would be permitted to return to stream flow. A 404(b)(1) permit would be required. The upstream-most disposal area would be subject to erosion for flow events greater than the 5- to 10-year recurrence interval. Loss of limited levels of fine sediments downstream would likely occur.


Long-term sediment storage site
100' wide channel bottom
A A
Riprap slope protection
Reservoir excavation by barge-mounted hydraulic dredge and lake drained
Dam removed
Dredge sediments slurried to downstream disposal sites
ALTERNATIVE 4A
SECTION A-A
Matilija Canyon Rd
TOP OF FILL (VARIABLE ELEVATION)
EXISTING GROUND
EXISTING GROUND
RIPRAP
6FT TERRACE (TYPICAL)
3:1
3:1
10'
5'
100'
(LOOKING UPSTREAM)
(DRAWING NOT TO SCALE)
Reach 9
Reach 9
Reach 9
Reach 9
Reach 8
Reach 7b
Reach 7a
Reach 6b
Reach 6a
Reach 5
Reach 4
Reach 3
Reach 2
Reach 1
Matilija Dam
Camino Cielo Bridge Modification
Slurry Alignment
Ojai
Meiners Oaks Protection
Robles Diversion Dam
Robles-Casitas Canal
Proposed Disposal Sites
Lake Casitas
Live Oak Protection
Santa Ana Bridge Modification
Casitas Springs Protection
Foster Park
Foster Park Wells
Toland Landfill
Santa Paula
Ventura
Pacific Ocean
N
Hanson Aggregate

A channel with a 100-foot wide base width and side slopes of 3:1 (horizontal to vertical) would be excavated within the original reservoir basin following an alignment similar to the 1947 "pre-dam" alignment. The invert (bottom) of the excavated channel would be to pre-dam elevation and similar gradient. Sediment excavated from the channel would be placed in storage site locations within the reservoir basin, and also within the area previously occupied by the 'Reservoir Area' sediment (following completion of slurrying operations). All sediment excavated from the "Delta Area' would be placed (stored) within the lower half of the reservoir basin. The 'Delta Area' materials contain the majority of the residual portions of the finer sediment trapped in the basin. Sediments within the original reservoir basin would be subject to natural erosion and transport downstream by stream flows. Selective segments of the channel within the lower half of the reservoir basin would be protected with soil cement revetment. The purpose of the revetment is to "meter" the erosion of the 'Delta Area' sediment whenever the revetment is overtopped by larger flows. The height of the revetment would extend 7 feet above the channel invert and 5 feet below the invert to prevent undermining of the structure. The revetment height would be overtopped by flows exceeding a 10-year storm event (12,500 ft^3/sec). At the upstream end of the soil cement revetment, a tie-in to the adjacent canyon slope or road embankment would be required to prevent circumventing of the structure by breakout channel flows. The tie-in could consist of either soil cement or larger boulders (collected from on-site). Coarser-grained materials within the reservoir basin located upstream of the revetment (i.e. within the 'Upstream Channel Area') would remain unprotected and subject to natural erosion by stream flow.

The soil cement revetment would be constructed utilizing aggregate available on site. All soil cement revetment would be removed from the site following sufficient evacuation of trapped sediment from the reservoir basin. The removal would occur in stages, and will be dependent on criteria established in the monitoring and adaptive management plan taking into account levels of sediment evacuation and limiting adverse effects downstream. Complete removal is expected to occur within 20 years. Figure 3-7 presents a schematic diagram showing the primary components of this alternative.

As part of the restoration effort, giant reed would be removed from the limits of the original reservoir basin and upstream in limited areas of Reaches 8 and 9 prior to any earthmoving or dam deconstruction activity. Giant reed removal would also continue in the downstream reaches (1 through 6) as construction activities proceed.

Following controlled blasting of the dam, the concrete rubble would be processed as required for transportation to a commercial concrete recycling plant, assumed to be Hanson Aggregates (approximately 28 miles from Matilija Dam). Metal debris would be hauled from the site and salvaged. Non-salvageable items would be hauled to the Toland Landfill, 41 miles away, between Santa Paula and Fillmore.

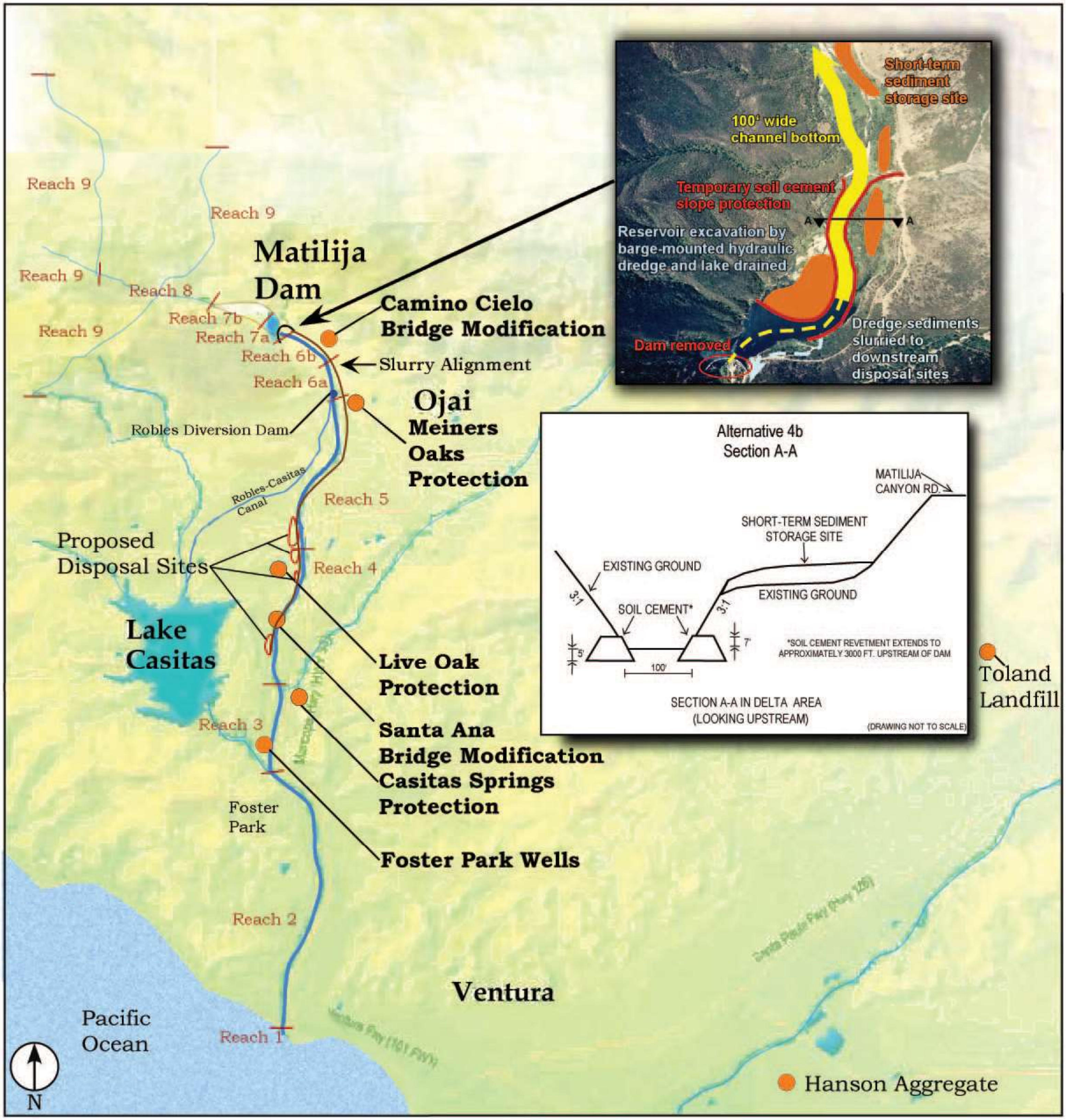
Downstream flood control protection would include purchase of the Matilija Hot Springs facility; purchase and removal of structures at Camino Cielo; removal/restore river channel width and replacement of Camino Cielo Bridge; extension of the Santa Ana Bridge and local river channel widening; and construction of new or raising existing levees and floodwalls at Meiners Oaks (5-ft average above the river bank), Live Oak and

Casitas Springs (6-ft and 5-ft average, respectively, above the existing levee). The levee and floodwall at Meiners Oaks would be new features.

Modifications for sedimentation impacts at Robles Diversion Dam would include a high flow bypass (radial sluice gates) structure to allow for evacuation of increased sediment loads at the facility debris basin resulting from removal of Matilija Dam. Modifications to the existing timber overflow weir structure would also be needed.

Modifications at the City of Ventura water supply facilities at Foster Park for increased turbidity impacts from suspended fines (silts and clays) would include the placement of two groundwater supply wells.

It is estimated that this alternative would require approximately 3 years to complete the slurrying operation of the 'Reservoir Area' sediment, removal of the dam, excavation of the channel, and construction of the soil cement revetment. While removal of the remaining trapped sediment will be variable and dependent upon the hydrology and natural fluvial processes, it is assumed that the re-vegetation phase within portions of the reservoir basin may be commenced within 10 years of initial earthmoving and deconstruction activities; other portions of the reservoir basin could require as long as 20 years.


Short-term sediment storage site
100' wide channel bottom
Temporary soil cement slope protection
Reservoir excavation by barge-mounted hydraulic dredge and lake drained
Dredge sediments slurried to downstream disposal sites
Dam removed
Alternative 4b
Section A-A
MATILIJA CANYON RD.
SHORT-TERM SEDIMENT STORAGE SITE
EXISTING GROUND
EXISTING GROUND
SOIL CEMENT*
3:1
3:1
5'
7'
100'
*SOIL CEMENT REVETMENT EXTENDS TO APPROXIMATELY 3000 FT. UPSTREAM OF DAM
SECTION A-A IN DELTA AREA
(LOOKING UPSTREAM)
(DRAWING NOT TO SCALE)
Reach 9
Reach 9
Reach 9
Reach 9
Reach 8
Reach 7b
Reach 7a
Reach 6b
Reach 6a
Reach 5
Reach 4
Reach 3
Reach 2
Reach 1
Matilija Dam
Camino Cielo Bridge Modification
Slurry Alignment
Ojai
Meiners Oaks Protection
Robles Diversion Dam
Robles-Casitas Canal
Proposed Disposal Sites
Lake Casitas
Live Oak Protection
Santa Ana Bridge Modification
Casitas Springs Protection
Foster Park
Foster Park Wells
Toland Landfill
Ventura
Pacific Ocean
N
Hanson Aggregate

Evaluation of Alternative Plans

The evaluation of the alternatives allows assessment and appraisal of the effects of the with-project conditions of each plan, and comparison to the future without project conditions. Specific criteria to be used in the evaluation of the alternatives, deemed the most important by the Sponsor, the Corps, Reclamation, participating environmental resource agencies and interest groups, and other stakeholders, are then used to compare the various plans against each other. The criteria established to be the most important in the evaluation of the alternatives and associated mitigation or restoration measures are presented below.

Sediment Impacts and Mitigation/Restoration Measures

Sediment Transport
- Downstream Riverine Deposition and Turbidity
- Flooding
- Beach Nourishment and Sediment Yield to the Ocean

Environmental Resources
- Dam Site Topography
- Biological Resources
- Cultural Resources
- Air Quality, Noise, and Traffic

Water Supply
- Water Source Need for Slurry Operation
- Robles Diversion Dam and Lake Casitas
- Foster Park
- Groundwater

Sediment Transport

Prior to describing sediment transport impacts and mitigation measures for the alternatives, a brief discussion of the *hydrologic input* to numerical models utilized in the evaluation of the alternatives will be presented. Various approaches for hydrologic input were considered depending on the assessed impact: downstream riverine deposition, turbidity, flooding, or sediment yield to the ocean.

<u>Riverine Deposition</u> The hydrologic input used to evaluate the long-term sediment depositional trends (including at Robles Diversion Dam) for the alternatives is a 50-year simulation utilizing a relatively wet period hydrograph of storm events from 1991 to 2001, repeated five times (see Figure 2-14). The hydrologic simulation does not include any events larger than the 20-year return period (5 percent exceedance). From a depositional perspective, large flood events (exceeding a 20-year return period) may actually produce less depositional effects downstream, as there may be more sediment transport to the ocean. The largest flows in the selected period occurred in 1992 and 1995 (approximately 20-year recurrence floods), and 1998 (approximately a 15-year

recurrence flood). The remaining flow events were between 2 and 7 yrs; two were less than the 2-yr event. Flow data from 1991 to 2001 has 15-minute intervals available, allowing sufficient representation of the rapidly varying flow conditions characteristic of the Ventura River. For establishing riparian habitat impacts as a result of riverine deposition and ensuing habitat recovery time periods, the results of the modeling prediction utilizing this established 50-yr simulation are appropriate. This information was utilized in the HEP assessment.

Turbidity Turbidity levels and durations associated under with-project conditions were also evaluated. Turbidity is the measurement of the suspended fine sediment (silts, clays, and fine sands) in the stream flow. Impacts due to increases in turbidity levels over existing or without-project conditions are of concern for the natural transport alternatives. The evaluation assessed the effects of a wet hydrograph, utilizing single back-to-back storm events (for a 3 to 4-year recurrence flood (1991 event) and a 15-year recurrence flood (1998 event)) and a dry hydrograph taken over a drought period (1954 to 1960). The latter hydrograph was evaluated because drought periods can cause the turbidity levels to persist longer, as the erosion capacity of lower flows is more limited to finer sediment (if readily available).

Flood Protection For with-project flooding mitigation, two approaches for hydrologic input were utilized. A preliminary assessment conducted for the purposes of evaluation and comparison of flood protection measures for the alternatives utilized a 50-yr simulation (described above) with the hydrologic record of the 1990's. This was then followed by a risk and uncertainty analysis that considered the hydrologic uncertainty attributed to the discharge-frequency relationships at selected river mile stations. Further discussion pertaining to flood protection is presented in "*Flood Protection Improvements,*" in the latter part of this section.

Sediment Yield to the Ocean An assessment of sediment yield to the ocean considered the results provided by sediment transport modeling utilizing the 1990 storms. However, limitations of the model with respect to representation of the dynamic estuary conditions precluded its sole use. The sediment delivery assessment depended largely on historical data and the factoring in of the sediment trapped behind Matilija Dam.

Downstream Deposition and Turbidity

The construction of Matilija Dam has contributed to the significant erosion that has occurred in the Ventura River. The channel elevation has decreased in some reaches over 10 feet. The removal of the dam would re-supply sediment downstream and change the trends in the river, most notably in the 8.5 miles between the dam and San Antonio Creek confluence, from degradational to aggradational. The deposition would continue until equilibrium of sediment supply in the riverine system is reached. A state of equilibrium occurs when the sediment entering the river system is in close balance with the sediment leaving the system. The equilibrium condition will be similar to that of the pre-dam condition. Each alternative will eventually reach equilibrium though the time frame will vary. Even if the dam was not removed (the No Action Alternative), at some time in the future all new sediment entering the reservoir would spill over the top and a replenishment process would be fully under way. Degradational trends would still likely however continue in Reach 2 (between river mile 5.5 and 3), though at slower rate depending on the action alternative. The main cause for erosion in this incised reach is channel constriction by bridges and the sediment trapping by Casitas Dam on the Coyote Creek tributary and the San Antonio Creek Watershed debris basins.

The deposition would re-create a riverine morphology similar to pre-dam conditions in terms of channel form characteristics, channel geometry, and riverbed material. However the aggradation may also cause flooding problems. There has been much infrastructure developed along the river corridor since the construction of the dam and some of these developments have come to depend upon the current river condition to prevent flooding. The process of returning the river to pre-dam conditions will increase the flooding risk of many of these structures. The level of flood risk is dependent on the alternative.

Depositional effects associated with the alternatives will be described below. Modeling results show that depositional levels for all the alternatives decrease in the downstream direction. The estuary reach is not expected to receive more than approximately 1 foot of deposition of sand, regardless of the alternative, over the 50-year period of analysis.

Associated with the removal of Matilija Dam is the increase above baseline conditions of turbidity levels in river flows following storm events. The impact varies according to the alternative and depends on whether all, a portion of, or no trapped fine (silts, clays, and fine sand) sediments are allowed to be naturally transported downstream, and also on the duration and rate of flows.

Following are the effects of the alternatives to hydraulic and sediment transport impacts.

No Action Alternative

Presently when a storm flow overtops the dam, of the sediment entering the Matilija Reservoir, fine sediment (mostly silts and clays) will be carried with the flows downstream. The coarser sediment entering Matilija Reservoir is still largely trapped behind the dam. With time, as the reservoir becomes more filled with sediment, these overtopping flows will contain greater amounts of coarser sediment. By approximately year 2040, after reservoir equilibrium is attained, sand and gravel size sediment entering the reservoir from the watershed will fully contribute to sediment loads passing over the dam. The erosional trend in the riverine system downstream will gradually become a depositional trend. Only in Reach 2 will this depositional trend not occur as this reach is controlled by local geologic features (This is the case for all the alternatives).

Under the No Action Alternative, it is estimated that it will take approximately 100 years for the Ventura River to be reach equilibrium. For the reaches between Matilija Dam and Robles Diversion Dam, this equilibrium will occur in approximately 50 to 70 years.

At Robles Diversion Dam, levels of deposition in the sediment basin (based on sediment removal records between 1966 and 1998) average about 13,300 cubic yards/year (yd^3/yr). Deposition however is highly variable and can range between practically zero during dry years to over 90,000 yd^3/yr for very large events (such as the 100-yr recurrence floods of 1969 and 1978). Based on model simulations (1991- 2001 hydrologic record), in the first year deposition at Robles Diversion Dam could reach 20,000 cubic yards. The main source of coarse sediment is currently from North Fork Matilija Creek. With future contributions from Matilija Creek coarse sediment, and eventual attainment of equilibrium in the upper reach, average annual deposition at Robles is expected to be two times the current average (26,600 yd^3/yr). Maintenance requirements would increase.

Under the No Action Alternative, it is estimated that fine sediment concentrations and associated turbidity levels downstream will increase by approximately 30 percent once the existing lake fills in (by approximately year 2020). Currently during storm events, silts and clays are transported with flows whenever the reservoir spills. The downstream reaches therefore experience approximately natural concentrations of fine sediment. These concentrations vary, according to flood flow (measured at Foster Park), between 10,000 mg/l (5000 ft^3/sec) to 1,000 mg/l (100 ft^3/sec). Natural fluctuation however may vary by a factor of two or more.

Alternative 1

For Alternative 1, all of the trapped sediment, 5.8 million cubic yards, will be mechanically removed from the riverine system (i.e., slurrying of 'Reservoir Area' sediment, 2.1 million cubic yards; sale of marketable aggregate by truck, 3.0 million cubic yards; trucking residual fines from the aggregate sale operations, 770,000 cubic yards). Unrestricted sediment from Matilija Creek watershed will gradually allow a natural re-supply of sediment to the downstream reaches. The complete return of the riverine system to pre-dam conditions will take approximately as long as the amount of time it took to degrade the river, or about 50 years. The reaches upstream of Robles Diversion Dam could reach a state of dynamic equilibrium within 10 years, assuming average hydrologic conditions prevail.

The deposition at Robles Diversion Dam is expected to increase by a factor of two- a magnitude similar to the No Action Alternative since in both cases trapped sediment behind Matilija Dam is not allowed downstream into the riverine system. The difference is that the increase under Alternative 1will occur sooner (within 10 years) than under the No Action Alternative (after 50 to 70 years). Maintenance efforts at the Robles facility would increase immediately.

Turbidity concentrations in the Ventura River upstream of the slurry disposal site will not significantly change over existing conditions, and can be expected to be similar to the No Action Alternative. At the slurry disposal site however (vicinity of Highway 150 Bridge), the upstream-most area is subject to erosion at flood events greater than the 5- to 10-year recurrence interval. There will likely be some erosion of fines into the riverine system if the containment dike is overtopped or if loss of any portion of the structure occurs. With time, a level of resistance to erosion would occur as vegetation becomes more established. It is expected that the majority of any eroded fine material however would be transported to the ocean. The other three disposal areas downstream of the bridge are located on higher floodplain terraces, and are not prone to flooding in events less than the 50- to 100-year level.

Alternative 2a

Alternative 2a slurries the 'Reservoir Area' sediment (2.1 million cubic yards) to the downstream disposal site, removes the dam in one phase, and allows the natural flows to erode the remaining sediment trapped within the original reservoir limits. When significant flows start to erode this material, rapid downcutting will cut a narrow deep channel through the material, followed by a slower and gradual widening of the channel. The rate of widening will be dependent upon bank stability and storm flow event. It is estimated that in the first year, approximately 1.0 million cubic yards of sediment could be eroded from the basin. The pre-dam thalweg within Reach 7 would essentially be re-established. The initial years could produce the most deposition downstream, especially in the upper reaches. It is estimated that the riverine system could reach a state of dynamic equilibrium within 10 years, assuming average hydrologic conditions prevail. If a dry period prevailed, as for example occurred during the 1940's Ventura River hydrologic record, the period necessary to reach equilibrium would be prolonged.

It is expected that the majority of the remaining trapped sediment in the original reservoir will eventually be eroded. The rate and extent of erosion at any time will depend on the hydrology and channel migration. A very large storm event, such as the 1969 flood, could potentially mobilize the remainder of the trapped sediment.

The outcome of the rapid downcutting stage will be an initial oversupply of sediment and aggradation to the downstream reaches. Some portions of reaches that have been significantly eroded, such as downstream of Robles Diversion Dam, can be expected to return to pre-dam conditions in a relatively short time frame. At some locations, aggradation levels may exceed pre-dam elevations. At these locations, the effects may be temporary, or the river may equilibrate at a slightly higher elevation. The deposition levels downstream would be monitored periodically to insure that deleterious effects could be minimized through mitigation measures. The growth of vegetation would also tend to stabilize these areas for a longer period of time. Relative depths of aggradation will decrease in the downstream direction.

Large amounts of sediment will deposit in the sediment basin area at Robles Diversion Dam. Deposition quantities will be dependent on the storm magnitudes following Matilija Dam removal. Based on model simulations, in the first year, deposition at Robles Diversion Dam could reach 70,000 cubic yards. Deposition volumes greater than 40,000 cubic yards will effectively shut down diversion operations. During the first few floods, sediment eroded from Matilija Reservoir could fill the sediment basin at the Robles Diversion facility and, without any maintenance intervention, spill over the diversion dam sluice gate crest.

For turbidity increases resulting from the removal of Matilija Dam, it is expected that levels at the Robles facility will not be excessive since the majority of fine sediments that were trapped at Matilija Dam have been slurried downstream of the diversion facility. The residual proportion of silt and clay remaining in the reservoir basin is a relatively small portion (about 20% or 770,000 cubic yards) of the total quantity of remaining trapped sediment within the 'Delta Area' and the 'Upstream Channel Area.' Before the flows of an average magnitude storm passes through the reservoir basin, turbidity levels are estimated to be between 2 to 10 times higher than No Action conditions. After the storm peak, turbidity levels will decrease to 2 to 4 times No Action conditions. These levels would be considered within the range of natural fluctuation under baseline conditions. After a period of three years, or just after one storm with a return period greater than 10 years, the increase in turbidity levels is expected to reduce to 10 to 50 percent greater than the No Action Alternative. Between 5 and 10 years, concentrations will be similar to the No Action Alternative. The duration and levels of turbidity increases associated with the trapped sediments however may be prolonged should an extended drought period prevail.

It is expected that turbidity increases will also be associated with at least one of the slurry disposal site areas, as described for Alternative 1.

Alternative 2b

Alternative 2b differs from Alternative 2a in that the 'Reservoir Area' sediment (typically silt) remains on-site and is allowed to be naturally eroded with the other trapped materials. However, as in Alternative 2a, erosion from Matilija Reservoir and deposition downstream is significant. From the reservoir, approximately 2.0 million cubic yards of sediment (twice the volume of erosion in the first year of Alternative 2a) could be eroded in the first year. The pre-dam thalweg will be re-established within the first year. The initial years could produce the most deposition downstream, especially in the upper reaches. Deposition at Robles Diversion Dam could reach 80,000 cubic yards in the first year following dam removal. It is estimated that the riverine system could reach a state of dynamic equilibrium within 10 years, assuming average hydrologic conditions prevail.

Turbidity will be exceedingly high immediately after the first storm flow following dam removal. The concentration of fine sediments downstream will be greater than 100,000 mg/l for a period of days to weeks, depending on flow rates. The higher the flow rate, the more sediment is eroded. Typical concentrations may remain 10 times higher than with the dam in place for a period of up to two years, depending on flow rates. Concentrations thereafter would decrease to levels up to 4 times natural conditions. (If one flood of average magnitude (2-year event) however were to occur, the concentrations would decrease to two to three times the levels experienced with the dam in place. These slightly higher than normal concentrations would persist for up to two more years, after which time the concentrations would return to normal levels.) After 10 years of average hydrology, the concentrations will not be significantly different from the No Action Alternative.

Alternative 3a

In the first phase of Alternative 3a, 'Reservoir Area' sediment (2.1 million cubic yards) is slurried to the downstream disposal site, and the initial portion of the dam is removed. A period follows when storm flows are allowed to erode trapped sediment until equilibrium is reached with the modified dam height. The remainder of the dam is removed entirely in the second phase. Remaining trapped sediment is then allowed to be eroded by flows and transported downstream.

Initiation of the second phase of dam removal could occur as early as the second year- if hydrologic conditions were consistent with the assumption of the 50-year simulation based on the wet period hydrographic input (described earlier in this subsection). However, if the region is experiencing drought conditions, (such as the hydrology similar to the 1940's) the period of removal between the first and the second phase would be prolonged. Should intermittent smaller storms re-deposit more sediment in previously evacuated areas within the reservoir limits, then the period between the first and second removal would be extended more.

Alternative 3a has a greater measure of control over the impacts of deposition, allowing monitoring upstream and downstream to the riverine environment and flood control system. For example, if more deposition occurred than acceptable at a particular location after the first phase of removal, it would be possible to mechanically remove that sediment from the stream channel before the remainder of the dam is removed. As an option to full removal of the remaining portion of the dam in the second phase, another increment could be removed if found to be warranted. Under average hydrologic conditions, it is estimated that the riverine system could establish equilibrium conditions within 10 years.

Erosion from Matilija Reservoir will be less than Alternative 2a during the first year since the dam is still in place (approximately 770,000 cubic yards). However, after the third year, the total amount of sediment eroded from the reservoir will be similar to Alternative 2a. Depositional trends downstream are similar to, though a little less than, Alternative 2a, including at Robles Diversion Dam. Turbidity levels and trends will be similar to Alternative 2a.

Alternative 3b

Alternative 3b differs from Alternative 3a in that the 'Reservoir Area' sediment remains on-site and is naturally eroded with the other trapped materials. Erosion from Matilija Reservoir is less than Alternative 2b in the first year because the dam is still in place. However, after the third year, the total amount of sediment eroded from the reservoir will be similar to Alternative 2b. Depositional trends downstream are similar to Alternative 2b, though moderated, including at Robles Diversion Dam. Turbidity levels will be similar to Alternative 2b, although after the second phase of removal a resurgence of levels would initially occur, followed by a diminishing pattern similar to the post-first phase removal. Under average hydrologic conditions, it is estimated that the riverine system could reach dynamic equilibrium conditions within 10 years. This alternative has a greater measure of control over the impacts of deposition, as compared to Alternatives 2a and 2b, allowing monitoring upstream and downstream to the riverine environment and flood control system.

Alternative 4a

Alternative 4a slurries the ‘Reservoir Area’ sediment (2.1 million cubic yards) to the downstream disposal area, and stabilizes the remaining trapped sediment (3.8 million cubic yards) within the Matilija Reservoir. The depositional impacts associated with this alternative are similar to Alternative 1 and will come from the natural re-supply of sediment from the Matilija Creek watershed upstream of the dam. No trapped sediment behind Matilija Dam will replenish the downstream riverine system for storm flows not exceeding the 100-year recurrence event. For turbidity impacts, concentrations in the Ventura River under Alternative 4a can be expected to be similar to the No Action Alternative except for increased effects resulting from the potential loss of slurried fines from the most upstream slurry disposal area. The time to reach riverine equilibrium conditions for Alternative 4a would be similar to Alternative 1, about 50 years.

Alternative 4b

Alternative 4b slurries the ‘Reservoir Area’ sediment (2.1 million cubic yards) to the downstream disposal area, and temporarily stabilizes the remaining trapped sediment excavated from the channel.

The volume of sediments eroded from the reservoir basin would depend on the magnitude of a specific storm event and access of flows to specific areas of the reservoir basin. Portions of the channel with soil cement revetment would provide a 10-yr recurrence level of protection. The flows from storm events less than the 10-yr return period would cause erosion of the coarser grained sediment not protected by soil cement revetment in the upper half of the reservoir basin (i.e. the ‘Upstream Channel Area’). The flows from storm events exceeding the 10-yr return period would, in addition to the above, have access to materials protected by soil cement in the lower half of the reservoir basin since overtopping of the structure would occur, allowing erosion of mostly medium-grain sediment with fines, largely in the middle portion of the reservoir basin (i.e. the ‘Delta Area’) as well as the lowermost portion of the basin where ‘Delta Area’ materials have been placed following channel excavation operations. With time, as the soil cement revetment is removed in stages, sediment in areas of the reservoir basin previously stabilized would be subject to variable levels of erosion, depending on the magnitude of the storm flow event, and subsequent transport downstream.

The depositional effects downstream associated with this alternative will be similar to Alternative 2a, though moderated.

With respect to turbidity levels, the soil cement revetment would provide a measure of control against the mobilization of fine sediment. This control would be with respect to timing and volume releases of these fines downstream. For storm events less than a 10-year recurrence interval, there would be no turbidity increases above the No Action levels. For storm events greater than a 10-year recurrence interval, the soil cement revetment would temporarily be overtopped, and fine sediment concentrations in the flows would likely result in turbidity levels on the order of 2 to 4 times greater than No Action conditions depending on the amount of fines made accessible and eroded into the active channel. These levels would be considered within the range of natural fluctuation for higher flow events under No Action conditions. Prior to the staged removal of the soil cement revetment, turbidity levels and durations would not be affected by the onset of a drought period.

During the staged removal of soil cement revetment (starting from the downstream end) to allow for the eventual complete erosion of the remaining protected sediment, it is estimated that turbidity levels could temporarily increase by a factor of 2 to 10 above No Action conditions. The duration and level of turbidity would depend on how much fine sediment is exposed to a given magnitude of flow event. During lower flow conditions, flows would remain in the active channel thereby limiting any access to the finer sediment (hence increased turbidity effects) along the unprotected portion of the bank. Following the final staged removal of the revetment, turbidity levels would be expected to stabilize to levels similar to the No Action Alternative after one or two average storm flow events pass through the reservoir basin. The staged removal of the revetment would be tied to a monitoring/adaptive management program designed to minimize impacts downstream.

It is expected that turbidity increases will also be associated with at least one of the slurry disposal site areas as described for Alternative 1.

Under average hydrologic conditions, it is estimated that the riverine system could reach equilibrium conditions within 20 years.

Flooding

The removal of Matilija Dam would increase flooding levels and risk above existing conditions. Flood mitigation measures to protect against structural damages would include construction of levees/floodwalls (either new or raising/extending existing structures) and bridge modifications. The source for earth materials for the levee improvements would likely be from the Matilija Dam reservoir basin. Where protection is not possible, due to engineering, social, legal, or economical reasons, land acquisition would be necessary. Mitigation for occasional damages to croplands, beyond without-project conditions, would also require compensation.

With-project floodplain inundation mapping (overflows) was performed for the 10-, 50-, 100-, and 500-yr return periods. Channel geometries and bed elevations used in the hydraulic model input for overflow mapping were obtained by the cumulative effect of simulating a 50-yr period (with flow data from 1991 to 2001) with year 2001 channel cross-sections as a starting base. Compared to the existing conditions overflow limits, with-project overflows are moderately more extensive in the Meiners Oaks, Live Oak and Casitas Springs areas. Flooding depths associated with the riverine transport alternatives

(2a, 2b, 3a, 3b, and 4b) are higher than depths associated with the mechanical sediment removal/permanent stabilization alternatives (1 and 4a).

An assessment was made on potential flood risks related to the location of the proposed slurry disposal site within the Ventura River floodplain in the vicinity of Highway 150 bridge. For the four distinct areas that make up the disposal site, only the area upstream of the bridge will impede flows along one of the several active channels within the river reach. Due to the width of the river in this reach, however, it was determined that flow conveyance would remain hydraulically adequate. Additional flooding would not be induced. The remaining three sites downstream of the bridge are on river terraces and would not impede flows.

Flood Protection Improvements

Preliminary Determination of Level of Protection During the course of the formulation of alternatives and the screening process, the design of the levee and floodwall improvements considered under with-project conditions were conservative due to the considerable uncertainty regarding the downstream depositional effects to flow conveyance. Two levels of protection were recommended: "low level" and "high level." The "low level" of protection was established by determining the 100-year flood water surface elevation of the river channel based on the maximum aggradation predicted during a 50-year simulation of the natural erosion Alternative 2b (worst case downstream aggradation scenario), and then adding four feet of freeboard in the reaches upstream and two feet of freeboard in the reaches downstream of Baldwin Road to account for uncertainties. The "high level" of protection was determined by adding six feet of freeboard above the "low level" of protection.

Level of Protection Based on Risk and Uncertainty At a later stage of the formulation process, a risk and uncertainty analysis was conducted on the tentatively recommended plan to better define recommended levee or floodwall protection heights. The discussion is presented in Chapter 4, Recommended Plan, in the paragraph: "*Mitigation for Flooding Impacts.*"

In categorizing the flood protection levels associated with the action alternatives, the mechanical sediment removal/permanent stabilization alternatives (1 and 4a) were placed into one group, and the natural transport alternatives (2a, 2b, 3a, 3b, and 4b) were placed into a second group. This categorization is based on the relative differences in potential flooding depths. The first group will require a lower level of flood protection, whereas the second group will require a higher level of flood protection. The higher level of protection is based on the results of the risk and uncertainty analysis conducted for the recommended plan. For simplicity, no further distinction was made for the potentially higher levels of protection needed for alternatives 2b and 3b. The lower level of protection was established by proportionately diminishing the higher level of protection by the difference between the preliminary "high" and "low" levels described above in the paragraph "*Preliminary Determination of Level of Protection.*"

No Action Alternative

Under existing conditions, there is flood risk along the lower Matilija Creek (downstream of the dam) and the Ventura River where several developed areas are within the floodplain. The Matilija Hot Springs facility, just downstream of the dam, is subject to inundation along its lower grounds under a greater than 50-yr flood event. After restoration of full sediment load contribution from Matilija Creek and the eventual re-supply to the upstream reaches in the future, the facility will be at an increased flood risk. There is risk of flooding at Camino Cielo, Meiners Oaks, Live Oak, and Casitas Springs. Under the No Action Alternative, no improvements to increase flood level protection are planned. Currently there is an on-going sediment removal maintenance program at Santa Ana Road Bridge (Reach 4) to insure that the bridge is able to pass flows at full capacity. The bridge itself acts as a severe constriction.

Alternatives 1 and 4a

Flood control improvements for “lower level” levee/floodwall height protection would be required. Table 3-1 summarizes the required downstream flood mitigation measures. The Engineering Design Appendix contains additional details including alignments and profiles.

With the removal of Matilija Dam and the majority of the trapped sediment, there would be restoration of full sediment load contribution from Matilija Creek. Purchase of Matilija Hot Springs facility would be required, though removal of structures would be limited to only those most subject to instability. Structures at Camino Cielo would be purchased/removed. Levee and floodwall modifications would be required at Meiners Oaks, Live Oak, and Casitas Springs. Camino Cielo bridge and the Santa Ana bridge would require modifications to increase capacities to pass higher flows. The Camino Cielo Bridge is a low-flow crossing (concrete box culvert), and severely constricts the channel. Removal of bridge and restoration to original channel width will improve conveyance and prevent backwater effects and additional deposition. At the Santa Ana Bridge, the bridge would be extended following widening of the channel. The current sediment excavation maintenance just upstream of the structure would need to continue and would likely increase. The deposition is caused by the natural constriction of the river channel.

Alternatives 2a, 2b, 3a, 3b, and 4b

Due to the downstream depositional effects to flow conveyance, levee and floodwall heights for “higher level” protection would be required. The modifications and activities described for alternatives 1 and 4a would be applicable. Levee and floodwall heights however would be higher. Table 3-1 summarizes the required downstream flood mitigation measures.

