CHAPTER 2.0

Description of Alternatives

This chapter presents alternatives that were developed to restore the natural production of anadromous fish on the Trinity River mainstem (as described in the purpose and need statement), as well as the no action baselines. Also presented are alternatives that were determined to be infeasible or inconsistent with the purpose and need, and therefore were not analyzed in detail. A summary of the fully analyzed alternatives is presented at the end of the chapter (Figures 2-7 and 2-8 and Tables 2-9 and 2-10).

The alternatives were formulated from public input, scientific information, and professional judgment, in a manner consistent with NEPA and CEQA. Analysis of the anticipated impacts associated with each alternative is presented in Chapter 3.

The alternatives were formulated from public input, scientific information, and professional judgment, in a manner consistent with NEPA and CEQA.

2.1 Alternatives

Four alternatives were identified as reasonable for meeting the purpose and need and goals and objectives:

- Maximum Flow
- Flow Evaluation
- Percent Inflow
- Mechanical Restoration

In addition, No Action and State Permit Alternatives were also fully analyzed. The No Action Alternative, or future without the proposed action, is the measure against which the environmental impacts and other aspects of the action alternatives were compared. Unless otherwise noted, the operations, policies, requirements, and other assumptions incorporated into the No Action are adopted into the other alternatives. The State Permit Alternative—although not a viable alternative because it would not meet purpose and need—is included because it functions as a baseline alternative for state permitting purposes (because the minimum Trinity River instream flow per Reclamation's SWRCB water rights permit is 120,500 af).

CEQA also requires that the Preferred Alternative be compared to an ***existing conditions*** baseline. The year 1995 was used as the existing conditions baseline because it was the date that the Bay-Delta Accord, signed December 15, 1994, was implemented by the SWRCB through Water Right Order 95-06, and because it was shortly after

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the NOP filed by Trinity County. The comparison of the Preferred Alternative to the existing conditions is presented in Chapter 3.

The Maximum Flow and Flow Evaluation Alternatives have variable flow schedules dependent on five ***water-year*** classes: critically dry, dry, normal, wet, and extremely wet. As shown in Table 2-1, historical records indicate that the likelihood of a normal water year occurring is 20 percent, and the likelihood of a critically dry year or extremely wet year is 12 percent for each. The proposed flow schedules for Maximum Flow and Flow Evaluation show the amount and timing of scheduled releases for each of the five water-year classes. The Percent Inflow flow schedule varies depending on the previous week's inflows above Lewiston Dam; however, for analytical purposes, flow schedules were identified for each of the five water-year classes. The No Action, Mechanical Restoration, and State Permit Alternatives all assume fixed annual flow schedules regardless of water-year class.

TABLE 2-1
Water-year Class

Water-year Class	Exceedance Probability	Occurrence Every 100 Years	Trinity Reservoir Inflow for Designation (af)
Critically dry	p > .88	12	<650,000
Dry	.60 < p < .88	28	650,000-1,024,999
Normal	.40 < p < .60	20	1,025,000-1,349,999
Wet	.12 < p < .40	28	1,350,000-1,999,999
Extremely wet	p < .12	12	>=2,000,000

In practice, the actual amount and pattern of water released from Lewiston Dam could on occasion exceed the flow schedules described in this DEIS/EIR. For example, releases may be increased for short periods to meet Safety of Dam criteria. Although the alternatives in this DEIS/EIR accommodate a wide range of hydrological, meteorological, and operational conditions, they cannot plan for all possible scenarios.

The Flow Evaluation, Percent Inflow, and Mechanical Restoration Alternatives include construction of two types of riverine rehabilitation projects—channel and side channel. Channel rehabilitation projects involve the mechanical removal of portions of ***riparian*** sand berms, which have built up since Lewiston and Trinity Dams were constructed. Side-channel projects are constructed parallel to the mainstem in existing high-flow channels along historic gravel and cobble bars. Other differences between the alternatives are described later in this chapter.

Although actions unique to some alternatives could be applied to all alternatives, they are not, for reasons of clarity and evaluation. For

example, the watershed protection component of the Mechanical Restoration Alternative could have been incorporated into the Flow Evaluation Alternative prior to analysis; however, keeping it separate allows for an evaluation of the TRFES as a stand-alone alternative. Similarly, an adaptive management program, as described under the Flow Evaluation Alternative, could have been incorporated into the Mechanical Restoration Alternative; however, the program would be more constrained in the latter alternative because of the reduced flows. Associating certain actions with certain alternatives in a DEIS/EIR does not preclude hybridizing alternatives in an ROD; both NEPA and CEQA allow decision-makers to integrate components from various alternatives if desired. A summary of the key features of the six alternatives is presented in Table 2-9.

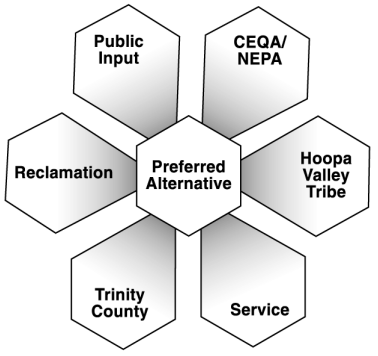
2.1.1 Selection of the Preferred Alternative

The Flow Evaluation Alternative, coupled with additional watershed protection efforts (described in the Mechanical Restoration Alternative), was identified as the Preferred Alternative in terms of best meeting the purpose and need and goals and objectives, while also minimizing adverse impacts. The selection of the Preferred Alternative also utilized the following screening criteria, which were jointly developed by the four co-leads (Service, Reclamation, Hoopa Valley Tribe, and Trinity County). The Preferred Alternative:

- Substantially increases natural production of anadromous fish on the Trinity River mainstem
- Substantially restores inriver and ocean fishing opportunities
- Improves tribal access to trust resources
- Balances environmental and social beneficial and adverse impacts across the Trinity River Basin, Lower Klamath River Basin/Coastal Area, and Central Valley Basin
- Allows for the continued operation of the TRD, including water exports
- Limits flooding impacts on the Trinity River

These screening criteria were developed not only to respond directly to the stated purpose and need (restoring and maintaining natural production of anadromous fish), but to minimize adverse impacts as a result of implementing the project. Given these criteria, the co-leads determined that the Flow Evaluation Alternative represented the best overall approach to substantially increasing natural production of anadromous fish and fishing opportunities, while allowing for continued water exports and flood control.

The Flow Evaluation Alternative, coupled with additional watershed protection efforts, was identified as the Preferred Alternative in terms of best meeting the purpose and need and goals and objectives, while also minimizing adverse impacts.



The watershed protection component of the Mechanical Restoration Alternative was included within the Preferred Alternative because the lead agencies believe it would enhance the benefits derived from the Flow Evaluation Alternative (although the model used to evaluate changes in fish production did not detect a measurable increase). Furthermore, the proposed watershed protection activities were included as part of the Preferred Alternative because (1) they have been determined in the past to help restore fish habitat by reducing sediment inputs to the Trinity River mainstem; (2) they are consistent with the ROD for the Northwest Forest Plan and its Aquatic Conservation Strategy to reduce upslope sediment production by improving drainage on necessary roads, while also decommissioning roads that no longer serve management purposes; (3) they are consistent with the Total Maximum Daily Load (TMDL) process established under the Clean Water Act, which has identified the Trinity River as a waterbody impaired by sediment and in need of remedial measures; and (4) a broad range of interest groups (e.g., environmentalists and Central Valley water users) specifically requested that non-flow watershed protection measures be fully considered for inclusion into the Preferred Alternative.

2.1.2 No Action Alternative

The No Action Alternative reflects conditions in the year 2020 and includes projections concerning future growth and land use changes.

The No Action Alternative represents ongoing activities and operations and is intended to meet the state CEQA Guidelines, §15126, as "a condition that would be reasonably expected to occur if the project were not approved." Components of this alternative are approved programs that have obtained all environmental clearances and permits. The No Action Alternative reflects conditions in the year 2020 and includes projections concerning future growth and land use changes per the DWR Water Plan Update (Bulletin 160-93). The year 2020 was identified as the planning horizon because of the interrelationship with the DWR Bulletin 160-93, data from the Trinity County General Plan, and the Central Valley DPEIS. The No Action Alternative includes assumptions concerning concurrent but separate issues, such as the assumption that ocean harvest limitations for sport and commercial salmon fishing would be consistent with 1992 policies and would be evaluated in a separate process by NMFS and other groups. The No Action Alternative does not assume implementation of any of the provisions or programs of the CVPIA, and is therefore identical to the No Action Alternative in the CVPIA Programmatic Environmental Impact Statement (PEIS) process.

Table 2-2 identifies the operations, policies, and regulatory requirements assumed in the No Action Alternative.

TABLE 2-2
Operations, Policies, and Regulatory Requirements Assumed in the No Action Alternative

Issue or Policy	Description
Acreage Limitations in Contracts	Existing acreage limitation regulations adopted to implement Reclamation Reform Act of 1982.
CVP Operations	Continued operations as presented in CVP-OCAP 1992 and other operational procedures for CVP, adjusted for biological opinions and water quality standards. (Biological Opinion [May 1995] for winter chinook salmon and delta smelt. Biological Opinion for winter chinook salmon assumptions include maintenance of minimum Shasta Reservoir carryover storage of 1.9 maf in all years, except in dryest 10 percent of years where reconsultation is needed. Monthly temperature targets at Bend Bridge and Jellys Ferry per the Biological Opinion, Bay-Delta Plan Accord, and SWRCB Order 95-06).
Contract Amounts for CVP (including shortage criteria)	Contracts would be renewed, per 1956 and 1963 Acts, prior to year 2020, including contracts with CVP and DWR associated with the Cross-Valley Canal. **Maximum Contract Amount:** Not-to-exceed existing contract amounts. Water deliveries not-to-exceed capacity of existing conveyance facilities. **Agricultural Water Service Contracts, Water Rights Contracts, and Exchange Contracts:** CVP water deliveries limited by maximum use between 1980 and 1993; projected use as addressed in environmental documentation; or maximum contract amount, whichever is less. Shortage criteria per, Operations Criteria and Plan (OCAP). **Municipal and Industrial Water Service Contracts:** Total demand based upon year 2020 demands in DWR Bulletin 160-93. CVP water deliveries limited by a) maximum use between 1980 and 1993; b) projected use as addressed in approved environmental documentation; or c) maximum contract amount, whichever is less. Shortage criteria with maximum shortage of 25 percent. **Refuges:** Delivery of Level 1 and Level 2 water supplies by existing suppliers. Shortage criteria using SWRCB Sacramento Valley 40-30-30 Index.
CVP Conservation Program	A long-term adaptive management program to address biological needs of special-status species, with an emphasis on habitat in areas affected by the CVP.
Coordinated Operations of CVP and SWP	Based upon COA framework with additional assumptions to implement new provisions of Bay-Delta Plan.
Delta Factors	Continued use of seasonal barriers at Old River and continued operation of Delta Cross-Channel gates.
Land Retirement	Retirement of 45,000 acres between 1992 and 2020 under existing State of California ***land retirement*** programs, per DWR Bulletin 160-93.

TABLE 2-2
Operations, Policies, and Regulatory Requirements Assumed in the No Action Alternative

Issue or Policy	Description
Minimum Instream Flow Requirements for CVP Facility	**Sacramento River:** Per SWRCB Order 91-01 and the Winter-run Chinook Salmon Biological Opinion. **American River:** Per Modified SWRCB D-1400 strategy of CVP operations with a fixed amount of flood control storage under the Corps interim requirements. **Stanislaus River:** Per SWRCB D-1422, including water quality standards on the San Joaquin River at Vernalis and ***dissolved oxygen*** requirements at Ripon; and 155,700 af/yr in all years but critically dry years, then 98,300 af/yr per initial studies conducted under the 1987 agreements with CDFG and the Service. **Trinity River:** Per Secretary's 1991 Decision and CVPIA 3406(b)(23) a flow not less then 340,000 af/yr in all years.
Shortage Criteria for State Water Project	Monterey agreement provisions for SWP.
Non-CVP Water Users	Use water demands in DWR Bulletin 160-93.
Power Marketing	Existing agreement between United States and Pacific Gas and Electric Company (PG&E) would not be renewed. Project use load met at all times.
Red Bluff Diversion Dam (RBDD) Gate Closure	Mid-May through mid-September per Winter-run Chinook Salmon Biological Opinion.
Tracy Direct Loss Mitigation Agreement	Reduces and offsets direct fish loss associated with operations of the Tracy Pumping Plant and Fish Facility.
Water Conservation	Water conservation levels based on assumptions presented in DWR Bulletin 160-93 for all water users, plus requirements by 1982 Reclamation Reform Act for CVP contractors.
CVP Rate Setting and Water Pricing	Existing rate setting and cost-allocation policies, and ability-to-pay policies per Reclamation Mid-Pacific Region Policies, including 1988 policies, and Reclamation Reform Act draft rules and regulations.
Water Transfer	CVP water can be transferred between ***CVP water service contractors***. SWP water can be transferred per the Monterey Agreement, and water rights holders can transfer water under SWRCB guidelines.
Water Rights	Total water rights would be delivered in all water-year classes (except in shortage conditions) even if water rights had not been previously fully utilized.
U.S. Department of Agriculture (USDA) Farm Commodities Program	Program would remain in place and would follow 1992 policies.

