Redwood Natnl Park; Sacklin, Ozaki, Hofstra, Smith 1988.

ENVIRONMENTAL ASSESSMENT

UPPER DAM REMOVAL, LOST MAN CREEK

Redwood National Park

August 1988

PURPOSE AND NEED

The upper dam on Lost Man Creek is a man-made structure located on a stream which is recovering from past logging and road construction activities in the watershed. It was originally built in 1936 to serve as a water source for the Prairie Creek Fish Hatchery. The dam was abandoned in 1955 and replaced by another dam lower on Lost Man Creek. The lower dam currently serves to divert water for hatchery operations. The pool behind the upper dam has filled with sediment, intake pipes are buried in sediment, and the water flumes and pipes constructed to supply water to the hatchery have disappeared.

The National Park Service is considering removal of the dam for a number of reasons. First, the former water intake sumps and the dam are a public nuisance and a safety hazard to park visitors.

Second, retaining the dam conflicts with National Park Service Management Policies which call for the restoration and preservation of natural resources of the park. National Park Service Guidelines for Dams and Appurtenant Structures call for removal of all such structures which are no longer necessary and, where feasible, restoration of the impoundment area.

Third, removing the dam will assist the natural recovery of the stream and help restore 1.8 miles of stream for salmonid spawning and rearing habitat. The dam is a partial barrier to migrating salmonids, in particular Chinook salmon.

The purpose of this environmental assessment is to evaluate a number of alternatives for removal of the upper dam in Lost Man Creek.

RESOURCES SUMMARY

Location and Description:

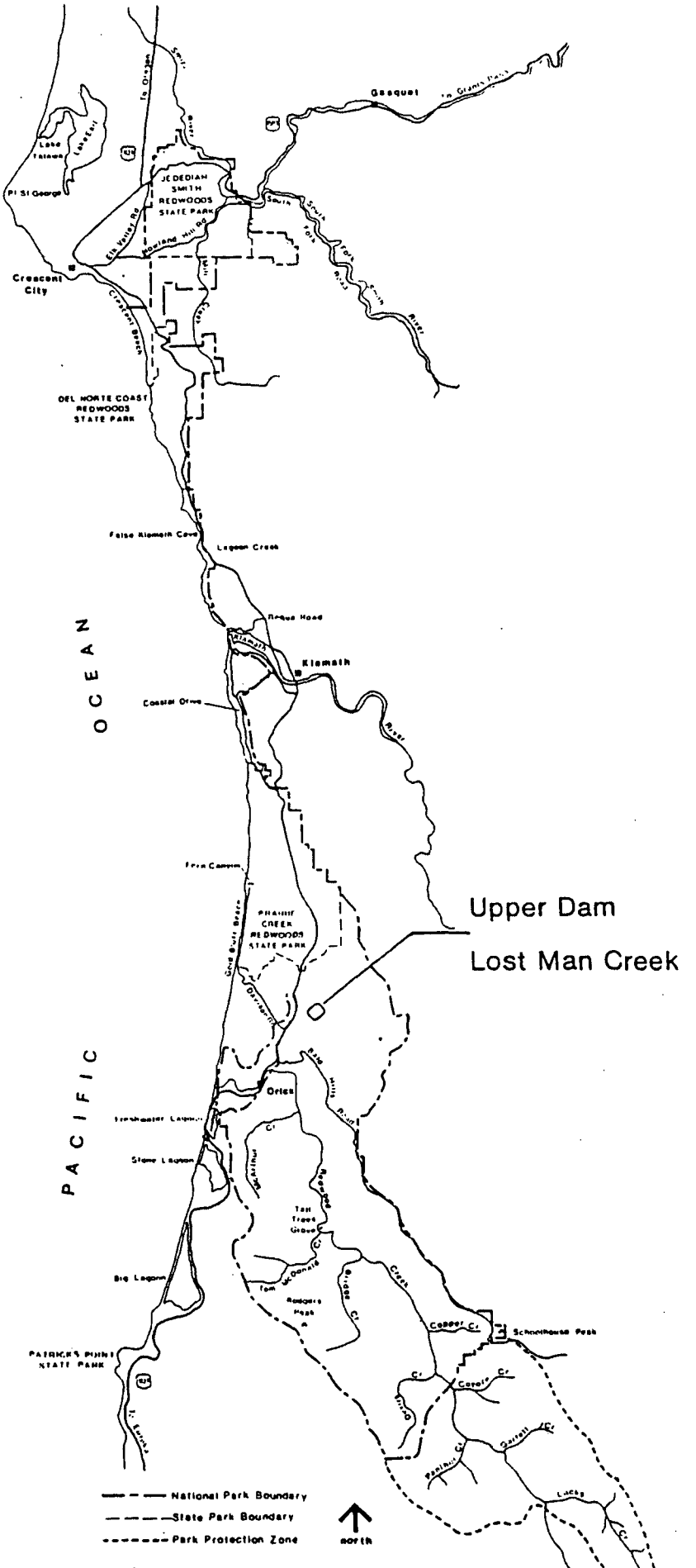
The upper dam is located in Lost Man Creek, a tributary of Prairie Creek in the Redwood Creek watershed. The dam is approximately 0.8 miles upstream of the confluence of Lost Man Creek with Prairie Creek (see maps). The dam is located in the Northeast Quarter of Section 23, Township 11 North, Range 1 East, Humboldt Meridian (Orick 7 1/2 minute Quadrangle). The gravity dam is a rock filled, concrete faced structure (see photographs). The dam face is approximately 24 feet long by 57 feet wide by seven feet high. Cement wing walls are located adjacent to the dam face on each stream bank. An additional cement wing wall extends approximately 100 feet south of the dam on the south bank, tying into the toe of the slope. The former water intake for the hatchery and a non-functional fish ladder are also located on the south bank. The water intake consists of two cement lined sumps, each five to eight feet deep. They are partially overgrown with vegetation.

Access:

Primary access to the upper Lost Man Creek dam is via an abandoned skid trail which intersects the Geneva Road approximately 0.5 miles east of U.S. Highway 101. The 570 foot long skid trail is overgrown with salmonberry and young (four to eight inch diameter) second growth alder and Sitka spruce. Common understory species include redwood sorrel, swordfern, sedge, snakeroot, tolmiea, and California brome. The tread is generally in good condition. The trail has a slope of 19 percent in its steepest area, restricting access to four-wheel drive vehicles.