Table 3-1: Required Downstream Flood Mitigation Measures							
Feature	**Reach**	**River Mile**	**Required Action**	**Level of Protection for Structural Modifications**			
				Lower Level (Alts. 1 & 4a)		Higher Level (Alts. 2a, 2b, 3a, 3b, 4b)	
					Location of Structures (River Mile)		Location of Structures (River Mile)
Matilija Hot Springs	6b	16.4	Purchase and Vacate Structures at Complex.	See Req'd Action		See Req'd Action	
Camino Cielo Bridge	6b	15.5	Remove Bridge and Restore Channel Section. Construct New Bridge.	See Req'd Action		See Req'd Action	
Camino Cielo Structures	6b	15.6 to 15.4	Purchase and Remove 2 Houses and 9 Cabins.	See Req'd Action		See Req'd Action	
Meiners Oaks Area	6a/5	14.3 to 13.4	Add Levee/Floodwall Along East Bank.	Levee: 2.8 ft. avg Floodwall: 2.8 ft. avg Levee: 2.8 ft. avg	14.3 to 14.1 14.1to 13.6 13.6 to 13.4	Levee: 5.0 ft. avg Floodwall: 5.0 ft. avg Levee: 5.0 ft. avg	14.3 to 14.1 14.1 to 13.6 13.6 to 13.4
Live Oak Levee	4	10.6 to 9.4	Raise Existing (West) Levee.	2.0 ft avg.	10.2 to 9.4	6.0 ft. avg.	10.2 to 9.4
Santa Ana Bridge	4	9.4	Extend Bridge. Widen Channel at Bridge and to 500 ft Upstream. Continue Sediment Removal Maintenance Program.	See Req'd Action		See Req'd Action	
Casitas Springs Levee	3	7.8 to 6.8	Increase Existing (East) Levee Ht. With Levee/Floodwall.	Levee: 2.4 ft. avg Floodwall: 2.4 ft. avg Levee: 2.4 ft.avg	7.8 to 7.5 7.5 to 7.4 7.4 to 6.8	Levee: 5.0 ft. avg Floodwall: 5.0 ft. avg Levee: 5.0 ft avg	7.8 to 7.5 7.5 to 7.4 7.4 to 6.8

Beach Nourishment and Sediment Yield to the Ocean

Dam removal will accelerate the restoration of sediment transport from the Matilija subwatershed to the Ventura River shoreline when compared to the No Action Alternative. The sediment transport model results show that equilibrium transport (pre-dam conditions) to the shoreline from the Matilija subwatershed will be restored within about 10 years for Alternatives 2a, 2b, 3a, and 3b; 10 to 20 years for Alternative 4b; 50 years for Alternatives 1 and 4a. It would take about 100 years to reach equilibrium transport of sediments to the shoreline under the No Action Alternative. Estimates of the percent increase in sediment loads for the alternatives are presented in Table 3-2. The sediment volumes include both the quantity trapped in the reservoir basin and that supplied from the watershed. The modeling results indicate that the increases in sediment volumes are not significant over 50 years when compared to the No Action Alternative, but there would be beneficial impacts to the local shoreline.

Table 3-2: Summary of Sediment Delivery to the Ocean

	No Action	Alts 1, 4a		Alts 2a, 3a, and 4b		Alts 2b, 3b	
Time to Reach Equilibrium Transport to Beach (Yrs)	~ 100	~ 50	% Increase from No Action	< 10 (2a,3a) < 20 (4b)	% Increase from No Action	< 10	% Increase from No Action
Net 50-Yr Fine Transport (yd^3)	18,000,000	18,600,000	3%	19,000,000	6%	21,000,000	17%
Net 50-Yr Sand Transport (yd^3)	5,900,000	7,100,000	20%	7,800,000	32%	8,100,000	37%
Net 50-Yr Gravel Transport (yd^3)	410,000	490,000	20%	570,000	32%	570,000	32%
Net 50-Yr Cobble Transport (yd^3)	23,000	27,000	20%	32,000	32%	32,000	32%

Beach nourishment, utilizing trapped sediment from Matilija Dam, was considered from the earliest stages of this feasibility study for the array of alternatives. Mechanical transport of sediment to the shoreline was dismissed based on the high costs associated with trucking, conveyor or slurry pipeline. Natural transport also allows the re-supply to the sediment-starved riverine system first, thereby restoring sediment transport equilibrium.

Benefits related to beach nourishment in the Ventura River shoreline area are derived from the increased transport of coarse-grained material, from sands to gravels and cobbles. A prominent marine cobble area characterizes Surfer's Point, at the mouth of the Ventura River. A large fraction of the coarse sediments are delivered to the coast during extreme flood events. Cobbles may assist in stabilizing the nearby shoreline due to the strong currents (littoral transport) that consistently erodes the beaches in the area.

Alternatives 2a, 2b, 3a, 3b, and 4b provide the most benefits to the Surfer's Point at a net increase of almost one-third (9,000 cubic yards) more cobbles when compared to the No Action Plan for the 50-year period of analysis. Mechanical placement of the same volumes of cobbles would be relatively expensive.

The Beach Erosion Authority for Clean Oceans and Nourishment (BEACON, 2004) has estimated that one cubic yard of sand delivered via river to the ocean roughly equates to one square foot of dry sand on the beach. For Alternatives 2b and 3b, the net difference in sand transport to the shoreline is about 2.2 million cubic yards. Alternative 2a, 3a, and 4b have a net increase of about 1.9 million cubic yards of sand over 50 years. Alternatives 1 and 4a have a 1.2 million cubic yard increase of sand. Benefits associated with this volume of beach nourishment can be equated to storm damage reduction, improved recreation with a wider beach, and better protection of the threatened coastal dunes along this portion of the Ventura County shoreline. Emma Woods State Beach, west of the Ventura River mouth, has eroded approximately 150 feet over the past 50 years, indicating an erosion rate of 2-3 feet per year. Loss of upper beach zones has caused a loss of spawning habitat for the California grunion, and the threatened western snowy plover. The diminishing coastal dunes provide habitat for the silvery legless lizard, a California species of special concern.

BEACON (2004) also estimated that mechanical placement of sand at the beaches from local sources cost between $10 and $15 per cubic yard. Therefore, when compared to mechanical placement of the same volume of sand over 50 years, there would be a $22-$33 million dollar benefit by restoring natural transport of sand to the beaches for Alternatives 2b and 3b, $19-$29 million dollars for Alternatives 2a, 3a, and 4b, and $12-$18 million dollars for Alternatives 1 and 4a, without future discounting.

Detrimental effects related to the restoration of increased sediment transport to the shoreline include the short-term impacts of fine sediments on local crustaceans, and the potential increase in future dredging at the Ventura and Channel Islands Harbors due to longshore transport of increased sediments from the Ventura River. Since the increase in volumes of fines and sands are relatively small when compared to the No Action Plan, the detrimental impacts are not considered significant for this study.

Environmental Resources

Dam Site Topography

No Action Alternative

Under the No Action Alternative, sediment from the Matilija Creek watershed will continue to deposit behind Matilija Dam. Currently there is an estimated 5.8 million cubic yards trapped within the original reservoir limits. By approximately year 2040, when equilibrium conditions in the reservoir are expected, the estimated total volume of trapped sediment will be 9.3 million cubic yards. The lake, and thereby, the water storage capacity of the dam, will be essentially eliminated by 2020. As the trap efficiency continues to decrease prior to 2040, more and more sediment will be transported over the top of Matilija Dam with flood flows. This re-supply of sediment will eventually replenish scoured areas in the Ventura River.

The loss of the lake and the additional sediment build-up behind Matilija Dam is not as adverse an impact when compared to the beneficial impact of sediment replenishment in the riverine system downstream of the dam.

Alternative 1

Construction activities (i.e. slurrying of 'Reservoir Area' sediments, processing of aggregate for sale, dam removal, temporary engineered channel, etc.) would substantially alter the topography of the dam site. The restoration of the site to a more natural state, similar to conditions that existed prior to the construction of the dam, and restoration of natural fluvial processes and sediment source from upper Matilija Creek to the Ventura River and ultimately the coastal regime, would be considered a beneficial impact.

The construction and filling of the preferred slurry disposal site with fine sediments and the associated containment dikes would be adverse. The site is made up of four noncontiguous areas, totaling approximately 118 acres just upstream and downstream of Highway 150 Bridge. The upstream-most area lies in the existing riverbed; the one just downstream of the bridge is only partially within the riverbed. The other two areas are lower floodplain terraces. Each area would require protection by an earthen containment dike. Dike heights would range from 10 to 30 feet high above the riverbed. Partial protection of the side slope of the upstream-most area would be needed since a portion would be exposed to more constant river flows. Riprap stone would be placed to provide protection up to the 5- to 10-year flood event. Stone sizes of a minimum of two-foot diameter would be required. For the three areas located downstream of the bridge, riverbed boulders would be sufficient.

The "lower level" downstream flood protection proposed for the alternative would in large part expand upon existing flood protection measures and so it would not significantly alter the topography of those areas. A new levee and floodwall is proposed at Meiners Oaks. Topographical impacts for this new location would be more significant.

Alternative 2a

Topographic impacts are greater than Alternative 1 as this alternative relies upon storm events to transport the majority of trapped sediment downstream. The magnitude of erosion from the dam reservoir and the resulting larger amounts of sediment being transported and deposited downstream would be far greater than that which would normally occur under natural conditions. The restoration of the site to a more natural state, similar to conditions that existed prior to the construction of the dam, and replenishment of trapped materials and new sediment from the upper Matilija Creek to the Ventura River and ultimately the coastal regime, would be considered a beneficial impact.

The effects of slurrying the 'Reservoir Area" materials to the same disposal site as described in Alternative 1 would have the same level of impact as that alternative.

The "higher level" of protection required for the downstream flood control structures would have a greater degree of topographical impacts than Alternative 1. Existing levees would be raised higher than the elevations necessary for Alternative 1, requiring a larger footprint. New levees and floodwalls at Meiners Oaks and Live Oak will have a more significant impact.

Alternative 2b

Although this alternative does not include slurrying of the "Reservoir Area' sediment to the disposal site and does not therefore have the associated impact as in Alternative 2a, it does have downstream topographic alterations that are slightly greater than in Alternative 2a. This is attributed to the additional sediment ('Reservoir Area' sediment) that will be introduced into the riverine system. The level of downstream flood protection and impacts will be the same as in Alternative 2a.

Alternative 3a

Topographic impacts for 3a would be similar to those described for Alternative 2a. However, there would be a reduced potential for impacts because the dam would be removed in phases, allowing for a more gradual erosion of trapped sediment.

Alternative 3b

Topographic impacts would be the same as those described for 2b. However, just as in Alternative 3a, there would be a reduced potential for impacts because the dam would be removed in phases, allowing for a more gradual erosion of trapped sediment.

Alternative 4a

Alternative 4a will return the site to a semi-natural topography upon completion of the project. The trapped sediment, with the exception of the 'Reservoir Area' sediment, will be regraded and stabilized on site. An excavated channel with riprap stone slope protection on both sides of the channel would remain a permanent feature at the site. These impacts are adverse, but are less than significant. The alignment of the channel would be similar to the 1947 "pre-dam" alignment. Although the site will not be returned to pre-dam conditions, the removal of the dam and replenishment of upper Matilija Creek sediment to the Ventura River and ultimately the coastal regime, would be considered a beneficial impact.

The use of a slurry disposal area for this alternative would have the same impacts as discussed in Alternative 1. The downstream flood protection proposed for the alternative would have the same topographical impacts as Alternative 1.

Alternative 4b

Topographic impacts for Alternative 4b would be initially similar to Alternative 4a. However with time, the channel, with a limited level of slope protection, would allow erosion of trapped sediment (side slopes and adjacent sediment storage stockpile locations) when flow elevations are higher than the revetment elevation. The channel protection (soil cement) would serve a temporary function as it would be removed once the majority of trapped sediment is eroded from the site. The restoration of the site to a more natural state, similar to conditions that existed prior to the construction of the dam, and replenishment of upper Matilija Creek sediment to the Ventura River and ultimately to the coastal regime, would be considered a beneficial impact.

The use of a slurry disposal area for this alternative would have the same impacts as discussed in Alternative 1. The downstream flood protection proposed for Alternative 4b would have the same topographical impacts as Alternative 2a.

Biological Resources

Prior to evaluation of the alternatives for biological resources impacts, the Robles fishway, the extent of giant reed removal, short-term sediment deposition impacts, turbidity, and the effects to the Ventura River estuary.

Robles Fishway: Implementation of the Robles fishway will open approximately six miles of additional spawning and rearing habitat for steelhead, upstream of Robles Dam, including a portion of North Fork Matilija Creek. The new operating criteria, as established under the Biological Opinion (NOAA Fisheries, 2003), for downstream releases will provide sufficient depth in the river channel downstream of the fishway for migration.

Giant Reed (*Arundo Donax)* Management: Removal and management of giant reed and other exotic plant species (such as tamarisk) will be conducted in Reaches 7 through 9 at the commencement of construction operations. Exotic plant species eradication for Reaches 1 through 6 downstream of the dam will also be included as part of the ecosystem restoration measures of this study. Following project completion, a maintenance program to control future growth will be initiated. The removal and management of these invasive weeds would greatly improve the riparian ecosystem quality within the study area.

Short-Term Sediment Deposition Impacts: In the HEP assessment, depositional depths of three feet or greater were characterized as an adverse impact to the riparian habitat. Riparian habitat values associated with affected areas were reduced in Target year 5 (a value of zero was used for the “native vegetation cover” variable in the Riparian Habitat Value component of the HEP formula). A full recovery value for native vegetation cover was not assigned to the affected area until Target Year 20.

Turbidity: With respect to biological impacts from turbidity levels associated with the alternatives, the larger consensus of the Environmental Working Group (EWG) has not objected to the concentration levels and durations estimated as part of the sediment transport modeling effort. As a result, the associated turbidity levels, with respect to each of the alternatives, are not considered to be a significant adverse impact to southern steelhead in the Ventura River.

Ventura River Estuary: The sediment transport modeling results do not indicate that there will be substantial deposition in the estuary (see previous discussion under subsection: *Sediment Transport,* paragraph: *Downstream Deposition and Turbidity*). Therefore biological resources impacts to the estuary resulting from the alternatives were not considered.

No Action Alternative

The existing 500 acre-feet reservoir is estimated to be filled in by approximately year 2020. As the reservoir fills, lacustrine habitat will continue to decrease, to the detriment of the aquatic inhabitants - some of which are exotic predators such as bullfrogs and largemouth bass. The wetland area behind the dam will initially increase as the reservoir fills, but will then decrease as the filled land behind the dam begins to dry. Riparian habitat will replace the lake and wetlands area. California red-legged frogs are known to occur in the riverine and wetlands habitat within the influence of the lake (USFWS, 2003). Giant reed will continue to spread throughout the area behind the dam once occupied by the existing reservoir and also upstream of the original reservoir. It is estimated that by year 50, giant reed will have fully displaced native riparian vegetation.

Downstream of the dam, the riparian habitat will continue to decline as exotic and invasive species, such as giant reed, continue to persist and outcompete native species. Long-term changes to the habitats resulting from exotic species abundance could significantly reduce wildlife diversity and use in the study area, including special status wildlife species.

Steelhead habitat will improve in the reaches below Robles Diversion Dam once the Robles fishway is in full operation. The quality of the habitat (conduciveness to spawning and rearing) in these downstream reaches overall, however, will still generally be impaired (below average) compared to its historical condition.

The reaches upstream of Matilija Dam will continue to have no value to southern steelhead. The dam will continue to disrupt river connectivity and present a barrier to migrating fish and other wildlife.

The long-term replenishment (up to 100 years) of sediment to the downstream riverine system from the Matilija watershed as the dam loses its trapping capacity will be beneficial to the natural processes within the Ventura River system. However the natural hydrology in the Ventura River will still be adversely impacted in the downstream reaches due to on-going groundwater extraction operations, surface flow diversions and discharges. From a HEP standpoint, the Natural Processes component will continue to reflect very low quality.

Alternative 1

Alternative 1 would result in the temporary loss of habitat for sensitive species in Reach 7 during demolition and earthmoving activities including riverine and upland habitat types. The lacustrine and wetland habitat associated with the lake would however be permanently lost- an ultimate fate similar for the No Action Alternative. Prior to the draining of the lake, native fauna will be trapped and relocated (including the red-legged frog, southwestern pond turtle, and two-striped garter snake); exotic species will be eradicated (including bullfrogs, crayfish, bass, sunfish, and any other non-native aquatic predators). Following the completion of construction operations, an estimated duration of up to ten years, re-vegetation efforts will be undertaken in the disturbed areas.

Wildlife movement in Matilija Canyon and along Matilija Creek would be temporarily disrupted for a period of up to ten years. However, the removal of Matilija Dam, which is a barrier to wildlife dispersal, would increase species diversity by allowing separate populations to move more readily upstream and downstream, especially fish and other aquatic species, including southwestern pond turtle and California red-legged frog.

With the removal of Matilija Dam and construction of an engineered channel, just over 17 miles of habitat will be immediately reopened to southern steelhead and other aquatic species, and as a result, significant environmental outputs will be produced. Reaches 8 and 9 are considered high quality steelhead habitat. The quality of steelhead habitat in Reaches 6 and 7 will gradually improve as the beneficial effects from the removal of the dam are manifested. Smolt productivity, for example, will increase as there is more efficient movement of nutrients downstream. Reach 7 will eventually return to near pre-dam conditions. The quality of steelhead habitat downstream of Reach 6 is expected to remain similar to the without-project conditions after the Robles fishway is in full operation.

The removal of giant reed and other exotic plant species within the original reservoir limits (Reach 7) and upstream of the reservoir limits (Reaches 8 and 9) and the planting of native riparian vegetation will improve the value of riparian habitat quality. In the downstream reaches (1 through 6), restoration activities related to exotic plant eradication will continue to improve the environmental outputs (habitat units) significantly over the 50-year life of the project.

The reestablishment of natural sediment transport processes will improve the quality of the habitat in the Ventura River in terms of natural riverine processes. However the time frame for re-establishment of riverine equilibrium conditions in the Ventura River will be approximately 50 years, a longer-term scenario made necessary due to the unavailability of trapped sediment (mechanically removed from the system) and sole reliance on the natural re-supply of Matilija Creek sediment. Reach 6 and 7 will benefit the most, as the former will reach equilibrium before the downstream reaches, and the latter becoming more similar to pre-dam conditions within a relatively short time (few years) of completion of aggregate sale operations. The improvement to the habitat quality from a natural processes perspective is less dramatic in the downstream reaches due to the same adverse impacts on the natural hydrologic regime as described for the No Action Alternative.

The use of soil cement as temporary slope protection for the channel to be excavated on the southern side of the reservoir basin will not have any adverse aesthetic or environmental impacts once the revetment is removed following completion of aggregate sale from the dam site.

Construction and operation of the slurry disposal site in the vicinity of the Highway 150 Bridge would disturb habitat and wildlife corridors along portions of the riverbed and the lower floodplain terraces adjacent to the Ventura River. The four areas comprising the site are of relatively moderate quality. Non-native grassland, oak trees, some alluvial scrub and giant reed are present. The site would be revegetated following completion of construction operations and drainage of the site. It is unlikely that any sensitive or listed species would be impacted as a result of the disturbance to the site.

The "lower level" downstream flood protection will impact limited areas beyond where existing levees or floodwalls are already present. The footprint for new protection improvements would permanently remove primarily upland habitats along the Ventura River and would disrupt wildlife movement corridors to a very limited extent.

In terms of the HEP assessment, Alternative 1 offers the second to least value amongst all of the action alternatives. This is largely due to the longer time period required to establish riverine equilibrium based on the sole reliance of resupply from Matilija Creek and no contribution from the sediment trapped behind Matilija Dam.

Alternative 2a

In Reach 7, the beneficial and adverse impacts to biological resources of Alternative 2a are similar to those of Alternative 1 although duration of the construction activities will be over a period of about two years. Re-vegetation efforts will be undertaken where necessary after the majority of trapped sediment has been evacuated from the reservoir. This period of time may be up to ten years.

Alternative 2a will affect downstream habitat conditions more than Alternative 1. In reaches 5 and 6, increased aggradation of sediment will occur, a large portion likely in the initial years following dam removal, replacing sediment lost to degradation in the past 50 years. Relative depths of aggradation will decrease in the downstream direction.

The sudden influx of large amounts of sediment will initially overwhelm the riverine system causing natural processes effects to the habitat to remain effectively low for a minimum of several years depending on storm flows. With time however, as the system returns to equilibrium, natural riverine processes will return to normal, and the beneficial effects of the removal of the dam will effectively improve the habitat quality especially in

Reach 6 and 7. Downstream of Reach 6, the improvement to the habitat quality is less dramatic, similar to Alternative 1.

Sediment will collect initially within incised river channels and then will spread laterally within the channel. As a result, the river bottom will be raised. Vegetation communities, especially in Reach 6, will be impacted with up to 1-foot of sediment and will need time to recover.

For Reaches 7 through 9, the riparian habitat quality will improve by the removal of existing giant reed and other exotic plant species. In the downstream reaches (1 through 6), restoration activities related to exotic plant species eradication will continue to improve the environmental outputs (habitat units) significantly over the 50-year life of the project.

The beneficial impacts to southern steelhead will be similar to Alternative 1, however, there is uncertainty with the time that fish passage opportunity through Reach 7 (reservoir limits) will be restored. The timing of downcutting of the initial shallow pilot channel (excavated in the reservoir basin sediment at the time of dam removal) will depend on the hydrology and magnitude of storm flows, and the restoration of fish passage will depend on the earliest establishment of a stable and satisfactory gradient within the Reach 7 channel accessible from the streambed elevation downstream of the dam site. The depth of trapped sediment in the 'Delta Area' is up to 60 feet. Following the removal of the dam, should there be a prolonged period of smaller storm events (less than a 3-year recurrence period) or drought conditions prevailing, this could potentially significantly delay the time required to create fish passage conditions in Reach 7. For this reason, Alternative 2a is less attractive from the perspective of the timing of fish passage opportunity and consistent quality of passage availability. The HEP assessment assumed that fish passage opportunity and consistency would be established no earlier than 7 years after completion of construction activities. Sediment transport modeling results indicate a 90 percent probability that passage would not be restored in less than 10 years (Appendix D- Hydrologic, Hydraulic, and Sediment Studies, Section 9.8).

In the reaches downstream of the dam, changes to channel characteristics with respect to readjustments in width and depth resulting from the increased aggradation are not expected to adversely affect steelhead migration.

Impacts related to the construction and operation of the slurry disposal site is similar to Alternative 1. The same is true for impacts resulting from construction of "higher level" protection levee and floodwall improvements, though to a slightly higher degree.

In terms of the HEP assessment, Alternative 2a offers one of the higher values amongst the action alternatives. The value however may be compromised if longer-term restoration of fish passage is assessed.

Alternative 2b

Impacts resulting from Alternative 2b are largely the same as those described above for Alternative 2a. However, by not slurrying the 'Reservoir Area' sediments offsite and instead allowing the materials to be naturally eroded and transported downstream by fluvial processes, the resulting degree of aggradation downstream is significantly increased. The time frame for system recovery from depositional effects is longer than needed in Alternative 2a; however, over a 50-year period the difference is not as significant. Under average storm conditions, vegetation communities, especially in Reach 6, may initially be impacted with up to 5 feet of sediment.

For fish passage opportunity through Reach 7 (reservoir basin), the time required to create acceptable conditions would likely be prolonged due to the inherent slope instabilities associated with any downcutting through the 'Reservoir Area' sediment. Like Alternative 2a, the HEP assessment assumed that fish passage opportunity and consistency would be established no earlier than 7 years after completion of construction activities. Sediment transport modeling results indicate a 90 percent probability that passage would not be restored in less than 14 years (Appendix D- Hydrologic, Hydraulic, and Sediment Studies, Section 9.8).

Alternative 2b does not have the adverse impacts associated with the construction and operation of the slurry disposal site as this feature is not included with this alternative.

In terms of the HEP assessment, Alternative 2b offers one of the higher values amongst the action alternatives. The value however assumes fish passage opportunity within 7 years of construction activities, and would be compromised if a longer-term were assumed.

Alternative 3a

The impacts of Alternative 3a would be very similar to those of Alternative 2a discussed above, except that changes to downstream conditions would be slightly moderated in the short term due to the amount of trapped sediment detained during the first phase of dam deconstruction. The majority of impacts under Alternative 3a would be the same as those described for Alternative 2a, although the continuation of dam deconstruction processes during the second phase of dam removal would temporarily disrupt habitat and wildlife corridors in Matilija Canyon and the area immediately upstream of the dam.

For Alternative 3a, the time for fish passage restoration in Reach 7 is uncertain. Following phase 1 removal of the initial portion of the dam, a period of time is required for storm flows to erode the trapped sediment to a new equilibrium slope with the modified dam height. The sediment transport model estimated this period to be as early as the second year after phase 1 removal using a wet period hydrograph simulation. However should a period of smaller storms or a drought scenario (as described above for Alternative 2a) prevail instead, the time period to phase 2 removal would be prolonged. In addition it could also be possible to have episodes of deposition, prior to phase 2 removal, from smaller flood events in Reach 7, prolonging completion of dam removal.

Following phase 2 removal, the timing of fish passage availability and consistent quality of passage would still likely require a number of years. For these reasons, Alternative 3a is less attractive from the perspective of fish passage. Like Alternative 2a, the HEP assessment assumed that fish passage opportunity and consistency would be established no earlier than 7 years after completion of construction activities. Sediment transport modeling results indicate a 90 percent probability that passage would not be restored in less than 14 years (Appendix D- Hydrologic, Hydraulic, and Sediment Studies, Section 9.8).

In terms of the HEP assessment, Alternative 3a offers one of the higher values amongst the action alternatives. The value however assumes fish passage opportunity within 7 years of construction activities, and would be compromised if a longer-term were assumed.

Alternative 3b

The impacts of Alternative 3b would be similar to those of Alternative 2b discussed above, except that changes to downstream conditions would be slightly moderated in the short term due to the amount of trapped sediment detained during the first phase of dam deconstruction. The majority of impacts under Alternative 3b would be the same as those described for Alternative 2b, although the continuation of dam deconstruction processes during the second phase of dam removal would temporarily disrupt habitat and wildlife corridors in Matilija Canyon and the area immediately upstream of the dam.

The time for successful restoration of fish passage for Alternative 3b would not be different from Alternative 3a above, though potentially more prolonged due to the presence of the 'Reservoir Area' sediment. Like Alternative 3a, the HEP assessment assumed that fish passage opportunity and consistency would be established no earlier than 7 years after completion of construction activities. Sediment transport modeling results indicate a 90 percent probability that passage would not be restored in less than 18 years (Appendix D- Hydrologic, Hydraulic, and Sediment Studies, Section 9.8).

In terms of the HEP assessment, Alternative 3b offers one of the higher values amongst the action alternatives. The value however assumes fish passage within 7 years of dam deconstruction, and would be compromised if a longer-term were assumed.

Alternative 4a

Biological resource impacts resulting from Alternative 4a are similar to those described for Alternative 1, with three primary differences in Reach 7:

- The duration of construction activities for Alternative 4a would be approximately three years as opposed to the estimated 10 years for Alternative 1
- Matilija Canyon would be returned to a semi-natural topography upon completion of the project, but would not return to pre-dam conditions
- A 100-foot bottom width channel following a pre-dam alignment and armored on both sides with riprap stone protection would remain a permanent feature

The 100-foot bottom width channel with a pre-dam alignment provides benefits to habitat quality because it promotes the creation of alternating alluvial bars, pools and a thalweg meander. However the presence of armored side slopes is not natural, especially as a permanent feature, and therefore results in a lower habitat value. Although some vegetation may become established naturally through the voids of the riprap stone, the presence of larger and full grown plants can be detrimental to the structure during storms events when the plants are subject to being ripped out, displacing stone and weakening the integrity of the structure.

The effects of the engineered channel with permanent armored side slopes and a return to semi-natural topography produces less habitat value as compared to a natural channel and a return to pre-dam conditions. In addition, similar to Alternative 1, the longer time period required to establish riverine equilibrium based on the sole reliance of re-supply of sediment from Matilija Creek with no contribution from the sediment trapped behind Matilija Dam benefits the quality of the habitat less in the short term. In terms of the HEP assessment, Alternative 4a offers the least value amongst the action alternatives.

Alternative 4b

For Reach 7, biological resource impacts from Alternative 4b are similar to those described for Alternative 1, except that the duration of construction activities for Alternative 4b would be approximately three years as opposed to the estimated 10 years for Alternative 1. The soil cement revetment (located in the lower half of the reservoir basin) which would protect the side slopes of the 100-foot bottom width pre-dam alignment channel would be temporary. Some segments could be removed within 10 years and others up to a period within 20 years. Re-vegetation efforts would commence after the majority of the sediment has been evacuated from the original reservoir limits.

Impacts from sediment deposition levels affecting downstream riparian habitat would fall between levels associated with Alternative 2a and 3a.

The impacts to southern steelhead will be similar to Alternative 1 in that fish passage creation to Reaches 8 and 9 is immediate following completion of construction activities. The quality of Reach 7 with the pre-dam alignment, 100-foot bottom width channel is high as it promotes the creation of alternating alluvial bars, pools and a thalweg meander. The ample channel width is also beneficial in minimizing the possibility of temporary channel blockage should there be a large influx of trapped sediment entering the channel from sloughing or an adjacent slope failure.

Impacts resulting from construction of “higher level” protection levee and floodwall improvements will be similar to Alternative 1, though to a slightly higher degree.

In terms of the HEP assessment, Alternative 4b offers the highest value amongst the action alternatives.

Restoration Measures For Biological Resources

Giant Reed Management

The study area reaches in which restoration benefits associated with the eradication of giant reed and other exotic plant species (such as tamarisk) that could be realized by this feasibility study extend from upstream beyond the influence of the original reservoir limits (Reaches 8 and 9), to downstream through the present dam site and reservoir (Reach 7) and the Ventura River to the estuary (Reaches 6 to 1).

Eradication efforts would need to start from the uppermost reach and work downstream. The reverse direction would be counterproductive since potential propagules transported fluvially from upstream areas would likely infest eradicated areas downstream. Prior to commencement of dam deconstruction and earthmoving activities, efforts to eradicate giant reed in Reaches 9, 8 and 7 must be completed.

It is assumed that eradication of giant reed stands would be accomplished by mechanical and manual removal of the biomass (chip and haul), followed by herbicide spraying of the ground area. Periodic follow-up treatment would be required for a period of at least 5 years. Monitoring and any additional eradication efforts within the study area would also be needed for the additional life span of the project. To achieve success in eradicating giant reed in the watershed, a watershed–wide giant reed management plan would need to be in place to control the damaging riparian weed in areas adjacent to the 100-year floodplain and within sub-watersheds of the Ventura River (such as Coyote and San Antonio Creek).

Costs for giant reed eradication efforts, including monitoring and maintenance, from Reaches 9 through 1 are approximately $10 million.

Cultural Resources Impacts

No Action Alternative

Verification will be necessary to determine whether the historic/prehistoric sites COE#1 and COE#2 in the vicinity of the reservoir will be impacted as sediment continues to accumulate in the reservoir to equilibrium levels. Based on sediment transport modeling data, it appears that at some point in the future the site could be adversely affected by sedimentation. Based on initial evaluation, COE#1 is eligible for listing on the National Register of Historic Places (NRHP), and COE#2 is potentially eligible.

With a lack of project-related disturbance, cultural resources along Matilija Creek and the Ventura River would not be adversely affected by project construction activities. However, land disturbance associated with continuing urban development in the study area could affect cultural resources in the future as new development projects are initiated.

Alternatives 1, 2a, 3a, 4a and 4b

Matilija Dam itself is not considered to be eligible for the NRHP, and no adverse affect would result from its removal. The NRHP ineligibility of the dam is subject to concurrence by the California State Historic Preservation Officer.

Historic/prehistoric sites COE#1 and COE#2 are located at the margin of sediment removal activities. Erosion after removal of sediment at the margin may undermine the stability of the sites and damage any cultural deposits present. Also, portions of them may be buried under the reservoir. Additional studies will be necessary to evaluate these sites for the NRHP, and determine their horizontal and vertical extent. If they are determined to be NRHP eligible, and will be affected by sediment removal, mitigation measures will be necessary.

Other project features, including the downstream slurry disposal site, slurry line alignment, bridge modification sites, and the desilting basin site, have yet to be surveyed for the presence of historic or prehistoric cultural resources. These additional surveys will occur during the Preconstruction, Engineering and Design phase. If any resources are found, and determined to be eligible for the NRHP, the first step would be to try to avoid these sites. If it were not feasible to redesign, they would likely be adversely affected by these activities. However, subsurface archeological sites might possibly be protected and preserved by burial under sediment placed at the disposal site. This would require a detailed and comprehensive plan to ensure that it is implemented in a manner that minimizes damage.

Undiscovered buried historic and prehistoric resources may be present beneath sediment behind Matilija Dam. Removal of sediment by natural and mechanical means would have an adverse effect on any buried resource eligible for listing on the NRHP. It would be very difficult to stabilize buried cultural deposits as sediment is removed without disturbing their integrity. A discovery plan will be developed to treat previously unknown resources found during implementation of the project. It will include procedures to monitor and treat cultural resources discovered during mechanical and natural removal of sediment behind Matilija Dam. It would also include procedures for discoveries made during grading and earth moving activities.

Potentially NRHP eligible Matilija Hot Springs, which is located just downstream of Matilija Dam, may be adversely affected by sediment re-supply. This results from potential increased flooding that would result from it being returned to the 100-year floodplain.

Alternatives 2b and 3b

Impacts associated with Alternatives 2b and 3b will be similar to those discussed above for Alternatives 1, 2a, 3a, 4a and 4b, except for those associated with the disposal site and slurry line. Alternatives 2b, 3b, and 4a do not include these features.

Air Quality, Noise, and Traffic

Construction activities common to all of the action alternatives is dam removal. For the structural concrete all of the action alternatives, except Alternative 1 and 4a, will minimally process the rubble and then haul it to Hanson Aggregate Company for recycling. Alternative 1 will process (crush) the material into aggregate size and sell it on-site. Alternative 4a will bury the concrete on site. For all the action alternatives, all non-salvageable materials will be hauled to Toland Landfill.

Also common to all the action alternatives are construction activities related to flood protection mitigation and improvements. This would include demolition/removal of structures, levee and floodwall construction and demolition/modifications to Santa Ana Bridge and Camino Cielo Bridge.

The source for earth materials for the levee improvements will likely be from Matilija Dam reservoir basin. The materials would be hauled by truck to the improvement locations.

The primary haul route to Hanson Aggregate would be State Highway 33- U.S. Highway 101- State Highway 126- local roads (approx. 28 miles). The same route would be used for Toland Landfill to avoid passing through the City of Ojai (approx. 41 miles). The alternate route, through Ojai, would be State Highway 33- State Highway 150- State Highway 126 – local roads (approx. 28 miles). The haul routes are shown on Figure 3-8.

No Action Alternative

Under the No Action Alternative, the project would not be implemented, thereby avoiding all potential impacts associated with air pollutant emissions, noise, and construction or aggregate sale operations.

Alternative 1

Construction activities for Alternative 1 will result in more significant short-term air quality impacts (emissions, dust), noise impacts, and traffic impacts, both on and off-site, than for the other action alternatives. A significant impact of this alternative is the effects, especially to traffic, related to the sale of aggregate from the dam site.

An estimate of road truck traffic for construction activities related to sale of aggregate, disposal of non-salvageable materials, levee modifications, removal of structures, modifications to the Santa Ana and Camino Cielo bridges is about 14,000,000 truck trip miles. For the sale of aggregate, round trip miles was assumed to be 90 miles.

Primary truck routes to be used in the transport of the aggregate include State Highway 33 - U.S Highway 101- local roads, and State Highway 33 - State Highway 150 - State Highway 126 - local roads. The radius of influence for anticipated truck routes extends 50 miles from the dam, throughout Ventura and southern Santa Barbara Counties.

As a result of the significant truck mileage associated with this alternative, the feasibility of constructing a dedicated road was considered. The road alignment utilized was within the Ventura River floodplain. Preliminary estimates of environmental impacts and costs were high, and the measure was therefore dismissed.

