EVALUATION OF FISH HABITAT
AND
BARRIERS TO FISH MIGRATION

RUSSIAN RIVER MAINSTEM
AND LOWER DRY CREEK

Winzler and Kelly Consulting Engineers
633 Third Street
Eureka, California 95501

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John R. Winzler	Principal in Charge
Richard C. Dornhelm	Project Manager
Gregory B. Nesty	Project Coordinator
Gary A. Miller	Computer Programmer
Steven Eskra	Graphics Coordinator
Michael Yapp	Graphics Artist
Judy Williams	Word Processing Coordinator
Teresa L. Clark	Editorial Assistant
Gene Leo Reed Kelly	Field Technicians

The following individuals are credited for supplying significant assistance in the preparation of their respective text:

Channel Hydraulics	Richard C. Dornhelm
Fisheries Review	Dr. John Dewitt Paul A. Kline
Instream Structure Review	Richard K. Jorgensen

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF TABLES

I. Introduction

A. Background

The Russian River drainage basin (Figure I-1) contains approximately 1,485 square miles of watershed in Sonoma and Mendocino Counties. The headwaters of the main (West) fork originate 18 miles north of Ukiah in the mountainous regions surrounding Redwood Valley. The East Fork joins the West fork four miles upstream from Ukiah. Natural flow in the East Fork is augmented by flow diverted from the Eel River and Van Arsdale Dam via the Potter Valley power project. Russian River flow (in the East Fork) is further regulated by the Coyote Dam Project completed in 1959.

The major tributaries flowing into the mainstem below "the forks" are Feliz Creek at Hopland, Big Sulphur Creek at Cloverdale, Dry Creek at Healdsburg, Mark West Creek at Mirabel Park, and Austin Creek at Duncan Mills. The river flows approximately 95 miles from the East Fork-West Fork confluence to the mouth at Jenner. Flow is southerly for the upper two thirds of the river extending through Ukiah, Hopland, and Alexander Valleys. The lower 30 miles of river flows west towards the Pacific Ocean cutting through the Mendocino Coast Range.

The Russian River drainage system provides valuable fishery habitat as well as water supply and recreation opportunities for both visitors and local residents. On the river and tributaries, up to 200 summer and recreational dams and road crossings are constructed annually. Instream structures vary in size from small gravel impoundments to large semipermanent dams inundating several miles of river for recreation, irrigation, and municipal water supply.

The Russian River drainage supplies spawning and nursery habitat for an estimated run of 57,000 steelhead and 6000 salmon. American shad also migrate into the river each spring and early summer to spawn. Specific data regarding the impact of temporary and semi-permanent structures on anadromous fish (steelhead, salmon, shad) passage was limited. Data on location and extent of fish habitat and spawning areas on the Russian River and tributaries was also limited. In addition, the effects of dams and road crossings on water temperature, dissolved oxygen content, and turbidity were largely unknown.

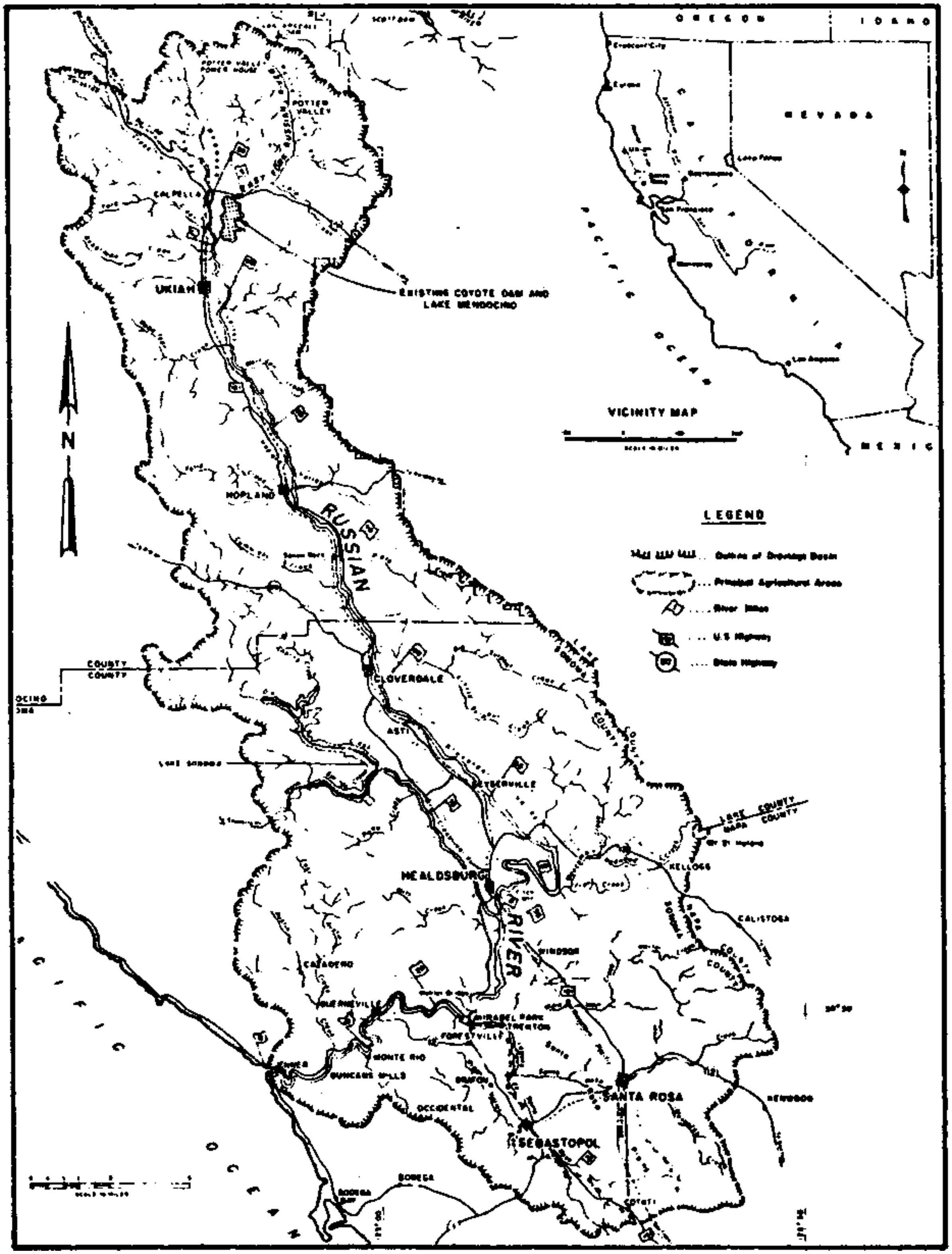


Figure I-1 Russian River Drainage Basin

B. Scope and Purpose of Work

The purpose of this study was to conduct a "systematic survey of existing and potential fish habitat and water impoundment structures and other structures that may pose barriers to fish migration in the mainstem Russian River and Dry Creek."

The scope of work includes a literature review of study methods, Russian River fishery resources and habitat, hydrology, and instream structures; wet and dry season field surveys of fish habitat and structures; evaluations of fish passage impediments, spawning habitat, and nursery habitat; and recommendations for optimum flow for spawning and nursery habitat. The area of study is the mainstem Russian River from the mouth to the confluence with the East Fork, and Dry Creek from the confluence of Russian River to Bord Bridge (see Figure I-1).

This study was initiated by the Corps of Engineers after the Russian River Basin Phase I Study Report (December 1976) identified significant data needs for preservation and enhancement of the Russian River fishery. The fish habitat and impoundment study is designed especially to contribute to management decisions regarding flow releases from Coyote Dam and the Warm Springs Dam and Lake Sonoma Project. Since virtually all management decisions within the basin will be related to flow releases, this study forms a vital part of the overall Corps Survey Study of the Russian River Basin.

II. Literature Review

A. Methods and Materials

1. General

Salmon and steelhead trout habitats have been evaluated on the basis of a wide variety of stream parameters. Evaluations based on one or just a few parameters have not been shown to be valid in rating fish production, except in cases of very adverse conditions, of which any one or two severely affected production. Platts (1976) states, "Past studies do demonstrate correlations...between parts of the aquatic system and...surroundings but not correlations between environmental variables...and fish populations." Platts (1974) searched for correlations between many common stream parameters and fish abundance, but found the correlation between any one condition and fish abundance to be low. Additionally, his analysis showed "that the amount of fine sediment in the channel had no effect on any observed variations in fish population numbers." "No clear trend was identified between total fish populations or individual fish species with percent rubble, although rubble was the only substrate class that had explained variation (two percent for total fish numbers)."

Apparently, more nearly valid evaluations are possible when only one species and life stage or biotope is involved in the assessment. For example, McNeil and Ahnell (1964), found correlation between the percentage of fine sediment (diameter <0.833 mm.) and the total sediment in pink salmon spawning areas and the escapement of adult pink salmon to spawning streams.

Studies by the Oregon State Game Commission (Smith, 1973), among others, have revealed that salmon and steelhead tend to spawn under certain conditions of water velocity and depth. The fall run king salmon tended to build nests where water velocities 0.4 feet above the bottom were from about 0.6 to 2.65 feet per second (fps), and where the mean depth was about 1.3 feet. Winter steelhead spawned mainly at velocities ranging from 1.3 to 2.9 fps and at a mean depth of about 1.4 feet. Nickelson (1976) found good correlation between the biomass of juvenile silver salmon and a "habitat quality" index based on water depth, velocity, cover, and substrate conditions in Elk Creek, Oregon. A recent comprehensive survey of the literature on pertinent ecological requirements of salmon and steelhead is provided by Giger (1973).

All currently available methodologies for evaluating fish production potentials from stream conditions are composed of one or more measurement or estimation techniques involving stream parameters known to be important in determining the success of some life stage of a given fish in a given biotope. The validity of such general methods is questionable, and no standard method for habitat evaluation exists. In fact, as Giger (1973), in his comprehensive review of evaluation methods, states "A...major problem (in evaluating streams) concerned the almost complete lack of uniformity of study methods." The most up-to-date and comprehensive discussion of current methodologies is that of Stalnaker and Arnette, (1976).

Baracco (1977) estimated the minimum flow requirements for steelhead, king and silver salmon in Dry Creek. His methodology was used as a guide to the development of appropriate techniques for this study because it represented California Department of Fish and Game methodology and because it was specifically applicable to Dry Creek. However, other methods were considered and some original techniques were devised in arriving at the final approach used in this study.

2. Fish Habitat Requirements

a. Fish Passage Velocities, Depths, and Dissolved Oxygen Concentrations

The passage of adult silver salmon and steelhead over riffles is deemed to be possible at water depths of 0.6 feet or greater. For king salmon, the depth criterion used was 0.8 feet (based on Hutchinson, et al., 1966, and Thompson, 1972). These criteria were adopted by Baracco (1977) in his flow requirement study of Dry Creek. Baracco considered riffles critical to fish passage if the shallowest continuous transect across the riffle did not contain a 10 percent continuous portion and a 25 percent total length meeting minimum depth criteria established by Thompson (1972).

The maximum water velocity criterion for adult steelhead and salmon passage over short distances of rapidly flowing water (e.g. culverts, dam spillways, etc.) was determined to be 8 fps.

Evans (1974) recommends a maximum allowable passage velocity of 6 fps for upstream migrating salmon and steelhead, while Baracco (1977), in evaluating critical riffle passage by steelhead and salmon in Dry Creek, utilizes 8 fps as the maximum passable velocity. Thompson (1972) uses this same maximum value of 8 fps for adult salmonids.

American shad passage criteria are not as available in the literature as data regarding steelhead and salmon. Collins (1951) found that shad were easily able to negotiate the fishway at Essex Company Dam in Lawrence, Massachusetts, where maximum water velocities did not exceed 3 fps. Weaver (1965) conducted experiments on shad passage in a section of controlled streamflow and water velocity on the Columbia River. Dealing with relatively high water velocities, Weaver determined that shad were able to travel an average distance of 30 feet in water flowing at 11.4 fps before becoming exhausted and falling back.

Shad passage in Denil fishways on the lower Russian River was investigated in 1973. Eleven shad were observed moving upstream and eight shad were observed moving downstream during the period of June 2 through July 14 (Baracco 1978). Although observations did not include the beginning of the shad migratory season (April-May), it was suspected that the fishways presented passage problems to American shad. Fishways were subsequently modified to reduce slopes and velocities (C.D.F.G., 1978a, 1978b). Morrison (1978) notes that slopes exceeding 1 in 6 are not easily passable by shad. Russian River Denil fishways are within the limit (C.D.F.G., 1978a, 1978b and Morrison, 1978). Fry (1973) indicates that, "shad are very poor at ascending fishways and are apt to be stopped even by a relatively low dam." Bell (1973) notes that shad generally reject orifice openings as low as 6 feet and that square corners may trap migrating fish. Bell suggests surface and wall side passage be provided for this species.

During the fall and winter upstream migration of adult salmonids, water temperatures are low and dissolved oxygen problems are not usually encountered. Levels of dissolved oxygen are generally near the saturation value. However, late summer and early fall runs in very warm or polluted streams might face oxygen problems. Sams and Conover (1969) reported that fall run king and silver salmon usually did not attempt to pass over a barrier on an Oregon river until oxygen concentrations rose to 4 or 5 mg/1. It is possible that adult salmon and steelhead would be under stress even at high dissolved oxygen concentrations when water temperatures are high. Temperatures commonly are high in the lower reaches of the Russian River during the minor August and September run of king salmon.

b. Spawning Habitat

1) Substrate

Whether a given stream bottom substrate is suitable for the successful spawning, incubation, and emergence of salmon or trout depends on at least the following interrelated conditions:

- Size-class composition of the substrate, particularly with respect to the amount of fine sediment in the substrate.
- Existing degree of compaction of the substrate.
- Porosity of the substrate down to below the point of egg deposition in the fish nest.
- Percolation rate of water through the substrate in the nest area.
- Depth and velocity of the water over the substrate in which the nest is constructed.

It is well known that the size of sediment particles influences the porosity of the spawning substrate. "Fines" (variously defined as particles less than 4.7 to 0.833 mm. in diameter) have been shown to reduce porosity and therefore permeability to water flow and thus adversely affect the success of reproduction of salmon and steelhead (see, e.g., Sheridan, 1968). McNeil (1946) found that where fines (of <0.833 mm.) in some Alaskan salmon stream spawning areas exceeded about 15 percent of the total sediment, permeability became greatly reduced. Hall and Lantz (1969) reported that the ability of steelhead and silver salmon fry to emerge from the gravel was reduced as the percentage of fines (1 to 3 mm.) increased. Success of emergence ranged from near 100 percent when no fines were present, to only 20 percent or less when the proportion of fines was 70 percent. Bjornn (1968) found that artificially stocked king salmon fry were able to emerge equally well from prepared mixtures of sediment in troughs that contained "sand" (0.1 to 0.25 mm. in diameter) in amounts from zero to 30 percent, but that at concentrations of 40 percent or more, very few or no fry emerged. Steelhead fry emergence was not reduced by concentrations up to 12 percent, but at a concentration of 61 percent, very few emerged. Burns (1970) found fines (<0.833 mm.) in mean concentrations from 10.2 to 23.2 percent in spawning riffles in several small undisturbed streams in California. In several disturbed (logged) watershed streams, concentrations ranged from 13.3 to 34.3 percent. The undisturbed streams had spawning beds made up of 13 to 33.7 percent sediment particles between 0.833 and 3.3 mm. The concentrations were from about 10.1 to 31.2 percent in the disturbed streams. Platts and Megahan (1975) found concentrations of fines (<4.7 mm.) up to 55 percent in some king salmon and steelhead spawning areas in Idaho.

A number of investigators have suggested standards of size-class composition of potential spawning area substrate. For example, Van Woert and Smith (1962) arrived at standards for king salmon, based on the literature and on observations in the upper Sacramento River system. Puckett and Hinton (1974) adopted the same standards in an Eel River study. Baracco's (1977) methodology (based largely on the work of Van Woert and Smith, 1966) was the primary source involved in developing standards for the Russian River study. Sediment predominantly between 0.5 and 4 inches diameter was considered suitable for the spawning of steelhead and silver salmon, and sediment between 1 and 6 inches in diameter was considered suitable for king salmon.

2) Water Velocity

Steelhead are reported to regularly spawn at velocities ranging from about 1.0 to 3.5 fps as measured at distances of 0.4 or 0.5 feet above the bottom (Thompson, 1972; Hunter, 1973). Silver salmon commonly spawn at velocities of 0.5 to 3.0 fps, at 0.5 feet from the bottom (Sams and Pearson, 1963). King salmon are known to regularly spawn at velocities of 0.9 to 3.1 fps, at 0.6 feet from the bottom (Sams and Pearson, 1963). Chambers, et al. (1955), reported fall run king salmon spawning in the Columbia River at velocities up to 3.75 fps, as measured at 0.4 feet above the bottom. Finnell (1970) believes that the minimum velocity of the flow over spawning substrates should be 1.5 fps for trout egg survival. Puckett and Hinton (1974) adopted 1 to 3 fps as their criterion of the suitable range of spawning velocities for king salmon in an Eel River study.

3) Water Depth

The commonly reported depths at which silver and king salmon and steelhead spawn range from about 0.3 to 2.3 feet (Sams and Pearson, 1963, Hunter, 1973, etc.). These fish are known to spawn in deeper water under some circumstances. Westgate (1958) used 4 feet as the maximum spawning depth of king salmon in his Consumnes River (California) evaluation of the relationship between flow and usable spawning gravel. Chambers et al. (1955), reported that fall run Columbia River king salmon commonly spawn at depths up to about 6.5 feet. Large rainbow trout typically spawn at depths of 5.8 to 6.6 feet in the Lardeau River in British Columbia (Hartman and Galbraith, 1970).

4) Water Temperature

The optimum temperature range for upstream migration and maturation of adult salmon and steelhead is said to be from about 7.2 to 15.5°C (45 to 60°F) (Burrows, 1963). He states that the optimum for spawning is from 5.8 to 12.8°C and for eggs and fry is from 0 to 12.5°C. The California Department of Fish and Game deems about 14.4°C the maximum that will allow normal egg development in upstream-migrating adult Sacramento River king salmon.

5) Dissolved Oxygen

Very little information on the dissolved oxygen needs of adult salmon and steelhead was found. Warren, Doudoroff, and Shumway (1973), recommend that dissolved oxygen concentrations not be lower than about the "air-saturation" level, regardless of temperature, for the well-being of silver salmon. However, their recommendation appears to be based on the results of studies with juvenile silver salmon. Various authorities deem 5.0 to 7.0 mg/1 of dissolved oxygen in open waters to be the minimum required for the protection of salmon and trout. Davis (1975) considered 7.85 mg/1 a safe level. Dissolved oxygen concentrations as low as 7.5 mg/1 (84.6% saturated) have been reported in the lower Russian River at Duncan Mills (C.D.W.R., 1968).

c. Nursery Habitat

1) Temperature

Pacific salmon and steelhead generally can tolerate up to a maximum of about 20°C without ill effects. At temperatures from about 20° to 25°C, temperature alone would not be expected to kill these fish, but they would be expected to suffer in some way (such as by reduced growth). Over a long period of exposure, (e.g., 1 week), some fish would be expected to die at 25°C, even when acclimated to a high temperature (based on Brett, 1952 and 1959). Edge (1974) and Vigg (1974) found that the 8 hour median tolerance limit (TLm) of juvenile northern California silver salmon acclimated to a low temperature (15°C) was 27.25°C. Under the same conditions, the TLm of juvenile steelhead was 27.4°C.

When acclimated to a higher temperature (20° to 22°C) the TLm's were 27.5°C for both fish. They found that at temperatures from 26.5°C to 28°C, some fish would be killed within 2 hours. Temperatures of 28°C or higher were quickly lethal (i.e., within 2 hours) to all fish tested.

Temperatures of 7.7°C +_ 1.6°C were considered "ideal" for the release of juvenile king salmon from the Spring Creek Hatchery into the Columbia River. Temperatures of 4.4 to 7.7°C (40 to 42°F) are considered "safe", and temperatures less than 4.4°C and over 10°C are considered "critical" (Junge and Phinney, 1963). These temperatures bear not only on these hatchery operations, but perhaps also on the success of natural reproduction and migration to the ocean under Columbia River conditions.

2) Water Depth

The importance of depth, except below certain minimums, in determining the production of juvenile salmon and steelhead is not clear. Platts (1974) found essentially no correlation between stream depth and the abundance of juvenile king salmon in his Idaho studies. Platts and Partridge (1978) reported that recent studies showed that most juvenile king salmon in several Salmon River (Idaho) tributaries utilized pools with depths over 0.5 feet. They rated pools with depths greater than 3 feet the highest quality. Stewart (1970) found mean depth to be the variable most highly correlated with rainbow trout biomass of 14 physical characteristics of streams he studied. Chapman (1966) believes that depth, per se, rarely is important, compared to velocity, turbulence, and cover, as a determinant of salmonid distribution in streams. On the other hand, Nickelson (1976) successfully used depth (as a factor in his "habitat index") in seeking correlations between habitat conditions and juvenile silver salmon biomass in Elk Creek, Oregon.

Various authors such as Everest and Chapman (1972), Thomson (1972), and Pearson et al. (1970), cite characteristic depths of juvenile salmon and steelhead nursery habitats. Generally, these range from about 0.5 to 4 feet. In small streams salmonid fry commonly are found at lesser depths; in large streams, older juvenile salmonids often are common in runs and fast pool sections much deeper than 4 feet. The water depths frequented by juvenile king salmon and steelhead in nursery streams typically vary considerably between day and night. At night in the summer, they commonly move inshore into very shallow water, sometimes less than 0.2 feet deep (Edmundson, et al. 1968).

Waters (1976) considered depths from about 0.3 to 5 feet as suitable "resting Microhabitat" for trout. For trout food organism "production" he considered depths from about 0.2 to over 5 feet suitable, but maximum production was deemed to be at depths between about 0.5 and 3 feet. Baracco (1977) adopted a minimum depth of 0.5 feet as a criterion of suitable nursery habitat for Dry Creek salmonids.

3) Velocity

Baracco (1977) adopted average water velocities of 0.5 to 3.5 fps as a criterion of suitable salmonid nursery habitat in his Dry Creek evaluation. Pearson et al. (1970) found juvenile silver salmon in pools at velocities up to a maximum of 0.7 fps, and they considered this velocity to be optimum for pools. Waters (1976) considered velocities (as measured 0.2 feet from the bottom) up to 1.0 fps suitable for trout "resting microhabitat." He rated velocities of approximately 0.5 fps highest in quality for this use. Thompson (1972) considered riffle velocities of 1 to 1.5 fps and pool velocities of 0.3 to 0.8 fps as suitable for juvenile salmonids. Edmundson, et al. (1968) found that juvenile steelhead and king salmon commonly use "quieter" waters during the night than they occupy during the day.

Besides having direct effects on fish distribution, velocity affects fish food organism distribution and production, surface turbulence, and rates of intragravel flow. Giger (1973) reviewed the literature and concluded that "...the greatest numbers of organisms can be found in riffles at...velocities (as measured in open water) ranging from 1.0...to about 2.5 fps..." Waters (1976) considered velocities (as measured at 0.2 feet above the bottom) of about 0.5 to 4.2 fps as "productive" of trout food organisms; velocities of about 2 to 3 fps were rated highest in "productivity."

4) Substrate

Juvenile salmonids make much use of substrate materials for protection from predators and from displacement by currents (Hartman, 1965). Edmundson, et al. (1968) reported, "Winter locations of steelhead trout and chinook salmon wore primarily under or between rubble particles and young fish were seen rarely without diligently searching in the substrate." Silver salmon may be less dependent than steelhead on the substrate. Hartman (1965) observed that silver salmon tend not to seek shelter under aquarium rocks in the winter. Giger (1973) states in his literature review, "Many authors have reported that there is increased association of fish with the stream substrate as current velocity increases..." and that "there is evidence that submerged objects such as large boulders can at times substitute for overhead cover." He also concluded that the degree of substrate irregularity apparently influences space requirements of fish through visual isolation, and that increased isolation can increase fish abundance. Waters (1975) rated Pit River (California) substrates as "resting microhabitats" for rainbow trout in descending order of quality as follows: rubble: 1.0, gravel: 1.0, sand: 0.9, boulders: 0.8, silt: 0.6, and bedrock: 0.

Many investigators have found relationships between substrate size-composition and stream invertebrate food organism abundance in general. Needham (1938) rated bottom types as to the average availability of fish foods as follows: rubble, coarse gravel, fine gravel, hardpan, and bedrock. Sprules (1947) listed rubble, gravel, muck, and sand in descending order of production of emerging aquatic insects in some Ontario streams. Kennedy (1967) found the majority of organisms on substrate composed of rocks 2.6 to 7 inches in diameter.

Waters (1975) rated the food-producing quality of Pit River (California) substrate materials as follows: rubble (3 to 12 inches diameter): 1.0, gravel (1/8-3 inches diameter): 0.6, silt: 0.2, and sand: 0.1.

The excessive deposition of fine sediment on coarse substrates is known to be harmful to food organism production as well as to fish. Giger (1973) summarizes the literature on sedimentation as follows: "It appears certain...that sedimentation largely influences rearing fish in an indirect manner through reduction of their food supply. The principal mode of invertebrate reduction appears to be through loss of habitat caused by the accumulation of silt among and over substrate particles." Cedarholm, et al. (1978) concluded, "It is important to keep the gravel interstices from clogging with fines (materials less than 0.85 mm. in diameter) because the substrate is a very important source of predator escape cover for salmonid fry in summer, and hiding cover from streamflows in winter."

5) Shelter

Shelter for stream fish may be provided by overhead vegetative canopy, instream vegetation, undercut banks, stream bottom materials such as rocks and logs, water depth, and surface agitation. Shelter provides fish resting places and protection from predators, currents, disturbance, and excessive sunlight. Many species of fish prefer shade. Some, such as juvenile silver salmon, avoid excessive shade (Ruggles, 1966). Lewis (1969) in his trout studies found pool mean current velocity and total cover to be more important than pool surface area, volume, and mean depth in accounting for the abundance of trout. Waters (1976) speculates that an "ideal" trout stream might have 10 percent of its wetted area composed of shelter.

Cover is not only of direct value to fish, but is indirectly important in food production and in water temperature control. Shallow streams in hot climates might require much more than 10 percent overhead coverage of wetted area in order to realize optimum control of temperature. In such streams, summer temperatures may be the most critical factor in the production of salmonids, and adequate shading of the water from the sun may be the most important requirement for satisfactory production.

6) Pool-Riffle Relationships

Riffles generally are the principal producing areas for fish food organisms in a stream, and they are important in providing shelter, among other requirements, of juvenile salmonids. Pools provide resting and feeding spaces, and they afford some degree of protection to fish. Generally, salmon and steelhead juveniles move from shallow riffle areas into deeper and faster water areas as they grow larger. The seasonal distribution of silver salmon and steelhead in Big Beef Creek in Washington (Allee, 1974) is approximately as follows: silver salmon fry emerged earliest by March and occupied shallow stream margins. Later these fish tended to take up residence in pools. At the same time, young-of-the-year steelhead, which had emerged after the silver salmon, still were occupying the shallow areas. By May, both silver salmon and steelhead young-of-the-year were occupying the pools. Yearling steelhead were found mainly in deep pools and in deep areas with high velocities.

In a given stream there may be a more or less ideal ratio between the amount of pool and riffle habitat for maximum production of a given species of salmon or trout. Thompson (1972) concluded that pool-riffle ratios around 1:1 generally are ideal for salmonids. Platts (1974) found that rainbow trout densities were greatest in areas with a 1:1 ratio. He also refers to mixed species populations in Idaho streams, stating that "densities of fish populations in relation to pool-riffle ratios were lower than the often quoted optimum pool-riffle ratio of 50:50. The highest total fish population densities occurred in areas of stream having 30 to 50 percent pool ratings." Fifty-nine percent of the juvenile king salmon he found were from stream stretches composed of less than 20 percent pools.

3. Optimum Stream Flow Estimation

The methods for estimating streamflows corresponding to optimum production of fish habitat are generally based on one of the following approaches:

- The fraction of the average or "base" discharge of a stream that is deemed, through long-term observation, to be generally adequate for a certain use (e.g., spawning) or for a certain season (e.g., winter), during which a certain stream usage by fish is provided (Tennant, 1975).

- Direct observations of the amount of suitable habitat available and/or used by fish in the stream at widely different observed flows (Westgate, 1958).

- Measurements of stream features and conditions along perpendicular transects. Transect conditions are assumed to represent stream section conditions. The sums of the section extrapolations are assumed to represent an entire stream study area (Cochnauer, 1976).

- Intensive observations of stream features and conditions all along relatively short stream sections, whose average quality is assumed to be representative of the entire study area (Newhouse, undated).

- Intensive examination of "critical areas." The flows deemed necessary to protect critical area conditions would be observed and estimated. Flows that would protect these areas are deemed adequate to protect the study area as a whole (Anonymous, 1973).

Stalnaker and Arnette's (1976) comprehensive review of methodologies for the determination of stream flow requirements was used herein as the main source of summary information on methods currently in use. Methods not listed by Stalnaker and Arnette, such as those described by Waters (1976), Baracco (1977), and Cochnauer (1976) were also considered in devising techniques for the habitat evaluations and optimum flow estimations required for this study.

Calculation of "optimum" flow for fish production is far from an exact science. This is due partly to poor understanding of the biological significance of many stream parameters affected by flow. In addition, as Platts (1976) indicates: "Difficulties arise in developing valid methodologies because of the problems encountered in quantitatively describing the true state of an aquatic system." In comparing methods in use, it will be noticed that some are applicable only to large streams, or only to small streams, or only to certain species of fish. In other words, no one method applicable to all situations has been developed.

B. Fishery Resources in the Russian River

Fishery resources of the Russian River include over 30 species of resident freshwater and anadromous fish. The important anadromous species include steelhead trout (Salmo gairdnerii), silver salmon (Oncorhynchus kisutch), king salmon (0.tshawytscha) and American shad (Alora sapidissima). An estimated 57,000 steelhead and 5,500 silver salmon use the drainage annually for spawning and subsequent juvenile nursery habitat (Vestal and Lassen, 1969). King salmon reportedly once spawned in small numbers in various stretches of the upper drainage. In the future it is likely that any king salmon run in the Russian River will be hatchery dependent (Jensen, 1973). American shad support a large sport fishery in the Russian River. Annual shad runs were estimated to be between 11,000 and 22,000 fish for the 1971 season (C.D.F.G., 1978 a).

The Russian River drainage network contains approximately 234 miles of salmon habitat and 449 miles of steelhead habitat, with 240 tributaries recognized as part of this network (C.D.F.G., Undated,a). Table II-1 indicates main tributaries of the drainage and their importance with respect to salmonid fishery habitat (Vestal and Lassen, 1969).

1. Steelhead

Steelhead enter the Russian River in late November and reach peak spawning activity in January and February (C.D.F.G., Undated,b). Steelhead habitat includes the mainstem, all major tributaries and many minor tributaries as long as fish passage criteria are satisfied. Spawning activity has reportedly diminished in recent years (Lee and Baker, 1975). Longhurst (1972) noted that prior to construction of Coyote Dam, major steelhead spawning occurred in the mainstem Russian River. During this period, the most critical factor controlling the success of fish propagation was low summer flow and resulting insufficient quantity of nursery habitat (C.D.F.G., Undated,c). Longhurst indicated (based primarily on personal communication with sport fishermen) that a limited amount of steelhead spawning still occurs in the upper mainstem, primarily above Healdsburg. Since construction of Coyote Dam, however, the most critical factor limiting steelhead propagation is the poor quality of the existing nursery habitat (C.D.F.G., Undated,c and Longhurst, 1972).

Tributary information regarding fish habitat in the Russian River drainage system is limited; much of the information is unpublished. The following contributions were considered pertinent to this discussion (Table II-1):

TABLE II-1
RUSSIAN RIVER AND TRIBUTARIES USED BY SALMONIDS

Sonoma County Streams	Total Miles	Total KS	Miles SS	Used by SH
Jenner Gulch	0.5			0.5
Sheep House Gulch	0.5		0.5	0.5
Austin Creek	7.5		4	7.5
Ward Creek	14.5		14.5	14.5
Kid Creek	2		2	2
Bear House Creek	3		3	3
Redside Creek	1.5			1.5
Kohute Creek	0.5		0.5	0.5
Black Rock Creek	1.5		1.5	1.5
East Austin Creek	12.5		10.5	12.5
Sulphus Creek	0.5			0.5
Devils North Ford Creek	1.5			1.5
Gray Creek	3.5			3.5
Thompson Creek	1			1
Gilliam Creek	3		3	3
Hulbert Creek	5.5			5.5
Fife Creek	6.5			6.5
Hobson Creek	1			1
Porter Creek	8		2	8
Dry Creek	30.5		11	30.5
Mill Creek	10		3	10
Felta Creek	4		1	4
Pine Ridge Creek	1			1
Crane Creek	1.5			1.5
Grape Creek	1.5			1.5
Healdsburg Slough	4.5			4.5
Pena Creek	15.5			15.5
Warm Springs	10.5			10.5
Strawberry Creek	1			1
Galloway Creek	6			6
Henry Creek	10			10
Yorty Creek	4			4
Smith Creek	5			3
Rail Creek	2			2
Dutch Creek	3			3
Barrelli Creek	1			1
Icarica Creek	4			4
Cloverdale Creek	2			2
Oat Valley Creek	3.5			3.5
Big Sulphur Creek	19.5			14.5
Frasier Creek	1.5			1.5
Squaw Creek	9.5			9.5
Little Sulphur Creek	16			16
Pine Mountain Creek	1			1

TABLE II-1
RUSSIAN RIVER AND TRIBUTARIES USED BY SALMONIDS
(Continued)

Sonoma County Streams	Total Miles	Total KS	Miles SS	Used by SH
Crocker Creek	1.5			1.5
Gill Creek	2			2
Miller Creek	2.5			2.5
Sausal Creek	10			8
Maacama Creek	6.5			6.5
Redwood Creek	4.5			4.5
Wallace Creek	4		3.5	4
Kellogg Creek	6			4.5
Franz Creek	13			13
McDonnell Creek	3			3
Ingalls Creek	2			1.5
Mark West Creek	28			28
Porter Creek	7			7
Horse Creek	1.5			1.5
Van Buren Creek	1			1
Humbug Creek	2			2
Winsor Creek	11.5			11.5
Weeks Creek	2			2
Santa Rosa Creek	17.5			17.5
Matanzas Creek	7.5			5.5
Green Valley Creek	16		16	16
Smith Creek	1.5		1.5	1.5
Dutch Creek	8		8	8
Freeze Out Creek	1		1	1
Willow Creek	6		6	6
Russian River	66	66	31.5	66
Unnamed Tributaries	20.5			20.5
	480.0	66	132.0	282.0

Mendocino County Streams	Total Miles	Total KS	Miles SS	Used by SH
Dry Creek	20			20
Comminsty Creek	7			7
Pieta Creek	17			17
Dooley Creek	6			6
Feliz Creek	16			16
Duncan Creek	1			1
Crawford Creek	0.5			0.5
Parsons Creek	1.5			1.5
Morris Creek	1.0			1.0
Robinson Creek	9.0			9.0
Howell Creek	4.0			4.0
Doolin Creek	6.5			6.5

TABLE II-1
RUSSIAN RIVER AND TRIBUTARIES USED BY SALMONIDS
(Continued)

Sonoma County Streams	Total Miles	Total KS	Mile s SS	Used by SH
Mill Creek	3.5			3.0
Sulphur Creek	1.5			1.5
Orrs Creek	6.0			6.0
Henesley Creek	1.0			1.0
York Creek	2.0			2.0
East Branch Russian F Ri	23.0	1		1
Forsythe Creek	19			19
Ackerman Creek	9			9
Unnamed Tributaries	4			4
Russian River	43.5	34.5		43.5
	202.0	35.5		166.5
	682.0	101.5	132. 0	448.5

Steelhead habitat evaluations were conducted by Forester and Jones (1973) in the Austin Creek drainage, an important lower Russian River tributary. Kubicek and Price (1976) discussed steelhead habitat conditions and spawning success in the geothermally active Geysers area of Big Sulpher Creek. West Fork Russian River steelhead fisheries were investigated by the California Department of Fish and Game (C.D.F.G., Undated,d). Steelhead management problems in East Fork Russian River below Coyote Dam were discussed by Allen (1960).

2. Silver Salmon

Silver salmon spawn in about 20 tributaries of the lower river up to and including Dry Creek (Lee and Baker, 1975 and Baracco, 1978). Upstream migration begins in November and spawning generally reaches peak activity in November, December, and January (C.D.F.G., Undated,b). During low flow conditions in lower Russian River tributaries, spawning may occur in the mainstem Russian River (Baracco, 1978).

Silver salmon are generally planted annually in several of the lower river tributaries. Austin Creek, Dutch Bill Creek, and Dry Creek receive most of the planting effort (C.D.F.G., Undated,e). Recent stocking efforts have concentrated on establishing runs for broodstock purposes in Dry Creek prior to construction of Dry Creek Hatchery (Vestal and Lassen, 1969).

Baracco (1977) has indicated spawning, nursery and passage criteria for silver salmon in the Dry Creek drainage. In addition, flow recommendations were made for minimum releases from the Warm Springs Dam and Lake Sonoma project. Forester and Jones (1973) discussed habitat requirements for silver salmon in the Austin Creek drainage and provided recommendations for stream management.

3. King Salmon

King salmon migrate upstream earlier in the season than steelhead and silver salmon. Migration can begin as early as late August with spawning occurring primarily in November and December (C.D.F.G., Undated,b). King salmon spawning activity occurs primarily in the mainstem Russian River (Vestal and Lassen, 1969).