Water Management. The flow schedule for the No Action Alternative is based on existing CVP operations and Section 3406(b)(23)(B) of the CVPIA, which states:

> "If the Hoopa Tribe and the Secretary do not concur, the minimum Trinity River instream fishery releases established under this paragraph (340,000 af annually) shall remain in effect unless increased by an Act of Congress, appropriate judicial decree, or agreement between the Secretary and the Hoopa Valley Tribe."

The No Action release pattern (called a ***hydrograph***) is shown on Figure 2-1. The TRD would be operated such that not less than 340,000 af of water would be released annually, regardless of water-year class. Although this quantity of water could be exceeded in the future for other purposes, such as Trinity Reservoir Safety of Dams releases (U.S. Bureau of Reclamation, 1979), this alternative assumes an annual flow not less than 340,000 af. ***Spills*** and other releases in excess of proposed flow schedules are assumed to continue for all alternatives, and are included in the analysis in Chapter 3 in the context of monthly projected reservoir inflows and storage. The PROject SIMulation Model (PROSIM) used in identifying water supplies does not take into account daily or weekly flood control operations, which generally vary substantially from monthly values. Refer to the Water Resources / Water Quality Technical Appendix A for a more detailed analysis of projected Safety of Dam releases.

(Under the No Action Alternative) the TRD would be operated such that not less than 340,000 af of water would be released annually, regardless of water-year class.

Water Operations. It is assumed that the CVP, including the TRD, would operate on the basis of the current (1992) CVP-OCAP, as well as on the stipulations included in various water quality standards and in the long-term Biological Opinion for the Sacramento River winter chinook salmon (National Marine Fisheries Service, 1993), and the 1995 Biological Opinion for Delta smelt (U.S. Fish and Wildlife Service, 1995). In addition, this alternative includes operating the CVP and SWP in accordance with the COA, and it complies with the December 15, 1994 Bay / Delta Accord Principles of Agreement. Exports from Lewiston Reservoir to the Sacramento River would typically be highest in the spring to achieve temperature needs on the upper Sacramento River and to meet other CVP demands. Trinity Reservoir would be operated to maintain a minimum ***carryover storage*** of 400,000 af between water years (i.e., on October 1).

Watershed Protection. It is assumed that the following programs and ordinances, relating to overall watershed protection in the Trinity River Basin, would continue:

- Watershed protection under the jurisdiction of U.S. Forest Service (USFS) and BLM would continue, including implementation of existing land management plans and the ROD on the President's Northwest Forest Plan (U.S. Department of Agriculture and U.S. Department of the Interior, 1994).

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- Trinity County's Decomposed Granite Grading Ordinance (No. 379) would be enforced for lands and projects under its jurisdiction.
- California Forest Practice Rules that regulate activities on private lands within the Trinity River Basin, which require erosion control measures that in turn minimize sediment inputs into the river, would be enforced by California Department of Forestry and Fire Protection.
- Implementation of the South Fork Trinity River Action Plan would continue. The Plan includes: watershed restoration to reduce sediment sources, upgrading inefficient irrigation systems and dedicating the saved water to instream fishery flows, cattle exclusion fencing to decrease sediment inputs and improve water quality, and riparian plantings to help decrease water temperatures and conserve streambanks.
- BLM would continue to acquire sensitive lands in the Grass Valley Creek watershed and along the Trinity River mainstem corridor.

The No Action Alternative assumes …dredging of sediment control ponds in Grass Valley Creek, operation of Buckhorn Reservoir, placement of spawning gravel, and maintenance of the 27 existing channel rehabilitation projects…would continue.

Fish Habitat Management. The No Action Alternative assumes current habitat improvement projects and programs—such as the dredging of sediment control ponds in Grass Valley Creek, operation of Buckhorn Reservoir, placement of spawning gravel, and maintenance of the 27 existing channel rehabilitation projects—would continue. These projects are administered by a variety of federal and state agencies.

The existing 27 channel rehabilitation projects constructed between the early 1980s and 1994 would be mechanically maintained. If side channels are blocked by sediment two or three times following sediment removal, those projects would be abandoned.

Spawning gravel would be placed as needed along the river below Lewiston Dam. Spawning gravels would be obtained from such sources as the Trinity River mainstem, Grass Valley Creek sedimentation ponds, and from available dredger tailing sites upstream of the Trinity River confluence with the North Fork Trinity River. The gravels would be screened to eliminate fine sediments, which are detrimental to fish habitat. Spawning gravel placement for this alternative is estimated to average 3,400 cubic yards (yd^3) per year; however, much of the placement is associated with Safety of Dam releases (i.e., gravel placement volumes would likely be significantly higher in wetter years). Spawning gravel needs excluding Safety of Dam releases are estimated to range from 600-750 yd^3 annually.

Fish Population Management. Fishing would continue under current harvest plans approved by the Klamath Fishery Management

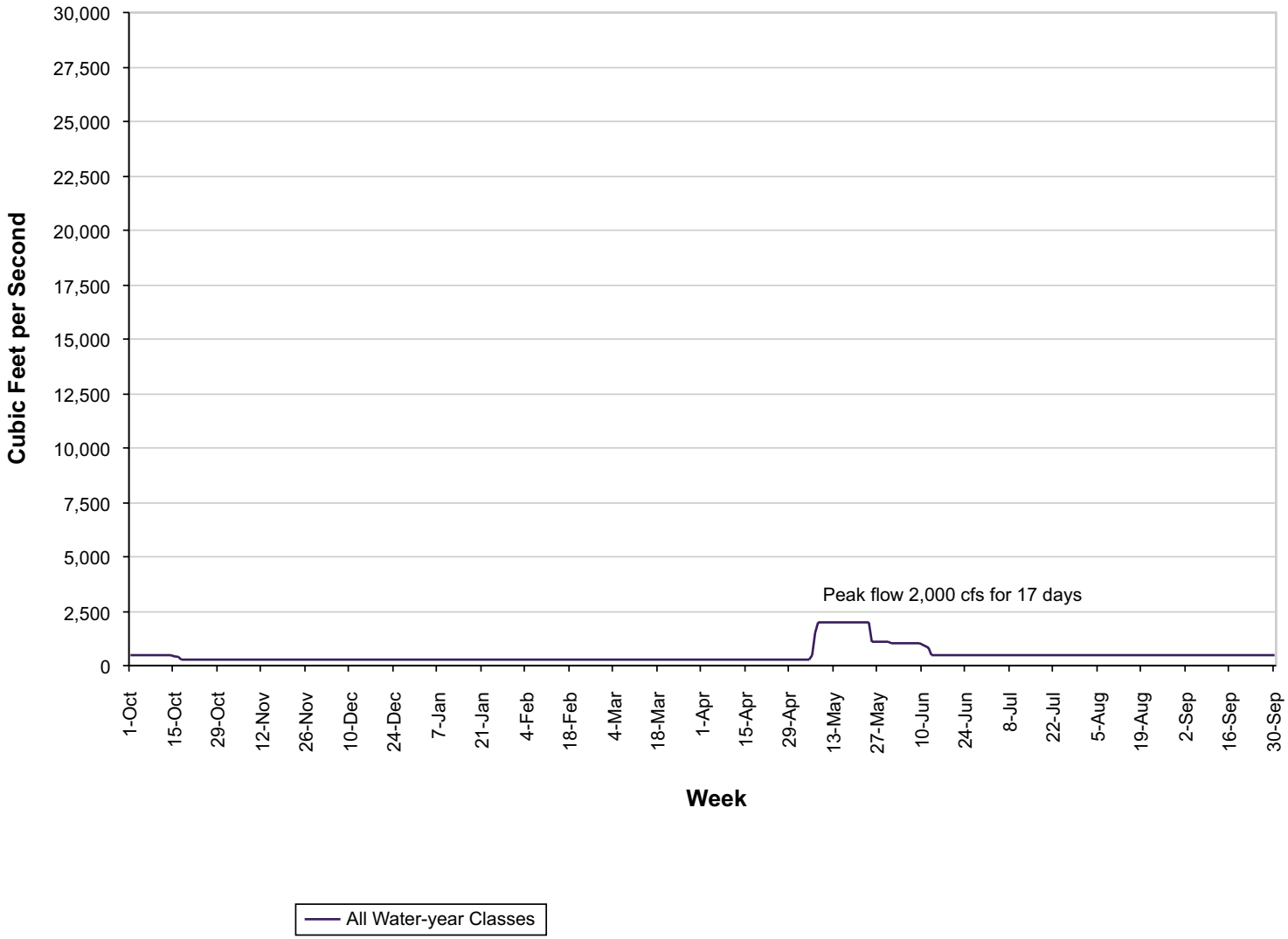

FIGURE 2-1
NO ACTION HYDROGRAPH
TRINITY RIVER MAINSTEM FISHERY RESTORATION EIS/EIR

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Council (KFMC) and the PFMC. Fisheries that do not have comprehensive management plans would continue to be managed by the responsible agencies or tribes. The TRSSH would continue to produce fish at current levels, as shown in Table 2-3.

TABLE 2-3
Trinity River Salmon and Steelhead Hatchery Production

Species	Egg Take	Smolt Release	Yearling Releases
Spring chinook	3,000,000	1,000,000	400,000
Fall chinook	6,000,000	2,000,000	900,000
Coho	1,200,000	N/A	500,000
Steelhead	2,000,000	N/A	800,000

Dam Modifications. The No Action Alternative assumes no modifications of Trinity or Lewiston Dams.

Estimated Costs. To manually remove vegetation from all 27 sites would cost a total of $1,000 every 3 years. To mechanically remove root systems on channel rehabilitation projects, and to modify side-channel openings as needed, would cost a total of $3,000 every 5 years.

Spawning gravel costs were derived from estimates of gravel requirements and costs of dredging, sifting, purchase, transportation, and placement. For this alternative, the spawning gravel requirements were estimated to average 3,400 cubic yards per year (yd^3/yr). A cost of $20 per yd^3 was estimated for dredging and sifting, purchase, transportation, and placement. Average annual spawning gravel costs were therefore estimated at $68,000 (with significant inter-year variability due to Safety of Dam releases).

2.1.3 Maximum Flow Alternative

The Maximum Flow Alternative would use all of the Trinity River inflows above Trinity Dam to restore the river ecosystem through managed flows, which would include periodic ***peak flow*** releases (30,000 ***cubic feet per second [cfs]***) that would promote streambed movement and restoration of pre-dam ***channel geomorphology***. These occasional large releases would occur in extremely wet water years and would be intended to approximate pre-dam floods. This alternative restores and maintains the river and its fishery resources using only flows and spawning gravel placement.

The Maximum Flow Alternative would use all of the Trinity River inflows above Trinity Dam to restore the river ecosystem through managed flows.

Water Management. Annual releases would vary by water-year class, as shown in Table 2-4.

The release pattern for each water-year class is shown on Figure 2-2.

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TABLE 2-4
Annual Volumes and Peak Releases—Maximum Flow Alternative

Water-year class	Acre-feet	Peak Flow (af)
Critically dry	463,000	2,000
Dry	889,000	3,800
Normal	1,206,000	5,429
Wet	1,508,000	6,786
Extremely wet	2,146,000	30,000

Peak flow releases and timing: 30,000 cfs/5 days in May (extremely wet years only)

Water Operations. This alternative plans for no exports to the Central Valley because the water entering the Trinity Reservoir would be needed to meet the flow schedule shown in Table 2-4 and on Figure 2-2. The alternative calls for a ramping up of releases as early as January (depending on water-year class); hence, Reclamation would need to modify its methods of determining water-year classes (i.e., make their determinations earlier). The alternative assumes that Trinity Reservoir would be operated to maintain a minimum carry-over storage of 400,000 af between water years. (Although other action alternatives assume a minimum carryover of 600,000 af for temperature benefits, the high peak flows associated with this alternative preclude an increase in minimum carryover.)

Watershed Protection. Watershed protection practices under this alternative would be the same as the No Action Alternative.

Fish Habitat Management. Because this alternative assumes periodic major flow events with the ability to dramatically reshape the river, no mechanical rehabilitation projects would be constructed, nor would mechanical maintenance be needed for existing projects.

This alternative's large releases would transport and distribute more spawning gravel than any other alternative. Estimates of spawning gravel replacement average 16,400 yd^3/yr, ranging from 0 yd^3 in critically dry years to more than 100,000 yd^3 during extremely wet years (a lack of data from large magnitude flows precludes a more precise upper-end estimate). The actual amounts of gravel placement would be determined by ongoing monitoring.