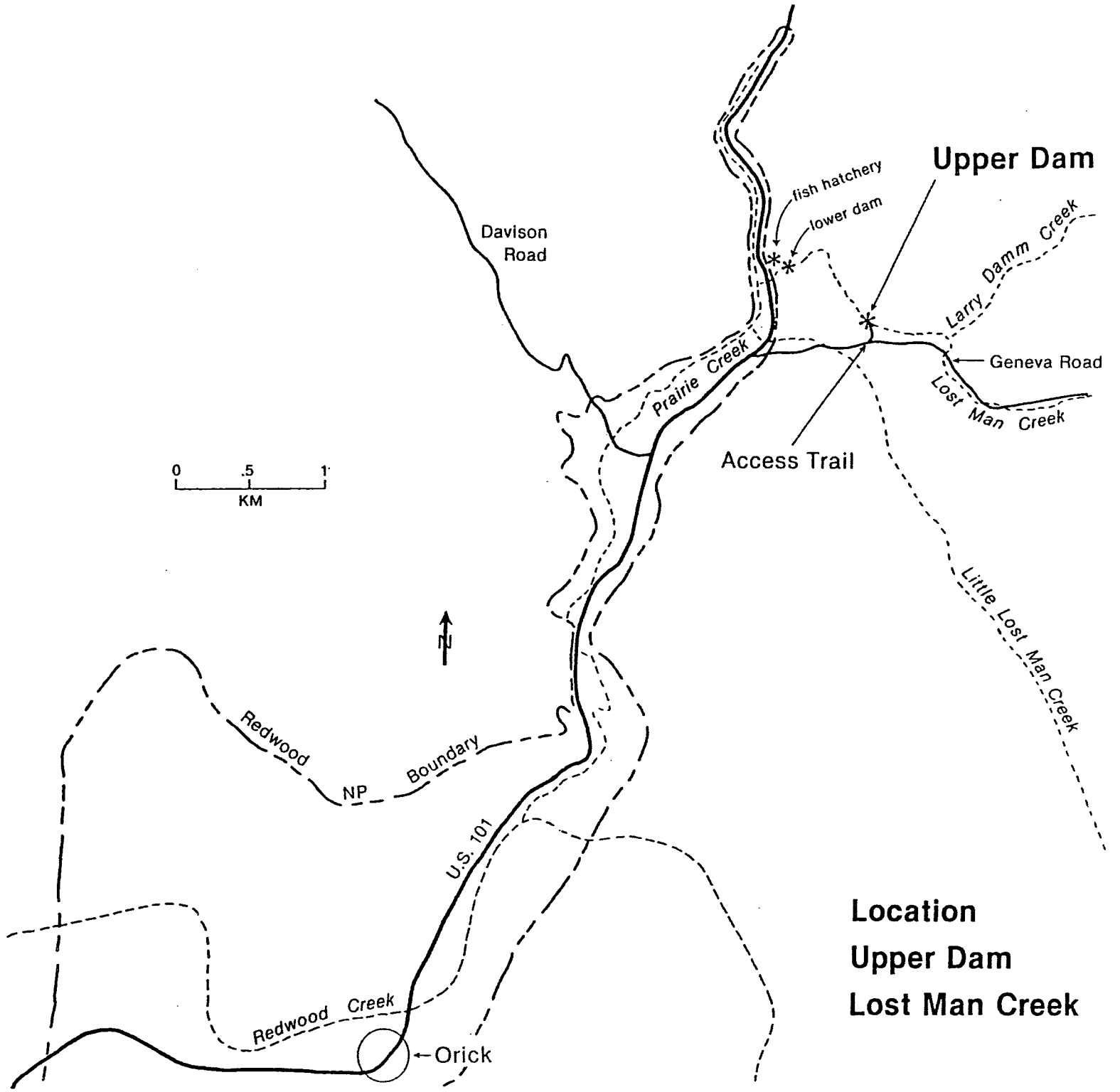
Hydrology:

The 12.4 square mile Lost Man Creek basin is located four miles north of Orick, California. The longitudinal profile of the lower 1.4 miles of Lost Man Creek exhibits changes in stream gradient upstream and downstream of the dam (see longitudinal profile). Immediately upstream of the dam, the channel gradient is low (0.18 percent) and reflects the accumulation of sediment and attendant flattening of the stream bed behind the dam. Upstream of this reach, the channel is steeper (0.64 percent) and more closely resembles the expected streambed profile prior to dam construction. The channel gradient downstream of the dam is 0.47 percent, and the average stream gradient on lower Lost Man Creek is 0.64 percent.



REDWOOD NATIONAL PARK

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE


Upper Dam
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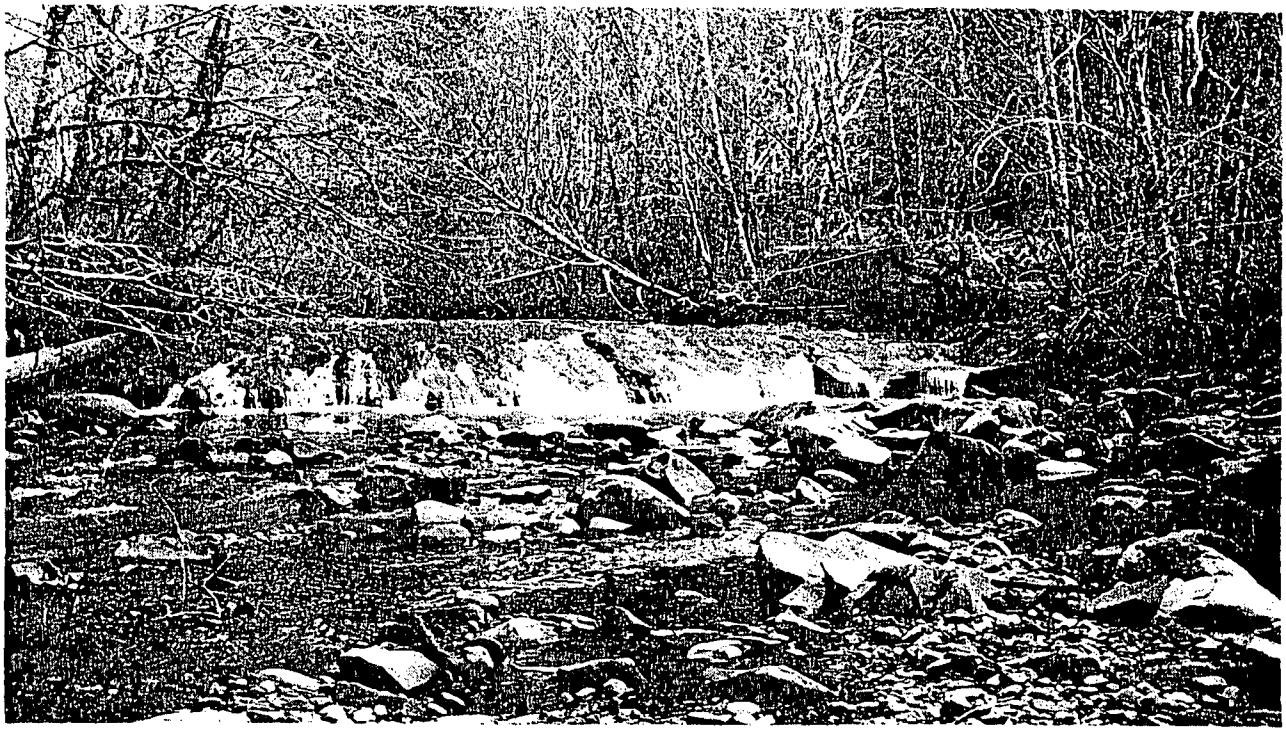
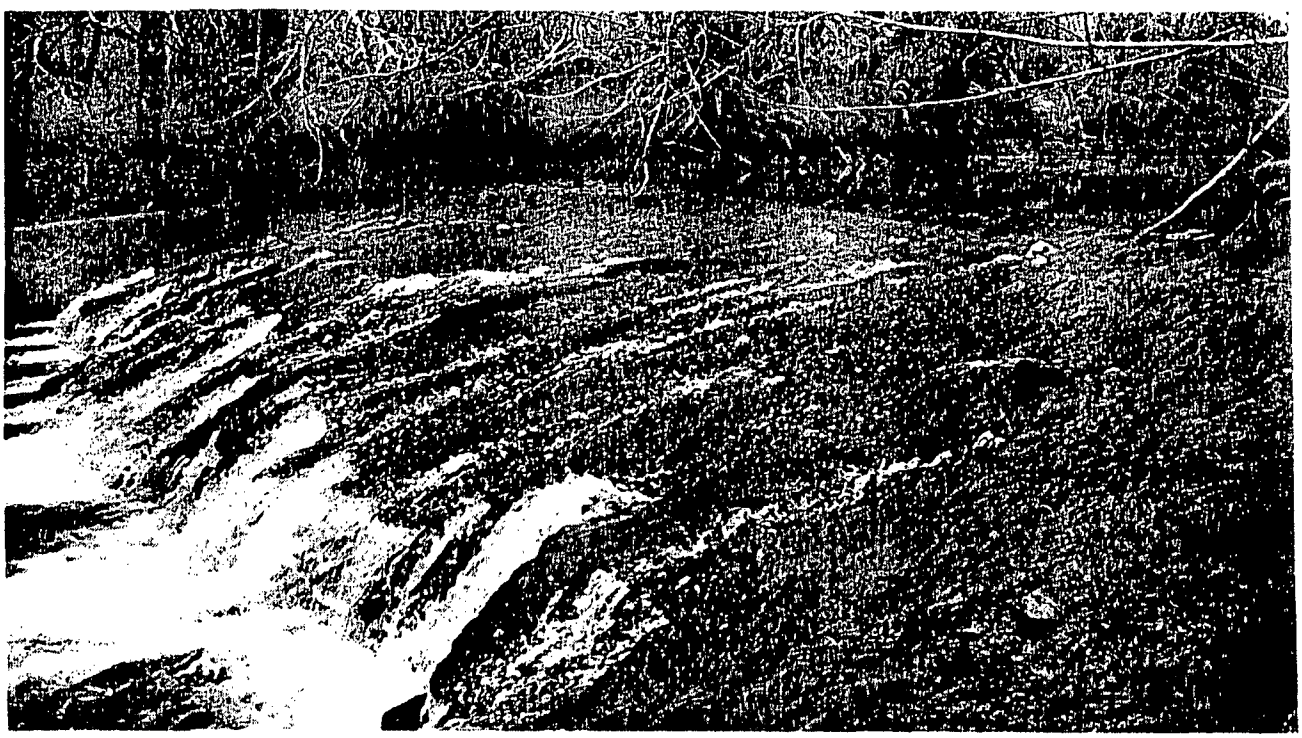