King salmon have not established a self-sustaining population in the Russian River drainage. The California Department of Fish and Game has a long history of king salmon planting in the Russian River. Numerous

Sacramento River fall run and winter run fish have been planted but have produced only temporary spurts in the fishery. King salmon planting efforts have not produced lasting results primarily due to early season returns of spawners when water temperatures were too high for successful egg and juvenile development (Baracco, 1978). More recent attempts to establish a king salmon run involved planting late running stock from the Green River in Washington (Jensen, 1973). New attempts will be made to establish a run of king salmon after the completion of the Warm Springs Dam and Lake Sonoma Project. Currently, it is estimated that approximately 500 king salmon enter the river annually (Robinson, 1972).

4. American Shad

American shad begin their upstream migration in March and spawn primarily between April and July (C.D.F.G., Undated,b). Shad utilize approximately 32 miles of the mainstem Russian River up to Healdsburg Memorial Dam. Unlike salmon and steelhead, shad spawn in the water column over gravel and sand substrates in areas satisfying velocity criteria (Baracco, 1978). Eggs drift seaward or settle, usually hatching within six days of spawning (Fry, 1973). Juvenile shad remain in the river and migrate to the ocean as fall approaches.

Many questions remain unanswered concerning Russian River American shad populations (Baracco, 1978). Spawning, feeding, juvenile life history, and migration of west coast populations need to be investigated. The most recent and complete Russian River shad studies were conducted by the California Department of Fish and Game in 1970 and 1971 (C.D.F.G., 1978a, 1978b). These studies indicate that an estimated 11,000 to 22,000 shad enter the river annually.

C. Basin Hydrology

Hydrologic data for the Russian River basin consists primarily of information accumulated by the Water Resources Division of the U.S. Geological Survey. Gage station data consists of records of stage, discharge and water quality (U.S.G.S., 1972). Period of record and parameters measured at each gage station vary. Appendix D indicates location, types of data recorded and averages and extremes for the period of record at the Russian River drainage gage stations.

Gage station data are published annually for each water year. Up-to-date information is available through the U.S. Geological Survey and various county and state cooperative agencies.

In addition to maintaining stream gage stations, the U.S. Geological Survey has conducted special investigations of turbidity and suspended sediment. Levels and sources of turbidity have been discussed (Brown, 1971 and Ritter and Brown, 1971). A study is in progress dealing with nutrient levels, algal concentration, and bacterial levels within the drainage (Sylvester, 1978).

Additional streamflow and water quality data are available through various state and county agencies:

- The California Department of Fish and Game has worked with the U.S. Geological Survey and has accumulated limited information on the effects of summer recreation dams on water quality. Fish and Game studies have also focused on East Fork Russian River water quality (Baracco, 1978).

- The California Department of Water Resources has collected considerable data on Russian River watershed water quality. Parameters tested included gage, streamflow, and water quality (C.D.W.R., 1975).

- The California Regional Water Quality Control Board sampled turbidity, dissolved oxygen, temperature, and nutrient levels between 1974 and 1977 (Church, 1978). Data was not compiled at the time of this report. Bacteriological reports have also been prepared for 13 sampling stations on mainstem Russian River (Klamp, 1978).

- The Sonoma County Water Agency collected streamflow and temperature data from spring 1976 through 1977. Emphasis was placed on tributaries and their condition during dry years. Forty-four sampling sites were established on numerous tributaries covering the length of mainstem, West Fork and East Fork Russian River (Kunselman, 1978).

- The U.S. Army Corps of Engineers has conducted surveys concentrating primarily on discharge and flooding. Data are available on Russian River basin hydrology, annual flow maximums, and peak discharge frequency (U.S.C.O.E., 1965 and 1973).

General water quality within the Russian River basin has improved in recent years, primarily because of more stringent federal and state discharge requirements (U.S.C.O.E. 1976). Community sewage treatment systems have been improved and period of discharge as well as dilution ratios are under greater control. The Regional Water Quality Control Board has determined that Russian River water generally meets the water quality objectives established for water contact recreation. Exceptions are the lower river communities of Rio Nido, Guerneville and Guernewood Park, which are increasingly confronted with failing septic tank systems. A sewage collection and treatment system has been proposed to serve these communities.

A future water quality control plan for California is currently being prepared by the State Water Quality Control Board. The plan will be effective through 1981 and includes an investigation of the relationship between water quality and quantity in the Russian River.

D. Instream Structures

Specific data regarding numbers and locations of instream structures placed in the Russian River drainage each year is limited. Major summer dams and summer road crossings constructed by local government agencies are well documented, but the majority of instream structures are located on small tributaries and are largely unknown. Detailed information regarding the effects of instream structures on fish habitat and fish migration is not available in the literature.

Selected hydrologic and stream flow data are recorded daily at specific U.S.G.S. gage station locations within the drainage. These data are the primary source of hydrological information for instream summer structures. The location of U.S.G.S. gage stations and instream temporary and semipermanent structures is indicated on the maps in Appendix A.

Appendix B describes the instream temporary and semi-permanent structures and summer road crossings on mainstem Russian River and Dry Creek determined by means of a thorough review of the literature, including archives of various government agencies.

Also located on the mainstem are channel improvement structures including cables and anchors, jacks, gravel blanket-wire mesh revetment, flexible fence lines, and levees (U.S.C.O.E., 1965; 1965a). These structures are not considered further in this report.

In addition to the structures on the mainstem of the Russian River and Dry Creek listed in Appendix B, numerous other structures are located in the Russian River drainage. Many of these structures are enumerated in Table II-2, which gives the name of the tributary, the number of structures on that particular tributary, and pertinent references.

A report in the files of the Yountville office of the California Department of Fish and Game contains a list of structures on the Russian River and its tributaries. The report is undated, but the most recent citation it contains is 1968. The report lists 52 structures on named tributaries and 225 additional impoundments on smaller unnamed tributaries.

Gravel extraction operations in the Russian River drainage are numerous and are not reviewed here. The most detailed information on specific operations is to be found in the files of the California Department of Fish and Game Form 1603: "Notification of Removal of Materials and/or

Table II-2
RUSSIAN RIVER TRIBUTARY INSTREAM STRUCTURES

Tributary	Number of Structures	Reference
East Branch Russian River	1	U.S.F.&W.S., 1962
West Branch Russian River	7	C.D.F.&G. Forms 1603-111-178-75, 1603-III-589-75, 1603-III-167-76, 1603-III-179-76, 1603-III-609-77, 1603-III-834-77 C.D.F.&G., 1970
Austin Creek Kidd Creek East Austin Creek	34	C.D.F.&G. Forms 1603-III-241-74, 1605-III-121-77 Robertson, 1978
Dutch Bill Creek	2	C.F.F.&G. Forms 1603-III-293-77, 1603-III-512-77
Mark West Creek Santa Rosa Creek	3	C.D.F.&G. Form 1603-III-219-77 Robertson, 1978 U.S.C.O.E., 1975
Felta Creek	1	C.D.F.&G. Form 1603-III-650-77
Dry Creek Mill Creek Dutcher Creek Warm Springs Creek Peters Creek	4	C.D.F.&G. Forms 1603-III-426-77, 1603-III-843-77 Chambers, 1960 U.S.C.O.E., 1975
Maacama Creek Franz Creek	1	Baracco, 1978 U.S.F.&W.S., 1965
Mill Creek McClure	1	C.D.F.&G. Form 1603-III-155-77
Big Sulphur Creek Squaw Creek,	5	C.D.F.&G., 1973 Robertson, 1978

Alteration of Lake, River, or Streambed Bottom or Margin", records all instream gravel extraction. Other agencies with information on Russian River sand and gravel extraction are the Sonoma County Public Works Department, the Mendocino County Planning Department, and the California Department of Mines and Geology.

Although gravel operations rarely block the river flow completely, they can have long-range effects on fish habitat in the river, both detrimental and beneficial. Pertinent literature on this subject is included in the bibliography.

III. Field Survey Methods and Materials

A. Selection of Sampling Sites

1. Instream Structures

A list of instream structures that could act as potential barriers to fish migration was developed from a search of the available literature and from personal communication with various federal, state and local government agencies. Low elevation U.S. Army Corps of Engineers aerial photography taken during the summer of 1975 was also examined to insure that no instream structures were overlooked. The list was restricted to those structures located within the study area on mainstem Russian River below the East Fork-West Fork confluence and on Dry Creek below Bord Bridge. Those structures considered to be potential barriers to fish migration were selected for the field survey verification. Locations of instream structures selected for the field survey are illustrated in Appendix A.

2. Fish Habitat

Aerial photographs of the entire Russian River-Dry Creek study area were examined in order to select sections to observe. Generally, the study sections were initially plotted randomly by rapidly rolling a film roll from its beginning to about every 10th photograph. The section on that frame, or on either adjacent frame, was selected, depending on ease of access by car or foot. The Dry Creek sites were located at about one-mile intervals along the 14-mile length of the creek within the study area. The sections selected may be slightly biased in regard to conditions related to access, but any such bias may have been reduced by the relatively long (quarter and half-mile) sections examined. Bias probably would be greatest for measurements of vegetative canopy and in-stream cover, since transects were established at points without excessive cover or debris.

In each quarter-mile section two transects, an upper and a lower, were examined; in each half-mile section three transects were examined. One transect of a section was generally located just opposite the point of access, but the other transect was a quarter mile above or below the access point.

A total of approximately 49 quarter-mile sections in the 94 miles of study area on the Russian River were selected. The number of sections observed was reduced to 39 because of lack of access to some sections. Ten sections were selected on Dry Creek, of which nine were observed.

Usually, after establishing the initial transect in a section, the other transect was located by stepping-off about a quarter mile downstream. The transects were established perpendicular to the main flow of the stream and were marked with flagging to facilitate orientation and relocation.

Each transect was examined from bank to bank; the measurements of the wetted width portion were recorded separately from the dry channel measurements.

Notes were taken on the general conditions prevailing between transects, i.e., in the section as a whole, in order to better relate transectional conditions and to describe the sections more adequately. Generally, little time was available for observations between transects, and most of the analysis of conditions is from the transect measurements. Notes were made directly on the aerial photographs to facilitate section evaluation.

Locations of study sections on Dry Creek and mainstem Russian River are indicated in Appendix A.

B. Features and Conditions Examined and Evaluated

1. Instream Structures

Those structures selected for the field survey were visited in the winter as field conditions (e.g., streamflow) became workable. With the exception of the permanent Willow County Water District diversion dam, the majority of instream structures are temporary or semi-permanent and contain removable components not in place during the winter season. Certain features of these structures (e.g., footings, piers) remain instream the entire year, facilitating structure site location.

Winter structure observations were directed toward evaluating the structure (or structure component) from a fish passage standpoint. Physical features of the structure as well as water surface velocities over or through the structure were examined. The availability of resting habitat above and below each structure was also observed.

Each structure or structure site was revisited in the summer for more detailed observations. All instream structures were installed by the end of May and were in place for the summer survey. Summer field observations were directed at structural features and habitat water quality conditions not observed during the winter season when the structures were not installed.

Table III-1 indicates those structural features and habitat conditions examined as well as the evaluation technique utilized in the field.

2. Fish Habitat

Table III-2 indicates measurements taken at each transect. Table III-3 discusses section measurements made between transects.

TABLE III-1

INSTREAM STRUCTURE MEASUREMENTS AND OBSERVATIONS

Observation	Technique
Structure composition	Field observation.
Structure extent (in-channel)	Transit and stadia rod; 100 ft. tape.
Channel & water surface width: Upstream from structure At structure Downstream from structure	Transit and stadia rod.
Air temperature	Pocket thermometer held in shade.
Water temperature: Upstream from structure At structure (depth profile) Downstream from structure	Remote sensing thermometer or pocket thermometer.
Dissolved oxygen: Upstream from structure At structure (depth profile) Downstream from structure	Water samples preserved in the field, with reagents, and returned to the water laboratory for azide modified Winkler titration. Depth samples were collected with a Van Dorn water bottle.
Turbidity: Upstream from structure Downstream from structure	Water sample collected and refrigerated. Turbidity determinations made with a Hach turbidimeter.
Water Velocity: Upstream from structure At structure (spillway velocity) Downstream from structure	Current meter or (occasionally) float and stopwatch.
Fish bypass facilities	Observation.
Spillway jumping distance	Transit and stadia rod.
Take-off pool & resting pool availability	Observation and graduated rod.

TABLE III-2

TRANSECT MEASUREMENTS AND OBSERVATIONS

OBSERVATION	TECHNIQUE
Water surface width	Horizontal straight-line measurements with 100-ft. tape; or transit and stadia rod; or by stepping off. Measured between readily apparent "normal" high water marks.
Full channel width	Measured between readily apparent "normal" high water marks.
Water depth	Graduated rod
Full channel cross section	Transit and stadia rod between high water marks.
Water velocities	Current meter or (occasionally) float and stop watch. 0.5 feet above bottom at quarter distance points surface and 0.6 of depth from surface at midstream.
Linear extents of: Instream cover Vegetative canopy Sediment size-classes (Full channel and wetted width)	Observer judgment with measurements by tape or stepping-off. Reliability confirmation by checks by McNeil-Abnell method (1964) in case of sediment size-classes.
Air temperature	Pocket thermometers held in shade.
Water temperature	Remote sensing thermometers or pocket thermometers.
Aquatic invertebrate distribution and abundance	1 square foot bottom samples (using Surber sampler on riffles). Unaided eye counts (i.e., of invertebrates generally longer than 3mm, with general notes on species composition). Also, continuous cursory observations.

TABLE III-3
SECTION MEASUREMENTS AND OBSERVATIONS

OBSERVATION	TECHNIQUE
Prevalence of filamentous algae	Observation
Fish abundance and distribution	Observation and collection
Shade and cover	Visual estimate of percent areal coverage
Water depth channel width	Graduated rod Stepping off or range finder
Substrate size-class composition	Observation and visual estimation of percentage of entire channel bed made up of "spawning gravel." Occasional checks of composition made with McNeil-Abnell method.
Pool/riffle ratio	Straight line length down channel by striding. Riffles were defined as rapidly flowing sections in which the water surface was substantially agitated. Rapidly flowing sections without surface agitation were considered runs and were included in "pool" length. Riffle length was measured; pool length was calculated to be total section length minus riffle length.
Apparent channel and bank stability	Visual inspection for banks with bare soil and signs of erosion and channel beds composed of large areas of loose substrate and showing obvious signs of recent shifting.
Water clarity and color	Visual estimates; clarity occasionally checked with Secchi disc.

C. Channel Flow Computations

The variation in mean velocity and discharge with depth of flow for the measured transects was computed from the field data by the following method. The flow in the river was considered to be uniform, that is (1) the depth, water area, mean velocity and discharge at every section of the channel are constant, and (2) the energy line, water surface and channel bottom are all parallel. Since streams and rivers in natural states rarely ever experience truly uniform flow conditions, the results obtained from this assumption are understood to be approximate. The results provide a relatively simple and satisfactory solution to many practical problems and therefore the uniform flow condition is frequently assumed in the computation of flow in natural streams. The flow is also considered to be steady, since unsteady uniform flow is practically nonexistent.

The computation is based on the familiar Manning formula expressed as follows:

$$AR^{2/3} = \frac{nQ}{1.49\sqrt{S}} \qquad (1)$$

The right side of equation (1) contains the values of channel roughness coefficient n, channel slope S, and discharge Q; the left side contains the channel cross-section area, A, and hydraulic Radius, R, which depend only on the geometry of the wetted cross section. When n and S are known at a channel section, it can be seen that there can be only one discharge for maintaining a uniform flow through the section, provided $AR^{2/3}$ always increases with increasing depth as is the case in natural streams. The expression $AR^{2/3}$ the Section Factor for uniform flow computation.

The Section Factor was computed from the channel cross-section data taken at each transect at incremental water depths of 1 foot from a minimum depth of 1 foot to the maximum depth of flow that could be conveyed between the channel banks.

Data on channel roughness and slope were not taken in the field. The value of n for natural streams was estimated from the literature, using field observations of stream conditions as a guide. Where transects were composed of several distinct subchannels, each with different roughness from the others, a composite value of n was estimated. The value of S was estimated by considering stream bed slope as determined from topography shown on U.S. Geological Survey 7.5 minute quad maps. These estimated quantities were combined into a single factor to be used in the flow calibration of the stage/discharge relationship.

The channel discharge during the field surveys was monitored at U.S. Geological Survey stream gaging stations on the mainstem and Dry Creek. The flows determined in this fashion were used to calibrate the stage/discharge relationship at each transect by varying the estimated quantity n/(1.49underlined check\s) to provide the best fit between the observed flow for the particular channel reach and the computed flow based on the Section Factor determined at the time of the field survey.

The calibration was performed for the summer survey flow conditions, and checked against limited winter survey observations; reasonable agreement was found. The stage/ discharge relationships determined assumed a constant value of n/(1.49 5), which is likely to be valid for the range of flows considered for the fish-habitat evaluations. However, it is unlikely that it would hold for the higher flows corresponding to the upper limit of the section-factor curves due primarily to changes in composite channel roughness that occur as the flow in the channel approaches and overtops the stream banks.

The mean velocity at a given flow for each transect was determined by dividing the flow by the corresponding cross-section area. Although measurements of velocity were taken at each transect, the Manning equation and its calibration was not based upon these velocities due to the large variability in observed velocities.

The flow condition that provides the optimum amount of spawning habitat was determined from the stage/discharge relationships discussed previously and field observations of the quality and location of spawning gravel. The spawning gravel observations noted the linear feet, along the transect, of potentially usable gravels and its relative location on each transect. In addition, optimum spawning habitat was characterized by a range of water depths over the spawning gravels and a range of velocities at 0.5 feet above the bottom. To facilitate the analysis, the calculations were actually based on the mean velocities in the cross section, and a relationship determined between those velocities and the velocities at 0.5 feet above the bottom. Although section observations wore made and recorded (Appendix C), all analysis was based upon observations along the transect lines.

A computer program was written to scan data for each transect and determine the linear feet of potentially usable gravels covered by depths and velocities within the range of optimum conditions for flows from 100 to 3000 sec-feet on mainstem and from 50 to 2000 sec-feet on Dry Creek. The sensitivity of the analysis to the definition of optimum spawning conditions was investigated by repeating the analysis for various ranges of conditions.

The mainstem has been divided into the three reaches shown on Figure III-1, based upon the hydrologic characteristics of the drainage basin. The lower reach extends from the river mouth to Section 18 near Healdsburg and includes the confluence with Dry Creek, the major tributary in the reach. The middle reach extends from Section 19 to Section 32 near Cloverdale, and includes the confluence with Big Sulfur Creek, the major tributary in the reach. The upper reach extends from Section 33 to the forks near Ukiah, the limit of the field study effort. The monthly mean discharge at the U.S. Geological Survey gaging stations on mainstem are shown on Table III-4, which illustrates the flow variability with time and distance in the respective reaches and demonstrates the validity of the reach designations adopted above.

The flow condition that provides optimum amount of spawning habitat was determined for each reach by totaling the linear feet of spawning gravel within the range of optimum conditions at corresponding flows for all transects within the reach. Optimum velocities for anadromous salmonid spawning were generally considered to be between 1 and 3 fps 0.5 feet from the bottom. Optimum spawning depth criteria were determined to be between 1 and 3 feet in depth. Optimum spawning substrate for steelhead and silver salmon was considered 0.5 to 4 inch material. Half-inch to 6 inch substrate was considered optimum for king salmon.

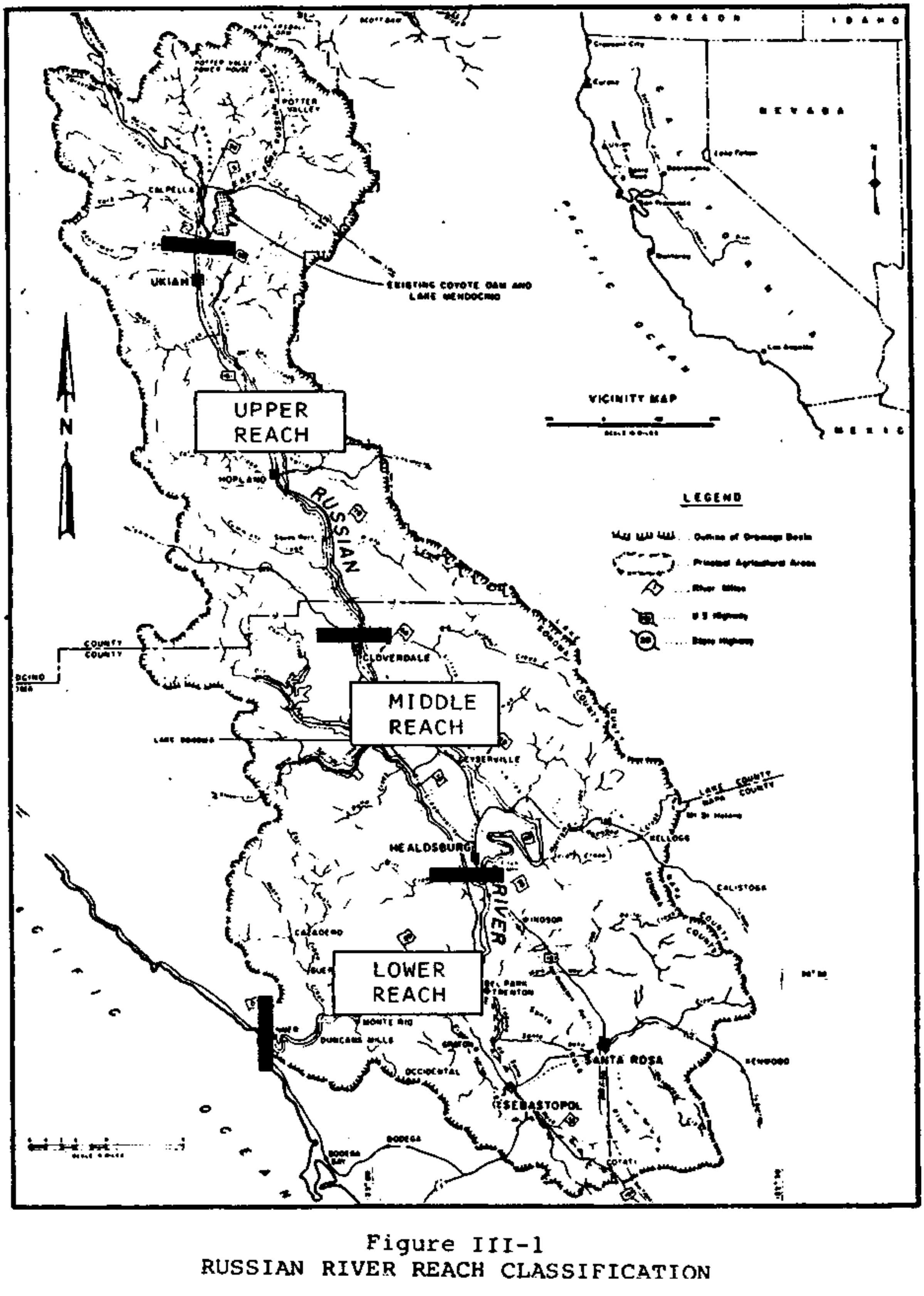


Figure III-1
RUSSIAN RIVER REACH CLASSIFICATION

TABLE III-4

AVERAGE MEAN DISCHARGE (CFS) FOR WATER YEARS 1972 THROUGH 1976.

J.S.G.S. GAGE STATION 11462000-RUSSIAN RIVER (EAST FORK) NEAR UKIAH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
325	229	258	513	757	575	163	234	258	293	289	261

U.S.G.S. GAGE STATION 11462500-RUSSIAN RIVER NEAR HOPLAND

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
324	317	534	1351	1938	1727	392	263	247	253	249	244

U.S.G.S. GAGE STATION 11463000-RUSSIAN RIVER NEAR CLOVERDALE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
334	393	655	1814	2906	2335	567	303	243	245	243	234

U.S.G.S. GAGE STATION 11464000-RUSSIAN RIVER NEAR HEALDSBURG

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
344	603	987	3227	4664	3414	857	375	234	224	225	218

U.S.G.S. GAGE STATION 11467000-RUSSIAN RIVER NEAR GUERNEVILLE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
373	993	1610	5844	7714	5248	1198	418	205	170	172	191

IV. Field Survey Results

A. Instream Structure Observations and Water Quality

Data regarding features and conditions examined and evaluated at instream temporary and semi-permanent structures are presented in Appendix B. Water quality data collected at instream structures are also presented.

Where field conditions were restrictive to the collection of data or where specific questions on the data form did not apply to the structure in question, "N/A" is indicated.

The date of each observation is indicated as well as the time of day when data were collected. Average streamflow at the nearest U.S. Geological Survey gage station is provided for the dates of observation.

B. Fish Habitat Observations

Fish habitat data for Russian River mainstem and Lower Dry Creek are presented in Appendix C. Data is organized by section number and rivermile.

Fish habitat data are presented for nursery and spawning habitat observation. Specific parameters investigated in the field as well as general section comments are presented. Where field conditions were restrictive to the collection of field data, "N/A" is indicated in the table.

Russian River mainstem spawning habitat observations were made during the period of May 5 through May 18, 1978. Dry Creek spawning habitat observations were made during the period of April 13 through April 15 and on May 15, 1978. Maximum, minimum and average streamflow for these periods are indicated below:

Gage Station	Maximum Streamflow (cfs)	Average Streamflow (cfs)	Minimum Streamflow (cfs)
Hopland	646	416	218
Cloverdale	795	575	285
Healdsburg	1090	839	578
Guerneville	1290	1060	707
Dry Creek	165	124	58

Russian River mainstem and Dry Creek nursery habitat observations were made during the period of July 6 through July 30, 1978. Maximum, minimum and average streamflow for this period is indicated below:

Gage Station	Maximum Streamflow (cfs)	Average Streamflow (cfs)	Minimum Streamflow (cfs)
Hopland	240	216	193
Cloverdale	238	215	193
Healdsburg	246	214	196
Guerneville	299	170	119
Dry Creek	2	<1	<1

Appendix C presents transect cross section profile data for mainstem and Dry Creek. Linear feet of potentially usable spawning substrate are indicated on each profile for those transects where this information could be obtained. The two narrow rectangles at the bottom of each profile contain the usable gravel data in the form of two horizontal bars, the upper indicating the cross section length of 0.5 to 4 inch gravel, the lower indicating 0.5 to 6-inch gravel. For example, the graph on page C-3 indicates the occurrence of suitable spawning substrate, according to the 0.5 inch to 4 inch definition, at the following locations:

Lower transect:	80 feet to 100 feet
	110 feet to 120 feet
Upper transect:	10 feet to 90 feet

Half-inch to 4-inch substrate was selected as optimal . spawning-size substrate based on the available literature. Half-inch to 6-inch substrate is included because king salmon can utilize this size range. All cross sections are oriented so that the left edge of the channel (looking downstream) is positioned on the left side of the profile. All discussion in this report utilizes the downstream convention for orientation.

V. Evaluations

A. Channel Hydraulics

The field data presented previously have been analyzed and summarized to facilitate the evaluation of fish habitat and barriers to fish migration. In order to recommend optimum streamflow, it is necessary to describe the relationship between streamflow and the known requirements for fish habitat and fish passage, including water velocity, depth, and surface width.

The monthly mean discharge at the U.S. Geological Survey gaging stations on mainstem are shown on Table V-1, which illustrates the flow variability with time and distance in the three defined reaches (see Section III.C.). Data for Dry Creek are also shown on the table.

The results of the calibration of the stage-discharge relationship for the transects on Dry Creek are presented in Figure V-1 and for the transects on mainstem in Figure V-2. The value of the calibration parameter corresponding to best agreement between the observed and computed flows is shown. Relatively little variation is indicated in the value on Dry Creek, with most values lying between 0.4 and 0.8. Relatively large variation is indicated on the mainstem, with values ranging from 0.2 to 3.8, but with most values falling between 0.2 and 1.4. The channel gradient, as determined from elevations on U.S. Geological Survey quad maps, is also shown on the respective figures for Dry Creek and mainstem. Estimating that the overall gradient from Section 1 to 9 on Dry Creek is .00161, since it appears to be nearly uniform for the entire reach, the average value of n for Dry Creek is computed to be 0.04. The gradient on mainstem is steepest in the upper and middle reaches, where an estimate of the overall gradient from Section 19 to 49 is .0016; it is flattest in the lower reach from Section 1 to 18 where the overall gradient is estimated to be .00038. The average values of n for the upper, middle, and lower reaches of mainstem are all computed to be 0.05. The values of n computed for Dry Creek and mainstem are consistent with values given in the literature for streams with similar characteristics (Chow, 1959).

Departures of the calibration parameter from the average could be due to local variations in both channel roughness and channel gradient; however, the field data did not permit a distinction to be made between these two causes of variation, and further refinement of the hydraulic analysis was not attempted. It was apparent from the field notes that significant departures of the gradient from the estimated

TABLE V-1

AVERAGE MEAN DISCHARGE (CFS) FOR WATER YEARS 1972 THROUGH 1976.

J.S.G.S. GAGE STATION 11462000-RUSSIAN RIVER (EAST PORK) NEAR UKIAH
(UPPER REACH)

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
325	229	258	513	757	575	163	234	258	293	289	261

U.S.G.S. GAGE STATION 11462500-RUSSIAN RIVER NEAR HOPLAND
(UPPER REACH)

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
324	317	534	1351	1938	1727	392	263	247	253	249	244

U.S.G.S. GAGE STATION 11463000-RUSSIAN RIVER NEAR CLOVERDALE
(UPPER REACH)

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
334	393	655	1814	2906	2335	567	303	243	245	243	234

U.S.G.S. GAGE STATION 11464000-RUSSIAN RIVER NEAR HEALDSBURG
(MIDDLE REACH)

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
344	603	987	3227	4664	3414	857	375	234	224	225	218

U.S.G.S. GAGE STATION 11467000-RUSSIAN RIVER NEAR GUERNEVILLE
(LOWER REACH)

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
373	993	1610	5844	7714	5248	1198	418	205	170	172	191

U.S.G.S. GAGE STATION 11462500-DRY CREEK NEAR GEYSERVILLE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
18	134	250	914	1182	779	183	46	13	4	.5	.4

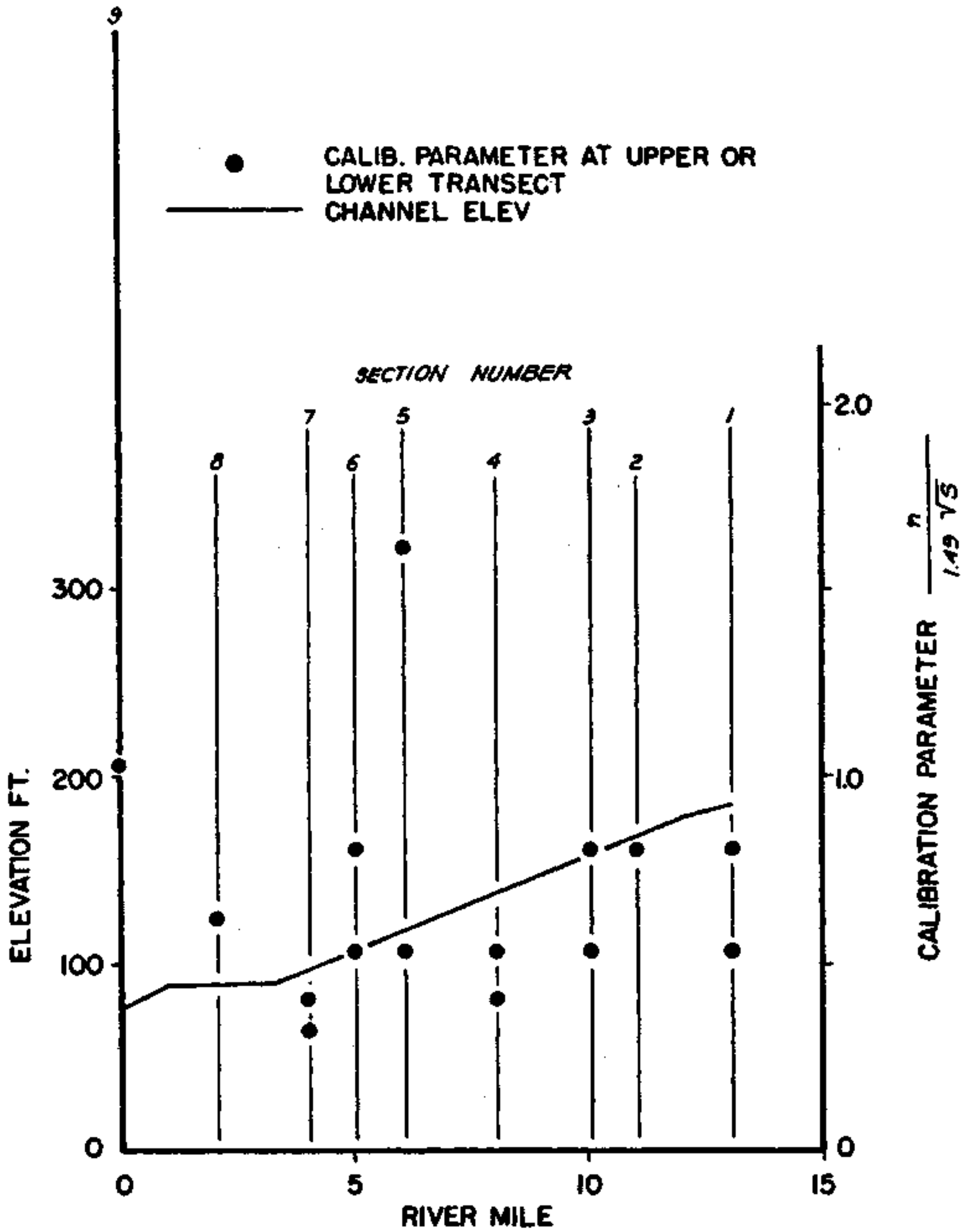


Figure V-1
ELEVATION AND CALIBRATION PARAMETER vs RIVERMILE
DRY CREEK

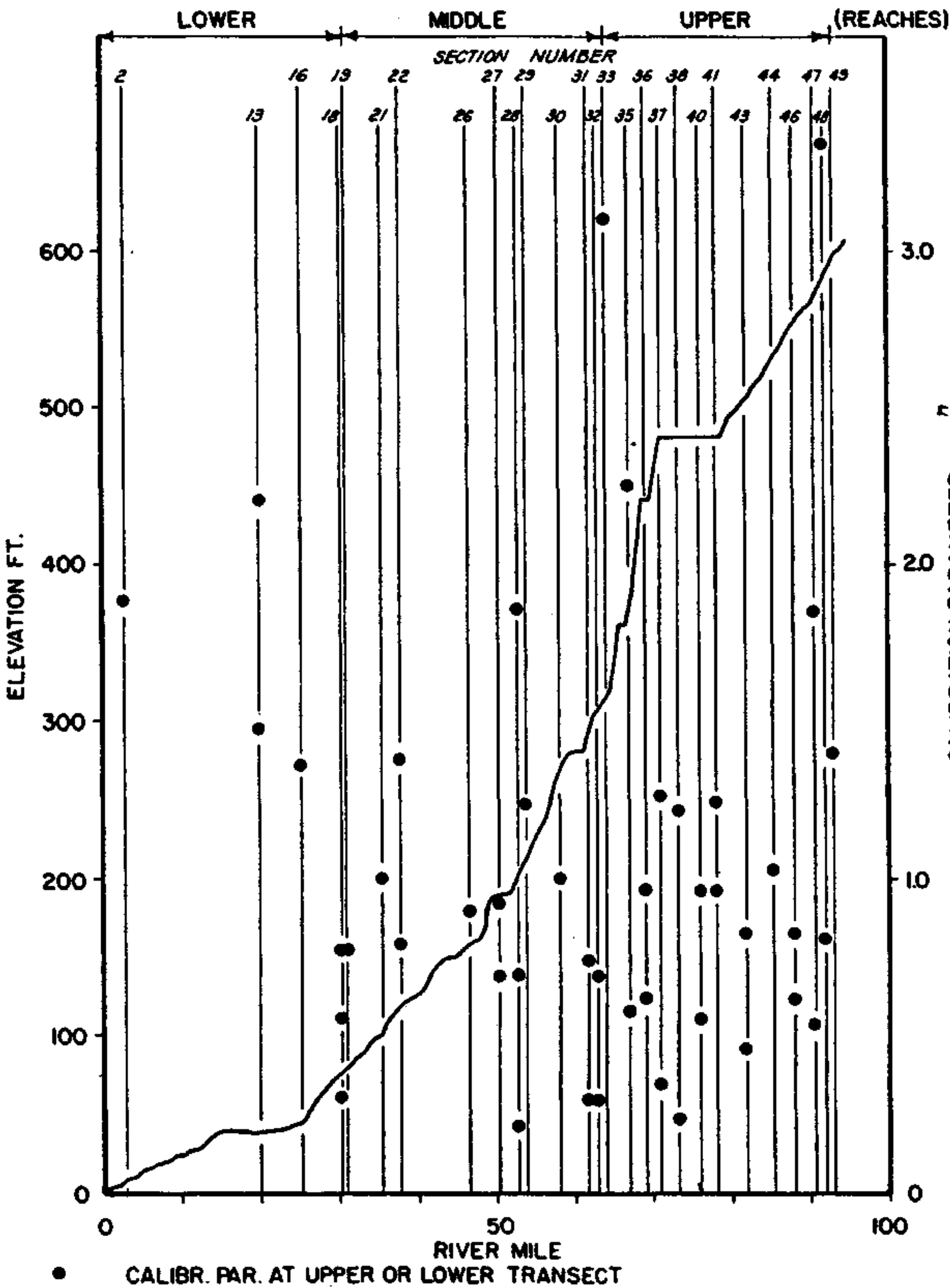


Figure V-2
ELEVATION AND CALIBRATION PARAMETER vs RIVERMILE
MAINSTEM

value were likely, particularly in pool and riffle sections, but quantification was not possible.

