COMPREHENSIVE NEEDS ASSESSMENT FOR CHINOOK SALMON HABITAT IMPROVEMENT PROJECTS IN THE SAN JOAQUIN RIVER BASIN

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State of California

The Resources Agency

Memorandum

Date: March 25, 1994

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From: **Department of Water Resources**

Subject: Comprehensive Needs Assessment for Chinook Salmon Habitat Improvement Projects in the San Joaquin River Basin

This report presents the findings of a comprehensive needs assessment for chinook salmon habitat improvement projects in the San Joaquin River Basin. The report completes Contract FG20841F/165038 between the California Department of Water Resources and the California Department of Fish and Game.

Questions about the information in this report should be directed to Paula Landis of this office at (209) 445-5289.

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INTRODUCTION

The Department of Water Resources, with biological and fisheries assistance from the Department of Fish and Game, conducted a comprehensive assessment of salmon habitat in the San Joaquin River Basin. The assessment identified types and locations of projects that can be constructed to improve salmon habitat on the Stanislaus, Tuolumne, and Merced Rivers. The assessment will be used to develop priorities for a systematic approach to habitat restoration in the San Joaquin Basin. The purpose of this investigation was to develop a list of potential habitat restoration projects and their relative priorities for construction. This approach will make the best use of available funds and will provide immediate benefits to San Joaquin salmon populations. Past restoration projects were identified and constructed on an individual basis. Benefits were determined on a site-specific basis rather than in the context of the overall river system. A total of 46 sites were identified; 23 of those sites were determined to be high-priority sites. In addition to the overall assessment, preliminary engineering was provided for ten spawning riffles at seven sites. The preliminary engineering was provided to expedite project implementation. Four types of restoration projects were looked at: (1) restoration of salmon spawning riffles, (2) isolation of predator habitat, (3) improvement of the migratory path, and (4) enhancement of rearing habitat. The 46 sites identified as feasible fall into the first three categories.

SITE SELECTION CRITERIA

Biologists from the Department of Fish and Game and engineers from the Department of Water Resources surveyed salmon spawning reaches of the Stanislaus, Tuolumne, and Merced Rivers. The criteria used to assess potential sites include historic use by salmon, bed slope, channel width, water depth, water velocity, bank vegetation, substrate conditions, potential for habitat diversity, adjacent land use, construction access, and potential quantifiable benefits. The potential for habitat diversity was also considered in selecting sites. Sites less that 100 feet in length are not addressed in detail in this report.

Sites were prioritized based on (1) their biological value and (2) the combined engineering feasibility and cost of project construction. Biological values were determined by the Department of Fish and Game, and engineering feasibility and cost were determined by the Department of Water Resources. In each of these two categories, a site was rated from one to three, with one being the highest. The ratings for each category were then added together. A total rating of two indicated a high-priority site. A total of three or four indicated a medium-priority site, and a total of five or six indicated a low-priority site. Sites further upstream were given preference for preliminary engineering investigations.

Biological value, which was determined by the Department of Fish and Game, was prioritized as follows:

Rating	Rating Definition
1	Project will have significant long-term benefits for salmon spawning and/or rearing.
2	Project will have moderate long-term benefits for salmon spawning and/or rearing.
3	Project will have relatively short-term or low long-term benefits for spawning and/or rearing.

Engineering feasibility and cost, determined by the Department of Water Resources, were prioritized as follows:

Rating	Rating Definition
1	Project is technically feasible using proven methods in the basin; cost would be relatively low.
2	Project is technically feasible; cost would be moderate.
3	Project would involve complex design or application of unproven technology; cost would be relatively high.

RESTORATION

Four types of restoration were looked at: (1) restoration of salmon spawning riffles, (2) isolation of predator habitat, (3) improvement of the migratory path, and (4) enhancement of rearing habitat. Studies have shown that lack of spawning habitat and excess of predation are two of many factors limiting salmon production on the San Joaquin River system. Sites selected for restoration are primarily in the these two categories. However, each restoration design maximizes the habitat diversity potential of the individual site.

Restoration of salmon spawning riffles involves reshaping the channel to provide a predetermined depth, slope, and velocity. In addition, the gravel is either replaced or reconfigured for optimum use by salmon. A reshaped channel can include some or all of the following: resting pools, gravel point bars, terraces, and floodplains.

Rock weirs are sometimes used in a spawning reach to maintain grade, provide a drop in grade, or keep gravel from moving downstream in high flows. In addition, drop weirs allow flows through the gravel that provide oxygen to the eggs and wash away wastes and sediment. The weirs are constructed of large interlocking boulders placed in trenches perpendicular to the flow.