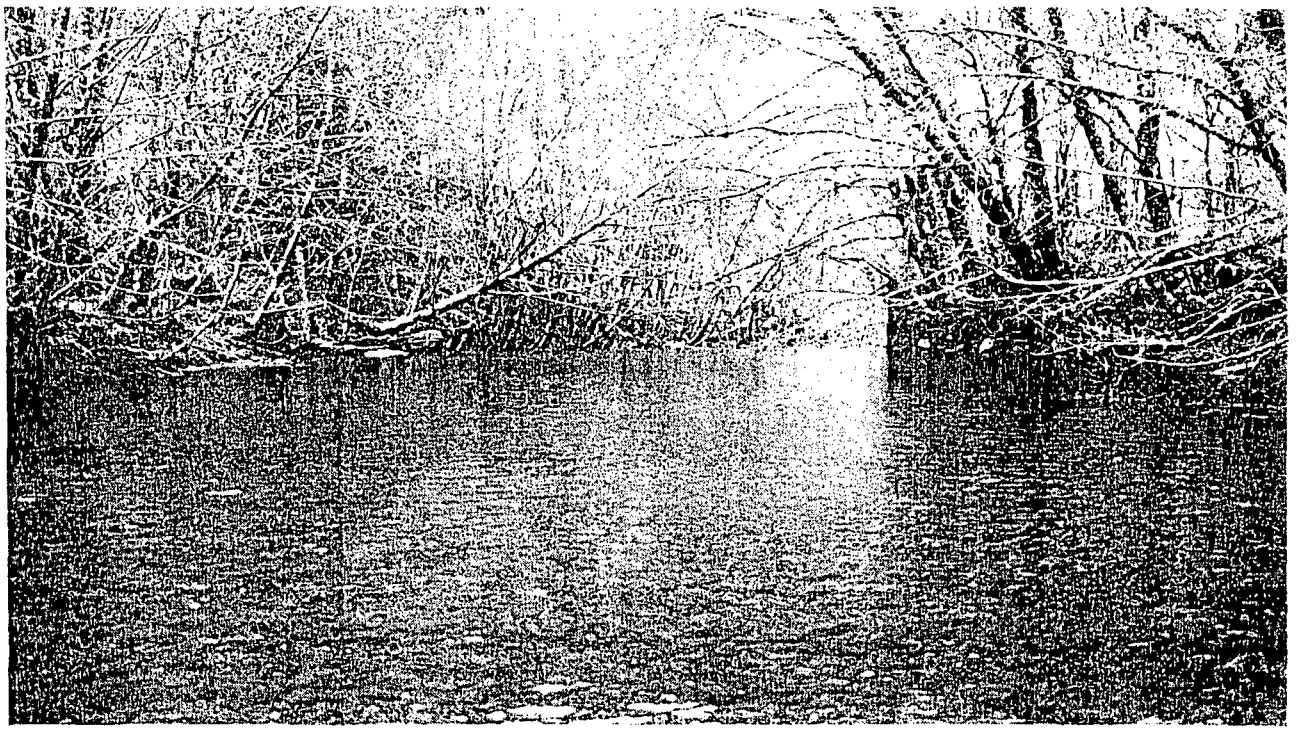
Upper Dam, Lost Man Creek looking upstream at dam. In this view, the south bank (including wing wall, water intake, and fish ladder) is to the right.

View of south end of dam, showing water intake, fish ladder, and south wing wall.

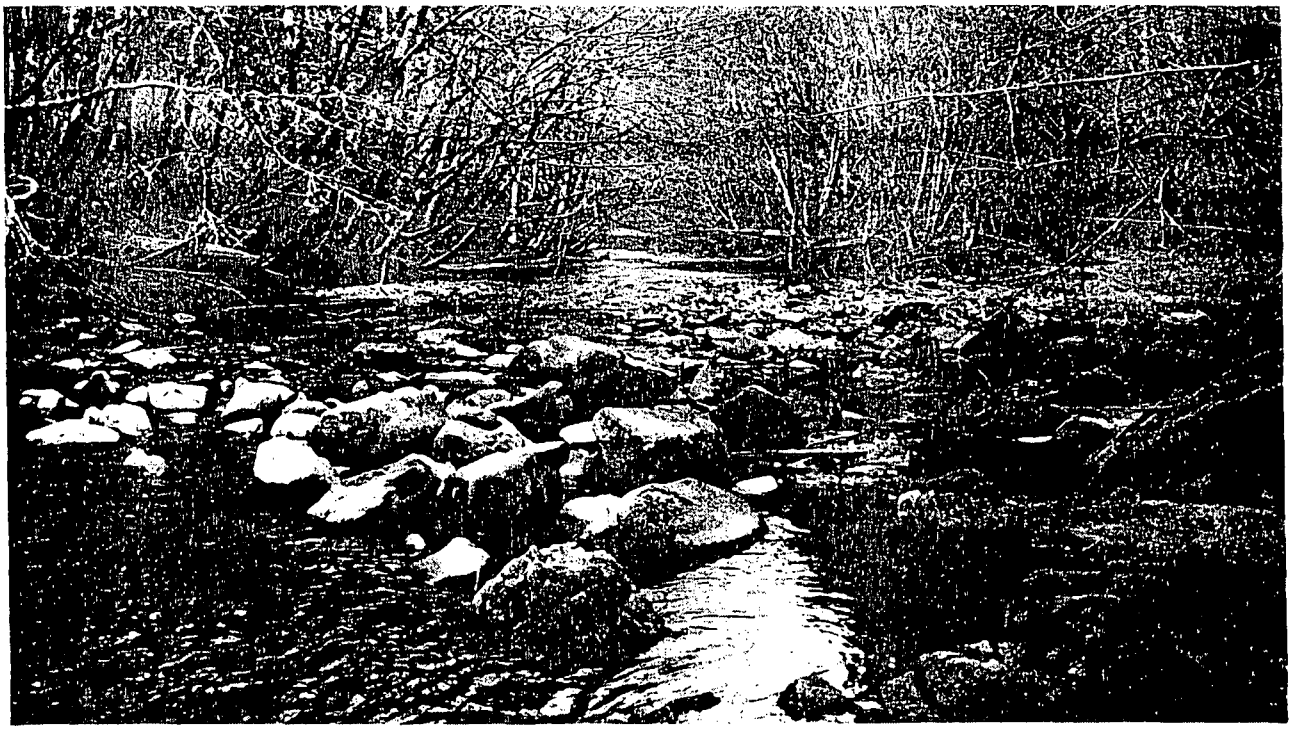
Close-up of water intake and south wing wall.



View north, across dam face. Note the north wing wall and deteriorating condition at bottom of dam face.