Fish Population Management. Fish population management under this alternative would be the same as the No Action Alternative.

Dam Modifications. Trinity Dam would be modified to accommodate the increased peak flows associated with this alternative (modifications to Lewiston Dam would not be necessary). Modifications to Trinity Dam would affect the release capability and, therefore, the Safety of Dams operational requirements. One of the

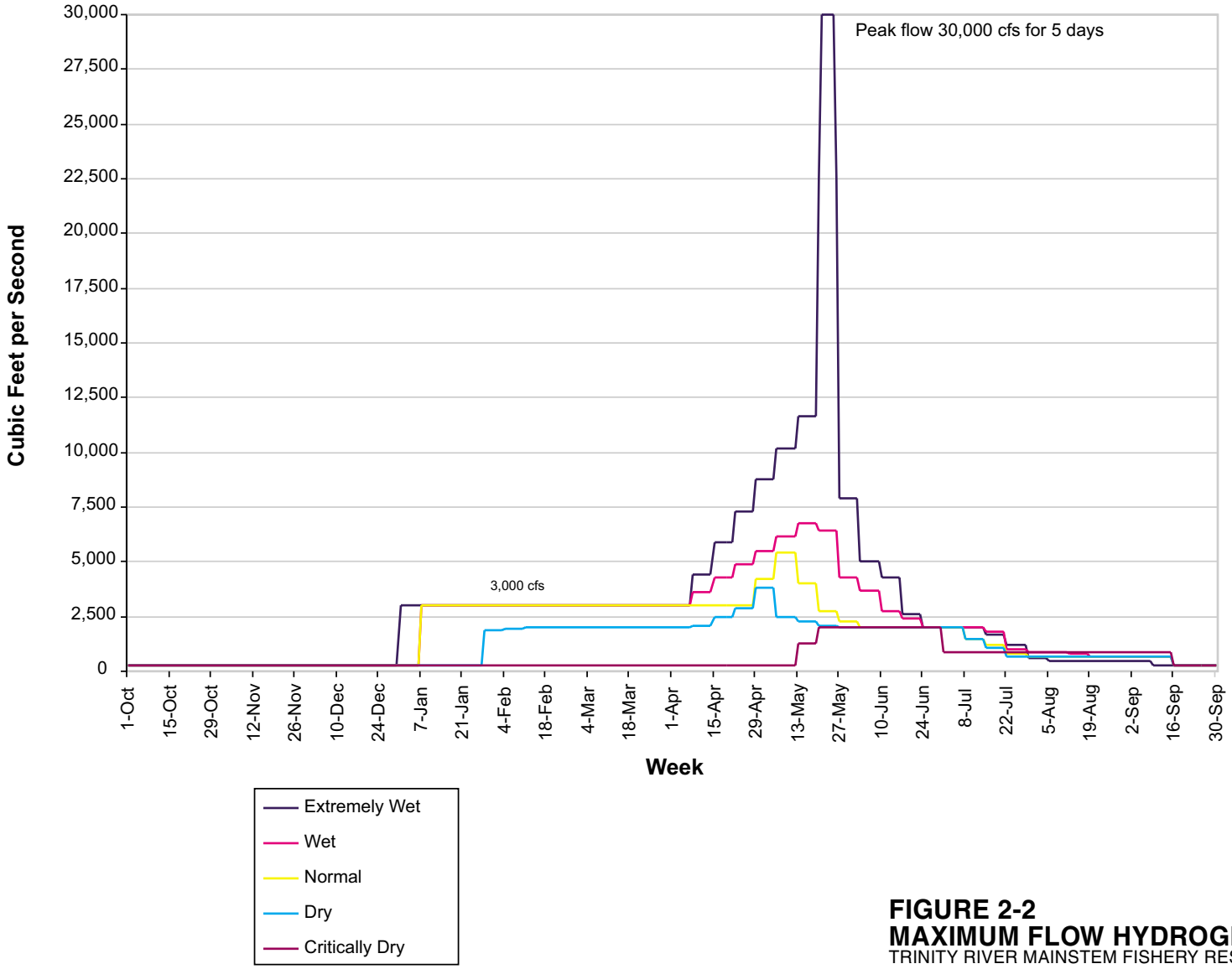

FIGURE 2-2
MAXIMUM FLOW HYDROGRAPH
TRINITY RIVER MAINSTEM FISHERY RESTORATION EIS/EIR

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following options could be used for these modifications (the options would be fully evaluated in a subsequent environmental document):

- **New penstock and tunnel connection—**Construction would take a minimum of 1 year and include the installation of an 11-foot-diameter penstock, one new guard and regulating gate, a control structure, and a one-half acre stilling basin at Trinity Dam. It would also require the construction of a tunnel connection between the main outlet and the fixed-crest morning-glory ***spillway*** tunnel, plus a gate chamber housing a guard and a regulating gate.

- **Tunnel connection and spillway ring gate—**Construction would take a minimum of 1 year and include construction of a tunnel connection between the main outlet and the spillway tunnel at Trinity Dam, plus a gate chamber housing a guard and a regulating gate. It would also require replacing the fixed-crest morning-glory spillway with a 54-foot-diameter sliding ring gate.

- **New penstock and spillway ring gate—**Construction would take approximately 1 year and include construction of an 11-foot-diameter penstock, one new guard and regulating gate, a control structure, and a 0.5 acre stilling basin at Trinity Dam. It would also require replacing the fixed-crest morning-glory spillway with a 54-foot-diameter sliding ring gate.

Similar equipment would be needed for all three methods, such as boom cranes, concrete batch and mixing plants, backhoes, dump-trucks, concrete trucks, pumps, and drilling equipment. A temporary construction staging area would be required for each method, ranging in size from 6-12 acres.

A new stilling basin and control house would be constructed in the river for the penstock-and-tunnel-connection and the penstock-and-spillway-ring-gate methods. This work would start with the installation of a temporary cofferdam and dewatering facilities, continue with the construction of the stilling basin and control structures, and end with the removal of the cofferdam and the restoration of the river channel. These activities would last about 6 months, during which reservoir releases would occur through the auxiliary outlet. The auxiliary outlet connects to the spillway tunnel and chute, which discharges about 600 feet downstream from the embankment toe.

New access roads would not be required for any of the methods, provided the dam crest road could be reserved for contractor use only. All existing roads and temporary staging areas that were used for construction would be restored to pre-project conditions.

Estimated Costs. Cost estimates for each of the three Trinity Dam modification options (U.S. Bureau of Reclamation, 1996) are:

- New penstock and tunnel connection—$72,980,000
- Tunnel connection and spillway ring gate—$63,600,000
- New penstock and spillway ring gate—$23,080,000

Spawning gravel costs are estimated to average $328,000 annually, ranging from $0 to over $2,000,000.

2.1.4 Flow Evaluation

The Flow Evaluation Alternative...would restore the river ecosystem necessary for the restoration and maintenance of the fishery through managed flows and mechanical rehabilitation projects. Flows would be higher than the No Action Alternative in all water-year classes.

The Flow Evaluation Alternative is based on recommendations in the TRFES (U.S. Fish and Wildlife Service and Hoopa Valley Tribe, 1999). The alternative would restore the river ecosystem necessary for the restoration and maintenance of the fishery through managed flows combined with mechanical rehabilitation projects. Flows would be higher than the No Action Alternative in all water-year classes. Flow volumes and timing are designed to address both habitat and temperature needs for all riverine life stages of salmonids. Peak flows are designed to support the physical processes necessary to maintain habitat in an alluvial river.

The Flow Evaluation Alternative also includes an adaptive management program. The adaptive management program would operate within the bounds of the TRFES recommendations. Adaptive management is a formal, systematic, and rigorous program of learning from the outcomes of management actions. Adaptive management accommodates change and improves management. Decision-makers use adaptive management programs to manage environments characterized by complexity, shifting conditions, and any remaining uncertainty.

The Flow Evaluation Alternative also includes an adaptive management program.

The Flow Evaluation adaptive management program would combine assessment and management by using conceptual and numerical models and the scientific method to develop and test management choices. The adaptive management program would assess the effects of reservoir operations, instream flows, and mechanical habitat manipulations on biotic resources of the Trinity River. Specifically, the program would (1) define objectives in measurable terms; (2) develop hypotheses, build models, compare options, and design system manipulations and monitoring programs; (3) propose modifications to operations that protect, conserve, and enhance biotic resources; and (4) implement monitoring and research programs to examine how selected management actions meet resource management objectives.

As described in the TRFES, the adaptive management program would be administered by an executive director appointed by the Secretary. The director would oversee a Trinity management council

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composed of fishery agency representatives. The council would serve as a policy group that reviews, modifies, accepts, or remands recommendations made by a technical modeling and analysis team. Also included in the process would be a scientific advisory board, a stakeholder's group, and external peer reviewers. The adaptive management program would typically convene in the winter to make decisions concerning the coming year's dam releases and other management actions (for a complete description of the adaptive management program see U.S. Fish and Wildlife Service and Hoopa Valley Tribe, 1999).

The adaptive management program could result in minor modifications to the Flow Evaluation hydrographs described in this DEIS/EIR. Any modifications resulting from the adaptive management program would be subject to additional NEPA and CEQA analysis as required by law. All mechanical ground-disturbing actions originating from the adaptive management program, regardless of whether they are described in this document, would be subject to site-specific environmental review.

Water Management. Annual releases would vary by water-year class as shown in Table 2-5.

TABLE 2-5
Annual Volumes and Peak Releases—Flow Evaluation Alternative

Water-year Class	Acre-feet	Peak Flow (af)
Critically dry	369,000	1,500
Dry	453,000	4,500
Normal	636,000	6,000
Wet	701,000	8,500
Extremely wet	815,000	11,000

Peak flow releases and timing: 11,000 cfs/5 days in May (extremely wet water-year class only)

(The Flow Evaluation Alternative) was developed to address the needs of each of the life stages of the anadromous fish present in the Trinity River, including the ability of the river to move sediment and reshape itself.

The release pattern for each water-year class (Figure 2-3) was developed to address the needs of each of the life stages of the anadromous fish present in the Trinity River, including the ability of the river to move sediment and reshape itself (i.e., ***fluvial geomorphic process***). Flow releases are different for each water-year class because different geomorphic processes are addressed in different water-years, as was the case prior to dam construction. Four primary components were identified and are addressed by the release patterns:

- **Summer/fall temperature control flows (July 1 through mid-October)**—These were developed in response to summer and early fall conditions when warm water temperatures are a concern for holding and spawning spring chinook salmon.

NCRWQCB criteria follow: from July 1 to September 14, temperatures no greater than 60 degrees Fahrenheit (°F) at Douglas City; from September 15 to September 30, temperatures no greater than 56°F at Douglas City; and from October 1 to December 31, temperatures no greater than 56°F at the confluence with the North Fork. Generally, flows of 450 cfs would be required during these periods to meet these temperatures.

- **Salmonid spawning/rearing flows (mid-October through late April/mid-May depending on water-year class)**—These were developed to provide suitable spawning and rearing habitat for chinook and coho salmon and steelhead. Flows of 300 cfs would be released during this period, since effective spawning has been observed at this flow level. In addition, such flows would provide habitat, minimize the potential for dewatering of ***redds***, and protect early life stages of salmonids.

  Fluvial geomorphic/salmonid smolt temperature control flows (late April/mid-May through June 30)—These were developed to provide fluvial geomorphic processes and suitable temperature and flow conditions for outmigrating salmonid smolts. Peak flows of 11,000 cfs would be released for 5 days beginning May 24 during extremely wet water years to assist in geomorphic processes such as mobilizing sediment, scouring the riverbed, reshaping the channel, and removing encroaching vegetation. The peak levels would vary for each water-year class, down to a minimum of 1,500 cfs in critically dry years. During such years, these flows would not be sufficient to recontour the channel, but would help prevent the germination of unwanted vegetation.

- **Ramping rates (all times of year)**—Refers to the rate at which flow releases are either increased (ramped up) or decreased (ramped down). The ramping rates were developed to mimic natural ramping rates for the Trinity River.

Exporting water through the Clear Creek Tunnel during summer/early fall results in water moving quickly through Lewiston Reservoir, thereby not allowing the water to warm.