The stage-height-discharge relationships for the transects on Dry Creek are presented on Figure V-3 and for the transects in the lower, middle, and upper reaches of mainstem on Figures V-4, V-5, and V-6 respectively. Stage height is reckoned from the lowest point in the transect, as shown on the profiles presented previously. The curves extend to the limit of bank-full flow, but should be considered most accurate in the flow range below 1000 cfs for Dry Creek and 2000 cfs for mainstem, due to the range of the limited calibration data available. Cross-reference between the stage-discharge curve and the corresponding transect profile provides information on streamflow vs. wetted channel surface width and water depth at individual transects.

The computed mean velocities used to define the range of optimum spawning conditions in Section VI must be related to the velocities at 0.5 feet from the bottom for which the range of optimum velocities has been defined in the literature. Field observations in Dry Creek and mainstem of velocities at 0.5 feet from the bottom are plotted in Figure V-7 against computed mean velocity based on the section factor determined at the time of field survey, and the calibrated stage-discharge curve. Considerable scatter in the data is evident; nonetheless a trend can be inferred from the data. It is reasonable to assume that the curve of best fit will pass through the origin, and that a direct proportionality exists for the velocity range of concern. The velocities at 0.5 feet from the bottom may be estimated by taking 150% of the computed mean velocity. In order to test the sensitivity of subsequent recommendations of streamflow for the production of optimum spawning habitat to the above velocity relationship, it should be noted that the velocity at 0.5 feet from the bottom may be taken as equal to the mean velocity as an approximate lower limit. For streamflows exceeding the range of optimum flows anticipated, the field data and the relationship derived from that data would appear not to be valid.

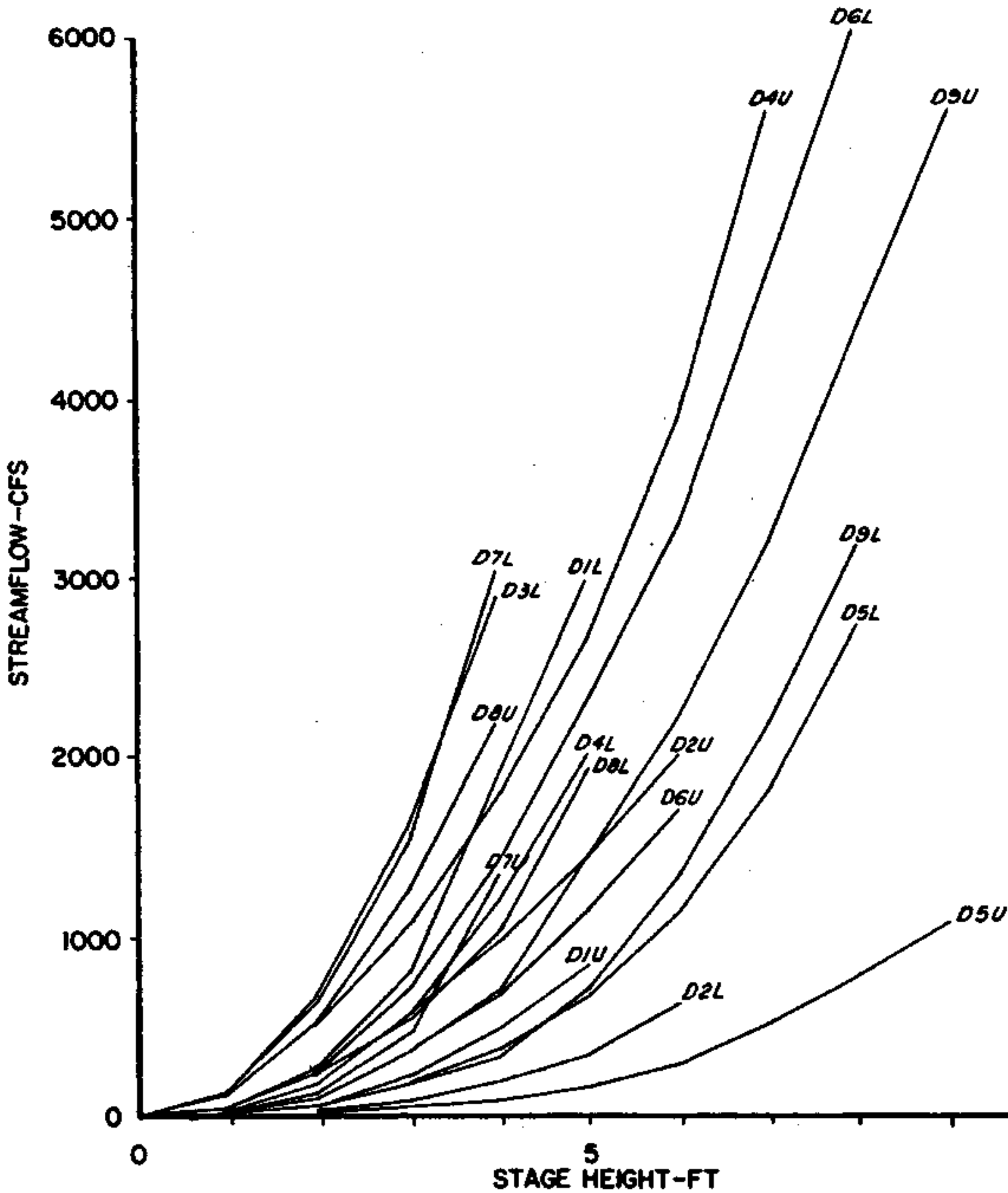


Figure V-3
STREAMFLOW vs STAGE HEIGHT
DRY CREEK TRANSECTS

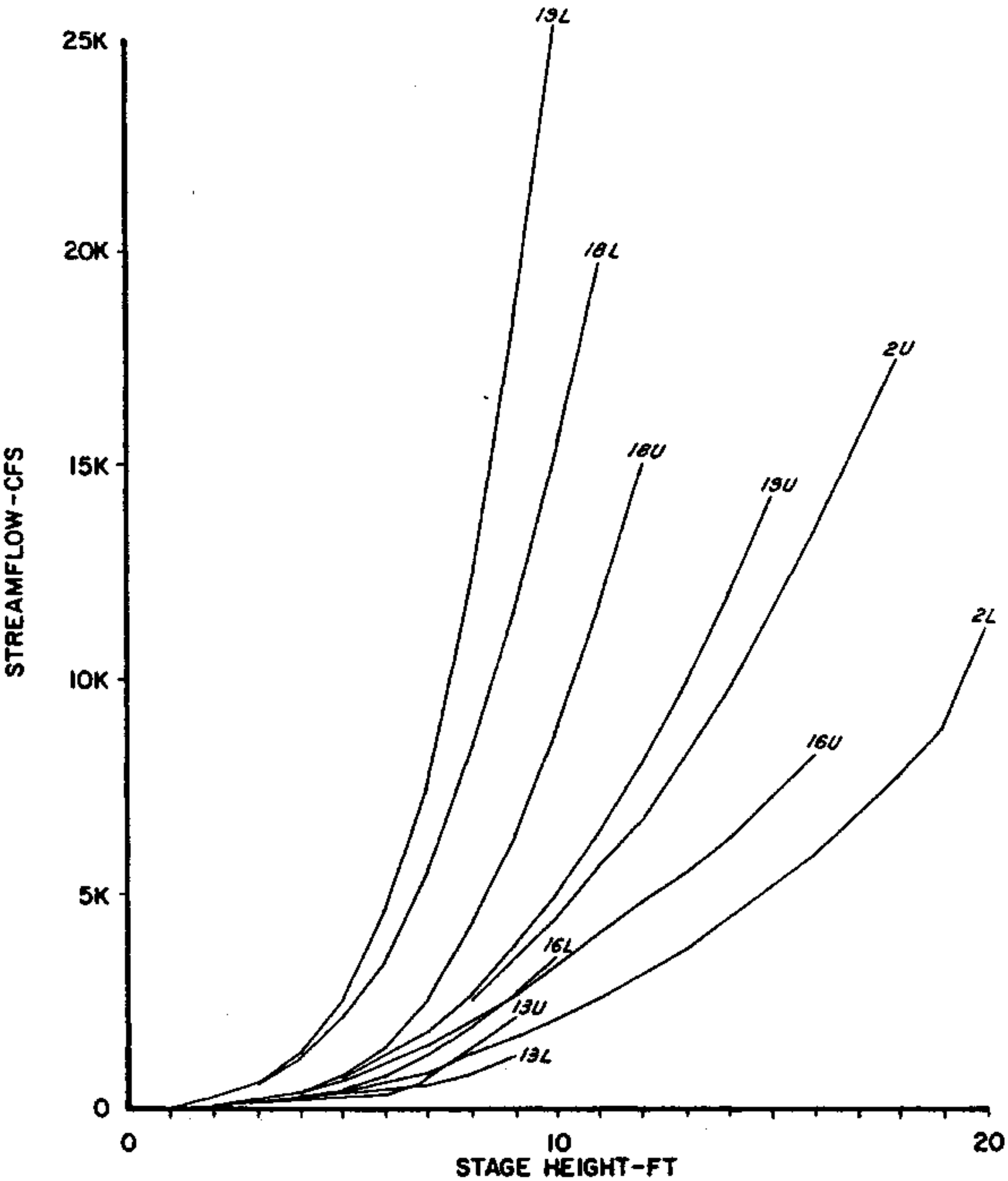


Figure V- 4
STREAMFLOW vs STAGE HEIGHT
MAINSTEM LOWER REACH TRANSECTS

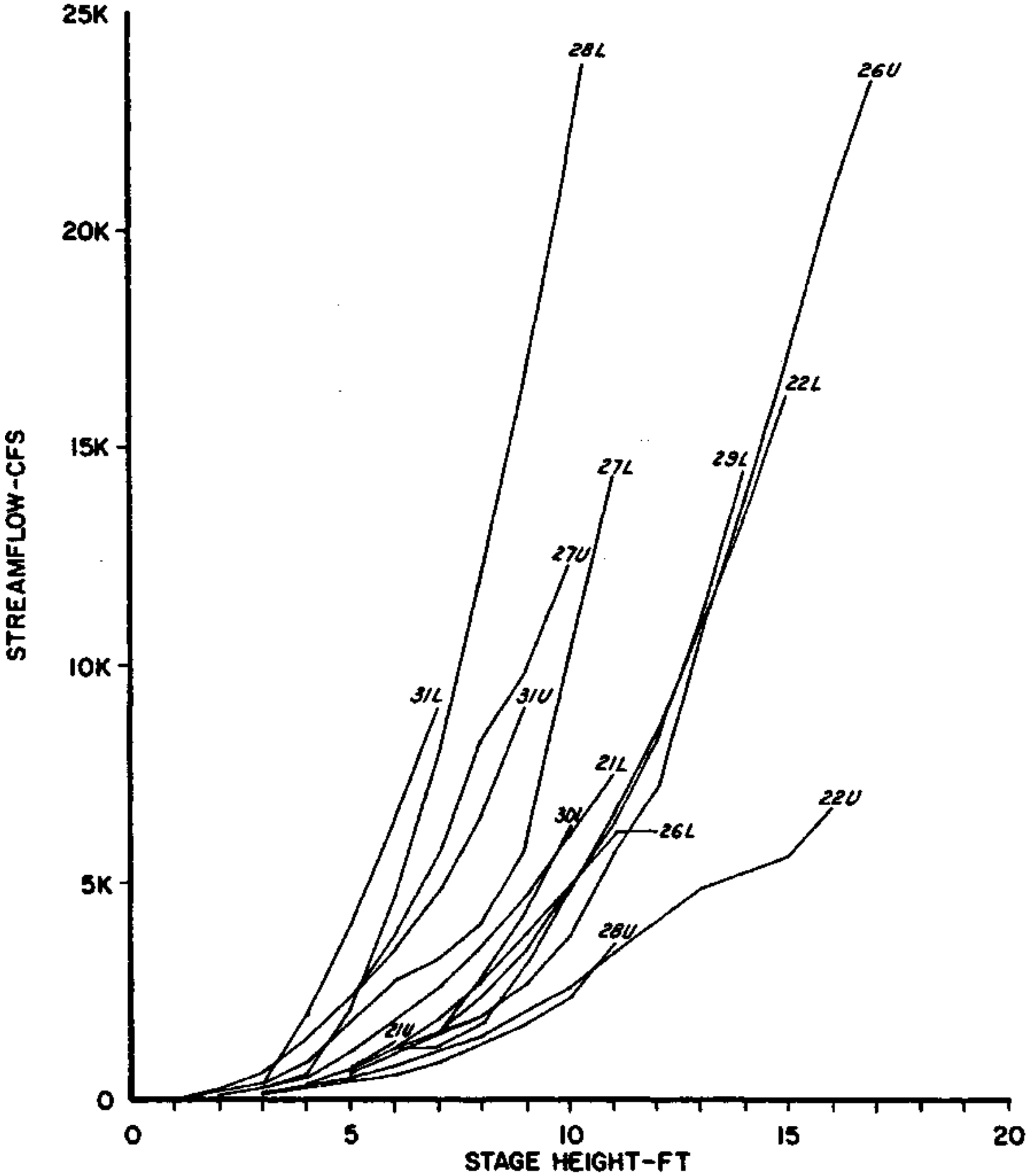


Figure V- 5
STREAMFLOW vs STAGE HEIGHT
MAINSTEM MIDDLE REACH TRANSECTS

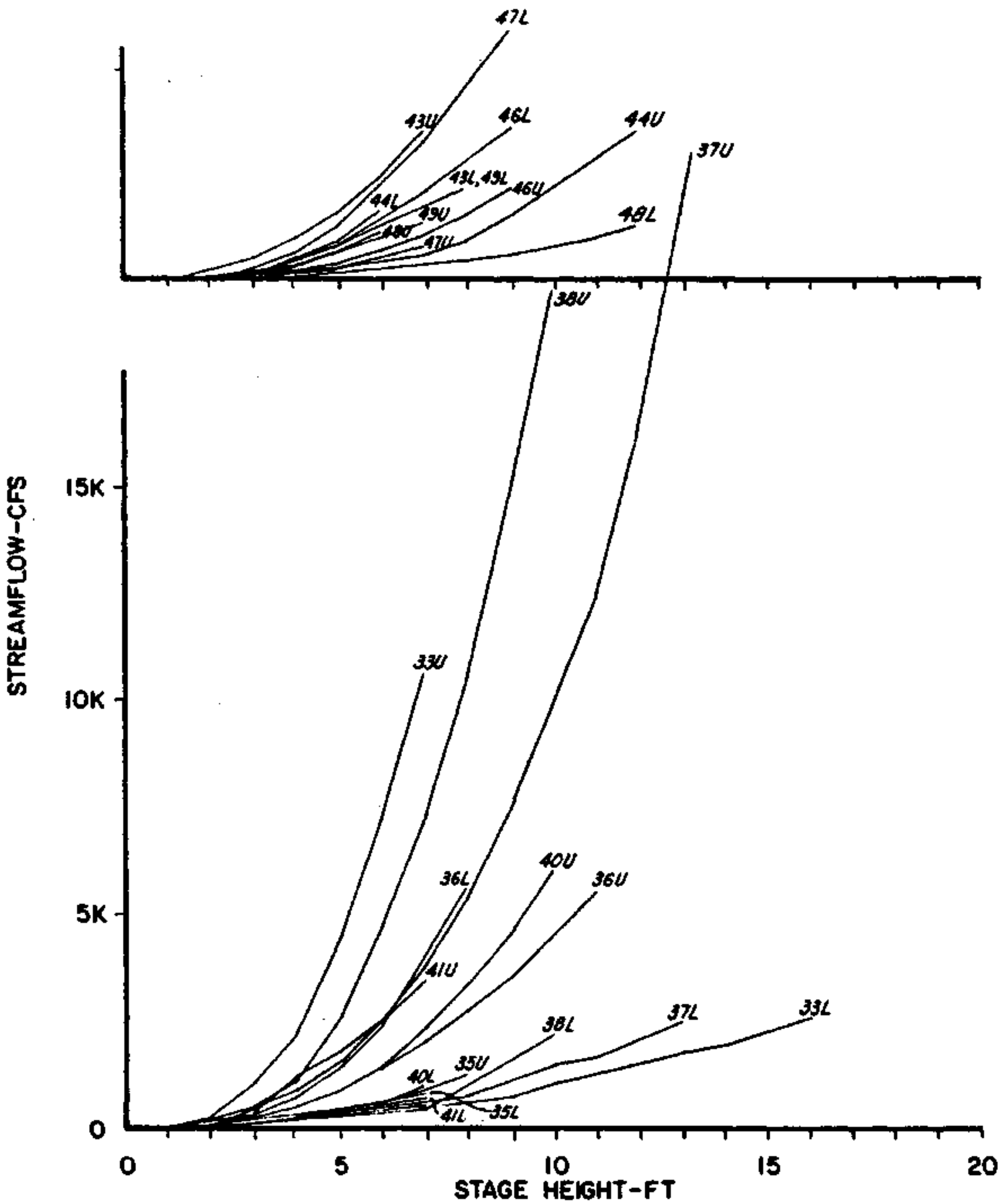


Figure V-6
STREAMFLOW vs STAGE HEIGHT
MAINSTEM UPPER REACH TRANSECTS

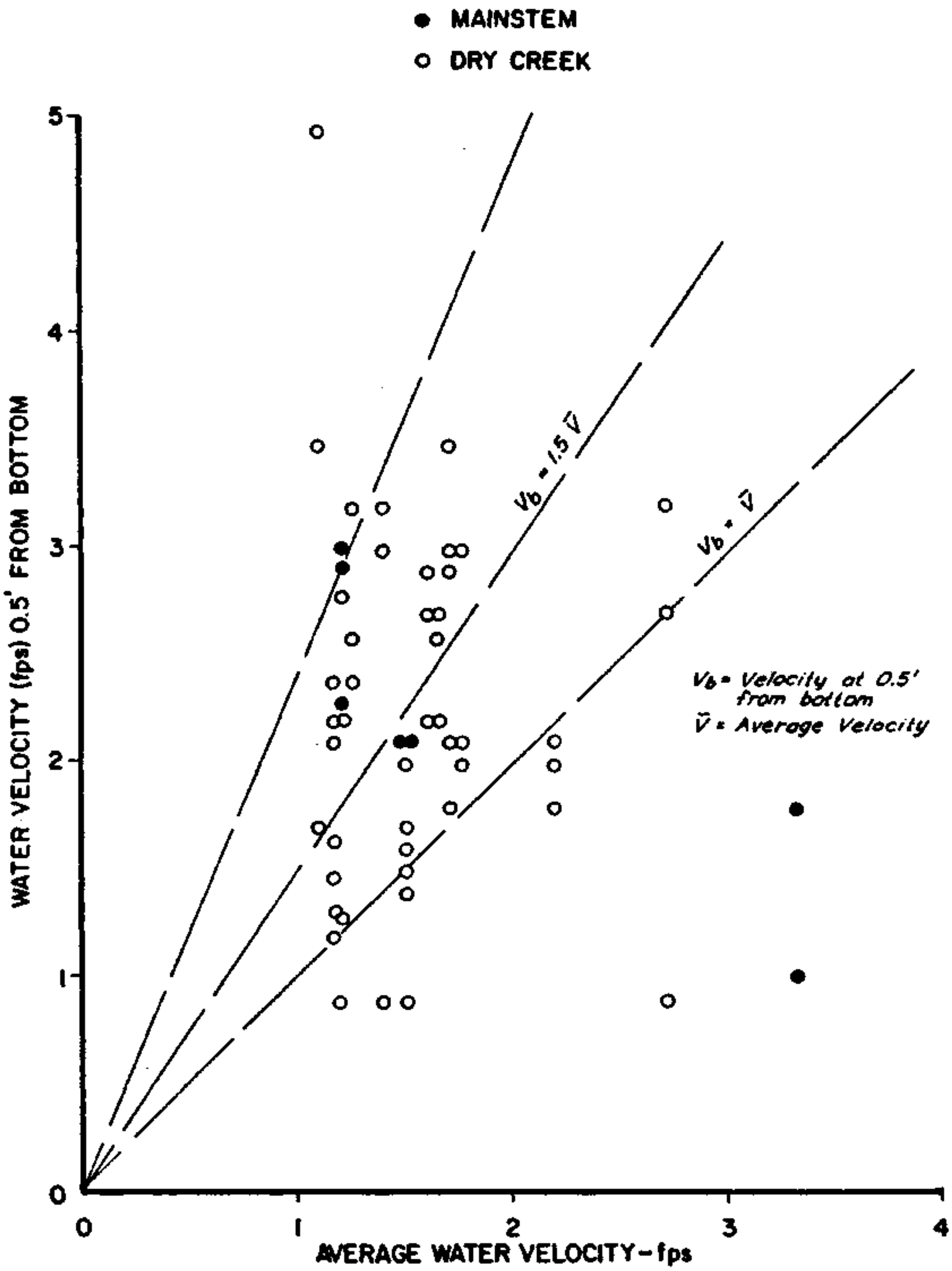


Figure V- 7
WATER VELOCITY AT 0.5 FEET FROM BOTTOM
vs AVERAGE (COMPUTED) WATER VELOCITY

B. Structure Fish Passage Evaluation

Instream structure field data have been analyzed to facilitate an evaluation of the potential structure impact on fish habitat and fish migration in mainstem Russian River and lower Dry Creek. Temporary and semi-permanent water impoundment dams as well as summer road crossings were considered. The evaluation includes an investigation of fish passage and migration, water quality (temperature, D.O., and turbidity), and structure fish habitat. The evaluation of fish passage at instream structures received primary consideration. Criteria developed to evaluate fish passage in terms of velocity and depth are presented in the literature review of fish passage (II.A.2).

In general, fish passage is not restricted on the mainstem Russian River during winter migratory periods of salmonids. Exceptions can exist during periods of unusually high or low flow. These conditions are discussed in the following evaluation of fish passage. Summer migration is affected on the mainstem Russian River by the presence of temporary dams and road crossings. The impact of these structures is also evaluated in the following discussion.

Dry Creek fish passage is generally unrestricted during the winter salmonid migratory season. Low flow winter conditions are potentially restrictive at certain locations on Dry Creek. Summer fish passage into Dry Creek is very limited due to a general lack of water and the presence of a major temporary obstruction near the confluence of Dry Creek and the Russian River. These conditions are discussed in the individual structure evaluations.

1. Willow County Water Diversion Dam

a. Fish Passage

At the observed flows, spillway velocities were near the limit of acceptable velocities for adult salmonid passage. The irregular shape of the rip-rap spillway most likely provides isolated areas with reduced velocities allowing upstream fish passage at some flows. Adequate resting pool habitat was available above and below the structure. Water depth over the spillway is an important variable at this structure. Insufficient flow will cause the water to flow only through the rip-rap spillway as opposed to over it, possibly preventing passage. Higher flows will pass over the spillway as well as through it. Over-spilling velocities may be excessive at higher flows.

b. Water Quality

Water temperature was essentially the same at upstream and downstream sampling sites. No vertical temperature stratification was observed in the impounded water.

c. Winter/Summer Habitat Comparison

This facility is permanently located instream the entire year. Pool habitat is present above and immediately below the structure. No information was available on pre-dam river habitat conditions.

2. Cummiskey Station River Ford

a. Fish Passage

Cummiskey Station ford would not prevent or interfere with fish passage at observed flow conditions. Railroad flat cars were noted on the right bank a distance away from the river. These cars were possibly utilized for a crossing structure at one time although no indication of current use was evident. Cummiskey Station river ford receives very little use.

b. Water Quality

No investigation of water quality was conducted at Cummiskey Station. The river was flowing freely and no indication of structure-induced conditions was apparent.

c. Winter/Summer Habitat Comparison

Very little variation in habitat was evident between summer and winter observations at Cummiskey Station ford, other than variation in streamflow and various associated hydraulic variables.

3. Asti Summer Road Crossing

a. Fish Passage

Flow of water was not restricted at Asti summer road crossing. The main channel was diverted to run through a bridge crossing on the left edge of the river channel. Flow was primarily along the right edge of the channel prior to construction and the steel bridge crossing would not restrict fish passage at the observed flow.

b. Water Quality

No impoundment of water was evident at Asti summer road crossing. Water quality conditions were considered uniform upstream and downstream of the structure. Depending on the method of removal of the summer road crossing, turbidity could temporarily increase downstream. The considerable amount of road fill utilized for this summer road crossing represents a significant source of sediment if left instream to wash out.

c. Summer/Winter Habitat Comparison

Summer habitat immediately above the bridge (left edge of channel) was primarily deep run habitat. Below the bridge crossing riffle-run habitat is predominant. The left side of the channel was dry when observed in the field prior to construction of the bridge. The construction of the road crossing re-routes the river. The majority of the road fill material is located on habitat that is primarily riffle in the winter. The flow is cut off in this section in the summer.

4. Del Rio Woods Dam

a. Fish Passage

Summer spillway velocities at the observed flow were near the upper limit of acceptable passage velocities for adult salmonids. Pools for take-off and landing were present upstream and downstream of the structure, although the downstream pool was marginal with respect to inadequate depth and excessive turbulence. Depth of water over the structure and the length of the spillway were perhaps the most limiting factors affecting fish passage. The majority of the 38-foot-long spillway was covered with approximately .5 feet of water, creating sub-optimal passage conditions.

Shad passage is questionable at present summer flow conditions. Jumping is required at the existing facility and the jumping ability of shad is well below that of salmonids. In the event that successful passage is facilitated at Healdsburg Dam, it is essential that the Del Rio Woods Dam be considered for installation of a fishway to provide access to the remaining 60 miles of mainstem Russian River and to West Fork Russian River.

b. Water Quality

Water temperature and D.O. upstream and downstream of the structure were consistent. No stratification was observed with depth for water temperature or D.O. Turbidity was similar upstream and downstream of the structure. A considerable amount of gravel fill is incorporated into the design of this structure. This material represents a potential source of sediment that could result in an increase in downstream turbidity.

c. Summer/Winter Habitat Comparison

Winter flow is through and around the spillway that remains instream the full year. Habitat type is principally deep riffle and run. During the summer, habitat immediately below the structure (formerly deep riffle) becomes relatively shallow riffle while pool habitat is created upstream from the structure.

5. Healdsburg Dam

a. Fish Passage

During the winter, a concrete footing and series of collapsed flashboards remains instream, creating a 5-foot high barrier extending the width of the channel. Velocities recorded over the spillway were near the upper limit for successful adult salmonid passage at the observed flow. Higher flows could create a velocity barrier. Low flow would reduce the depth of water flowing over the spillway and reduce the resting habitat and take-off area below the structure. Rip-rap placed below the structure to prevent streambed degradation occupies considerable space, creates turbulent conditions, and limits pool area for jumping.

During the summer, the flashboards are raised to create the dam. The only bypass of water is through the spillway which is a freefall approximately 15 feet high. Passage of any fish species is very unlikely. For a single summer about seven years ago, a makeshift plywood flume with baffles was installed to facilitate fish passage, but no record of fish passage over that structure exists.

b. Water Quality

Water temperature, D.O. and turbidity did not vary significantly between upstream and downstream measurements. No stratification with depth was observed for temperature or D.O. A temporary increase in turbidity could result downstream when the dam is lowered in September. Gravel is utilized as a temporary access road into the channel when the structure is raised in the spring. In addition, the dam may trap and deposit sediment during the summer that would wash out when the structure is lowered.

c. Summer/Winter Habitat Comparison

Winter habitat above the collapsed structure is predominantly run. This habitat becomes pool in the summer, extending several miles upstream. Downstream from the structure summer habitat conditions are predominantly pool, resulting primarily from a Basalt Rock Company summer road crossing located approximately .5 miles below Healdsburg dam. Winter habitat below Healdsburg dam is run.

6. Basalt Summer Road Crossing

a. Fish Passage

Fish passage is not restricted during fall and winter migratory seasons. During the summer, channel flow is restricted to a section of permanent bridge on the left edge of the channel. No fish passage problems were evident at the observed flow.

b. Water Quality

Temperature and D.O. did not vary significantly between upstream and downstream sampling stations. A decrease in turbidity was observed downstream from the road crossing where flow was greatest. A temporary increase in turbidity would be expected when the structure is removed.

c. Summer/Winter Habitat Comparison

Streamflow is not restricted when the road crossing is not installed. Habitat type is predominantly run and deep riffle. When the road crossing is installed, the upstream habitat becomes pool and the only flow is on the left side of the channel through the one section of permanent bridge. The pool habitat extends upstream to the vicinity of Healdsburg Dam. Summer habitat downstream is deep riffle, confined to the left edge of the channel. Further downstream, unrestricted flow resumes.

7. Wohler Dam

a. Fish Passage

Fish passage is not restricted when Wohler Dam *is* deflated. During the summer, Wohler Dam is inflated with water to create a spillway height of 13 feet. Two Denil fishways are incorporated into the structure with approximate slopes of 1 foot of rise to 8 feet of run. Turning pools located in each fishway provide temporary, in-transit, resting habitat. Baffle sections also provide less turbulent water on the bottom of each fishway. The fishways are equipped with a debris barrier (floating line anchored above dam). Both denil fishways were clear and no evidence of jamming was observed. Migrating late summer and early fall king salmon should not have difficulty ascending these fishways prior to the deflation of the spillway. The structure is deflated for the majority of salmonid upstream migration.

Some American shad are known to negotiate the fishways at Wohler Dam, but quantitative data is lacking. Additional investigation of shad passage at this facility is needed.

b. Water Quality

Temperature, D.O. and turbidity did not vary appreciably between upstream and downstream sampling sites. Depth profiles in impounded water indicated a slight decrease in both temperature (1.5°C) and D.O. (0.6 ppm).

8. Mirabel Park Old Dam Site

a. Fish Passage

No fish passage problems are presented by old Mirabel Park Dam site. Approximately 30 wooden pilings remain instream, creating a potential hazard only to summer boaters. This site was regarded as being free from instream structures and no additional data was collected.

9. Korbel Summer Road Crossing

a. Fish Passage

No impoundment of water was evident at Korbel summer road crossing. Streamflow was unimpeded and no fish passage problems were noted at the observed summer flow. Winter streamflow is not restricted, and presents no passage problems to upstream-migrating salmonids.

b. Water Quality

No data was collected since summer streamflow was not affected by Korbel summer road crossing. Downstream turbidity could increase for an undetermined length of time when the crossing is removed and streamflow increases*

c. Winter/Summer Habitat Comparison

Habitat type is similar throughout the year, although depth, velocity, volume of water, and water surface width are greater during the winter season. A standing pool of water was observed upstream from the structure on the left side of the channel, possibly indicating one site of road fill excavation.

10. Guernewood Summer Road Crossing

a. Fish Passage

Streamflow is not restricted through one section of permanent bridge during the summer period of service of Guernewood summer road crossing. American shad and late summer king salmon encounter little if any passage obstruction. During the winter, no road crossing surface or fill is in place, allowing unrestricted upstream migration of salmonids.

b. Water Quality

Very little difference was observed between upstream and downstream temperature and D.O. values. A minor increase in turbidity (1 NTU) was observed in flowing water under the bridge as compared to upstream and downstream values. Downstream turbidity is likely to temporarily increase when this structure is removed in the fall. A considerable amount of road fill is incorporated in the construction of this road crossing, as is the case with most Russian River summer road crossings.

c. Winter/Summer Habitat Comparison

Summer streamflow is restricted to the left portion of the river channel. An island is located instream that acts as an anchoring point for both permanent and temporary components of the summer road crossing. Water tends to accumulate on the right side of the channel behind the fill segment of the road crossing.

During the winter flow occurs on both sides of the island, but the majority of winter streamflow is on the right side of the island where potentially usable salmonid spawning substrate was observed. This portion of the channel is covered and blocked by the construction of the summer road crossing. Removal of the road fill, either by machine or winter washout, could have a deleterious effect on this section of potentially usable spawning habitat if precautions are not taken to prevent depletion or degradation of spawning gravel.

11. Johnson's Beach Summer Dam

a. Fish Passage

During the winter, concrete and steel piers that support summer flashboards remain in place in the channel. These footings pose little threat to upstream-migrating salmonids at the observed winter flow. A considerable amount of debris is trapped by these footings, which could conceivably render sections of the river unpassable.

When the dam is in place, the only upstream migration is through a modified Denil fishway. Early run king salmon do not encounter velocity barrier problems in the fishway. During the main steelhead and silver salmon spawning migration, the fishway and dam are not in place. American shad are theoretically able to pass the Johnson's Beach fishway, although additional verification is needed.

The fishway at this facility had accumulated debris at the upper end, possibly interfering with migration. Fish could enter the ladder easily and ascend it, yet possibly encounter debris when trying to leave it.

b. Water Quality

Temperature and turbidity values did not vary greatly between upstream and downstream sampling sites on the date of observation. Dissolved oxygen content was approximately 1.5 ppm less downstream than upstream. Values of dissolved oxygen were near or above saturation levels for the observed temperatures. Profiles of temperature and D.O. with depth indicated very little variation in these parameters in the 6-to-8-foot deep impoundment.

c. Winter/Summer Habitat Comparison

River habitat type is primarily run at this site during the winter season. A minor amount of turbulence (depending on the amount of trapped debris) exists where streamflow passes through the permanent piers.

Summer habitat conditions differ both above and below the dam. Upstream habitat becomes pool while downstream habitat begins as a deep riffle or run but soon loses velocity from the effects of Guernewood summer road crossing and Vacation Beach summer dam, located downstream.

12. Vacation Beach Summer Dam and Road Crossing

a. Fish Passage

During the winter streamflow is not restricted and no barriers exist to prevent or impede salmonid spawning migration. Four summer road crossing footings and the summer dam foundation remain instream during the winter.

During the summer, when the dam and road crossing are in place, the only upstream migration is over a single modified Denil fishway at the dam. The road crossing does not pose a fish passage problem. Salmonids are able to negotiate the Vacation Beach fishway. It is known that American shad are able to pass this facility, but quantitative passage information is lacking. No debris was observed at this fishway, but debris accumulation similar to that observed at Johnson's Beach Dam is possible.

b. Water Quality

Water temperature, turbidity, and D.O. did not vary significantly between upstream and downstream sampling sites at observed conditions. Water temperature and D.O. did not vary appreciably between water surface and bottom values in the impoundment. Transparency was approximately 3 feet in the impoundment behind the dam. A decrease in transparency was observed in the lower river below Mark West Creek confluence. Turbidity values reflect these findings. Turbidity could temporarily increase downstream when this facility is removed in the fall.

c. Winter/Summer Habitat Comparison

Winter river habitat conditions are primarily deep riffle and run. When the road crossing and dam are installed, upstream habitat becomes pool-like, extending up to the vicinity of Guernewood summer road crossing. Downstream habitat is primarily riffle and run. With the exception of *a* sand bar at the mouth of the river, no additional water impoundments are located below Vacation Beach summer road crossing and dam facilities.

13. Basalt Summer Crossing (Dry Creek)

a. Fish Passage

During the winter, the road crossing is not installed and no fish passage problem exists. Summer conditions restrict the flow in Dry Creek to six culverts. At the beginning of the summer, when streamflow in Dry Creek was still relatively high, all culverts were flowing with an average velocity potentially restrictive to upstream fish migration (including salmonids) at observed conditions. These conditions do not coincide with the time of upstream salmonid migration, but American shad are present during this time and would not be able to bypass these culverts. The culverts are positioned 2.5 feet above the water surface, further decreasing any possibility of shad passage. As the summer progresses, streamflow commonly diminishes to a level where little if any surface flow is evident in the culverts.

b. Water Quality

Insufficient water was available in Dry Creek to allow sampling during the July data collection period.

c. Winter/Summer Habitat Comparison

Winter habitat conditions are not affected by Basalt summer crossing, which is removed prior to any major increase in streamflow. Summer habitat conditions are variable, depending upon the amount of streamflow. A pool is created upstream behind the road crossing. The pool usually becomes dry as the summer progresses. This location is primarily riffle-run habitat during the winter. Downstream from the road crossing, flow is maintained in the summer until the water level in the impoundment drops below the elevation of the bypass culverts. Any further flow is sub-surface through the road crossing fill gravel.

C. Spawning Habitat Evaluation

Field data regarding Russian River mainstem and lower Dry Creek spawning habitat are presented in Appendix C. The following discussion is an evaluation of these data for the streamflow conditions observed during the field surveys.

1. Dry Creek

a. Spawning Habitat Access

During the winter upstream migration of adult silver salmon and steelhead, average streamflow conditions in Dry Creek do not restrict access to spawning habitat located within the study area. Silver salmon and steelhead generally enter the Russian River in November and complete migration in February or March before access is reduced by low flow conditions. King salmon begin their migration relatively early in August and continue through November. The present summer condition of Dry Creek would restrict king salmon from entering the creek until a road crossing barrier is removed and normal seasonal flow resumes. Similarly, American shad migration is restricted by this barrier. Fish passage evaluations are dealt with in greater detail in Section V.B.

b. Spawning Habitat Availability and Quality

The amount of potential spawning habitat at optimum spawning depth and velocity is shown in Figure V-8 for Dry Creek. The average potential spawning habitat is shown by the broken line on the figure. Optimum spawning conditions are defined in section III.C., based upon the literature review. Potential spawning habitat is considered to be substrate .5 to 4 inches in diameter for silver salmon and steelhead and .5 to 6 inches in diameter for king salmon.

Figure V-8 indicates that, in general, more potential spawning habitat was available, per transect, above Dry Creek mile 5 than below this point. Exceptions exist, however, such as the transects in Dry Creek study section 9, located in Dry Creek mile 0. These transects contained the greatest linear distance of potential spawning habitat encountered on Dry Creek, partly because of the wide channel in this segment of Dry Creek.

