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BIOLOGICAL MONITORING
OF THE U.S. 101 BYPASS

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INTRODUCTION

Congress directed in Public Law 95-250 that a bypass highway be built east of Prairie Creek Redwoods State Park. The intent of the bypass would be to alleviate the conflict between visitor and commercial traffic in one of the most popular areas of Redwood National Park.

The environmental analysis concluded that moderate to high soil erosion could occur during the five-year construction period and for an indeterminate number of years thereafter. The resulting sedimentation has the potential to significantly reduce aquatic productivity of project area streams.

Of most concern is the impact to salmon and trout. Fishery resource losses during the construction phase of the bypass project has been estimated as high as 75 - 100% in May Creek, the stream most affected by highway construction. Fishery losses for other streams in the project area have been estimated from 13 to 90%.

Approximately \$6 million ^{has} have been set aside for fisheries mitigation and water quality and erosion control. To compensate for anticipated fish losses, funds will be utilized for fish replacement in the Klamath River drainage, and habitat rehabilitation in the Prairie Creek drainage and at the mouth of Redwood Creek. To minimize construction related impacts, specific erosion control measures will be incorporated into the contract plans and specifications.

OBJECTIVES AND SCOPE

Both Redwood National Park (RNP) and the California Department of Transportation (Caltrans) recognized the need and mandated, as part of fisheries mitigation for the 101 Bypass, a monitoring program to determine the amount of sediment reaching the streams and to assess the actual effects on fisheries resources. Hydrologic and water quality baseline data has been monitored by Caltrans personnel since 1980 in the streams to be affected by the bypass construction. At the same sites, biological monitoring of aquatic invertebrates was conducted by RNP personnel during 1980 and 1981. Caltrans will continue monthly hydrologic and water quality monitoring and has proposed a program to measure surface erosion from construction sites.

This proposal outlines a program for biological monitoring during the construction phase of the 101 Bypass project (1984-1988). The program will concentrate on fisheries resources as indicated in the fisheries mitigation section of the Environmental Impact Statement - U.S. 101 Bypass. The objectives will be to measure changes (over time) in juvenile fish numbers, aquatic invertebrates, and stream habitat parameters which influence aquatic organisms. Monitoring will evaluate the relative success of the erosion control efforts and determine if the fishery losses in the various streams were accurately projected.

The proposed monitoring program will begin ^{baseline} summer, 1984 and, along with existing data, will represent preconstruction conditions. Beginning in the summer of 1985 and continuing through 1988, the monitoring program will be conducted while road construction is under progress. Data will be

continuously analyzed and reports prepared annually for distribution to concerned agencies. By 1985, all data collected prior to construction (including 1980-81 biological monitoring and other associated information) will be made available in a formal public report. Another formal report summarizing the results of the monitoring program will be made available to the public toward the end of the project.