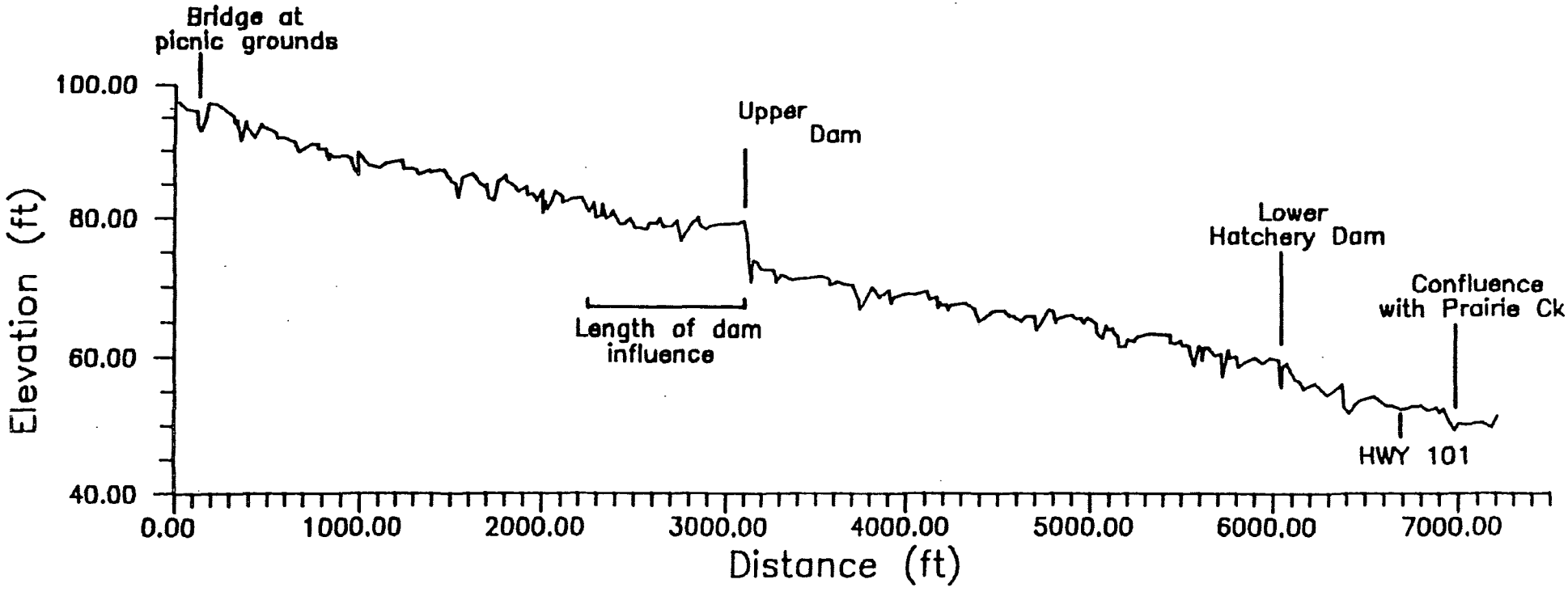


View upstream from top of the dam.



View downstream from top of the dam.

Lostman Creek Longitudinal Profile



Between 1973 and 1975, water and sediment data were collected periodically at U.S. Geological Survey gaging station 11482450 located in the upper one-third of the Lost Man Creek basin. In addition since 1973, the U.S. Geological Survey has measured water and sediment discharge in the adjacent, unlogged Little Lost Man Creek watershed (U.S. Geological Survey). Estimates of water and sediment discharge are based on these two sets of gaging records.

Flows on Lost Man Creek range from summer baseflows of 0.36 cubic feet per second to winter peak flows as high as 3125 cubic feet per second. The average flow is estimated to be 37 cubic feet per second.

Bedload transport rates in Lost Man Creek from 1973 to 1975 were about 200 cubic yards per year (318 tons per year) or about 600 cubic yards per year at the dam site. This represents an estimate of bedload transport for Lost Man Creek during two high flow years. More recently, winter flows have been lower. Consequently, bedload transport has probably been much less (less than 300 cubic yards per year). Sediment transport records from Little Lost Man Creek indicate bedload transport occurs primarily during large storms (that is, flows that are equalled or exceeded seven percent of the time).

About 5000 cubic yards of sediment are trapped behind the dam. The length of stream directly influenced by the dam extends approximately 800 feet upstream of the structure. The length of time required to move the volume of sediment stored behind the dam depends on winter flow conditions. It would take as long as 15 years under normal winter flows and as little as 8 years under successive years of high magnitude, large sediment transport events to stabilize or move about 5000 cubic yards of sediment completely out of the Lost Man Creek system and into Prairie Creek. Partial to total recovery of pool-riffle diversity, channel morphology, and riparian vegetation would occur during this time period.

Vegetation:

The alluvial flats north and south of the dam contain a second growth, alder, and Sitka spruce forest with salmonberry and swordfern typical in the understory. Alder and Sitka spruce range up to eight inches diameter with a typical height of 40 to 60 feet. Second growth redwood, Douglas-fir, and grand fir of a similar size are less common overstory components. Areas close to the toe of the slope are wettest due to slope runoff. Understory species include California brome, candy flower, tolmiea, swordfern, buttercup, bedstraw, nettle, elderberry, and thimbleberry.

Adjacent to the stream, alders growing on the banks typically overhangs the creek, forming a nearly complete canopy.

The U.S. Fish and Wildlife Service has classified Lost Man Creek as part of the National Wetlands Inventory. The lower reach is described as PFO1C, or Palustrine, Forested, Broad Leaved Deciduous, Seasonally Flooded (U.S. Fish and Wildlife Service). The alluvial flats were not classified.

Fisheries:

Lost Man Creek supports runs of Chinook and coho salmon along with steelhead trout. Cutthroat trout were probably more numerous at one time in Lost Man Creek, however land use and stream modifications have significantly reduced their numbers. Lamprey (also an anadromous species) and sculpin are found in the creek. During winter spawning surveys of Lost Man Creek, carcasses along the streambank and spawning redds are counted. These surveys reveal significantly more carcasses and redds below the upper dam than above the dam, indicating that many salmonids (especially Chinook salmon) are unable to get over the dam.

Currently, the lower 0.8 miles of Lost Man Creek below the upper dam are available for salmonid spawning and rearing. Upstream of the upper dam, an additional 1.8 miles could be available. The upper limit of spawning and rearing habitat is a large, impassable log jam. In addition, a short stretch of Larry Damm Creek (a tributary of Lost Man Creek upstream of the upper Lost Man Creek dam) is available for spawning and rearing.

The dam's configuration is a partial barrier to fish passage; that is, fish passage depends on stream flows. Salmon need both a plunge pool and standing wave at the base of a structure which are large enough for the fish to gain the necessary momentum to jump over the structure. The larger the fish and higher the structure, the more substantial a wave is required. At the upper Lost Man Creek dam, the relatively long and low angled dam face, shallow plunge pool, and lack of standing wave at the dam bottom all contribute to prevent fish from gaining the momentum necessary to pass the structure. Under lower flow conditions, the standing wave at the bottom of the dam is too small and water flows across the face of the dam are too shallow for use by salmon, especially the larger Chinook. They are trapped below the dam.

Geology:

The Lost Man Creek drainage basin is predominantly underlain by unmetamorphosed mudstones, sandstones, and pebble conglomerates of the Mesozoic Franciscan Complex (Harden and others, 1982).

In the Lost Man Creek basin, these rocks are part of the Coherent Unit of Lacks Creek, meaning the rocks have undergone less intense shearing and have a higher sandstone content than most sandstones and mudstones in the Redwood Creek basin. As a result, erosion rates and sediment yields from Lost Man Creek are lower than in other tributaries of Redwood Creek. Rocks of the Franciscan Complex are overlain by unconsolidated sands and gravels of the Plio-Pleistocene Gold Bluffs Formation. The Gold Bluffs Formation occurs extensively as terrace deposits on ridge tops on the east side of the Lost Man Creek basin, but only as a narrow linear ridge on the west side of the basin.

Cultural Resources:

Prehistoric: At the time of first significant contact between Europeans and Native Americans in northwestern California, the Lost Man Creek watershed was within the area inhabited by the Yurok Indians. This was an area which extended along the coast from Wilson Creek on the north to Little River just below Trinidad on the south. It also extended along the Klamath River from the ocean upstream to Weitchpec. Although the major Yurok settlements were located both on the coast and the Klamath River, inland areas such as Lost Man and Prairie Creeks were used for travel and seasonal gathering, fishing, and hunting.