Although transect data are considered valuable as the primary source of quantitative field data, additional observations were made of sections between transects on

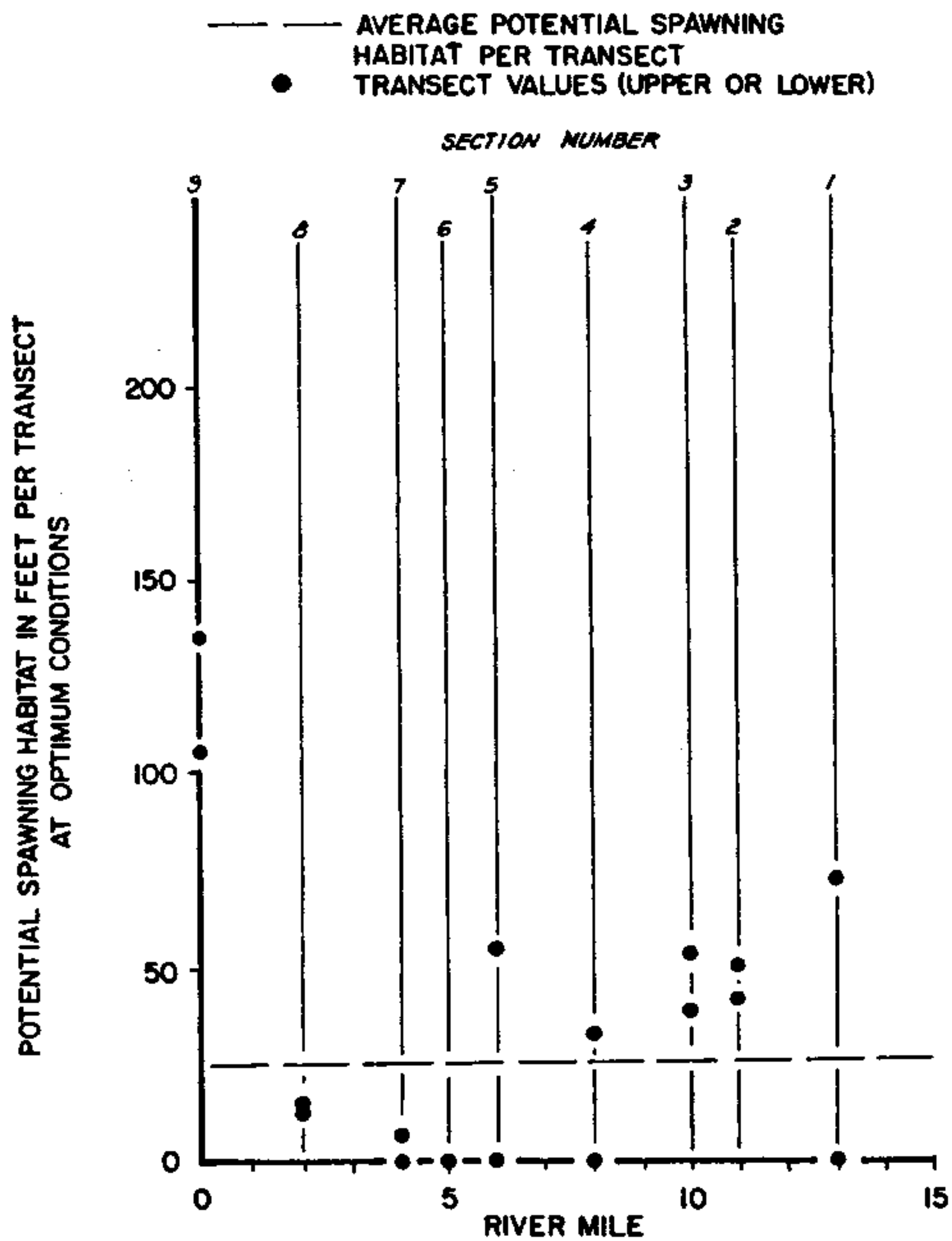


Figure V-8
MAXIMUM POTENTIAL SPAWNING HABITAT PER TRANSECT vs RIVERMILE
DRY CREEK

Dry Creek and mainstem. These river section observations include visual analyses of potential spawning habitat with respect to quantity and quality. In general, based on river section observations, Dry Creek contains considerable quantities of potential spawning habitat. Much of the potentially usable spawning-size substrate in the sections was exposed during field observations and additional investigation would be required to determine how much additional substrate could become usable at optimum streamflow criteria.

A general progressive decrease in the availability of potential spawning habitat was observed below river mile 6. In addition, an increase in the content of sand and fine sediment was noted as part of this transition. Section 8 contained the least amount of potential spawning habitat of the nine Dry Creek study sections. A general lack of suitable size substrate was observed in this river section. Historically, instream gravel extraction has occurred in the immediate vicinity of this river section although no indication of current excavation was observed, due to a pending lawsuit by landowners that has temporarily halted excavation. An increase in the availability of potentially suitable spawning substrate was observed in Dry Creek mile 0 at section 9 (as indicated by the previously mentioned transect data). Despite this availability, this stream section contained a relatively high concentration of sand and fine sediment, reducing the overall quality of this potential spawning habitat.

2. Russian River Mainstem

a. Spawning Habitat Access

American shad spawning migrations are influenced by the presence of temporary and semi-permanent water impoundment structures as discussed earlier in this report. Only 32 miles of the mainstem are available for shad spawning after the late May installation of Healdsburg dam. Before this installation, any shad bypass at Healdsburg Dam (in its collapsed winter condition) is highly unlikely because of excessive spillway velocities and restrictive jumping distances.

The degree of utilization of the Russian River by late summer running king salmon is uncertain. If spawning adults enter the river in late August, they have only 32 miles of mainstem for spawning until Healdsburg Dam is lowered in early September. In addition, until seasonal precipitation restores flow to the major tributaries, spawning must be confined to the mainstem.

Steelhead and silver salmon enter the Russian River long after all temporary and semi-permanent structures have been removed for the winter. Upstream migration is potentially restricted at Healdsburg Darn and Willow County Water Diversion Dam, both of which are discussed in greater detail in the sub-sections on instream structure evaluations (V.B.) and fish passage considerations (VI.A.).

b. Spawning Habitat Availability and Quality

The amount of spawning habitat at optimum spawning depth and velocity conditions in the three reaches of mainstem Russian River is shown on Figure V-9. Average potential spawning habitat per transect is indicated by the broken lines for the three reaches defined for mainstem. These averages indicate that the greatest amount of potential spawning habitat, at optimum conditions, occurs in the middle reach of the river (between study section 19 (river mile 30) and study section 32 (river mile 62)]. Relatively less potential spawning habitat is located in the upper reach of the river [between study section 33 (river mile 63) and study section 49 (river mile 92)]. The least amount of potential spawning habitat was located in the lower reach of the river [below section 19 (river mile 30)].

These data indicate the maximum potential spawning habitat at conditions of depth and velocity considered optimum for salmonid spawning. Potentially available spawning substrate is not the limiting factor for successful spawning on mainstem Russian River. Good quality substrate was generally available, although concentrations of sand and fine sediment varied considerably. The controlling factors in determining what fraction of this sediment was usable (at transects) were depth and velocity variables incorporated into the analysis from transect cross-section data.

Figure V-9 indicates that the upper reach contains a relatively consistent distribution of potential spawning habitat, which extends downstream to approximately section 37. Between section 37 and 31, the mainstem is characterized by a relatively steep river gradient, high water velocities, and a general reduction in the availability of spawning substrate. The average potential spawning habitat per transect in the upper reach was estimated to be 30 linear feet.

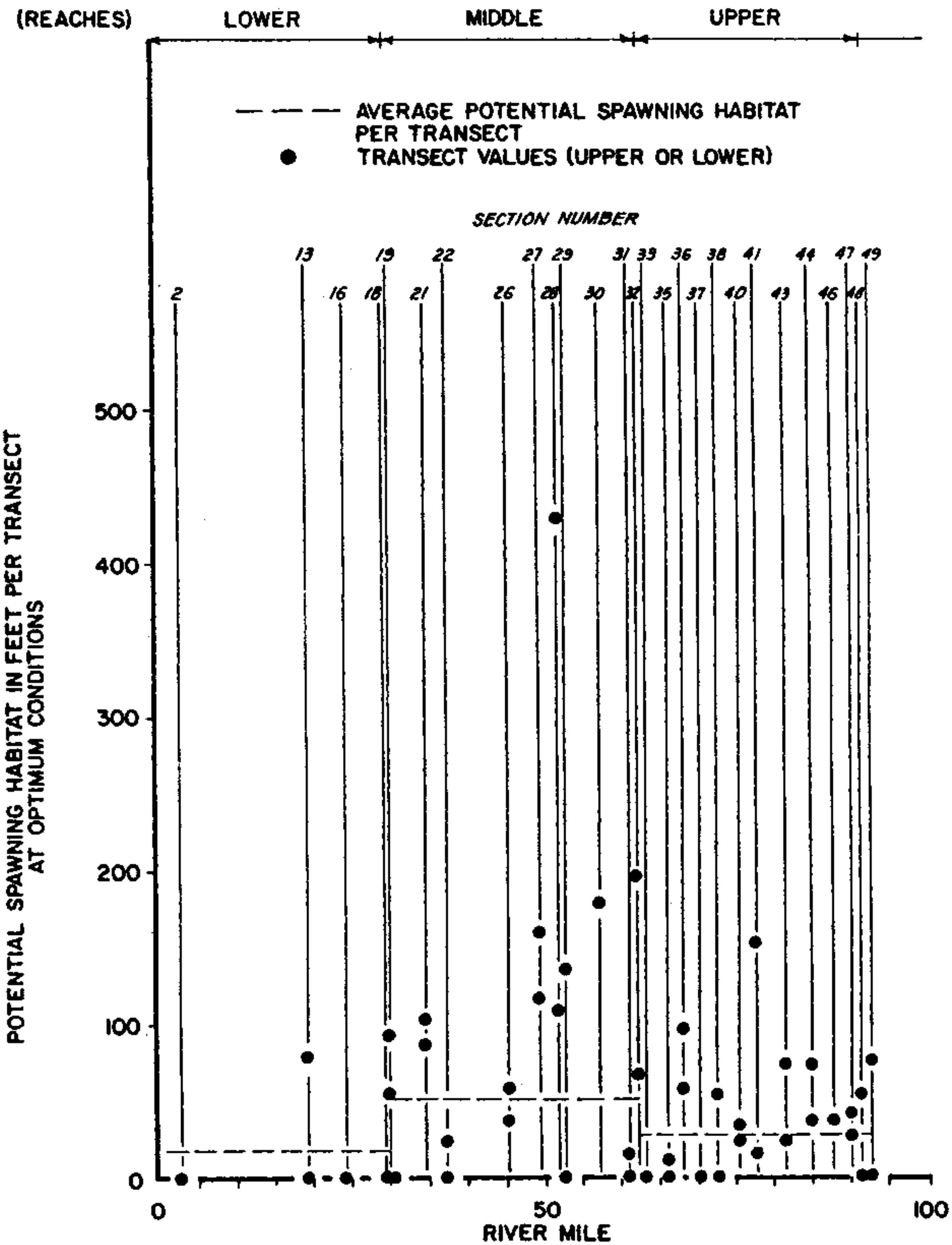


Figure V-9
MAXIMUM POTENTIAL SPAWNING HABITAT PER TRANSECT
vs RIVERMILE
MAINSTEM

The middle reach averaged approximately 55 feet *of* potential spawning habitat per transect. This increase in availability is, in part, attributable to a general abundance of spawning-size substrate, a reduction in the average river gradient, and a relatively wide river channel. These characteristics enable more potential spawning habitat to meet optimum depth and velocity criteria.

The lower reach averaged approximately 20 feet of potential spawning habitat per transect. In general, suitable size class substrate was less available in this river reach than in the middle and upper reaches, particularly toward the mouth. River section data are more available for this reach than are transect values of potential spawning habitat. These section data confirm the downstream reduction in substrate availability and quality, especially below section 11. Among the variables that affect spawning habitat in this reach of the mainstem are increasing depth, expansive channel width, marine influences, and a general decrease in the availability and quality of spawning substrate.

D. Nursery Habitat Evaluation

Field data regarding Dry Creek and Russian River mainstem nursery habitat evaluations are presented in Appendix C. Observations were made during the period of July 6 through July 20, 1978. The following evaluation of observed nursery habitat conditions involves a discussion of those parameters considered important with respect to evaluating nursery habitat quantity and quality. The evaluation considers such variables as instream canopy and cover, predatory fish and birds, substrate size, food abundance, pool: riffle ratio and water temperature, depth and velocity.

1. Dry Creek

Average streamflow conditions in CFS in Dry Creek are indicated below. Conditions represent a 4-year average (1972-1976) for the U.S. Geological Survey gage station located at Dry Creek mile 10.

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
18	134	250	914	1182	779	183	46	13	4	.5	.4

Streamflow diminishes steadily once winter precipitation and runoff cease for the year, and frequently becomes sub-surface at various locations during the summer. These conditions decrease nursery habitat for juvenile salmonids that remain in Dry Creek through the summer.

Because of fluctuating summer streamflow, water depths and velocities constantly change. Nursery habitat was considered sub-optimal with respect to depth and velocity during the summer field survey when average water year conditions prevailed.

Dry Creek summer velocities were generally low. Reasonable surface agitation and substrate cleansing were only evident in the swiftest river sections. Depths were generally shallow because of the lack of water and the relatively wide river channel that permits a "spreading out" of the flow. Deep pool habitat was scarce in Dry Creek during the July field survey.

Young-of-the-year steelhead, silver salmon, and yearling fish were not observed in Dry Creek during July.

Coarse instream substrate was common in Dry Creek and provided good habitat and protection from predatory species of fish and birds.

One to 3 inch squawfish (_Pytchocheilus_ _grandis_) were very abundant and several larger individuals were observed in some of the deeper pools. Juvenile smallmouth bass (Micropterus _dolomieui_) up to 8 inches in length, were also observed. These species are considered predatory and rely on small forage fish as an integral part of their diet. Green heron (Butorides virescens), great blue heron (_Ardea_ _herodias_), belted kingfisher (_Megaceryle_ _alcyon_), and Osprey (_Pardion_ _haliaetus_) were also observed on Dry Creek. Green heron were particularly numerous.

In addition, coarse substrate is utilized, particularly in riffles, by invertebrates that provide a source of food for maturing fish. An average of 52 benthic invertebrates was collected per square foot sample in Dry Creek; caddisfly larvae (Trichoptera) were predominant. Based on the literature, this average represents "good" fish food conditions. Areas containing boulder and bedrock were uncommon in the Dry Creek study area. These bottom materials provide protection and cover for juvenile salmonids.

Dry season water temperature in Dry Creek was considered the limiting factor affecting the quality and quantity of nursery habitat. A several degree diurnal temperature fluctuation occurred. No zonation in temperature was observed between transects in the upper reaches of the study area; however, lower Dry Creek exhibited a general warming progression downstream. Mid-day temperatures were potentially lethal in the lower 2 miles of Dry Creek. Because of the critical influence of temperature upon nursery habitat, a more detailed discussion of this subject is presented in Section V.E.

Canopy and cover were available primarily in the form of riparian vegetation along the high water mark of the channel. In general, protection and shade were available where water flowed along a bank. Even then, protection was not continuous, for gaps in riparian vegetation were common. Rarely did the flow fill the channel, with the result that only one edge of the water was shaded at one time. A general lack of shading was evident in the majority of Dry Creek within the study area.

Another index of habitat quality is the pool: riffle ratio. A value of 1:1 is deemed by some authorities to provide optimum resting and residence space as well as food production and feeding station space. Pool: riffle ratios averaged 2.1:1 for the Dry Creek study area (Figure V-10). No evident relationship between pool:riffle ratios and river

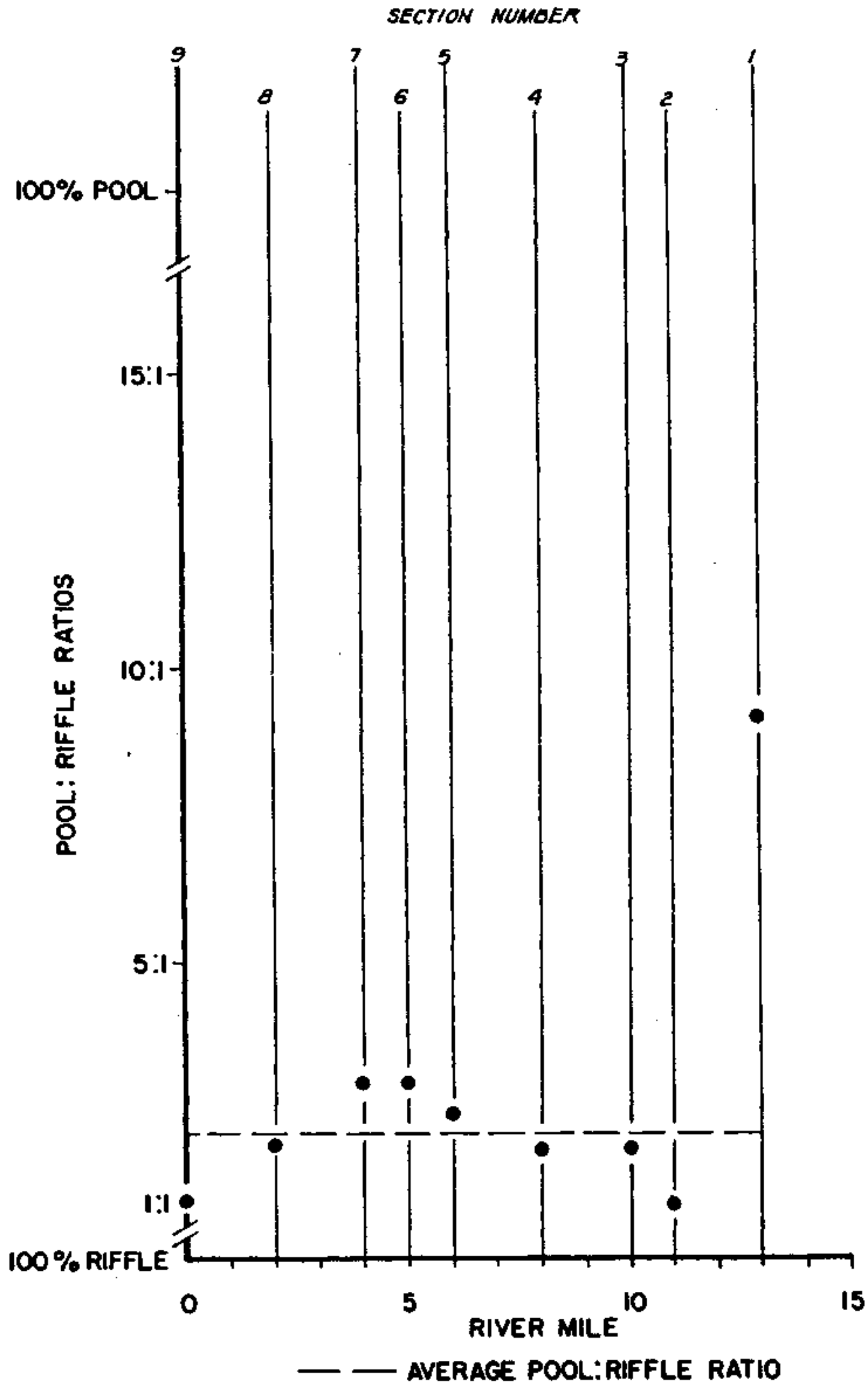


Figure V-10
RIFFLE RATIOS BY SECTION
vs RIVERMILE
DRY CREEK

mile was observed for Dry Creek. Figure V-11 shows the availability of potential resting nursery habitat by transect for Dry Creek, defined by mean velocities of 0.7 fps or less.

2. Russian River Mainstem

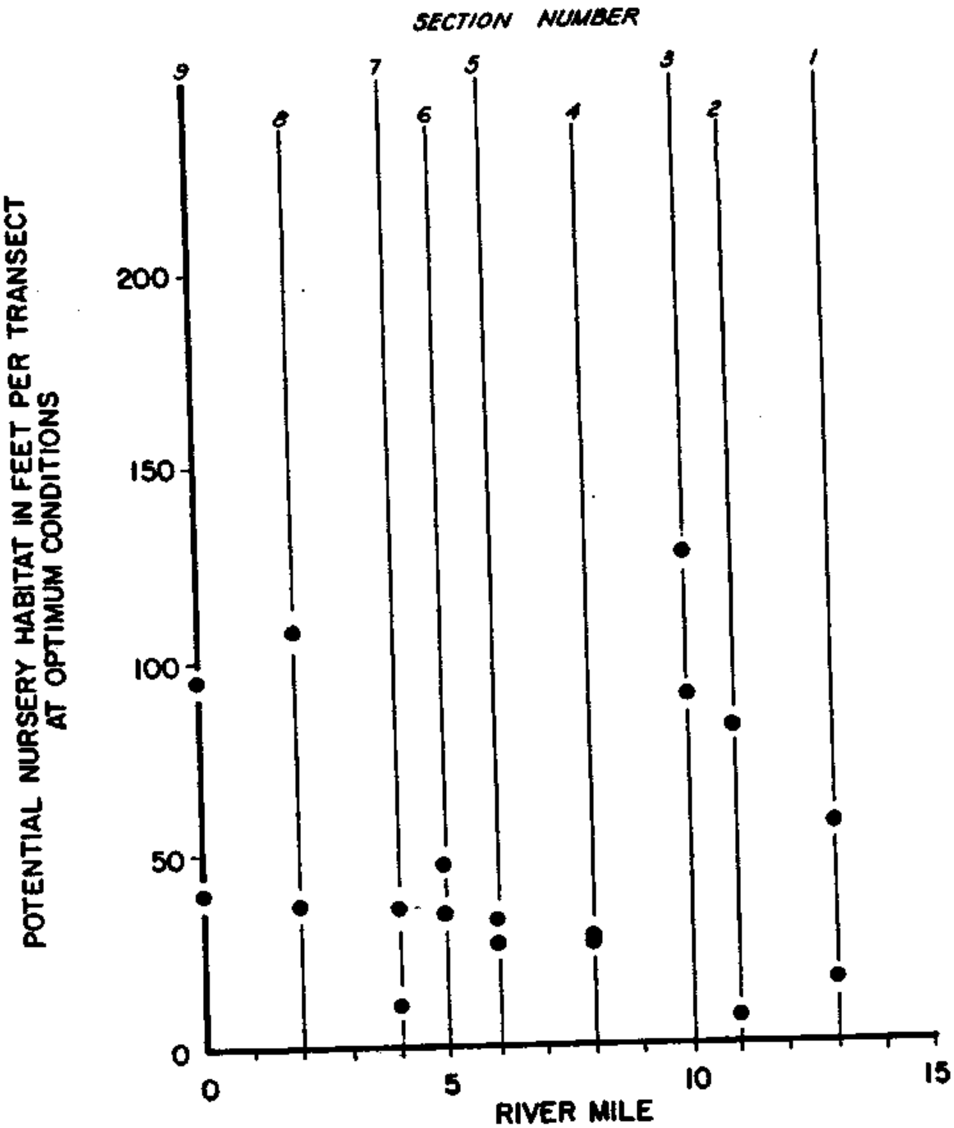
Average mean discharge for water years 1972 through 1976 was indicated for several Russian River mainstem gage stations in Table V-1. Streamflow generally diminishes in April and by June reaches a fairly uniform volume, which is maintained throughout the summer by releases from Coyote Dam. Streamflow conditions remain generally constant throughout the mainstem once temporary and semi-permanent instream structures are installed in late May. The closure of the river mouth at Jenner creates an extensive pool that remains intact until headwater becomes great enough to open the mouth.

Because of the relatively constant streamflow, river depth and velocity do not greatly fluctuate unless release patterns at Coyote Dam are altered or unless precipitation increases streamflow. A wide range of depths and velocities was available on the mainstem for summer nursery habitat at the observed conditions.

Juvenile steelhead (fingerlings and yearlings) were collected in the upper reach of the mainstem in July. All successful collecting occurred upstream from river mile 88. Attempts to collect salmonids elsewhere in the mainstem were not successful despite the fact that collecting techniques remained constant.

Russian River in-channel sediment composition did not greatly change with respect to river mile. Size classes up to 6 inches were represented in all segments of mainstem, but substrate larger than this was considered scarce. As indicated in the discussion of Dry Creek, coarse substrate can provide a significant amount of habitat and protection for juvenile salmonids. For example, such instream cover can reduce mortality from predation by piscivorous rough fish, which were observed as frequently in Russian River as in Dry Creek.

In general, the larger the substrate the larger the fish seeking refuge. Yearling salmonids that remain in various reaches of a particular tributary or river can simply outgrow the available protective habitat unless larger substrate is available. Only isolated areas of the mainstem (e.g. Squaw Rock, river mile 66) contain large substrate and bedrock.



● Transect values (upper or lower)

Figure V-11
MAXIMUM POTENTIAL NURSERY HABITAT PER TRANSECT
vs RIVERMILE
DRY CREEK

In addition to providing protective refuge and living space, instream substrate enables aquatic invertebrates to establish themselves during particular stages of their life cycles. Caddisfly larvae (Trichoptera) and mayfly nymphs (Ephemeroptera) were the two most dominant aquatic insects discovered in square foot benthic samples taken in July. Occasionally, midge larvae (Dyptera) were discovered in great numbers. The availability of these invertebrates varied, yet was considered to be good in certain areas of the mainstem. For example, the upper reach (sections 33 through 49) averaged approximately 94 organisms per square foot of riffle bottom, while the middle (sections 19 through 32) and lower (sections 2 through 18) reaches averaged only 26 organisms per square foot.

Predatory bird species were noted on the mainstem as well as on Dry Creek. Fewer green heron were observed on mainstem, but more osprey were noticed.

Water temperature in the mainstem was considered the limiting factor affecting salmonid nursery habitat quality. A zone of relatively cool water is located within the upper reach below Coyote Dam. The extent of this zone is largely controlled by ambient environmental conditions and streamflow and is difficult to define. During normal summer streamflow conditions, temperatures generally remain below 20°C downstream to the vicinity of Ukiah (River Mile 90). Below this zone, temperatures generally increase as is indicated in Table VI-1 for U.S.G.S. mainstem gage stations. The 1972 through 1976 average maximum July temperatures for U.S.G.S. mainstem gage stations were as follows:

Ukiah - 14.9°C
Hopland - 20.2°C
Healdsburg - 26.8°C
Guerneville - 28.3°C

Below river mile 10, coastal fog and other marine influences have a minor cooling effect on surface water temperature. In addition to these influences, the sand bar closure at the river mouth provides areas of cool, deep water. Bottom temperatures were up to 5°C lower than surface values in this stretch. This coastal river zone probably provides generally suitable summer temperature and other conditions for salmonids.

Most of the mainstem was considered sub-optimal salmonid nursery habitat primarily from a temperature standpoint. The majority of the channel between the upper (Coyote

Dam controlled) zone and the lower (fog belt) zone of suitable temperature is relatively wide and the proportion of the river channel unshaded by riparian canopy is high. Isolated pools with good instream cover and canopy as well as relatively deep willow-lined runs were available, yet water temperatures remained restrictive (see Section V.E. for a more detailed discussion of Russian River nursery habitat suitability from a temperature standpoint).

Pool riffle ratios for the mainstem Russian River are indicated in Figure V-12. The average value, represented by the broken line on the figure, was calculated to be 4.8:1. This value is considerably greater than the value of 1:1 sometimes cited in the literature as optimum for salmonid nursery habitat. No evident correlation between pool:riffle ratios and river mile was observed for mainstem Russian River. Figure V-13 shows the availability of potential resting nursery habitat by transect for mainstem, limited to mean velocities of 0.7 fps or less.

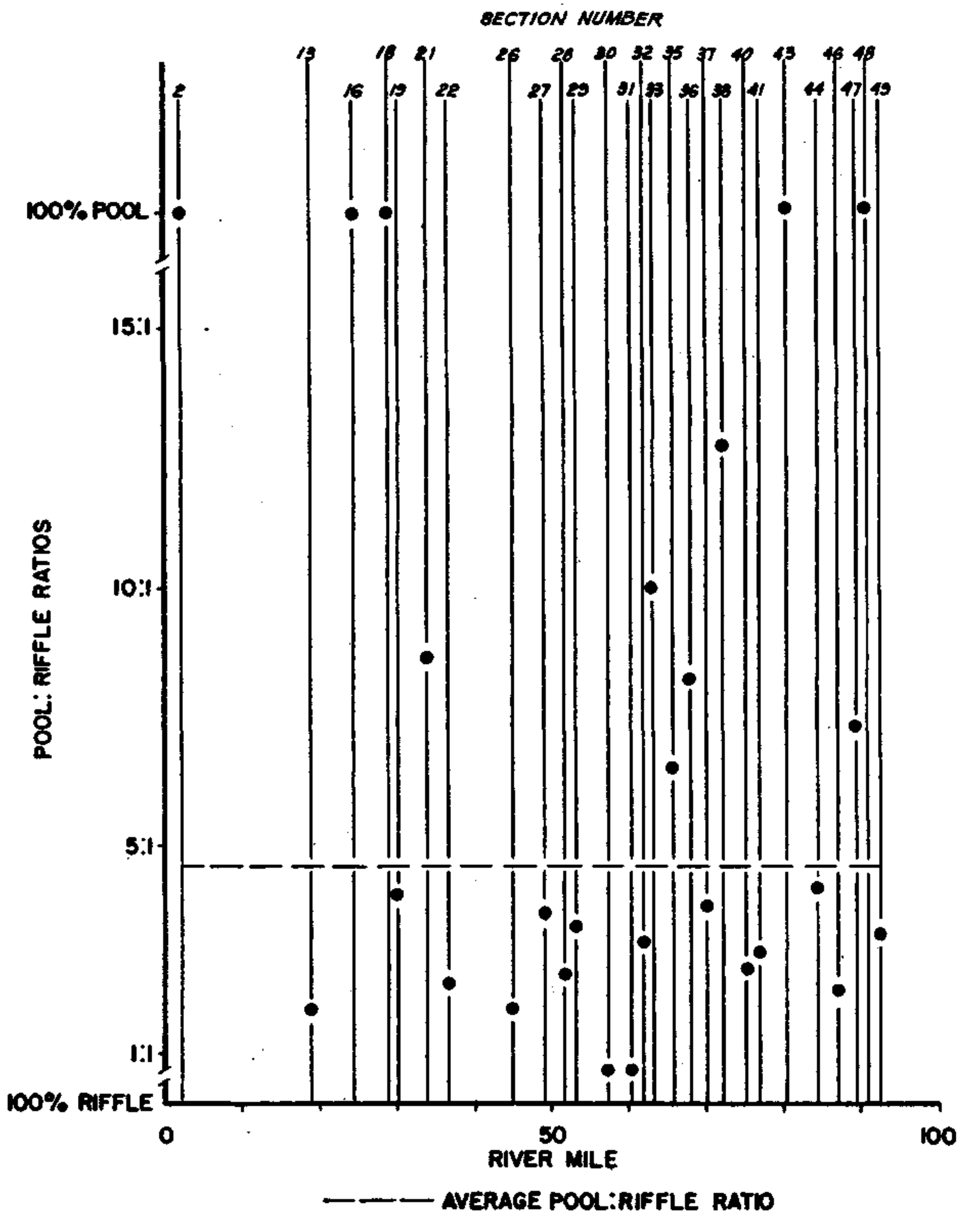


Figure V-12
POOL: RIFFLE RATIOS PER SECTION
vs RIVER MILE
MAINSTEM

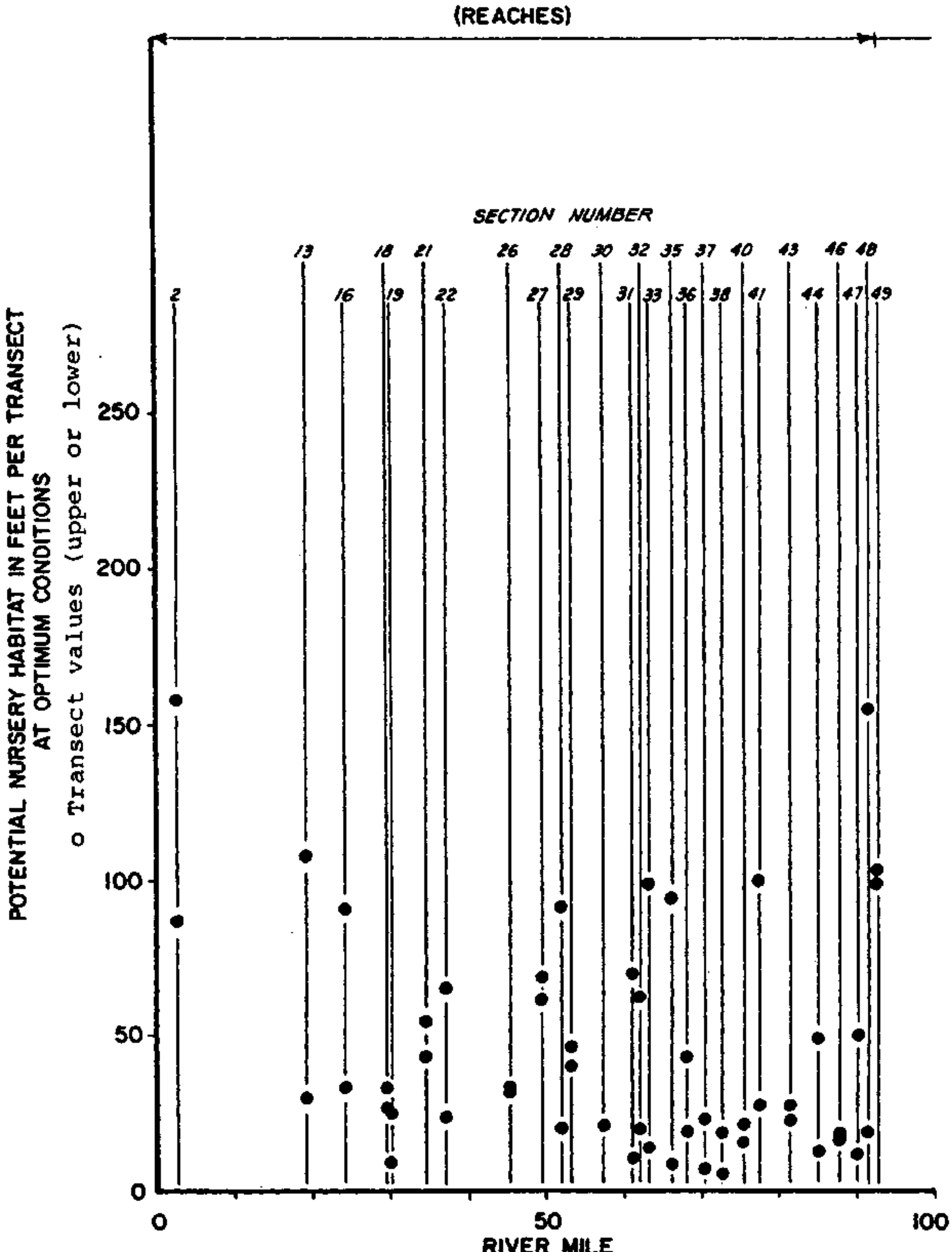


Figure V-13
MAXIMUM POTENTIAL NURSERY HABITAT PER TRANSECT
vs RIVERMILE
MAINSTEM

E. Water Temperature and Nursery Habitat

The classification of a natural stream as to habitat quality requires data on the temperature and duration of exposure for localized rearing areas. Water temperatures can vary considerably from point to point depending upon water depth, canopy, instream cover, etc. in a short section of stream. Thus, the general temperature level may not be the same as the temperature to which the fish are exposed since fish tend to seek out the most favorable areas. On the other hand, relatively brief exposures to lethal temperatures would be significant, even though the average temperatures were satisfactory. Sufficiently detailed temperature data were not available to attempt an accurate classification of steelhead and silver salmon nursery habitat based on water temperature, so the following system, which defines the range of habitat quality, was developed:

Nursery Quality		Temperature Range °C
Excellent	(E)	15.0
Good	(G)	15.1 - 19.7
Satisfactory	(S)	19.8 - 22.5
Marginal	(M)	22.6 - 24.7
Unsuitable	(U)	24.8

Table V-2 presents the classification for the critical summer months based on the maximum monthly water temperature as determined at U.S. Geological Survey gaging stations. Table V-3 presents the classification for the critical summer months based on an estimate of the average monthly water temperature at the same stations. The average temperature was estimated by taking the mean of the maximum and minimum monthly values, since the data from which to compute the true average were not available.

The classifications presented on Tables V-2 and V-3 indicate that much of the mainstem, particularly below Cloverdale, is either marginal or unsuitable for juvenile salmonids due to elevated wafer temperatures during the summer months. Dry Creek is classified as satisfactory or marginal by the same criteria.