Isolation of predator habitat involves removing large, deep ponds containing warm, slow-moving water from the river active channel. Ponds of this type provide habitat for various fish species that prey upon out-migrating juvenile salmon. Generally the ponds are abandoned gravel mining pits with levees that have failed or are the result of major gold dredging operations. Restoration is accomplished by repairing the failed levee sections, improving existing levees to withstand high flow conditions, and directing the flow of the river away from the levees. Levee repair projects generally have a greater overall cost than construction of spawning riffles. However, greater benefits are also possible.

Improvement of the migratory path involves re-configuring the river to create meanders, resting pools, and a steady flow directed downstream. This steady flow is essential to directing out-migrating salmon smolts on their way to the ocean.

Enhancing rearing habitat requires the construction of areas for cover, resting and foraging.

PRELIMINARY COST ESTIMATES

Preliminary engineering and designs were completed between fall 1992 and fall 1993. The preliminary designs and estimated costs for ten riffles on the Stanislaus, Tuolumne, and Merced Rivers are shown in Appendices A, B, and C, respectively. Cost estimates include mobilization and demobilization of equipment, excavation, placement, revegetation, materials, design, construction, and permitting.

The designs and estimates provided in this report will be submitted to the Department of Fish and Game. Several State and federal funding sources are available; however, the agreement between the Department of Fish and Game and the Department of Water Resources to offset fish losses in relation to the Harvey O. Banks Pumping Plant (Four Pumps Agreement) will be the primary source of funding.

Monitoring of restored sites will be done by the Department of Fish and Game under an existing program. The monitoring information will be used to improve design and construction techniques for future restoration sites. Monitoring costs are not included in the estimated cost figures.

SITE ASSESSMENTS AND SELECTIONS

The assessments and selections of sites on the Stanislaus, Tuolumne, and Merced Rivers are presented below. Field studies of the sites were conducted from late 1992 through 1993.

Stanislaus River

Nine potential salmon habitat restoration sites were identified on the Stanislaus River during field studies conducted in fall 1992. Site locations and river miles are shown on Figure 1. Approximately 20 miles of river were surveyed, from Knights Ferry to Jacob Meyers Park. Six sites are high priority. Estimated sizes, brief descriptions, and rankings are shown in Table 1.

Three sites were selected for preliminary engineering. These sites are representative of different types of restoration projects. Two gravel replacement projects and a channel reconfiguration are proposed. The preliminary engineering and costs are shown in Appendix A. The three remaining priority sites and their descriptions are shown in Appendix D.

Tuolumne River

Approximately 26 miles of the Tuolumne River were surveyed, from La Grange Dam to Fox Grove. Sixteen potential salmon habitat restoration sites were located during surveys conducted in March 1993. All of the sites are spawning riffles. Site locations and river miles are shown on Figure 2. Seven sites are high priority. Estimated lengths, brief descriptions, and rankings are shown in Table 2. Channel widths vary from 75 to 100 feet wide, depending on location on the river and bank conditions. Preliminary engineering and designs have been completed on two sites and are outlined in Appendix B. The remaining five priority sites and their descriptions are shown in Appendix E.

Preliminary engineering is provided for Riffles 4A and 4B. Tim Ford, a biologist with the Turlock Irrigation District, and EA Engineering Consultants have stated that they consider restoration of Riffles 5A, 13A, and 13B greater priority than Riffles 4A and 4B. All five riffles are identified as high priority in this report.

Merced River

Approximately 20 miles of the Merced River were surveyed, from the Crocker-Huffman Dam to Oakdale Road. Twenty-one potential salmon habitat restoration sites were located during surveys conducted in 1993. Site locations and river miles are shown on Figure 3. Estimated lengths, brief descriptions, and rankings are shown in Table 3. Ten of the 21 sites are high priority. Preliminary engineering and designs have been completed on two sites and are outlined in Appendix C. The remaining eight sites and their descriptions are shown in Appendix F.