Water Operations. The timing of diversions through the Clear Creek Tunnel would be shifted from spring/summer to the summer and early fall periods to maintain suitable release temperatures for the inriver fishery resources. Summer/fall is a critical period for holding/spawning spring chinook salmon, migrating/spawning fall chinook salmon, and holding summer steelhead. Shifting exports to the summer/early fall maintains coldwater reserves in Trinity Reservoir for use in the Trinity River, versus exporting this water earlier to assist coldwater maintenance in the Sacramento River. Additionally, exporting water through the Clear Creek Tunnel during summer/early fall results in water moving quickly through

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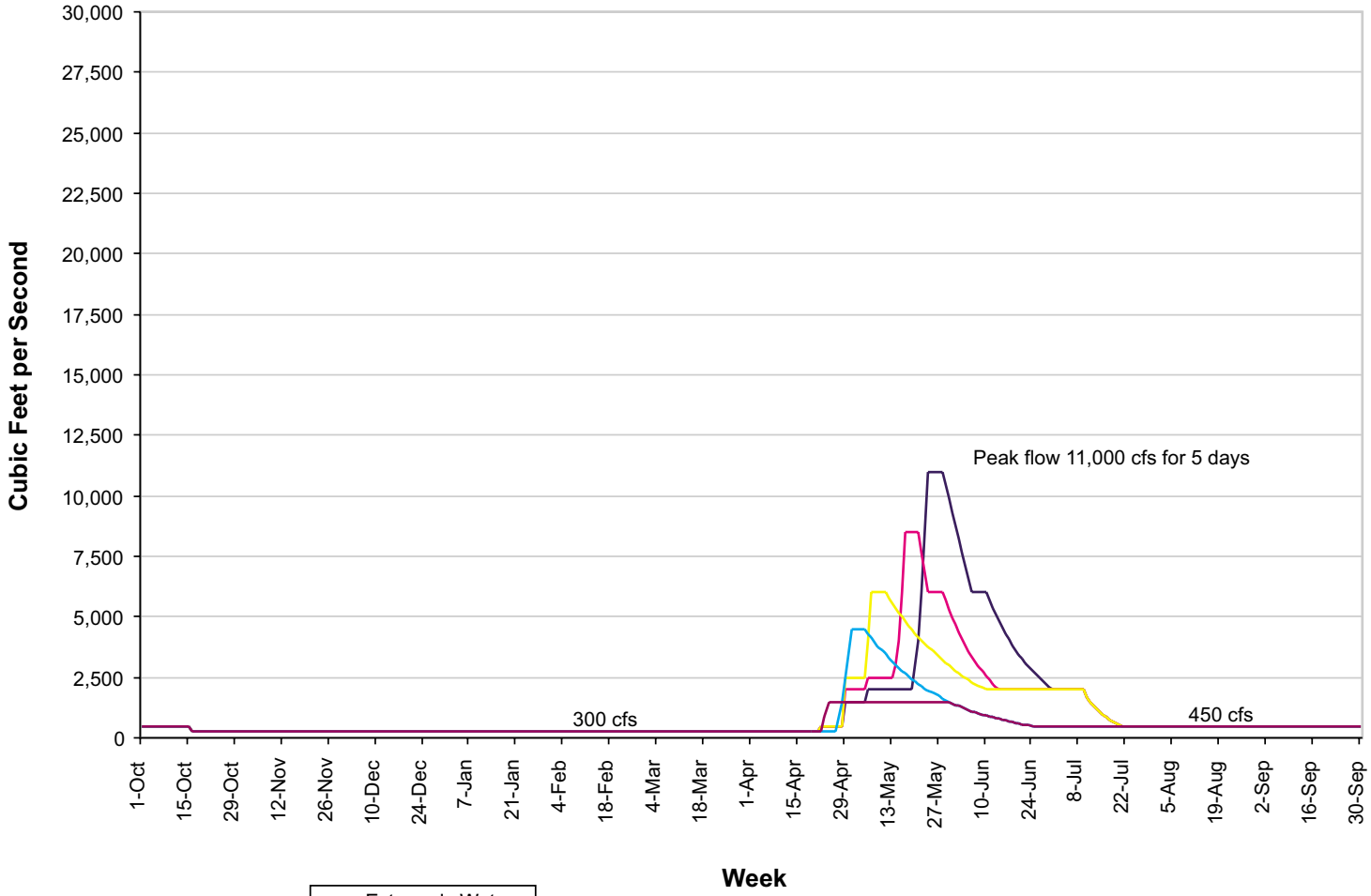

FIGURE 2-3
FLOW EVALUATION HYDROGRAPH
TRINITY RIVER MAINSTEM FISHERY RESTORATION EIS/EIR

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Lewiston Reservoir, thereby not allowing the water (which is eventually released from Lewiston Dam) to warm. The alternative assumes that Trinity Reservoir would be operated to maintain a minimum carryover storage of 600,000 af between water years. The increased carryover provides cooler water for dam releases for the benefit of the inriver fishery resources.

Watershed Protection. Watershed protection practices under this alternative would be the same as the No Action Alternative.

Fish Habitat Management. Forty-seven mechanical rehabilitation projects would be constructed because the flow schedule associated with this alternative is too low to remove the existing riparian berms along the river. Figure 2-4 shows the location of each proposed rehabilitation site as well as existing sites. Once portions of the berms are mechanically removed, high flows and gravel transport would naturally create and maintain dynamic alluvial features and floodplain riparian communities. Consequently, no mechanical maintenance would be planned for the proposed or existing channel rehabilitation projects.

(Under the Flow Evaluation Alternative,) once portions of the berms are mechanically removed, high flows and gravel transport would naturally create and maintain dynamic alluvial features and floodplain riparian communities.

The proposed mechanical rehabilitation projects would involve the following:

- A total of 47 mechanical rehabilitation projects would be constructed between the Lewiston Dam and the confluence with the North Fork Trinity River. The sites would encompass approximately 665 acres. Construction would be scheduled between July 15 and September 15 to minimize impacts to fall chinook, coho, and steelhead.
- Of these 47 mechanical rehabilitation projects, 44 would be channel rehabilitation projects, and the remaining three would be side-channel projects. Twenty-four of the channel projects would be built in the first 3 years, with the remainder to be completed contingent upon an evaluation by the adaptive management program. A typical mainstem rehabilitation project would be approximately 150 feet wide (measured from the water's edge) and 500-5,000 feet long. A typical side-channel improvement would be 80 feet wide and 800 feet long.
- A typical project would take 6 weeks to construct and would require the use of front-end loaders, bulldozers, screens, and trucks.

Spawning gravel placement would average about 10,300 yd^3 annually, with an estimated range from 0 yd^3 in critically dry water years to 49,100 yd^3 in extremely wet water years (actual amounts would be determined by ongoing monitoring). The estimates

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assume that there would be no need for additional gravel placement as a result of Safety of Dam releases.

Fish Population Management. Population management under this alternative would be the same as the No Action Alternative.

Dam Modifications. The maximum release of 11,000 cfs associated with this alternative would not require modification to either Trinity or Lewiston Dams.

Estimated Costs. The cost of constructing the 47 new channel rehabilitation projects follows: 44 channel rehabilitation projects at $300,000 each and three side-channel projects at $50,000 each. Of the total cost of $13,350,000, approximately 55 percent is expected to be incurred in the first 3 years.

Spawning gravel costs are estimated to average $206,000 annually, with a range of $0 in critically dry water years to $982,000 in extremely wet water years.

Preliminary cost estimates for the adaptive management program range from $2,450,000-$4,450,000 annually. Because of the inherent flexibility of adaptive management, future costs may vary from preliminary estimates.

2.1.5 Percent Inflow Alternative

The Percent Inflow Alternative would approximate natural flow patterns, at a reduced scale.

The Percent Inflow Alternative would approximate natural flow patterns, at a reduced scale, by releasing water into the Trinity River at a proportion of the rate it flows into Trinity Reservoir. Lewiston Dam releases would change weekly, with releases for any given week equal to approximately 40 percent of the previous week's Trinity Reservoir inflow. Each year's release schedule would be unique, varying according to the hydrology of a specific year. The 40 percent figure is based on House Report No. 602, 84th Congress, May 16, 1955, and Senate Report No. 1154, 84th Congress, July 27, 1955, which state that approximately 704,000 af would be diverted to the CVP; that figure leaves approximately 41 percent for the Trinity River. There is no minimum instream release built into the alternative; however, the maximum release would be 11,000 cfs. That figure is comparable to 40 percent of the highest recorded inflow above Trinity Dam.

Water Management. Annual flows would vary each year. However, for comparison and modeling purposes, Table 2-6 presents the average annual release for each water-year class.

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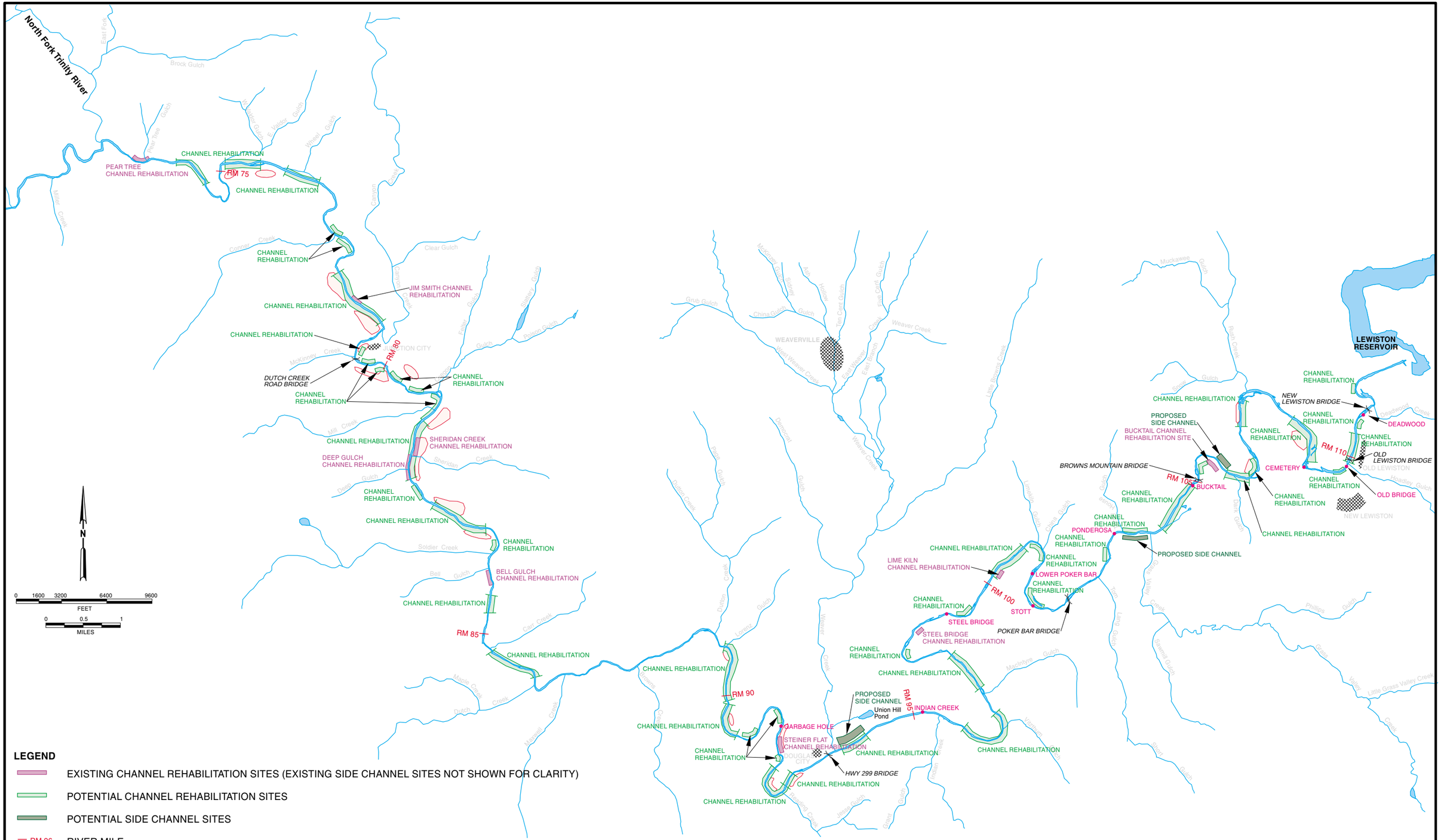

LEGEND

- EXISTING CHANNEL REHABILITATION SITES (EXISTING SIDE CHANNEL SITES NOT SHOWN FOR CLARITY)
- POTENTIAL CHANNEL REHABILITATION SITES
- POTENTIAL SIDE CHANNEL SITES
- RM 96 — RIVER MILE
- GOLD MINING DREDGER TAILINGS (APPROXIMATED FROM 1975 AIR PHOTOS)
- POTENTIAL DREDGING POOL LOCATIONS

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Source: McBain & Trush

FIGURE 2-4
TRINITY RIVER
EXISTING AND POTENTIAL
CHANNEL REHABILITATION SITES
TRINITY RIVER MAINSTEM FISHERY RESTORATION EIS/EIR

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TABLE 2-6
Annual Volumes and Peak Releases—Percent Inflow Alternative

Water-year Class	Acre-feet	Peak Flow (af)
Critically dry	165,000	696
Dry	325,000	1,306
Normal	443,000	1,740
Wet	655,000	2,476
Extremely wet	978,000	3,745

Peak flow over modeled hydrologic record: 11,000 cfs

Table 2-7 shows the predicted frequency and magnitude of peak releases at Lewiston Dam (based on the historic record of inflow above Trinity Dam).