In order to better describe the water temperature conditions for the period of observation, the field data for the winter and summer survey are presented in Figure V-14 for Dry Creek and Figure V-15 for the mainstem. The winter data indicate a nearly uniform warming trend with downstream distance on both Dry Creek and the upper and middle reaches of mainstem. The quality of the nursery habitat in terms of winter water temperature, however, may

TABLE V-2
QUALITATIVE CLASSIFICATION OF NURSERY
HABITAT SUITABILITY BASED UPON
SUMMER MONTH MAXIMUM WATER TEMPERATURES

GAGING STATION LOCATION	MONTH APR	MAY	JUN	JULY	AUG	SEP	OCT
Mainstem							
Ukiah	E	E	E	E	S	S	S
Hopland	G	S	G	S	S	S	S
Healdsburg	S	U	U	U	U	M	S
Guerneville	S	U	U	U	U	U	S
Dry Creek							
Geyserville	S	M	M	M	M	-	S

TABLE V-3
QUALITATIVE CLASSIFICATION OF NURSERY
HABITAT SUITABILITY BASED UPON
SUMMER MONTH ESTIMATED AVERAGE WATER TEMPERATURES

GAGING STATION LOCATION	MONTH APR	MAY	JUN	JULY	AUG	SEP	OCT
Mainstem							
Ukiah	E	E	E	E	G	S	G
Hopland	E	G	G	G	G	G	G
Healdsburg	G	S	S	S	S	S	G
Guerneville	G	S	M	M	M	S	G
Dry Creek							
Geyserville	E	G	S	S	S	-	G

E-Excellent S-Satisfactory U-Unsuitable
G-Good M-Marginal

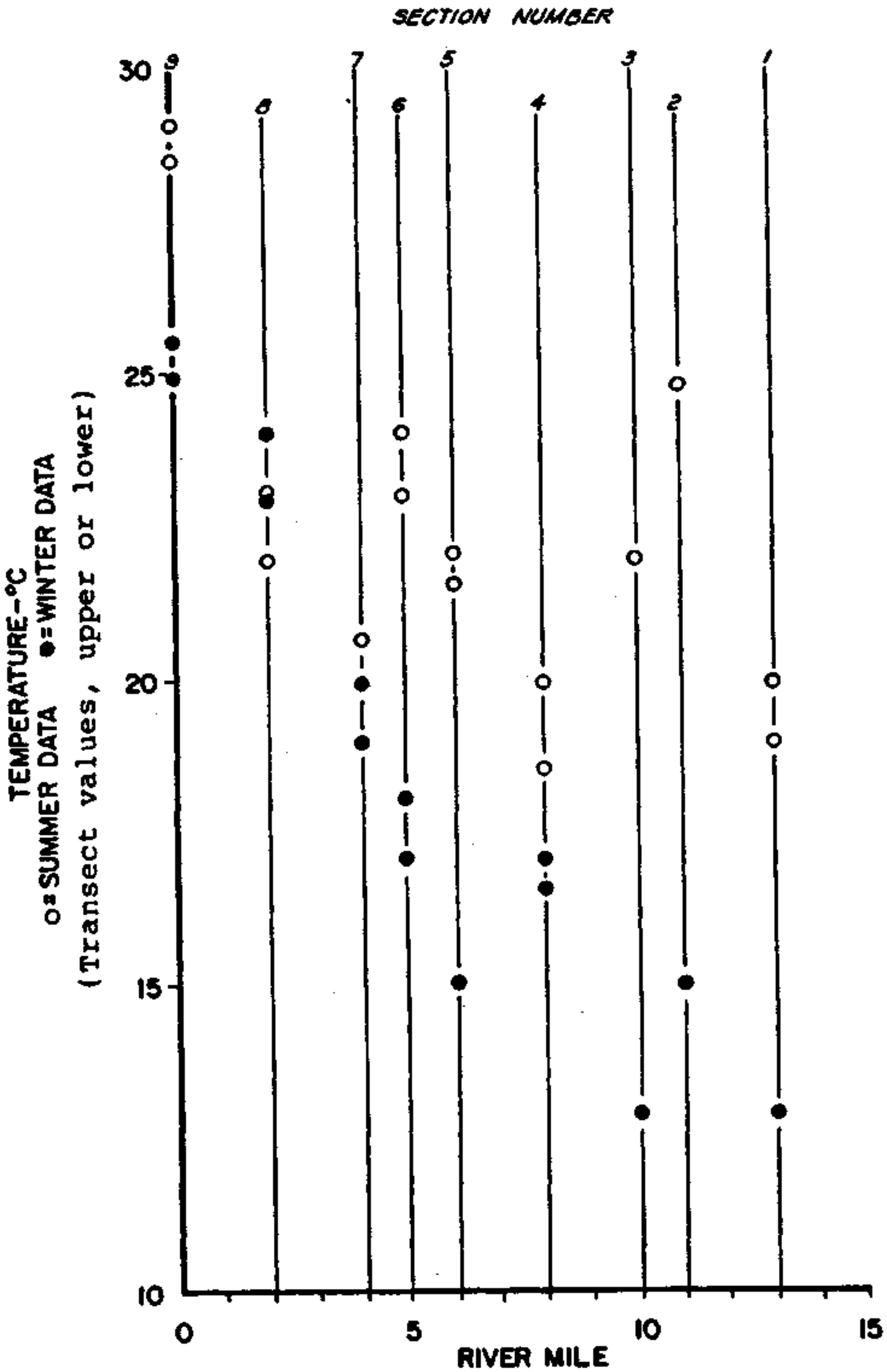


Figure V-14
WATER TEMPERATURE vs RIVERMILE
DRY CREEK

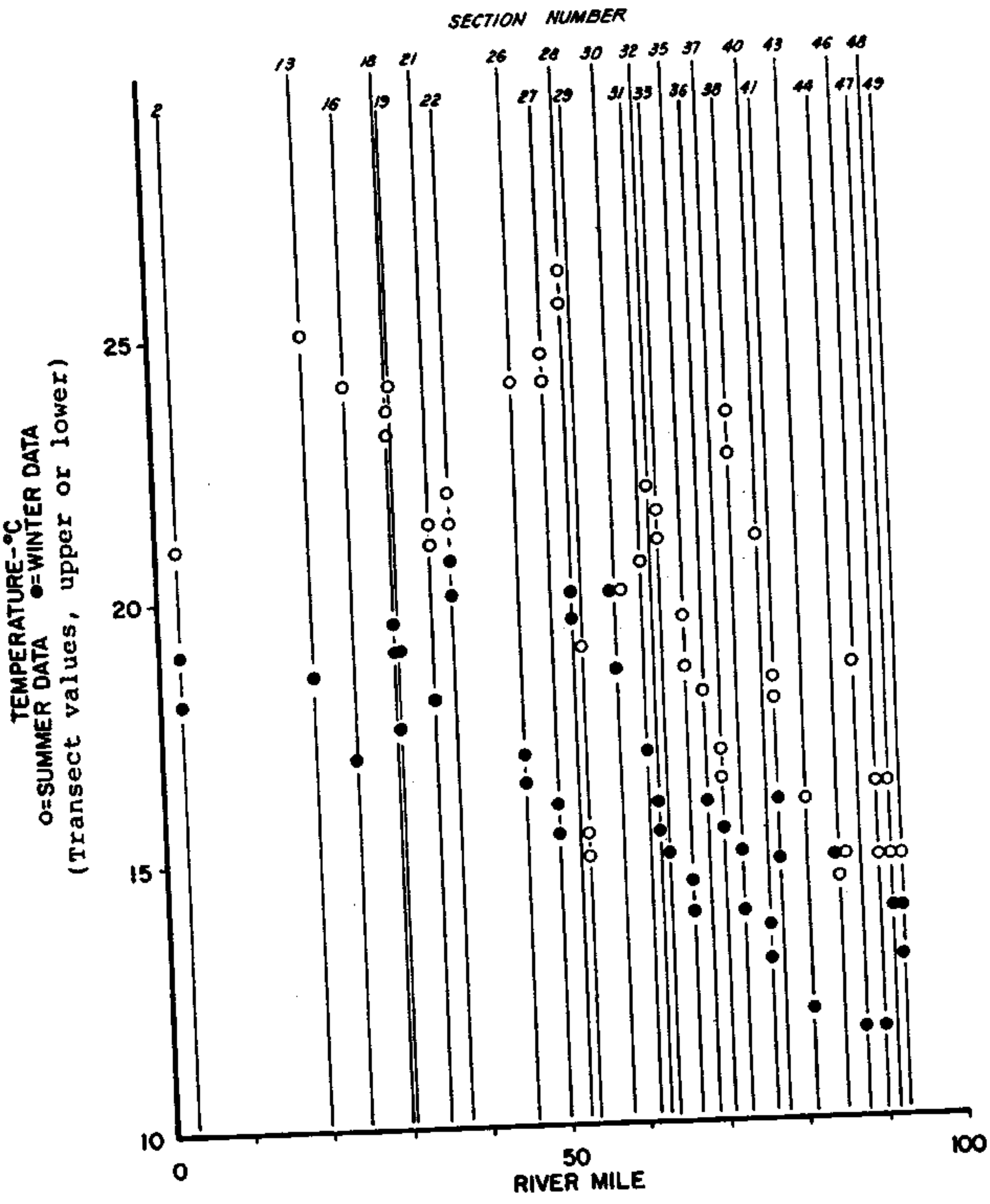


Figure V-15
WATER TEMPERATURE vs RIVERMILE
MAINSTEM

generally be described as good to excellent. The summer data on Dry Creek do not indicate a trend with distance downstream; however, a clear warming trend from morning to afternoon is apparent (cross-reference times of temperature measurements at the various transects) and is responsible for the large spread in the data. The habitat quality may be generally described as good during the morning hours and marginal during the afternoon. The summer data on the mainstem clearly indicate a warming trend in the upper reach, a nearly uniform temperature zone in the middle and lower reaches, and possibly a cooling trend near the mouth of the river within the influence of the coastal fog belt. Diurnal warming is also evident in one mainstem. The habitat quality may be generally described as good entering the upper reach, satisfactory to marginal leaving the upper reach and in the middle reach, and marginal to unsuitable in the lower reach, with the exception of the portion influenced by coastal fog, where satisfactory quality exists.

VI. Optimum Flow Considerations for Fish Habitat

A. Fish Passage

1. General

The following fish passage recommendations for critical riffle sites and instream temporary and semipermanent water impoundment dams and road crossings deal primarily with streamflow conditions observed during winter and summer field surveys in 1978. The discussions of optimum spawning and nursery habitat present recommended streamflow values required to provide optimum abundance of spawning and nursery habitat in lower Dry Creek and mainstem Russian River.

The optimum streamflow values are generally higher than present average streamflow values occurring over the period of service of instream structures. Existing instream temporary and semi-permanent water impoundment dams and summer road crossings will need to be evaluated with respect to their structural capacity to accommodate increases in streamflow. In addition, fish passage requirements will need to be examined at each instream structure to determine what impact an increase in streamflow could have on fish passage at the existing instream structures. Various structural modifications might be required to provide acceptable velocity and depth values at instream structures, especially for recommended nursery habitat flows.

2. Instream Structures

Instream temporary and semi-permanent water impoundment dams and summer road crossings were evaluated so that recommendations could be made regarding optimum fish passage flows at the various structures. Primary consideration was given to water impoundment facilities and recommendations are provided for each facility. Because fish passage is not a significant problem at summer road crossings, the discussion of passage flow recommendations deals with these structures collectively, except for Basalt summer road crossing.

a. Basalt Summer Road Crossing (Dry Creek)

Basalt summer road crossing, located in mile 0 of Dry Creek, is constructed annually to provide access for gravel extraction. Six culverts and road fill make up the entire structure. Summer flow conditions at this facility are variable and fish passage is restricted when streamflow is relatively high at the beginning of the summer. In addition to high flow and particularly high velocity, a jumping distance of 2.5 feet separated the culvert openings from the water surface at the observed flows. Access would be improved if the culverts were positioned closer to the streambed to reduce or eliminate the jumping distance required to enter the culverts.

The issue of access to the Dry Creek drainage during present summer habitat conditions is perhaps academic. Low streamflow and high water temperature likely do not provide acceptable nursery habitat for anadromous species, particularly shad.

b. Summer Road Crossings (Russian River)

The remaining summer road crossings, with the exception of the Basalt summer crossing on mainstem Russian River, are installed and maintained by the Sonoma County Department of Public Works. Each facility incorporates similar structural design; impacts on streamflow and fish passage do not vary significantly from one structure to the next.

At the observed streamflow, fish bypass is not restricted at summer road crossings (including Basalt summer crossing). Their structural design accommodates normal summer streamflow, maintaining velocity and depth values well within acceptable limits for passage.

c. Water Impoundment Dams

1) Willow County Water Diversion Dam

Depending on streamflow, fish passage could be partially restricted at this structure. It is recommended that enough water be released from Coyote Dam to provide adequate spillway depth for fish passage during spawning migrations. Releases at least in excess of the observed summer streamflow (227 cfs) should provide suitable spillway water depth at this facility. High streamflow could, however, create a velocity barrier. Additional information regarding winter velocities and success of fish passage is necessary to evaluate these conditions and recommend passage flows.

2) Del Rio Woods Dam

Water depth over portions of the spillway averaged 0.5 feet at the observed summer streamflow.

Because of the relatively long spillway (38 feet), it would be desirable to provide enough water to increase spillway depths. Spillway velocity at the observed flow was estimated to be near acceptable upper limits for salmonid passage. An increase in streamflow to increase spillway water depth could create a velocity barrier.

3) Healdsburg Dam

Winter conditions are possibly restrictive to upstream fish migration at certain high or low flow conditions. In general, winter conditions are acceptable for salmonid passage. In the event that attempts are successful to establish a future run of Russian River king salmon, and for the benefit of those early running king salmon presently returning to the river in August, a fishway would be a valuable asset at Healdsburg dam. American shad would also benefit from such an addition if their passage requirements are incorporated into the fishway design. The addition of such a structure would greatly increase the amount of habitat available to spawning shad and allow early-running king salmon to reach relatively cool water in the upper Russian River, possibly resulting in significantly higher instream egg development and hatching success. An integral part of this access plan is the installation of a fishway at Del Rio Woods Dam, located approximately 2 miles upstream from Healdsburg Dam.

4) Wohler Dam

Existing facilities pose little or no threat to salmonid migration in the event that early runs of king salmon encounter this structure. The debris that accumulates behind the floating line should be periodically cleared.

5) Johnson's Beach Dam

If late summer and early fall king salmon eventually encounter the Johnson's Beach denil fishway, successful bypass should not be problem. American shad passage is more uncertain. The upper end of the fishway should be periodically checked and cleared of debris.

6) Vacation Beach Summer Dam

Fish passage conditions at Vacation Beach summer dam are similar to conditions encountered at Johnson's Beach summer dam. Denil fishways are incorporated at each facility and average slopes and fishway lengths are similar. Efforts should be made to keep the fishway clear of debris.

3. Non-Structural Barriers

Various natural conditions, including debris or log jams and critical riffles, may also restrict upstream fish migration.

During the upstream migration of spawning salmonids, mean streamflow in Dry Creek is sufficient to provide adequate fish passage. As flow decreases, certain locations (primarily where a channel is lacking and streamflow is evenly distributed) become unpassable, primarily due to insufficient depth. Baracco (1977) has indicated the location of five critical passage sites in Lower Dry Creek and recommends minimum streamflows required to allow fish migration over them. Several of Baracco's sites were re-visited at observed streamflows of approximately 40 to 50 cfs. At these streamflows, upstream migration would definitely be restricted by shallow depth. Although low flow conditions similar to those observed in the field are not likely to be encountered during salmonid spawning migrations, it is necessary to keep streamflow above Baracco's recommended average value of 100 cfs to insure successful fish passage at these critical sites.

No critical passage sites (from a depth standpoint) were discovered on the mainstem Russian River during the summer (low flow) field survey. Log and debris jams are not a particular problem in the study area.

B. Spawning Habitat

Streamflows for the production of optimum spawning habitat are based on the governing ecological requirements for spawning during the months of salmonid reproduction in the river. The potential spawning habitat is defined for optimum spawning conditions for channel substrate and water depth and velocity over the substrate. It is expressed in linear feet totaled from the transect data, and may be determined for individual transects, or for an entire reach by summing the results for the transects within that reach. Although different transects require different flows to produce maximum amounts of potential spawning habitat, totaling the lengths of potential spawning habitat for all transects at corresponding flows reveals the optimum flow for the river reach under consideration. This analysis assumes, as we believe is the case, that regulation of streamflow to produce optimum conditions of water depth and velocity over the maximum amount of suitable spawning substrate observed in the field will result in 1) adequate depths and suitable velocities for passage, particularly over critical riffles and barriers (see Section VI.A), and 2) maintenance of water temperatures below about 14.9°C during the entire salmonid reproduction period, including adult migration, spawning, egg incubation, and yolk sac fry (alevin) development months. For steelhead and silver salmon at least, the temperature assumption appears valid based on the mean monthly water temperatures as recorded at the various U.S. Geological Survey gaging stations for the months from December through April, corresponding to the period of peak steelhead and silver salmon reproduction (see Table VI-1).

The variation in potential spawning habitat with flow for Dry Creek is shown on Figure VI-1, and for the reaches of mainstem on Figure VI-2. The calculations were performed for three cases to investigate the sensitivity of the analysis to the definition of the range of optimum spawning conditions as follows:

	Units	Case A	Case B	Case C
Substrate size	in.	0.5-6	0.5-6	0.5-6
Mean velocity	fps	0.7-2	1-3	0.7-2
Water depth	ft.	1-3	1-3	0.5-3

The base case for the study is considered to be Case A, which best represents the range of optimum conditions as determined from the literature. The selection of the alternative mean velocity ranges is due to variability in the relationship between the velocity at 0.5 feet from the

Table VI-1
AVERAGE MAXIMUM AND MINIMUM TEMPERATURE (°C)
FOR WATER YEARS 1972 THROUGH 1976.

U.S.G.S. GAGE STATION 11462000-RUSSIAN RIVER (EAST FORK) NEAR UKIAH

OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
20.4	.	16.6	11.5	11.8	9.0	10.2	7.5	9.5	7.6	11.3	8.6
APRIL		**MAY**		**JUNE**		**JULY**		**AUGUST**		**SEPTEMBER**	
MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
11.6	9.0	11.3	9.5	12.3	10.7	14.9	11.6	19.8	15.0	21.5	18.9

U.S.G.S. GAGE STATION 11462500-RUSSIAN RIVER NEAR HOPLAND

OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
20.7	14.0	16.1	9.9	11.7	8.6	11.5	6.6	11.8	7.0	14.5	8.0
APRIL		**MAY**		**JUNE**		**JULY**		**AUGUST**		**SEPTEMBER**	
MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
17.1	10.4	20.7	11.4	18.7	12.6	20.2	13.6	21.9	15.4	22.2	16.9

U.S.G.S. GAGE STATION 11464000-RUSSIAN RIVER NEAR HEALDSBURG

OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
21.3	12.3	16.8	8.8	12.5	16.8	11.5	6.3	12.5	8.3	15.3	8.0
APRIL		**MAY**		**JUNE**		**JULY**		**AUGUST**		**SEPTEMBER**	
MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
20.7	10.3	26.0	14.4	25.8	17.4	26.8	17.0	25.3	19.1	24.1	16.8

U.S.G.S. GAGE STATION 1146700-RUSSIAN RIVER NEAR GUERNEVILLE

OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
21.2	13.3	15.5	9.8	12.7	8.3	12.0	6.2	13.3	8.0	14.4	9.2
APRIL		**MAY**		**JUNE**		**JULY**		**AUGUST**		**SEPTEMBER**	
MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
19.8	12.1	24.8	15.0	27.3	19.0	28.3	19.5	26.5	19.5	25.1	17.8

U.S.G.S. GAGE STATION 11465200-DRY CREEK NEAR GEYSERVILLE

OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH	
MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
20.0	13.3	16.8	8.9	13.3	6.8	12.5	5.5	13.3	9.0	16.2	8.0
APRIL		**MAY**		**JUNE**		**JULY**		**AUGUST**		**SEPTEMBER**	
MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
20.4	9.4	23.6	13.9	24.1	16.6	24.4	18.6	23.2	17.5	---	---

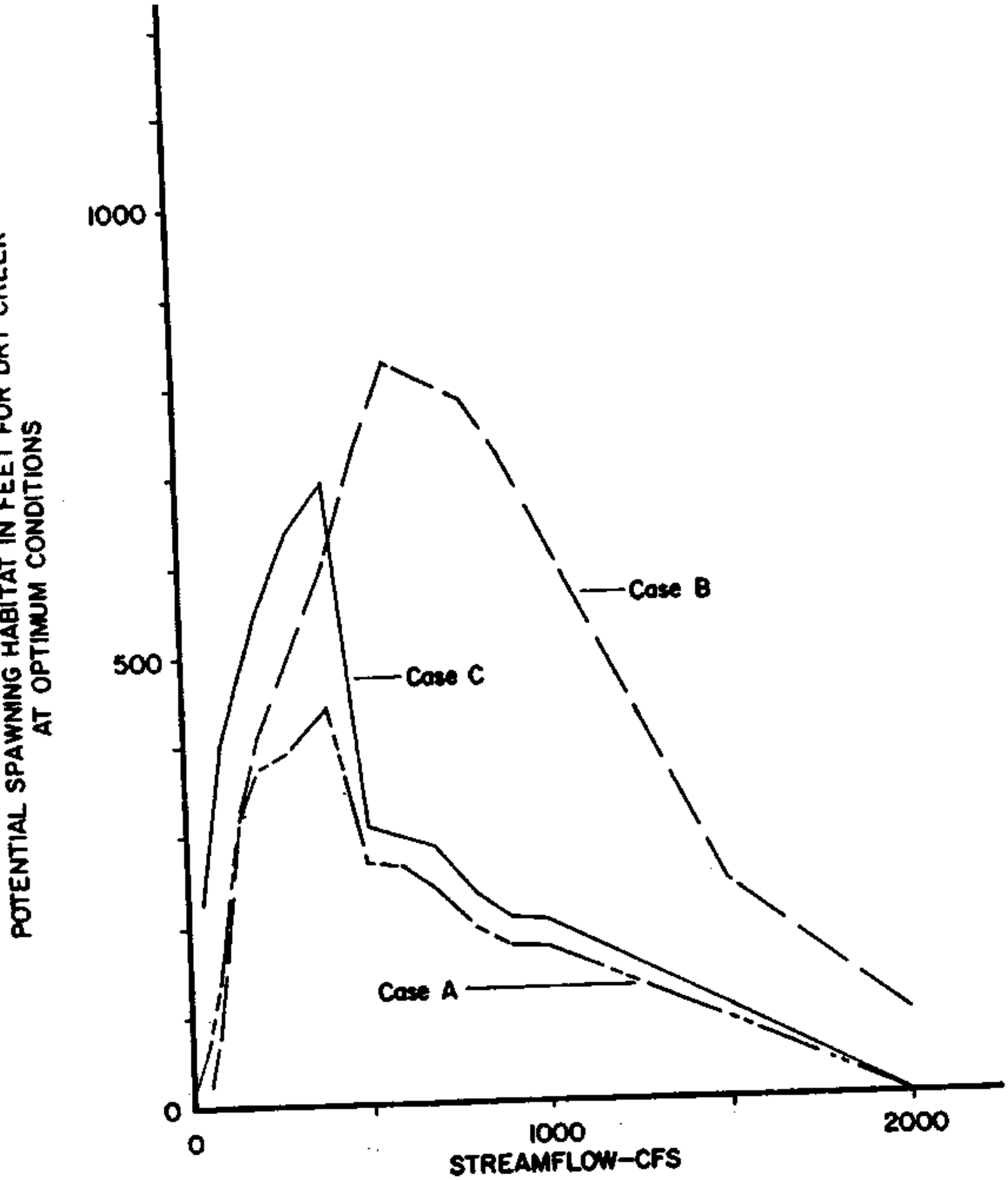


Figure VI-1
MAXIMUM POTENTIAL SPAWNING HABITAT IN DRY CREEK
vs STREAMFLOW

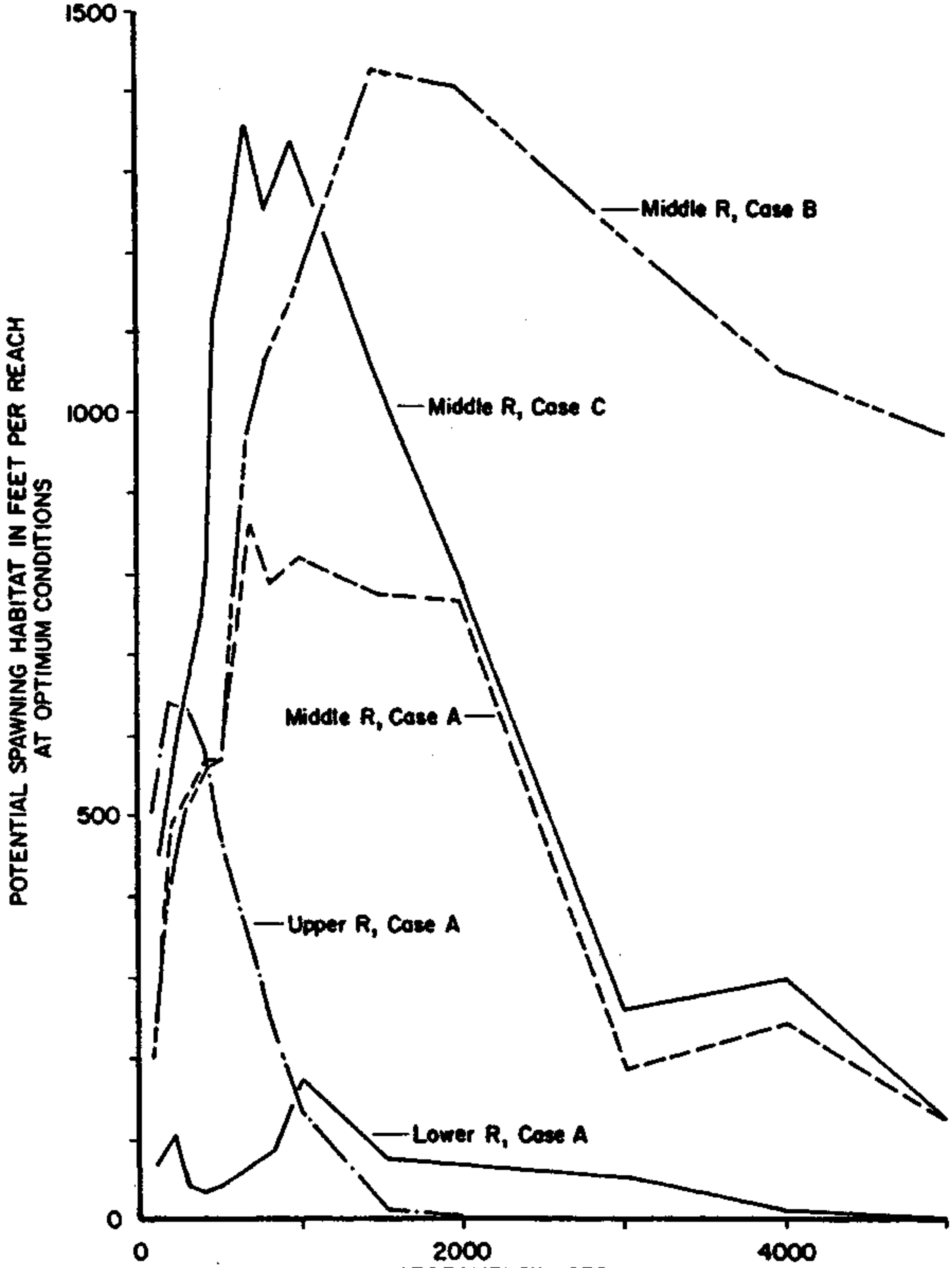


Figure VI-2
MAXIMUM POTENTIAL SPAWNING HABITAT ON MAINSTEM
vs STREAMFLOW

bottom, which is the factor analyzed in the literature, and the mean velocity. The range of optimum salmonid spawning velocities at 0.5 feet from the bottom is generally recognized to be from 1 to 3 fps. The alternative water depth ranges recognize the uncertainty in the literature over the lower limit of optimum depth, since depths as low as 0.5 feet have been reported as optimum. Variation in substrate size was not considered. Although the limits shown correspond to those reported as optimum for king salmon, consideration of a range from 0.5 to 4 inches that is applicable to steelhead and silver salmon would not significantly alter the outcome of the analyses. This is because the 0.5-to 4-inch range is nearly everywhere coincident with the 0.5-to 6-inch range. Therefore the analysis is valid for the steelhead and silver salmon, *as* well as for king salmon.

Inspection of the results indicates that the optimum flows within a reach are not particularly sensitive to variation in the definition of optimum spawning conditions (Cases A, B and C), and range from 400 to 600 cfs on Dry Creek, and from 700 to 1500 cfs on the middle reach of mainstem. However, the amount of potential spawning habitat appears to fall off more rapidly as flows increase beyond the optimum value for the lower range of mean velocity represented by Cases A and C. The increase in the amount of potential spawning habitat for the broadened velocity and depth ranges represented by Cases B and C respectively is not unexpected, and can be neglected, for the primary purpose of the analysis was to define the optimum flow, which remains essentially unchanged.

The optimum streamflow for spawning habitat, defined by the peak on the curve for Case A, is 400 cfs on Dry Creek, and 1000, 700 and 200 cfs for the lower, middle and upper reaches of mainstem, respectively. Since the curves exhibit fairly broad peaks, or could be modified slightly by alternative definitions of optimum spawning conditions, the streamflows given above could vary. To be conservative, the given streamflows can be said to represent the lower bound, below which the available potential spawning habitat decreases very rapidly from its peak value. For comparison, Table VI-2 (page 98) presents the average monthly discharge at mainstem and Dry Creek U.S.G.S. gage stations during the critical spawning months.

The variation in the optimum streamflow necessary to provide the maximum amount of potential spawning habitat for individual transects is shown on Figure VI-3 for Dry Creek and Figure VI-4 for the mainstem. The points representing

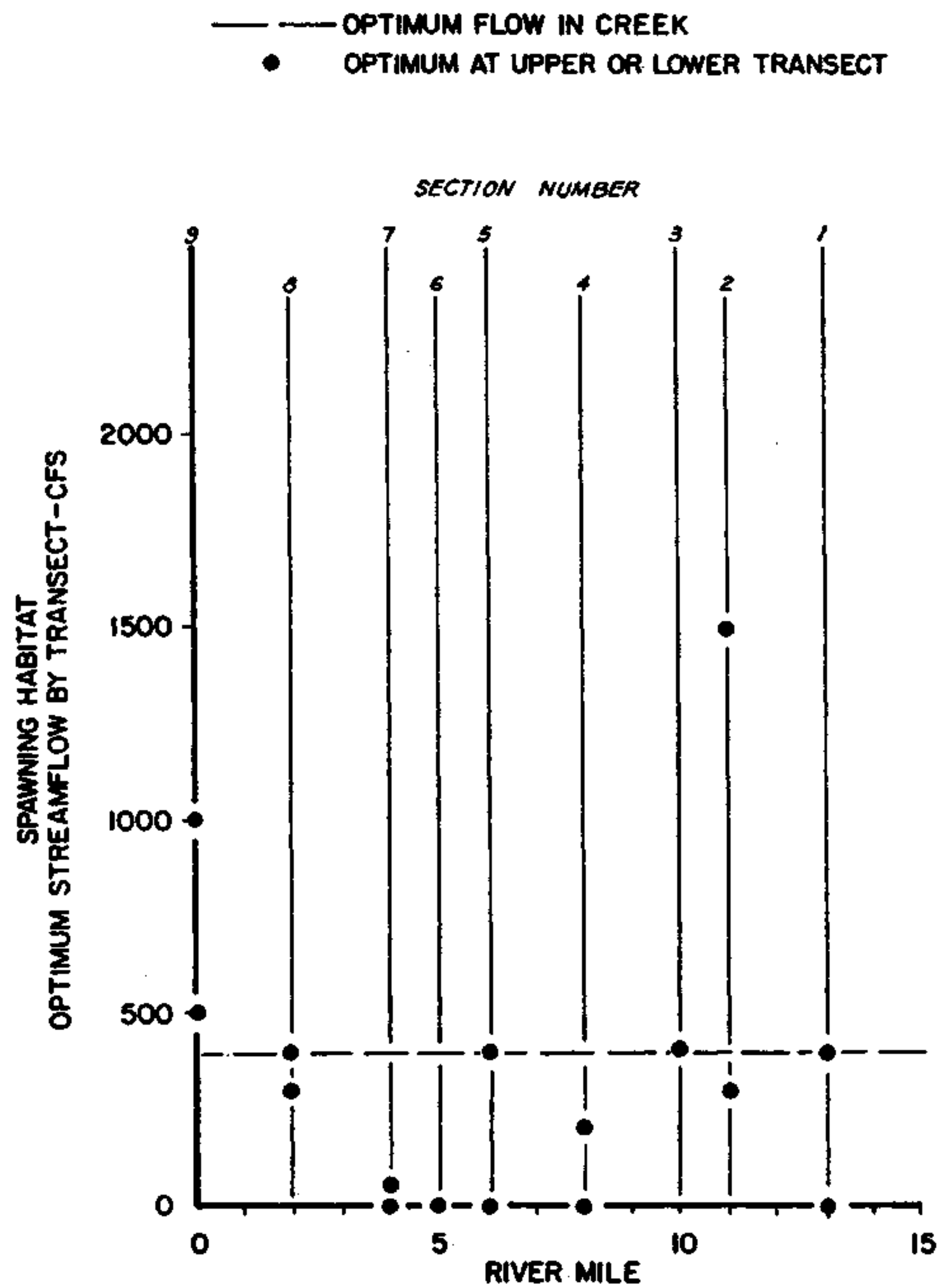


Figure VI-3
POTENTIAL SPAWNING HABITAT
OPTIMUM STREAMFLOW BY TRANSECT vs RIVERMILE
DRY CREEK-CASE A

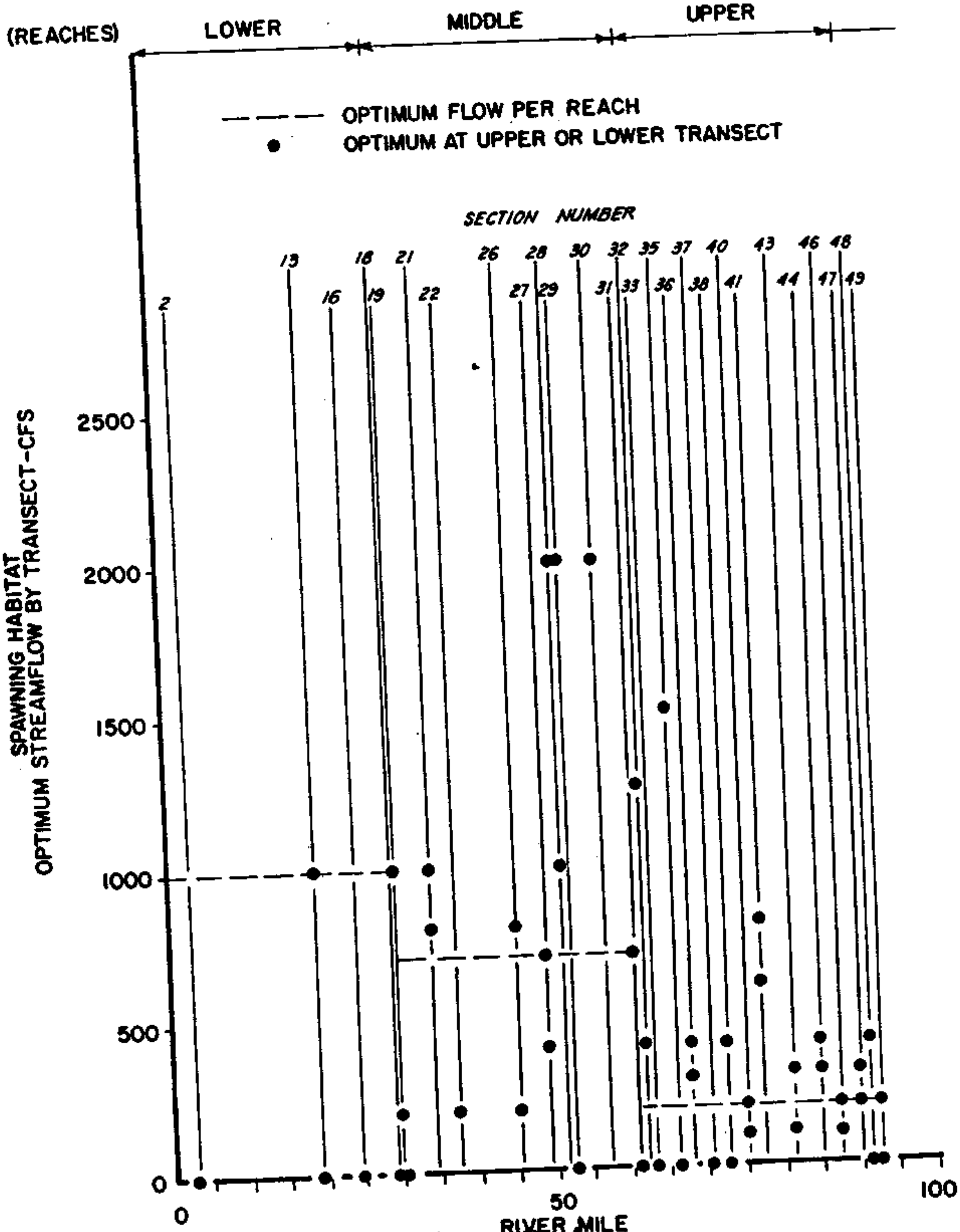


Figure VI-4
POTENTIAL SPAWNING HABITAT
OPTIMUM STREAMFLOW BY TRANSECT vs RIVERMILE
MAINSTEM-CASE A

zero flow indicate that no spawning habitat is available on that transect. The overall optimum flow for the various reaches is shown by the dotted line on the figures.

Dry Creek exhibits a nearly uniform distribution of optimum streamflow with rivermile, which is consistent with the field observations of nearly uniform hydraulic and ecologic characteristics. At the mouth of Dry Creek, however, where flattening of the channel gradient and widening of the streambed occur, there is a distinct increase in the optimum streamflow. The nearly uniform increase of optimum streamflow with distance downstream on the mainstem corresponds to a similar flattening of the channel gradient and widening of the streambed. This is also clearly reflected in the optimum streamflows for the reaches of the mainstem.

The preceding analysis is essentially based on the spawning requirements only. During the egg incubation period, it may be possible to decrease the optimum spawning flows by up to 1/3 as suggested by Thompson (1972), since it appears difficult to justify the high spawning streamflow necessary to maintain optimum water depths and velocities during this period. The maximum water temperature requirement, however, remains a critical factor, and must be considered in any decision to reduce the streamflows during incubation.