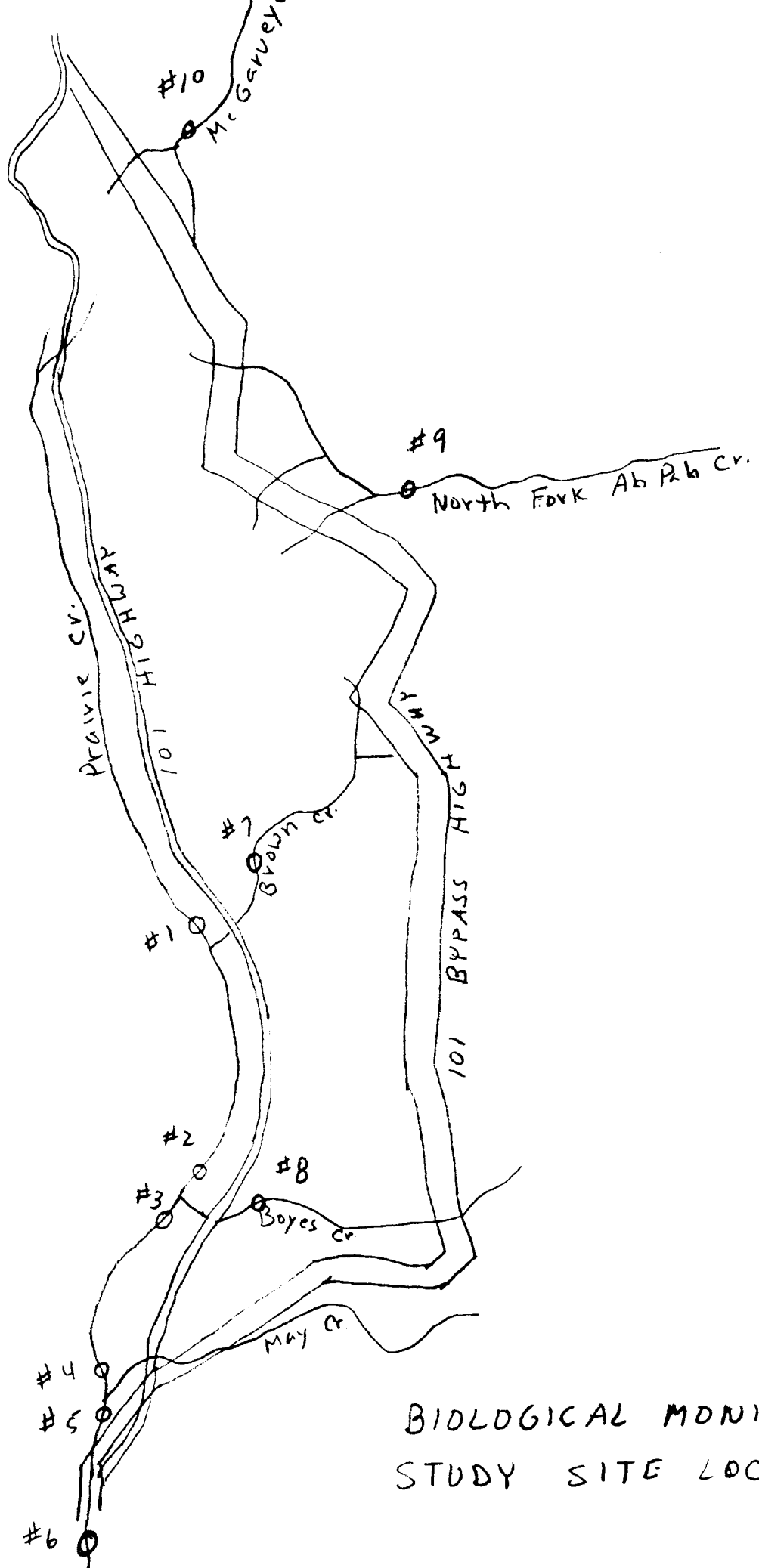
STUDY SITE

The attached map shows the study sites in relation to the bypass alignment.

The site locations are as follows:

- 1) Prairie Creek above the confluence of Brown Creek;
- 2) Prairie Creek above the confluence of Boyes Creek;
- 3) Prairie Creek below the confluence of Boyes Creek;
- 4) Priarie Creek above the confluence of May Creek;
- 5) Prairie Creek below the confluence of May Creek;
- 6) Prairie Creek below the channelization area;
- 7) Brown Creek below construction area
- 8) Boyes Creek below construction area.
- 9) North Fork Ah Pah Creek below construction area; and
- 10) McGarvey Creek below construction area.

Study sites were located in 1980 by Caltrans for water quality and hydrologic monitoring program. Most of the sites were also used in RNP's 1980-81 biological monitoring program. The specific sites for the proposed study will be 50-100 meter representative reaches which have the necessary stream features to allow all fisheries and aquatic habitat measurements.



BIOLOGICAL MONITORING
STUDY SITE LOCATION

Six of the ten sample sites were strategically located on Prairie Creek. This is the major watershed in Prairie Creek Redwoods State Park and is relatively undisturbed. It also has good access and ideal water flow for biological monitoring. Site 1 is outside the influence of highway construction since Brown Creek is the furthestmost upstream tributary to Prairie Creek affected by the bypass. With some discretion, Site 1 can be used as a control study reach for other Prairie Creek sites. Sites 2 through 5 are immediately above and below two major Prairie Creek tributaries to be affected by the bypass. Site 6 will be directly below a 400 foot section of Prairie Creek to be channelized for the southern highway intersection and represents the furthestmost downstream sample site. Sites 7 and 8 are located below the construction area on two of the three Prairie Creek tributaries to be affected by the bypass. There will be no study site on the third tributary, May Creek, because all of the stream section where a site could be located, will be within the construction area. Two Klamath River tributaries, Ah Pah and McGarvey, will be affected by the bypass construction. Site 9 will be located on North Fork Ah Pah, and Site 10 on McGarvey Creek. There will be no sites on the Klamath River because its size would make these sampling procedures impossible.

STUDY DESIGN

The study objective is to detect possible impacts to fish and aquatic invertebrates in streams affected by highway construction. There will be three components to the biological monitoring program:

- 1) Juvenile fish monitoring;
- 2) Aquatic invertebrates monitoring; and
- 3) Aquatic habitat monitoring.