TABLE 2-7
Projected Distribution of Percent Inflow Peak Releases Based on Historical Flows

Flow Threshold (cfs)	Percentage of Years
1,500	88
2,000	76
3,000	50
5,000	15
6,000	6
8,500	4
10,000	1
11,000	1
14,000	0

The release pattern for each water-year class is shown on Figure 2-5.

Water Operations. The timing of diversions through the Clear Creek Tunnel would be altered similar to the altered diversion timing for the Flow Evaluation Alternative. Diversions would be shifted to the summer and early fall to maintain suitable release temperatures for the inriver fishery. Trinity Reservoir would be operated to maintain a minimum carryover storage of 600,000 af between water years. The increased carryover, relative to No Action, provides cooler water for dam releases for the benefit of the inriver fishery.

Watershed Protection. Watershed protection practices under this alternative would not differ from the No Action Alternative.

Fish Habitat Management. This alternative would incorporate the same mechanical channel rehabilitation projects and schedule described in the Flow Evaluation Alternative; however, since this alternative does not include an adaptive management program, a less systematic review of the projects would be conducted at year 3 before commencing on the balance of the proposed projects. As in the Flow Evaluation Alternative, the Percent Inflow Alternative assumes that flow alone would maintain the proposed and existing

projects. Consequently, no mechanical maintenance would be necessary. Spawning gravel requirements for this alternative are estimated to average 950 yd^3/yr, with a range from 0 yd^3 in critically dry water years to 4,650 yd^3 in extremely wet water years. These estimates assume that no gravel placement would be necessary as a result of Safety of Dam releases.

Fish Population Management. Population management under this alternative would be the same as the No Action Alternative.

Dam Modifications. Reviews of historic hydrology, in terms of weekly inflows to the Trinity Reservoir, indicate the maximum release would be about 11,000 cfs. Accordingly, no modification to either Trinity or Lewiston Dams was assumed necessary.

Estimated Costs. The cost of constructing the 47 new channel rehabilitation projects follows: 44 channel rehabilitation projects at $300,000 each and three side-channel projects at $50,000 each. Of the total cost of $13,350,000, approximately 55 percent is expected to be incurred in the first 3 years.

Spawning gravel costs are estimated to average $19,000 annually, with a range of $0 in critically dry and dry water years to $93,000 in extremely wet water years.

2.1.6 Mechanical Restoration Alternative

(In the Mechanical Restoration Alternative the) rehabilitation projects would be mechanically maintained because the relatively limited flows…would be insufficient to promote adequate streambed and sediment mobilization.

This alternative depends on mechanical means to restore fish population. Flows would be maintained at not less than 340,000 acre-feet per year (af/yr). The level of mechanical rehabilitation projects identified in the Flow Evaluation and Percent Inflow Alternatives would be the same for this alternative. However, unlike those alternatives, the mechanical rehabilitation projects would be mechanically maintained because the relatively limited flows associated with this alternative would be insufficient to promote adequate streambed and sediment mobilization.

A key element of this alternative would be the inclusion of an extensive watershed protection component, which would limit sediment inputs into the mainstem Trinity River.

Water Management. Annual releases would be identical to those for the No Action Alternative (see Table 2-1).

Water Operations. The diversion pattern and carryover storage requirements would be identical to those for the No Action Alternative.

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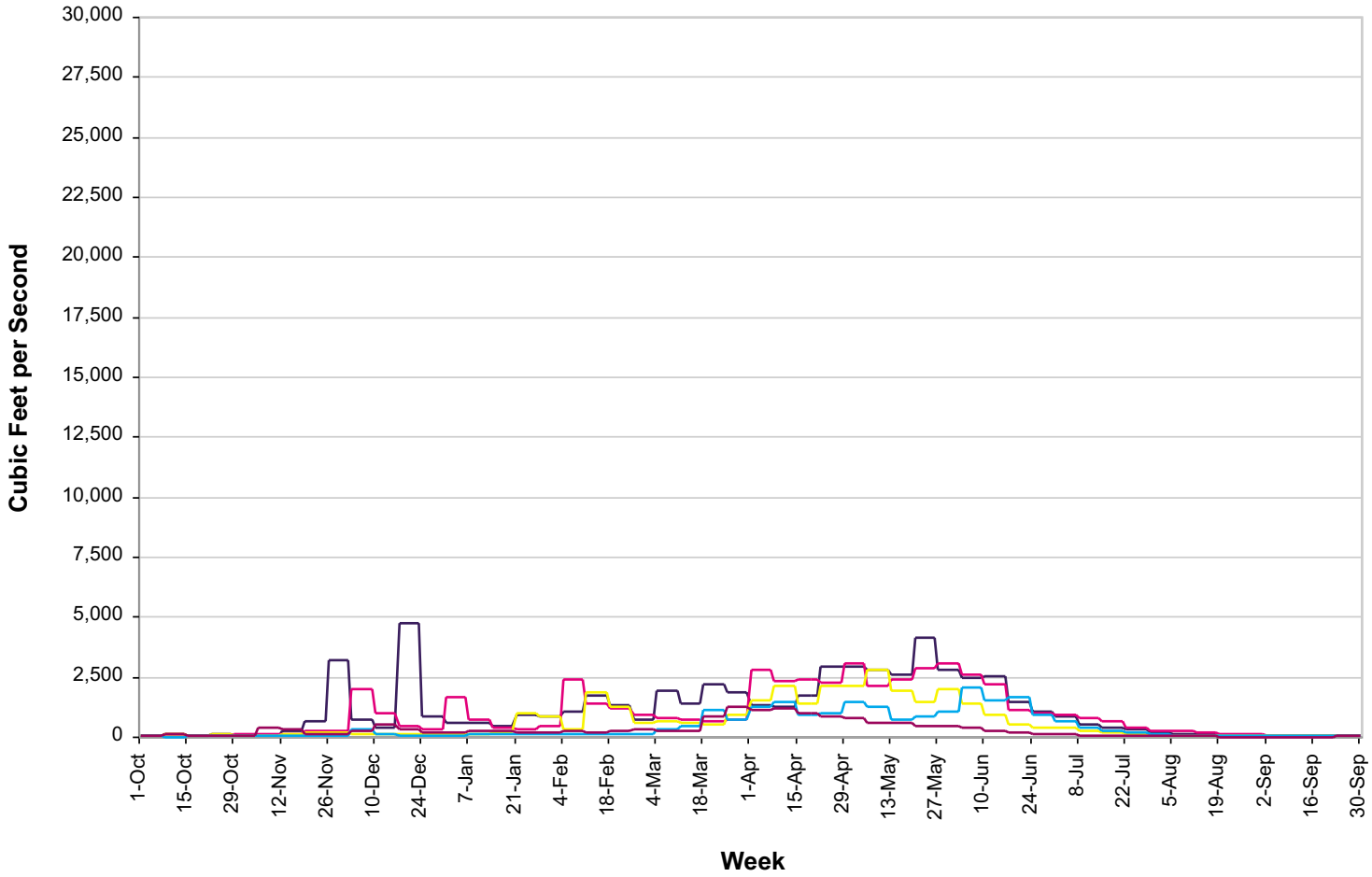

NOTE:
Water year in parenthesis. Weekly releases are 40 percent of modeled reservoir inflow for the previous week. This set of hydrographs presents releases that would have occurred in actual water years.

FIGURE 2-5
PERCENT INFLOW HYDROGRAPH BASED ON REPRESENTATIVE YEARS
TRINITY RIVER MAINSTEM FISHERY RESTORATION EIS/EIR

2655_420 (8/5/99)

Watershed Protection. The Mechanical Restoration Alternative would include measures to limit sediment inputs into the mainstem Trinity River beyond those assumed under the No Action Alternative, including accelerated road decommissioning, road maintenance, and road rehabilitation on public and private lands. These additional measures would essentially represent a modification of a portion of a 1993 proposal by the Committee for Healthy Communities in Healthy Forests, as endorsed by the Trinity BioRegional Group and Trinity County for implementation of the President's Forest Plan.

The Mechanical Restoration Alternative would include measures to limit sediment inputs…including accelerated road decommissioning, road maintenance, and road rehabilitation.

Accelerated road decommissioning, road maintenance, and road rehabilitation would primarily be focused on public lands within Trinity National Forest watershed (South Fork and mainstem areas below Lewiston Dam), which contains approximately 3,450 miles of mostly unpaved roads. The area would also include a small portion of the Six Rivers National Forest in the lower South Fork and lower mainstem watersheds, as well as the private lands and county roads within the entire Trinity River watershed. This type of proposed work is identified as critical in restoring salmon and steelhead habitat as part of the ROD on the President's Forest Plan (Option 9: U.S. Department of Agriculture and U.S. Department of the Interior, 1994). The USFS, through the plan, adopted new Riparian Management Zone Standards and Guidelines prescribing improved standards for roads and decommissioning of those roads deemed unnecessary.

Road decommissioning would consist of removing culverts, outsloping, and ripping roads (primarily Level 1 roads) that cannot be maintained with existing and foreseeable budgets. Many of the roads are already closed to public traffic, but pose potential and ongoing erosion problems. Rehabilitation of the remaining roads would consist of resurfacing or culvert replacement over 22 years to support ongoing USFS, county, and private efforts, which are currently very limited due to funding and staffing. Annual maintenance, which is primarily grading and some placing of rock, would ensure that all drainage structures perform as designed.

BLM's Trinity River Watershed Analysis contains an average annual sediment yield estimate at Hoopa of 1,283 yd^3 per square mile (U.S. Bureau of Land Management, 1995). Extrapolating this to the entire basin (exclusive of the areas upstream of Lewiston Dam and federally designated roadless / wilderness areas), the 2,223-square-mile area in question would produce approximately 2.85 million yd^3 of sediment per year. Full-scale implementation of the watershed protection program would result in a reduction of 240,000-480,000 yd^3 / yr, which is approximately 9-17 percent of the average annual sediment produced in the Trinity River Basin.

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Fish Habitat Management. Construction of the 47 channel rehabilitation projects described in the Flow Evaluation and the Percent Inflow Alternatives would be a major component of this alternative; however, since this alternative does not include an adaptive management program, a less systematic review of the projects would be conducted at year 3 before commencing on the balance of the proposed projects. Mechanical maintenance would be needed at these 47 sites, as well as the 27 existing sites. The maintenance schedule for the sites is the same as for the No Action Alternative.

This alternative also identifies 10 pools for dredging in the Trinity River mainstem (see Section 3.5.1 for information on fish benefits from the pools). These pools are located within a 21-mile stretch of the river between the old Lewiston Bridge (1.2 river miles [RM] downstream of Lewiston Dam) and an area 3 miles downstream of the confluence with Weaver Creek (Figure 2-4). Pool sizes range from approximately 5,000-10,000 yd^3. Each pool would be dredged approximately every 4 years. Spawning gravel placement would be the same as the No Action Alternative.

Fish Population Management. Population management under this alternative would not differ from the No Action Alternative.

Dam Modifications. No modification to either Trinity or Lewiston Dams would be required.

Estimated Costs. The cost of constructing the 47 new channel rehabilitation projects follows: 44 channel rehabilitation projects at $300,000 each and three side-channel projects at $50,000 each. Of the total cost of $13,350,000, approximately 55 percent is expected to be incurred in the first 3 years.

To manually remove vegetation from all 27 existing sites would cost a total of $1,000 every 3 years. To mechanically remove root systems on channel rehabilitation projects, and to modify side-channel openings as needed, would cost a total of $3,000 every 5 years.

To manually remove vegetation from all 47 proposed sites would cost a total of $6,000 every 3 years. To mechanically remove root systems on channel rehabilitation projects, and to modify side-channel openings as needed, would cost a total of $30,000 every 5 years.

Spawning gravel requirements are assumed to be the same as the No Action Alternative. Average annual spawning costs were estimated at $68,000; however, the actual yearly amount is largely dependent on Safety of Dam releases.

The expanded dredging plan would remove sediment from 10 pools within the mainstem of the Trinity River. Approximately 80,000 yd^3

of sediment would be removed from these pools over a 4-year cycle. Assuming 20,000 yd^3 are dredged each year at a cost of $10 per yd^3 (includes transport and storage), the annual labor cost would total about $200,000.

The road maintenance cost is estimated at $1,781,000 for the first year. Road decommissioning is expected to lower this cost by approximately 40 percent to $1,069,000 by year 22 (average annual cost across the first 22 years is $1,425,000). Perpetual road maintenance at the $1,069,000 level is expected after reaching the 22-year mark.

Road decommissioning/rehabilitation is planned for only the first 22 years, at an average annual cost of $1,123,000. Total road decommissioning/rehabilitation over the 22-year period would cost approximately $24.7 million.