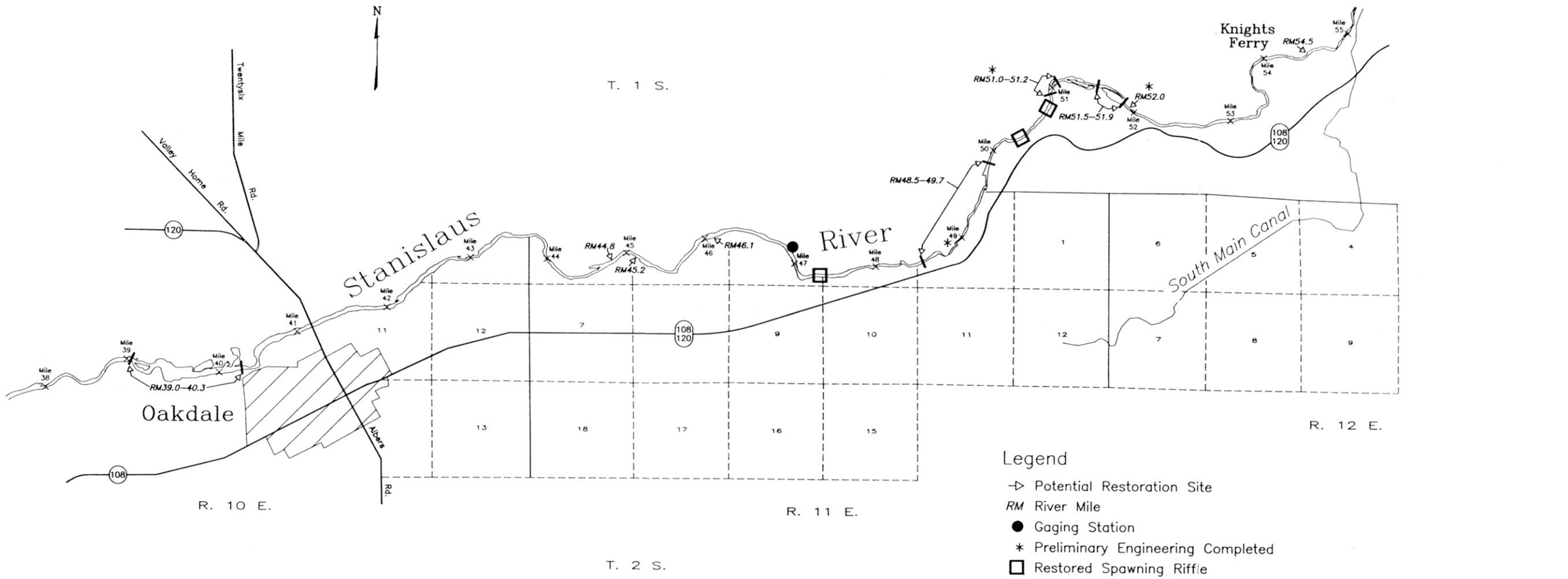

Figure 1. Stanislaus River, Salmon Habitat Assessment

DWR/SJD Jan. 1994 Prepared by P. J. Landis Drawn by K. Winden

TABLE 1

STANISLAUS RIVER
POTENTIAL SALMON HABITAT IMPROVEMENT PROJECTS

River Mile	Site	Approximate Length or Area	Habitat Type	Site Description	Project Description	Rank (B+E)*
54.5	Knights Ferry	50-75 feet	Spawning	Low-cost project. Area is used by salmon.	Enlarge spawning area. Use material on existing gravel bar to fill deep area of channel.	2+1
52.0**	Lover's Leap	300 feet	Spawning	Currently lots of cobble and silt. Good shade, slope and access.	Replace gravel.	1+1
51.6-51.9	Willms	50 acres	Predator	Breached levees. Flow passes through abandoned gravel pit.	Isolate predator habitat. Reconstruct approximately 1,500 feet of levee. Put river back into original channel and revegetate.	1+1
51.0-51.2**	Graupner	600 feet	Spawning	Good riparian and drop. Opportunity for habitat diversity.	Clear side channel. Use existing gravel.	1+1
48.5-49.7, 48.8-48.9**	Honolulu Bar	5,000 feet	Spawning	Opportunity for habitat diversity, riffle, pool, run sequence.	Replace gravel. Block off south channel to increase flow in north channel.	1+1
46.1	Rodden Road	600-700 feet	Spawning	Long reach with good drop. Near areas used for salmon spawning and rearing.	Replace gravel.	1+2
45.2-45.3	Dillwood Road	300-400 feet	Spawning	Good drop. Low-cost project.	Reconfigure channel. Use existing material on gravel bar.	1+1
44.7-44.9	Valley Oak	600-700 feet	Spawning	Good width, depth, velocity, and access.	Replace gravel.	1+1
39.0-40.3	Oakdale Recreation Area	150 acres	Predator	Mosaic of abandoned gravel pits with breached levees.	Isolate predator habitat by reconstructing 2,500 feet of levee and revegetate. Major project.	2+3

* B = biological value. E = engineering feasibility and cost.
** Preliminary surveying, design, and engineering estimates are completed.