Alternative 2a, 2b, 3a, 3b, and 4b

Construction activities for Alternative 2a, 2b, 3a, 3b and 4b include similar impacts as Alternative 1, with the exception that there is no activity related to sale of aggregates from the dam site.

An estimate of road truck traffic for construction activities related to disposal of concrete rubble and non-salvageable materials, levee modifications, removal of structures, modifications to the Santa Ana and Camino Cielo bridges is about 600,000 truck trip miles.

Alternative 4a

Construction activities for Alternative 4a include similar impacts as Alternative 1, with the exception that there is no activity related to sale of aggregates from the dam site, and that the concrete rubble will be buried on site. The contractor however would have the option of processing the rubble and selling it as aggregate.

An estimate of road truck traffic for construction activities related to disposal of non-salvageable materials, levee modifications, removal of structures, modifications to the Santa Ana and Camino Cielo bridges is about 150,000 truck trip miles. With the sale of aggregate, the truck trip miles could be similar to Alternative 2a, 2b, 3a, 3b, and 4b.

Water Supply

Water Source for Slurry Operation

Alternatives that slurry 'Reservoir Area' sediment (i.e. Alternatives 1, 2a, 3a, 4a, and 4b) would require the purchase of 4,500 ac-ft of water. Due to the high regional demand of water from Lake Casitas and limitations to safe yield, the purchase of 4,500 ac-ft of water from CMWD is not feasible.

The City of Ventura at present has a surplus supply of water, utilizing sources from diversions at Foster Park (surface and subsurface), as well as entitlements from CMWD and State water. The City has offered to consider the supply of 4,500 ac-ft of water for the use of the dam removal alternatives. The City does not utilize its full entitlement from CMWD. Water allocation could be made directly from Lake Casitas and purchased from CMWD at the same rate charged to the City (Year 2003 rates: $177/ac-ft). The project costs would need to include the construction of an 8-mile pipeline from Lake Casitas to the dam site. Another option under consideration is to utilize an existing

CMWD tap water connection at Lomita Avenue near Rice Road. However the rates at this source may be cost prohibitive.

Other potential sources to consider would be local groundwater in the vicinity of the dam site. Further investigation of the existing groundwater regime, including water rights, would need to be performed during the Pre-construction, Engineering, and Design phase.

Robles Diversion Dam and Lake Casitas

It is expected that both *without-project* and *with-project conditions* will cause adverse impacts to the Robles diversion facility and Lake Casitas in terms of both water supply and water quality. Deposition at the facility's sediment basin was addressed in the prior subsection *"Sediment Transport Impacts."*

<u>Loss of Diversion Operations</u> In the event that sediment deposition levels at the facility exceed 40,000 cubic yards, diversion operations to Lake Casitas will be interrupted until the sediment basin is cleared out. Should this occur at the beginning or middle of the diversion season, the facility will miss diversion opportunities for the remaining portion of the season. Environmental regulations do not allow for maintenance during the wet season. Repeated missed diversion opportunities could adversely affect the safe annual yield for Lake Casitas. The safe annual yield is defined as the amount of water that the reservoir can yield for consumption without producing unacceptable negative impacts on the long-term water supply within the jurisdictional boundaries of Casitas Municipal Water District.

<u>Deposition in Robles-Casitas Canal and Fish Screen</u> When sediment loads are high, sands carried in suspension may deposit in the canal due to the gentle gradient of the structure. In addition, once the fish screen is installed, deposition in the canal may increase upstream of the screen due to reduction in flow velocities. (The fish screen is a component of the soon-to-be completed fishway - the screen will function to keep downstream migrating steelhead from being entrained into the canal and transported to Lake Casitas). This deposition would increase maintenance requirements and even cause interruptions (short or long-term) to diversion operations. Increases to existing levels of deposition in the canal are difficult to determine since the effects of the screen on the flow regime under higher sediment loads cannot be evaluated until the component is on-line and operational and maintenance data become available. Deposition will also occur in the fishway (downstream and off-line of the canal), and will require periodic maintenance cleanout. The majority of sand deposition however under higher sediment loads is expected to occur upstream of the screen.

<u>Turbidity</u> Levels of turbidity associated with each of the alternatives was addressed in the prior subsection "*Sediment Transport Impacts."* Turbidity from fine sediment (silts and clays) in Ventura River flows diverted to the Robles-Casitas Canal can contribute to water quality problems at Lake Casitas. Fine sediments, especially clays, do not easily come out of suspension. Fine sediments contain absorbed nutrients that tend to promote algal production, currently a problem at the reservoir. Water treatment efforts may also

need to be increased should large amounts of fine sediment be introduced into the reservoir lake and remain in suspension. These efforts, including additional chemical use, backwashes, filter media replacement, and staffing, result in cost increases. Fine sediment can also contribute to storage loss and can also adversely affect recreational activities (i.e. fishing, boating). The action alternatives that limit the introduction to Lake Casitas of fine sediment currently trapped at Matilija Dam will limit the adverse impacts there.

Lost Storage From Removal of Matilija Dam This issue only applies to with-project conditions. A study of flow diversions at the Robles Diversion facility conducted by the Bureau of Reclamation (Appendix D- Hydrologic, Hydraulic and Sediment Studies, Section 2.3) concluded that an average of 590 ac-ft/year of water is available for Robles diversions by operation of Matilija Dam in accordance with the current operating criteria. The current water rights agreement between VCWPD and CMWD for water storage use at Matilija Dam expires in year 2009. Should early termination of the agreement be necessary due to the removal of Matilija Dam prior to 2009, CMWD would be entitled to restitution of the potential lost water diversion opportunity and resulting impact to safe yield at Lake Casitas.

Other Water Quality Concerns This issue only applies to with-project conditions. Concerns expressed by CMWD regarding the detection of arsenic and DDT in discrete samples of the trapped sediment obtained from field investigations conducted in July through September 2001 in the Matilija reservoir basin, and the potential threat to Lake Casitas and Mira Monte well were assessed by the Corps and the VCWPD. Consultation with another water agency indicated that the concentration levels detected were considered within normal background levels and would not usually be associated with adversely impacting water quality (Related information is provided in the Geotechnical Appendix). Initial consultation by the Corps has occurred with the Environmental Protection Agency and the California Department of Health Services. Additional efforts to evaluate arsenic, DDT, and other regulated substances will not be pursued at this time. For the recommended plan, future consultation with the California Department of Health Services and the California Regional Water Quality Control Board will continue during the Preconstruction, Engineering and Design (PED) phase.

No Action Alternative

Once Matilija Dam reservoir reaches equilibrium and Matilija Creek is contributing coarse sediment loads downstream (within 50 to 70 years), the deposition and maintenance requirements at the Robles Diversion facility will significantly increase from current levels. The average annual deposition at the facility's sediment basin is expected to be twice the current average volume deposited of 13,300 yd^3/yr. The deposition capacity of the facility (40,000 yd^3), which is currently only exceeded by floods exceeding a 20-year return period (with the main source of coarse sediment upstream of the Robles Diversion facility currently being the North Fork Matilija Creek), would be exceeded even under a flood event larger than a 3- to 4- year return period. The probability of an interruption of diversion operations, potentially affecting an entire season of diversion, would therefore be significantly increased.

Deposition in the diversion canal and at the fish screen would also be expected to increase requiring additional maintenance effort by CMWD. Suspended sands entering the diversion canal could increase by as much as a factor of three. Deposition in the fishway is also expected to increase.

Turbidity impacts at Lake Casitas for the No Action Alternative are expected to increase by approximately 30 percent once the existing lake fills in (by approximately year 2020). Existing fine sediment concentrations vary, according to flood flow, between 10,000 mg/l (5,000 ft^3/sec) to 1,000 mg/l (100 ft^3/sec).

Alternative 1 and 4a

For Alternatives 1 and 4a, the sediment deposition impacts to the Robles Diversion facility would be similar to the No Action Alternative. However, the facility would experience these impacts within 10 years of dam removal compared to 50 to 70 years under the No Action Alternative.

To accommodate the increase of approximately twice the average sediment deposition levels at the sediment basin, and in addition, to preclude potential interruption of diversion operations should a storm event larger than a 3- to 4-year return period deposit sediment volumes that exceed the capacity for the facility to remain in operation, a high-flow sediment bypass that would allow for sediment flushing through the Robles Diversion facility has been determined to be a warranted feature. According to preliminary hydraulic modeling results, a high-flow sediment bypass placed at the sediment basin would limit the amount of deposition at that location to approximately existing condition levels. The effects of the high-flow sediment bypass, however, on suspended sediment loads when considering volumes being bypassed and volumes remaining in the sediment basin, is difficult to assess and is dependent on the operation of the bypass, the current sluice gates, and the magnitude and duration of the storm event. It is conservatively assumed that the bypass operation will keep a substantial amount of suspended sediment in the forebay to become available for diversion.

Other measures to control the increase in deposition at the Robles Diversion facility were dismissed after consideration, and include more frequent sediment removal operations and sediment basin enlargement.

The costs associated with the additional sediment removal efforts from the sediment basin over a period of 30 years (the period prior to takeover of maintenance responsibilities by CMWD) and restitution of at least one season of lost diversions would more than justify the cost of a high-flow bypass (including modification to the existing timber crib structure).

The enlargement of the existing sediment basin from its current capacity (about 40,000 cubic yards) was also considered. This concept was not further considered for several reasons: 1) the increase in the trap efficiency from basin size enlargement would tend to deposit more sands in suspension (due to the deeper, slower water) that may have otherwise been sluiced downstream through the diversion dam sluice gates during periods of no diversion operation to Lake Casitas, hence increasing the volume of sediment deposition; 2) removal of larger quantities of sediment and the need to haul away from the site would be costlier; and 3) a larger and deeper sediment basin would require lowering of the existing diversion dam sluice gates elevation – a costly modification.

Deposition of sand in the Robles-Casitas Canal, at the fish screen, and in the fishway is expected to be similar to the No Action Alternative as suspended sand loads entering the canal would increase by a factor of three over existing conditions. Maintenance requirements would be higher than under existing conditions and additional provisions would be needed for sediment clearing from the canal especially upstream of the fish screen. For estimation purposes, it is assumed that deposition upstream of the screen could approach a depth of one foot with a total accumulation of about 200 cubic yards of sediment once or twice a year. No significant water losses, however, due to diversion interruptions would be anticipated.

Turbidity impacts at Lake Casitas due to Alternatives 1 and 4a would not be significantly different from existing conditions (see No Action Alternative discussion above) as trapped sediments behind Matilija Dam would either be removed mechanically from the riverine system or permanently stabilized, and all fine sediment contributions to the riverine system would be from Matilija Creek flows. No mitigation measures for turbidity impacts are warranted.

Alternatives 2a and 3a

Without mitigation, the impacts to the Robles Diversion facility from Alternatives 2a or 3a would be significant. Potential deposition in the sediment basin of coarser sediments (coarse sand, gravel and cobbles) in the first few years of storms after full dam removal could potentially be large enough to effectively shut down diversion operations for the respective diversion season. Incremental removal in Alternative 3a does not moderate the impact very much. A high-flow sediment bypass would be a warranted feature. Preliminary modeling utilizing a 1998 storm (15-year recurrence flood) indicate that a high-flow sediment bypass placed at the sediment basin would limit the amount of deposition at the sediment basin to 18,000 cubic yards above existing levels even while full diversion operations are continuing throughout the storm event. Without a high-flow sediment bypass and assuming Robles was attempting to divert water (i.e the existing sluice gates were not fully open), deposition would be about 90,000 cubic yards for the same storm event. The model predicted that following only a few storm events through Matilija Reservoir basin, the deposition at the Robles facility would approach equilibrium conditions (i.e. influence from Matilija Creek only and no effects from Matilija Dam or trapped reservoir basin sediments).

Other measures to control sediment deposition in lieu of a high-flow sediment bypass were also considered, but were not cost effective as described above under Alternatives 1 and 4a.

There would also be significant quantities of suspended sand entering the Robles-Casitas Canal, increasing deposition within the structure, especially at the fish screen. For estimation purposes, it is assumed that deposition upstream of the screen could approach a depth of two to three feet with a total accumulation of about 400 cubic yards of sediment once or twice a year. Maintenance needs would potentially result in short-term interruption to diversions operations. Some sediment clean-out in the fishway would also be needed.

It is expected that turbidity impacts at Lake Casitas will likely result in water quality problems, including prolonged duration of algal bloom production, and potential increases in water treatment efforts (Refer to previous section *Downstream Deposition and Turbidity* for related discussion on turbidity levels associated with Alternatives 2a and 3a). Because of the uncertainties related to level and duration of impacts, especially in a drought scenario (where low flows could be still transport turbid loads), a desilting basin to settle out fines prior to conveyance to Lake Casitas is deemed warranted.

Alternatives 2b and 3b

For Alternatives 2b and 3b, coarse sediment deposition in the sediment basin would be at least as significant as Alternative 2a or 3a. For reasons similar to those stated in the discussion above for Alternative 2a and 3a, a high-flow bypass is warranted for Alternatives 2b and 3b.

Unlike Alternatives 2a and 3a where 2 million cubic yards of sediment from the 'Reservoir Area' (composed mostly of silts and clays) are slurried off-site, Alternatives 2b and 3b allow this volume of fine sediment to be fluvially transported in the riverine system. Sediment deposition in the canal and at the fish screen would be expected to be excessive if diversion operations were occurring when flows were carrying high levels of suspended sediment loads. These fine sediments would present significant and long–term water quality problems at Lake Casitas should these materials be conveyed there. A desilting basin that could intercept and settle out the fine sediment loads prior to conveyance to the reservoir would significantly reduce adverse impacts.

An ideal location for a desilting basin would be upstream of the diversion canal headworks and fish screen allowing the basin to function "in-line." However limited space in the basin upstream of Robles would preclude this. (For Alternatives 2b and 3b, the desilting basin would also need to be very large at least 40 acres). Therefore, since a desilting basin could only be placed downstream of the canal headworks and fish screen, build-up of sediment in these areas would be inevitable.

For Alternatives 2b and 3b, even with a high-flow sediment bypass and a desilting basin in place as mitigation features, diversions could not be assured due to the excessive finer sediments accumulating at the fish screen. An entire diversion season could essentially be missed or severely impaired if opportunities had to be foregone as a result of having to interrupt operations for potentially extended periods of time to allow for cleanout maintenance.

An assessment was performed to evaluate potential water supply losses to CMWD. The level of risk assumed in the evaluation was adopted by criteria utilized by CMWD to establish its safe annual yield to meet water supply demand after the current lease for use of Matilija Dam expires in 2009 (Entrix, 2002). For Lake Casitas, safe annual yield is defined as the amount of water that the reservoir can yield for consumption without producing unacceptable adverse impacts on long-term water supply within the boundaries of the water district. The primary criteria for determining safe annual yield was to insure that the water supply in Lake Casitas, when full, would extend through a period characterized by the most severe drought on record.

To plan for the missed diversions due to the removal of Matilija Dam, the reduction in safe annual yield that CMWD would need to accommodate is an annual volume of 6,000 ac-ft for a period of 8 years. CMWD has determined safe yield by utilizing the hydrologic record of 1944 to 1964. This is the driest period from the available 75-yr stream gage record starting from 1929. If it is assumed that the dam removal begins during a period such as this, then it would take approximately 8 years to remove enough trapped fine sediment from the reservoir during which time diversions at Robles would need to be interrupted so as to not cause adverse impacts at the facility. After 8 years, CMWD would be able to reinstate diversion. During that 8-yr period, it is assumed that CMWD would have a shortfall of 6,000 ac-ft per year compared to the No Action alternative. A survey of the cost to import water from an outside water purveyor was conducted by VCWPD and found to be an average of $650 per ac-ft. Therefore a total of $31 million dollars would be needed to purchase water to provide restitution to CMWD. As part of the cost estimates for alternatives 2b and 3b, a high-flow bypass feature was included but not a desilting basin. The high cost associated with water restitution to CMWD for Alternatives 2b and 3b provides the justification to not pursue these specific alternatives any further in the feasibility study.

From a turbidity standpoint, a drought period would prolong the adverse effects of turbidity since the lower flows associated with this period are capable of eroding and transporting only the trapped finer sediments. During this 8-year period, there would be a few intermittent storm events that cumulatively would allow mobilization of the sediment in the ‘Reservoir Area’ where the majority of fines (2.1 MCY) are trapped.

In an effort to assess whether other means exist that would preclude the potential costly shutdowns to diversion operations and long-term losses of water to CMWD, reconfiguring the Robles facility was considered. The need however to accommodate a large desilting basin, and reconstructing portions of the canal headworks, fish screen and fishway, would exceed $31 million including real estate acquisition, operation and maintenance and permanent disposal for the sludge fines. There would also be significant environmental impacts related to this option. The option of reconfiguring the Robles facility was therefore dismissed.

Alternative 4b

For Alternative 4b, the deposition impacts from coarser sediments in the sediment basin at the Robles facility would approach levels described for Alternatives 2a and 3a. A high-flow sediment bypass would be a warranted feature.

Prior to the staged removal of soil cement, flows below a 10-yr storm event would exhibit turbidity levels similar to No Action conditions. Moreover, should there be an onset of drought conditions, turbidity levels would still not increase above No Action conditions. For flows above a 10-yr storm event, turbidity levels would be on the order of 2 to 4 times greater than No Action conditions. During these high-flow events, the fine sediment concentrations are already high, and therefore the increase in turbidity would be expected to be within the natural variability.

During the staged removal phase of the soil cement revetment (removal phase sequence would be downstream to upstream), due to the likely temporary increases in turbidity levels, from 2 to 10 times greater than No Action conditions, it would be prudent to coincide removals in periods when reservoir levels at Lake Casitas are at or above average. Removal phases would be coordinated utilizing a monitoring/adaptive management plan. Turbidity levels would be expected to stabilize to levels similar to the No Action Alternative after one or two storm events of average magnitude pass through the reservoir basin.

Turbidity impacts to Lake Casitas resulting from the removal of Matilija Dam are not expected to be significant. A desilting basin would not be a warranted feature as part of a Federal plan.

Alternative 4b offers a compromise: providing a benefit to water supply by limiting turbidity impacts and at the same time providing environmental benefits to habitat quality by timely release of trapped sediment from Matilija Dam.

Only in the situation of a very large storm event (e.g. 100-yr recurrence), would the benefit of having the soil cement revetment be negated as the structure could be conceivably destroyed. In this situation, however, most of the trapped sediment in the basin would be transported to the ocean, thereby resulting in no adverse impact to water supply. The Robles facility was severely damaged during the 1969 storm (100-yr recurrence event).

Mitigation Measures For Diversion Operation Impacts to Robles Diversion Dam and Lake Casitas

Sediment Bypass A sediment bypass would limit the amount of deposition (typically coarser sediment) in the sediment basin at the Robles Diversion facility by allowing increased sediment loads associated with removal of Matilija Dam to be flushed downstream of the facility. The high-flow sediment bypass would be located to the east of the sediment basin overflow weir at the Robles Diversion facility. The bypass would be a radial gate structure (140-ft wide) with four gates, and have a capacity of 10,000 ft^3/sec. The advantage of a radial gate system is that it allows water levels to be maintained constant in the forebay for diversion operations while also allowing flushing of sediment at the gates from the lowermost portion of the water column profile where sediment loads (coarse materials) are the highest. The current sluice gate structure (three radial gates) to the west of the overflow weir would remain in place and would continue to operate as needed. It has a capacity of approximately 7,000 ft^3/sec.

In addition to the high-flow sediment bypass, a modification to the existing timber crib structure overflow weir is necessary to provide stability to the sediment bypass. Although the existing overflow weir structure is designed to withstand a 100–year event storm, a loss of the structure would undermine the stability of the high-flow sediment bypass. A new concrete overflow weir would need to be constructed allowing it to be tied into the concrete foundation of the sediment bypass structure.

The preliminary cost estimated for the high flow sediment bypass and the modification to the existing timber crib structure is $3.4 million and $1.3 million, respectively, for a total of $4.7 million.

The benefits associated with the high-flow sediment bypass, as well as operations to the existing Robles Diversion facility are:

- Limitation of deposition at the sediment basin to No Action Alternative levels within a short-term time frame.
- Increase of diversion opportunities to a wider range of river flows
- Potential improvement of fish passage opportunity at higher flows

Desilting Basin This feature is considered a Locally Preferred associated feature and applies to the tentatively recommended plan. The inclusion of a desilting basin would minimize any fine sediment introduction and related turbidity problems at Lake Casitas resulting from a) residual fines remaining in the Matilija Reservoir basin after slurrying operations; and b) natural levels of fine sediment concentrations associated with Matilija Creek and North Fork Matilija Creek.

The desilting basin, an off-line structure to the Robles-Casitas canal located downstream of the diversion canal headworks and fish screen, would function by allowing diverted flows from the Ventura River to settle out fine sediment (silts, clays) prior to conveyance of flows via the canal to Lake Casitas. Two potential sites for the desilting basin have been identified by the local sponsor. The preferred site is located on two parcels (totaling 16.9 acres) located less than a mile from Lake Casitas and owned by the Bureau of Reclamation.

The proposed basin would have a capacity of 61 ac-ft and would require excavation and levee construction to contain the diverted flows. (The capacity was determined by using the fine sediment load of 46 ac-ft, resulting from a 3- to 4-yr recurrence 1991 storm event; total fine sediment loads attributed to trapped sediment at Matilija Dam remaining after slurrying of ‘Reservoir Area’ sediment is 200 ac-ft). To prevent infiltration losses, a geofabric liner would be installed. The intake structure to the canal will require modification. The estimated cost of the basin is $5.7 million, and includes land acquisition of up to 13.2 acres. Costs could be lower should federal land become available.

Fine sediment would be settled out by the addition of a flocculating polymer. The resulting sludge would require periodic removal and disposal on another parcel nearby.

Alternate Water Source: Subsurface Diversion A preliminary assessment was performed to determine whether the local groundwater regime could support production quantities to temporarily offset the need for surface diversions at the Robles facility. This would effectively allow full or partial removal of trapped sediments at Matilija Dam by fluvial means without impacting diversion operations to Lake Casitas.

CMWD diverts an average of 12,000 ac-ft from the Ventura River to Lake Casitas. The local aquifer has a capacity of only 6,000 ac-ft and would therefore not be adequate for diversion needs.

Diversion Operation Impacts to Foster Park

The diversion at Foster Park (owned by the City of Ventura) is an operation dependent on surface diversion and subsurface wells. The surface diversion includes both a shallow intake (4 feet below the riverbed surface) and a riverbed surface diversion. The subsurface wells are approximately 50 feet deep. It should be noted that the riverbed surface diversion has not been operated since year 2000 as the river has shifted and has subsequently abandoned, for the time being, the channel where the structure is located. This situation cannot be assumed to persist under future without-project or with-project conditions.

Impacts to diversion operations at Foster Park under without-project and with-project conditions are described below. Figures for average surface diversion rates, average days of diversion shutdown per alternative, and average volume lost per day due to diversion shutdown, are based on an assessment described in Appendix D- Hydrologic, Hydraulic and Sediment Studies, Section 10.4.

Foster Park surface diversion operations are interrupted when turbidity levels exceed 10 NTU (NTU is a measurement for clarity or cloudiness of water). The shallow intake structure diversion is also affected by this limit because fines can be drawn into the pervious riverbed materials and decrease the infiltration rate in the vicinity of the intake. Based on City of Ventura diversion flow records for the period of 1984 to 2002, diversion shutdowns due to turbidity for an average rainfall year occur about 17 days/yr. This will be considered as baseline conditions. During shutdown periods, a representative flow rate based on the 90th percentile confidence limit is 2.5 ft^3/sec for the shallow intake and 4.6 ft^3/sec for the surface diversion. A day of missed surface diversion is approximately 14 ac-ft.

To account for the considerable uncertainty in the potential lost diversion days per year at Foster Park, an upper and lower bound for annual surface water loss was established based on modeling results and comparison of without- and with-project turbidity levels associated with various storm events. To evaluate and compare the effects of with- and without-project impacts to surface diversion losses due to above threshold (10 NTU) turbidity limits, a 15-year period was chosen as a time frame representative of when the trapped sediments from Matilija Dam could contribute most significantly. This period was divided into segments of three years based on the minimum recurrence interval of a storm (2.7 years) that could produce a sufficient peak flow (over 3000 cfs) to mobilize a significant amount of sediment.

Table 3-3 presents the estimated annual surface diversion water loss for each alternative at Foster Park Diversion. Results are presented in terms of lower and upper bounds.

For Alternatives 1 and 4a, the values presented assume conditions similar to No Action, except in the first time interval (1 –3 yrs) when turbidity levels could be slightly higher due to availability to natural erosion of remnant fine sediments remaining in the reservoir following slurrying operations

Mitigation Measures For Diversion Operation Impacts at Foster Park

For losses to surface water supply at Foster Park due to missed diversions, the Federal government would need to provide mitigation for alternatives 2a, 2b, 3a, 3b, and 4b. Alternatives 1 and 4a would not require mitigation as the net increase from the No Action condition is not substantial.

One option would be to purchase replacement water from an outside purveyor. According to a survey conducted by VCWPD, the estimated rate would be $650 per ac-ft. The costs associated with Alternatives 2a, 2b, 3a, 3b, and 4b would range from $700,000 to $2.5 million for the lower bound; and $2.7 to $5.4 million for the upper bound.

Another option would be to replace the surface water diversion operation with groundwater wells. Wells would not be affected by increased turbidity concentrations. It is estimated that two wells (50 feet deep each) would be needed at a total cost of $800,000. This option is more cost effective than the purchase of replacement water, and is therefore recommended. The operation of the two wells by the City of Ventura must insure that the increased water extraction capability provided by the two wells will not produce any net loss to the quantity of surface flows otherwise extracted by the surface diversion operation.

Table 3-3: Estimated Annual Surface Water Volume Not Diverted at Foster Park due to Above 10 NTU Threshold Turbidity (ac-ft/yr)

Lower Bound

Alternative	Yr. 1 - 3	Yr. 4 – 6	Yr. 7 - 9	Yr. 10 - 12	Yr. 13 -15	15-Yr. Total (ac-ft)	Change from No Action (ac-ft)
No Action	240	240	240	240	240	3600	-
1, 4a	330	240	240	240	240	3870	270
2a, 3a	420	330	330	240	240	4680	1080
2b	950	700	330	240	240	7380	3780
3b	950	700	330	240	240	7380	3780
4b	330	330	330	330	330	4950	1350

Upper Bound

Alternative	Yr. 1 - 3	Yr. 4 – 6	Yr. 7 - 9	Yr. 10 -12	Yr.13 -15	15-Yr. Total (ac-ft)	Change from No Action (ac-ft)
No Action	240	240	240	240	240	3600	-
1, 4a	420	330	240	240	240	4410	810
2a, 3a	700	700	420	420	330	7710	4110
2b	950	950	700	420	330	10050	6450
3b	950	950	950	700	420	11910	8310
4b	700	700	700	420	420	8820	5220

Groundwater Impacts

Within the study area, impacts to groundwater levels and groundwater quality resulting from removal of Matilija Dam have been assessed for the array of alternatives under consideration. The following summarizes the impacts and concerns.

<u>Groundwater Levels in Vicinity of Dam</u> Impacts to groundwater levels resulting from the array of alternatives are not expected to be significant. There are five groundwater wells located upstream of the reservoir limits of Matilija Dam. The well with the lowest elevation is more than 60 feet above the elevation of the dam crest. Should Matilija Dam be removed, the groundwater levels for upstream users would not be impacted even though within the limits of the original reservoir area the creek bed would be lowered and the gradient of the bed steepened to pre-dam conditions. Natural spring flows replenishes the aquifer upstream of the dam. Downstream effects of dam removal on groundwater levels would be expected to be minimal.

Downstream Infiltration Rates There are numerous groundwater wells that access the water in the Upper Ventura Aquifer and includes floodplains along the mainstem of the Ventura River from Casitas Springs upstream though Meiners Oaks to Camino Cielo Road. Meiners Oaks County Water District (MOCWD) operates 2 wells located approximately 1 mile downstream of Matilija Dam and 2 wells near Meiners Oaks adjacent to Rice Road. Ventura River County Water District (VRCWD) operates three wells located between Meiners Oaks and the Highway 150 crossing. Rancho Matilija Mutual Water Company also operates several groundwater wells along the Ventura River, serving agricultural water to approximately 400 acres. The City of Ventura diversion structure is located at Foster Memorial Park.

Impact to groundwater recharge is not expected to be significant. The infiltration to the Upper Ventura Aquifer occurs primarily through the active channel bed of the Ventura River. The river bottom carries runoff flows and also allows percolation to occur readily due to the bed composition of gravel and cobbles, with some sand and very few fines. The floodplain terraces are less important for aquifer recharge because they are subject only to rainwater and generally have soils with more fines and are therefore less conducive to percolation. The median particle diameter in the bed of the Upper Ventura River is over 4 inches. There is almost no silt or clay in the river bed. The Upper Ventura River Aquifer is recharged during the wet season as river flows percolate into the aquifer.

Recharge within the riverine system would be affected if fine sediments were to blanket the river bottom and side slopes and remain for an extended period of time. Due to the steepness of the river channel, very few of the fines will deposit in the main active channel. It is assumed that the recharge capacity that presently occurs will not be altered by any of the alternatives.

The 2.1 million yd^3 of slurried reservoir sediment (mostly silts) placed at disposal sites, located just upstream and downstream of Balwin Road Bridge (Highway 150), will be stabilized and protected so that this sediment is not accessed by flows smaller than the 10-yr flood. Sediment will be placed at or above the 10-yr flood elevations on the river terraces. Flows larger than the 10-yr flood may contact and mobilize some of the sediment, while smaller flows will not. These high flows typically transport very large amounts of sediment and have a large sediment supply. Therefore, sediments eroded from the disposal sites will constitute a small incremental increase in sediment concentrations during these events. When the high flows event captures this slurry sediment, it will not substantially change the overall character of the flow or result in substantial changes to the riverbed composition or configuration. The majority of the fines will be carried out to the ocean and the minor amounts deposited in the river will not affect percolation.

The disposal sites will not substantially reduce the percolation of water into the Upper Ventura Aquifer. The potential for fines to migrate into the pore spaces below the slurry site will be limited due to the low permeability of the fine sediment. In addition, the sites will be lined with sand or other filter that will prevent the potential downward movement of fines through soil pores carried by water. Compaction of the lower layers of the deposited fines would actually form a hard pan that would further be another barrier to water passage. In addition, the upper layers of the deposited material will be mixed with and covered with topsoil suitable for planting vegetation. This will reduce the potential for runoff to erode and carry fines into the river.

Comparison of the Alternative Plans

All of the action alternatives involve removal of Matilija Dam. The only variation between the alternatives is the duration of the removal. The majority of the action alternatives remove the dam in one phase (Alternative 1, 2a, 2b, 4a, and 4b), and the remainder in at least two phases (3a and 3b).

Reestablishment of fish passage upstream of Matilija Dam is also common to all the action alternatives, though the timeframe for restoration of fish passage varies between alternatives. For Alternatives 1, 4a and 4b, fish passage opportunity is immediate following completion of construction activities (For Alternative 1, the on-site aggregate sale operation for 10-years does not affect the constructed channel and hence fish passage). For Alternatives 2a, 2b, 3a and 3b, fish passage opportunity is dependent on hydrology and the magnitude of storm events and may require many years (up to possibly decades) to downcut through up to 60 feet of trapped sediment. The incremental removal alternatives (3a and 3b) will require the most time.

From the perspective of sediment management of the 5.8 million cubic yards of trapped materials to be removed from behind the dam, the fate of the materials, in general terms, involves two measures: removal out of the riverine system or mobilization into the riverine system. Removal out of the riverine system includes sale of materials from on-site (Alternative 1) or stabilization of materials on-site (Alternative 4a). Mobilization of the materials into the riverine system allows the sediment to be fluvially transported downstream (Alternatives 2a, 2b, 3a, 3b and 4b). Most of the action alternatives have some portion of both measures.

From the perspective of a riverine system in equilibrium (i.e when the sediment entering the river is in close balance with the sediment leaving the system), all of the alternatives, including the No Action, ultimately reach equilibrium. The natural transport alternatives (2a, 2b, 3a, and 3b) are estimated to reach equilibrium in the shortest time frame (up to 10 years). Alternative 4b may require up to 20 years. The alternatives with the longer time frame to reach equilibrium are Alternative 1and 4a (50 years) and the No Action Alternative (up to 100 years). The impacts associated with natural transport alternatives, however, are also the greatest. These impacts include higher deposition levels downstream, greater risk to flooding (hence higher flood control features), and greater impacts to Robles Diversion Dam.

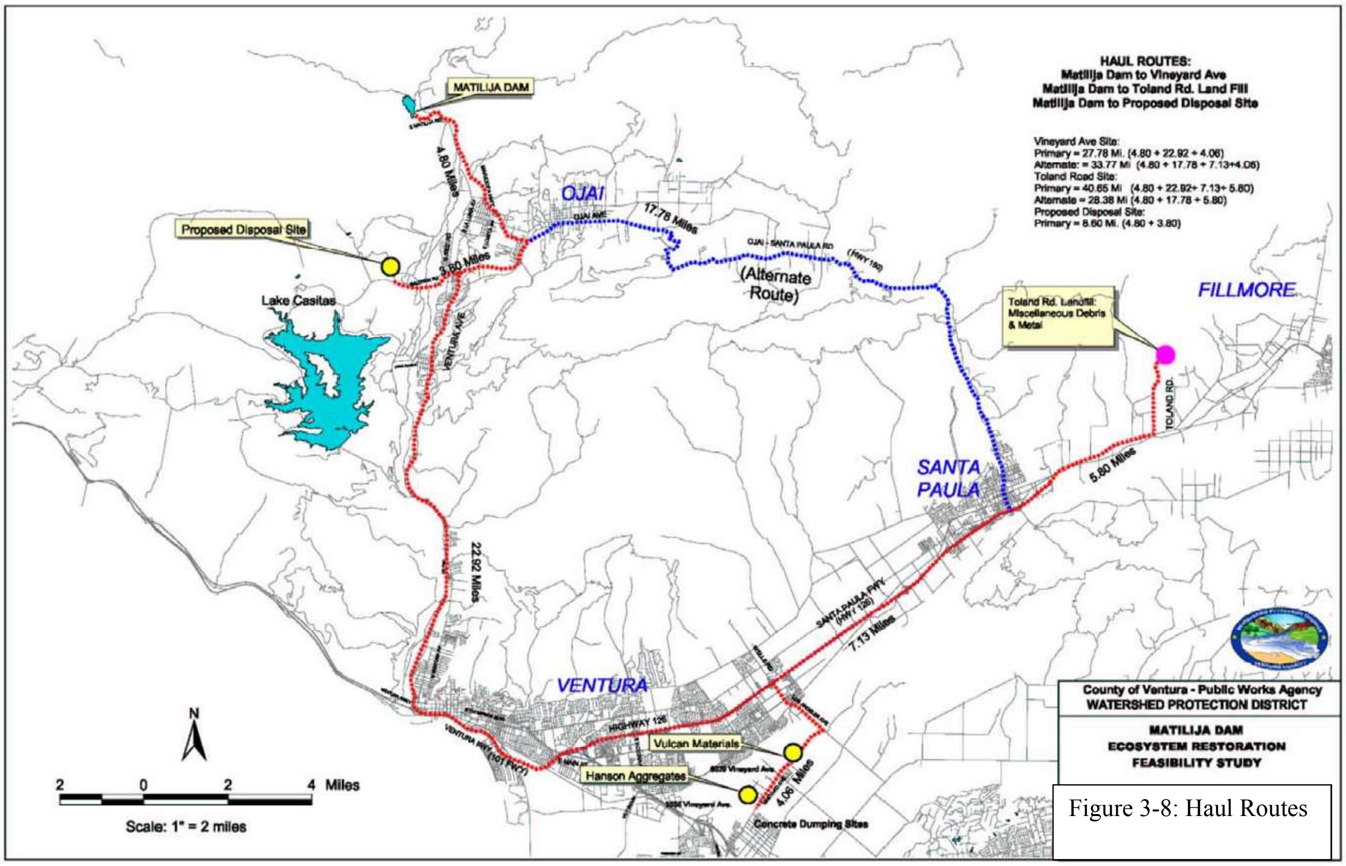


Figure 3-8: Haul Routes

Sediment delivery to the ocean, and resulting benefits to beach nourishment, would occur sooner for the action alternatives as compared to the No Action Alternative. Time frames would be similar as those described for the establishment of riverine equilibrium. Over a period of 50 years, increases in sediment delivery volumes would be approximately one-third greater than the No Action Alternative for sand, gravel, and cobble-sized sediment. The Beach Erosion Authority for Control Operations and Nourishment (BEACON) has estimated that a cubic yard of sand roughly equates to a square foot of dry sand on the beach. Detrimental effects related to the restoration of increased sediment transport to the shoreline include the short-term impacts of fine sediments on local crustaceans, and the potential increase in future dredging at the Ventura and Channel Islands Harbors due to longshore transport of increased sediments from the Ventura River. Since the increase in volumes of fines and sands are relatively small when compared to the No Action Plan, the detrimental impacts are not considered significant for this study.