The optimum streamflow for shad spawning cannot be determined due to lack of sufficient data in the literature on optimum shad spawning requirements. Shad reproduction occurs during the period when the streamflows in the river would be governed by the requirements for salmonid rearing, but it is not possible to assess the effect of these flows on shad spawning. It is conceivable that the requirements for shad spawning in terms of current and temperature can be met by these flows.

Streamflows for the production of optimum nursery habitat should be based on the governing ecological requirements for salmonid rearing. The control of water temperature to 19.7°C or lower throughout the year is necessary, since steelhead and silver salmon in one life stage or other can be found in the river at all times. An additional consideration for streamflow for optimum nursery habitat is that flow should not be so great as to severely limit resting habitat. However, sufficient flow should be available to permit juvenile migration over critical riffles and past instream structures as necessary to leave localized nursery areas that may become progressively unsuitable. A more complete discussion of fish passage requirements was provided in Section VI.A.

The variation in potential nursery habitat with flow for Dry Creek is shown on Figure VI-5, and for the reaches of mainstem on Figure VI-6. The potential nursery habitat is defined in terms of average water velocity limits for the production of resting space. Resting space is limited to flows that result in velocities of 0.7 fps or less. The potential nursery habitat is expressed as linear feet of water surface width on each transect. It may be determined for an entire reach by summing the results for the individual transects within that reach. Although different transects require different flows to produce maximum amounts of potential nursery habitat, summing the lengths of potential nursery habitat for all transects at corresponding flows reveals the overall optimum flow for the reach under consideration.

The optimum streamflow for nursery habitat determined by the peak on the curve is 20 cfs on Dry Creek and about 20 cfs for all the reaches of mainstem. The variation in optimum stream flow necessary to provide the maximum amount of potential nursery habitat for individual transects is shown on Figure VI-7 for Dry Creek and Figure VI-8 for the mainstem. The overall optimum flow for the various reaches is shown by the dotted line on the figures. The optimum flows can be compared to existing flows by reference to Table VI-2.

These streamflows are derived from a limited definition of nursery habitat in terms of resting space only. It appears likely that these optimum streamflows are well below the flows necessary to satisfy water temperature requirements during the summer months. Water temperature conditions may be improved by increasing streamflows, and/or by selective withdrawal of cold temperature water from upstream impoundments. The extent to which such programmed releases from

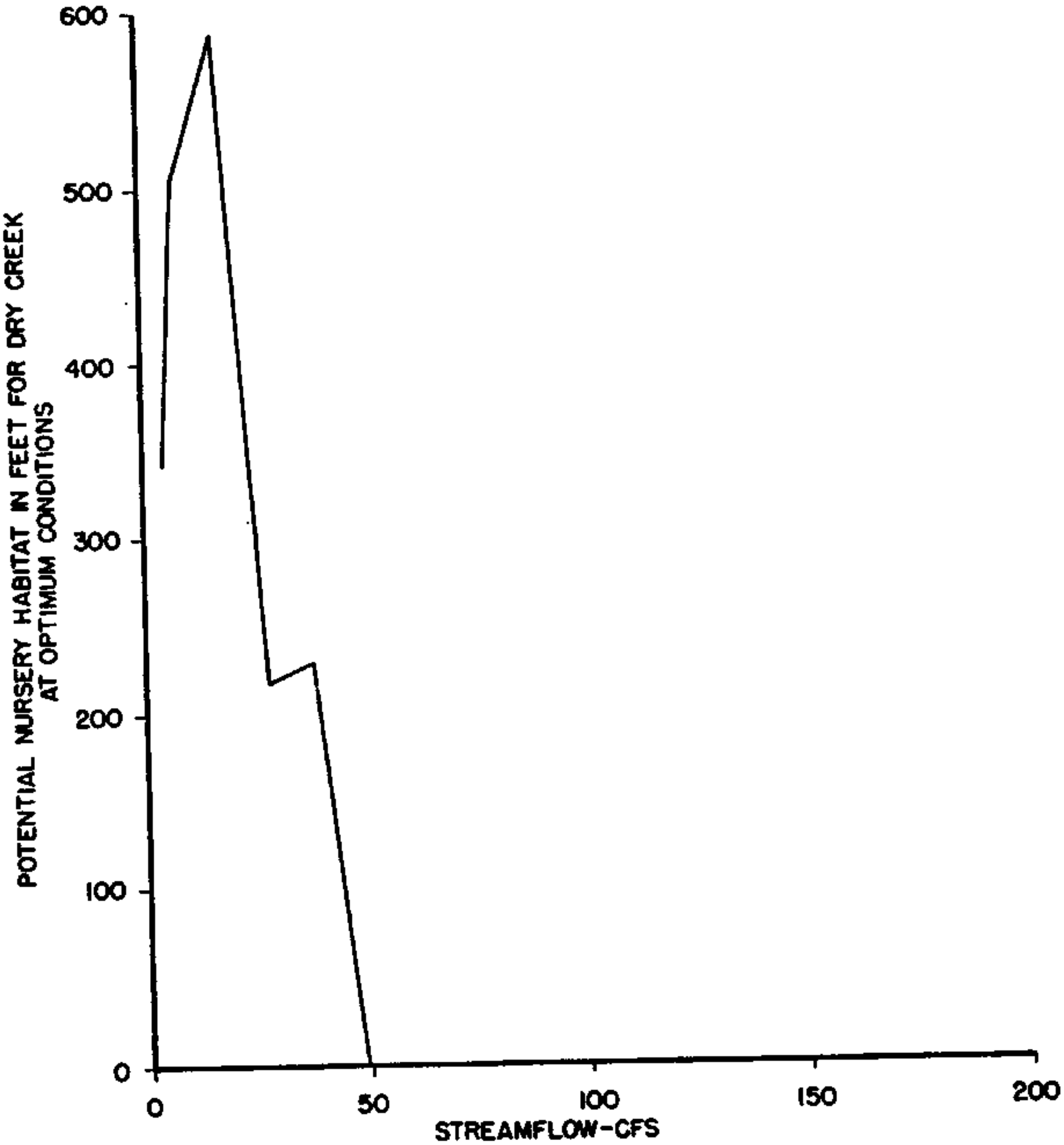


Figure V-5
MAXIMUM POTENTIAL NURSERY HABITAT IN DRY CREEK
vs STREAMFLOW

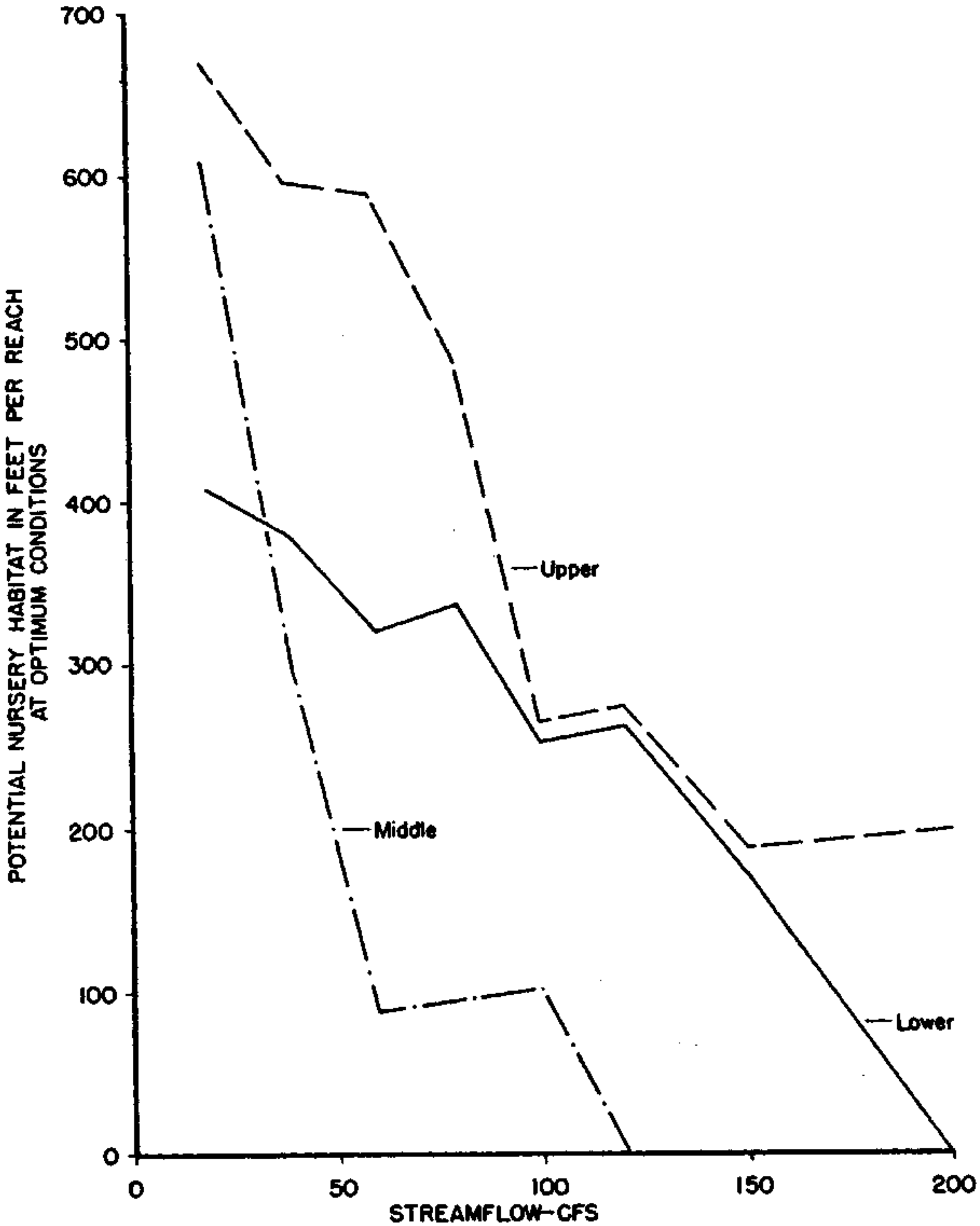


Figure VI-6
MAXIMUM POTENTIAL NURSERY HABITAT ON MAINSTEM
vs STREAMFLOW

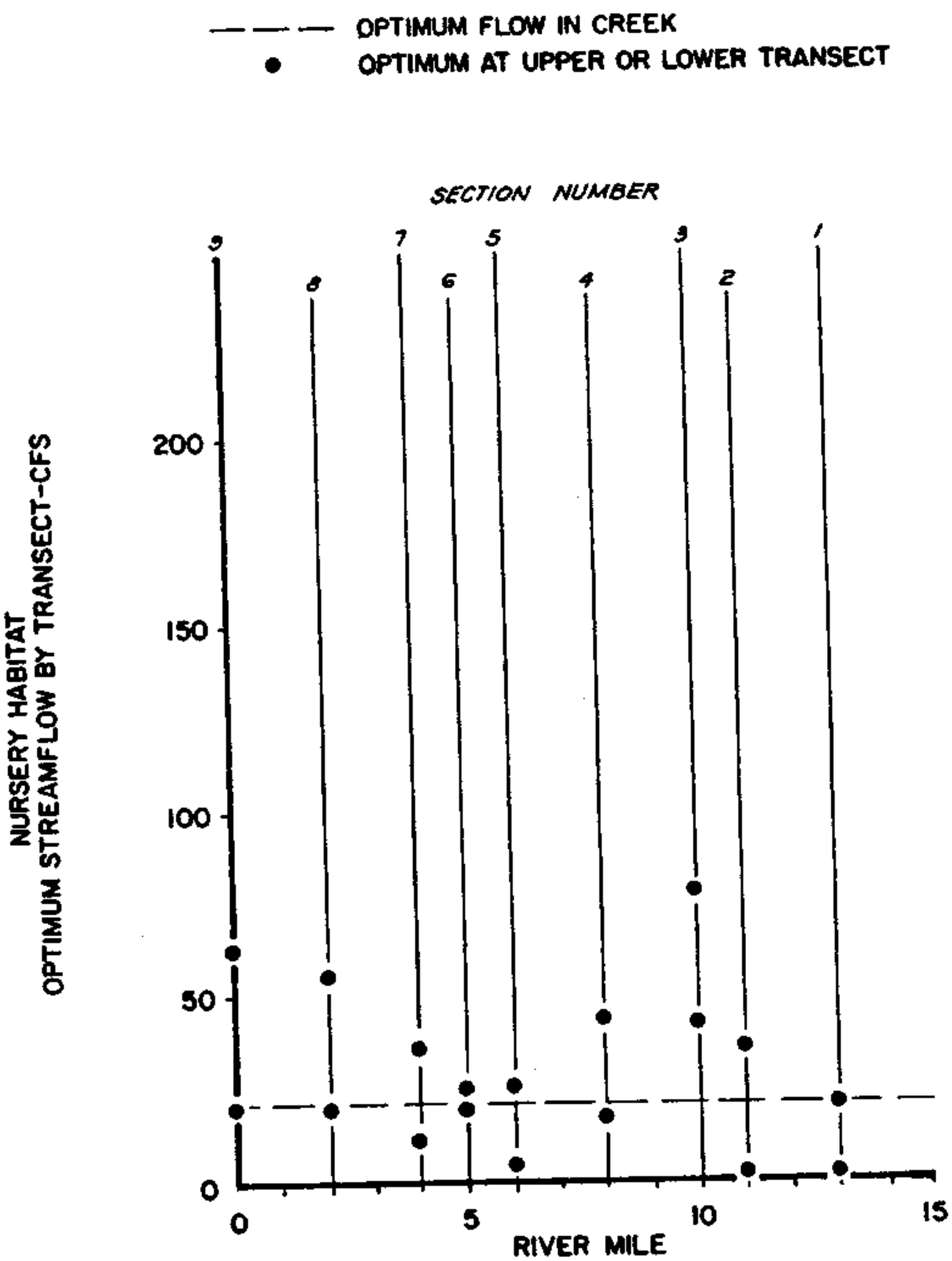


Figure VI-7
POTENTIAL NURSERY HABITAT
OPTIMUM STREAMFLOW BY TRANSECT vs RIVERMILE
DRY CREEK

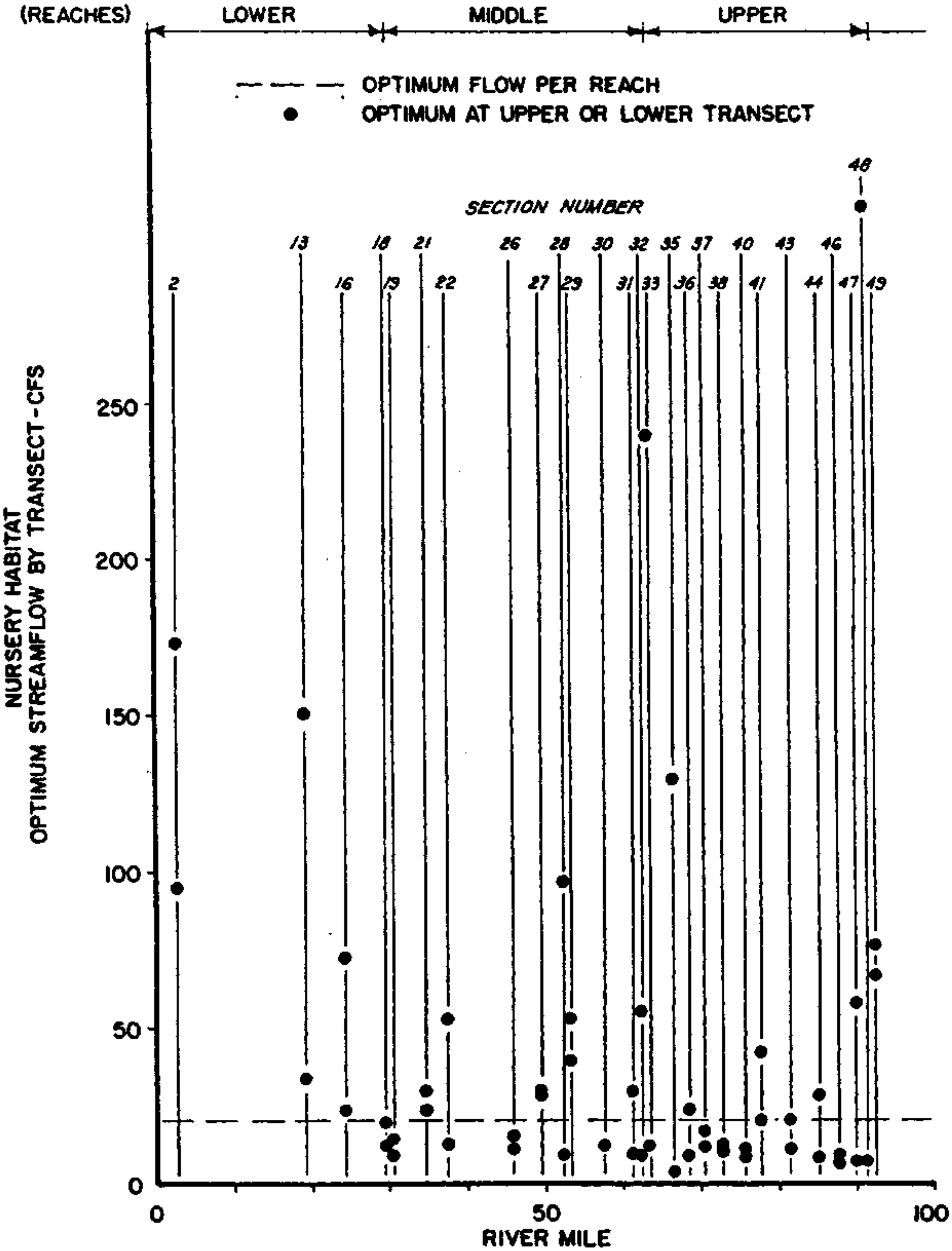


Figure VI-8
POTENTIAL NURSERY HABITAT
OPTIMUM STREAMFLOW BY TRANSECT vs RIVERMILE
MAINSTEM

TABLE VI-2

AVERAGE MEAN DISCHARGE (CFS) FOR WATER YEARS 1972 THROUGH 1976
AS RELATED TO SPAWNING AND NURSERY SEASONS

J.S.G.S. GAGE STATION 11462000-RUSSIAN RIVER (EAST FORK) NEAR UKIAH

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
325	229	258	513	757	575	163	234	258	293	289	261

U.S.G.S. GAGE STATION 11462500-RUSSIAN RIVER NEAR HOPLAND

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
324	317	534	1351	1938	1727	392	263	247	253	249	244

U.S.G.S. GAGE STATION 11463000-RUSSIAN RIVER NEAR CLOVERDALE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
334	393	655	1814	2906	2335	567	303	243	245	243	234

U.S.G.S. GAGE STATION 11464000-RUSSIAN RIVER NEAR HEALDSBURG

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
344	603	987	3227	4664	3414	857	375	234	224	225	218

U.S.G.S. GAGE STATION 11467000-RUSSIAN RIVER NEAR GUERNEVILLE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
373	993	1610	5844	7714	5248	1198	418	205	170	172	191

U.S.G.S. GAGE STATION 11462500-DRY CREEK NEAR GEYSERVILLE

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
18	134	250	914	1182	779	183	46	13	4	.5	.4

SPAWNING - SILVER

SPAWNING - STEELHEAD

SPAWNING - KING

NURSERY - SILVER AND STEELHEAD

NURSERY - KING

upstream reservoirs could be expected to improve the nursery habitat was not determined as it was beyond the scope of work for this contract. It is safe to say, however, that the limit of excellent to satisfactory nursery habitat that presently exists below Coyote Dam during the summer months may be extended further downstream, thus replacing the marginal to unsuitable habitat in the middle and lower river, if streamflows are increased by allowing greater dry season releases from Lake Mendocino. Similarly, the existing marginal summer salmonid nursery habitat in Dry Creek will be improved by cold water releases from the Warm Springs Dam and Lake Sonoma Project.

Although streamflows intended to satisfy temperature requirements would result in less than optimum production of resting space, the higher flows would increase the riffle to pool ratio, bringing it closer to the assumed ideal value of 50:50. Such increased streamflows, considering water temperature and riffle to pool ratio as well as resting space, should result in an overall improvement of nursery habitat. Furthermore, the presence of resting space as microhabitat within high velocity reaches of channel helps offset the anticipated loss of resting space based on the average velocities only. These considerations limit the validity of the above-stated optimum streamflows for nursery habitat.

Because of the lack of sufficient quantitative information on the nursery habitat requirements of shad, determination of the optimum streamflow for shad nursery is not possible at this time.

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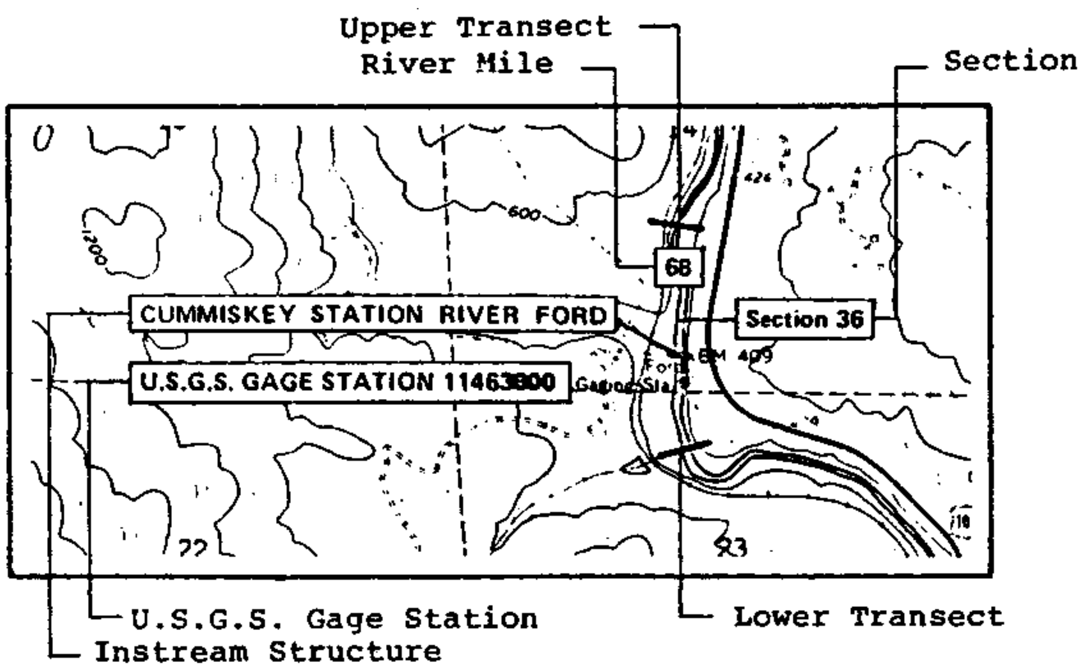
Appendix A

Location of Transects, Study Sections,
Instream Structures and U.S. Geological Survey Gage Stations
-Russian River and Lower Dry Creek

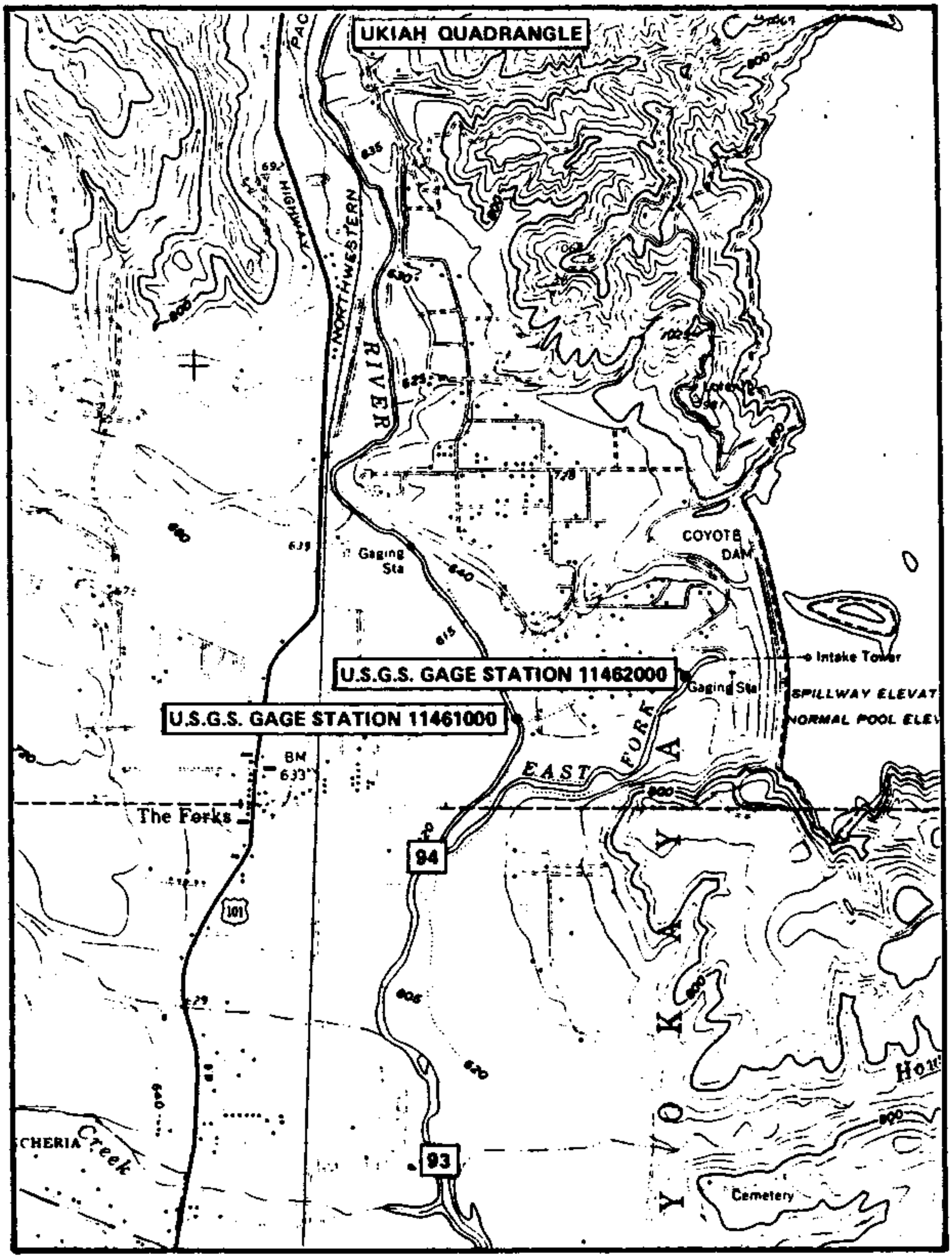
Symbols used are defined in the following example



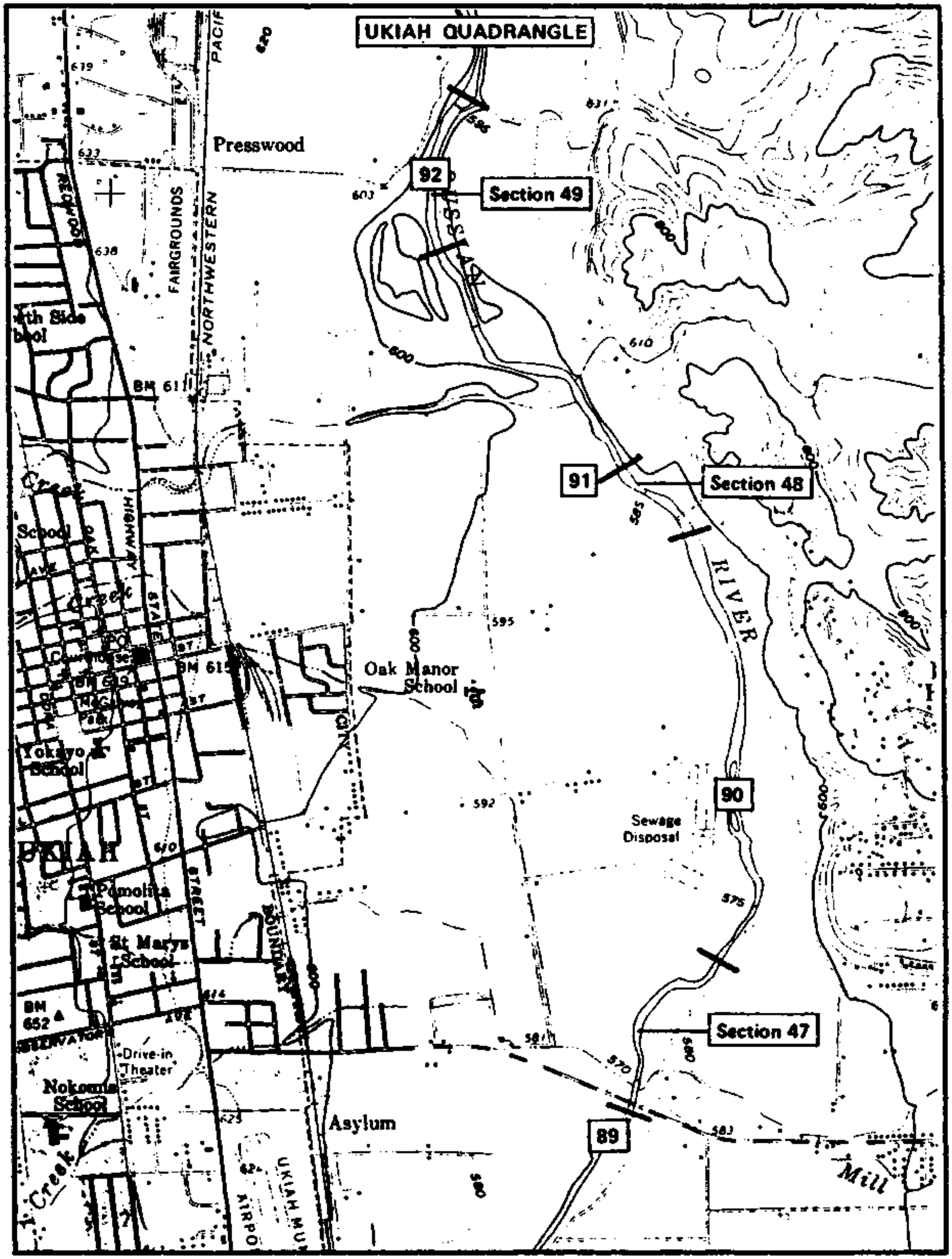
MAINSTEM

RUSSIAN

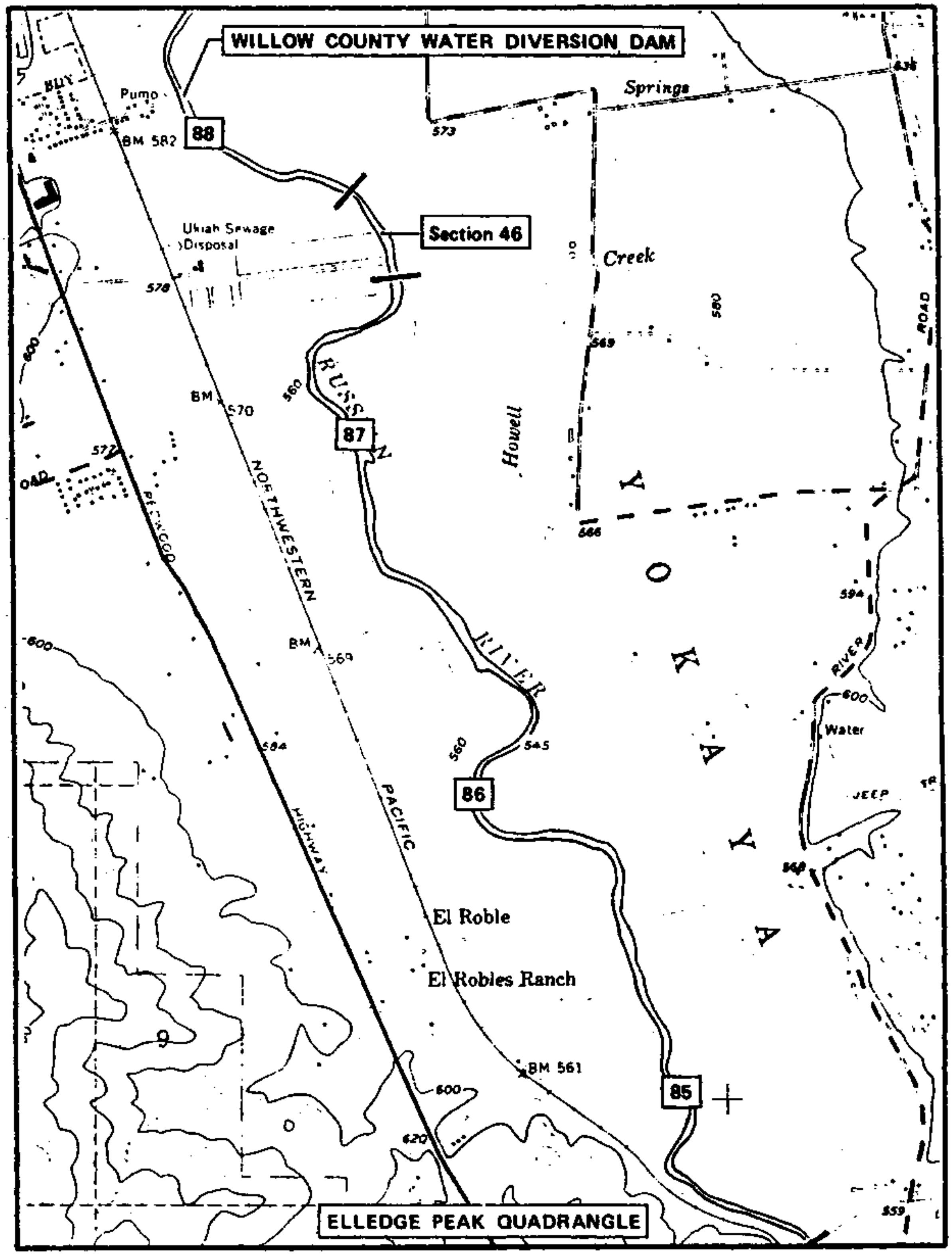
RIVER



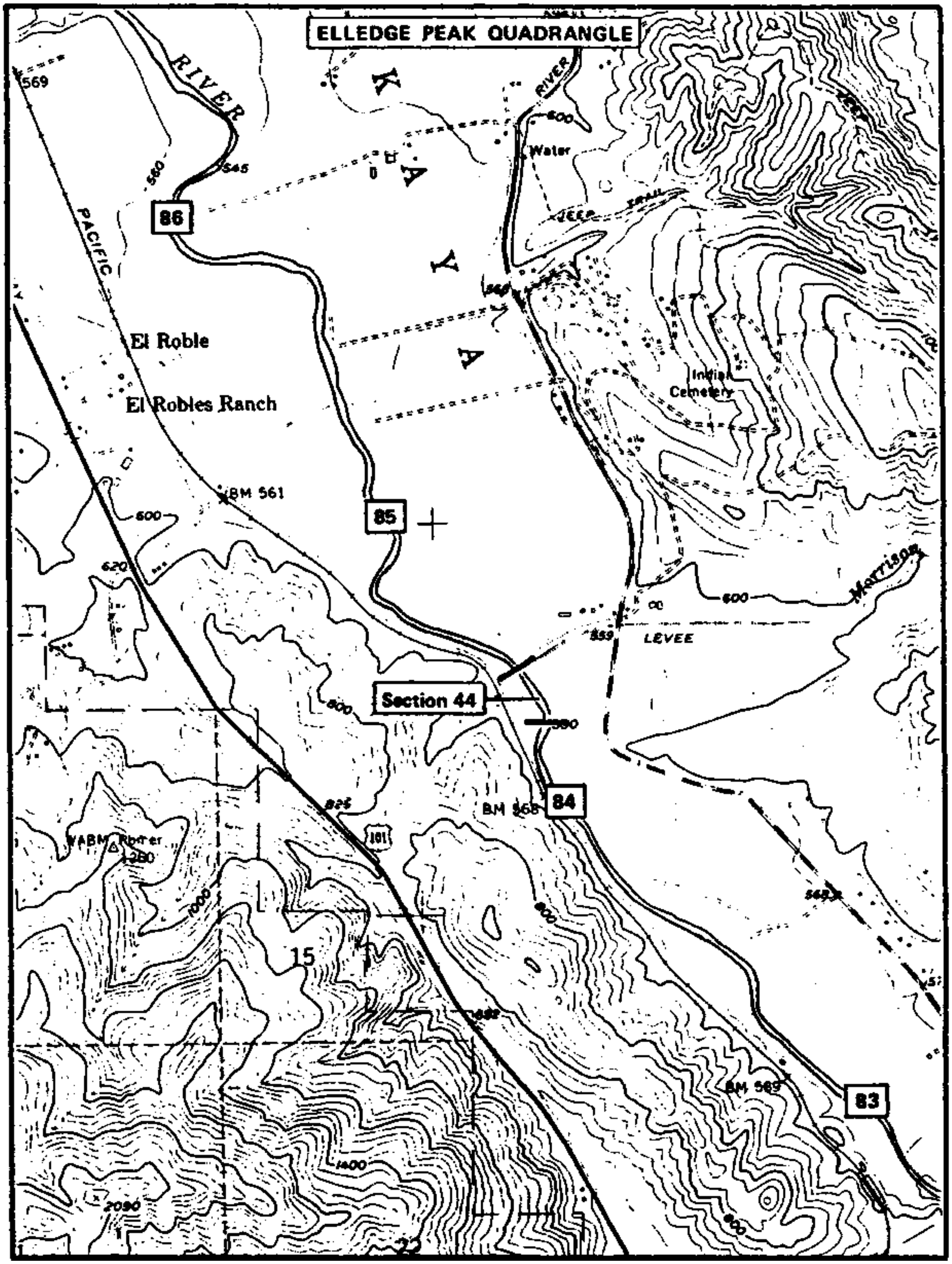
Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