This three component study design will best describe the complex changes which can occur in the aquatic system due to increased sediment and petroleum-based contaminants. For example, the most obvious significant impact would be a decrease in the total number of fish. However, fish populations in coastal salmon streams can be affected by other uncontrollable factors such as commercial and sport fishing, global weather, and salmon hatchery egg-taking operations. Since aquatic invertebrates are not subject to commercial and sport harvest, they provide a more reliable means of monitoring aquatic impacts.

Since there are many different species of stream invertebrates as compared to only a few fish species, invertebrate community analysis can provide more precise environmental quality data. Examination of invertebrate community changes and decreases in diversity and other ecological indices can reveal subtle, as well as, acute impacts. In addition, aquatic invertebrate monitoring can explain possible decreases in fish numbers since fish are directly dependent on aquatic invertebrates as a food source.

Aquatic habitat monitoring will provide information on physical stream changes which would contribute to changed² fish and invertebrate numbers. Data from Caltrans hydrologic and water quality monitoring will also be used to correlate biological and physical changes.

Fish Monitoring

Within each study reach a 30 meter section of stream will be sampled to estimate juvenile fish numbers. The section will be blocked at each end

with a net to prevent immigration and emmigration of fish. Fish numbers will be determined twice a year (May/June and September/October) using the Moran-Zippin multiple pass method and an electroshocking device used to collect the fish. Fish species will be counted, weighed, and measured.

This sample design will provide the following information:

- 1) Estimated number of individuals per unit area;
- 2) Species composition;
- 3) Year-class composition;
- 4) Condition factor;
- 5) Summer and winter survival rates; and
- 6) Estimated smolt production per stream.

Aquatic Invertebrate Monitoring

There will be two aquatic invertebrate sampling objectives -- estimate biomass per unit area, and describe seasonal community composition.

Aquatic invertebrate biomass will be estimated twice a year in conjunction with the fish population estimates. Within each study reach, a uniform riffle (having relatively consistent depth and velocity within and among study reaches and throughout the years¹) will be divided into grids. Three grids

¹ A statistical procedure, analysis of convariance, may be used to equate depth of velocity within and among sites in order to detect significant differences in aquatic invertebrate parameters.

will be chosen at random and invertebrate samples taken using a Hess substrate sampler. Aquatic invertebrates from each sample will be identified, enumerated and each taxonomic group weighed.

Aquatic invertebrate community structure will be measured by continually sampling riffles and pool sections during summer and fall months. Small Artificial Substrate Baskets (SASB)² samplers will be placed in the study reach in May/June. After a six-week colonization period, three samples will be randomly taken from both pool and riffle sections. Sampling will occur every three to four weeks until winter peak flows prevent sampling (five to seven times). Aquatic invertebrates will be identified, enumerated and their body length measured.

This sample design will provide the following information:

- 1) Total aquatic invertebrate biomass per unit area;
- 2) Species composition relative to biomass;
- 3) Seasonal (June-Oct.) aquatic invertebrate community composition including:
 - a) Functional group composition, i.e., predators, grazers, shredders and collectors;
 - b) Total number of individuals;
 - c) Total number of taxa;

²SASB Sampler as developed and described by the author in his MS Thesis from Humboldt State University, California entitled "An evaluation of techniques for collection and analysis of benthic invertebrate communities in second order streams in Redwood National Park."

- d) Diversity index;
 - e) Other ecological indices; and
- 4) Life histories for most common species.

Aquatic Habitat Monitoring

Once a year at each sample site, gravel composition will be sampled in a riffle of uniform depth and velocity. A tri-tube "freeze-core" gravel sampler will be used to obtain samples for substrate size composition analysis and for determining vertical stratification. The first year (1984), three samples will be randomly taken in each riffle area. Using this information, the optimal number of samples will be determined for subsequent years samplings.

Each of the study reaches will be mapped annually in detail using conventional surveying equipment. Permanent survey points will be established along a longitudinal profile of the study reach. Enough (depending on the actual stream morphology) cross-sectional depth profiles will be made to accurately measure pool and riffle volume. Other stream features important as aquatic habitat (i.e., large organic debris, bank characteristics and canopy cover) will be described, and, if appropriate, measured.

Representative photo points will be established annually to provide visual comparisons.

This sample design will provide the following information:

- 1) Gravel composition;
- 2) Vertical gravel profile;
- 3) Total pool volume;
- 4) Total riffle volume;
- 5) Photo history; and
- 6) Other aquatic habitat features.