The severity of downstream impacts for the natural transport alternatives is moderated if the dam is removed incrementally versus all in one phase. Incremental removal allows monitoring upstream and downstream of the environment and the flood control system between phases. To increase the level of control over uncertainties, the number of removal phases could be increased. As a result of increasing the number of removal phases, the level of risk would decrease, thereby allowing the degree of flood protection improvements to be moderated.

At Robles Diversion Dam, a mitigation feature is needed for the natural transport alternatives (2a, 2b, 3a, 3b, and 4b) to reduce or eliminate interruptions to diversion operations or turbidity impacts to Lake Casitas. This feature is a high-flow bypass to flush sediment eroded from behind Matilija Dam to downstream of the Robles facility. Alternatives that slurry the ‘Reservoir Area’ sediment off-site (1, 2a, 3a, 4a, and 4b) overall affect water supply issues less than alternatives that do not slurry these materials (2b and 3b).

Alternative 1 has the highest impacts to the community in terms of truck traffic as a result of the aggregate sale operation. In terms of public acceptability, the impacts associated with air quality, noise and traffic would warrant dismissal of this alternative.

For cultural resources impacts, Alternatives 2a, 2b, 3a, 3b, and 4b have the potentially highest impacts. The Matilija Hot Springs property is at risk of inundation due to its proximity downstream of the dam.

A summary of the affects of the different plans (System of Accounts) is shown on Tables 3-4 to 3-6.

To further provide an assessment of the alternatives, it is helpful to consider four evaluation criteria as outlined in Corps planning guidance: completeness, effectiveness, efficiency, and acceptability.

Completeness

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. In general, the alternatives are all complete. Impacts resulting from the action of dam removal, common to all the action alternatives, and necessary mitigation measures were evaluated. No further measures are needed to allow for the functioning of the alternatives.

Effectiveness

Effectiveness is the extent to which an alternative plan alleviates the specified problems, achieves the specified opportunities, and satisfies constraints. Each of the alternatives is effective in addressing the problems and opportunities identified as part of this study, and all make significant contributions to the objectives, while satisfying constraints. The degree of effectiveness however varies for the criterion of time required for fish passage opportunity. Alternatives 1, 4a, and 4b allow immediate passage; Alternatives 2a, 2b, 3a, and 3b are dependent on hydrologic conditions and have a 90 percent or higher probability of requiring at least 10 years.

Efficiency

Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment. The individual components or measures of an alternative were selected after careful consideration of alternate means, including costs, of accomplishing a similar goal. For an ecosystem restoration study, the selection of the recommended plan, as will be addressed in the next section, will be based on cost-effectiveness and maximization of net benefits through an incremental cost analysis.

Acceptability

Acceptability is the workability and viability of the alternative plan with respect to acceptance by state and local entities and the public and compatibility of existing laws, regulations, and public policies. Besides being do-able, the alternatives with the best chance of acceptance are those that impact the environment and the community the least. Three action alternatives were found to be unacceptable due to significant adverse impacts: Alternative 1 (air quality, noise and traffic); Alternatives 2b and 3b (water supply). The other alternatives provide more of a measure of control against adverse impacts and at the same time benefiting the environment the most.

Table 3-4: Summary of NED/NER Outputs

Alt #	Alternative	*NED/NER Summary*						*HEP Outputs*	
		Initial Construction Cost ($)	Annual Cost of Maintenance (O&M) ($)	Avg. Annual Costs ($)	Net Annual Benefits ($)	Annual Benefit to Annual Cost Ratio	Average Cost per AAHU ($/AAHU)	50-Yr Avg Annual Habitat Units (AAHU)	Change in AAHU over 'No Action"
	No Action Alternative - (Without Project Condition)	$0	$0	$0			NA	1393	NA
1	Full Dam Removal/Mechanical Sediment Transport: Dispose Fines, Sell Aggregate	$110,188,667	$289,265	$6,916,938			$11,358	2002	609
2	Full Dam Removal/Natural Sediment Transport								
	Slurry "Reservoir Area" Fines Offsite	$103,139,409	$433,256	$6,636,928			$9,789	2071	678
b.	Natural Transport of "Reservoir Fines"	$127,067,641	$319,910	$7,962,827			$11,745	2071	678
3	Incremental Dam Removal/Natural Sediment Transport								
	Slurry "Reservoir Area" Fines Offsite	$107,465,608	$436,483	$6,900,369			$10,178	2071	678
b.	Natural Transport of "Reservoir Fines"	$127,786,153	$319,526	$8,005,660			$11,808	2071	678
4	Full Dam Removal On-Site Sediment Stabilization								
	Long-Term Transport Period/100' Channel (base width) behind Dam	$111,640,835	$283,785	$6,998,805			$12,633	1947	554
b.	Short-Term Transport Period /100' Channel (base width) behind Dam	$102,620,140	$325,594	$6,498,033			$8,889	2124	731

Table 3-5: Summary of Environmental Quality Outputs

Alt #	Alternative	*Environmental Quality Impacts*									
		Turbidity	Air Quality (On/Off-Site)	Noise (On/Off-Site)	Road Truck Traffic: Total Trip Miles	Road Truck Traffic: Avg. Trip Mi/Day	Water Quality (Toxicity)	Vegetation (Impact Footprint in Acres)	T & E Species	Cultural and Historic Resources	Reach with Greatest Sedimentation Rate (6B)
	No Action Alternative - (Without Project Condition)	Low	NA	NA	NA	NA	Low	NA		Low	Gradual
1	Full Dam Removal/Mechanical Sediment Transport: Dispose Fines, Sell Aggregate	Low	High	High	14,000,000	13,000	Low	264	Moderate	Moderate	Gradual
2	Full Dam Removal/Natural Sediment Transport										
	Slurry "Reservoir Area" Fines Offsite	Moderate	Moderate	Moderate	625,000	860	Low	268	Moderate	Moderate	Moderate
b.	Natural Transport of "Reservoir Fines"	High	Moderate	Moderate	625,000	860	Low	175	Moderate	Moderate	Significant
3	Incremental Dam Removal/Natural Sediment Transport										
	Slurry "Reservoir Area" Fines Offsite	Moderate	Moderate	Moderate	625,000	570	Low	268	Moderate	Moderate	Moderate
b.	Natural Transport of "Reservoir Fines"	High	Moderate	Moderate	625,000	570	Low	175	Moderate	Moderate	Significant
4	Full Dam Removal On-Site Sediment Stabilization										
	Long-Term Transport Period/100' Channel (base width) behind Dam	Low	Moderate (Least)	Moderate	155,000	140	Low	179	Moderate	Moderate	Gradual
b.	Short-Term Transport Period /100' Channel (base width) behind Dam	Low To Moderate	Moderate	Moderate	155,000	140	Low	268	Moderate	Moderate	Moderate

Table 3-6: Summary of RED & OSE Outputs

Alt #	Alternative	*Other Impacts*				*Regional Economic Development (RED)*			*Other Social Effects (OSE)*		
		Constructibility Risks	Beach Nourishment (Time to Reach Riverine Equilibrium)	Robles Diversion Sedimentation Without Mitigation (See also impacts under 'Turbidity')	Levees/ Floodwalls Required	Benefits to Regional Beach Industry	Aggregate Sale	Regional Construction Industry	Flood Risk	Aesthetics (levees, revetment, etc)	Recreation Benefit
	No Action Alternative - (Without Project Condition)	NA	~ 100 yrs	2 times existing levels in future. Existing avg: 13,300 yd3	No Improvements to Existing Levees				Moderate - High	Low	Dam site has no public access
1	Full Dam Removal/Mechanical Sediment Transport: Dispose Fines, Sell Aggregate	Moderate	~ 50 yrs	2 times existing levels	Some Modifications				Low	Low	High
2	Full Dam Removal/Natural Sediment Transport										
	Slurry "Reservoir Area" Fines Offsite	Moderate (Least)	< 10 yrs	Up to 8 times existing levels	Substantial Modifications				Low	Moderate	High
b.	Natural Transport of "Reservoir Fines"	High	< 10 yrs	Up to 9 times existing levels	Substantial Modifications				Low	Moderate	High
3	Incremental Dam Removal/Nat Sed Transport										
	Slurry "Reservoir Area" Fines Offsite	Low (Least)	< 10 yrs	Up to 6 times existing levels	Substantial Modifications				Low	Moderate	High
b.	Natural Transport of "Reservoir Fines"	High (Least)	< 10 yrs	Up to 6 times existing levels	Substantial Modifications				Low	Moderate	High
4	Full Dam Removal On-Site Sediment Stabilization										
	Long-Term Transport Period/100' Channel (base width) behind Dam	High (Least)	~ 50 yrs	2 times existing levels	Some Modifications				Low	Moderate	Moderate
b.	Short-Term Transport Period/100' Channel (base width) behind Dam	Low	< 20 yrs	Similar to Alt. 3	Substantial Modifications				Low	Moderate	High

Alternative Benefits

All of the benefits associated with the alternatives are presented in non-monetary terms (Habitat Units). Ecosystem restoration benefits for this study have been prepared using a modified HEP analysis. The Average Annual Habitat Units (AAHUs) computed from the HEP are analyzed for each alternative in the same manner as the methods used for the baseline conditions analysis. The HEP is also used to analyze the benefits associated with the restoration alternatives. Table 3-7 presents the total benefits for each alternative, including breakdown by HEP formula component. Alternative benefits are compared to the 50-year average baseline condition, which includes the existing condition (year 0), year 5, year 20 and year 50 for the No Action alternative. The No Action alternative (without-project) is compared to the with-project condition to determine the gain in habitat units for each alternative. Details are presented in the Habitat Valuation Analysis, an appendix to the EIS/R.

Table 3-7: Comparison of Environmental HEP Outputs

ALT	STEELHEAD		RIPARIAN		NAT. PROCESS		TOTAL	
	Total AAHU	Increase Beyond No Action	Total AAHU	Increase Beyond No Action	Total AAHU	Increase Beyond No Action	Total AAHU	Increase Beyond No Action
No Action	231	0	917	0	245	0	1393	0
1	491	260	1143	226	368	139	2002	609
2a	473	242	1136	219	462	235	2071	678
2b	473	242	1136	219	462	235	2071	678
3a	473	242	1136	219	462	235	2071	678
3b	473	242	1136	219	462	235	2071	678
4a	493	262	1140	223	315	77	1948	554
4b	514	283	1147	229	464	233	2125	731

Alternative 4b provides the most net benefits to the ecosystem based on the HEP analysis, with an overall increase of 731 AAHUs when compared to the No Action Alternative. The outputs for Alternative 2a, 2b, 3a, and 3b are in a relatively close second position. There is a more distinct separation in AAHUs going to the next lower Alternative 1, followed by Alternative 4a.

Alternative Costs

The cost estimate for each of the alternatives, including initial construction costs, annual cost of maintenance and average annual costs is presented Table 3-8. The detailed cost estimates are presented in Technical Appendix F, Cost Estimates.

For some of the alternatives, there is an added measure of risk and uncertainty related to constructibility. Most affected by constructibility risk are the two natural transport alternatives with no slurrying of 'Reservoir Area' sediment off-site (Alternatives 2b and

3b). These alternatives require excavation and placement of all or a portion of 'Reservoir Area' sediment upstream, evacuation of water from the reservoir, and dam deconstruction (full or incremental), prior to the occurrence of a significant storm. Failure to accomplish these operations would result in re-deposition of the excavated sediment into the work area behind the dam. As a result of this risk, the costs for Alternatives 2b and 3b have added contingency. The estimates of the added costs however were preliminary and more detailed evaluation would be needed to refine the assessment. The constructibility risks associated with the other alternatives are somewhat less and are sufficiently covered under the standard contingency (25 percent).

Costs for Alternatives 2b and 3b are the highest since sediment and turbidity impacts would be so great at Robles Diversion Dam that water from an outside purveyor would need to be procured to restitute CMWD for lost diversion opportunity for a duration as long as 8 years should a drought period persist following dam removal.

Real Estate costs included in the alternatives analysis are for flood control improvement rights-of-way, purchase of structures, and the slurry disposal site. The desilting basin is also included as part of real estate costs for alternatives 2a and 3a.

TABLE 3-8: ECONOMIC OUTPUTS (FY 2004 Price Levels)							
	Alt. No. 1	Alt. No. 2A	Alt. No. 2B	Alt. No. 3A	Alt. No. 3B	Alt. No. 4A	Alt. No. 4B
Average Annual Habitat Units (AAHU)	2002	2071	2071	2071	2071	1947	2124
Gains beyond No Action[1] (AAHU)	609	678	678	678	678	554	731
Gross Project Costs							
First Costs	$98,879,834	$92,554,052	$114,026,494	$96,807,677	$115,298,299	$97,563,070	$92,088,077
Interest During Construction (Phase 1 only)	$5,376,043	$5,032,113	$6,199,558	$5,101,088	$5,961,246	$8,223,981	$5,006,779
Phase 2 Adjustment for Alt.3 Const. to base year				-$251,618	-$391,290		
Monitoring and Adaptive Management	$4,943,992	$4,627,703	$5,701,325	$4,840,384	$5,764,915	$4,878,153	$4,604,404
Cultural Resources	$988,798	$925,541	1,140,265	$968,077	$1,152,983	$975,631	$920,881
Total Gross Investment[2]	$110,188,667	$103,139,409	$127,067,641	$107,465,608	$127,786,153	$111,640,835	$102,620,140
Annual Costs							
Annual Cost of Total Gross Investment	$6,627,674	$6,203,672	$7,642,917	$6,463,886	$7,686,135	$6,715,019	$6,172,439
Annual Cost of Maintenance (O&M)	$289,265	$433,256	$319,910	$436,483	$319,526	$283,785	$325,594
Total Annual Costs (AAC)	$6,916,938	$6,636,928	$7,962,827	$6,900,369	$8,005,660	$6,998,805	$6,498,033
IV. Average Annual cost per AAHU	**$11,357.86**	**$9,788.98**	**$11,744.58**	**$10,177.54**	**$11,807.76**	**$12,633.22**	**$8,889.24**

[1]No Action Alternative has 1393 AAHUs

[2]Total Gross Investment does not include recreation costs (all alternatives) and associated feature costs for desilting basin (Alternative 4b).

National Ecosystem Restoration Plan

Table 3-9 presents the alternatives in order of increasing output (habitat units). From a cost effectiveness perspective, an alternative is cost effective if there are no other alternatives that provide the same output at a lower cost. Alternative 4b is the only cost effective alternative.

Table 3-9: Cost Effectiveness Analysis		
Alternative	Avg. Annual Habitat Units (AAHU)	Avg. Annual Cost ($)
No Action	Not Applicable	0
4a	554	6,999,000
1	609	6,917,000
3b	678	8,006,000
2b	678	7,963,000
3a	678	6,900,000
2a	678	6,637,000
4b	**731**	**6,498,000**

An incremental cost analysis is not necessary since there are no changes in output levels to be compared and levels to be selected, except for the No Action Alternative. Alternative 4b is the NER plan. Alternative 4b reasonably maximizes the ecosystem restoration benefits relative to costs. The average annual cost per average annual habitat unit is $8,890 (see Table 3-8 on previous page).

Locally Preferred Plan

The Plan Formulation Group (PFG) met in January 2004 to discuss the alternatives analyses results. In a consensus decision, the Sponsor and the majority of the stakeholder participants identified Alternative 4b as the preferred plan. In addition, however, to the NER plan, the group agreed to add a desilting basin as an additional feature to Alternative 4b. It was understood that the desilting basin would be considered a project associated feature. The Casitas Municipal Water District General Manager deferred to committing to Alternative 4b until further discussions of any remaining issues was possible with the CMWD Board of Directors. VCWPD is currently pursuing additional discussions with CMWD.

Revisions to Costs

Since the completion of the Public Draft Report costs have been updated to reflect technical review comments. In particular, cost estimates for the levees at Meiners Oaks, Live Oak and Casitas Springs have been revised based on further review of the necessary fill quantities for the structures. This increase in levee costs does not affect the selection of the Recommended Plan. Table 3-8 remains valid for screening purposes. The revised costs for the Recommended Plan are presented in Chapter 4, Table 4-4.

4. THE RECOMMENDED PLAN

General

This Chapter presents information on the tentatively Recommended Plan. This includes descriptions of the major project features associated with construction of the project, real estate requirements, and operation and maintenance requirements. Information is also presented on project construction and maintenance costs, benefits of the project, and an economic analysis. This chapter also summarizes the environmental impacts determined in accordance with the required procedures to comply with the National Environmental Policy Act and California Environmental Quality Act, as well as other regulatory requirements.

Plan Description

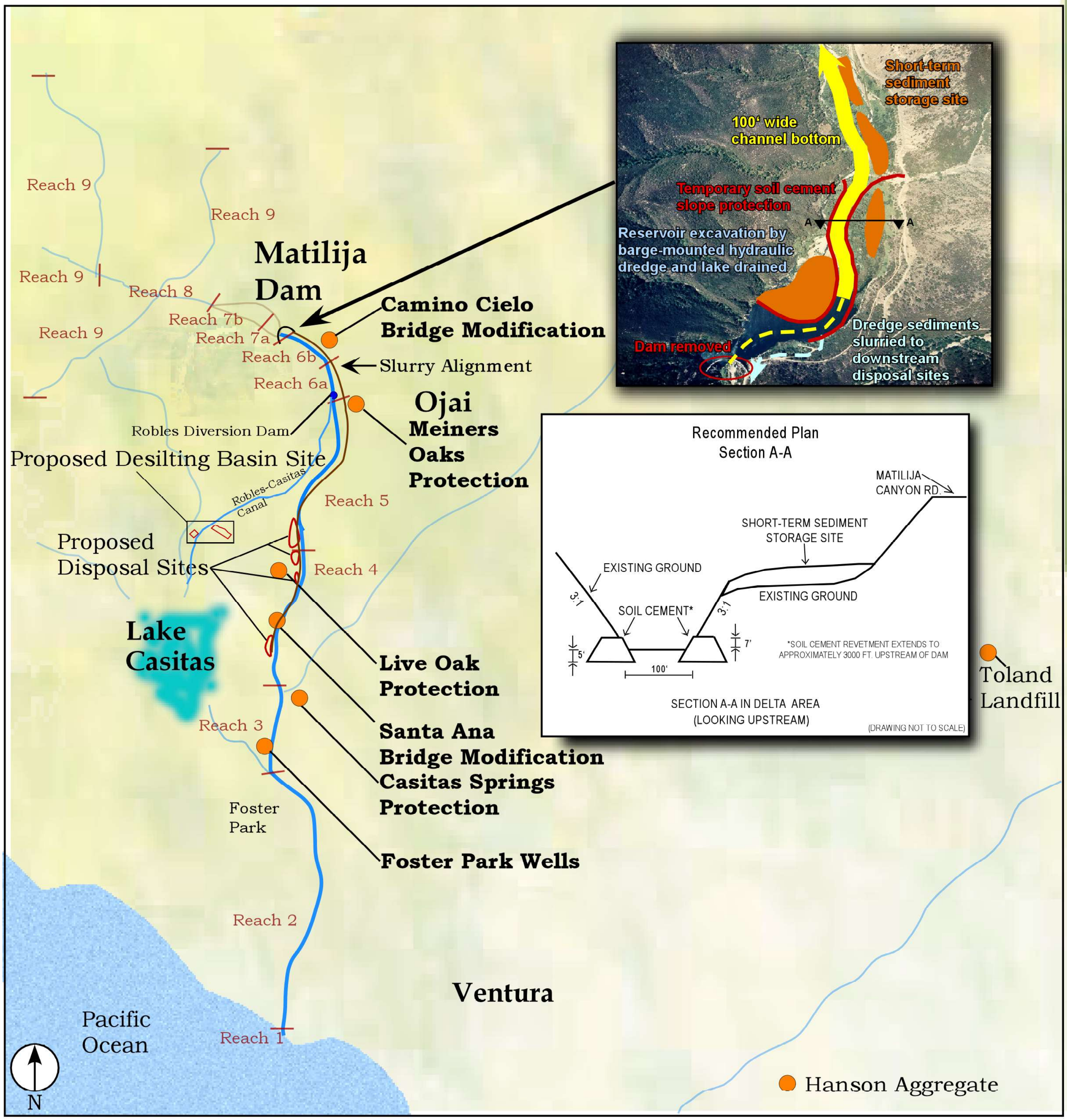
The plan formulation process resulted in the selection of Alternative Plan 4b as the Recommended Plan. This plan will best contribute to the primary study ecological restoration objective to restore the Matilija Creek and Ventura River ecosystem, while maintaining downstream water supply operations and flood protection along the Ventura River. The Recommended Plan is expected to result in significant benefits to the ecosystem. From an adverse environmental impact analysis standpoint, temporary adverse impacts will occur during construction as well as during the period sediment from the reservoir area is transported downstream. The Recommended Plan includes measures to mitigate these adverse impacts related to increases in downstream flood damage potential and adverse impacts to water supply facilities. Details of the design of the Recommended Plan are presented in the Design, Hydrology and Hydraulics, and Geotechnical Appendices. The major components of the Recommended Plan are shown in Figure 4-1 and described below.

Site Preparation

Prior to any earthmoving activities, the perimeter of the reservoir area, and the delta and upstream sites will be stripped of most of the existing vegetation, particularly the large stands of giant reed (Arundo donax). Other native vegetation will also be removed because it has been overwhelmed by, and is intertwined in the giant reed. One stand of oak trees that is in the Upstream Channel area, but has not been subject to significant amounts of sediment deposition, will be protected in place. Current assumptions for giant reed removal at the dam site include a combination of mowing with a flail mower, removal of the cut biomass from the site, and application of high concentrations of glyphosate or similar herbicide. Other non-native invasive species, such as Tamarisk, will be removed from the area.

Removal of ‘Reservoir Area’ Sediments

The ‘Reservoir Area’ sediment, approximately 2.1 million cubic yards of mostly silt, underlying the existing lake behind Matilija Dam will be slurried to a designated downstream disposal site, allowing for removal of the dam.


Short-term sediment storage site
100' wide channel bottom
Temporary soil cement slope protection
Reservoir excavation by barge-mounted hydraulic dredge and lake drained
Dredge sediments slurried to downstream disposal sites
Dam removed
Recommended Plan
Section A-A
MATILIJA CANYON RD.
SHORT-TERM SEDIMENT STORAGE SITE
EXISTING GROUND
SOIL CEMENT*
EXISTING GROUND
*SOIL CEMENT REVETMENT EXTENDS TO APPROXIMATELY 3000 FT. UPSTREAM OF DAM
100'
SECTION A-A IN DELTA AREA
(LOOKING UPSTREAM)
(DRAWING NOT TO SCALE)
Reach 9
Reach 9
Reach 9
Reach 9
Reach 8
Reach 7b
Reach 7a
Reach 6b
Reach 6a
Reach 5
Reach 4
Reach 3
Reach 2
Reach 1
Matilija Dam
Camino Cielo Bridge Modification
Slurry Alignment
Ojai
Meiners Oaks Protection
Robles Diversion Dam
Proposed Desilting Basin Site
Robles-Casitas Canal
Proposed Disposal Sites
Lake Casitas
Live Oak Protection
Santa Ana Bridge Modification
Casitas Springs Protection
Foster Park
Foster Park Wells
Toland Landfill
Ventura
Pacific Ocean
N
Hanson Aggregate

Prior to initiation of the slurry operation, a relocation plan will be implemented for sensitive species such as the California red-legged frog and the southwestern pond turtle. An eradication program for bullfrogs, crayfish and green sunfish will also be pursued, as recommended by the U.S. Fish and Wildlife Service, to prevent downstream relocation.

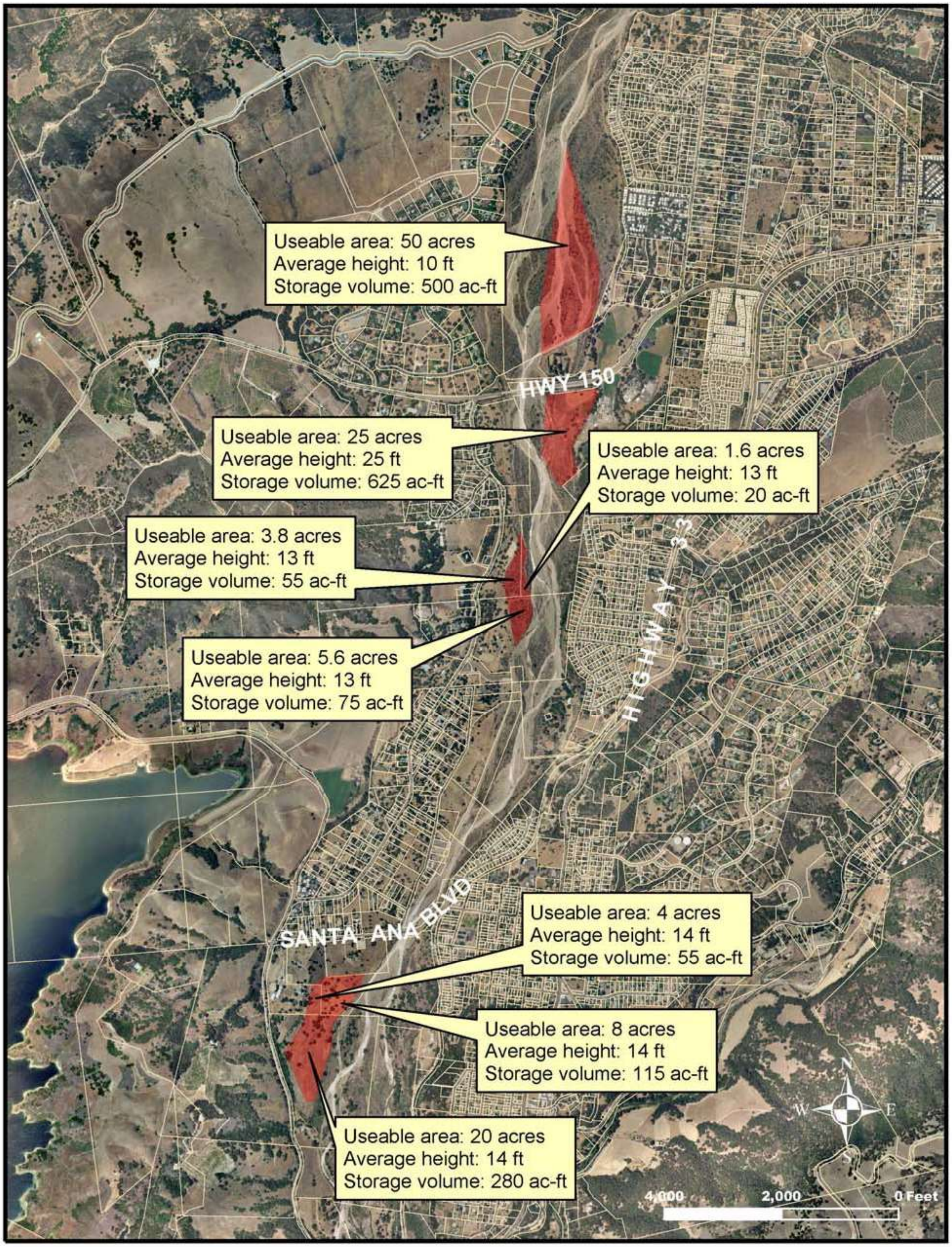
Two 12-inch cutter head suction dredges working 24 hours a day, 7 days a week will be utilized to slurry the 2.1 million cubic yards of fine sediment in approximately 9 months. Fresh water from Lake Casitas (4,500 acre-feet) will be used for the slurry media. The slurry will then pass through a stationary screen to eliminate any coarse material and enter a thickener. The thickener will be used to increase the solids concentration of the slurry and recycle water for the dredging operation. A make-up water pump will be required to pump water back to the dredges. The slurry will then be transported by pipeline to disposal areas located downstream.

A single 400-horsepower pump will be required at the dam to maintain slurry velocity in the pipeline. An 8-mile long fresh water pipeline and pumping system will be needed from Lake Casitas. The fresh water pipeline will be carbon steel and the slurry pipeline will be high-density polyethylene (HDPE). Additionally, a 90,000-gallon water storage tank will be placed at the left abutment to provide surge capacity. The thickener overflow can be fed directly into the storage tank if sufficient elevation difference between the thickener and storage tank is made available.

Slurried materials will be deposited within several areas in proximity of the Highway 150 (Baldwin Road) Bridge. The areas, comprising 118 acres in the floodplain, are both upstream and downstream of the bridge and are distant from 3.6 to 6.3 miles downstream of Matilija Dam. The locations of the slurry disposal areas are shown in Figure 4-2. The thickness of the required placement will vary by area and range between 10 and 25 feet. Earthen containment dikes will be constructed to contain the slurried materials. The dikes will be constructed of sands and gravels obtained from required on-site excavation and grading. Slopes on the basin side will be 2H:1V; slopes on the outside of the basin are assumed to be 3H:1V. The heights of the containment dikes will likely range between 10 and 30 feet, with an average of approximately 20 feet. Interior dikes will be constructed during slurry placement to enhance stability and separation of the fines from the water. Following dewatering of the slurried materials, the return effluent would be permitted to return to stream flow. Prior to placement, the area will be cleared of vegetation to enhance percolation. Additional features, such as collection systems, settlement ponds, observation and pumping wells, could be added to enhance collection of water.

For the upstream-most slurry disposal site located just north of the Highway 150 Bridge, slope protection will be required and will consist of riprap stone of approximately 2-foot diameter, imported from a local quarry located in the vicinity of the damsite. The stone will be placed on the outside dike slopes to an elevation that will provide a 5- to 10- year level of protection. The three other disposal areas, downstream of the bridge, are located mostly on low floodplain terraces and would be subjected to less frequent flows. Stone protection for these areas to a limited height may consist of boulders obtained from excavation activities for the construction of the dikes. Willows may also be planted on the side slopes to provide soil stabilization during larger storm events. Once the slurried materials are sufficiently dewatered, the disposal areas can be revegetated using native plants.

FIGURE 4-2: SLURRY DISPOSAL SITE



Management of 'Delta' and 'Upstream Channel' Area Sediments

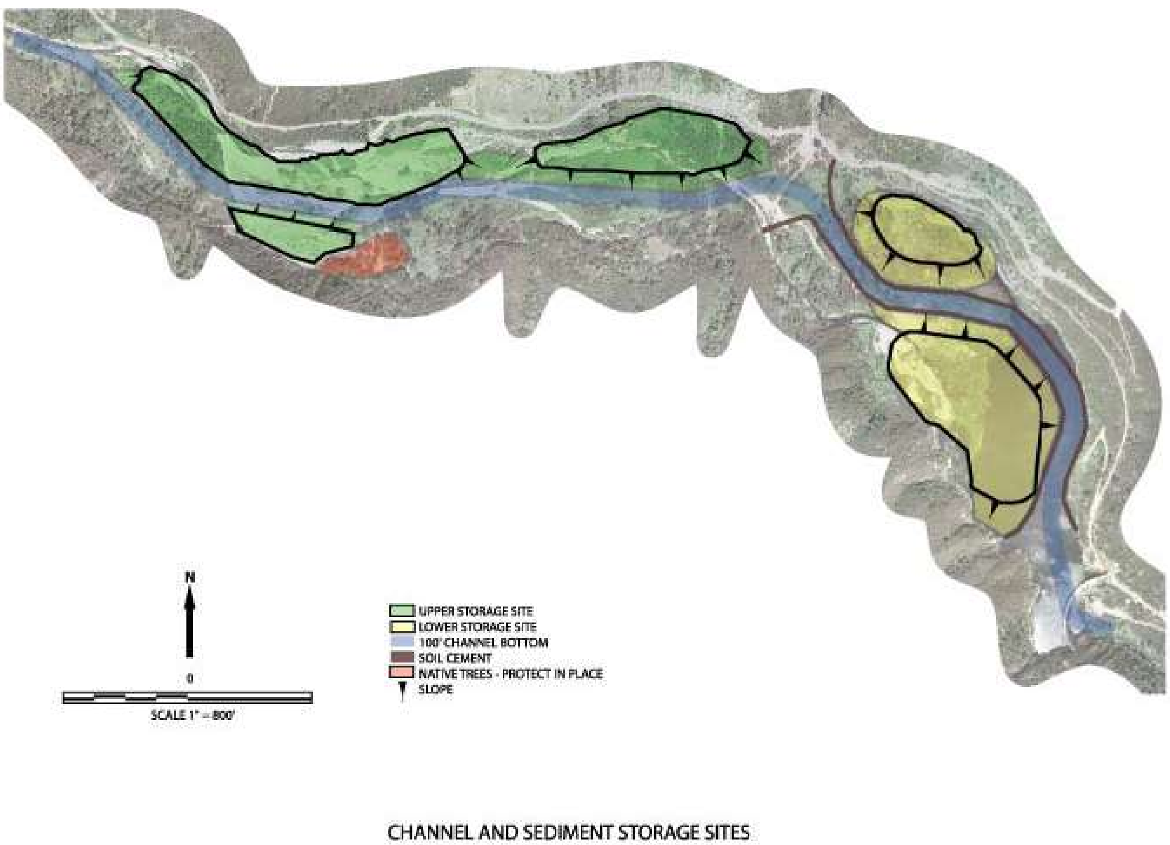
While the slurry operation is taking place, excavation operations will commence in the 'Delta' and 'Upstream Channel' areas to construct a channel with an alignment similar to the pre-dam channel. The 1.1 million cubic yards of sediment excavated will be temporarily placed in several storage sites within the reservoir basin, and also within the 'Reservoir Area' following slurrying operations. Figure 4-3 presents the layout of the excavated channel alignment and the temporary storage sites.

The excavated channel will be 100 feet in width to allow for a smaller meandering channel to naturally develop in the channel bottom between storm events. The channel will have side slopes of 3H:1V. The invert (bottom) of the excavated channel will be to pre-dam elevation and similar gradient. Sediment excavated from the 'Upstream Channel' area, consisting predominately of coarse-grained materials, will be placed in storage sites located in the upper half of the reservoir basin. All sediment excavated from the "Delta Area' will be placed in storage sites within the lower half of the reservoir basin. The 'Delta Area' materials contain the majority of the residual portions of the finer sediment trapped in the basin. Sediments within the original reservoir basin will be subject to natural erosion and transport downstream by stream flows. Selective segments of the channel within the lower half of the reservoir basin will be protected with soil cement revetment. The purpose of the revetment is to "meter" the erosion of the 'Delta Area' sediment whenever the revetment is overtopped by larger flows. The height of the revetment will extend 7 feet above the channel invert and 5 feet below the invert to prevent undermining of the structure. The revetment height will be overtopped by flows exceeding a 10-year storm event (12,500 ft^3/sec). At the upstream end of the soil cement revetment, a tie-in to the adjacent canyon slope or road embankment will be required to prevent circumventing of the structure by breakout channel flows. The tie-in may consist of either soil cement or larger boulders (collected from on-site). Coarser-grained materials within the reservoir basin located upstream of the revetment will remain unprotected and subject to natural erosion by stream flow.

The soil cement revetment will be constructed utilizing aggregate available on site. Material behind the revetment will periodically need to be graded to avoid undermining of the revetment and improve erosion potential. All soil cement revetment would be removed from the site following sufficient evacuation of stored sediment from within the original reservoir limits. The removal will occur in stages, and will be dependent on criteria established in the monitoring and adaptive management plan taking into account levels of sediment evacuation and limiting adverse effects downstream. Complete removal is expected to occur within 20 years.

Locations for the sediment storage sites were selected to align the channel in a similar way to pre-dam conditions, to minimize impacts to more sensitive habitat areas, and to ensure the natural aesthetics of the area were not adversely affected by the temporary stockpile of sediments. The design slopes for the storage sites are 4H:1V. The top elevations of the storage sites will not impede views of the canyon from Matilija Road. No revegetation plans of the storage sites or channel are included in the Recommended Plan. It is assumed that the area will naturally revegetate after several years.