Waterman (1920) documented Yurok villages along the coast west of Lost Man Creek, a camp site at the confluence of Prairie and Redwood Creeks south of Lost Man Creek (probably destroyed by highway construction), and trails between the coast and the Klamath River, to the north of Lost Man Creek; no specific places were recorded in the vicinity of the project area. Over the past twenty years, a number of archeological surveys have been conducted both in the Lost Man Creek drainage and in areas north and south of the project area. In 1969, Ritter (1969) recorded prehistoric seasonal use sites at the north and south end of Elk Prairie, about one mile north of the project area. In 1973, as part of a much larger reconnaissance, Moratto (1973) surveyed a portion of the Lost Man Creek drainage, including the project area; he did not find any evidence of prehistoric or historic cultural resources. Parker (1977), in conjunction with proposed Highway 101 widening, checked an area in Elk Prairie with negative results. In 1980 and 1985, Smith (King, 1980; Smith, 1985) surveyed areas just to the north of the project area for the construction of the Highway 101 Bypass. No archeological resources were recorded. Douglas (1984) conducted archeological surveys along Highway 101 west and south of the project area for the replacement of bridges across Lost Man Creek and Prairie Creek; again, no evidence of cultural resources was noted. Recently, Haversat and

Breschini (1986, 1987) surveyed the Highway 101 road corridor in the vicinity of the project area in conjunction with a proposed powerline; they recorded a single isolated prehistoric artifact in the northern portion Elk Prairie. Finally, in 1988, the park archaeologist field checked the Upper Lost Man Creek dam access trail and approximately 0.25 acres immediately adjacent to each side of the dam. No surface evidence of prehistoric cultural resources was noted.

Contemporary Native American Cultural Resources: Park consultations with local Native Americans who have traditional ties to the project area have been held since 1978 in conjunction with a variety of projects, including the General Management Plan, the proposed May Creek Visitor Center, and construction of the U.S. Highway 101 Bypass. Although information was obtained about ethnographic trails north and south of the Lost Man Creek watershed and about fishing camps in the vicinity of Elk Prairie (recorded by Ritter in 1969) just northwest of the project area, no specific information about Lost Man Creek was obtained. The park met with the Redwood National Park's Orick Native American Heritage Advisory Committee in June 1988 to again discuss the Lost Man Creek area. Consultants stated that this creek was known as a good fishing area, but specific camps could not be identified.

Historic Resources: Since the Upper Dam on Lost Man Creek is over 50 years of age, it was possible that is might be a significant historic cultural resource. Therefore, the park requested Laurence H. Shoup, a professional historian, to research and evaluate the dam. His findings are summarized below (Shoup, 1988). When the Prairie Creek Station was first constructed in 1927 and 1928, water for its operation was obtained directly from Lost Man Creek. In 1936, the state purchased the land on which the hatchery stood from Hammond and Little River Redwood Company, and constructed more modern and permanent facilities including the concrete diversion dam on Lost Man Creek. By 1955 the old hatchery required extensive repairs and was largely discontinued. In 1957, Humboldt County assumed operation of the hatchery, and in 1961, the County acquired the facility from the state. The upper dam was abandoned sometime following 1955.

In his evaluation of the cultural resource, Shoup first consulted a number of standard sources on dams in order to determine how common or rare the upper Lost Man Creek dam is. The dam was not listed on any of the sources, although the larger, older, and more important concrete structures did appear. Next, the National Register of Historic Places Significance Criteria, that is, association with significant events or people, embodiment of distinctive characteristics, or potential to yield important information, were applied to the structure. Shoup concluded that upper Lost Man Creek dam

meets none of the significance criteria: it is not associated with important events or with important people; it is part of a common class of cultural resources, concrete gravity dams, and is not especially old, large, or otherwise distinctive; and it has little information potential. It is therefore not eligible for listing on the National Register of Historic Places.

ALTERNATIVES

Four alternatives are evaluated in this assessment: (1) Completely remove dam in one season; (2) Completely remove dam over six seasons; (3) Dismantle and partially remove dam in one season; and (4) No action.

Baseline Data Collection and Resource Monitoring:

Each alternative, with the exception of no action, would include a comprehensive study to determine baseline conditions and to evaluate the physical and biological effects of dam removal on Lost Man Creek. This will include: (1) potential impacts to currently available fish habitat, (2) potential impacts to riparian vegetation, (3) volume and probable locations of sedimentation downstream due to dam removal and sediment release, (4) expected changes in channel morphology caused by increased sediment loads, and (5) possible effects on upstream road stabilization work completed in 1983.

The aquatic system analysis would include:

1. Quantifying aquatic habitat types on Lost Man Creek from Redwood National Park's Lost Man Creek picnic area downstream to the confluence with Prairie Creek.

2. Characterizing winter and summer aquatic ecosystems by defining diversity, identifying habitat type distribution, surface area, volume, and cover for aquatic vertebrate and invertebrate species.

3. Establishing a baseline measure of salmonid populations per habitat type and shelter rating to compare changes to the aquatic ecosystem that may result from dam removal.

4. Documenting the relationship between physical habitat and biological components within the aquatic habitat types in terms of salmonid population, standing crop, carrying capacity, and preference per habitat type by volume, surface area, shelter, and unit/type sequence.

Physical monitoring and evaluation would include:

1. Surveying cross section and longitudinal profiles on the lower 1.5 miles of Lost Man Creek to document channel configuration and morphology (width, depth, and channel gradient) before and after dam removal.

2. Establishing permanent photo points to document conditions before and after dam removal.

3. Quantifying sediment size distribution and assessing gravel quality through pebble counts and freeze core sampling.

Alternative 1: Completely remove dam within one season (preferred alternative).

All remnants of the dam would be removed from the streambed and banks during one summer season. Much of the sediment trapped behind the dam would be excavated and hauled away during the dam removal process. Heavy equipment (large hydraulic excavator, backhoe, wheel loader, large bulldozers, and dump trucks) supplemented by hand crews would be used to accomplish the work. The work would be directed by park geologists and fisheries biologists.

Hand crews would initially construct a sediment holding pond downstream of the dam. Heavy equipment would be used to create a hole in the dam, improve the sediment holding pond, and excavate a trench in the trapped sediment upstream of the dam. These initial tasks would help reduce downstream turbidity and lower the base level of the stream to near the pre-dam level, helping drain water out of the trapped sediment. The equipment would work upstream, excavating additional sediment trapped by the dam and creating a replica of a natural channel. Where appropriate and available, large organic debris unearthed during the excavation would be retained in the channel. Once a channel had been created, the balance of the dam structure would be removed, including the face, fish ladder, and wing walls. Finally the sediment pond created downstream of the dam would be removed.

An existing skid trail which leads from the Geneva Road to the dam site would be reopened. Second growth alder, Douglas-fir, and Sitka spruce would be removed, and the tread would be bladed smooth so that equipment could access the site. A gravel ramp would be required at the base of the slope to help improve the road grade for dump truck access. Road upgrading would require disturbing an area approximately 25 feet wide by 570 feet long.

A 200 foot by 200 foot equipment and materials staging area would be created adjacent to the dam on the south bank of Lost Man Creek.

In total, approximately 3,500 cubic yards of sediment would be excavated from behind the dam. In addition, the dam structure itself includes about 500 cubic yards of concrete and rock which would be removed. Excavated material would be hauled to an abandoned rock quarry on the Geneva Road (0.1 mile west of the top of the skid trail). The excavated sediment would be used to cover concrete and rock removed from the dam area, the disposal site would be re-contoured and replanted, and much of the rock pit would be rehabilitated.

Approximately 1,500 cubic yards of sediment would be left in the stream channel to allow creation of a defined water course and alluvial flats within the area previously impacted by the dam.

At the completion of the dam removal, the skid road used for access would be rehabilitated by outsloping utilizing heavy equipment brought in for dam removal. The disturbed area would be replanted with a mix of native conifers and hardwoods to mimic the indigenous forest type. Excess material used to create the ramp would be end-hauled to the rock quarry on the Geneva Road.

Alternative 2: Completely remove dam over six seasons

This alternative is similar to Alternative One, except removal of all dam remnants would occur over six summer seasons, and only a portion of the sediment stored behind the dam would be removed. Hand crews would notch the face of the dam, increasing the depth and width of the hole in the dam face each year over five years. During the sixth year, heavy equipment (D-8 size bulldozer and hydraulic excavator) would be brought in and the balance of the dam face, wing walls, and fish ladder would be removed from the stream. About 500 cubic yards of dam material would be removed. In addition, approximately 500 cubic yards of the stored sediment would be excavated from behind the dam. The remaining sediment would remain in the stream and would erode naturally over a period of five to twelve years, depending on streamflows.

All components of the dam would be stored on the alluvial flat immediately south of the dam site, and the excavated sediment would be used to cover material and recontour the slope. The storage site would be replanted with a mix of native conifer and hardwood seedlings. In addition to the 200 by 200 foot area necessary for staging, a 100 by 200 foot area on the south bank would be used for dam remnant and sediment storage. Similar road upgrading and restoration

activities to Alternative One would be implemented under this alternative at the conclusion of work in year six.