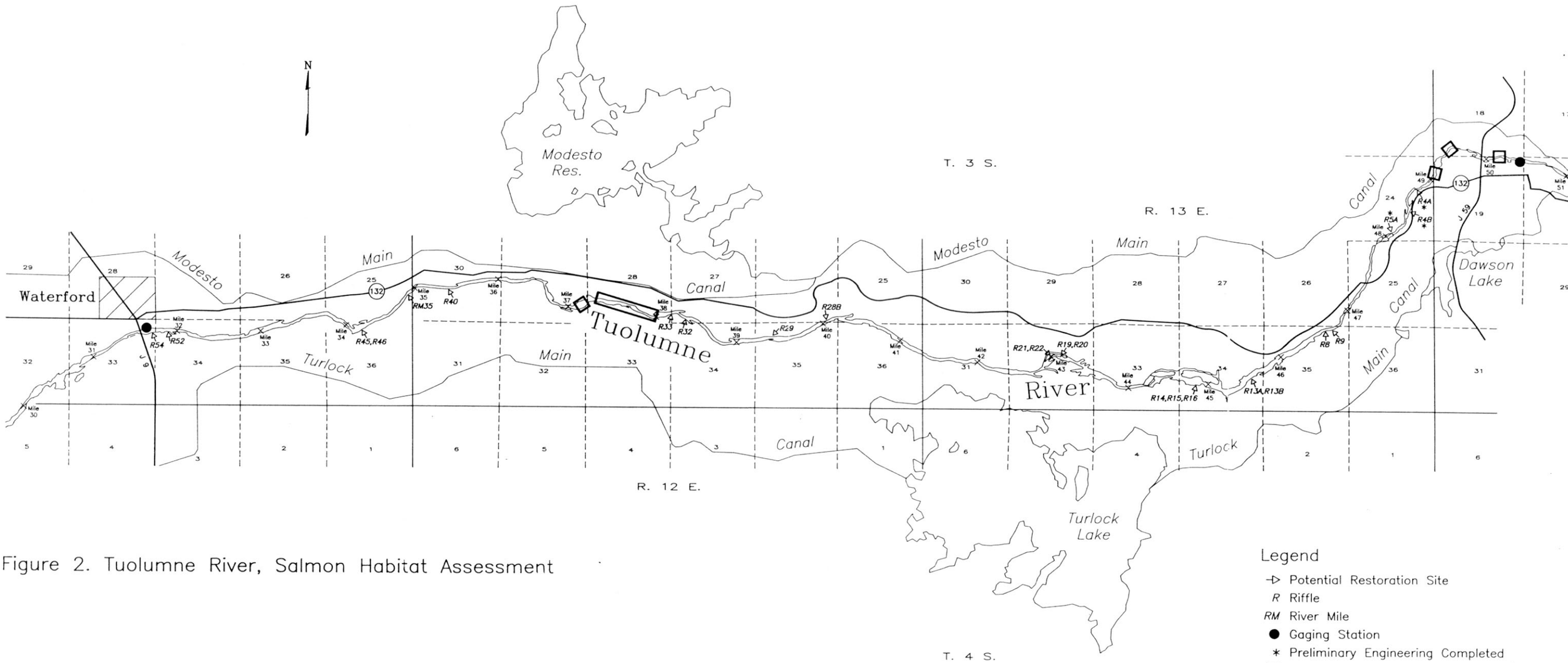

Figure 2. Tuolumne River, Salmon Habitat Assessment

Legend

- Potential Restoration Site
- *R* Riffle
- *RM* River Mile
- ● Gaging Station
- ✶ Preliminary Engineering Completed
- □ Restored Spawning Riffle