2.1.7 State Permit Alternative

This alternative would reduce flows from the current level of 340,000 af/yr to the 120,500 af/yr level specified in Reclamation's seven California water permits issued in 1959. The reason for including this alternative is that Reclamation's existing water permits with the SWRCB identify minimum Trinity River instream flow at 120,500 af (the amount of water identified by Congress in 1955 as the minimum amount to be released down the Trinity River).

The reason for including (the State Permit Alternative) is that Reclamation's existing water permits with the SWRCB identify minimum Trinity River instream flow at 120,500 af.

Water Management. Annual flows would be fixed at 120,500 af regardless of water-year class, excluding releases for other purposes such as the Trinity Reservoir Safety of Dam's criteria. Planned peak flows would be 250 cfs for a period of 30 days during November (Figure 2-6).

Water Operations. The diversion pattern would follow the same general approach as the No Action Alternative, although the total quantity of water diverted would be greater. Trinity Reservoir would be operated to maintain a minimum carryover storage of 400,000 af between water years.

Watershed Protection. Watershed protection practices under this alternative would be the same as the No Action Alternative.

Fish Habitat Management. No additional channel rehabilitation projects would be constructed as part of this alternative because the flow would result in river levels lower than any of the proposed projects. No maintenance would be provided, either mechanically or by flows. No variation in the annual 120,500 af amount would occur, excluding the release of additional flows for Trinity Reservoir Safety of Dams criteria or other needs. Spawning gravel placement would average about 3,700 yd^3/yr. This is slightly higher than the No

No additional channel rehabilitation projects would be constructed as part of (the State Permit Alternative) because the flow would result in river levels lower than any of the proposed projects.

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Action Alternative due to increased gravel placement associated with the potentially higher rate of Safety of Dam releases.

Fish Population Management. Population management under this alternative would be the same as the No Action Alternative.

Dam Modifications. No modification to either Trinity or Lewiston Dams would be required.

Estimated Costs. The only additional costs associated with this alternative are for spawning gravel placement. Average annual spawning gravel costs were estimated at $74,000; however, for most years the cost would be $0. Spawning gravel placement under this alternative would most likely occur as a result of Safety of Dam releases.

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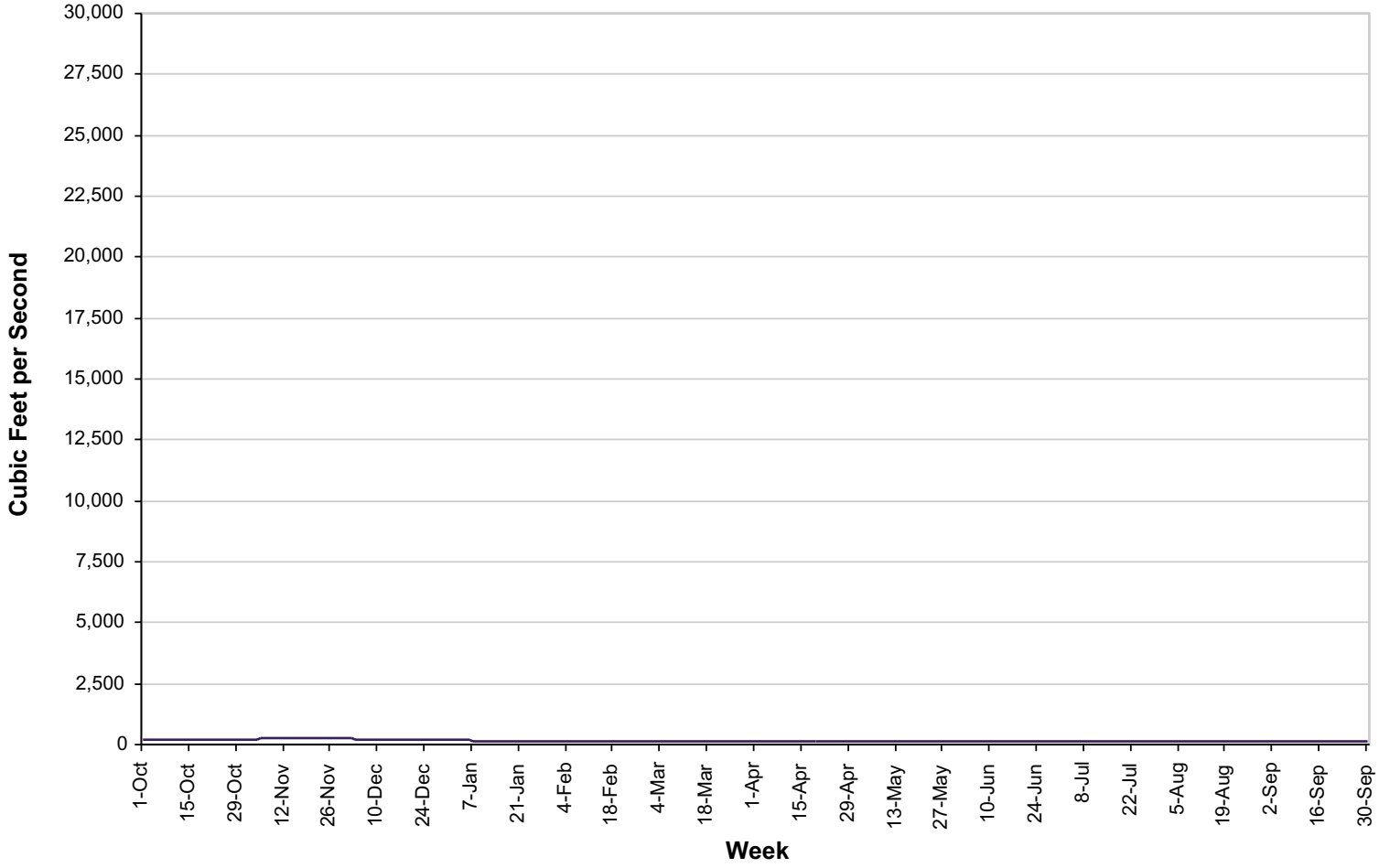

FIGURE 2-6
STATE PERMIT HYDROGRAPH
TRINITY RIVER MAINSTREAM FISHERY RESTORATION EIS/EIR

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2.2 Alternatives Considered but Eliminated

The discussion below describes alternatives that were considered, but not carried forward for detailed analysis. The removal of Trinity and Lewiston Dams is presented in detail because of the amount of input received from the public during the scoping process.

2.2.1 Remove Trinity and Lewiston Dams

The removal of Trinity and Lewiston Dams was not considered a viable solution in restoring the Trinity River fishery because the environmental impacts, foregone benefits, and costs associated with removing the dams were deemed excessive. (However, see Section 5.1 for the perspective of the Yurok and Karuk Tribes.)

The removal of Trinity and Lewiston Dams was not considered a viable solution in restoring the Trinity River fishery because the environmental impacts, foregone benefits, and costs…were deemed excessive.

Options were considered where only a portion of the dams would be removed and associated facilities would be allowed to remain in place, even if no longer functional (e.g., J.F. Carr Powerhouse). Partial removal of the dams would generate significant public safety concerns from a major storm event washing such facilities downstream. In addition, partial removal would result in relatively minor savings and would cause additional safety concerns over powerhouses that were no longer operated but were allowed to remain unattended. Partial removal of dams was determined not to be a feasible action.

Environmental Impact of Removing Dams. Removal of the dams would require a major demolition effort, and would take 3-3.5 years to complete. Even with a full-scale concentrated effort, full removal of the dams and rehabilitation of the Trinity River to pre-dam conditions could take decades. The fishery would likely suffer during dam removal and for some time after completion. Anticipated major issues associated with dam removal include:

- The 50-acre impact area necessary to tear down dams, store construction equipment, and establish laydown areas
- Removal and disposal of the dams and the 30 million yd^3 of sediment behind the dams; identification of area(s) to dispose of this material
- Removal or decommission of most associated facilities such as the four powerplants, electric transmission lines, and switchyards
- Rehabilitation of the Trinity River through the areas that are currently inundated by the Lewiston and Trinity Reservoirs, and the areas occupied by the dams
- Rehabilitation of the inundated portion of each reservoir beyond the original river channel

Partial removal would result in relatively minor savings and would cause additional safety concerns over powerhouses that were no longer operated but were allowed to remain unattended.

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- Flooding of structures, infrastructure, and roads in the floodplain below the dams
- Water quality and sediment concerns and impacts on fish, wildlife, and other beneficial uses from dredging of sediment behind the dams, as well as removal of the dams
- ***Air quality*** concerns including the generation of dust and vehicle emissions during the removal process
- Socioeconomic issues of a large construction force requiring housing, food, services, and other infrastructure (likely generating a number of beneficial economic effects in addition to negative impacts [e.g., exceeding existing service levels])

Operation of Trinity River Division. The TRD is an important asset in terms of providing economic benefits within and outside the Trinity River Basin. According to a preliminary Safety of Dams economic screening study (U.S. Bureau of Reclamation, 1993), removal of the dams would result in the loss of about $261 million annually in project benefits (over the life of the dam, which is estimated to be another 60+ years). Additionally, removing the dams could result in $24.2 million in flood damages. These figures are comprised of the following:

- A one-time acquisition and/or modification of private and public property along the river, including homes, bridges, and other facilities that are within the floodplain (approximately $24.2 million total)
- Lost generation of power at Trinity, Lewiston, Spring Creek, and J.F. Carr Powerplants (approximately $156.5 million annually over the life of the dam)
- Lost recreational use and economic benefits associated with Trinity and Whiskeytown Reservoirs (approximately $4.8 million annually over the life of the dam)
- Lost benefits derived from use of water within the Central Valley (e.g., agricultural and M&I), including temperature control to assist in Sacramento River fisheries and Delta salinity control (approximately $100 million annually over the life of the dam)

Property Loss within the Trinity Basin. Removal of Trinity and Lewiston Dams would return the Trinity River to its natural, uncontrolled state. Public and private property, structures, and infrastructure would be subject to loss and as such would require relocation or removal.

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The flood damage estimate of $24.2 million was based on the probable maximum flood and focuses exclusively on impacts to the following structures:

- Highways, roads, and streets (including bridges)
- Residences and property

Lost Power Generation. Removing the two dams on the Trinity River would generally render the four existing powerplants useless. The Lewiston and Trinity powerhouses, located adjacent to the Lewiston and Trinity Dams, would be removed for safety reasons prior to dam removal. These powerhouses have the capability to generate 0.35 megawatt (MW) and 140 MW, respectively. The J.F. Carr Powerhouse (157 MW) would be unable to generate as efficiently because water would no longer be diverted from the Trinity River through the Clear Creek Tunnel. The Spring Creek Powerhouse (190 MW), located near the terminus of the Spring Creek Tunnel at Keswick Reservoir, could be operated, but would do so with inflow from Clear Creek only. The absence of Trinity River water within the Keswick Reservoir would result in the reservoir being reduced by 75 percent, which in turn would reduce power generation by an equal percent.

The four powerplants within the TRD provide up to 487 MW of total capability, which represents approximately 30 percent of the capability of the entire CVP. Removing these facilities would create the need for a new powerplant. The new plant(s) would likely burn a fossil fuel such as coal, oil, or natural gas, with resultant air quality impacts.

The four powerplants within the TRD provide up to 487 MW of total capability, which represents approximately 30 percent of the capability of the entire CVP. Removing these facilities would create the need for a new powerplant. The new plant(s) would likely burn a fossil fuel such as coal, oil, or natural gas, with resultant air quality impacts.

The power benefits analysis assumes an average annual generation loss of approximately 2.1 billion kilowatt-hours (kWh). Applying a $75 per 1,000 kWh replacement cost rate, based on construction of a new ***baseload*** plant, results in an annual loss of approximately $156.5 million.

Lost Recreational Use and Benefits. Trinity, Lewiston, and Whiskeytown Reservoirs provide recreation for fishing, camping, boating, water skiing, swimming, and houseboating. Although recreationists could use Shasta Reservoir or other areas if the Trinity and Lewiston Reservoirs did not exist (Whiskeytown would be significantly drawn down in dry and critically dry years), the degree of site substitution would be limited by carrying capacity and distance. Some recreationists might choose instead to recreate on the Trinity River, but those interested in boating, water skiing, or houseboating would likely forego such recreational activities. Also, traveling to Shasta Reservoir and other recreation facilities within the Sacramento Valley would be inconvenient, and because demand currently exceeds supply for other non-reservoir facilities within the Shasta-

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Trinity National Forest, the majority of recreational use and benefits would be lost. Assuming a 75 percent loss in reservoir recreation valued at a very conservative $5 per day, results in an annual loss of approximately $4.8 million.