Alternative 3: Dismantle and partially remove dam in one season

Under Alternative Three, the dam would be dismantled in place during one summer season. Hand crews with hand or hand-held power tools would break up the rock face of the dam, the concrete structural components, the wing walls, and fish ladder. The water intake sumps would be broken up and filled in with dam remnants. The side wall extending south from the dam would be left in place.

Hand crews would brush open a three foot wide path down the existing skid trail from the Geneva Road to the dam site. The hand crews would haul most of the broken up dam to the flat adjacent to the south side of the dam; however, some of the dam's remnants would remain in the stream bed. No sediment would be removed from behind the dam; the stream bed would be allowed to stabilize naturally over an eight to fifteen year period, depending on flow conditions.

Alternative 4: No Action

Under Alternative Four, the No Action alternative, the dam would remain in place. No work would occur to remove the structure or the sediment stored behind the dam. In addition, no studies would occur to document baseline conditions and to evaluate implementation of restoration alternatives.

Alternative Considered and Rejected: Retain Dam and Restore Fish Ladder

The upper dam contains a fish ladder adjacent to the south wing wall. The ladder is no longer functional. It is filled with sediment, the lower end has eroded away, leaving a relatively large step, and the upper end of the ladder is blocked by a small log jam and several moderate size alder trees. The ladder could be cleaned out and the approaches restored. Water could be channelized through the ladder rather than over the entire dam face, encouraging migrating salmonids to use the ladder. The water intake sumps could be filled, reducing the safety hazard to the public. This alternative was rejected because it would not meet National Park Service policy requirements. The dam would remain as a man-made structure in a natural setting within the park.

ENVIRONMENTAL CONSEQUENCES

A summary of the impacts of each alternative is contained in the impact matrix (next page).

National Park Service Policy:

Redwood National Park was established by Public Law 95-250 to preserve significant examples of the primeval coastal redwood forest and streams and seashores for the purpose of public inspiration, enjoyment, and scientific study. Management objectives for the park include "to restore and maintain the natural ecosystems of the park as they would have evolved without disturbance by human technology" and "to eliminate non-conforming uses within the park" (U.S. Department of the Interior). Implementation of Alternatives One through Three would meet the legislative and management objectives for the park; however, achievement of the objectives would be a decade slower under Alternatives Two and Three. Also under Alternative Three, concrete rubble would be visible on the streambank until overtaken by vegetation, again in about ten years. Alternative Four would not meet the objectives.

National Park Service Guidelines for Dams and Appurtenant Works Maintenance, Operations, and Safety (NPS-40) state that dams which are not essential for environmental preservation, management, or operation of parks and do not have any purpose should be dewatered and removed and the impoundment area restored if economically and environmentally warranted. Alternatives One through Three meet this guideline with varying degrees of success. Alternative One would allow complete removal of the dam and stored sediment and restoration of the stream reach around and above the dam. Under Alternative One, the dam and water intake sumps would be eliminated as a safety hazard. Thus, it would most closely match the NPS guidelines.

Alternative Two would also meet the guidelines, albeit at a slower pace. The dam structure itself would be removed during the sixth year, and most of the excess sediment stored above the dam would erode naturally. Over the course of five to twelve years after dam removal, the stream reach would be restored to a natural setting. The dam and water intake sumps would be eliminated as a safety hazard once the work was complete. The balance of the dam structure would be placed on the streambank and buried in excavated sediment. As revegetation occurs, it would not be readily visible.

Implementation of Alternative Three would also meet the guidelines, again at a slower pace. It would reduce the problems the dam presents as a barrier to fish passage;

UPPER DAM, LOST MAN CREEK

IMPACT MATRIX

Alternatives:	One	Two	Three	Four
Summary	Remove entire dam and most trapped sediment in one season (preferred alternative).	Dismantle and entirely remove dam over six seasons. Partially remove trapped sediment.	Dismantle and partially remove dam in one season. Remove no trapped sediment.	No action: retain dam.
Resource:				
NPS Policy	Closely match legislative and management objectives for park.	When removal is complete, legislative and management objectives would be met.	Legislative and management objectives for park would eventually be met.	Legislative and management objectives would not be met.
Fisheries	1.8 miles of creek would be fully available for fish use. One year increase in turbidity and sedimentation would have minor, adverse effect on fisheries resources.	1.8 miles of creek would be fully available for fish use. Release of 500 yd^3 of sediment yearly for 5 to 8 years. Up to 12 years moderate adverse effect on downstream fisheries habitat.	1.8 miles of creek would be fully available for fish use. Release of 3500 yd^3 of sediment in 2 to 3 years. Up to 15 years moderate adverse effect on downstream fisheries habitat.	The dam would remain as a partial barrier to fish passage, restricting use of 1.8 miles of stream above the dam.
Vegetation	1.75 acres of vegetation (1.5 acres riparian) would be disturbed on-site. No downstream riparian impacts are expected.	2 acre of vegetation (1.75 acres riparian) would be disturbed on-site. Downstream riparian habitat could be adversely impacted.	0.3 acres of riparian vegetation would be disturbed on-site. Downstream riparian habitat could be adversely impacted.	No disturbance of on-site or downstream vegetation would occur.
Physical	800 feet of streambed in Lost Man Creek would be restored. Minor increases in turbidity and sediment would occur during work and first winter. Restore abandoned rock quarry on Geneva Road.	800 feet of streambed in Lost Man Creek would be restored. Minor increases in turbidity during work would occur. Excess sediment released could fill downstream pools and widen channel.	800 feet of streambed in Lost Man Creek would be restored. Minor increases in turbidity would occur during work. Excess sediment released would exceed capacity of stream, filling downstream pools and widening streambed.	The streambed would not be restored. No impacts to downstream pool/riffle sequence would occur.
Water rights; right-of-way	Transfer water diversion license to lower dam; donate right-of-way to NPS.	Transfer water diversion license to lower dam; donate right-of-way to NPS.	Transfer water diversion license to lower dam; donate right-of-way to NPS.	Water diversion license would not be transferred to lower dam. Right-of-way would not be donated.
Cultural	No adverse impacts to cultural resources are expected.	No adverse impacts to cultural resources are expected.	No adverse impacts to cultural resources are expected.	No effect on cultural resources are expected.
Cost	$29,000	$13,000	$2,000	No fiscal impact would occur.

however, some of the structure would remain as rubble within the stream and on the streambank. Over an eight to fifteen year period, the stream reach would be partially restored as excess sediment moves downstream during winter storms. Evidence of the dam would remain in the stream for an undetermined period of time. Concrete rubble left in the stream could also pose a potential hazard to visitors walking up the streambed of Lost Man Creek. Concrete rubble piled on the streambank would be overtaken by vegetation within ten years. The water intake sumps would be broken down and filled in, eliminating them as a hazard to park visitors.

Alternative Four would not meet the above guidelines. The dam would remain as a barrier and an unsafe and unnatural condition in and adjacent to Lost Man Creek would be perpetuated. The water intake sumps, located on the south bank, are five to eight foot deep, concrete lined holes in the ground. They are not readily visible to a person walking in the area and a visitor could fall into the sumps. Similarly, the dam and concrete wing walls on the stream banks would remain in place under Alternative Four, continuing an unnatural scene.

Alternatives One, Two, and possibly Three (see below) would necessitate closure of the Geneva Road and Lost Man Creek picnic area while heavy equipment is working. The closure should not exceed one month and would require coordination with park interpretation and protection personnel to minimize visitor inconvenience.

Fisheries Resources:

Removing or dismantling the upper Lost Man Creek Dam under Alternatives One through Three should result in approximately 1.8 stream miles being made available for spawning and rearing by salmonids. This distance includes the area directly affected by trapped sediment behind the dam and an additional 1.6 miles of Lost Man Creek currently restricted for salmonid spawning and rearing. Baseline studies would quantify the extent of habitat and estimate the number of fish which the restored habitat could support (see Baseline Data Collection and Resource Monitoring, above).