FIGURE 4-3: TEMPORARY SEDIMENT STORAGE SITES



Dam Demolition

The dam demolition process for Alternative 4b will be conducted in one phase, initiated during slurry operations. A small cofferdam would be constructed to direct flows away from the dam during demolition. The portion of the dam at the left abutment will be demolished early to improve access to Highway 33. Following dredging of the Reservoir area, the remainder of the structure above the original streambed (approximate elevation 975) will be removed. This will be done by controlled blasting, in approximately 15-foot vertical increments. Concrete rubble (77,000 cubic yards, assuming a bulking factor of 1.5) will be processed after blasting as required for transportation to a commercial concrete recycling plant, assumed to be Hanson Aggregates (approximately 28 miles from Matilija Dam). For estimating purposes, the concrete is assumed to be processed to a maximum diameter of two feet and all reinforcement, or other embedded metal will be cut flush with the concrete, by torch, as required by the aforementioned recycling plants. Metal debris will be hauled from the site and salvaged when possible. The processing of any concrete which remains too large after blasting will be assumed to be performed by a hoe-ram. It should be noted that the contractor may choose to process the material for sale on site. Non-recyclable debris will be sent to Toland Landfill.

Final Clean-up

It is estimated that this alternative will require approximately 36 months to complete the slurrying operation of the 'Reservoir Area' sediment, removal of the dam, excavation of the channel, and construction of the soil cement revetment. While removal of the remaining trapped sediment will be variable and dependent upon the hydrology, it is assumed that within 20 years of initial earthmoving and deconstruction activities, the re-vegetation phase will be completed.

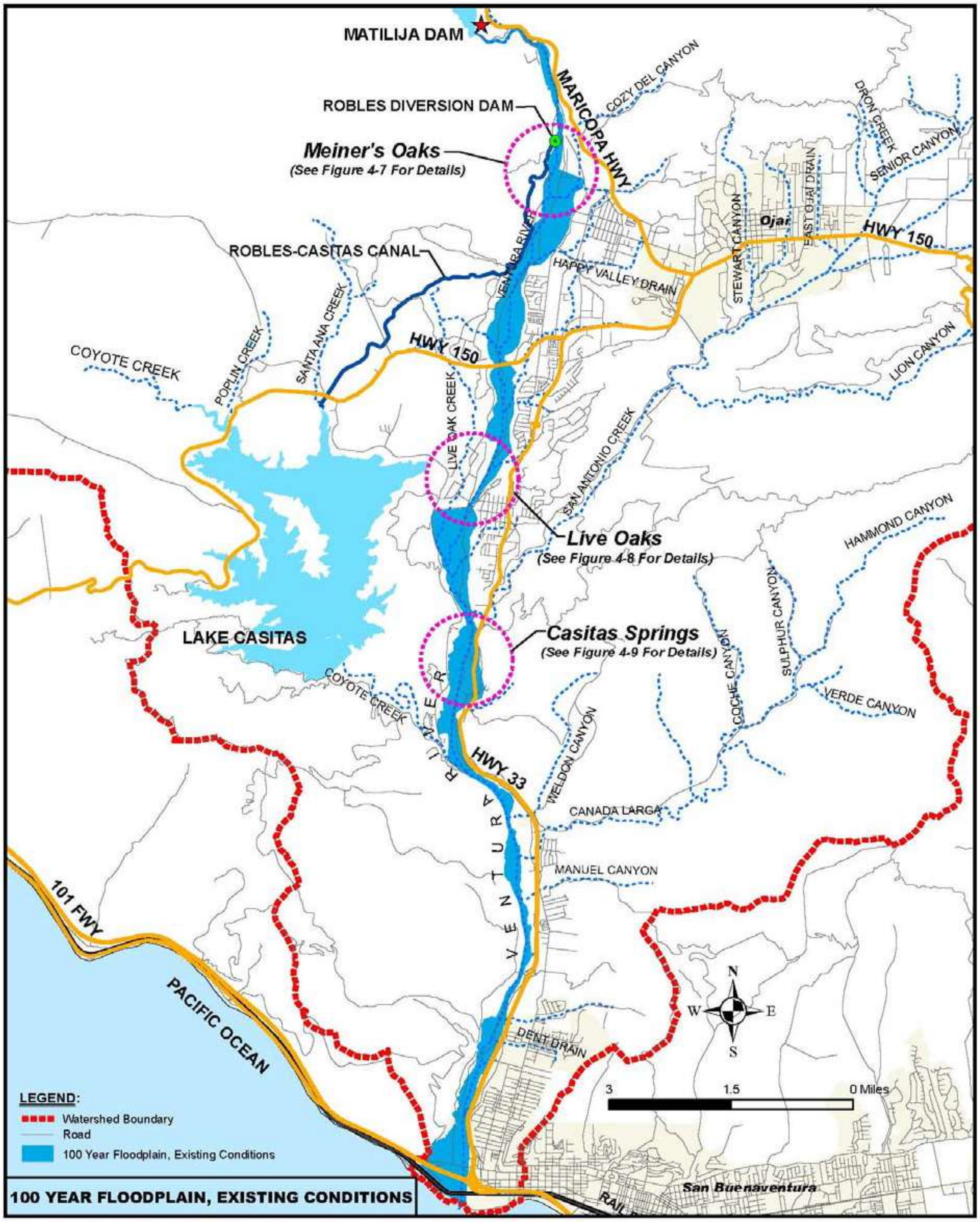
Mitigation for Flooding Impacts

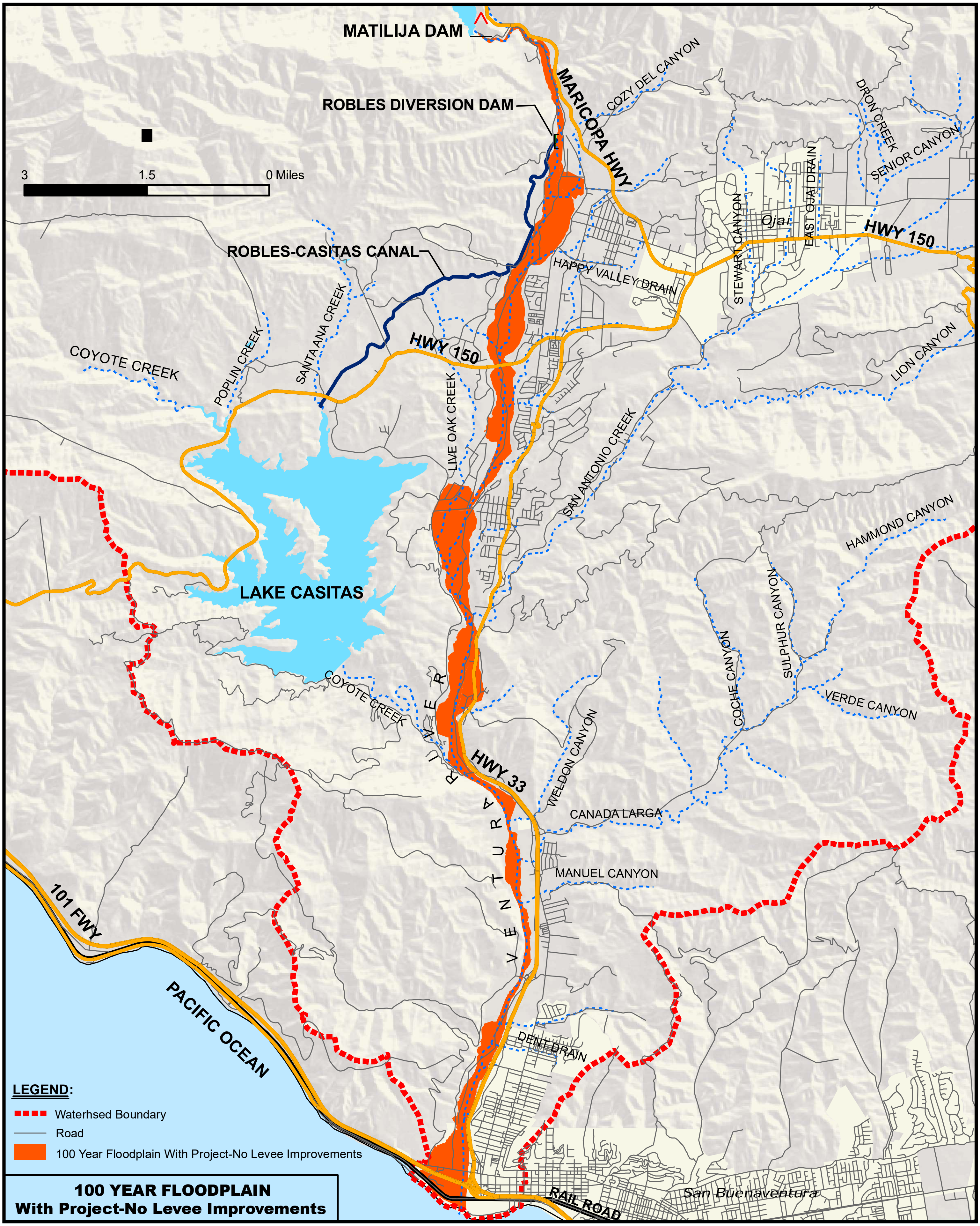
Justification for Mitigation of Downstream Damages

Flood mitigation measures to protect against structural damages include construction of levees/floodwalls (new, or raising/extending existing structures) and bridge modifications. Where protection is not possible, due to engineering, social, legal, or economical reasons, land must be acquired. Mitigation for occasional damages beyond without-project conditions to parcels not proposed to require levee modification measures, such as croplands, will also require compensation. Additional modeling will be performed in the next detailed design phase to allow for refined assessment with respect to the acquiring of land, and also for the need for flowage easements. Table 4-1 summarizes the mitigation measures resulting from analyses performed at this feasibility level.

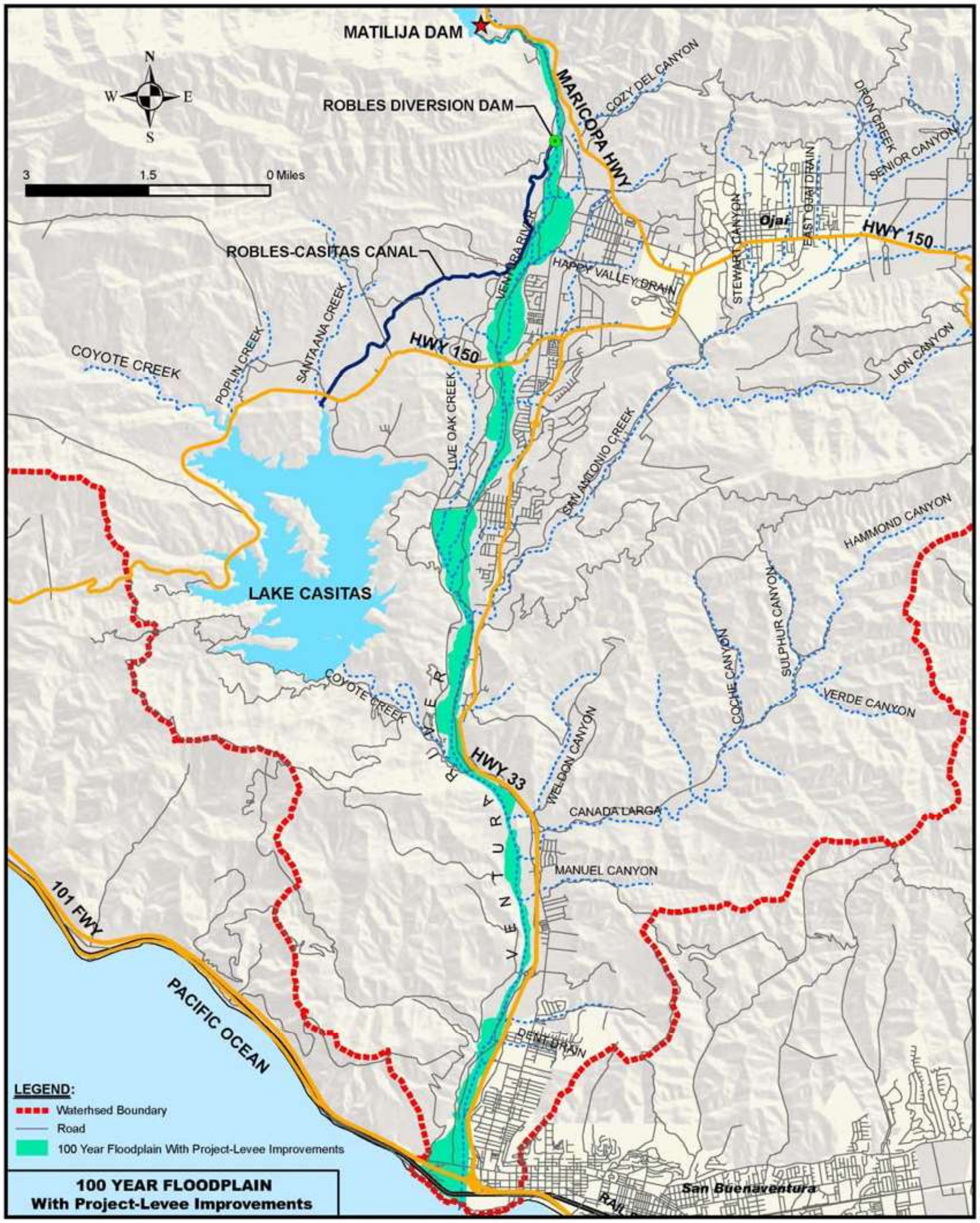
Figures 4-4 and 4-5 show the 100-year floodplain for the without-project conditions and post-dam removal with no levee modifications. Figure 4-6 shows the floodplain for the Recommended Plan with levee improvements. Details of the differences in floodplains limits and mitigation improvements for Meiners Oaks, Live Oak, and Casitas Springs are presented on figures 4-7 through 4-9.

Table 4-1: Downstream Flood Mitigation Measures		
Location	Mitigation	Justification
Matilija Hot Springs	Buy-out	Proximity of Hot Springs site to dam and channel, narrowness of canyon, and limited flood conveyance area, poses high risk from sediment-laden flows in event of a very large storm event and limits the effectiveness of any structural protection.
Camino Cielo Properties	Buy-out	Proximity of six residential tracts to dam and channel, and narrowness of canyon, poses high risk from sediment-laden flows in event of a very large storm event and limits the effectiveness of any structural protection.
Camino Cielo Bridge	Improve conveyance. Removal and replacement at new location. Restore channel width at original location.	Existing low flow crossing (concrete box culvert) exacerbates constricted channel. Removal of bridge and restoration to original channel width will improve conveyance and prevent backwater effects. New bridge with higher deck at a wider channel section is justified because bridge is sole ingress\egress for remaining Camino Cielo residential tracts not impacted by potential flooding.
Meiners Oaks	Construct new (east) levee/floodwall	Flood protection less costly than real estate acquisition. Number of structures already prone to flooding under existing conditions would increase. Under with-project conditions, water depth increase by 2 ft min. Confinement by levee at lower end necessitates continuation of protection upstream.
Live Oak	Raise existing (west) levee	Flood protection less costly than real estate acquisition. Constricted nature of channel and expected rise in water surface in high flow events upstream of Santa Ana bridge necessitates levee raising. Confinement by levee at lower end necessitates continuation of protection upstream.
Santa Ana Bridge	Improve conveyance by widening channel and extending bridge length.	Existing bridge is severe constriction, and not capable of passing a 100-yr discharge with additional sediment-laden flows. Due to constricted channel upstream of bridge, current sediment removal maintenance efforts will need to continue albeit channel widening for a limited distance (500 ft) upstream of bridge.
Casitas Springs	Raise existing (east) levee	Flood protection less costly than real estate acquisition. Number of structures already prone to flooding under existing conditions would increase. Under with-project conditions, water depth would increase by 2 ft min.


MATILIJA DAM
ROBLES DIVERSION DAM
Meiner's Oaks
(See Figure 4-7 For Details)
MARICOPA HWY
COZY DEL CANYON
DRON CREEK
SENIOR CANYON
EAST OJAI DRAIN
Ojai
HWY 150
STEWART CANYON
ROBLES-CASITAS CANAL
VENTURA RIVER
HAPPY VALLEY DRAIN
SANTA ANA CREEK
POPLIN CREEK
COYOTE CREEK
HWY 150
LION CANYON
LIVE OAK CREEK
SAN ANTONIO CREEK
Live Oaks
(See Figure 4-8 For Details)
HAMMOND CANYON
LAKE CASITAS
Casitas Springs
(See Figure 4-9 For Details)
COYOTE CREEK
COCHE CANYON
SULPHUR CANYON
VERDE CANYON
WELDON CANYON
HWY 33
CANADA LARGA
MANUEL CANYON
VENTURA RIVER
101 FWY
PACIFIC OCEAN
N
W
E
S
DENT DRAIN
3
1.5
0 Miles
LEGEND:
Watershed Boundary
Road
100 Year Floodplain, Existing Conditions
San Buenaventura
100 YEAR FLOODPLAIN, EXISTING CONDITIONS



MATILIJA DAM
ROBLES DIVERSION DAM
MARICOPA HWY
COZY DEL CANYON
DRON CREEK
SENIOR CANYON
EAST OJAI DRAIN
STEWART CANYON
Ojai
HWY 150
3
1.5
0 Miles
ROBLES-CASITAS CANAL
HAPPY VALLEY DRAIN
SANTA ANA CREEK
POPLIN CREEK
COYOTE CREEK
HWY 150
LION CANYON
LIVE OAK CREEK
SAN ANTONIO CREEK
HAMMOND CANYON
LAKE CASITAS
SULPHUR CANYON
COCHE CANYON
VERDE CANYON
COYOTE CREEK
VENTURA RIVER
WELDON CANYON
HWY 33
CANADA LARGA
MANUEL CANYON
101 FWY
PACIFIC OCEAN
DENT DRAIN
RAIL ROAD
San Buenaventura
LEGEND:
Waterhsed Boundary
Road
100 Year Floodplain With Project-No Levee Improvements
100 YEAR FLOODPLAIN
With Project-No Levee Improvements



100 YEAR FLOODPLAIN
With Project-Levee Improvements

FIGURE 4-7 MEINERS OAKS – 100-YEAR FLOODPLAIN

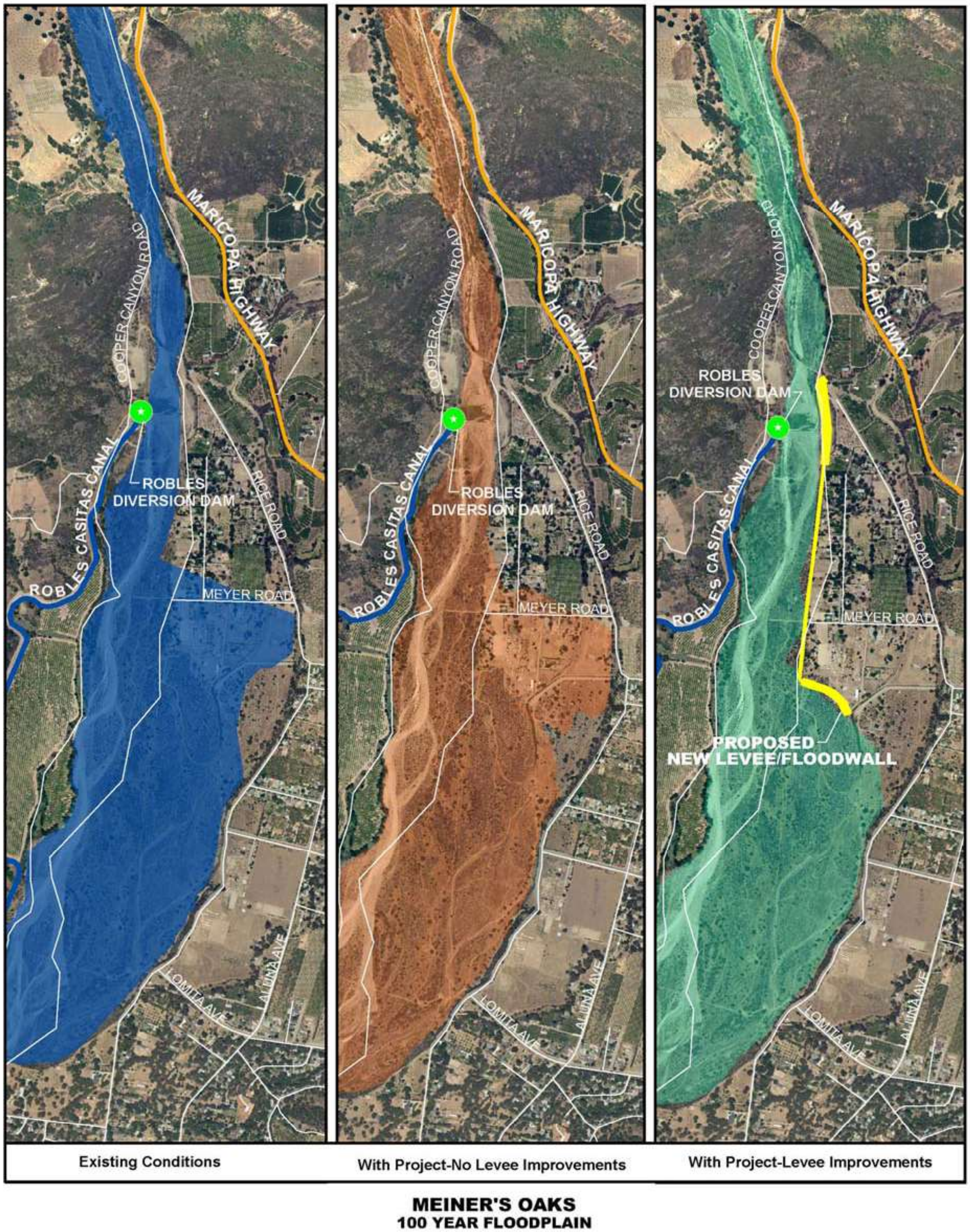
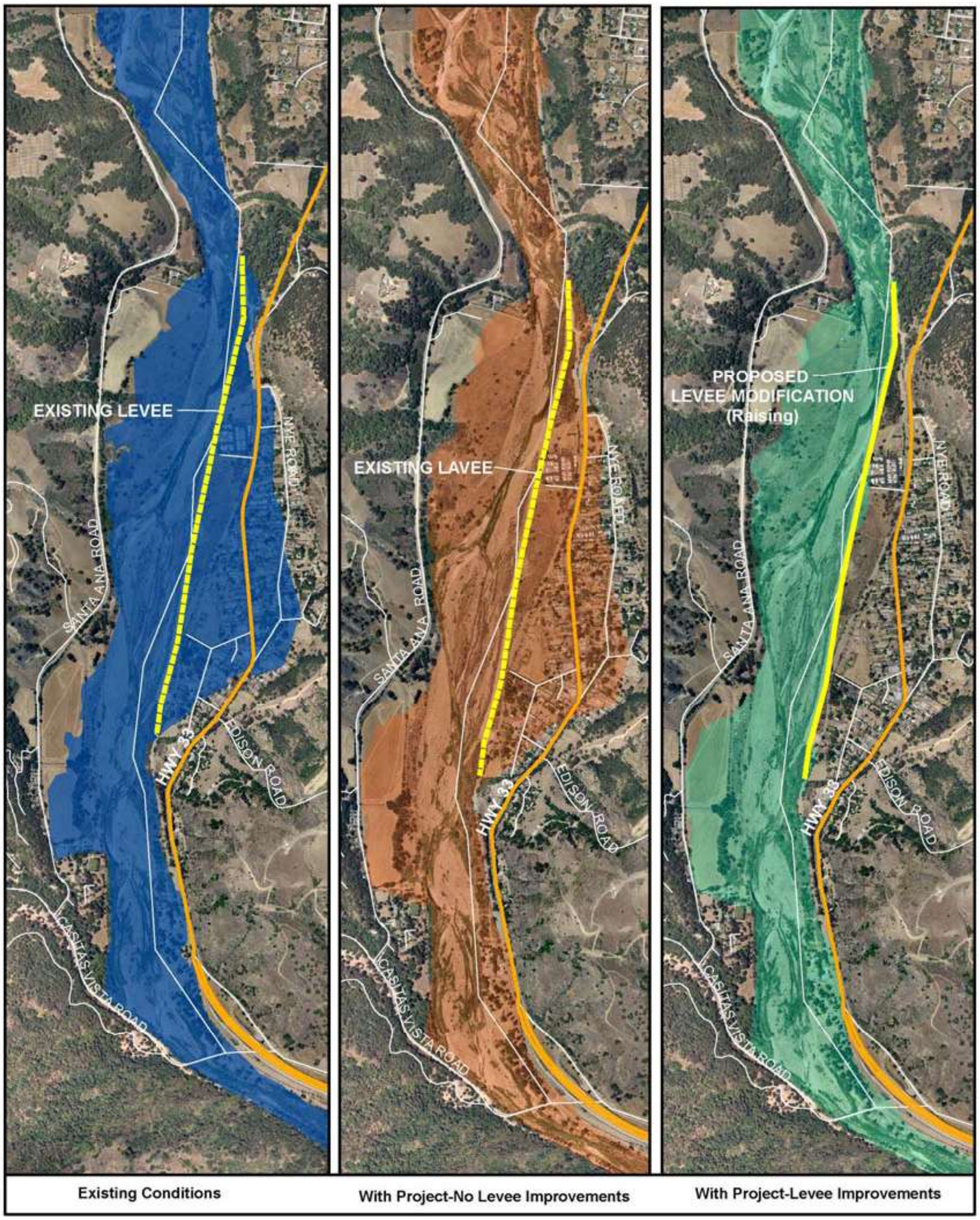


FIGURE 4-8 LIVE OAK- 100-YEAR FLOODPLAIN

LIVE OAKS
100 YEAR FLOODPLAIN

FIG 4-9 CASITAS SPRINGS- 100-YEAR FLOODPLAIN



CASITAS SPRINGS
100 YEAR FLOODPLAIN

Levee Heights Based on Risk and Uncertainty A risk and uncertainty analysis was conducted to better define recommended levee or floodwall protection heights for Alternative 4b. The analysis is in conformance with Corps of Engineers' reference EM 1110-2-1619, "Risk-Based Analysis for Flood Damage Reduction Studies." For additional details, see appropriate discussions in Appendix D (Hydrologic, Hydraulic, and Sediment Studies; Section 10.2) and Appendix F (Economics; Risk and Uncertainty).

Areas with building structures shown to be prone to flooding under with-project conditions include the Matilija Hot Springs facility, Camino Cielo residences, and Meiners Oaks, Live Oak, and Casitas Springs townships. Matilija Hot Springs and Camino Cielo were not included in the risk-based analysis as these areas will be at very high risk during high flow events. For each of the other areas (Meiners Oaks, Live Oak, and Casitas Springs), one representative river mile station was selected.

At the selected river mile stations (index locations), the procedure first established the hydrologic and hydraulic uncertainty. The hydrologic uncertainty determination utilized the discharge-frequency relationships based on available stream gage records. The hydraulic uncertainty determination considered both the uncertainty in streambed elevations associated with future deposition (or erosion) in the Ventura River, and also that of the Manning's roughness coefficient "n" (utilized in numerical modeling for computing water surface profiles). Water surface profiles were generated for several flow frequency events (10-, 50-, 100-, and 500-year) utilizing various streambed profiles that were determined to best represent conditions of low, mean, and high bed levels. At each index location, the stage-discharge relationship for each flow frequency level was determined, and finally the water surface elevation based on standard deviation analysis of high and low values was computed.

In accordance with current Corps guidance for certification of existing and proposed levees or floodwalls, a Flood Damage Reduction Analysis computer program (HEC-FDA), a risk-based analysis, was used to determine recommended heights for the flood protection features. The selected flood level of protection corresponds to a 95 percent conditional non-exceedance level.

For this level of analysis, only one average height was established for each levee/floodwall location. During the next phase of study (Preconstruction, Engineering and Design) further analysis will be performed to establish levee/floodwall profiles.

The risk analysis considered: 1) maintaining existing levels of flood protection, and 2) increasing existing levels of protection to FEMA 100-year levels. The results are presented in Table 4-2.

Table 4- 2: Summary of Risk and Uncertainty for Recommended Plan Levees

Feature	Current Level of Flood Protection	Index Station (River Mile)	Improvement	Mitigation to Current Level of Protection (Ft)	100-yr FEMA Level (Ft)
Meiners Oaks	100-yr	13.7	New (East) Levee/Floodwall	5	5
Live Oak	100+ yr	9.6	Raise Existing (West) levee	6	4
Casitas Springs	50-yr	7.4	Raise Existing (East) Levee	3	5

<u>Level of Protection for Flood Mitigation</u> The Sponsor has expressed interest in raising the current level of flood protection to the 100-year level for flood control structures requiring modification and that are currently less than the 100-year level of protection. Casitas Springs levee would be the only structure to consider. Only one levee, Live Oak, offers greater than 100-year protection. For the Live Oak levee the mitigation would require the structure to be raised beyond the 100–year levee height to maintain the existing level of protection (100-year plus). For existing conditions, a flood damage analysis (structure/ content and agricultural crops) concluded that a separable element under NED for flood control was not justified. Therefore, under with-project flood mitigation, any improvement beyond maintaining the existing level of protection would be considered a betterment.

Investigations have been conducted to address the justification of the levees and floodwalls, and the acquisition of properties presented in Table 4-1. A cost effectiveness/incremental cost analysis (CE/ICA) has been prepared in the Economic Appendix and includes evaluation of the Meiners Oak, Live Oak, and Casitas Springs levees/floodwalls and Santa Ana and Camino Cielo Bridge modifications.

The cost estimates for the levees have been revised based on further review of the necessary fill quantities for the levees. Costs range from $413,000 to $1.3 million, depending on the location of the levee/floodwall.

Based on potential induced damages prevented in each area, the Casitas Springs levee is the only economically justified measure at this time. On the whole, the damages prevented by the levees/floodwalls and bridge modifications amount to $8.7 million, and the total costs for these features (including real estate interests) are $11.1 million.

A takings analysis has not been prepared to date. But judging from the current level of property costs and real estate values, the building of levees and the bridge modifications are the most likely least cost option.

Purchase of the properties in the Camino Cielo area and the Matilija Hot Springs are necessary at this time due to the close proximity to the dam site and the risk and uncertainties associated with sediment deposition in the area. Currently, water surface elevations of model runs related to the Recommended Plan show inundation at or near some of the structures that have been identified for acquisition.

Further refinement of the modeling during the detailed design phase will allow for more runs to be conducted in verification of properties, or portions of properties, needed to be acquired. At that time, justification for federal interest for levee and bridge modifications will be also be re-assessed. In addition, temporary flood impacts to croplands in reaches 2, 4, and 6 will be addressed. Currently some parcels are subjected to without-project flooding, and will be more at risk under future without-project conditions. Flowage easements may be necessary and/or compensation for crop damage under with-project conditions.

At present, flood mitigation will be to maintain the current level of protection. Until further evaluation is possible, at this time it is assumed that federal interest in cost-sharing the flood mitigation described is warranted.

An Item of local cooperation has been added to capture the non-Federal requirement to maintain their channel cleanout activities upstream of the Santa Ana Bridge**.**

Additional Flooding Impacts and Mitigation The hydraulic and sediment transport analysis has indicated that the Ojai Valley Sanitary District Wastewater Treatment Plant, located at RM 5.0, will be placed in 500-year floodplain under with-project conditions. Though the facility is not currently in the 500-year floodplain for existing conditions, it will be under the future without-project condition. The facility includes the treatment plant structure and a sludge pond. Additional risk and uncertainty analysis will be performed in the detailed design phase to recommend flood protection measures. Due to limited space, it would be likely a floodwall would be required at that location. Currently the Canada Larga levee protects this reach of the river.

Summary of Mitigation Features

Table 4-3 presents a summary of the features included in the Recommended Plan to mitigate the induced flooding impacts of removing Matilija Dam.

Table 4-3: Summary of Measures Included to Mitigate Induced Flooding

				Levee/Floodwall (LV/FW)	
Feature	Reach	River Mile	Action	Heights (ft)	River Mile
Matilija Hot Springs	6	16.4	Purchase and vacate structures at complex		
Camino Cielo Bridge	6	15.5	Purchase and remove/restore original channel width. Construct bridge at new location.		
Camino Cielo Structures	6	15.6 to 14.2	Purchase and remove 2 houses and 9 cabins		
Meiners Oaks Area	6/5	14.3 to 13.4	Add levee along east bank	LV: 5 (avg) FW: 5 (avg) LV: 5 (avg)	14.3 to 14.1 14.1 to 13.6 13.6 to 13.4
Live Oak Levee	4	10.6 to 9.4	Add levee/floodwall to existing (west) levee	LV: 6 (avg) FW: 6 (avg)	10.6 to 9.9 9.9 to 9.4
Santa Ana Bridge	4	9.4	Extend bridge and widen channel.		
Casitas Springs Levee	3	7.8 to 6.8	Increase existing (east) levee ht. with levee/floodwall	LV: 3 (avg) FW: 3 (avg) LV: 3 (avg)	7.8 to 7.5 7.5 to 7.4 7.4 to 6.8
Croplands	2,4 and 6		Compensation		

Water Supply Impacts

The Recommended Plan will accelerate the restoration of natural sediment supply to the Ventura River from the Matilija Creek subwatershed when compared to the baseline conditions. In addition, the approximately 4 million cubic yards of trapped sediment remaining in the reservoir basin following slurry operations will also contribute to downstream replenishment. The volume of sediments eroded from the reservoir basin following dam removal will depend on the magnitude of a specific storm event and access of flows to specific areas of the reservoir basin. Portions of the channel with soil cement revetment will provide a 10-year recurrence level of protection. The flows from storm events less than the 10-year recurrence level will cause erosion of the coarser grained sediment not protected by soil cement revetment in the upper half of the reservoir basin (i.e. the ‘Upstream Channel Area’). The flows from storm events exceeding the 10-

yr return period would, in addition to the above, have access to materials protected by soil cement in the lower half of the reservoir basin since overtopping of the structure would occur, allowing erosion of mostly medium-grain sediment with fines, largely in the middle portion of the reservoir basin (i.e. the 'Delta Area') as well as the lowermost portion of the basin where 'Delta Area' materials have been placed following channel excavation operations. With time, as the soil cement revetment is removed in stages, sediment in areas of the reservoir basin previously stabilized would be subject to variable levels of erosion, depending on the magnitude of the storm flow event, and subsequent transport downstream.

The outcome of removing Matilija Dam is expected to have little effect on local landowner water extraction operations. There are some short-term impacts to two large-scale public water supply diversion operations: at the Robles Diversion Dam and at Foster Park. Adverse impacts are related to both coarse-grained and fine-grained sediment delivery and deposition. The following summarizes the impacts and concerns related to both water supply and water quality.

Robles Diversion Dam

Loss of Diversion Operations: In the event that sediment deposition levels at the facility exceed 40,000 cubic yards, diversion operations to Lake Casitas will be interrupted until the sediment basin is cleared out. Should this occur at the beginning or middle of the diversion season, the facility will miss diversion opportunities for the remaining portion of the season. Environmental regulations do not allow for maintenance during the wet season. Repeated missed diversion opportunities could adversely affect the safe annual yield for Lake Casitas. The safe annual yield is defined as the amount of water that the reservoir can yield for consumption without producing unacceptable negative impacts on the long-term water supply within the jurisdictional boundaries of Casitas Municipal Water District (CMWD). Based on the sediment transport modeling studies for the Recommended Plan, without including any mitigation measures, in the first few years of storm events potential deposition in the Robles sediment basin could be large enough to effectively shut down diversion operations for the respective diversion season.

Turbidity: Turbidity from fine sediment (silts and clays) in Ventura River flows diverted to the Robles-Casitas Canal can contribute to water quality problems at Lake Casitas. Fine sediments, especially clays, do not easily come out of suspension. Fine sediments contain absorbed nutrients that tend to promote algal production, currently a problem at the reservoir. Water treatment efforts also need to be increased should large amounts of fine sediment be present in the reservoir and remain in suspension. Fine sediment can also contribute to storage loss and can also adversely affect recreational activities (i.e. fishing, boating).

The modeling studies for the Recommended Plan show that prior to the staged removal of soil cement, flows below a 10-year storm event would exhibit turbidity levels similar to baseline conditions. For flows above a 10-year storm event, turbidity levels would be on the order of 2 to 4 times greater than baseline conditions. During these high-flow events, the fine sediment concentrations are already high, and therefore the increase in turbidity would be expected to be within the natural variability.