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TABLE 2

TUOLUMNE RIVER
POTENTIAL SALMON HABITAT IMPROVEMENT PROJECTS

River Mile	Riffle	Length (feet)	Habitat Type	Site Description	Project Description	Rank (B+E)*
48.5	4A**	400	Spawning	Wide, shallow channel. Cobble substrate.	Narrow channel using spoil material, remove cobble, add spawning gravel, and create diversity.	1+1
48.0	4B**	400	Spawning	Vegetation encroachment. Slow velocity.	Re-engineer for variation, reduce width. Construction combined with 4A.	1+1
47.5	5A	300	Spawning	Narrow, fast; large cobble, vegetation encroachment.	Re-engineer and replace gravel.	1+1
46.5	8A&9	300-450	Spawning	Split flow. Cobble substrate.	Replace or rip gravel.	1+1
45.5-45.6	13A&B	600	Spawning	Split flow, deep channel on north, vegetation on south.	Spread drop over length. Replace gravel.	1+1
45.0-44.6	14-16	1,100	Spawning	Split flow, good diversity.	Re-engineer channel, replace gravel, and clear out vegetation.	2+2
43.4-43.0	19-22	700-1,000	Spawning	Split flow, good diversity.	Replace gravel and remove vegetation.	1+1
40.7	27	150-200	Spawning	Deep, fast, good drop.	Replace gravel.	1+1
40	28	300	Spawning	Bedrock in middle.	Remove vegetation.	2+1
39.7	29	400	Spawning	Good drop.	Remove vegetation. Add terraces.	2+1
38.8	32	700-800	Spawning	Erosion on right bank.	Move channel to left. Work with gravel operator.	2+2
38.6	33	500	Spawning	Split flow.	Rechannelize. Replace gravel.	2+1
35.5	40	100-150	Spawning	Split flow, good drop.	Enlarge island.	2+2
34.3-34.2	45&46	200-400	Spawning	Diverse habitat.	Replace gravel.	2+2
33.2	52	200	Spawning	Poor access.	Replace gravel.	3+2
31.8	54	400	Migratory	No flow in original channel.	Move river back to original channel.	3+3

* B = biological value. E = engineering feasibility and cost.
** Preliminary surveying, design, and engineering estimates completed.