Alternatives One through Three would have varying degrees of impact on downstream biological resources. Alternative One would have relatively minor impacts over a one year period. During the excavation work, turbidity and fine sediments would be generated as a result of the in-stream work by heavy equipment, resulting in a temporary reduction in water quality. Creation of a sediment holding pond just downstream of the dam at the start of the work will help minimize downstream turbidity. During the first winter, despite creation of a channel which approximates natural stream

conditions, minor quantities (estimated 200 to 300 cubic yards) of additional sediment will be discharged as the stream reworks the newly excavated channel. By conclusion of the first winter, it is expected that the stream channel will have stabilized and sediment transport will return to near background levels.

Alternative Two would have a longer term and more significant impact on downstream biological resources. Notching the dam may release approximately 500 cubic yards of sediment per year, which may be more sediment than the Lost Man Creek system is capable of transporting in a single year. That sediment may deposit in the stream reach between the upper and lower dams on Lost Man Creek. That additional sediment may damage existing salmonid spawning and rearing habitat by covering existing spawning gravels and filling in pools available for summer rearing. The impacts would be evident for up to a 12 year period.

Alternative Three would have even greater impacts than Alternative Two, since most of the trapped sediment could begin moving downstream in the first winter season. Dismantling the dam by hand is expected to lower the dam height by three to four feet, leaving a two to three foot high step in the creek at the dam site. Since no sediment would be excavated, dismantling the dam could release up to three-quarters (3500 cubic yards) of sediment now trapped behind the dam. The sediment would be initially deposited in the stream reach immediately below the dam. Depending on winter stream flows, excess sediment would be transported and redistributed through the Lost Man and Prairie Creek systems over a five to ten year period. Dam-stored sediment could damage existing salmonid spawning and rearing habitat by covering spawning gravels and filling pools available for summer rearing. Similar to Alternative Two, the impacts on downstream physical resources would be evident for up to 15 years.

Under Alternative Three, 1.8 miles of stream would also become available for salmonid spawning and rearing. However, the benefits would be derived over a longer period of time. Downstream sedimentation would temporarily diminish the existing quality of habitat available, while a short section of habitat immediately upstream of the dam would remain depressed because some sediment trapped behind the dam would remain in place. However, the section of stream with good quality habitat made available by dam removal would exceed that temporarily impacted by sediment moving downstream.

Alternative Three, which anticipates breaking up the dam in place, could result in a partial barrier to fish, depending on concrete and boulder placement. Monitoring the stream and

readjustment of concrete blocks and boulders could be necessary.

Alternative Four would continue the existence of the dam as a partial barrier to migrating salmonids. No new impacts to downstream fisheries resources would occur through dam retention.

Currently, Humboldt County operates the Prairie Creek Fish Hatchery at the confluence of Prairie and Lost Man Creeks. A portion of the hatchery is on Redwood National Park lands and that portion is operated under a special use agreement with the National Park Service. As part of the hatchery operation, mechanical weirs are placed in both Prairie and Lost Man Creeks to force upstream migrating fish into the hatchery. By agreement with the California Department of Fish and Game, the weir on Prairie Creek is operated on a 24 hours on, 24 hours off basis during the fall and winter months to obtain fish both for hatchery and for other northcoast fish rearing operations. The weir on Lost Man Creek is allowed to operate continuously. Those fish in excess of the hatchery allotment are released upstream of the Lost Man Creek weir and allowed to spawn naturally.

Restoration of the Lost Man Creek fishery through removal of the dam could be partially negated or offset by continued withdrawal of fish from the stream by the hatchery. Fish destined for Lost Man Creek are diverted into the hatchery until the hatchery's needs are met. Some native fish which could utilize the newly available habitat in Lost Man Creek for spawning and rearing would instead go to the hatchery. Under Alternatives One, Two, and Three, the park will suggest a modification in the time periods during which the Lost Man Creek weir could operate.

Impacts of the U. S. Highway 101 bypass construction project could have an indirect relationship to removal of the upper Lost Man Creek dam. Fisheries impacts resulting from the bypass construction were forecast to adversely affect May and Boyes Creeks (tributaries of Prairie Creek upstream of Lost Man Creek) along with Prairie Creek itself. Although these expected impacts have been mitigated through habitat restoration at the mouth of Redwood Creek and other projects, restoration of fisheries habitat on Lost Man Creek and other tributaries of Prairie Creek could additionally offset the forecast losses and speed natural recovery of the Prairie Creek system.

Vegetation Resources:

Alternatives One and Two would require reopening the abandoned skid trail and creation of a staging area adjacent to Lost Man Creek. Under Alternative One, approximately 0.25 acres

would be required for the road upgrading, and one acre would be needed for the staging area. In addition implementation of Alternative One will disturb streamside riparian vegetation from the dam upstream 800 feet. Heavy equipment working in the stream will damage overhanging alder trees and branches, intermittently disturbing up to a total of 0.5 acres in a linear strip on the streambanks. Cumulative vegetation disturbance under Alternative One is 1.75 acres.

In addition to road upgrading and the staging area, Alternative Two would necessitate disturbing 0.5 acre for dam rubble and sediment disposal. Streamside disturbance would be limited to 0.25 acres in the dam vicinity, resulting in a total disturbance of two acres.

Vegetation impacts under Alternative Three would be limited to approximately 0.3 acres, primarily to store dam remnants.

Under Alternative One, approximately 1.5 acres of the area to be impacted would be riparian resources. Under Alternative Two, the riparian resource impact area would increase to 1.75 acres, and much of that impact would occur in the sixth year of dam removal. Alternative Three would require approximately 0.3 acres of riparian habitat near the south bank of Lost Man Creek to hand pile the dam remnants.

On-site impacts from Alternatives One, Two, and Three are expected to be visible for up to ten years, until planted hardwoods and conifers reach a sapling size. Bare ground created by disturbance will be revegetated within one year.

Alternative One is expected to have little impact on downstream streamside vegetation resources. The quantity of sediment which would be released can be transported by the Lost Man Creek system and no aggradational effects are expected.

In contrast, under Alternatives Two and Three, downstream aggradational effects on vegetation resources could result in removal of riparian vegetation as the stream channel fills and widens. Such impacts depend primarily on winter stream flow conditions, thus the area of potential impact cannot be accurately predicted.

Alternative Four, no action, would result in no net change to riparian habitat up or downstream of the dam.

Physical Resources:

Alternatives One and Two would result in the restoration of approximately 800 feet of streambed in Lost Man Creek to a facsimile of its natural condition. Development of a pool and riffle sequence could take three to eight years following

removal of the dam and excavation of trapped sediment. Under Alternative Three, the stream reach around the upper dam would be improved for fish passage; however, restoration of the stream would be delayed as the sediment naturally flushes out of the system.

Alternative One is expected to have little short term physical impact on downstream physical resources. Minor amounts of turbidity will be generated during the excavation operation, reducing water quality. Release of trapped sediment during the first winter following excavation is expected to have a minor aggradational effect on the stream.

Alternative Two would result in releasing significant amounts of trapped sediment over a five to eight year period. The stream channel downstream of the dam will adjust to the increased sediment load by filling pools and widening the channel. Increased flooding of streamside areas could occur as the stream bed rises.

Alternative Three is expected to have a similar impact to Alternative Two, except that downstream physical effects could be more concentrated. Minor increases in turbidity will occur during the actual work. In addition, significant quantities of sediment would be released during the first winter following dismantling of the dam. As with Alternative Two, the stream channel downstream of the dam will adjust to the increased sediment load by filling pools and widening the channel. Increased flooding of streamside areas could occur as the stream bed rises.

Implementation of Alternatives Two or Three have the greatest potential to impact downstream Humboldt County hatchery operations. Sediment released from behind the dam may fill the pool immediately upstream of the lower dam on Lost Man Creek, impairing the hatchery's ability to withdraw water from the dam. Alternatives One through Three also could impact hatchery operations through increased turbidity in the stream. Most of the hatchery's water for operations comes from wells, and the lower dam is only used as an emergency source of water. In addition, over the past several years, the hatchery has drawn most of its water from the creek during the winter months, when natural turbidity levels are higher. Thus increases in summertime turbidity in Lost Man Creek should have a minor effect on hatchery operations. The park would keep the hatchery manager fully informed about the time schedule for any dam removal project so that hatchery personnel would be aware of any expected increases in turbidity.

Alternative Four, no action, would result in a continued man-made modification of an 800 foot reach on Lost Man Creek.