During the staged removal phase of the soil cement revetment (removal phase sequence would be downstream to upstream), due to the likely temporary increases in turbidity levels, from 2 to 10 times greater than baseline conditions, it would be prudent to coincide removals in periods when reservoir levels at Lake Casitas are at or above average. Removal phases would be coordinated utilizing a monitoring/adaptive management plan. Turbidity levels would be expected to stabilize to levels similar to the No Action Alternative after one or two storm events of average magnitude pass through the reservoir basin.

Turbidity impacts to Lake Casitas resulting from the removal of Matilija Dam are not expected to be significant.

Lost Storage: CMWD has a lease with the Ventura County Watershed Protection District to use stored water at Matilija Dam until 2009. Matilija Dam provides an average of 590 ac-ft/yr of water for Robles diversions under current operating criteria. The construction timeframe for the project is not anticipated to begin until 2008 at the earliest. The first year of construction will include downstream features such as bridge modifications, levee construction and slurry pipeline and disposal site construction. The slurry of fines and dam deconstruction will not begin until the second year of construction, in 2009. Therefore, the CMWD lease with the VCWPD will expire prior to any construction activities that may impact the Matilija Dam water supply.

Deposition in Robles-Casitas Canal and Fish Screen: When sediment loads are high, sands carried in suspension may deposit either in the canal due to the gentle gradient of the structure or at the fish screen due to reduced velocities. The fish screen is a component of the fish passage facility (Fishway) currently under construction at the Robles diversion facility. The screen will function to keep downstream migrating steelhead from being entrained into the canal and transported to Lake Casitas. The sedimentation in the fish screen or canal could increase maintenance requirements and even cause interruptions (short-term) to diversion operations.

Other Water Quality Concerns: Concerns expressed by CMWD regarding the detection of arsenic and DDT in discrete samples of the trapped sediment obtained from field investigations conducted in July through September 2001 in the Matilija reservoir basin, and the potential threat to Lake Casitas and Mira Monte well were assessed by the Corps and the VCWPD. Consultation with another water agency indicated that the concentration levels detected were considered within normal background levels and would not usually be associated with adversely impacting water quality. Initial consultation by the Corps has occurred with the Environmental Protection Agency and the California Department of Health Services. Additional efforts to evaluate arsenic, DDT, and other regulated substances will not be pursued at this time. Future consultation with the California Department of Health Services and the California Regional Water Quality Control Board will be pursued during the Preconstruction, Engineering and

Design (PED) phase. As an outcome of consultation with these regulatory agencies, appropriate action as needed, including monitoring and/or mitigation measures would be implemented by the Corps and VCWPD during the pre-construction, construction and subsequent post-construction adaptive management period.

Foster Park Water Supply Facilities

The increase in sediment deposition resulting from the Recommended Plan will also cause impacts to water supply facilities located at Foster Park. These facilities include both groundwater and surface water diversions, and are owned and operated by the City of Ventura. The surface diversion is actually a combination of an aboveground surface diversion and an intake that is approximately 4 feet below the riverbed. The subsurface wells are approximately 50 feet deep. Groundwater pumping operations of up to 6,000 acre-feet annually will not be affected by the implementation of the Recommended Plan. Surface water diversions averaging 7 ft^3/sec, with a maximum of 24 ft^3/sec, will be adversely impacted by implementation of the Recommended Plan.

Water Supply Mitigation Measures

The following mitigation measures are included in the Recommended Plan to reduce impacts specifically associated with water supply and water quality at the CMWD and City of Ventura facilities**.** Project associated features , included in the plan by the Sponsor are described in the section "*Local Associated features*" in this chapter.

Sediment Bypass: A sediment bypass structure is included in the Recommended Plan to limit the amount of additional coarse sediment deposition, associated with the removal of Matilija Dam, in the sediment basin at the Robles Diversion Dam. Sediment transport modeling performed to date indicates that though deposition levels following removal of Matilija Dam may be greater for a given storm event compared to current levels, the sediment bypass will significantly reduce the amount of additional deposition. In addition, for larger flow events that may cause interruptions to diversion operations under current conditions, the bypass structure will effectively prolong the time to which diversion operations would be impacted by allowing deposition to occur more gradually. Emergency intervention time would thereby be made possible. Modeling indicates that after flows from several storm events have passed through the Matilija reservoir basin, the deposition at the Robles facility will approach equilibrium conditions (i.e. influence from Matilija Creek only and no effects from Matilija Dam or trapped reservoir basin sediments).

The bypass includes four radial gates that, when combined with the existing sluice gate structure, allow for passage of sediments and flows up to 17,000 ft^3/sec. Initial modeling shows that a sediment bypass structure placed at the sediment basin would limit the amount of deposition to approximately No Action levels after only a few storm flow events have passed through the reservoir basin. This bypass feature would significantly reduce any potential impacts related to water diversions at the Robles facility. Impacts to the facility and to Lake Casitas due to increased turbidity levels are conservatively assumed to remain unaffected by the bypass structure since fines will remain suspended in the water that is being held at a constant level in the forebay during diversion operations. Adverse downstream impacts are not anticipated with this bypass feature in place.

A new concrete overflow weir will replace the existing timber crib weir structure to insure the adjacent sediment bypass structure is not undermined during very large flow events. Selective operations of the bypass sluice gates in conjunction with the existing sluice gates could allow the diversion at Robles to remain in operation in larger flood events than previously possible. In addition, there may be the possibility of improvement of fish passage opportunities at higher flows. More detailed study will be conducted on the operation of the bypass structure during the Pre-construction, Engineering and Design phase. The conceptual plan is shown in Figure 4-10.

FIGURE 4-10 ROBLES SEDIMENT BYPASS STRUCTURE

Foster Park Facility Losses: The Recommended Plan includes the construction of two groundwater wells at Foster Park to mitigate impacts to the water supply facilities in this area. Well depths are estimated to be about the same as the existing 50-foot well depths. The operation of the two wells by the City of Ventura must insure that the increased water extraction capability provided by the two wells will not produce any net loss to the quantity of surface flows otherwise extracted by the surface diversion operation.

Other Environmental Features

A giant reed (*Arundo donax)* management/removal plan has been developed for this study, particularly for the downstream reaches of the Recommended Plan, including the Ventura River mainstem. Current estimates of the extent of giant reed infestation in reaches 1-9 (mouth of Ventura River to upstream of the original reservoir basin of Matilija Dam) are about 250 acres, with the highest concentration in Reach 7 behind Matilija Dam (118 acres). The current cost estimate for the removal of the giant reed, monitoring and maintenance is about $10.0 million.

Densities of giant reed cover vary between 3 and 95 percent cover. Upstream of the dam, there is 118 giant reed acres in reach 7 (reservoir) that will be removed with large equipment during clearing and grubbing; 0.4 giant reed acres in reaches 8 and 9 will be removed by hand. Downstream of the dam, there is 123 giant reed acres in reaches 1-6; the balance of giant reed cover is low density (3% cover) spread over 1059 acres.

Other Environmental Mitigation Measures

A number of environmental mitigation measures have been identified in the U.S. Fish and Wildlife Service draft Coordination Act Report (CAR). In addition to a giant reed management plan, the Recommended Plan includes other CAR recommendations such as a management program for bullfrogs, crayfish and green sunfish around the reservoir before dam removal to preclude downstream relocation, a relocation plan for the California red-legged frog, southwestern pond turtle, coastal whiptail, two-striped garter snakes, and other special status and native species. Revegetation and stream restoration programs are also recommended, as are survey programs for the endangered least Bell's vireo and the southwestern willow flycatcher. Details are provided in the draft EIS/R document.

An initial 106 compliance letter (National Historic Preservation Act) has been prepared to the California State Historic Preservation Office (SHPO) to address cultural resources. Two historic/prehistoric sites located in the vicinity of the reservoir basin will need to be evaluated for NRHP eligibility. Other project features that make up the Recommended Plan include the slurry disposal site, the slurry line alignment, the bridge locations where modifications will take place, and the desilting basin.

Design and Construction Considerations

The features included in the Recommended Plan are currently designed to develop reasonable cost estimates to assess the cost of alternatives and the Recommended Plan as well as environmental impacts. In some cases such as the design of mitigation measures, the design and construction requirements are somewhat conservative to assure impacts would be fully mitigated. During the Preconstruction Engineering and Design phase, further studies will be made to refine information on the magnitude of impacts and mitigation requirements. This will include consideration of possible other less costly and more environmentally acceptable measures.

Real Estate Requirements

The Real Estate Plan (Appendix G) presents information on the lands, easements, rights-of-way, utility relocations, and disposal area requirements (LERRDs) associated with the Recommended Plan. The Plan also discusses the ownership of project properties, requirements for acquisition, and costs based on information provided by the Ventura County Watershed Protection District. A gross appraisal study has been completed to better define the requirements and costs.

Dam and Sediment Removal

For the dam and mechanical sediment removal of sediment, real estate requirements include the acquisition in fee of the118-acre slurry disposal site, and temporary easements for the 30-foot wide, 3-mile long right-of-way strip of properties for the slurry pipeline. Lands will also be required for several staging areas in the dam and reservoir area, and disposal site. The fresh water pipeline from Lake Casitas to the disposal area would be placed along the existing maintenance road along the CMWD canal from the lake to Robles Diversion Dam. Special considerations would be required at several crossings. Upstream of the disposal area, the fresh water pipe would utilize the same right of way as that required for the slurry pipe. It is expected that the slurry pipeline rights of way will also be used for developing trails as part of the Recreation Plan for the project. If so, these lands will need to be acquired in fee. The reservoir is Sponsor-owned land and will be included under LERRDs.

Mitigation for induced Flooding

The LERRDs requirement for implementing the mitigation measures for induced flooding include the acquisition of Matilija Hot Springs and 11 other structures in the flood plain. These properties would include purchase in fee, relocation of occupants, and removal of structures. Additional right of way would be required for the new/raised levees and flood walls. A summary of the LERRD requirements for flood mitigation is as follows.

- Matilija Hot Spring property acquisitions.

- Camino Cielo: There are 11 cabin structures and a bridge that will be acquired in fee and removed. The Camino Cielo bridge relocation/construction site is included in land to be acquired in fee.
- Meiners Oaks/Robles Area. The mitigation measure includes constructing a 4,400 foot-long floodwall/levee. Floodwall requires 20 ft. by 2,500 ft., or 1.2 acres of right-of-way; levee requires 80’ by 2,000’, or 3.7 acres. VCWPD currently has no right-of-way at this location.
- Live Oak area. Mitigation includes 6,300’ long levee. VCWPD currently maintains existing Live Oak Levee and has right of way in this location. Additional rights-of-way to acquire is estimated to require a strip of land 30 feet by 3,050 or 2.1 acres.
- Modification of Santa Ana Bridge. The channel width will be widened at the bridge, and the existing structure will be extended with a new span that allows greater flows to pass under the bridge. Vehicular traffic cannot be completely cut off at this location. A temporary low-flow crossing will be needed during construction. Land rights for temporary traffic realignment are included in the acquisitions needed for the improvements. Some utilities will also be affected, including a water and gas line.
- Casitas Springs. Ventura County Watershed Protection District currently maintains the existing Casitas Springs levee and has the ROW of a 200’ wide strip along the levee. A 20’ wide and about 5,000-foot long ROW is needed for the levee extension.
- Construction and maintenance requirements. Information to define staging and other construction land requirements for the flood mitigation measures has been preliminarily identified.

Mitigation for Water Supply Impacts

The LERRDs required for implementing the features required for mitigating the impacts to water supply are as follows:

- Sediment Bypass: Robles Diversion Dam is owned by the Bureau of Reclamation and leased to Casitas Municipal Water District. No real estate requirements are included at this time for this mitigation feature.
- Foster Park Wells: Right- of- entry (temporary work) permits will be acquired from the City Of Ventura to install two groundwater wells.
- Slurry Disposal site (near Highway 150 Bridge): Acquisition from private ownerships located within the river bottom comprises 97 acres. LERRDs includes containment dikes and associated features.
- Desilting Basin (associated feature): The proposed site is on Bureau of Reclamation property, adjacent to the Robles-Casitas canal. The site includes five acres for the desilting basin, and 11.9 acres for the sludge disposal. Access rights would be required. An easement would be required for sediment deposition and maintenance activities.

Giant Reed Removal/Control

Downstream of the dam, permanent access easement will be required to enter impacted properties for initial removal and continued maintenance. Upstream of the dam, no real estate interest is needed in the reservoir basin as it is owned by the Local Sponsor.

Local Associated Features

Measures for mitigating induced flooding damage and water supply impacts may result in benefits as compared to the without-project condition. There are a number of areas where there is flood damage potential under the without-project condition. This without-project damage potential will be reduced by the with-project mitigation. There is some potential that the final design of the flood control mitigation measures could be increased to assure a minimum of 100-year protection in some areas. The review of the impacts and mitigation requirements will be conducted during final design to ascertain whether the benefits are incidental to the project or whether portions of the mitigation should be considered a separable feature (eligible for Federal flood control participation) or a local associated feature.

A desilting basin is included as a local associated feature for the Recommended Plan. This feature is being considered an associated feature with respect to improving diversion operations at Robles Diversion as compared to the baseline conditions. The desilting basin, an off-line structure to the Robles-Casitas canal, functions by allowing diverted flows from the Ventura River to settle out fine sediment (silts, clays) prior to conveyance of the flows via the canal to Lake Casitas. Canal waters would be diverted through the desilting basin, reducing the velocity of the flows and allowing the fines to settle in the basin. Conceptual plans are shown in Figure 4-11.

The size of the basin is based on the required storage capacity to settle fines for a 1991 storm event. USBR model simulations estimated that the storage capacity would need to be 61 acre-feet to settle about 46 acre-feet of fine sediments, providing extra volume to limit the maximum velocity of the diverted flows. The proposed basin would require excavation and levee construction to contain the diverted flows. Fine sediment would be settled out by the addition of a flocculating polymer. The resulting sludge would require periodic removal and disposal to a nearby storage site. To prevent infiltration losses, a geofabric liner would be installed. The intake structure to the canal will require modification. The Sponsor has identified two potential locations for this basin. Costs could be lower should federal land (USBR) near Lake Casitas become available. The estimated cost of the basin is $5.7 million and is based on the need to acquire up to 13.2 acres of (non-Federal) land. The Sponsor would initially operate this facility for the Casitas Municipal Water District.

Two potential locations for the basin are presented in Figure 4-12. The primary site at this time being considered is on Federal land.

FIGURE 4-11

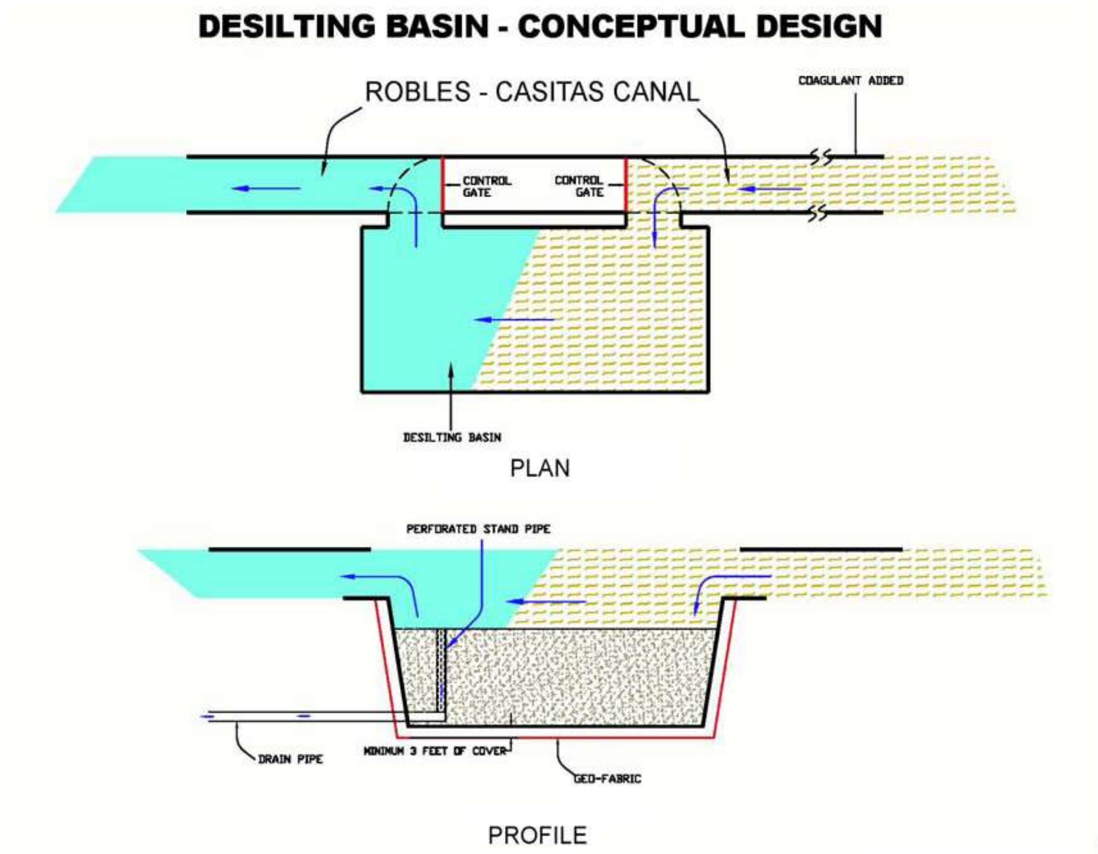
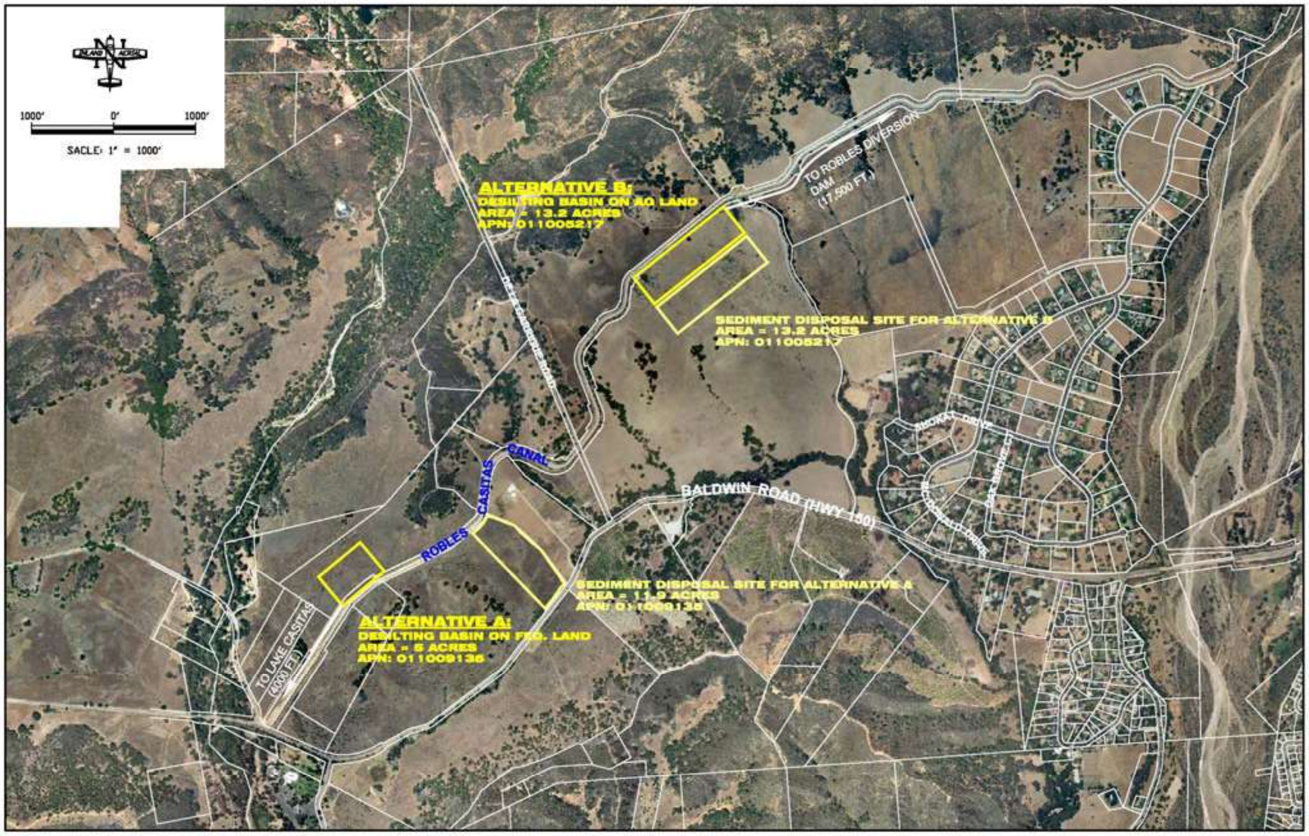

DESILTING BASIN - CONCEPTUAL DESIGN
ROBLES - CASITAS CANAL
COAGULANT ADDED
CONTROL GATE
CONTROL GATE
DESILTING BASIN
PLAN
PERFORATED STAND PIPE
DRAIN PIPE
MINIMUM 3 FEET OF COVER
GEO-FABRIC
PROFILE

FIGURE 4-12: POTENTIAL DESILTING BASIN SITES



Monitoring and Adaptive Management

For complex specifically authorized projects that have higher levels of risk and uncertainty of obtaining the proposed outputs, monitoring and adaptive management measures may be recommended. For this project, a Monitoring and Adaptive Management Plan will be established to evaluate the effectiveness of the implemented restoration measures and to make adaptive changes, if required, to obtain project objectives. Initial monitoring and adaptive management measures for the project have been developed. Details are presented in Appendix K of the EIS/R. Additional refinement is necessary and will be based on more detailed work to be performed during the Pre-construction, Engineering and Design (PED) phase.

In general, the monitoring of project performance and outputs is considered necessary to provide feedback for future projects and to assure the project is functioning in accordance with its objective. Adaptive management measures may be taken to address project performance problems such as trapped sediment evacuation and unforeseen circumstances such as additional removal of exotic species and revegetation. In general, the period for monitoring and adaptive management is limited to no more than five years following completion of construction unless there is justification to extend this period. The cost of monitoring project performance and outputs is generally limited to 2 percent of total project costs; adaptive management actions, if needed, is limited to 3 percent of the project cost. Extension of the monitoring and adaptive management period to 10 years is justified and has been approved based on the higher levels of risk and uncertainty associated with this proposed project. Monitoring and adaptive management percent allocations however will remain at 2 and 3 percent, respectively, of total project costs.

Considerable uncertainty exists regarding removal of dams and sediment impacts as related to achieving restoration objectives and minimizing adverse impacts. This is because limited projects involving dam removal, especially large projects of the magnitude of Matilija Dam removal, have been completed to date. Given the lack of precedent and scarcity of empirical data, there is uncertainty regarding a number of aspects of the design, construction and operation of the recommended alternative.

For the Recommended Plan there is uncertainty regarding the volumes and frequency of sediment transport from flow events and resulting impacts on ecosystem, flooding, water quality, and water supply. Monitoring with respect to project performance and achieving output objective will be required. The effectiveness of revegetation efforts and eradication of exotic species are also uncertainties that need to be monitored. The monitoring of sediment transport and revegetation and exotic species eradication shall be accomplished through periodic surveys of sediment deposits and quantities to assure unforeseen performance results do not degrade the restored ecosystem or increase flooding or water supply impacts. Adaptive management measures to address unforeseen sediment transport impacts include partial or complete removal of deposits as well as further stabilizing sediment sources in the reservoir areas. Additional eradication of exotics and revegetation efforts may also be necessary to achieve project performance objectives.

Though the level of uncertainty remains appreciable, proposed features of the Recommended Plan will be in place to reduce levels of risk and uncertainty. Features to reduce turbidity impacts include the slurrying of the majority of the trapped fine sediment downstream; allowing a degree of control with respect to the release of the remaining trapped finer sediments from the Matilija reservoir basin by use of soil cement revetment; the addition of a desilting basin (Local Sponsor preferred feature) to serve to completely remove any (infrequent) remnant levels of increased turbidity from reaching Lake Casitas; and the installation of two groundwater wells at Foster Park. Levees and bridge modifications will reduce flooding risks.

The Monitoring and Adaptive Management Plan for the Recommended Plan has been developed by the Environmental Working Group, with input from the Technical Studies Working Group. The goal of this effort is to restore the pre-dam natural ecology of Matilija Creek and allow species to have unobstructed access to and from the upper watershed habitat and achieve other natural habitat and ecosystem improvements. It is expected that the habitat value of the restored natural river regime will have good to above average quality. It is also expected that the restored habitat will be suitable for native wildlife. The quality of the habitats (i.e., average or high) is expected to dictate the abundance or density of wildlife. Additional goals of the Monitoring and Adaptive Management Plan include, but are not limited to, the following actions: 1) monitor deposition and erosion in the riverine system and at the estuary and to take necessary actions to reduce any adverse impacts including blockage to fish passage and increase to flooding risks; 2) monitor erosion of trapped sediment from the reservoir basin, performance of the soil cement protection, and plan and execute staged removal of soil cement; 3) monitor turbidity levels and suspended sediment concentrations with the intent to minimize impacts to water supply; 4) monitor water quality for regulated substances potentially transferred to the water by trapped sediments associated with Matilija Dam, and negotiate any necessary mitigation measures in accordance with consultations with the Regional Water Quality Control Board; and 5) monitoring effects of sediment bypass to sediment deposition and diversion operations at the Robles Facility, and also effects to the fish passage facility function and operation , with the intent to minimize any impacts to current operating criteria of the diversion facility. Further refinement and/or additional goals will be established during the PED phase.

The Monitoring and Adaptive Management Plan will provide a description of: the habitats to be restored, the density and composition of the plantings to restore habitat, surveys to monitor the expected, natural re-introduction of native wildlife into the restored habitats, the monitoring protocols, and the performance or criteria and monitoring protocol to evaluate success of the restoration effort. The plan will also present adaptive management actions (or maintenance activities) that may be performed to ensure a successful restoration effort and reporting requirements.

The Monitoring and Adaptive Management Plan covers monitoring and adaptive management actions during the first 10 years after initial construction. After the first 10 years, monitoring and/or adaptive management becomes the responsibility of the Local Sponsor. During the PED phase, more specific monitoring details (e.g., exact monitoring transect locations, reference site locations, more specific performance/success criteria, more specific monitoring protocols, etc.) will be added to the Monitoring and Adaptive Management Plan.

The Corps and/or the non-Federal Sponsor will be responsible for collecting monitoring data and preparing annual Monitoring Reports. A Technical Committee consisting of, at least, U.S. Fish and Wildlife Service, National Marine Fisheries, California State Fish and Game, and possibly other agencies or organizations, will assist in collection of monitoring data, review monitoring data results, and provide recommendations of possible adaptive management measures. The Technical Committee will recommend adaptive management measures to the existing project's design should habitat not achieve the identified goal and objectives. If designed vegetation species composition are not achieved: replanting, additional irrigation, and/or removal of vegetation (especially exotics) may be necessary. Annual Monitoring Reports and any adaptive management measures recommended by the Technical Committee will be forwarded to an Executive Committee that will consist of, at least, a representative of the non-Federal Sponsor and the U.S. Army Corps of Engineers. The Executive Committee will decide whether to adopt adaptive management measures recommended by the Technical Committee.

Recreation Plan

The U.S. Army Corps of Engineers policy for ecosystem projects recognizes that at many ecosystem restoration projects, the lands used for project construction also provide a low-cost opportunity to provide recreation facilities. Recreation at ecosystem restoration projects should not only be compatible but also enhance the visitation experience by taking advantage of the natural values. The recreational experience should build upon the ecosystem restoration objective and take advantage of the restored resources rather than distract from them. Recreation development at an ecosystem project should be totally ancillary. The facilities may be added to take advantage of the education and recreation potential of the ecosystem project, but cannot be specifically formulated for a recreation purpose. Planning of recreation facilities to be cost-shared must comply with three major criteria (a) the philosophy noted above and limited to certain facilities included in a Corps of Engineers checklist, (b) economic justification where the combined monetary and non-monetary benefits exceed the monetary and non-monetary costs, and (c) the level of Federal participation cannot increase the Federal cost of the ecosystem restoration project by more than ten percent unless otherwise approved by the Assistant Secretary of the Army.

The entire Matilija Canyon lies within the Los Padres National Forest, although there are extensive non-Federal in-holdings as well, totaling over 2,245 acres, including the 442-acre Ventura County Watershed Protection District Matilija Reservoir site. Additionally, Matilija Canyon habitats support a number of federally listed species of animals that are sensitive to human activities, including recreational activities. Therefore, private interests and environmental resources have been important considerations in developing a recreation plan in conjunction with the Recommended Plan.

Matilija Canyon has been a favorite destination for outdoor enthusiasts since 1865, and a favorite haunt of trout fishers since the establishment of a private resort near the mouth of Matilija Canyon in 1872. The construction of Matilija Dam, and the VCWPD operation of the once-private Matilija Hot Springs, altered the nature and intensity of recreational use of this popular canyon within the Los Padres National Forest. Removing Matilija Dam and restoring the reservoir site and downstream reaches of Matilija Creek and the Ventura River has the potential to provide opportunities for regional open space/recreation network connectivity. There are many opportunities to integrate the project site into a broader, regional network of open space, recreational and educational amenities, providing links between existing trail systems from the Los Padres National Forest to trails near the Ventura River.

The Recreation Planning Committee established the overall concept of the recreation plan including the location of trails, rest areas, educational kiosks, parking and facilities. A recreation benefit analysis was prepared by the Corps of Engineers to examine the expected visitation and to evaluate the economic value of the proposed recreation opportunities. This economic (unit-day) analysis included ranking of certain evaluation criteria including added recreational opportunities, the availability of similar nearby recreation opportunities, the adequacy of proposed facilities for activities, accessibility and the environmental aesthetic qualities of the site. Details of the economic analysis are presented in the Economics Appendix.

Recreation Trails and Associated Features

The U.S. Forest Service (USFS) manages the Los Padres National Forest in the upper portion of the Matilija Creek watershed. A trailhead provides access to the wilderness area upstream of the dam site beyond the cluster of private residential holdings that line the middle reach of Matilija Creek. This trailhead also functions as a conduit for reaching three trails maintained by the USFS including the trail that traverses the Upper North Fork of Matilija Creek, the Bald Hills Trail, and a trail that coincides with an unimproved road up Matilija Canyon. These three trails also provide access to four campgrounds in the Matilija Creek watershed, including the Maple, Middle Matilija, Matilija, and Murietta campgrounds, as well as access to other trails that continue to other areas of the Forest.

The new trail includes a hiking trail linking the existing Los Padres National Forest Matilija Wilderness Area trails to the Matilija Reservoir Area (See Figure 4-13). The dirt trail would then be designed for multiple uses (hiking, equestrian and mountain biking) from Rest Area C (Figure 4-13) along the existing unimproved access road that parallels the eastern edge of the Matilija Reservoir Area to the road entrance below the dam site. The upper portion of the trail lies within the footprint of the sediment deposition behind Matilija Dam on lands already owned by the Sponsor.

A future parallel trail could be cut down slope from the multi-use trail in the vicinity of the dam site. This trail would facilitate better access to the project site while providing opportunities for low-impact wildlife observation near the riparian areas of the creek. Because the lower trail would be located in an area currently inundated with sediment, precise delineation of the lower trail would be subject to coordination with the specifications associated with the project and may require evacuation of sediment from the storage sites prior to construction.

The multi-use trail would continue downstream along the Ventura River using the slurry pipeline and service road alignment after completion of that phase of the project. The trail would extend from Matilija Road to the Highway 150 Bridge (Baldwin Road) crossing (see Figure 4-14). An opportunity is available to link the new trail to the network of other trails located in the adjacent Ventura River-Rancho El Nido Preserve managed by the Ojai Valley Land Conservancy. The Sponsor would pursue a link between the lower end of this proposed trail at Highway 150 Bridge crossing to the County of Ventura Ojai Valley Trail located along Highway 33, about a ¼ mile away.

An optional link to provide a paved biking path may be pursued for the project, where the existing Ojai Valley Trail bikeway is extended from the Highway 150/ Highway 33 junctions to the dam site. This optional link would be a shorter distance, but would require more coordination.

Vegetative barriers, such as chaparral, would be used along portions of the trail to protect adjacent private properties and environmentally sensitive habitat areas from unwanted access by trail users. Fencing would be installed where vegetative barriers could not be used.

Two trailheads would be constructed for the multi-use recreation trail. The lower site would be located at the Highway 150 Bridge as part of the restoration plan for the disposal site, and the upper site would be at Rest Area A at the current location of Matilija Dam. Consideration would be given to including turnarounds, parking, footbridges and other measures for access and circulation as well as safety measures along the trails.

Three rest areas are proposed for the project area based on existing facilities and landscape features. Specific facilities at these areas could include comfort stations, shelters, picnic areas, drinking fountains and faucets, interpretive signs and markers, and similar features consistent with Corps of Engineers guidance.

Rest Area A, located at the dam site, has the greatest opportunity for interpretation, as well as ancillary facilities such as restrooms and water. At a minimum, this 9-acre area could function as a gateway and staging area to the project area as well as Matilija Canyon as a whole. The Matilija Hot Springs complex could also potentially be used as this staging area. Rest Area A could include an informational kiosk and educational materials or potentially a small interpretive center. The rest area would also include plans for vehicular parking for approximately 20 vehicles. This location is also strategic for the local community in that it would alleviate the adverse effects of recreational staging in the residential area further up Matilija Canyon.

Rest Area B would be located at Hanging Rock, a historically significant geologic landmark that has been buried due to sedimentation associated with operation of the dam. The Hanging Rock is a landmark that has been the subject of many historic postcards and images of Matilija Creek to the point of being an icon of the area. Should the opportunity arise as a result of the project to restore this landscape feature, the Hanging Rock would be a likely location where users would stop along the trail. As such, this would be a strategic location to provide interpretive amenities and/or a rest area. The historic significance of this site as a natural landscape feature would provide numerous interpretive opportunities.

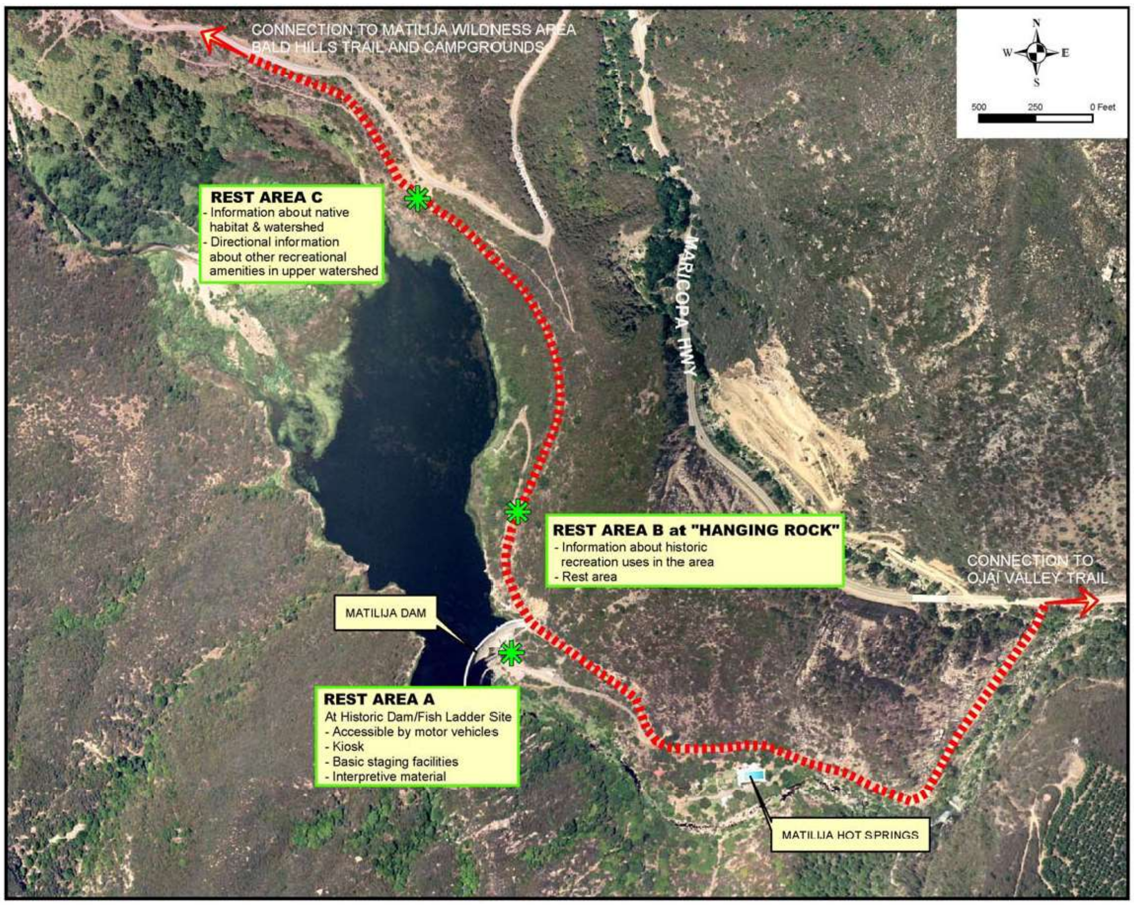
Rest Area C would be located at the northern end of the immediate project area where the proposed multi-use and hiking trails converge. This site could be designed to encourage casual trail users to turn around to minimize impacts to residences further up the canyon. An alternative route would be safer for both trail users and motor vehicle drivers while providing a more wilderness/rural experience for the trail user and minimizing potential conflicts between recreation and canyon residents.