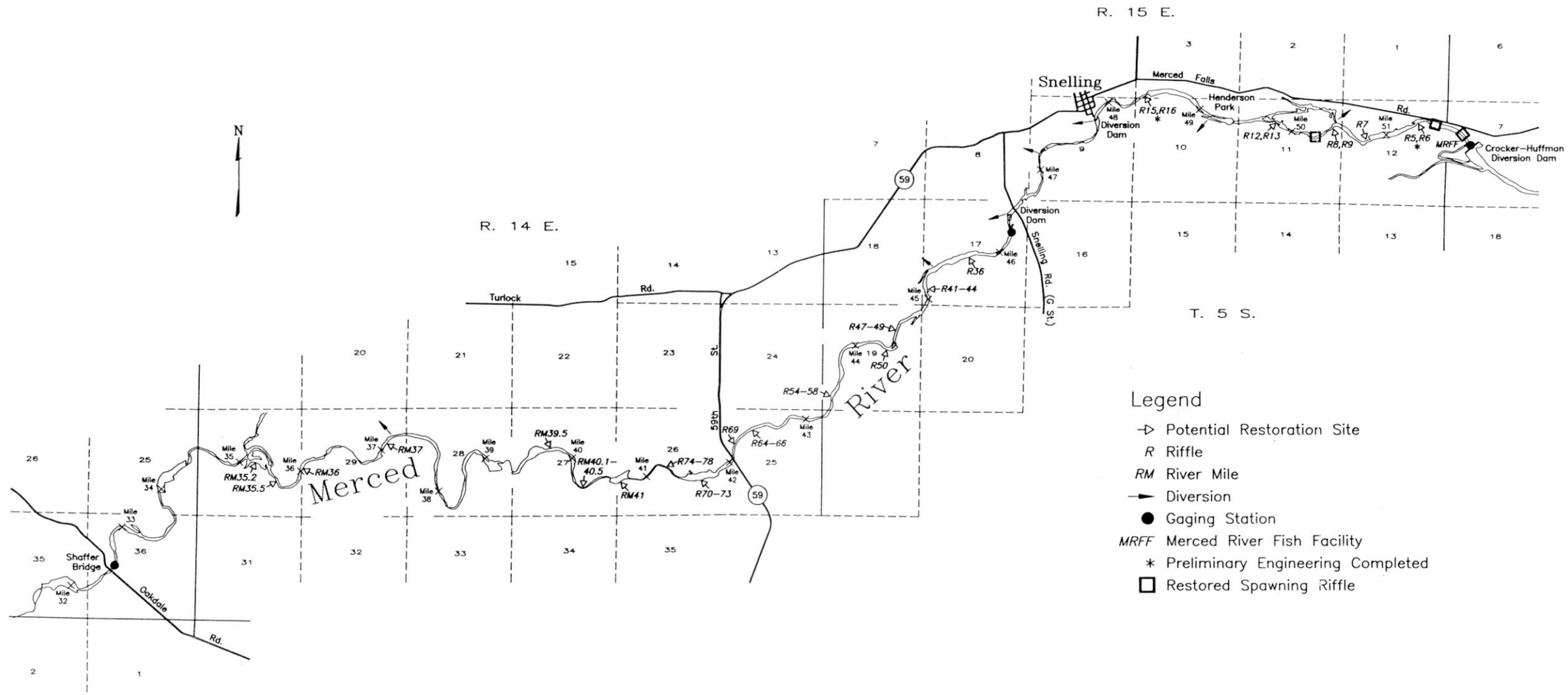

Figure 3. Merced River, Salmon Habitat Assessment

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TABLE 3

MERCED RIVER
POTENTIAL SALMON HABITAT IMPROVEMENT PROJECTS

River Mile	Riffle	Approximate Length or Area	Habitat Type	Site Description	Project Description	Rank (B+E)*
51.4**	5&6	600 feet	Spawning	Tall riparian on both sides. Good backwater area. Great drop and access.	Replace gravel.	1+1
50.6	7&7A	300 feet	Spawning	Vegetation on north side. Narrow. Poor access.	Replace cobble and add drop structure.	2+3
50.4	8	300 feet	Spawning	Good overhanging riparian. Good access off Merced ID road on north side. Possible split flow. 1.5-to-2-foot drop.	Replace gravel (large armored cobble).	1+1
49.9	12&13	400+400-foot split flow	Spawning	Good site. Combination of seven riffles over 700 to 800 feet. Access from dredger road on south.	Excavate substrate. Replace with spawning gravel.	1+1
48.4**	15&16	600 feet	Spawning	Great site. 2-to-3-foot drop over length. Great access from north.	Excavate substrate. Replace with spawning gravel.	1+1
46	36	100 feet	Spawning/ Predator	Side channel is choked with hyacinth.	Repair breach and cut off side channel from main channel.	2+1
45.5	41-44	700 feet	Spawning	Great site. Concerns regarding cattle. Existing cobble. Good drop and velocity. Good access.	Replace gravel.	1+1
44.8	47-49	600 feet	Spawning	Great site. Concerns regarding cattle. Existing cobble. Good drop and velocity. Good access.	Replace gravel.	1+1
44.5	50	500 feet	Spawning	Great site. Concerns regarding cattle. Existing cobble. Good drop and velocity. Good access.	Replace gravel.	1+1
43.5	54-58	800 feet	Spawning	Great site. Concerns regarding cattle. Existing cobble. Good drop and velocity. Good access.	Replace gravel.	1+1
42.7	64-66	800 feet	Spawning	Good access. Cattle concerns.	Replace gravel.	1+1

TABLE 3 (continued)

MERCED RIVER
POTENTIAL SALMON HABITAT IMPROVEMENT PROJECTS

River Mile	Riffle	Approximate Length or Area	Habitat Type	Site Description	Project Description	Rank (B+E)*
42.1	69	200 feet	Spawning	Great access.	Rechannelize. Combine with Caltrans bridge protection funds.	3+1
41.5	74-78	600 feet	Spawning/ Migratory	Split flow. Hyacinth blocking south channel.	Combine four gravel replacement projects with rechannelization. Possible elimination of erosion source.	2+1
41.5			Predator	Large pools in flow path. Need historic photos to determine original channel location.	Locate and repair levees. Create channel.	2+3
40.1-40.5		2,500 feet 200 acres	Predator	Huge ponds. Potentially significant benefits.	Minimal levee repair relative to benefits.	1+1
39.8	70-73	550 feet	Spawning	Good access.	Combine three sites. Replace gravel. Repair side channel.	2+1
39.5		400 feet	Spawning	Good access. Riparian on north bank.	Replace gravel.	2+1
37-37.1		450 feet	Spawning	Good site. Good access.	Replace gravel. Combine 150-foot riffle with 300-foot riffle.	2+1
36		400 feet	Spawning	Good site. Good access. Narrow. Good vegetation.	Could be widened.	2+2
35.5		400 feet	Spawning	Dirty gravel. Good access.	Needs to be ripped.	3+1
35.2		150 feet 20 acres	Predator/ Migratory	Flows exit channel through small diversion into a large pool.	Isolate pond. Minimal length of repair for large benefit.	2+1

* B = biological value. E = engineering feasibility and cost.
** Preliminary surveying, design, and engineering estimates completed.

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