Pool and riffle sequences, characteristic of natural streams, would not develop in this area. No new impact on downstream physical or riparian resources or hatchery operations would occur.

Under Alternative One, disposal of the dam and excess sediment would allow partial rehabilitation of an abandoned rock quarry on the Geneva Road. The lower portion of the 200 foot high quarry would be filled and replanted. The quarry is an eyesore to park visitors and will remain in that condition without positive rehabilitation action. It is revegetating slowly, primarily with exotic species (pampas grass). Under Alternatives Two, Three, and Four, the abandoned rock quarry would not be restored under this project. However, as part of Redwood National Park's overall resources management program, control of exotic species such as pampas grass would occur.

A portion of the Geneva road approximately 500 feet upstream of the dam failed during the 1982-1983 winter. The road was reconstructed in 1983 and new rock fill was placed between the road and the creek. That new fill partially rests on sediment trapped by the upper Lost Man Creek dam. If the dam were removed under Alternatives One, Two, or Three, the sediment could erode. Thus, the toe of the reconstructed road fill could require placement of additional rock to ensure stability of the Geneva road. Either existing, available rock or dam rubble could be placed by heavy equipment under Alternative One and Two. Alternative Three may require use of a drag line crane positioned on the Geneva Road to place rock at the toe of the fill. Use of a crane would necessitate temporary closure of the Geneva Road and Lost Man Creek Picnic Area.

Water rights and right-of-way:

The County of Humboldt holds a license (Application A008391, Number 002355) to divert 1.86 cubic feet per second from Lost Man Creek for the purpose of hatchery operations. That license, originally issued in 1935, is site specific to the upper dam on Lost Man Creek (State of California). However, since 1969, the County has drawn water from a well and from the lower dam on Lost Man Creek, not the upper dam. As part of implementation of Alternatives One through Three, the National Park Service would enter into negotiations with the County and the State Water Resources Control Board, Division of Water Rights to transfer that license to the lower dam on Lost Man Creek. Other than a transfer of water rights, no modification of the lower dam is proposed.

In 1961, the State of California transferred operation of the hatchery to Humboldt County (Humboldt County). As part of

the transfer, the state issued a quit claim deed to the county, turning the hatchery over to the county. That deed included provision of a right-of-way for and maintenance of a pipe line, flume or other conductor of water from Lost Man Creek to the hatchery. Although the original water conductors have disappeared, the right-of-way remains in place. The ability of the County to exercise their right-of-way across National Park property would be limited. Under Alternatives One through Three, the National Park Service would enter into negotiations with the County to donate that right-of-way to the Service.

If Alternative Four were implemented, the right-of-way and water rights would remain in County ownership.

Cost of dam removal:

Alternative One, total removal in one season, would cost approximately $29,000. Alternative Two, phased removal over six years, would cost approximately $13,000. Alternative Three, dismantle and partially remove the dam, would cost approximately $2,000.

Cultural Resources:

The National Park Service is bound by its policies and pertinent federal legislation to evaluate the effects of its actions on cultural resources eligible for listing on the National Register of Historic Places. Since no prehistoric or contemporary Native American cultural resources exist within the project area, Alternatives One, Two, and Three will have no effect on these two types of cultural resources. An historic cultural resource, the dam itself, exists in the project area and Alternatives One, Two, and Three will effect that resource. The dam has been thoroughly recorded and the results of research and studies show that it is not eligible for listing on the National Register of Historic Places. The Park will obtain State Office of Historic Preservation concurrence on the ineligibility of the Lost Man Creek upper dam for listing on the National Register of Historic Places. By completion of these actions, the Park has fulfilled its obligations concerning historic cultural resources.

CONSULTATION AND COORDINATION

Removal of the upper Lost Man Creek dam has been discussed with State of California, Department of Fish and Game personnel on a number of occasions. Department representatives have generally supported removal of the dam.

The National Park Service has discussed removal of the dam with Humboldt County representatives during preparation of the environmental assessment. Those discussions addressed water rights, rights of way, and design of the dam.

If the dam is to be removed, the National Park Service will first apply for a Department of the Army permit, a Department of Fish and Game Streambed Alteration agreement, and a Regional Water Quality Control Board waste discharge permit prior to initiating any modifications of the dam. During the public review process, consultation with other agencies, including the U.S. Fish and Wildlife Service and State of California, Office of Historic Preservation, will occur.

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Table 1. Total numbers, and percentages of adult live salmonids, carcasses, and redds, counted above and below the upper Lost Man Creek dam during winter stream surveys.

Spawning Year	Date	Live Fish			Carcasses			Redds		
		Below (%)	Above (%)	No.	Below (%)	Above (%)	No.	Below (%)	Above (%)	No.
1984-85	02-25-85	44	56	16	0	100	6	-	-	-
1985-86	12-18-85	100	0	25	88	12	8	100	0	3
1987-88	01-26-88	86	14	126	78	22	37	72	28	29
	02-10-88	88	12	43	74	26	35	79	21	33
1988-89	12-06-88	84	16	111	100	0	3	88	12	16
	01-25-89	93	7	127	85	15	27	89	11	52
	02-15-89	90	10	38	94	6	31	96	4	50
1989-90	12-05-89	100	0	2	0	0	0	0	0	0
	01-23-90	72	28	102	48	52	27	62	38	40
	03-22-90	79	21	24	86	14	7	65	35	54
1990-91	01-16-91	25	75	4	0	0	0	0	100	2
	01-31-91	59	41	17	41	59	22	61	39	18
	02-27-91	100	0	18	64	36	14	67	33	15
	03-18-91	65	35	26	0	100	2	100	0	3
1991-92	01-02-92	100	0	1	50	50	2	44	56	9
	01-29-92	49	51	33	75	25	4	67	33	21
	02-13-92 03-03-92	89	11	74	70	30	20	75	25	84
	03-24-92	50	50	6	80	20	5	88	12	40

Table 2. Yearly total numbers and percentages of adult live salmonids, carcasses, and redds, counted above and below the upper Lost Man Creek dam site during winter stream surveys of Lost Man Creek, Humboldt County, California.

Spawning Year	No. of Surveys	Live Fish			Carcasses			Redds		
		Below (%)	Above (%)	No.	Below (%)	Above (%)	No.	Below (%)	Above (%)	No.
1984-85	1	43.8	56.2	16	0.0	100	6	-	-	-
1985-86	1	100	0.0	25	87.5	12.5	8	100	0.0	3
1987-88	2	86.4	13.6	169	76.4	23.6	72	75.8	24.2	62
1988-89	3	88.8	11.2	276	90.2	9.8	61	91.5	8.5	118
1989-90	3	73.4	26.6	128	55.9	44.1	34	63.8	36.2	94
1990-91	4	70.8	29.2	65	47.4	52.6	38	63.2	36.8	38
1991-92	4	75.4	24.6	114	71.0	29.0	31	75.3	24.7	154

(Dark line signifies surveys before and after dam removal in August 1989.)

Table 3. Yearly total numbers and percentages of adult live salmonids, carcasses, and redds, counted below the lower hatchery dam, above the lower dam and below the upper Lost Man Creek dam site, and above the upper dam site and the Double Bridges, during winter stream surveys of Lost Man Creek, Humboldt County, California.

Spawning Year	No. of Surveys	Live Fish			Carcasses			Redds		
		Lower Hatchery Dam (%)	Below (%)	Above (%)	Lower Hatchery Dam (%)	Below (%)	Above (%)	Lower Hatchery Dam (%)	Below (%)	Above (%)
1984-85	1	0.0	43.8	56.2	0.0	0.0	100	-	-	-
1985-86	1	20.0	80.0	0.0	0.0	87.5	12.5	33.3	66.7	0.0
1987-88	2	41.4	45.0	13.6	9.7	66.7	23.6	3.2	72.6	24.2
1988-89	3	51.1	37.7	11.2	34.4	55.8	9.8	28.8	62.7	8.5
1989-90	3	43.8	29.6	26.6	29.4	26.5	44.1	14.9	48.9	36.2
1990-91	4	35.5	35.4	29.2	10.5	36.9	52.6	7.9	55.3	36.8
1991-92	4	18.5	57.0	24.6	16.1	54.8	29.0	21.4	53.9	24.7

(Dark line signifies surveys before and after dam removal in August 1989.)