Secondary interests for the management of the recreation trails are being pursued because the Sponsor cannot assume long-term responsibility for OMRR&R of the proposed recreational facilities based on the constraints of our mission statement. Provisions are made for recreational uses of VCWPD facilities only where it does not interfere and is not inconsistent with the broader public safety purpose, as is the case for the proposed recreation trails for the Matilija Dam Recommended Plan. Therefore, VCWPD can participate in the costs associated with the acquisition, construction or installation of the recreational trail and other features, but not the OMRR&R of the trail.

The Sponsor has initiated discussions with the U.S. Forest Service and the Ojai Valley Land Conservancy. Both entities have indicated interest in extending their OMRR&R responsibilities to include new trails that would connect to existing trails they currently maintain. The U.S. Forest Service would only be interested in extending their OMRR&R responsibilities of trail maintenance through Matilija Canyon, upstream of Matilija Dam. Other entities, including the County of Ventura Parks Department and the Trust for Public Lands have also been identified as potential sponsors. However, no formal agreements have been reached.

The VCWPD will assume responsibility for the OMRR&R at this time, and will take the lead in securing a long-term sponsor for the recreational trails until such time that VCWPD secures a second party OMRR&R agreement. The issue of OMRR&R will be further addressed during the detailed Planning, Engineering and Design (PED) phase of the project. The trail above Matilija Dam will be excluded from the final plan prior to execution of a Project Cooperation Agreement (PCA) if the U.S. Forest Service agrees to operate and maintain that portion of the trail.

The potential recreation benefits identified in the economic appendix justify a recreation cost of about $4,000,000. Total estimated construction costs for the recreation features, including trails, signs, fencing and barriers and rest areas are about $1,000,000. The costs of the recreation trails and associated facilities are well justified based on the economic benefits.


CONNECTION TO MATILIJA WILDNESS AREA
BALD HILLS TRAIL AND CAMPGROUNDS
N
W
E
S
500
250
0 Feet
REST AREA C
- Information about native habitat & watershed
- Directional information about other recreational amenities in upper watershed
MARICOPA HWY
REST AREA B at "HANGING ROCK"
- Information about historic recreation uses in the area
- Rest area
CONNECTION TO OJAI VALLEY TRAIL
MATILIJA DAM
REST AREA A
At Historic Dam/Fish Ladder Site
- Accessible by motor vehicles
- Kiosk
- Basic staging facilities
- Interpretive material
MATILIJA HOT SPRINGS

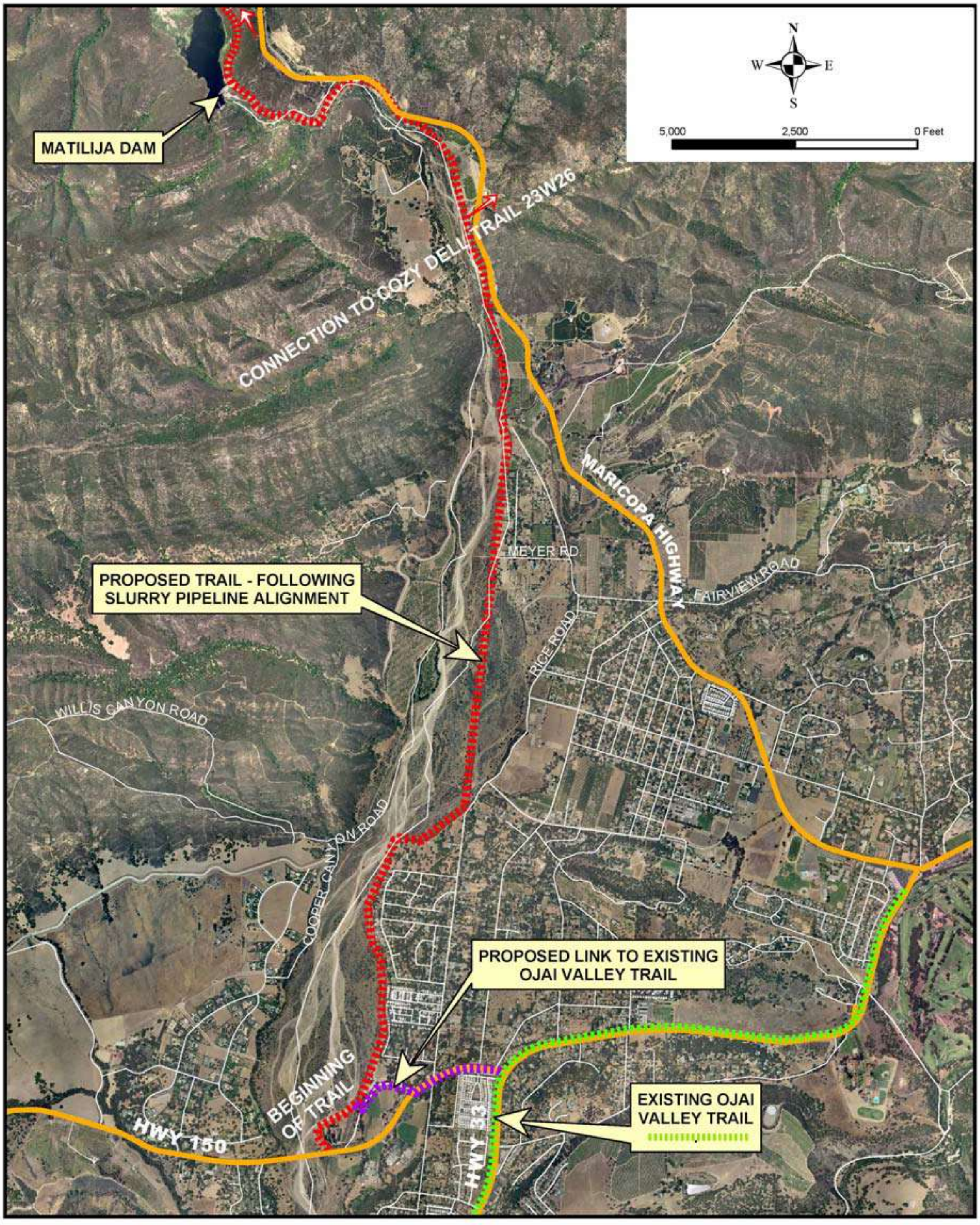


Figure 4-14 - Lower Portion of Recreation Trail

Design and Construction Considerations

Preconstruction, Engineering and Design studies (PED) will be accomplished to further design the project features and prepare plans and specifications. These studies will include further analysis of sediment transport potential and impacts, particularly as related to ecosystem benefits, induced flood damages and impacts to water supply and quality. The results of these studies will be used in further design of the mitigation features. The further development of these mitigation features will also consider the potential for other less costly or environmentally acceptable measures to be used for mitigation.

Further investigations will also be conducted on the dam structure itself and methods for dam removal. This will include finite element studies on the dam structure to better define the approach for dam removal.

It is recognized that the construction sequence for the project will require mitigation measures for induced flooding and impacts to water quality to be implemented prior to dam removal. The construction of the mitigation features could occur coincidently with removal of sediments from the reservoir area. In fact, PED studies will further analyze the reservoir materials and sediment basin material to determine whether they can be used for levee and floodwall construction.

Operations, Maintenance, Repair, Rehabilitation & Replacement Considerations (OMRRR)

An Operation and Maintenance Manual will be developed as part of turning the project over to the local sponsor. The manual will describe the specific requirements expected for properly operating and maintaining project features to assure they will continue to function. The OMRRR requirements for the project features are described in general below.

Ecosystem Restoration Features

The most significant OMRRR requirements will be for the giant reed management/removal plan for Reaches 1 through 9. Over 80 percent of total OMRRR for the Recommended Plan is for this feature.

In general, there will be little OMRRR requirements necessary for those features of the project specifically related to sediment management in the reservoir basin after construction and adaptive management is completed. Occasional grading will be necessary behind the soil cement to prevent undermining of the backside of the structure. As sediment behind the soil cement is depleted, the soil cement will be removed in stages and the residual area of the reservoir will be revegetated, as necessary. It is expected that all sediments associated with the dam will be depleted after a 10 to 20-year period and the hydrologic and sediment transport relationships in this reach will be restored to pre-dam conditions.

Mitigation for Induced Flooding

The OMRRR requirements for the induced flooding mitigation features will require maintenance of the levees and floodwalls. This includes periodic inspections, especially after flood events of the constructed features, and appropriate repair of any damages that could impact its function.

The on-going sediment removal program performed by the Sponsor in the vicinity of Santa Ana Bridge will need to continue as the channel upstream of the bridge will still remain a constriction.

Mitigation for Water Supply Impacts

Sediment deposition OMRRR will be required at Robles Diversion Dam, although maintenance should not be substantial with the construction of the sediment bypass. The responsibility of removal of the additional accumulation of sediment at the Robles Facility, attributed to the release of trapped sediment from Matilija Dam, will be borne by the Sponsor.

Other Environmental Features

At the Robles Diversion facility, anticipated additional deposition of mostly sandy sediment will occur at the fish screen and within the fishway. For the recommended plan, preliminary estimates of two to three feet of deposition, or about 400 cubic yards, may occur upstream of the fish screen once or twice a year. Some deposition would occur in the fishway. Under baseline conditions, the fishway has been designed to require only low maintenance and to typically function for the entire diversion season before requiring routine maintenance. Under with-project conditions, adaptive management would be needed to insure that if the fish screen or fishway was affected by sediment accumulation and was operating at a below normal capacity, maintenance intervention would be limited as much as possible to outside the migration period. Should maintenance to the structure(s) be required during the migration season, the portion of the facility requiring maintenance would be shut down only for as long as needed to perform the necessary maintenance. With a sediment bypass in place, shutdowns to the diversion facility (which would also affect the fishway) due to large sediment accumulation in the basin should be limited.

Recreation Plan

Maintenance requirements needed for the Recreation Plan include items to assure continued functioning of the features and public safety. This will include assuring trails are kept clean of debris, emptying trash barrels, repairing or replacing picnic facilities, comfort stations, etc.

Desilting Basin

OMRRR requirements for the desilting basin, which is included as an associated feature, will require periodic removal of sediments (silts and clays), including chemical additives, such as ferric chloride, used to promote settling, to restore trapping capacity. The basin sediments would be cleaned out after sedimentation depths exceed one-foot, or prior to the beginning of the rainy season. The materials will be deposited at a permanent storage site, a preferred location currently identified as Bureau of Reclamation land less than 1 mile away from Lake Casitas along the Robles-Casitas Canal.

The permanent storage site will be operated and maintained in a similar fashion as a standard landfill. Disposed materials would be graded to drain to a collection system. The site, underlain by a synthetic barrier, will include a leachate collection system. Collected leachate will be disposed of in accordance with environmental regulations. A monitoring program will be implemented to insure that no contamination to the local groundwater occurs both during operation and following closure of the site. Once the site has reached capacity, an impermeable soil cap will be placed over the site and will be subsequently replanted with native vegetation. Efforts that will include detailed design and operation of the desilting basin and the permanent storage site will be conducted during the Pre-Construction, Engineering and Design phase.

Project Costs

First Costs

Table 4-4 presents the details of the first costs required for implementing the Recommended Plan. The estimated project first costs have been developed in accordance with MCACES estimating procedures and guidelines for estimating project construction costs. The current estimate of costs are based on FY 2004 price levels and reflect estimates developed by the Los Angeles District and review of information provided by the local sponsor. The cost estimate includes those costs needed for implementing the project. This includes costs for all LERRDs, construction of the ecosystem restoration features, construction of mitigation requirements to reduce induced flooding and water supply impacts, monitoring and adaptation measures, cultural resource mitigation, and costs to construct the recreation plan. The first cost of the project also includes the cost for the next phase of study, the Pre-Construction, Engineering and Design (PED) phase. The PED costs are estimated to be 10% of total construction costs, and include such products as the final detailed design, the plans and specifications, further development of real estate requirements, actions necessary to acquire estates, and costs for developing and executing a Project Cooperation Agreement (PCA) for the construction phase. The first cost of the project also includes Supervision and Administration (S&A) costs of construction activities and engineering during construction (E&D) (6.5 % for S&A and 1% for E&D, respectively).

Real Estate Costs

LERRD costs are based on a review of real estate acquisition requirements and costs provided by the Ventura County Watershed Protection District. The real estate estimate includes acquisitions costs for the Matilija Hot Springs, Camino Cielo structures, Camino Cielo and Santa Ana Bridge right-of-way, and right-of-way for the levees and floodwalls at Meiners Oaks, Live Oak and Casitas Springs, slurry line and slurry disposal sites. The groundwater wells at Foster Park will require a right-of-entry (temporary work) permit. The cost estimate also includes VCWPD administrative costs for acquiring the necessary estates and Federal costs for assuring all estates are available for the project. Details are presented in the Real Estate Plan Appendix.

Table 4-4: First Cost to Implement the Recommended Plan (Fiscal Year 2004 Price Levels)				
Description	Estimated Quantity	UOM	Unit Cost	Estimated Cost
REAL ESTATE				
LERRDS				
Non-Federal Sponsor Owned Land, Easements & ROW	1	LS	$872,500	$872,500
Land, Easements & ROW to be Accquired by Non-Fed Sponsor				
Fee	1	LS	$5,570,000	$5,570,000
Permanent Easement (including Arundo removal)	1	LS	$80,500	$80,500
Temporary Easement	1	LS	$150	$150
PL 91-646 Relocation Assistance	1	LS	$750,000	$750,000
Facility/Utility Relocation	1	LS	$4,570,000	$4,570,000
Non-Federal Sponsor Admin Cost	1	LS	$500,000	$500,000
Remove Existing Camino Cielo Bridge/Replace 150' Long Bridge	1	LS	$5,100,000.00	$5,100,000
Santa Ana Bridge Modification (75' extension)	1	LS	$2,800,000.00	$2,800,000
Federal Admin Cost	1	LS	$35,000	$35,000
SITE PREPARATION				
Mobilization, Demobilization, and Preparatory	1	LS	$5,000,000.00	$5,000,000
Clearing & Grubbing	134.60	ACR	$3,800.00	$511,480
Arundo Eradication				
Eradication (Reach 7)	118.00	ACR	$10,000.00	$1,180,000
Eradication (Reach 8 & 9)	0.40	ACR	$28,000.00	$11,200
Diversion & Control of Water	1	LS	$100,000.00	$100,000
Fish Rescue & Relocation	1	LS	$100,000.00	$100,000
MATILIJA RESERVOIR SEDIMENT COMPONENTS				
Diposal Site Closure	1	LS	$200,000.00	$200,000
Soil Cement Wall	62,900	CY	$30.00	$1,887,000
Channel Excavation	1,113,000	CY	$3.00	$3,339,000
SLURRY SYSTEM COMPONENTS				
Import Water from Casitas				
Cost of Water	4,500	ACR-FT	$171.00	$769,500
Pipeline Corridor Preparation (24ftx22,000ft)	648,000	SF	$1.00	$648,000
Fresh Water Supply Pumps, 800 HP Each, Goulds Vertical Turbines, in	1	EA	$125,000.00	$125,000
Parallel				
Power to Pumps from Casitas for 9 Months	3,900,000	KW-HRS	$0.15	$585,000
Fresh Water Pipeline, 8 Miles Long, 24"x.357" Wall, A53 Cast Iron	42,240	LF	$15.00	$633,600
Water Storage Tank, 90,000 Gal, 25ftx25ft Carbon Steel	1	EA	$130,000.00	$130,000
Makeup Water Pumps, 900 HP Each, Goulds Centrifugals, in Series	3	EA	$112,000.00	$336,000
Makeup Waterline, 1 Mile Long, 24"x.357" Wall,	5,280	LF	$26.00	$137,280

Table 4-4: First Cost to Implement the Recommended Plan (Fiscal Year 2004 Price Levels)				
Description	Estimated Quantity	UOM	Unit Cost	Estimated Cost
A53 Cast Iron				
Power for Makeup System for 9 Months	13,053,000	KW-HRS	$0.15	$1,957,950
12" Cutter Head Suction Dredge, 9 Months Continuous	2	EA	$3,150,000.00	$6,300,000
Slurry System				
Pipeline Corridor Preparation (30ftx41,470ft)	1,244,100	SF	$1.00	$1,244,100
Thickener, 115' Diameter, incl. Flocculant Package, 40 HP Rake Motor	1	EA	$1,100,000.00	$1,100,000
Slurry Pipeline, 7.85 Miles Long, 20" SRD 11, HDPE Pipe, 16.146" ID	41,470	LF	$23.00	$953,810
Slurry Pumps, 1,200 HP Each, Warman Slurry Pumps in Series	1	EA	$88,000.00	$88,000
Power for Slurry System for 9 Months	1,934,000	KW-HRS	$0.15	$290,100
Operation Crew: 4 Operators, 1 Technician, 24hrs x 270 days	26,000	MAN-HRS	$54.00	$1,404,000
Clear disposal area	97	ACR	$4,300.00	$417,100
Construct containment dikes (excavation, place & compact in disposal area)	416,000	CY	$5.00	$2,080,000
Misc. detail at dikes (drainage, grading, imported stone 4600cy)	1	LS	$671,000.00	$671,000
Dust Abatement	1	LS	$135,000.00	$135,000
Site Restoration	1	LS	$1,037,500.00	$1,037,500
Road Repair	2	MILE	$61,300.00	$122,600
DAM REMOVAL COMPONENTS				
Excavation & Removal of Concrete Fish Trap	120	CY	$245.00	$29,400
Excavation & Removal of Concrete Control House	70	CY	$300.00	$21,000
Excavation of Concrete Dam	51,100	CY	$36.00	$1,839,600
Drilling & Blasting for Dam Removal				
Blasting Horizontal Rows	9,550	EA	$18.00	$171,900
Drilling Horizontal Holes	124,400	LF	$28.00	$3,483,200
Blasting Vertical Holes	7,600	EA	$19.00	$144,400
Drilling Vertical Holes	122,000	LF	$23.00	$2,806,000
Process Concrete for Hauling	9,638	CY	$2.00	$19,276
Haul Concrete to Recycling Plant	72,285	CY	$25.00	$1,807,125
Removal & Disposal of Misc. Metal Work	46,513	LB	$2.50	$116,283
ROBLES DIVERSION DAM COMPONENTS				
High Flow Sediment Bypass (for project life)				
Radial Gates (120' section)	1	LS	$3,300,000.00	$3,300,000
Timber Crib Structure Replacement (210' section)	1	LS	$1,350,000.00	$1,350,000
DOWNSTREAM FLOOD MITIGATION COMPONENTS				
Levees/Floodwalls				
Meiners Oaks/Robles Levee/Floodwall	1	LS	$1,100,000.00	$1,100,000
Live Oaks Levee/Floodwall	1	LS	$1,300,000.00	$1,300,000
Casitas Springs Levee/Floodwall	1	LS	$413,000.00	$413,000
FOSTER PARK COMPONENTS				

Table 4-4: First Cost to Implement the Recommended Plan (Fiscal Year 2004 Price Levels)				
Description	Estimated Quantity	UOM	Unit Cost	Estimated Cost
Wells	2	EA	$400,000.00	$800,000
DOWNSTREAM ARUNDO ERADICATION				
Arundo Control				
Control (Reach 1-6) Med-High Density	123.00	ACR	$28,000.00	$3,444,000
Control (Reach 1-6) Low Density	1,059.00	ACR	$1,500.00	$1,588,500
Subtotal				$77,506,054
Contingency			25%	$19,376,513
Planning, Survey, Engineering and Design			10.00%	$7,750,605
Engineering During Construction			1.00%	$775,061
Supervision and Administration			6.50%	$5,037,893
TOTAL PROJECT CONST. COST FOR RECOMMENDED PLAN				**$110,450,000**
Cultural Resources			1%	$1,104,500
Monitoring			2%	$2,209,000
Adaptive Management			3%	$3,313,500
TOTAL NER PROJECT COSTS FOR RECOMMENDED PLAN				**$117,077,000**
Desilting Basin (Associated Feature)			LS	$5,700,000
Recreation			LS	$1,000,000
TOTAL PROJECT COSTS FOR RECOMMENDED PLAN				**$123,777,000**

Monitoring and Adaptive Management Plan Costs

The costs for the adaptive management are based on Corps of Engineers upper limit guidelines. The cost for monitoring is estimated to be 2 percent of total project costs and will not exceed a ten-year period. The cost for adaptive management is estimated not to exceed 3 percent of total project costs. The plan and costs will be refined during the Pre-Construction, Engineering, and Design phase.

Associated Feature Costs

The cost for the desilting basin is considered an associated feature since it is expected that the control of fine sediment without the feature is sufficient to mitigate adverse impacts to Lake Casitas. It is estimated to cost about $5.7 million for construction.

OMRRR Costs

The costs for operation, maintenance, repairs, replacements, and rehabilitation of project requirements are presented in Table 4-5. These costs are presented on an average annual basis.

Table 4-5: OMRRR Costs

Feature	Duration	Avg. Annual Cost
Grading behind Soil Cement Revetment	1st 10 Yrs	$1,200
Rip Rap for Downstream Slope Protection (for project life)	Once every 10 Yrs	$1600
Robles Sediment Basin Excavation	1st 5 Yrs	$9,200
Other Water Supply Mitigation Measures	1st 7 Yrs	$1,100
Channel Sediment Removal	50 Yrs	$5,000
Arundo Removal/Control (Reaches 1-9)	50 Yrs	$242,000
Subtotal NER OMRRR Costs		
Recreation Plan	50 Yrs	$90,000
Total OMRRR		$350,000

Project Benefits

Ecosystem Restoration Benefits

Prior to construction of Matilija Dam in 1947, historic records reported the Ventura River watershed supported a substantial steelhead run of at least 4,000 to 5,000 spawning fish. Sections of the middle to upper Matilija Creek are thought to have been the primary spawning habitat, representing over half of the historically used habitat. Today, the steelhead is designated a Federal endangered species.

The Recommended Plan would remove Matlija Dam and reservoir area and restore fish passage and eventually the natural ecology to pre-dam conditions. Matilija Creek in the reaches upstream of Matilija Reservoir's influence has high quality spawning and rearing habitat. About 21.6 miles of prime steelhead habitat will be available including an estimated 4.3 miles of habitat on the Lower North Fork of Matilija Creek and 17.3 miles of habitat above Matilija Dam. The Plan will also restore a more natural ecology consistent with about 30 miles of the upper reaches of Matilija Creek and its tributaries that are designated as Wild and Scenic Rivers.

The Recommended Plan will also result in improved ecology downstream from the dam, where many reaches have experienced severe erosion since construction of Matilija Dam. The elimination of the Dam will restore natural hydrologic and sediment transport conditions, such that many of the eroded areas could recover to a more stable equilibrium.

The Environmental Working Group included representatives from the California Department of Fish & Game, National Marine Fisheries Service (NMFS), USFWS, University of California's Cooperative Extension, Casitas Municipal Water District (CMWD), the Matilija Coalition, the

Southern California Wetlands Recovery Project, VCWPD and the Corps. As presented in earlier Chapters, this group developed a modified Habitat Evaluation Procedure (HEP) to measure the relative value of biological resources of concern in quantitative, non-monetary terms. Three riparian ecosystem components were used to quantify HEP values: riparian habitat, steelhead habitat and natural processes. Details of the HEP analysis for without- and with-project conditions are presented in HEP Appendix of the EIS/R.

The HEP value in terms of natural processes for the reservoir is considered very low due to the extreme alteration of hydrologic regime and the unnatural alteration to the sedimentation regime. The environment has transformed from a pre-dam riverine system, to an open water and delta system following the construction of Matilija Dam.

The Recommended Plan will remove Matilija Dam and eventually the sediments trapped in the reservoir will be depleted resulting in a more natural hydrologic and sediment transport system similar to pre-dam conditions. The with-project HEP values shown in Table 4-6 reflect that just over 17 miles of habitat will be re-opened to southern steelhead and, as a result, significant environmental outputs will be produced. Reaches 8 and 9 are presently considered high quality steelhead habitat and would be accessible to steelhead once the dam is removed and a more natural channel condition is created. The quality of steelhead habitat in Reaches 6 and 7 will gradually improve as the beneficial effects from the removal of the dam are manifested. Smolt productivity, for example, will increase, as there is more efficient movement of nutrients downstream. Reach 7 will eventually return to near pre-dam conditions.

TABLE 4-6: HEP Comparison of No Action to Recommended Plan (Habitat Units)

	Steelhead Habitat Component		Riparian Habitat Component		Natural Processes Component		TOTALS	
TARGET YEAR	No Action	With Project	No Action	With Project	No Action	With Project	No Action	With Project
0	177	177	1032	1032	228	228	1437	1437
5	234	501	1029	1125	228	240	1491	1866
20	234	543	944	1145	228	520	1406	2208
50	234	544	782	1183	286	570	1302	2297
AAHUS	231	514	917	1147	245	464	1393	2128
Change in AAHUs	----	283	----	229	----	219		731
% Change	----	122%	----	25%	----	89%		53%

The removal and management of giant reed (*Arundo donax)* and other exotic plant species will greatly improve the riparian ecosystem quality within the study area.

The reestablishment of natural sediment transport processes will improve the quality of the habitat in the Ventura River in terms of natural riverine processes. Reach 6 and 7 will benefit the most, with the latter becoming more similar to pre-dam conditions with time. The improvement to the habitat quality from a natural processes perspective is less dramatic in the downstream reaches.

Coastal Benefits

Sediment released from behind the dam and the Matilija watershed will not only deposit within downstream Ventura River reaches, but will also nourish the nearby shoreline. The sediment transport modeling showed that there would be an approximate 32% increase in the delivery of sands, gravels, and cobbles over a 50-year timeframe when compared to the No Action plan. This equates to an increase of about 1.9 million cubic yards of sand, 80,000 cubic yards of gravel and 5,000 cubic yards of cobble (see Table 3-2). The delivery of fines will also increase by about 6% over 50-years, by approximately 400,000 cubic yards. The fines will dissipate soon after delivery by the storms due to strong littoral currents.

Cobbles are anticipated to settle by the mouth of the Ventura River at Surfer's Point. The cobbles act to stabilize the point, thereby decreasing the potential nearby shoreline erosion. Each cubic yard of additional sand could potentially equate to an additional square foot of dry sand on the beach based on the Beach Erosion Authority for Clean Oceans and Nourishment (BEACON) estimates. The assumption is that some of the sand will deposit on the beach after storm events and will contribute to increases in beach widths, benefiting recreational beach uses, increasing the aesthetic appeal of the beach, and adding storm damage protection to local shoreline structures.

If other nearby sources were pursued for beach nourishment estimates of mechanical placement of sand on these beaches range between $10 and $15 per cubic yard. Therefore, the restored natural transport of sand to the shoreline also provides a significant economic savings when compared to sources of sand that require mechanical dredging and transport.

Delivery of additional sand and cobbles could also help stabilize the upper beach zone, a spawning habitat for the California grunion and the threatened western snowy plover. Coastal dunes in the area have also been subject to erosion. Additional beach sand could help to stabilize the dune loss, which provides habitat for the silvery legless lizard, a California species of special concern.

Nearshore habitats should not be adversely affected by increased sediment delivery from the Ventura River watershed. The plumes of fines could add nutrients to the coast. Hard bottom habitat is also not expected to be adversely impacted by the increased delivery of sediment due to the strong littoral currents in the nearshore area.

Flood Protection Benefits

Under without-project conditions there are about 170 structures within the 50-year floodplain, 220 residential, commercial and industrial structures within the 100-year floodplain and over 400 structures within the 500-year floodplain. There are a number of existing levees that provide protection to existing development. A preliminary estimate of potential flood damages that could occur under the without-project condition is about $4 million and over $5 million for the 50-year and 100-year events respectively, and over $18 million for the 500-year event. Equivalent average annual damages are estimated to be about $152,000. The relatively low average annual damage potential is not considered sufficient to justify flood protection measures as a separable project. However, in view of the potential increase in these damages resulting from with-project sediment transport and deposition, mitigation for induced impacts is considered necessary. There could be some incidental benefits to the existing development as a result of these mitigation measures.

Water Supply Benefits

At the Robles diversion facility the sediment bypass structure will limit the amount of deposition in the sediment basin under with-project conditions to approximately existing conditions.

Other measures to control the with-project increase in deposition at the Robles diversion facility were dismissed after consideration and include more frequent sediment removal maintenance operations and sediment basin enlargement. The costs associated with either of these measures were greater than the sediment bypass structure (including the timber crib structure modification). Additional details are provided in the *Plan Formulation Chapter, Water Supply* section.

At the Foster Park facility (owned by the City of Ventura), the two groundwater wells as mitigation will offset the diversion losses due to operation shutdown of the surface diversion when turbidity concentrations exceed maximum allowable levels under with-project conditions. An estimate for lost water diversion opportunity due to number of shutdown days from high turbidity was determined for a 12-year period. The replacement cost of the water, using the least cost rate (Casitas Municipal Water District- from which the City of Ventura does not fully utilize its full entitlement) justifies the cost of the two wells.

Economic Summary

Table 4-7 presents an economic analysis of the Recommended Plan. The estimated first costs and OMRRR costs have been developed using the Corps MCACES cost estimating system.

Table 4-7: Economic Analysis of Recommended Plan	
Item	**Amount**
First Cost	
LERRDs	$25,340,000
Construction	$71,540,000
Monitoring and Adaptive Management	$5,520,000
Cultural Resources	$1,100,000
Subtotal	$103,510,000
Engineering and Design	$8,530,000
Supervision and Administration	$5,040,000
Subtotal	$117,080,000
Total NER First Costs	**$117,070,000**
Associated feature- Desilting Basin	$5,700,000
Recreation Plan	$1,000,000
Total Project First Cost	**$123,770,000**
Average Annual Cost	
Annual Cost of Total Gross Investment	$7,403,000
OMRR&R	$260,000
Total Average Annual Cost	$7,663,000
Average Annual Benefits	
Increased Habitat Units	731
Number of acres Restored	2,814
Incidental Flood Protection	
Incidental Water Supply	
Recreation	
Total non-monetary benefits	731
Total monetary benefits	N/A
Average Annual Cost per Habitat Unit	$10,127
Avg Annual Equivalent Cost per Acre	$2,723/acre
First Cost per Acre	$43,984/acre

The first costs include all costs associated with final design and construction and mitigation of the project, LERRDs, and monitoring and adaptation. The OMRRR costs are presented on an average annual basis. The average annual costs include the interest and amortization of project first costs, including interest during construction, and OMRRR costs, presented on an average annual basis. These values are based on Fiscal Year 2004 price levels, and an interest rate of 5.625 percent and a 50-year period of economic analysis. The costs for associated features, and the recreation Plan are not included in the average annual cost calculations for the NER analysis. The average annual benefits reflect the increase in habitat units based on HEP values, reflecting non-monetary benefits.

Project Justification

The Recommended Plan is considered justified based on the significance of the non-monetary benefits as compared to average annual costs. The average annual cost per habitat unit is $8,890 and the first cost per acre is $37,070. The ecosystem benefits are considered very significant in view of the restoration of 2,814 acres of important riparian and wetland habitat for a wide variety of native wildlife species, including many sensitive species and several threatened and endangered species.

Environmental Commitments

The environmental impacts of the Recommended Plan are addressed in the Environmental Impact Statement/Environmental Impact Report (EIS/R). Table ES-1 in the EIS/R presents a summary of the impacts associated with the Recommended Plan and mitigation measures that are being considered for incorporation into the project.

The efforts for the Matilija Dam Ecosystem Restoration Recommended Plan encompass a watershed scale and would restore essential physical and natural processes responsible for creating and sustaining habitats and ecosystem functions that support a wide variety of native species, including listed species. The Plan would also benefit current weak stocks of southern steelhead by providing the species access to historically high quality spawning and rearing steelhead habitat.

The primary beneficial impact of the Recommended Plan is restoration of Matilija Creek to natural riverine conditions prior to construction of Matilija Dam. This results in allowing fish passage to over 17 miles of historic spawning and rearing habitat area for the Federal endangered steelhead. Although it eliminates the lake ecology currently existing, it is expected that this environment would eventually be lost due to continued sediment trapping in the reservoir area. There could be some adverse impacts to species currently existing in the reservoir area. These will be minimized by relocating significant species prior to and during construction operations in the dam and reservoir area. The recommended plan also includes removal and control of exotic and invasive plant species, particularly giant reed (*Arundo donax*) from the reservoir basin, upstream of the basin, and in the downstream reaches of the Ventura River. This action will reverse a habitat degradation trend in the watershed and will promote the support of sensitive species that rely on native willow, cottonwood, and other native riparian species. The action of dam removal will also benefit beach and coastline nourishment and the associated habitats.

The major adverse impacts relate to impacts of sediment transport to downstream areas, and measures to mitigate the impacts resulting from induced flooding potential and impacts to water supply operations. The removal of structures, replacement of bridges and construction of levees and floodwalls will have significant adverse impacts to existing habitat located in the construction footprints, and adjacent areas. The height of the levees and floodwalls will also impact aesthetics and local resident vistas.

Adverse impacts will occur to habitat at the desilting basin due to frequent sediment deposition and removal operations, and within the footprint of the sediment bypass facilities.

There will also be significant adverse impacts related to construction activities. These impacts will be minimized to the extent practicable by including best management practices as part of the environmental plan for construction.

Relationship to Environmental Requirements

The degree to which the Recommended Plan complies with the applicable laws, policies and plans is summarized in Table 4-9.

Table 4-9: Degree of Compliance with Environmental Requirements		
	Environmental Requirement	Status
	Federal	
1	National Environmental Policy Act	On-going
2	Clean Air Act	On-going
3	River and Harbor Act	N/A
4	Clean Water Act, Section 404(b)	On-going
5	CEQ Policy on Prime or Unique Farmlands	N/A
6	Federal Water Project Recreation Act	N/A
7	Land and Water Conservation Fund Act	N/A
8	Marine Research and Sanctuaries Act	N/A
9	Watershed Protection and Flood Prevention Act	
10	Wild and Scenic Rivers Act	N/A
11	EO 11988 – Flood Plain Management	
12	Archaeological and Historic Preservation Act	On-going
13	EO 11593 – Protection and Enhancement Cultural Environment	On-going
14	National Historic Preservation Act	On-going
15	Coastal Zone Management Act	On-going
16	Fish and Wildlife Coordination Act	On-going
17	Estuary Protection Act	N/A
18	Endangered Species Act	On-going
19	Executive Order 11990 – Wetlands	On-going
20	Chief of Engineers Wetlands Policy	
	State	
21	State of California Wetlands Policy	On-going
	Local	
22	Local Land Use Plans	
	Legend	
	On-going – will be completed for the EIS/EIR	
FC:	Full Compliance – All requirements of the law, policy, or related regulations have been met.	
PC:	Partial Compliance – Some requirements of the law, policy, or related regulations has been met.	
NA:	Not Applicable – The law, policy, or related regulations do not apply.	

5. PLAN IMPLEMENTATION

General

This Chapter presents information on the Federal and non-Federal requirements for implementing the recommended plan. It presents the required cost sharing and other requirements for the construction of the project including adaptive management and monitoring and operation, maintenance, repair, rehabilitation, and replacements over the life of the project. It also presents the schedule for implementation including activities to complete the feasibility, design, and construction phases. Finally, it presents the Sponsor's support for the project and financial capability to meet their required contributions.

Federal and Non-Federal Costs

The apportionment of the first cost between Federal and non-Federal interests is based on applying the requirements of current Federal laws and policies, as defined in Section 210 of the Water Resources Development Act of 1996, and other laws and policies related to cost-sharing in recreation development.