Lost Benefits to the Central Valley. Water diverted from the Trinity River to the Sacramento River provides measurable benefits in terms of agriculture and M&I consumptive use. Trinity River water also assists in controlling temperatures for Sacramento River fisheries and Delta salinity control, in addition to affecting commercial and recreational fishing. The Trinity Reservoir represents approximately 23 percent of the reservoir storage capacity of the CVP. If the dams were removed, the average diversion of 1 maf of water per year, which has augmented Sacramento River flows since the construction of the TRD, would not be available. This amount of water represents less than 5 percent of the total inflow that reaches the Delta. Assuming a very conservative value of this water to agriculture, M&I, recreational and commercial fishing, and temperature moderation of $100 per af, the lost benefit of this quantity of water would total approximately $100 million annually.

Costs. Reclamation performed an analysis to completely remove Trinity Dam and to partially remove Lewiston Dam. The lower portions of Lewiston Dam would remain in place to initially contain sediment released from behind Trinity Dam. The cost to remove these dams was estimated at $192 million.

2.2.2 Harvest Management

Harvest management of commercial, sport, and tribal fisheries was identified during scoping as a potential alternative to restore Trinity River fish populations. Historical over-harvest is believed to be partly responsible for the decline of some west-coast anadromous fish populations and was cited as a causative factor in the decline of the Southern Oregon / Northern California Evolutionary Significant Unit (ESU) of coho salmon (National Marine Fisheries Service, 1997).

Additional harvest restrictions were analyzed for effectiveness in increasing natural production of anadromous fish in the Trinity River. Three methods were developed to assess the effectiveness of restricting harvest, with one method ultimately selected as the most appropriate (see fishery resources Technical Appendix B for descriptions of the three methods and the results of the analysis). The selected method focused on fall chinook salmon because (1) an extensive database exists for Klamath River Basin (including Trinity River) fall chinook, and (2) harvest models for this species have been developed and are used by harvest management agencies. The habitat assumptions of the No Action Alternative were used as a baseline, and a harvest-rate model was used to calculate ocean and

inriver harvest and spawner escapement at several levels of harvest restriction (25, 50, 75, 90, and 100 percent) from the existing allowable harvest rates (Amendment 9 of PFMC Salmon Management Fishery Plan, 1988).

The results of the analysis indicated that although spawner escapement increased due to increasing harvest restrictions, natural production, as indicated by the production index, actually decreased (Table 2-8). The lack of a positive response (i.e., increase in production) with increasing harvest restrictions was due to the current quantity and quality of anadromous fish habitat in the Trinity River. In other words, the analysis indicated that habitat, and not the number of spawning adults, is the limiting factor in the natural production of anadromous fish in the Trinity River. Increasing escapements above the level that is supportable under the habitat conditions of the No Action Alternative is likely to oversaturate available habitat and result in decreased production due to ***density-dependent*** mortality. Based on the results of this analysis, this alternative does not meet the purpose and need of restoring natural production of anadromous fish in the Trinity River.

The (Harvest Management) analysis indicated that habitat, and not the number of spawning adults, is the limiting factor in the natural production of anadromous fish in the Trinity River.

TABLE 2-8
Estimated Harvest and Escapement for Trinity River Chinook Salmon at Varying Reductions of Ocean and Inriver Harvest Rates (numbers rounded to the nearest 100)[a,b]

Harvest Reduction	Tribal Harvest	Non-tribal Harvest	Total Harvest	Spawner Escapement	Production Index[c]
0%	5,600	6,300	11,800	5,500	17,300
25%	4,400	4,800	9,200	7,700	16,900
50%	3,200	3,200	6,400	10,300	16,700
75%	1,700	1,700	3,400	13,100	16,500
90%	700	600	1,300	15,000	16,300
100%	0	0	0	16,200	16,200

[a] Numbers presented here are not intended to represent actual harvest levels, but are to be used for comparisons to the results of other alternatives.

[b] Reductions in ocean and inriver harvest rates were calculated without adjusting for equal sharing of the numbers of harvested chinook between tribal and non-tribal fisheries.

[c] Production index calculated by adding total harvest and spawner escapement and not an estimate of recruits at a specific age.

Further evidence that harvest is not limiting the recovery of Trinity River chinook stocks can be found in a 1998 assessment by NMFS, which states that natural populations (of Trinity River chinook salmon) have frequently failed to meet modest escapement goals despite active harvest management (National Marine Fisheries Service, 1998). The NMFS assessment suggested that the presence of dams, along with other habitat degrading factors, is likely responsible for the decline of Trinity River chinook stocks.

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Although a quantitative assessment of the effectiveness of restricting harvest of coho salmon and steelhead was not conducted, neither species is expected to be restored via further harvest restrictions. Coho were listed as a threatened species pursuant to the ESA in 1997, even though harvest had been virtually eliminated along the west coast since 1994. This evidence indicates that harvest is not a limiting factor in the species' recovery.

Once habitat conditions improve (i.e., suitable habitat increases), a reassessment of harvest management could be conducted. Assuming improved habitat conditions, modifications to existing harvest management could be employed in some cases to speed restoration.

2.2.3 Fish Passage Facilities

Although fish ladders have been used with degrees of success throughout California and the nation, the enormous size of Trinity and Lewiston Dams and Reservoirs made this alternative infeasible.

Although ***fish ladders*** have been used with degrees of success throughout California and the nation, the enormous size of Trinity and Lewiston Dams and Reservoirs made this alternative infeasible. For example, both reservoirs have submerged riverine habitat that would not be accessible to salmonids even if they were provided access above the dams. Furthermore, even if salmon did spawn upstream of the reservoirs, it is unlikely that juvenile fish could navigate downstream through the reservoirs and dams. This alternative was also eliminated because the purpose and need of the proposed action focuses on the mainstem below the dams.

2.2.4 Truck Fish around the Dams

Programs whereby fish are loaded into trucks and transported around dams or pumps are currently being implemented along a number of streams. Such a program was considered infeasible for the Trinity River because of the difficulty of transporting fry and juvenile fish around the dams during their downstream migration. A trapping and transporting program would be costly and the potential benefits questionable. A trapping and transporting program has been used extensively on the Columbia River with less than satisfactory results. Also, the purpose and need is for restoration of natural fish production below the dams.

2.2.5 Predator Control

Marine mammals (harbor seals and California sea lions) congregate annually at the mouth of the Klamath River and prey on fish migrating up the river (and eventually up the Trinity River). If the mammals were eliminated, then a primary predator of salmon would be eliminated, to the potential benefit of the fishery. However, this alternative was eliminated because it would not increase natural production of anadromous salmonids due to density-dependent factors (see Harvest Management).

2.2.6 Increase Hatchery Production

This approach was determined not to meet the purpose of the proposed action, which is to restore the natural production of anadromous fish. The concept of restoring natural fish production was included in the purpose and need statement, in part, because of the concerns associated with hatcheries and because the Trinity River Basin Fish and Wildlife Management Reauthorization Act of 1995 specified that the purpose of the Trinity River hatchery is to "serve its purpose of mitigation of fish habitat loss above Lewiston Dam while not impairing efforts to restore and maintain naturally reproducing anadromous fish stocks within the basin."

Evidence shows that increasing hatchery production can significantly impair efforts to restore and maintain naturally reproducing fish stocks.

Evidence shows that increasing hatchery production can significantly impair efforts to restore and maintain naturally reproducing fish stocks. In general, the data show the following:

- Increased hatchery production could allow increased harvest of these hatchery fish, but this increased harvest could also increase harvest of naturally produced populations of salmon, thereby accelerating the decline of naturally produced fish populations.
- Over-production of hatchery fish creates direct competition for food and habitat necessary for successful naturally produced fish populations.
- Increased hatchery production increases the potential for predation on naturally produced fish populations by hatchery stocks, which may ***residualize*** in the river.

Increased hatchery releases would not be successful unless there was improved habitat in the mainstem Trinity River to accommodate the increased number of fish. During drier years especially, habitat is already limited for the current number of fish in the Trinity River. Improving inriver habitat conditions would benefit all Trinity River fish, including naturally and hatchery-produced stocks.

2.2.7 Pumped Storage Project

A pumped storage project using the Sacramento River as a source of water for storage behind an enlarged Trinity Dam was also proposed. Such a proposal would increase flexibility of dam operation. However, the proposal represented more a potential method of lessening impacts to CVP operations and deliveries than an alternative that could assist in restoring the Trinity River fishery, and did not by itself meet purpose and need.

2.2.8 Channel Augmentation Using Weaver Creek

Channel augmentation through transfer of Stuart's Fork (of the Trinity River) water into Weaver Creek and subsequently into the

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Trinity River near Douglas City was proposed as one method of increasing flows within the river. This concept was determined infeasible because the proposed action is focused on the river downstream from Lewiston Dam, and this approach would be incapable of modifying instream flows within the approximately 18-mile segment of the river upstream of Douglas City. In addition, no value was seen in constructing a project to divert flows around the dam when releases could be made through the existing dam facilities.

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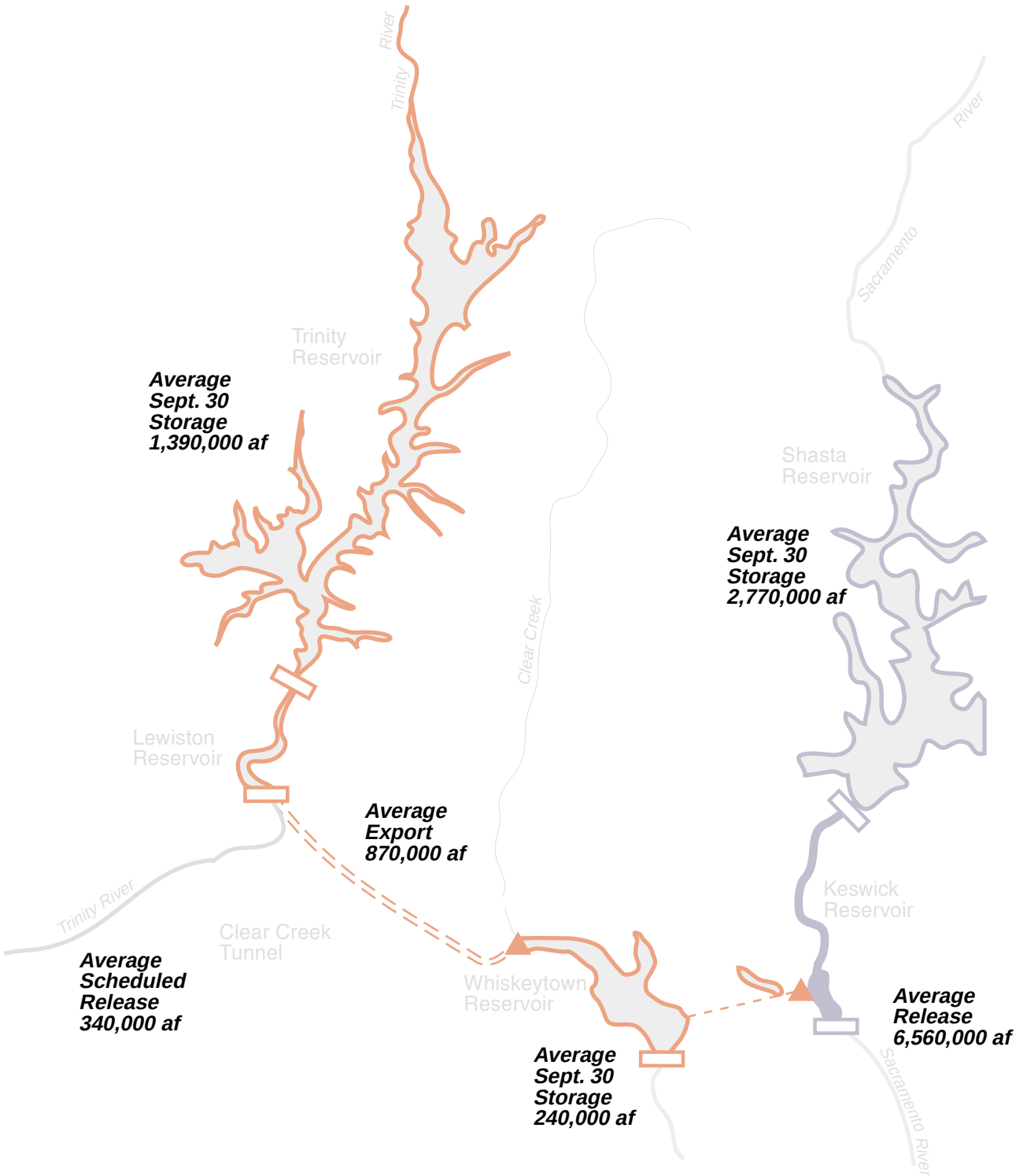

FIGURE 2-7
NO ACTION (AND MECHANICAL RESTORATION) LONG-TERM AVERAGE ANNUAL EXPORTS AND RELEASES
TRINITY RIVER MAINSTEM FISHERY RESTORATION EIS/EIR

2655 400 (8/9/99)

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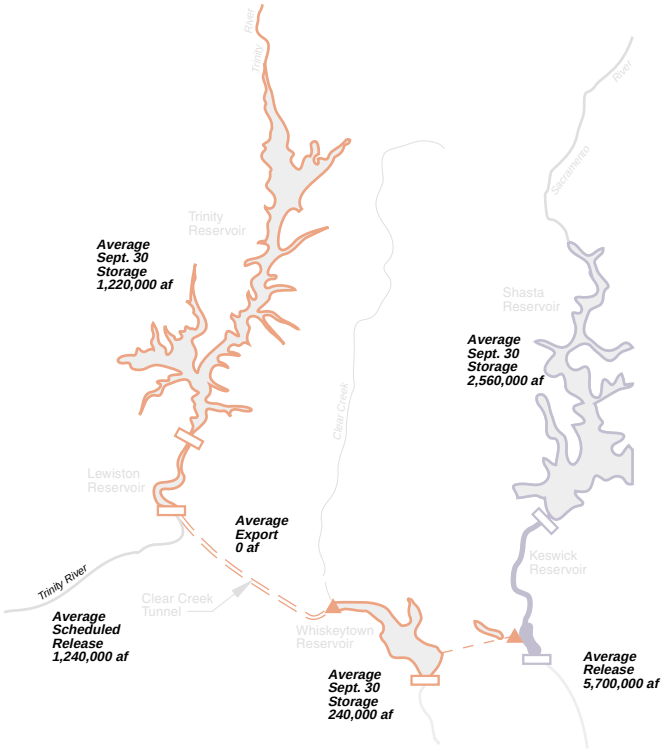
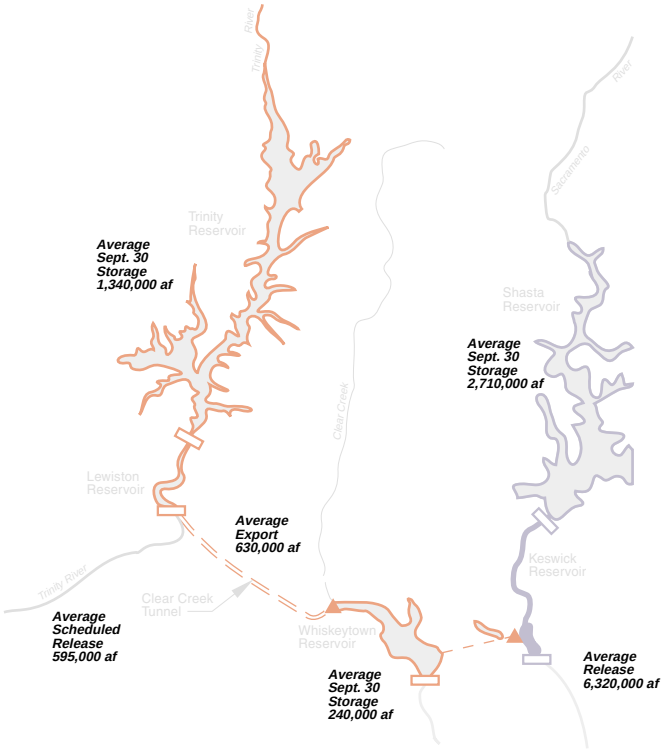
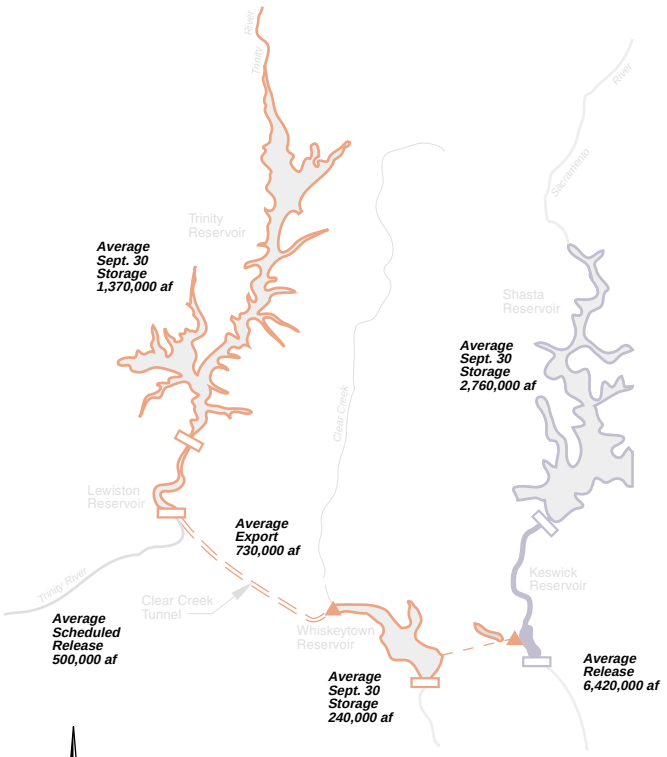
Maximum Flow



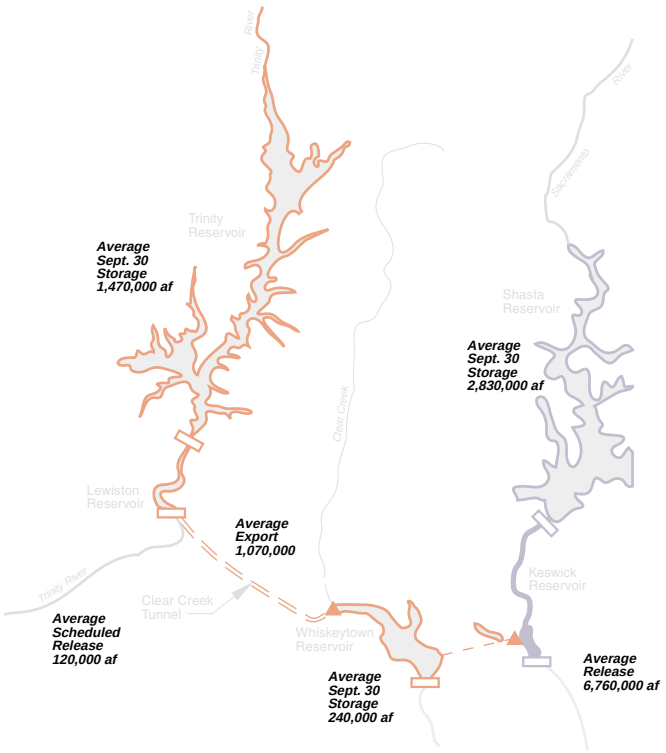
Flow Evaluation



Percent Inflow



State Permit



NOT TO SCALE

LEGEND

- Trinity River Division
- Shasta Division

NOTE: Numbers derived from PROSIM simulation including spills.

FIGURE 2-8
LONG-TERM AVERAGE ANNUAL EXPORTS AND RELEASES FOR MAXIMUM FLOW, FLOW EVALUATION, PERCENT INFLOW, AND STATE PERMIT ALTERNATIVES
TRINITY RIVER MAINSTEM FISHERY RESTORATION EIS/EIR

2865 330 (9/23/99)

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TABLE 2-9
Summary Description of Alternatives

Features	Alternatives					
	No Action	**Maximum Flow**	**Flow Evaluation**	**Percent Inflow**	**Mechanical Restoration**	**State Permit**
Water Management Trinity River instream flows	Not less than 340,000 af in all water-year classes	Critically dry 463,000 af Dry 889,000 af Normal 1,206,000 af Wet 1,508,000 af Extremely wet 2,146,000 af	Critically dry 369,000 af Dry 453,000 af Normal 636,000 af Wet 701,000 af Extremely wet 815,000 af	Critically dry 165,000 af Dry 325,000 af Normal 443,000 af Wet 655,000 af Extremely wet 978,000 af	Same as No Action	120,500 af in all water-year classes
Peak flow releases and duration	2,000 cfs for 17 days in May	30,000 cfs for 5 days in May (extremely wet water year)	11,000 cfs for 5 days in May (extremely wet water year)	Estimated peak release of 11,000 cfs for 1 week (based on historical records)	Same as No Action	250 cfs for 30 days in November
Water Operations	Maintain current operation of CVP as identified in CVP-OCAP (including current Biological Opinions & December 15, 1994 Bay/Delta Accord Principles).	No diversions through Clear Creek Tunnel; assumes appropriate revisions to OCAP and endangered species consultation as necessary. Water-year determinations would likely need to emphasize storage-based criteria in addition to predicted Trinity inflow.	Timing of diversions through Clear Creek Tunnel would be shifted to the summer/ early fall period; assumes appropriate revisions to OCAP and endangered species as necessary.	Timing of diversions through Clear Creek Tunnel would be shifted to the summer/early fall period; assumes appropriate revisions to OCAP and endangered species consultation as necessary.	Same as No Action	Greater quantity of water would be diverted through the Clear Creek Tunnel; assumes appropriate revisions to OCAP and endangered species consultation as necessary.
Carryover storage	400,000 af	Same as No Action	600,000 af	600,000 af	Same as No Action	Same as No Action
Watershed Protection	Maintain sediment control structures Administer existing land management plans and enforce Trinity County grading ordinance Implement South Fork Trinity River Action Plan Enforce CDF Forest Practice Rules	Same as No Action	Same as No Action	Same as No Action	No Action measures plus additional maintenance and rehabilitation of road system within the watershed	Same as No Action
Fish Habitat Management						
Mechanical Channel Rehabilitation						
Maintain 27 existing rehabilitation projects	X				X	
Construct 47 additional rehabilitation projects			X	X	X	
Maintain existing and proposed projects mechanically					X	
Maintain existing and proposed projects with flow			X	X		
Place spawning gravel (quantity/ frequency) (note – the figures are estimates, actual volumes could vary by plus/minus 50 percent or greater)	Place 3,400 yd^3/yr of gravel (assumes gravel placement associated with Safety of Dam releases)	Water-year Class / yd^3/yr Critically dry 0 Dry 150 Normal 1,500 Wet 14,550 Extremely wet >100,000 (assumes that placement of spawning gravel associated with Safety of Dam releases does not occur)	Water-year Class / yd^3/yr Critically dry 0 Dry 200 Normal 2,000 Wet 14,200 Extremely wet 49,100 (assumes that placement of spawning gravel associated with Safety of Dam releases does not occur)	Water-year Class / yd^3/yr Critically dry 0 Dry 0 Normal 50 Wet 1,350 Extremely wet 4,650 (assumes that placement of spawning gravel associated with Safety of Dam releases does not occur)	Same as No Action	Place 3,700 yd^3/yr of gravel (assumes gravel placement associated with Safety of Dam releases)
Sediment dredging pools	Grass Valley Creek ponds	Same as No Action	Same as No Action	Same as No Action	No Action measures plus 10 pools in mainstem	Same as No Action
Fish Population Management	Maintain current fishing policies	Same as No Action	Same as No Action	Same as No Action	Same as No Action	Same as No Action
Trinity Dam Modifications	No	Yes	No	No	No	No

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TABLE 2-10
Implementation Costs[a,b]

Features	No Action ($)	Maximum Flow ($)	Flow Evaluation ($)	Percent Inflow ($)	Mechanical Restoration ($)	State Permit ($)
Spawning gravel[c]	68,000/yr (most years would be 13,500)	0-2,000,000+/yr (weighted mean = 328,000/yr)	0-982,000/yr (weighted mean = 206,000/yr)	0-93,000/yr (weighted mean = 19,000/yr)	68,000/yr (most years would be 13,500)	74,000/yr (most years would be 0)
Existing channel projects maintenance[c]	950/yr	0	0	0	950/yr	0
New channel projects						
Construction	0	0	2,450,000/yr for years 1-3 and 6,000,000 total for years 4-22	2,450,000/yr for years 1-3 and 6,000,000 total for years 4-22	2,450,000/yr for years 1-3 and 6,000,000 total for years 4-22	0
Maintenance[c]	0	0	0	0	8,000/yr	0
Dredging mainstem pools	0	0	0	0	200,000/yr	
Watershed restoration						
Road maintenance[c]	0	0	0	0	1,425,000/yr[d]	0
Road decommissioning	0	0	0	0	1,123,000/yr	0
Adaptive management program[c]	0	0	2,450,000-4,450,000/yr	0	0	0
Modifying Trinity Dam	0	23,080,000-72,980,000	0	0	0	0

[a]The TRRP funds ongoing restoration projects in the Trinity River Basin that are not described as part of the proposed alternatives, but are assumed to continue under all alternatives. Examples include dredging of the sediment control ponds in Grass Valley Creek, maintenance of Buckhorn Reservoir, and operation of the TRSSH. In addition, the table does not include potential mitigation costs (e.g., modifying bridges in the Trinity River floodplain). Therefore, total federal expenditures for Trinity River restoration would likely be larger than those disclosed in this table.

[b]Except for the adaptive management program and modifying Trinity Dam costs, all costs are contract costs, i.e., they do not include administrative expenses such as planning, inspections, and overhead.

[c]Costs are perpetual, i.e., would continue after year 2020.

[d]Annual costs are on a declining scale. See text.