Ecosystem Restoration

The Non-Federal share of the first cost for implementation of the project is 35 percent of the project or separable element implementation allocated to ecosystem restoration. These costs include pre-construction, engineering and design (PED), and construction of the ecosystem restoration features including monitoring and adaptive management, and the cost for mitigating potential flood damage impacts and water supply. The Federal participation in monitoring will be limited to a five-year period after construction, and adaptive management should be accomplished within that period. At this time the specifics of the monitoring and adaptive management plan have not been defined, therefore a limit of two percent (2%) and three percent (3%) for each item, respectively, is included based on current policy on maximum Federal interest.

The non-Federal sponsors shall also provide 100 percent of the costs for lands, easements, rights-of-way, utility or public facility relocations, and dredged or excavated material disposal areas (LERRDs) that are required for implementation or operation and maintenance of the project. The value of LERRDs shall be included in the non-Federal 35 percent share. If the Government determines that the LERRDs costs exceeds the non-Federal sponsors 35 percent share, the sponsor will be reimbursed for the value of LERRDs which exceeds their 35 percent share.

Recreation

The non-Federal sponsor is also responsible for providing 50 percent of the project or separable element of the project allocated to recreation. The non-Federal sponsor will provide 100 percent of the cost for any additional LERRDs required for recreation. At this time all recreation features will be on acquired project lands, and the facilities and costs will be consistent with Corps policy for Federal interest in recreation as part of ecosystem restoration projects.

Other Purposes or Associated features

There are many areas downstream of the dam that have a potential for flood damages under the without-project conditions. The recommended ecosystem plan will cause an increase in the flood damage potential, and mitigation measures are included in the plan. The extent that the proposed features are mitigating the increase in flood damage potential has been reviewed, and it has been determined that the measures are providing improved flood protection. The increase in flood protection however has been determined to reflect an insignificant increase in protection beyond mitigation, and therefore the costs associated with these improvements would be considered incidental.

In regard to water supply, a review was made to determine if the mitigation measures included in the recommended plan to reduce the impacts of increases in downstream sediment include an improvement over without-project conditions. The features included reducing sediment deposition and turbidity impacts caused by the recommended plan may be effective in reducing sediment impacts being experienced under the without-project condition. Accordingly, there may be an increase in water supply availability beyond the losses of water supply that may be impacted by the recommended plan. If that is the case, then a separable water supply feature or cost may be defined from this review. The local sponsor would be responsible for 100 percent of these costs, which would be classified as an associated feature.

The high-flow sediment bypass at the Robles Diversion Dam sediment basin will reduce impacts of sediment deposition and potential interruptions in diversion operations attributed to the release of trapped sediments from Matilija Dam. The bypass is also expected to decrease future deposition amounts and limit diversion interruptions once Matilija Dam trapped sediments are completely evacuated. This improvement over existing conditions is a benefit to ecosystem restoration as it assures that there is more sediment flow past the facility. In addition, the presence of the sediment bypass will increase the opportunity of fish passage at the facility to a wider range of flows than presently exist. No portion therefore of the sediment bypass will be considered an associated feature.

The desilting basin is considered to be an associated feature since the turbidity impacts to the Robles diversion and Lake Casitas are expected to improve over existing conditions.

Cost Apportionment

Table 5-1 presents the breakdown of Federal and non-Federal project costs associated with the Recommended Plan.

TABLE 5-1: RECOMMENDED PLAN COST APPORTIONMENT			
ITEM	FEDERAL	NON-FEDERAL	TOTAL (Rounded)
REAL ESTATE			
Non-Federal Sponsor Owned LERRDs	0	1,090	1,090
LERRDs to be acquired	0	7,060	7,060
PL 91-646 Relocation Assistance	0	940	940
Facility/Utility Relocation	0	5,710	5,710
Non-Federal Sponsor Administration	0	630	630
Federal Administration	40	0	40
Bridge Modification/Replacement	0	9,880	9,880
Subtotal Real Estate	40	25,300	25,350
CONSTRUCTION COST-SHARING FEATURES			
Construction	71,530	0	71,540
PED	7,750	0	7,750
Engineering During Construction	780	0	780
S&A	5,040	0	5,040
Subtotal Construction Cost	85,100	0	110,400
Monitoring	2,210	0	2,210
Adaptive Management	3,310	0	3,310
Subtotal 65/35 Cost Share	90,660	25,300	115,970
Adjustment for 65/35 Cost Share	(15,280)	15,290	0
TOTAL FIRST COST	75,380	40,590	115,970
PERCENT OF FIRST COST	65%	35%	100%
OTHER COSTS			
Recreation (50% Fed/50% Sponsor)	500	500	1,000
Cultural Resources (1st 1% of Federal Cost - 100% Federal)	980	120	1,100
Associated Cost (Desilting Basin)	0	5,700	5,700
TOTAL CASH CONTRIBUTION	76,860	21,610	98,470
TOTAL PROJECT COST	76,860	46,910	123,770

Operation, Maintenance, Repair, Rehabilitation, & Replacement (OMRRR) Costs

The non-Federal sponsor is responsible for providing all requirements and 100 percent of the costs associated with operating and maintaining the project including any repairs, replacements, or rehabilitation of project features that are needed to continue obtaining project benefits. Table 5-2 presents a summary of the OMRRR costs associated with the Recommended Plan on an average annual basis.

Table 5-2: OMRRR Costs

Item	Avg. Annual Cost ($)
Grading behind Soil Cement Revetment	1,180
Riprap for downstream slope protection	1,630
Robles Sediment Removal (5 yrs only)	9,200
Other Water Supply Mitigation Measures	1,060
Downstream Sediment Removal	5,000
Giant Reed Removal (Reaches 1-9)	241,930
Recreation Features	90,000
Total Average Annual OMRRR Costs	350,000

Other Non-Federal Requirements

In addition to cost sharing, there are a number of other requirements established by Federal laws and policies that are to be provided by the non-Federal sponsor. A list of all non-Federal sponsor project requirements are as follows:

a. Provide 35 percent of the total project costs allocated to ecosystem restoration and 50 percent of the total project costs allocated to recreation, as further specified below:

(1) Enter into an agreement that provides, prior to execution of a project cooperation agreement for the project, 25 percent of design costs;

(2) Provide, during construction, any additional funds needed to cover the non-federal share of design costs;

(3) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project;

(4) Provide or pay to the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that

may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and

(5) Provide, during construction, any additional costs as necessary to make its total contribution equal to 35 percent of the total project costs allocated to ecosystem restoration and 50 percent of the total project costs allocated to recreation.

b. Provide during construction 100 percent of total project costs allocated to the desilting basin project feature.

c. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the local sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

d. Assume responsibility of operating, maintaining, replacing, repairing, and rehabilitating (OMRR&R) the project or completed functional portions of the project, including mitigation features and the desilting basin without cost to the Government, in a manner compatible with the project's authorized purpose and in accordance with applicable Federal and State laws and specific directions prescribed by the Government in the OMRR&R manual and any subsequent amendments thereto.

e. Maintain responsibility for the continued OMRR&R of the Ventura River channel flow capacity at the Santa Ana Bridge.

f. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

g. Hold and save the Government free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.

h. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.

i. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

j. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project.

k. Agree that, as between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and, to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

l. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by title IVk the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

m. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c)).

n. Provide the non-Federal cost share of that portion of total cultural resource preservation mitigation and data recovery costs attributable to ecosystem restoration that are in excess of one percent of the total amount authorized to be appropriated for ecosystem restoration.

o. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

p. Prevent obstructions of, or encroachments on, the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the ecosystem restoration, hinder its operation and maintenance, or interfere with its proper function, such as any new development on project lands or the addition of facilities which would degrade the benefits of the project.

q. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms.

Schedule

Table 5-3 presents the steps and milestones required to complete the feasibility report, obtain project approvals, authorization of construction, final design and construction. The schedule for project implementation assumes conditional authorization in the proposed Water Resources Development

Act of 2004, no later than December 31, 2004. After project authorization, the project would be eligible for construction funding. The project would be considered for inclusion in the President's budget based on: national priorities, magnitude of the Federal commitment, economic and environmental feasibility, level of local support, willingness of the non-Federal sponsor to find its share of the project cost and the budget constraints that may exist at the time of funding. Once Congress appropriates Federal construction funds, the Corps and the non-Federal sponsor would enter into a project cooperation agreement (PCA). This PCA would define the Federal and non-Federal responsibilities for implementing, operating and maintaining the project. Project construction would begin following the certification of the real estate requirements. After construction, the final acceptance and transfer of the project to the non-Federal sponsor would follow the delivery of an O&M manual and as-built drawings.

Table 5-3: Milestone Schedule

Milestones	Schedule
AFB Meeting	April 2004
Complete Draft Report	June 2004
Public Review	July 2004
Final Report	September 2004
Division Engineer Notice	September 2004
Washington Level Review	October 2004
Chief of Engineers Report	December 2004
ASA and OMB Review	December 2004
ASA Report to Congress	March 2005
WRDA Authorization	December 2004
Execute Cost-Sharing Agreement for PED	January 2005
Complete Design Documentation Report	July 2007
Complete Plans and Specifications	July 2008
Execute PCA	September 2008
Complete Real Estate Acquisition	March 2008
Advertise Construction	April 2008
Construction Start	May 2008
Complete Construction	October 2017
Turnover Project to Local Sponsor	December 2017
Initiate Monitoring and Adaptive Management	October 2009
Complete Monitoring and Adaptive Management	June 2017
Complete Design Documentation Report	July 2007

Cost Estimate

The estimated cost for the Recommended Plan is shown in 2004 price levels in Table 5-4. Estimated project funding requirements by fiscal year are also summarized in Table 5-4. The local sponsor will be required to provide 25 percent of the cost for Preconstruction Engineering and Design as part of the PED phase. These costs will be credited toward the ecosystem restoration cost sharing for the project.

TABLE 5-4: Funding by Fiscal Year ($000) Rounded

ITEM	FEDERAL	NON-FEDERAL	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13-17	TOTAL
REAL ESTATE												
Non-Federal Sponsor Owned LERRDs	0	1,090			400	690						1,090
LERRDs to be acquired	0	7,060			3,000	4,060						7,060
PL 91-646 Relocation Assistance	0	940			940							940
Facility/Utility Relocation	0	5,710				1,000	2,500	2,210				5,710
Non-Federal Sponsor Administration	0	630			200	150	150	100	30			630
Federal Administration	40	0			10	10	10	5	5			40
Bridge Modification/Replacement	0	9,880				6,000	3,880					9,880
Subtotal Real Estate	40	25,300	0	0	4,550	11,900	6,540	2,315	35	0	0	25,340
CONSTRUCTION COST-SHARING FEATURES												
Construction	71,530	0				22,000	28,000	9,000	5,500	4,030	3,000	71,530
PED	7,750	0	3,000	3,500	1,250							7,750
Engineering During Construction	780	0				230	290	100	65	50	45	780
S&A	5,040	0				1,505	1,895	655	428	332	226	5,040
Subtotal Construction Cost	85,100	0	3,000	3,500	1,250	23,735	30,185	9,755	5,993	4,412	3,270	85,100
Monitoring	2,210	0				638	704	295	220	188	165	2,210
Adaptive Management	3,310	0				912	1,106	493	380	322	98	3,310
Subtotal 65/35 Cost Share	90,660	25,300										
Adjustment for 65/35 Cost Share	(15,280)	15,290										
TOTAL FIRST COST	75,380	40,590	3,000	3,500	5,800	37,185	38,534	12,858	6,627	4,922	3,544	115,970
PERCENT OF FIRST COST	65%	35%										100%
OTHER COSTS												
Recreation (50% Fed/50% Sponsor)	500	500							400	400	200	1,000
Cultural Resources (1st 1% - 100% Federal)	980	120				400	500	200				1,100
Associated Cost (Desilting Basin)	0	5,700				5,700						5,700
COST SUMMARY												
TOTAL CONTRIBUTION - Federal	76,990		2,250	2,625	938	25,695	26,806	8,388	4,490	3,400	2,399	76,990
TOTAL CONTRIBUTION - VCWPD		46,790	750	875	4,853	17,590	12,228	4,670	2,537	1,923	1,365	46,790
VCWPD - Cash		21,490	750	875	313	5,700	5,698	2,360	2,507	1,923	1,365	21,490
VCWPD - LERRDs		25,300	0	0	4,540	11,890	6,530	2,310	30	0	0	25,300
TOTAL PROJECT COST	76,990	46,790	3,000	3,500	5,800	43,285	39,034	13,058	7,027	5,322	3,744	123,770

Sponsor Support

The Ventura County Watershed Protection District has expressed the desire for implementing the project and sponsoring project construction in accordance with the items of local cooperation that are set forth in the recommendations chapter of this report.

Financial Analysis

The non-Federal share for implementing and maintaining the project is expected to be obtained from a number of sources including State grants and local bond measures. The financial analysis indicates that the non-Federal sponsor is financially capable of participating in the Recommended Plan.

6. SUMMARY OF COORDINATION, PUBLIC VIEWS & COMMENTS

Public Involvement Program

A Public Outreach Group was established for the feasibility study, comprised of representatives from the Sponsor, the Corps, County Board of Supervisors, the Matilija Coalition, and other interested parties. This group worked closely together to develop a Public Involvement Plan for the feasibility study and the other studies within the watershed that the Steering Committee/Task Force oversees. Activities include:

- A newsletter published by the Matilija Coalition.
- A website to provide information on the study status, updates, meeting schedules and summaries. The website address is http://www.matilijadam.org.
- Development of a public outreach informational brochure and a public outreach matrix that identifies target audiences, project messages, and vehicles for administering public outreach.
- Preparation of newspaper articles.
- Watershed tours to the public and interested agencies.
- Video documentaries of the people and projects and studies that have affected the environment within the study area. Members of the Matilija Coalition are involved in the production of this documentary.

Public Workshop

A co-chaired public workshop was held in January 2002 to inform the public of the feasibility study and to solicit public input. Additionally, an overview of the NEPA/CEQA compliance regulations was presented along with the announcement of the initiation of the public scoping period. The intent of the scoping process was to encourage participation in the environmental review process from public agencies, special interest groups and the general public in the identification of the key issues and concerns relevant to the scope of the EIS/EIR. The response from the general public who attended the session was generally positive. Many of the participants voiced support for efforts to remove the dam, though there were also some concerns and questions regarding potential adverse impacts. Comments also included personal accounts of historical perspectives from Native Americans with ancestral ties to the region, and also from one of the members of the original survey crew that was involved in mapping the site where the dam was constructed. Various participants provided proposals for modifications to the dam that would allow for sediment delivery downstream. The transcript of the workshop and responses to comments have been posted on the website for the study.

Public Concerns

A number of public concerns have been identified during the course of the Appraisal Study (BOR), the Corps reconnaissance study and the Public Workshop. Initial concerns were expressed in the study authorization. Additional input was received through coordination with the sponsor and other agencies. The public and agency concerns formed the bases of the initial problem and needs statements addressed in this report, and have been summarized as follows, in no particular order:

1) Restoration of Steelhead Habitat - The steelhead habitat in Matilija Creek upstream from the dam was historically the most productive steelhead spawning and rearing habitat in the Ventura River system. Today, this represents 50% of the remaining steelhead habitat**.** As well as physical barriers, steelhead success within the watershed may be adversely affected by poor water quality in the Ventura River. Increased water temperatures, low dissolved oxygen levels, and potentially high nutrient loads may also affect the success of the steelhead trout in the Ventura River.

2) Habitat Changes - Removal of Matilija Dam would provide steelhead access to suitable spawning and rearing habitat upstream of the dam. Improvements to water quality within Matilija Creek/Ventura River (reduced temperatures, increased dissolved oxygen levels, among others) would reduce environmental stresses on steelhead and potentially improve breeding and survival rates.

3) Beach Nourishment - There may be potential beneficial uses of the accumulated sediment (behind the dam) to nourish the downstream beaches and protect development from coastal storm damage.

4) Flooding – The potential for flooding downstream of the dam should be investigated for dam removal measures. Additionally, any impounded dam sediment that is released downstream may deposit in reaches of the river and create areas prone to flooding as a result of loss of channel capacity.

5) Socioeconomic – Dam removal will result in a loss of water supply to the CMWD. Approximately 400 acre-feet of water per year would be lost as a result of the project. Historically, the water stored in the reservoir has also been used for fighting forest fires. The predicted filling of the reservoir over the next ten years would negate this concern.

6) Traffic – All public roads (that may be used to haul equipment, sediment and/or debris) are highly traveled and frequently congested. The project may impact traffic, may damage parts of the road (wear and tear), and may impact access to properties.

7) Bank Erosion - There may be a potential of bank erosion along the channel if the dam is removed. The dam has altered the natural profile of the creek, creating a milder slope upstream along Matilija Creek. If the dam and sediment is removed, and the creek is returned to its

natural profile, there is the possibility that the channel banks could erode, thus creating additional problems.

8) Reservoir Wetlands – More than 20 acres of land in the reservoir area upstream of Matilija Dam have developed into wetland type environments. These areas support numerous species of plant and animal life. Removal of the dam/sediment behind the dam would result in a loss of these wetland areas.

9) Ventura River Estuary – The effect of dam removal on the estuary will need to be considered. The estuary is located near the mouth of the Ventura River, and together with its associated wetlands, comprises about 100 acres.

10) Endangered Species – There are 35 special status species known or expected to occur from the aquatic, riparian, and wetland habitats in the study area including 17 listed species (endangered, threatened, or fully protected) and 18 California species of special concern.

11) Non-Native Vegetation – The giant reed (*arundo donax*) is a non-native riparian plant species that is recognized as a significant problem in the study area. There is an extensive population in the reservoir, as well as the length of the Ventura River. Removing this species and re-vegetating disturbed areas with native riparian species is a critical component of improving steelhead habitat and water quality. Salvaged uses of giant reed could also be considered.

12) Fish Passage – One of the preliminary alternatives is to keep the dam in place, or a portion of the dam, and construct a fish ladder for steelhead passage upstream to spawning grounds. There is evidence that fish ladders over 25 feet high are not effective at allowing fish passage.

13) Cultural Resources – Matilija Dam is potentially eligible for listing on the National Register of Historic Places (NRHP). In addition, there may be other NRHP resources present. Cultural Resources studies will be required to identify and evaluate all resources in accordance with Section 106 of the National Historic Preservation Act. Also, construction activities would have to mitigate for adverse impacts to the Matilija Hot Springs, downstream of the dam.

14) Dam Safety - The dam has been subject to concrete deterioration due to alkali-silica reaction. The original configuration has been modified by notching to relieve stresses on the dam.

15) Water Quality (Turbidity) – A dam removal project is expected to increase stream turbidity levels during deconstruction and may

continue to adversely affect water quality after deconstruction. The mechanical excavation and/or re-deposition of sediment, creek diversion, and dewatering activities have the potential to discharge turbid water downstream of the dam, even after going through a settling pond. Casitas Municipal Water District may be required to increase treatment of water that passes through Robles Diversion Dam. Poor water quality could have adverse consequences to the habitat and wildlife, especially on steelhead spawning habitat.

16) <u>Water rights</u> – Casitas Municipal Water District has water rights for Matilija Dam to 2009. Impounded water is used to supply customers along the Matilija Conduit. Alternate means by Ventura County water districts to supply these customers will be necessary in the future, especially if dam removal is considered and efforts commence prior to 2009.

17) <u>Air Quality</u> – Construction and removal operations (especially by trucking) would send large amounts pollutants into the air in the project area and the haul routes.

18) <u>Recreation</u> – Trout fishing may be restricted in areas that become accessible to the endangered steelhead. Currently the dam and reservoir are not accessible to the public. The removal of the dam and creation of a new Matilija Creek channel could provide additional wildlife habitat and recreational area for public use. During construction, if sediment disposal sites are used, there may be a safety hazard. Excessive sediment released downstream may cause wetland and riparian habitat degradation reducing passive recreation in these areas. If pipelines/conveyers are used, public access could be restricted to the Ventura River and beach areas. Property owners are concerned about trespassing, littering, vandalism, and other impacts should areas not open to the public become accessible.

19) <u>Project Costs</u> – The costs for an environmental restoration project may be substantial.

Public Review of Draft Report

Public review of the draft report was conducted during July and August 2004. A public meeting was held on July 28th at the Ventura County Watershed Protection District. The meeting was well attended by a diverse group of stakeholder interests. The public meeting transcript and the public comments and responses are provided under separate cover (see *Final Environmental Impact Statement/Environmental Impact Report (EIS/EIR) – Changes to Draft EIS/EIR – Responses to Comments on Draft EIS/EIR*).

Institutional Involvement

Study Team: During the feasibility study, staff from Ventura County, the State of California Coastal Conservancy and other Federal, State, Regional, and local interests participated in the Study Task Force and the study team, as described in Chapter 1 of this Report. They participated directly in the study effort and on the Executive Committee. This involvement has led to the general support for the implementation of the Recommended Plan, Alternative 4b.

Agency Participation: During the feasibility study, coordination with the U.S. Fish and Wildlife Service (USFWS) was conducted in accordance with the Fish and Wildlife Coordination Act. The USFWS has provided the Corps with a Planning Aid Report (PAR, July 2003). The USFWS has prepared a draft and final Coordination Act Report (CAR) that includes their views on the Recommended Plan. All USFWS recommendations have been given full consideration. The USFWS has coordinated their report with the National Marine Fisheries Service and the California Department of Fish and Game. The CAR provided by USFWS presents substantial information on ecosystem conditions including types of species and habitats, including threatened and endangered species related to the study area. The report also includes a preliminary evaluation of potential impacts associated with the alternative plans considered in the study. Based on this evaluation, the CAR provides recommendations as follows:

- Continued surveys for Federal endangered least Bell's vireo and southwestern willow flycatcher should be conducted in the present study area.
- To avoid impacts to nesting birds, a monitoring program for such activity should be developed in the project area, particularly in the vicinity of the reservoir.
- Surveys for bats should be conducted in the vicinity of the dam.
- An Arundo eradication project should be initiated prior to initiation of dam removal. Tamarisk and other non-native invasive plants encountered should also be removed. Measures to prevent the spread or introduction of these species, such as avoiding areas with established native vegetation, restoring disturbed areas with native species, and post-project monitoring and control of exotic species should be developed.
- An intensive eradication program for bullfrogs, crayfish, and green sunfish should be completed prior to initiation of a dam removal project both within the reservoir and downstream of the dam. Eradicating these species from the reservoir prior to dam removal will prevent any downstream relocation. Downstream eradication of non-native species may result in lower mortality to native species.
- A relocation plan for the California red-legged frog, southwestern pond turtle, coastal whiptail, two-striped garter snake, and other special status species should be developed and initiated prior to initiation of a dam removal project. Other native species should also be considered for possible relocation out of the project area.
- Revegetation and stream restoration programs should be developed prior to the start of any dam removal activities. A native plan nursery should be developed at or near the project site to provide a source of plants and trees for revegetation.

Cultivation of locally native tree species should be initiated as soon as possible to help incorporate multiple age class forests in the revegetation plan.

- A wildlife care facility should be contracted to treat sick, injured, or orphaned animals found in the study area.
- A reintroduction program for arroyo toad and California red-legged frog into the study area should be evaluated.
- There should be no-net loss of in-kind natural habitat.
- Mortality and injury to species within the project site could be reduced by minimizing and clearly demarcating the boundaries of the project areas and equipment access routes and locating staging areas outside of sensitive areas.
- Avoiding work activities during the breeding season would reduce adverse impacts to sensitive species.
- Improper handling, containment, or transport of individual species should be reduced or prevented by use of qualified biologists.
- The creation of nuisance ponds in the project area that may render native species vulnerable to predatory species should be avoided.
- Project workers should be informed of the importance of keeping the project site free of trash to avoid attracting predators to the project site, which could harass or prey on aquatic species.
- Project workers should be informed of the importance of preventing hazardous materials from entering the environment. Locating staging and fueling areas a minimum of 65 feet from riparian areas or other water bodies, and by having an effective spill response plan in place could reduce harmful effects and mortality to wildlife.
- Best management practices should be implemented and the area to be disturbed should be reduced to the minimum necessary to assist in reducing the amount of sediment that is washed downstream as a result of project activities.
- Project workers should be informed of the presence of species and the measures that are being implemented to protect them during project activities.
- In the event that the project proceeds forward with an alternative that releases sediments downstream of the dam, this recommendation is offered. Monitoring of benthic invertebrates, amphibians, reptiles, fishes, birds, vegetation, and wetlands should be considered downstream of the dam in Matilija Creek, Ventura River, and Ventura River estuary.

Additional Coordination

The final report on the study results and recommendations will be formally coordinated with a number of Federal and State agencies as required by Federal and state laws and policies. The final report includes a draft Coastal Consistency Determination, which will be submitted to the California Coastal Commission for their concurrence in the findings. The final report will also be submitted to the Regional Water Quality Control Board Office for their approval related to the Clean Water Act as well as regional Air Quality Control offices. The final report and proposed recommendations will be provide to the State Historic Preservation Officer for their approval on the impacts and recommendations associated with cultural and historic resources. Other Federal and State agencies that will receive copies of the final report for their review and approval include Federal and State Environmental Protection Agencies, the State Clearinghouse, and other agency interests. Other organizations have participated in the study process to date and that provided formal comments, particularly members of the Plan Formulation Group and other agencies listed in the *"Study Participants and Coordination"* section of the report (see Introduction Chapter).

Report Recipients

A mailing list of Federal, State, County, local and regional agencies, environmental organizations, and interested groups and individuals are available upon request. These interests will receive a Public Notice of the final feasibility report documents and other notifications on report and project decisions and status.

7. CONCLUSIONS

General

This Chapter summarizes the draft findings and conclusions of the Matilija Dam Environmental Restoration Study.

Construction of the 190-foot high Matilija Dam was completed in 1947 by the Ventura County Flood Control District to provide water storage for agricultural needs and limited flood control. This concrete arch dam is located about 16 miles from the Pacific Ocean and just over half a mile upstream from the Matilija Creek confluence with the Ventura River.

Problems associated with the dam were soon evident. These problems include: large volumes of sediment deposited behind the dam and the loss of the majority of the water supply function and designed flood control capability; the deteriorating condition of the dam; the non-functional fish ladder and overall obstruction to fish passage; the loss of riparian and wildlife corridors between the Ventura River and Matilija Creek; and the loss of sediment transport and resulting erosion to downstream reaches of the Ventura River, the estuary and the sand-starved beaches along the Ventura County shoreline.

Sedimentation behind the dam rapidly reduced the ability to store a significant amount of water for future use. A relatively small and shallow reservoir remains behind the dam, presently estimated to be about 500 acre-feet or 7% of the original capacity. It is estimated that approximately 6 million cubic yards of sediment (silts, sands, gravels, cobbles and boulders) has accumulated behind the dam. Currently Matilija Dam is subject to overtopping during storm flows.

By year 2040, the reservoir is expected to have reached an equilibrium condition and be completely filled with sediment totaling over 9 million cubic yards. As the dam overflows, full sediment loads from the upstream watershed will be carried downstream.

Historically, the Ventura River system supported a substantial number (approximately 4,000 to 5,000 spawning fish) of southern California steelhead, an endangered species of migratory trout. NOAA Fisheries most recent population estimates for steelhead are less than 100 adults for the entire Ventura River system. The steelhead habitat upstream from Matilija Dam was historically the most productive spawning and rearing habitat in the Ventura River system. It is estimated that about 17.3 miles of prime steelhead habitat was lost due to the construction of Matilija Dam.

Other physical barriers to fish passage include the Robles Diversion Dam, less than two miles downstream of Matilija Dam on the Ventura River. This dam diverts water from Ventura River to Casitas Dam, the remaining significant surface water supply for the Ventura watershed and surrounding areas. The Casitas Municipal Water District is currently pursuing restoration for fish passage at the Robles Facility and implementation is expected by 2005.

The problems and opportunities identified in this study were used to describe specific planning objectives that represent desired positive changes in the without project conditions and provided focus for the formulation of alternative plans. The primary ecosystem restoration study objectives are:

- Improve aquatic and terrestrial habitat along Matilija Creek and the Ventura River to benefit native fish and wildlife species, including the endangered Southern California steelhead trout.
- Restore the hydrologic and sediment transport processes to support the riverine and coastal regime of the Ventura River Watershed.
- Create recreational opportunities along Matilija Creek and the downstream Ventura River system.

Planning constraints also have been identified through the study process, particularly during meetings with the Sponsor, resource agency representatives and other stakeholders. Some of the key constraints that were considered in formulating and evaluating alternatives included:

- Maintain the current level of flood protection along the Ventura River downstream of Matilija Dam.
- Limit adverse impacts to normal water supply quantity, quality and timing of delivery to Casitas Reservoir via Robles Diversion Dam
- Limit impacts to water quality in Lake Casitas by potentially turbid flows resulting from the release of Matilija Dam trapped finer sediments.

Preliminary studies considered a wide range of alternative measures to provide positive outputs to the planning objectives, as well as consideration of the impacts and mitigations needed to address the major constraints. The initial screening of alternative measures and plans led to the comparison and evaluation of seven action alternatives evaluated in detail, organized into alternatives 1 through 4, with alternatives 2, 3, and 4 formulated with "a" and "b" options. The alternatives involved various combinations for removing the dam and reservoir sediments. The cost for the plans ranged from $104 million to $129 million, and benefits measured as increases in average annual habitat units ranged from 554 to 731 AAHUs. The final alternatives were analyzed based on cost effectiveness, and incremental cost analysis, considering changes to national economic development, environmental quality, regional economic development and social and other impacts. The tradeoffs to these accounts and between the plans were identified, as well as consideration of other evaluation criteria required by Federal laws and policies. The Plan that optimizes the increase in environmental benefits as compared to minimizing economic costs was identified as the National Ecosystem Restoration Plan (NER). The NER Plan is Alternative 4b. The Locally Preferred Plan is Alternative 4b with the addition of a desilting basin as a project associated feature.

The Recommended Plan is Alternative 4b. The Recommended Plan includes full dam removal in one phase. Portions of the trapped sediment will be removed by slurry line to a downstream 97-acre disposal site, in the proximity of Highway 150 Bridge, and the remaining two-thirds of trapped sediment will be contoured to restore a fish passage channel, allowing storms to naturally erode sediments downstream. Four sediment storage sites will be used in conjunction with the construction of the fish passage channel, and soil cement will protect these sites from erosion for the more frequent storm flows (less than 10 year return periods). These actions will lessen turbidity levels downstream, except for larger storm events, reducing potential adverse impacts to fish migration and water diversion activities along the Ventura River.

Removal of Matilija Dam will cause erosion trends downstream to reverse and become depositional trends, eventually restoring more stable (equilibrium) conditions to the Ventura River reaches. The deposition would recreate a riverine morphology, in terms of channel and riverbed materials characteristics, similar to pre-dam conditions. The estimated timeframe to reach equilibrium is approximately 10 years for the Recommended Plan.

The process of returning the river to pre-dam conditions will increase the flooding risk to infrastructure that has developed along the river corridor since the construction of the dam. The Recommended Plan includes features to mitigate the induced flood risk including removal of structures, replacement of a bridge, and raising and extending downstream levees and floodwalls.

The removal of Matilija Dam will also cause impacts to downstream water supply facilities. A sediment bypass structure and sediment desilting basin is proposed to reduce impacts to the Robles Diversion and Lake Casitas facilities, while construction of two wells at Foster Park is included to reduce impacts to City of Ventura facilities.

Ecosystem restoration measures also include exotic and invasive species removal and planting of native species in the downstream reaches. Recreation measures will also be implemented involving a system of trails and interpretive centers.

Ecosystem restoration benefits for this study have been prepared using a modified Habitat Evaluation Procedure (HEP) analysis. The Average Annual Habitat Units (AAHUs) have been computed over a 50-year period. The Recommended Plan will restore the Matilija Creek ecosystem to natural riverine predam conditions, thereby providing fish passage for the steelhead to over 17 miles of critical habitat. It is estimated that this can result in restoration of a healthy and sustainable adult steelhead population, similar to what existed prior to the construction of Matilija Dam.

The first cost for implementing the recommended plan is estimated to be $123,777,000 (Fiscal Year 2004 Price Levels), which includes costs for lands, easements, rights-of-way, relocations, and material disposal site; construction costs for the restoration and mitigation features, monitoring and adaptive management plan, associated costs for purchasing mitigation water, and recreation features. The estimate of first costs also includes the cost for preconstruction, engineering, and design (PED) and construction management. Operation and maintenance costs are estimated to be about $350,000 per year, and include rip rap protection for downstream levees, some sediment and debris removal around Robles Dam to maintain water supply diversions, and Arundo removal and control.

An economic analysis comparing the average annual costs of the recommended plan to the project outputs as defined by the increase in average annual habitat units, indicates a cost of about $10,130 per average annual habitat unit. The recommended plan would improve about 2,814 acres of the Matilija and Ventura River ecosystem. This reflects a first cost per acre of about $44,000. The recommended plan is considered justified when considering the significance of the output benefits as compared to project costs.

The environmental impacts of the recommended plan were evaluated in accordance with the requirements of the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA). The findings reflect the positive benefits of restoring the natural ecosystem to pre dam conditions. It also reflects that significant adverse impacts will occur to those areas affected by flood control and water supply mitigation measures. These generally include impacts to affected and adjacent habitats, aesthetics and vistas due to levee and floodwall construction, and other impacts associated with construction activities, and operation and maintenance requirements.

The non-Federal share of the cost of implementing the project is 35 percent of the first cost for implementing the project and 100 percent of the OMRRR costs. The project sponsor is responsible for providing 100 percent of the LERRDs for the project and will get credit for their value towards their 35 percent of the project. The sponsor is also responsible for 50 percent of the cost for implementing the recreation features and 100 percent of the OMRRR cost for the recreation features. There are a number of other items of local cooperation required by the non-Federal Sponsor, which is outlined in the report. At this time, the Ventura County Watershed Protection District has indicated their interest in proceeding with the Recommended Plan for authorization for construction.

A number of Federal, State, County, and local agencies as well as some other interests participated in the study as part of the Study Task Force or Working Group members. In general, there is strong support for the Recommended Plan.

8. RECOMMENDATIONS

I recommend that the Matilija Dam Ecosystem Restoration Plan recommended and described herein to restore the natural ecology within the Ventura River Basin be authorized for implementation as a Federal project, with such modifications thereof as in the discretion of the Commander, USACE may be advisable. The estimated first cost of the Recommended Plan is $123,777,000 and the estimated annual OMRR&R cost is $350,000. The Federal portion of the estimated first cost is $75,380,000. The non-Federal sponsor shall, prior to implementation, agree to perform the following items of local cooperation:

a. Provide 35 percent of the total project costs allocated to ecosystem restoration and 50 percent of the total project costs allocated to recreation, as further specified below:

(1) Enter into an agreement that provides, prior to execution of a project cooperation agreement for the project, 25 percent of design costs;

(2) Provide, during construction, any additional funds needed to cover the non-federal share of design costs;

(3) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project;

(4) Provide or pay to the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and

(5) Provide, during construction, any additional costs as necessary to make its total contribution equal to 35 percent of the total project costs allocated to ecosystem restoration and 50 percent of the total project costs allocated to recreation.

b. Provide during construction 100 percent of total project costs allocated to the desilting basin project feature.

c. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the local sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

d. Assume responsibility of operating, maintaining, replacing, repairing, and rehabilitating (OMRR&R) the project or completed functional portions of the project, including mitigation features and the desilting basin without cost to the Government, in a manner compatible with the project's authorized purpose and in accordance with applicable Federal and State laws and specific directions prescribed by the Government in the OMRR&R manual and any subsequent amendments thereto.

e. Maintain responsibility for the continued OMRR&R of the Ventura River channel flow capacity at the Santa Ana Bridge.

f. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

g. Hold and save the Government free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.

h. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.

i. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

j. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project.

k. Agree that, as between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and, to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

l. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by title IVk the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

m. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c)).

n. Provide the non-Federal cost share of that portion of total cultural resource preservation mitigation and data recovery costs attributable to ecosystem restoration that are in excess of one percent of the total amount authorized to be appropriated for ecosystem restoration.

o. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

p. Prevent obstructions of, or encroachments on, the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the ecosystem restoration, hinder its operation and maintenance, or interfere with its proper function, such as any new development on project lands or the addition of facilities which would degrade the benefits of the project.

q. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

David H. Turk
Colonel, US Army
Acting District Engineer

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