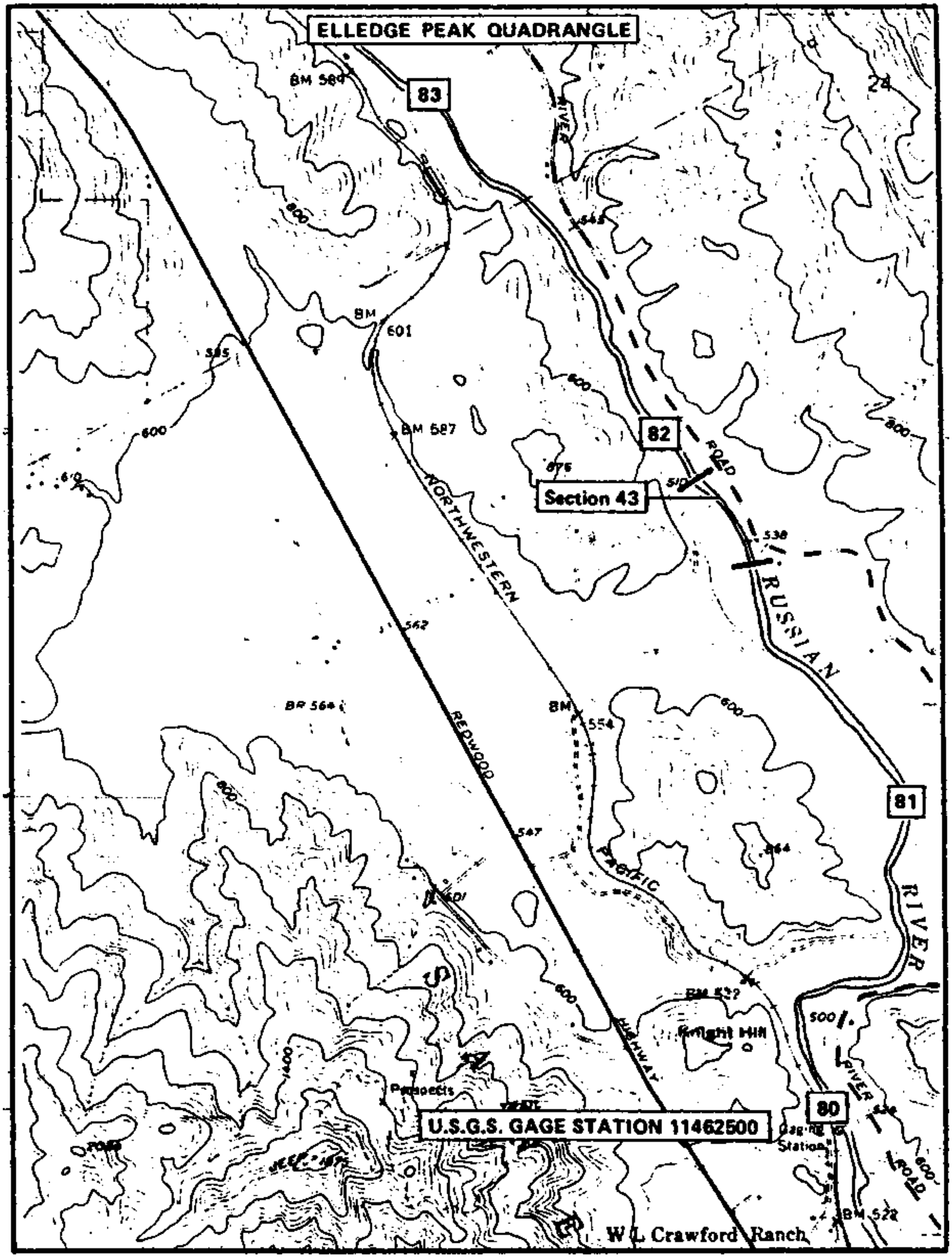
Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



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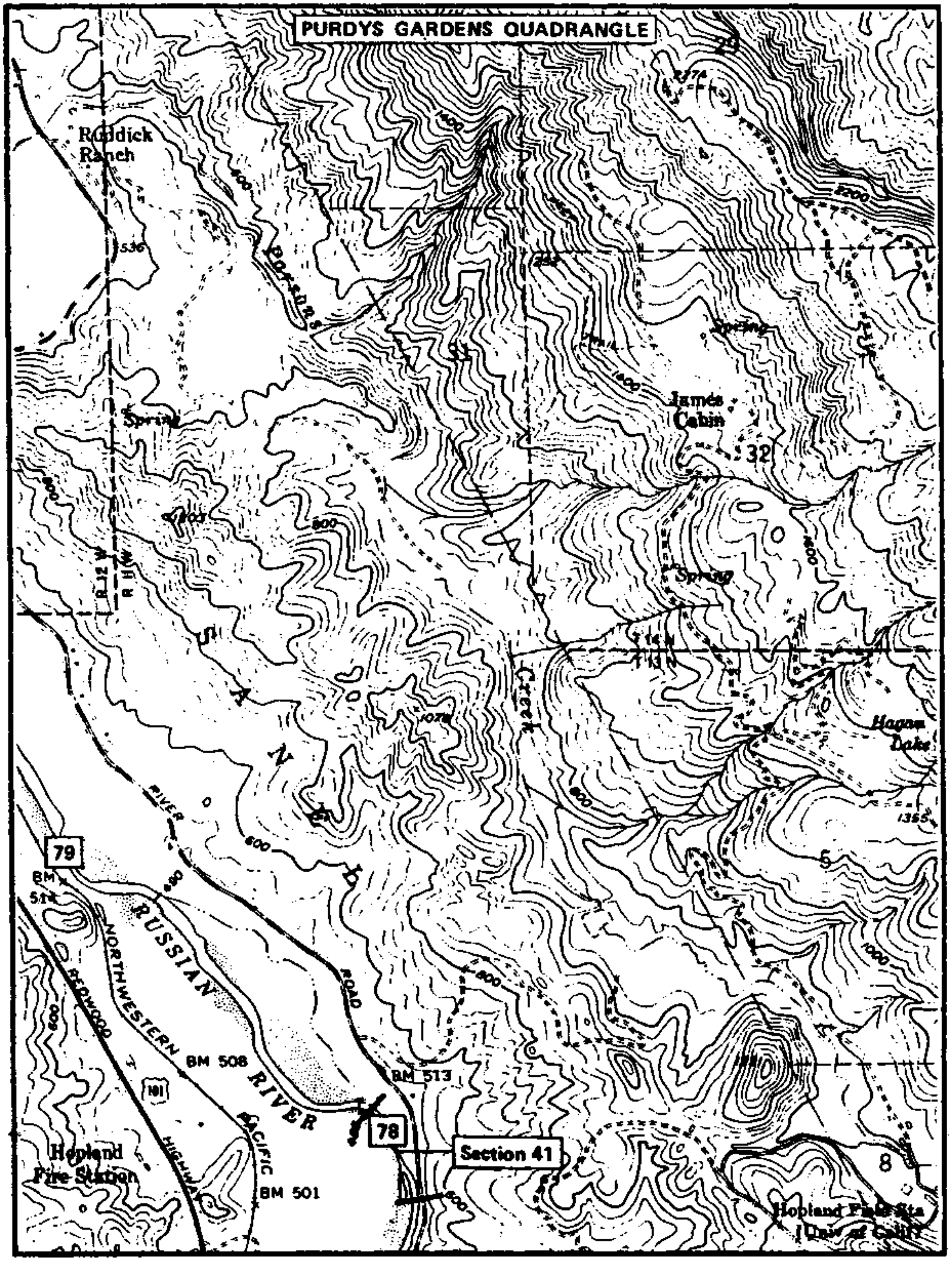

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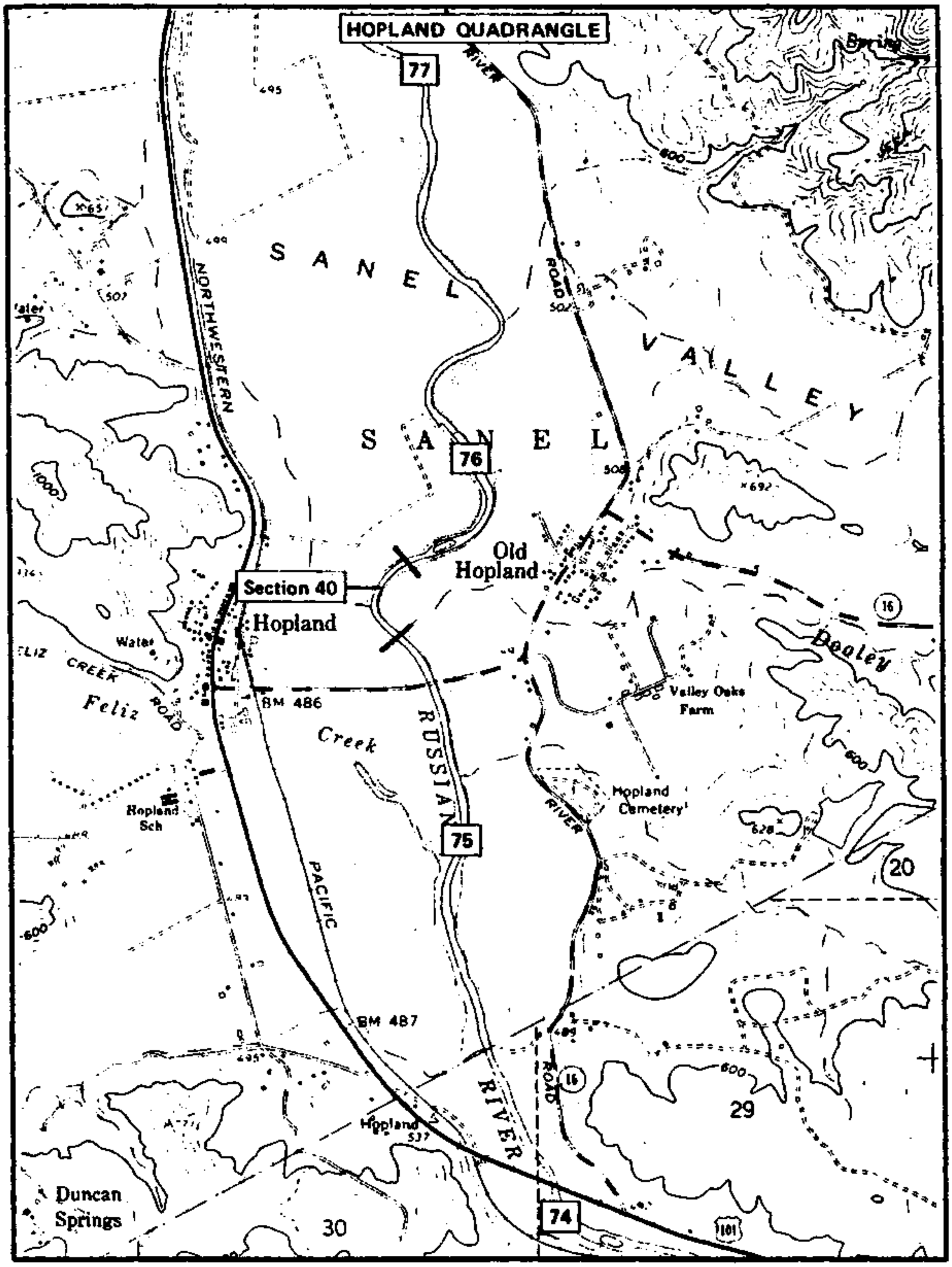

Location of Study Sections, Instream Structures and
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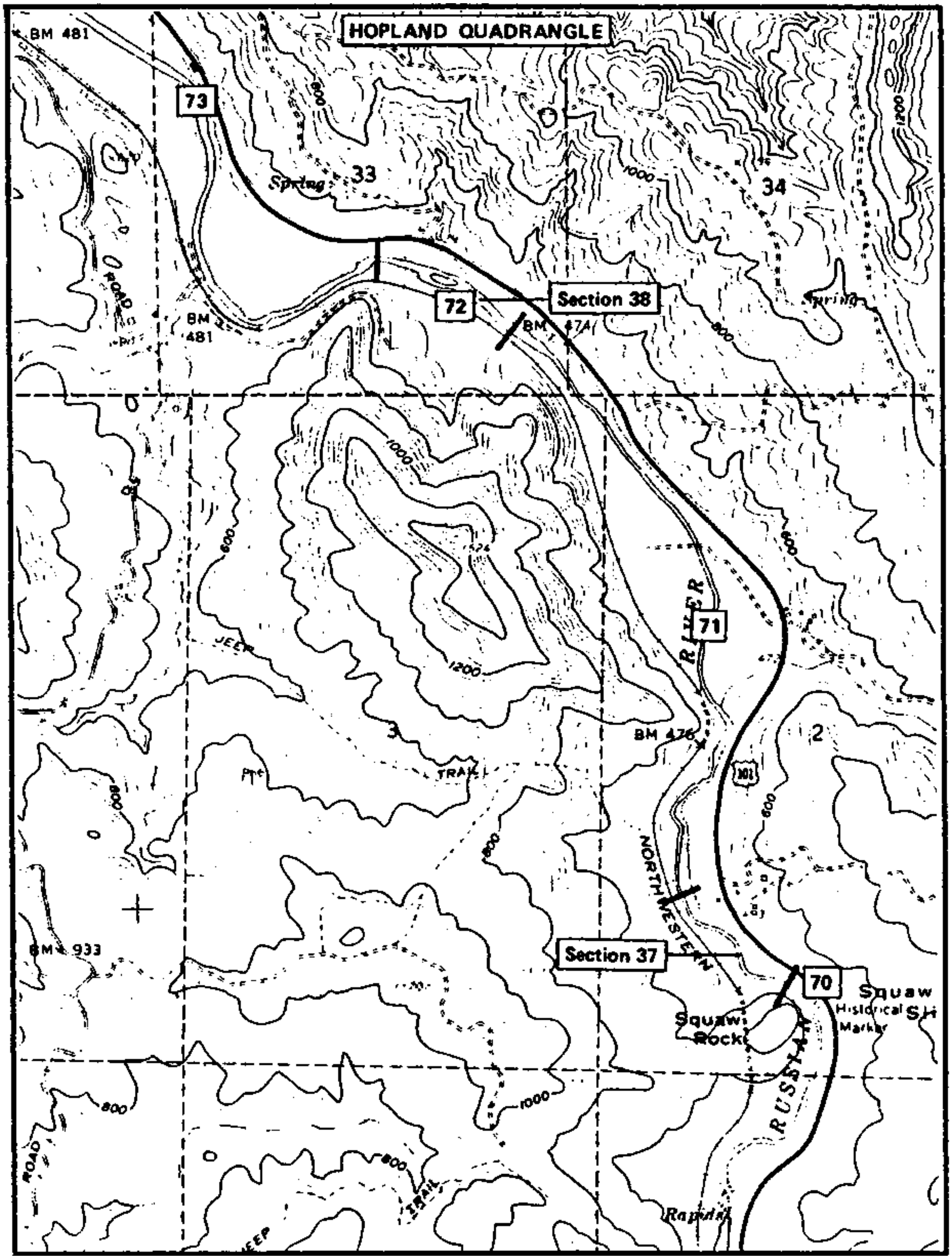

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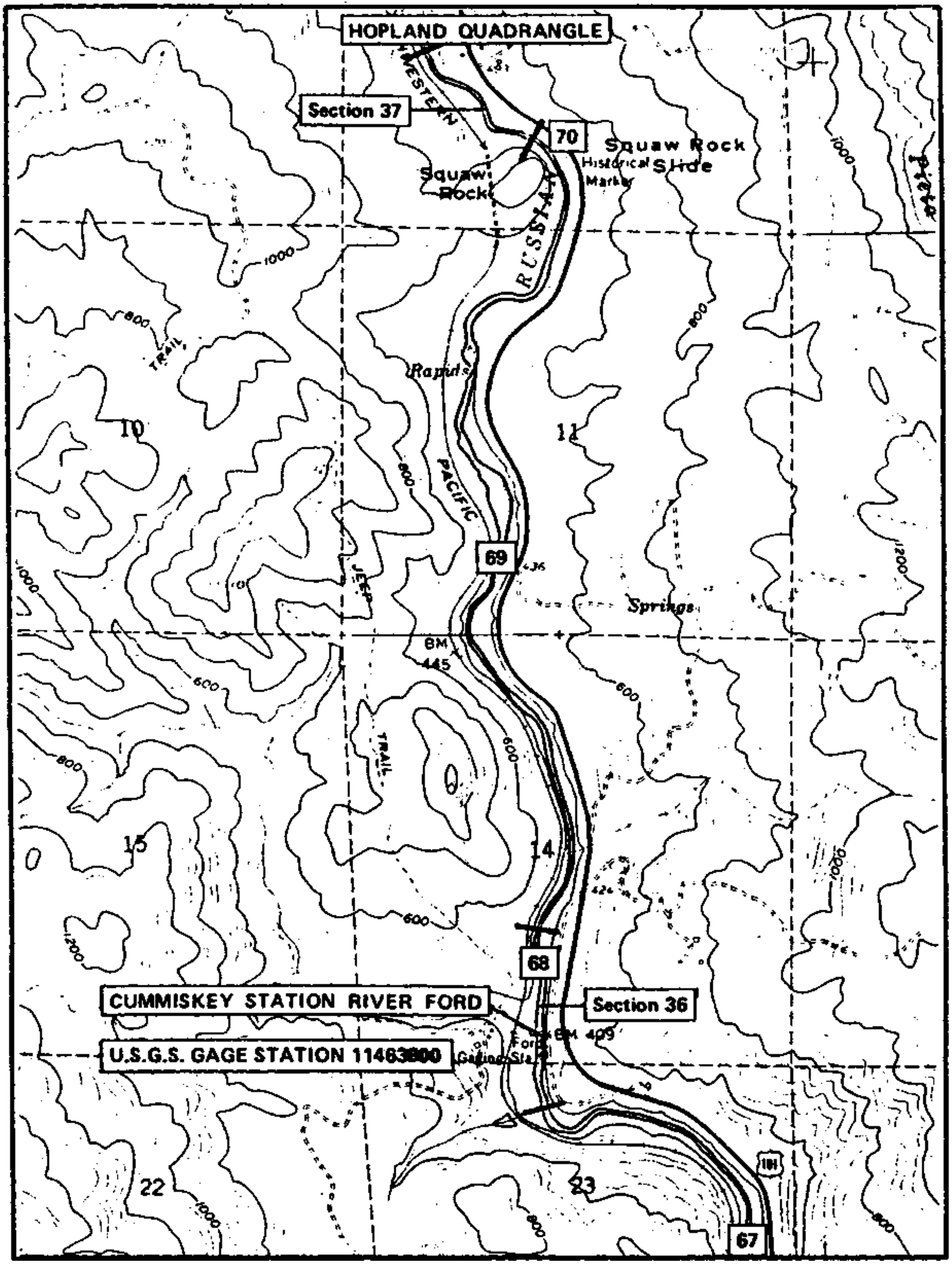
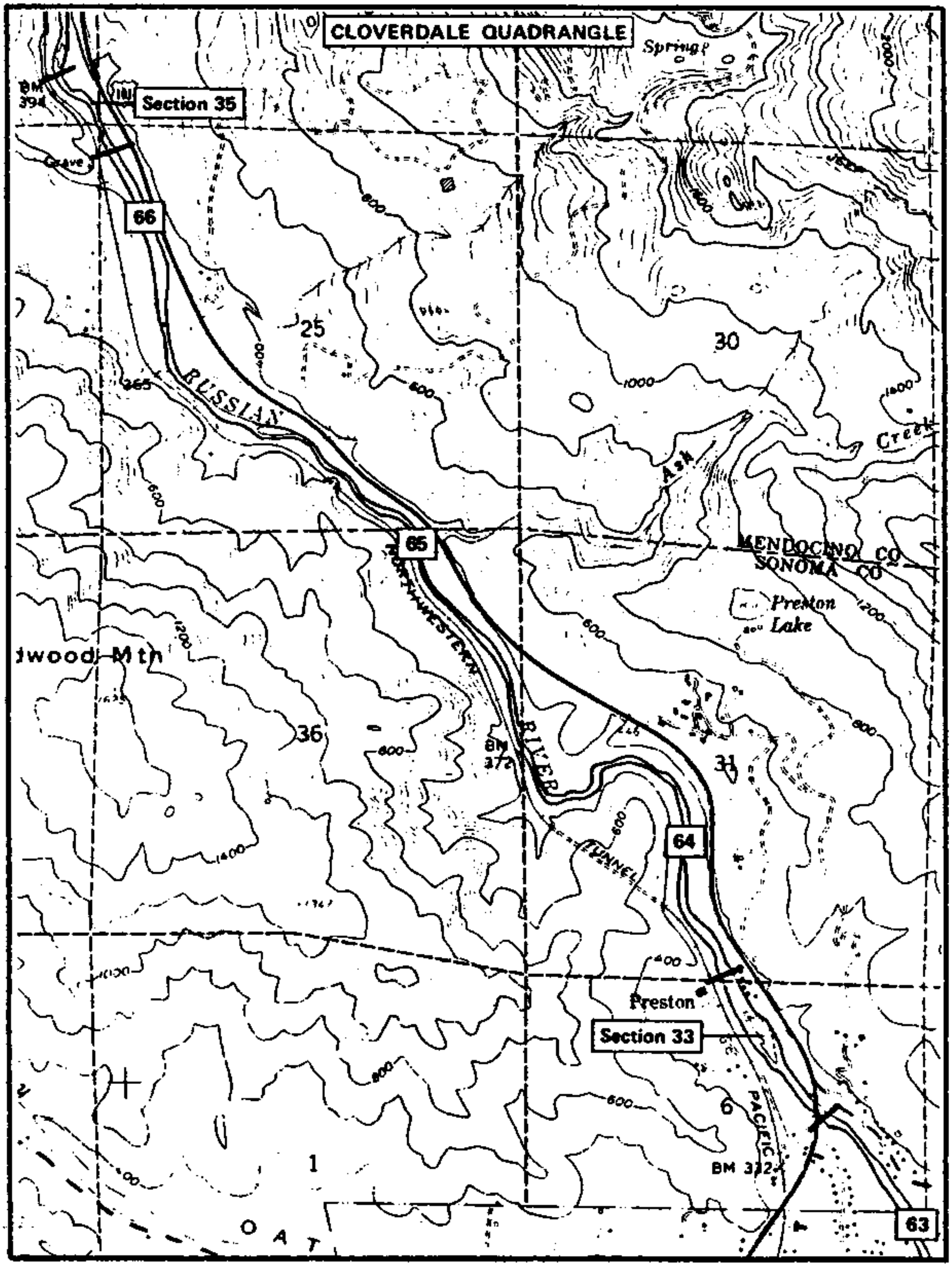


Location of Study Sections, Instream Structures and U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



Location of Study Sections, Instream Structures and
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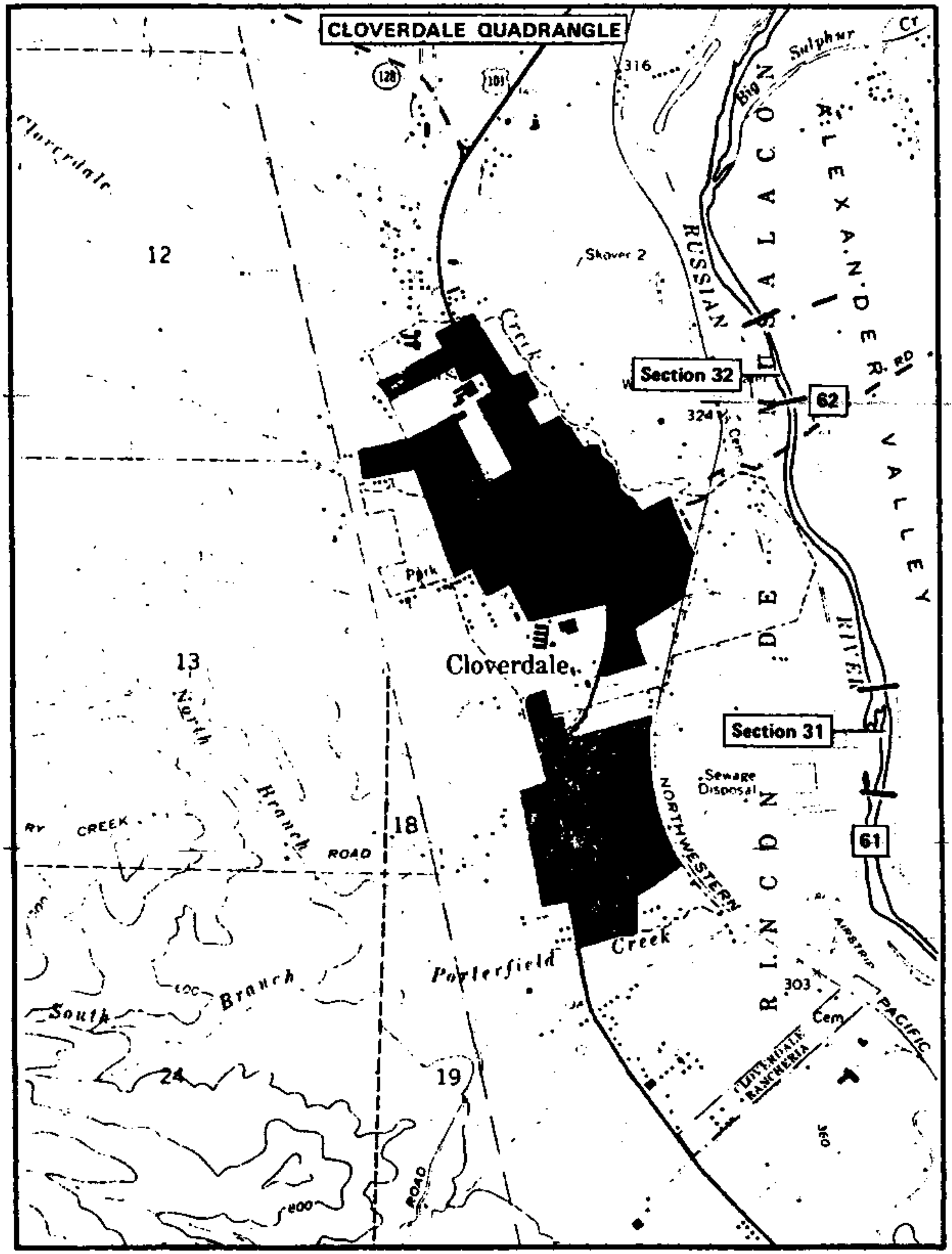

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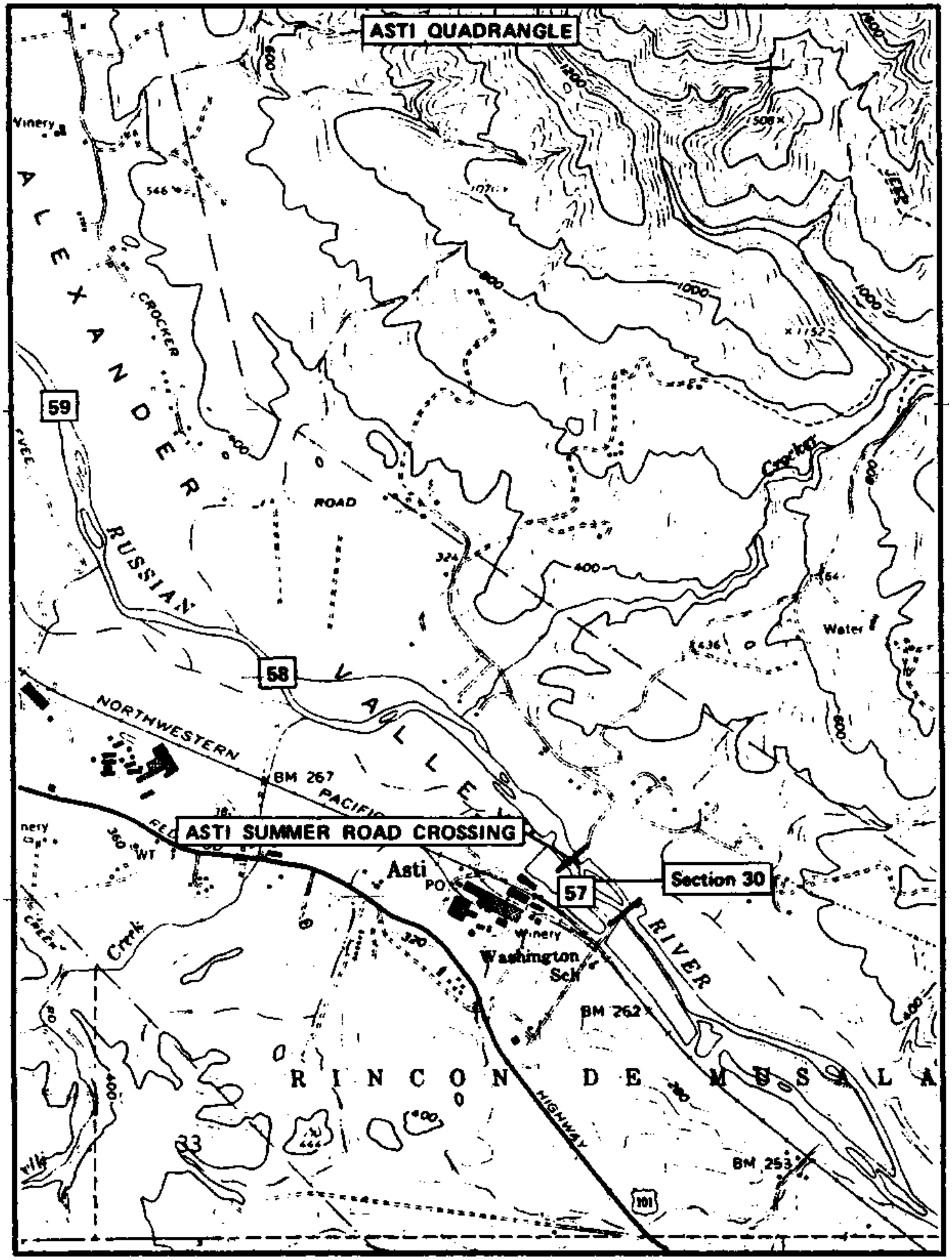
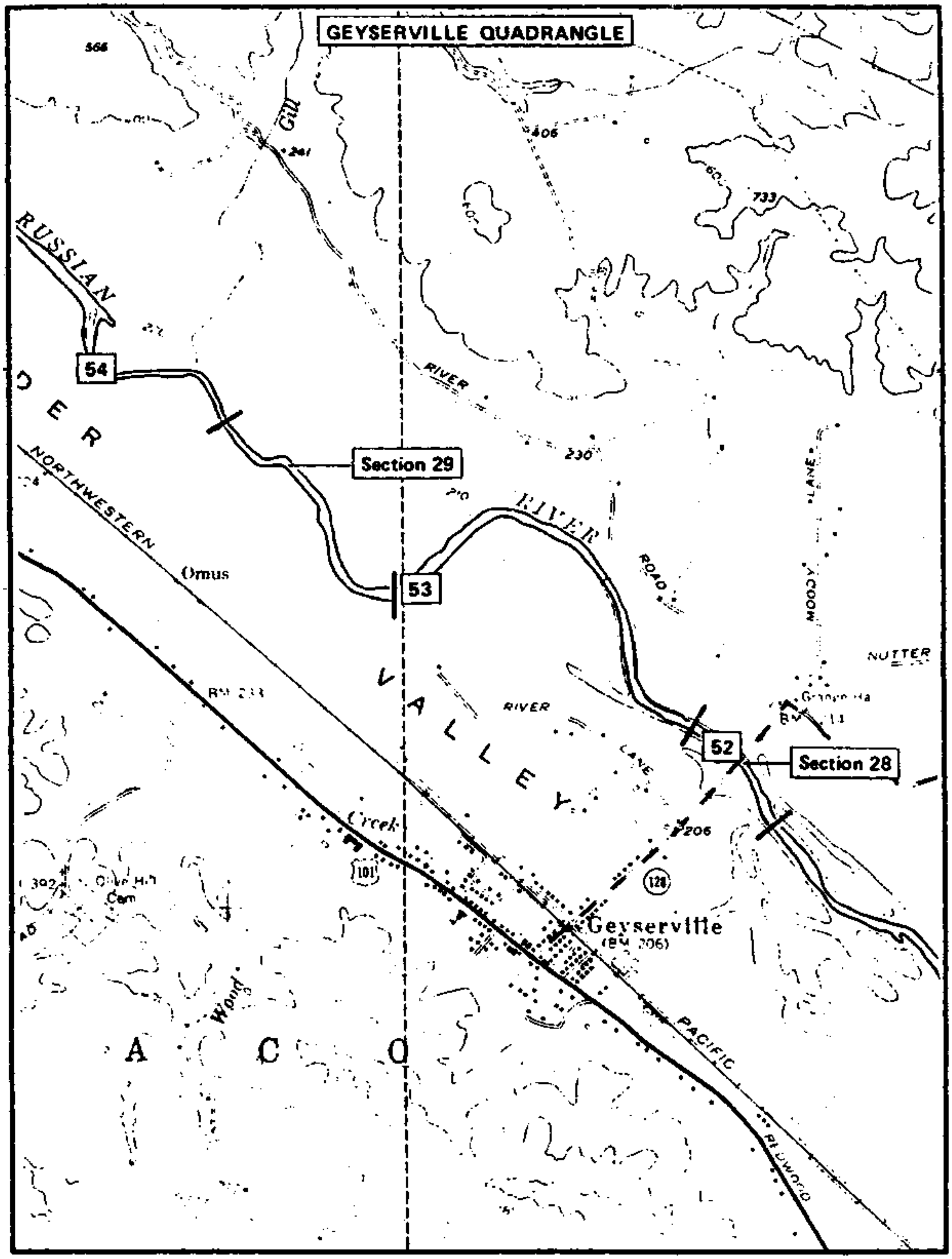


Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



Location of Study Sections, Instream Structures and
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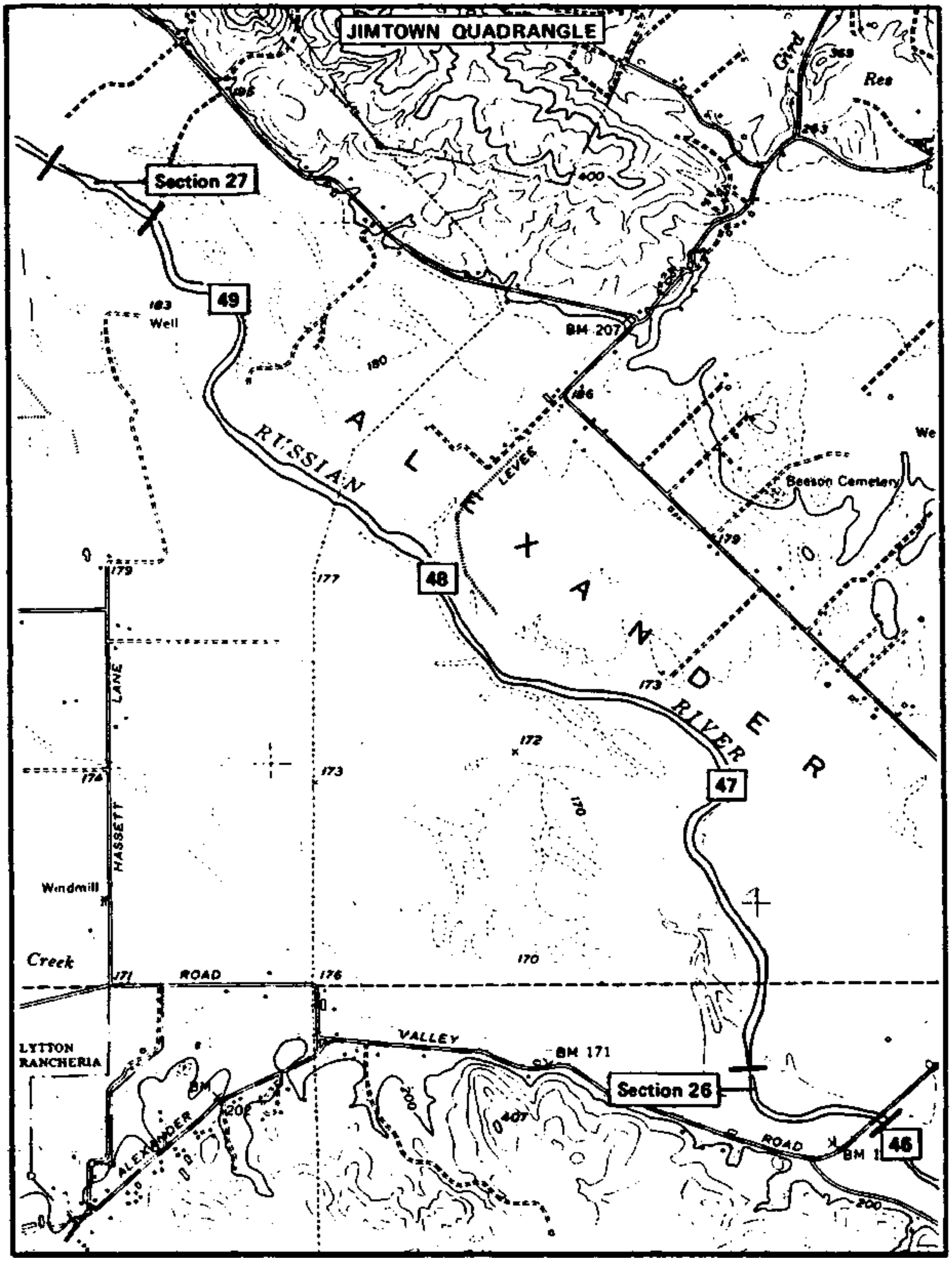
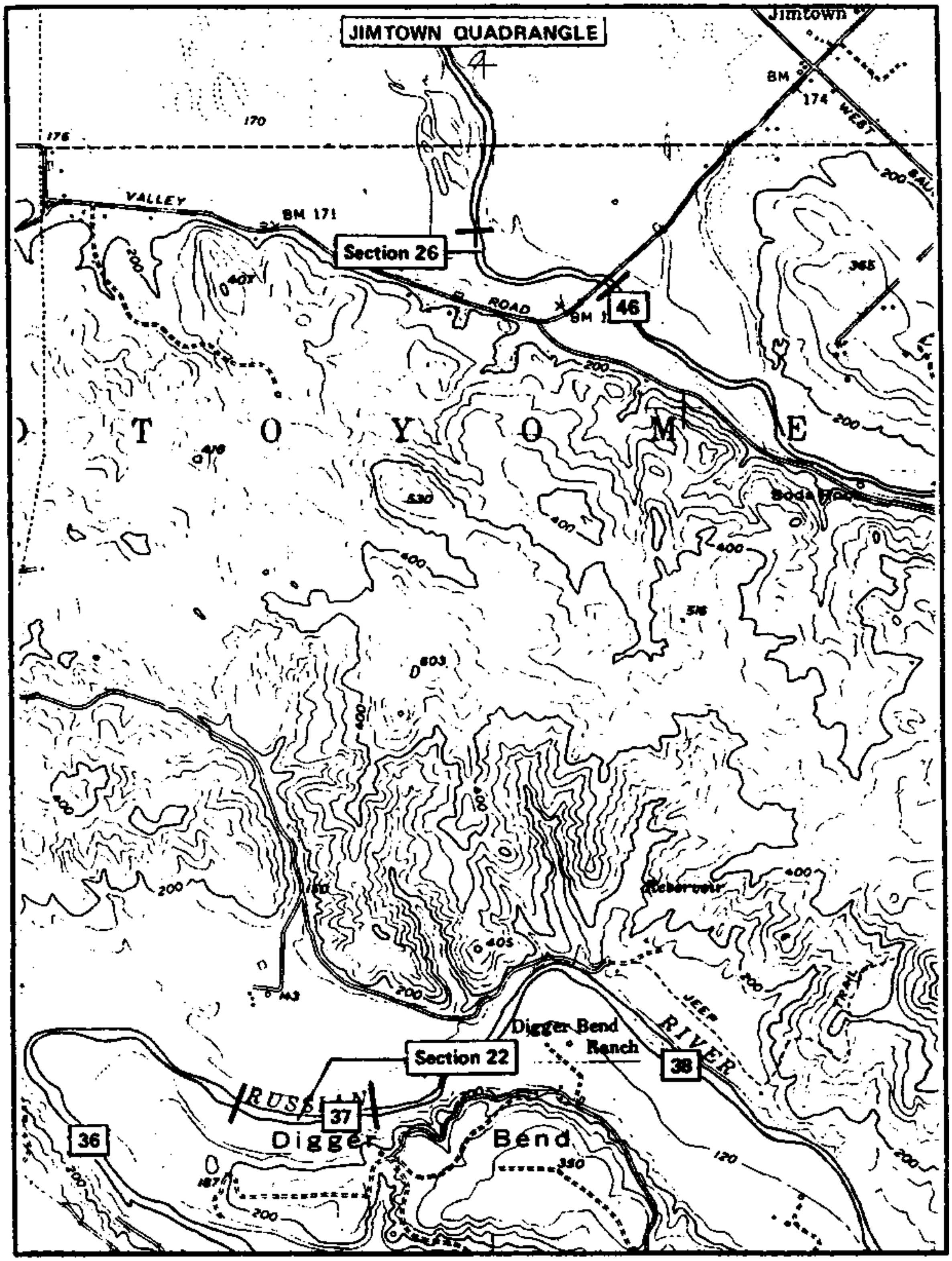
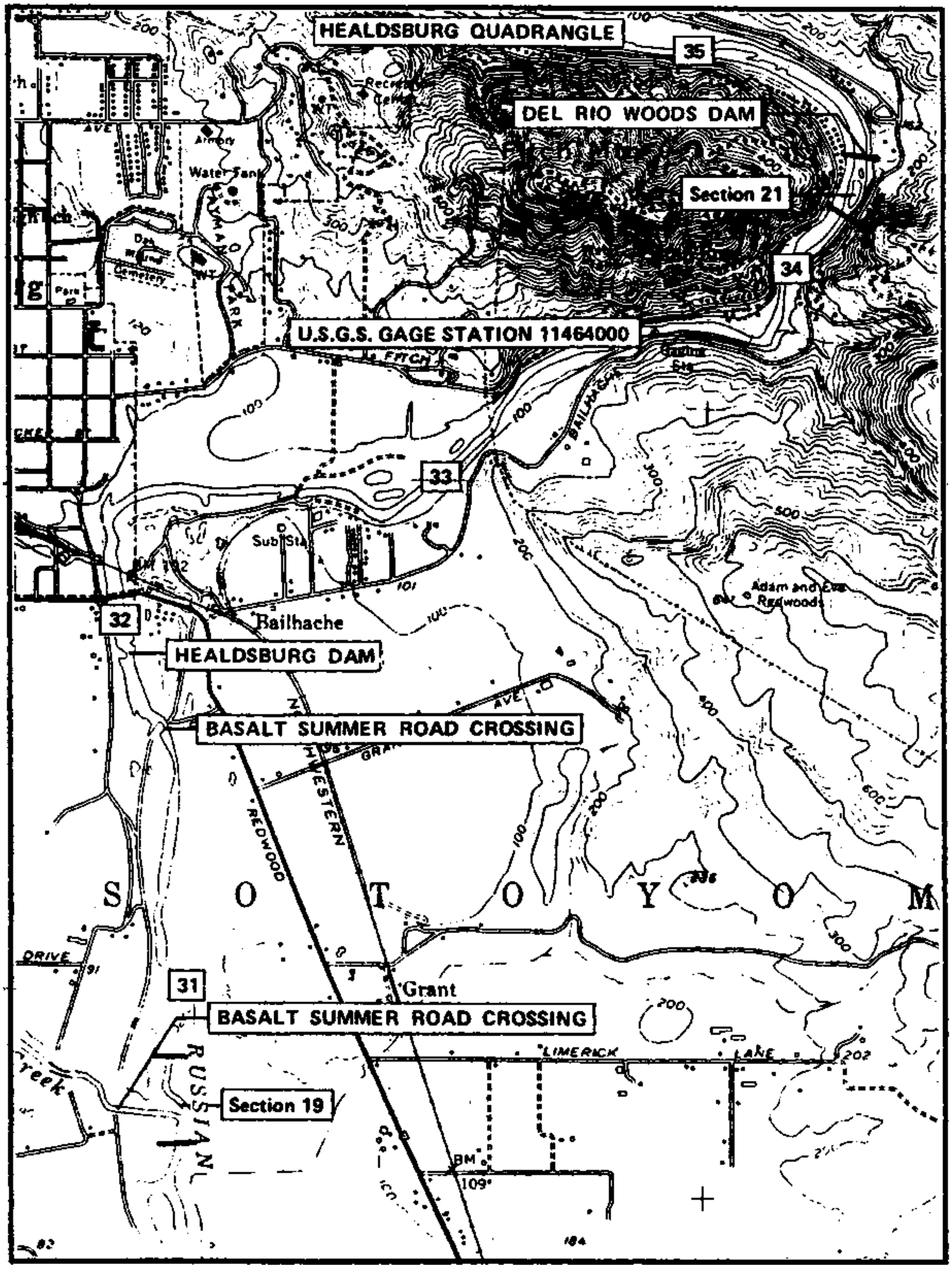


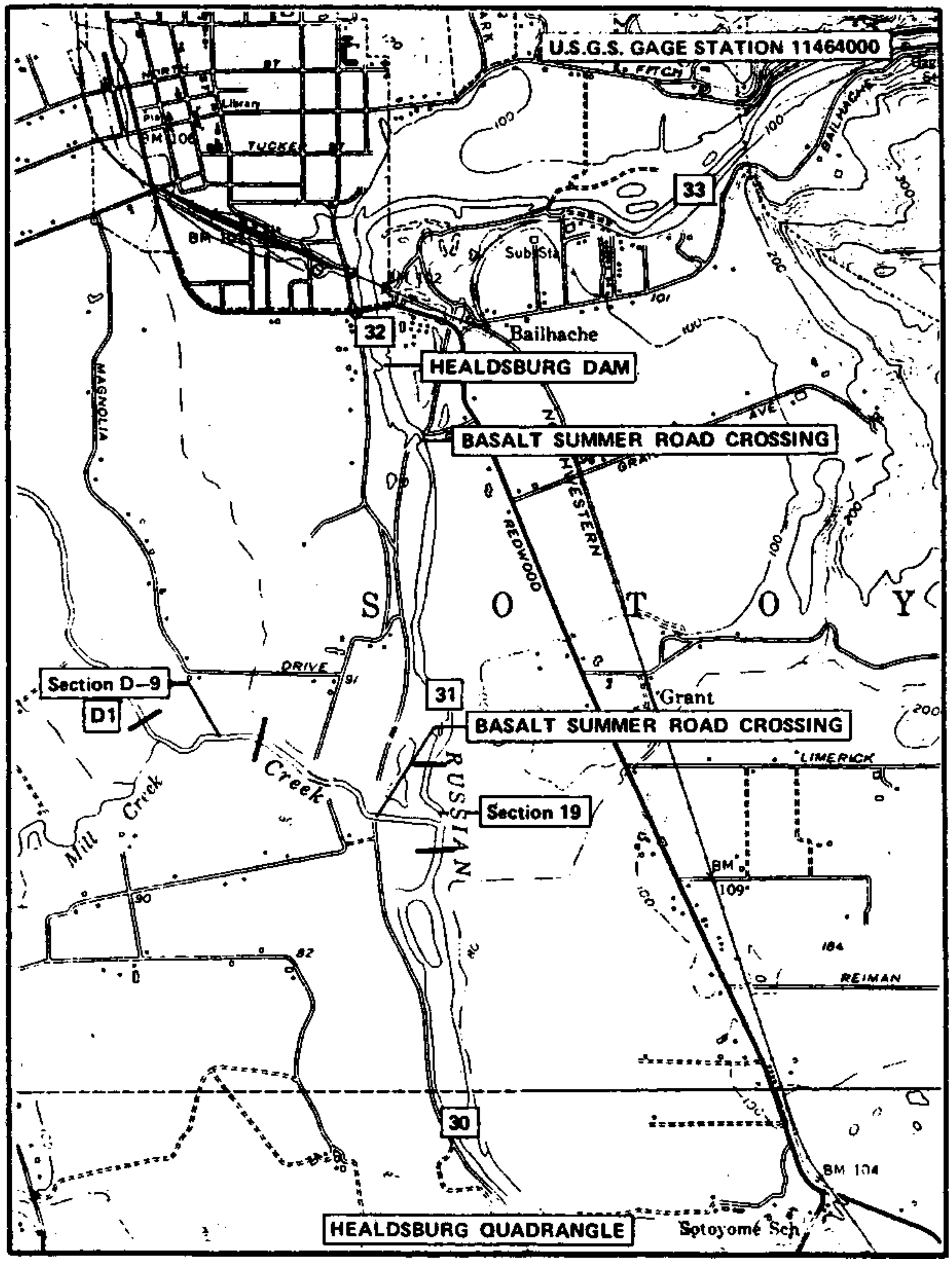
Location of Study Sections, Instream Structures and U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



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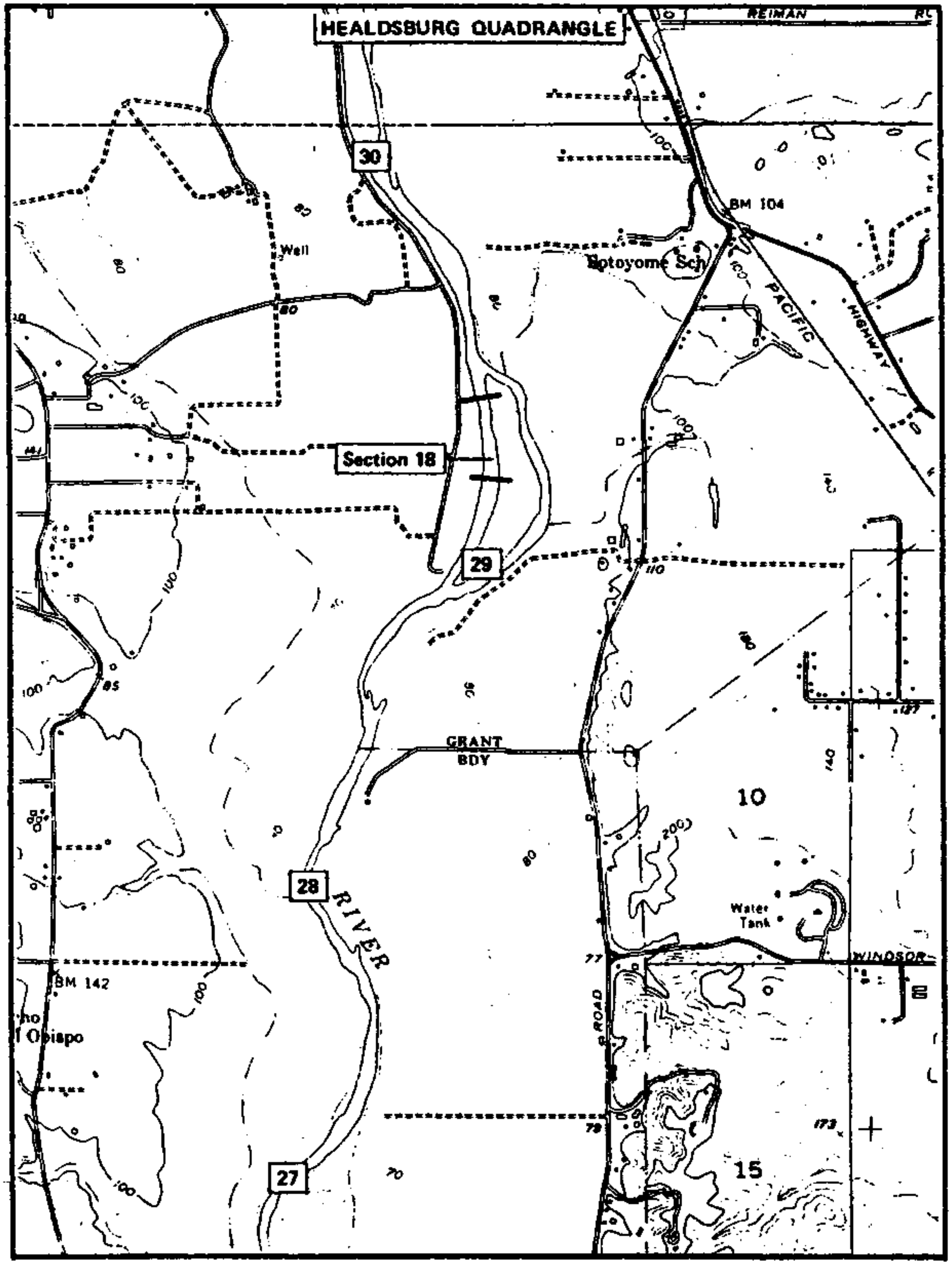
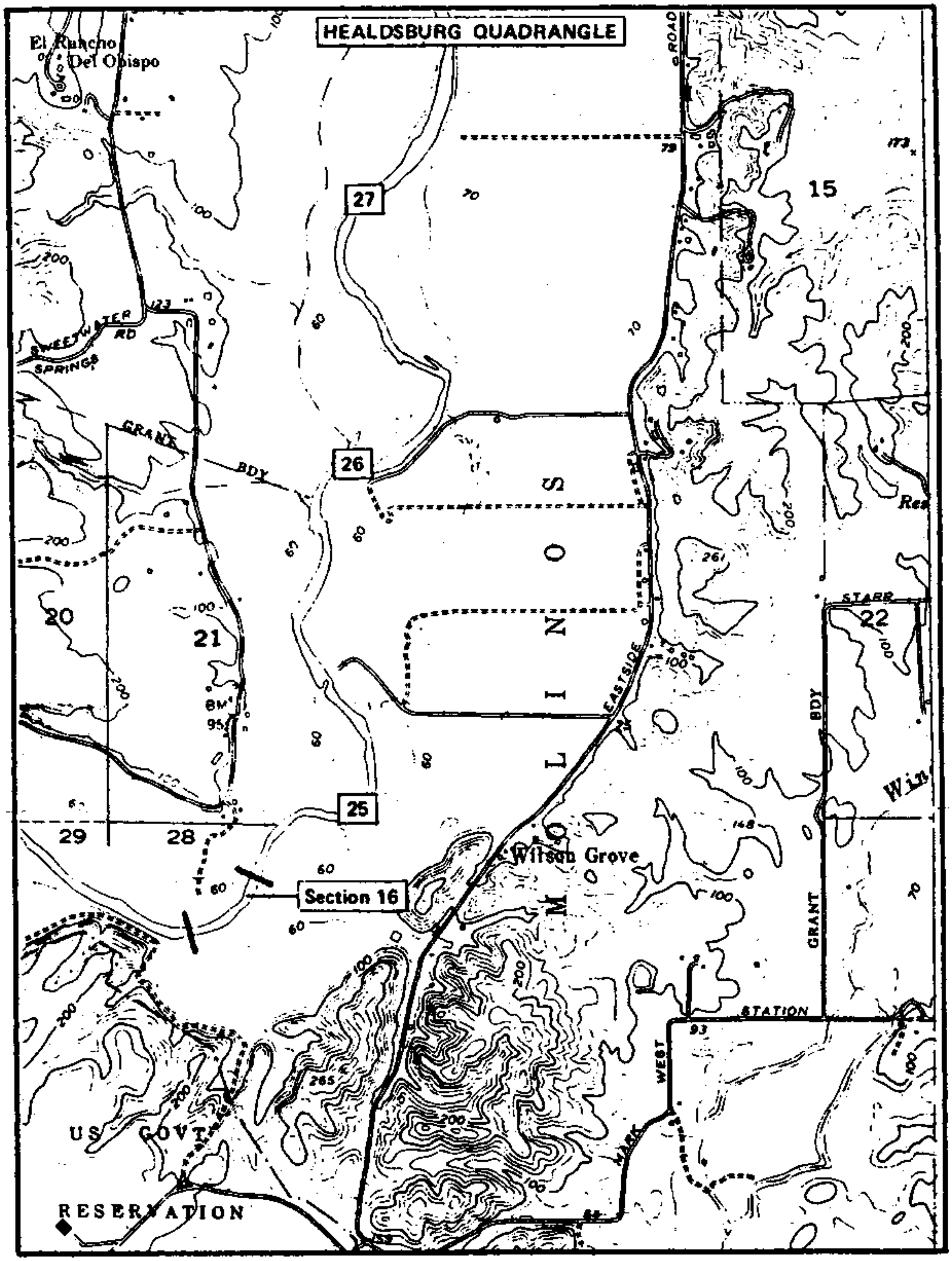


Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



Location of Study Sections, Instream Structures and
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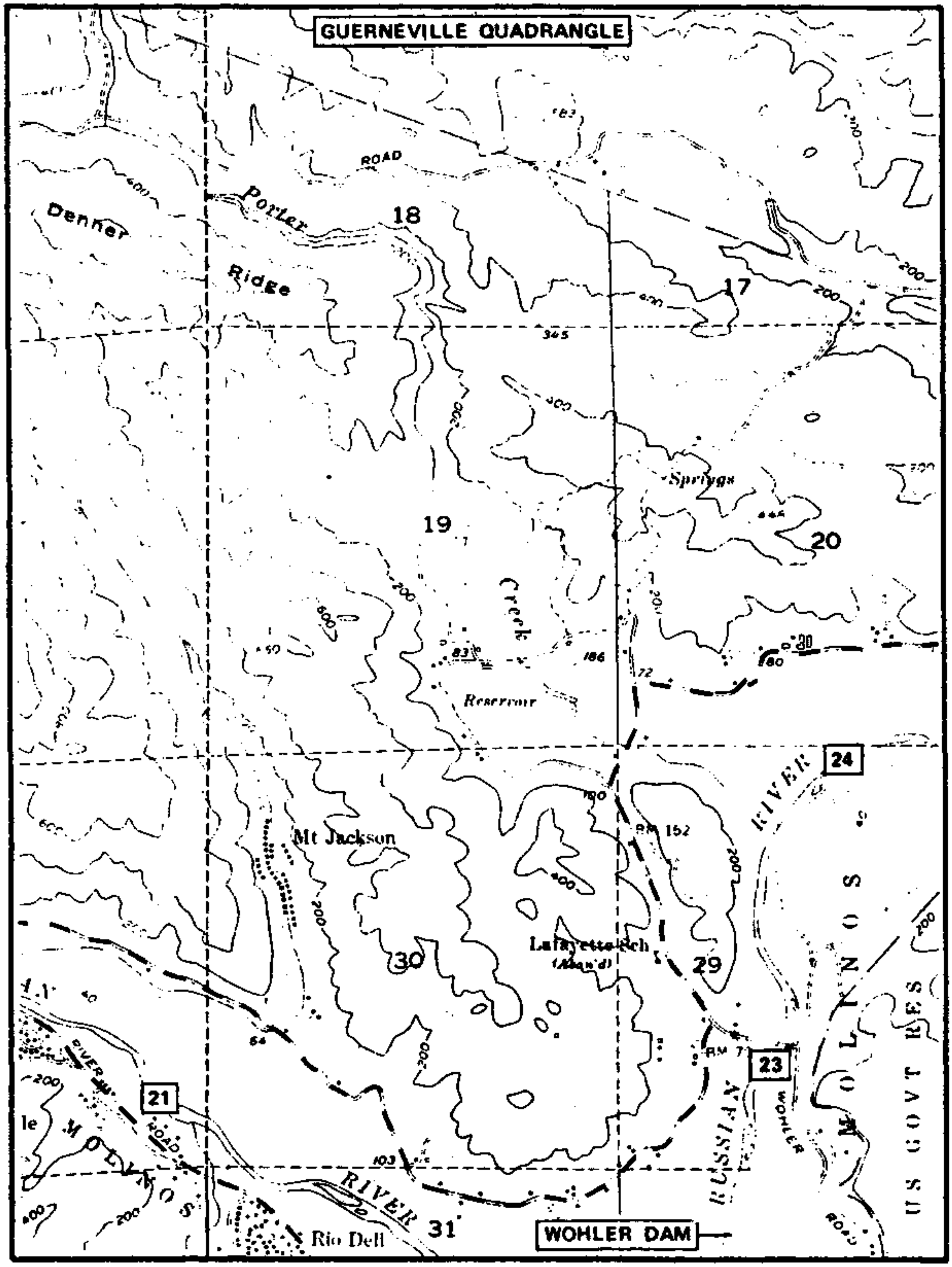

Location of Study Sections, Instream Structures and
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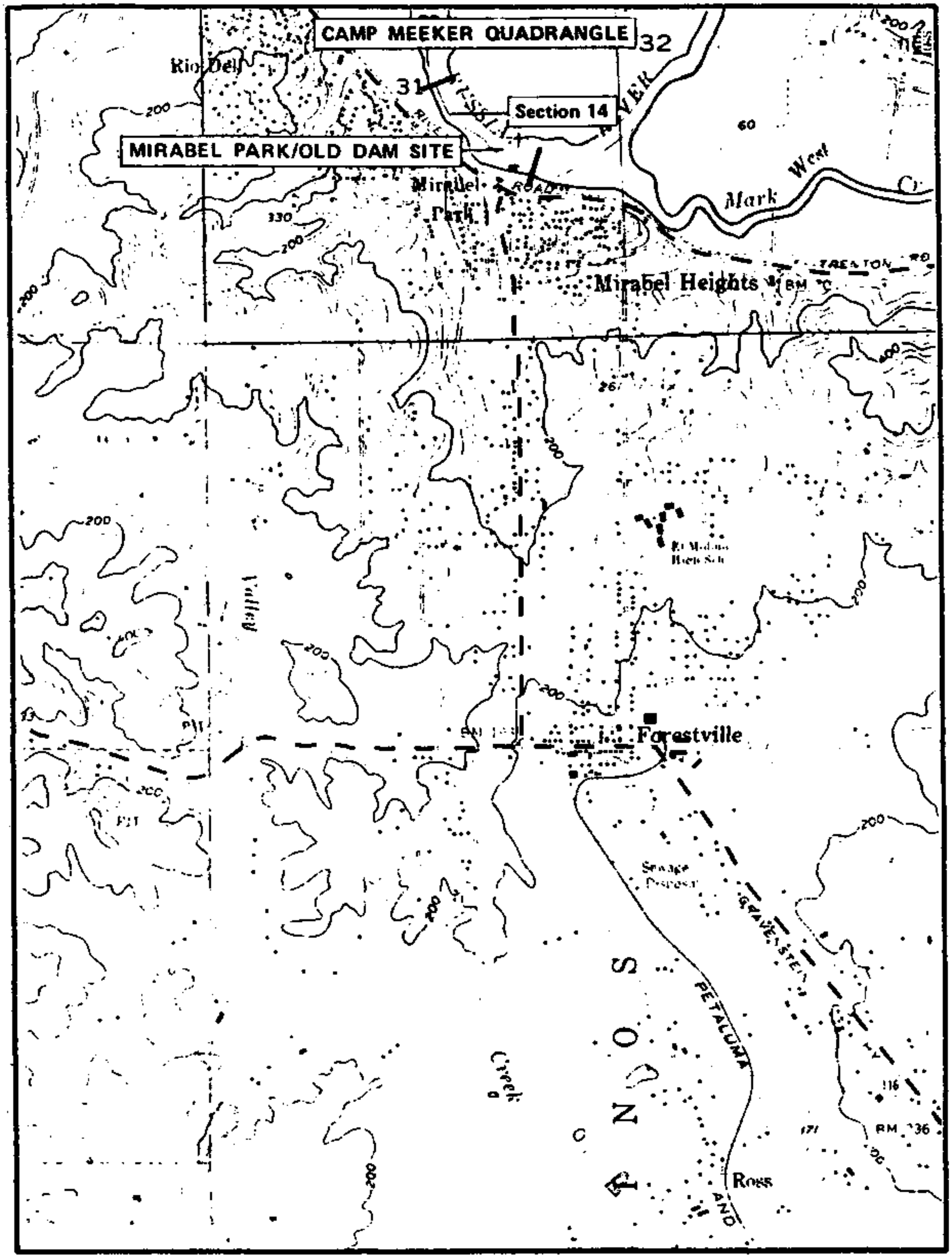
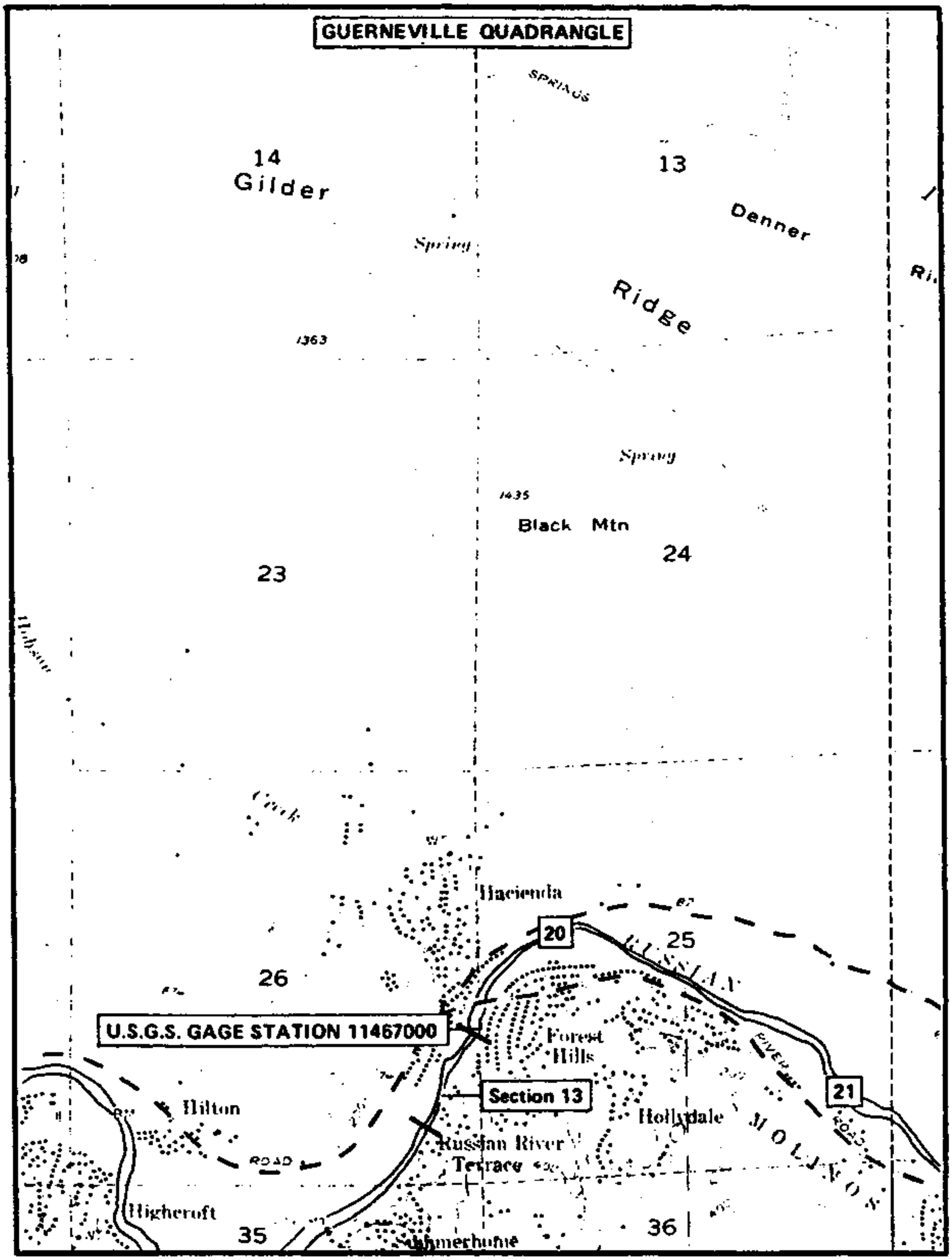
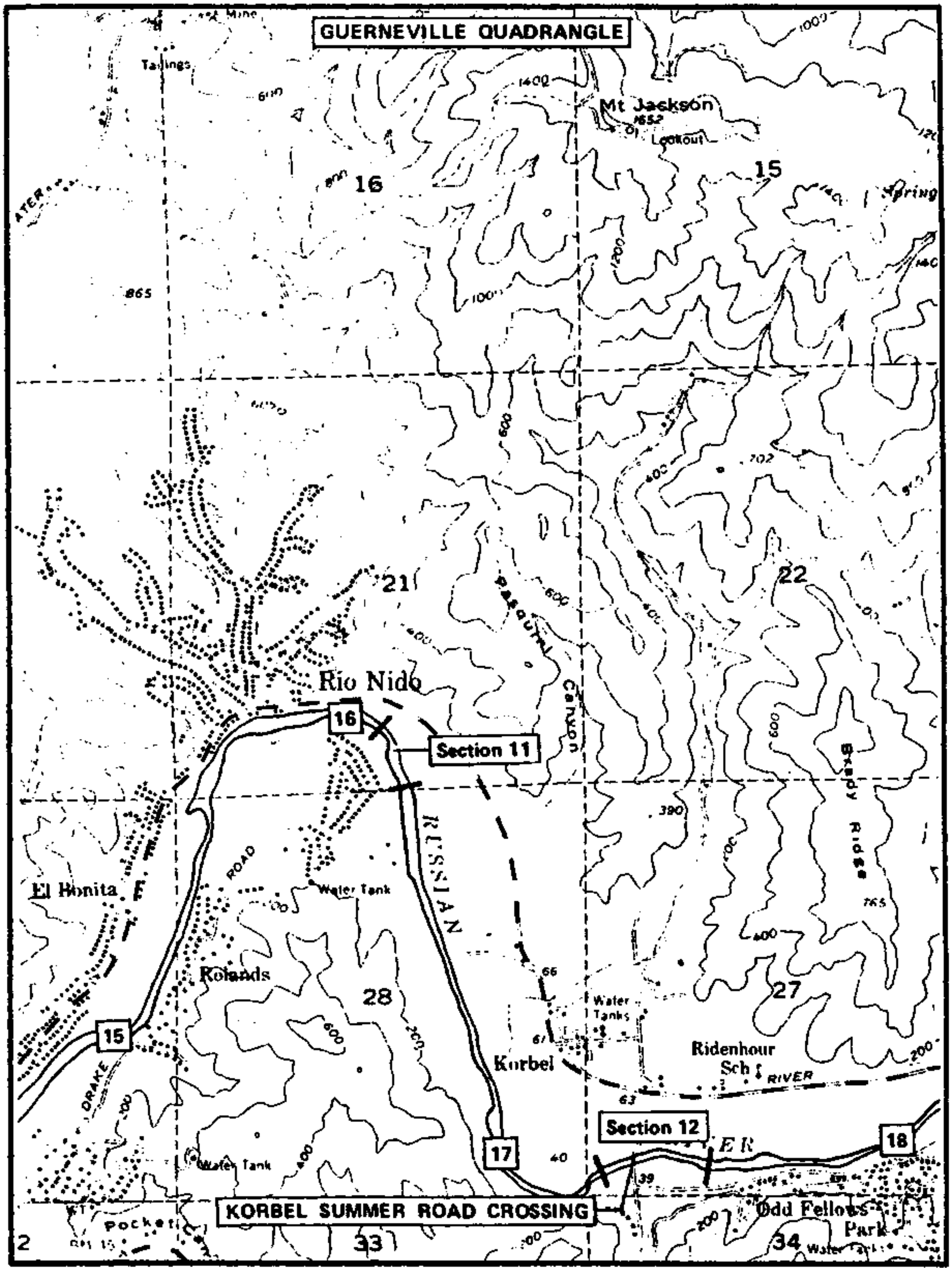


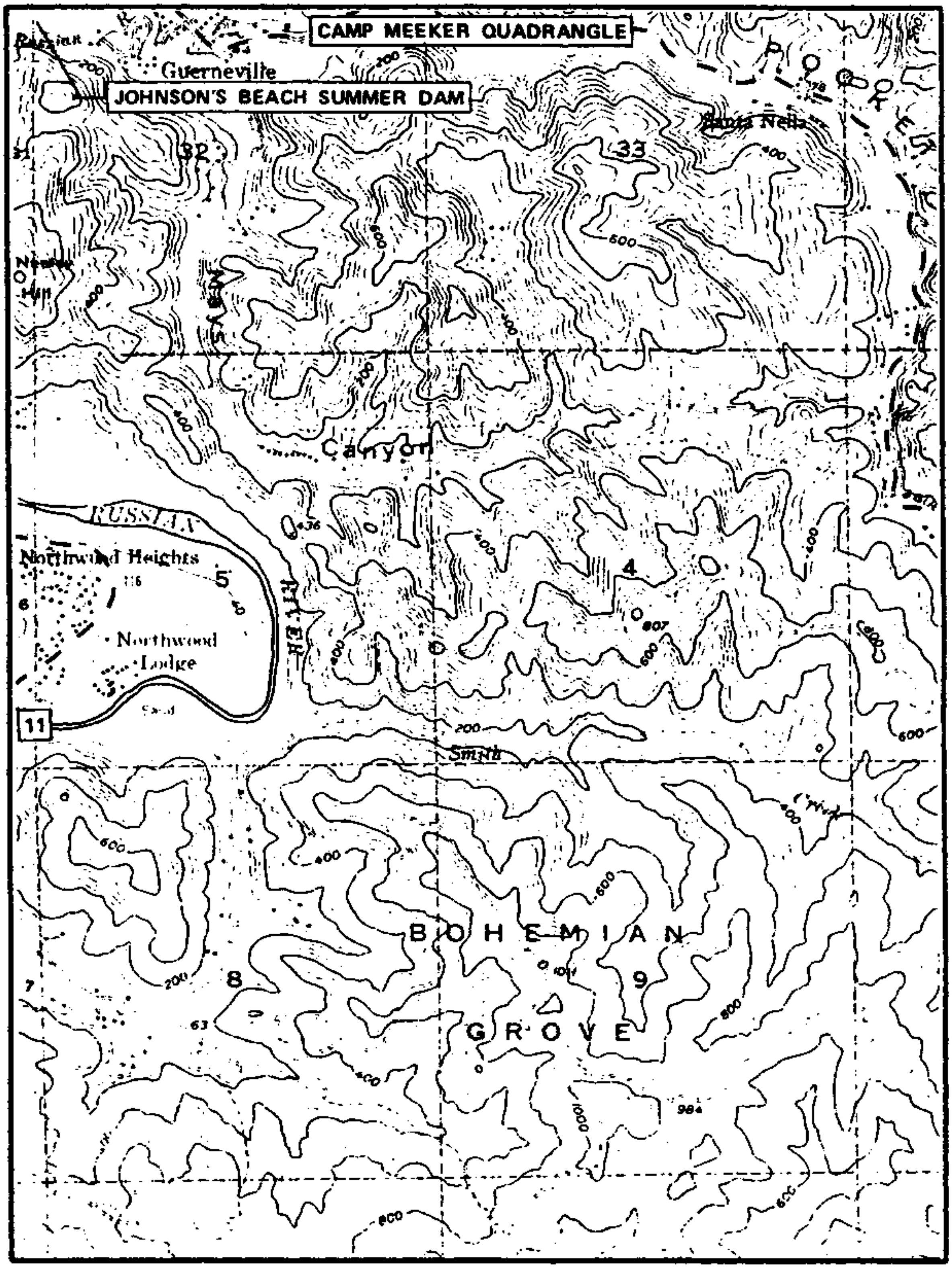
Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



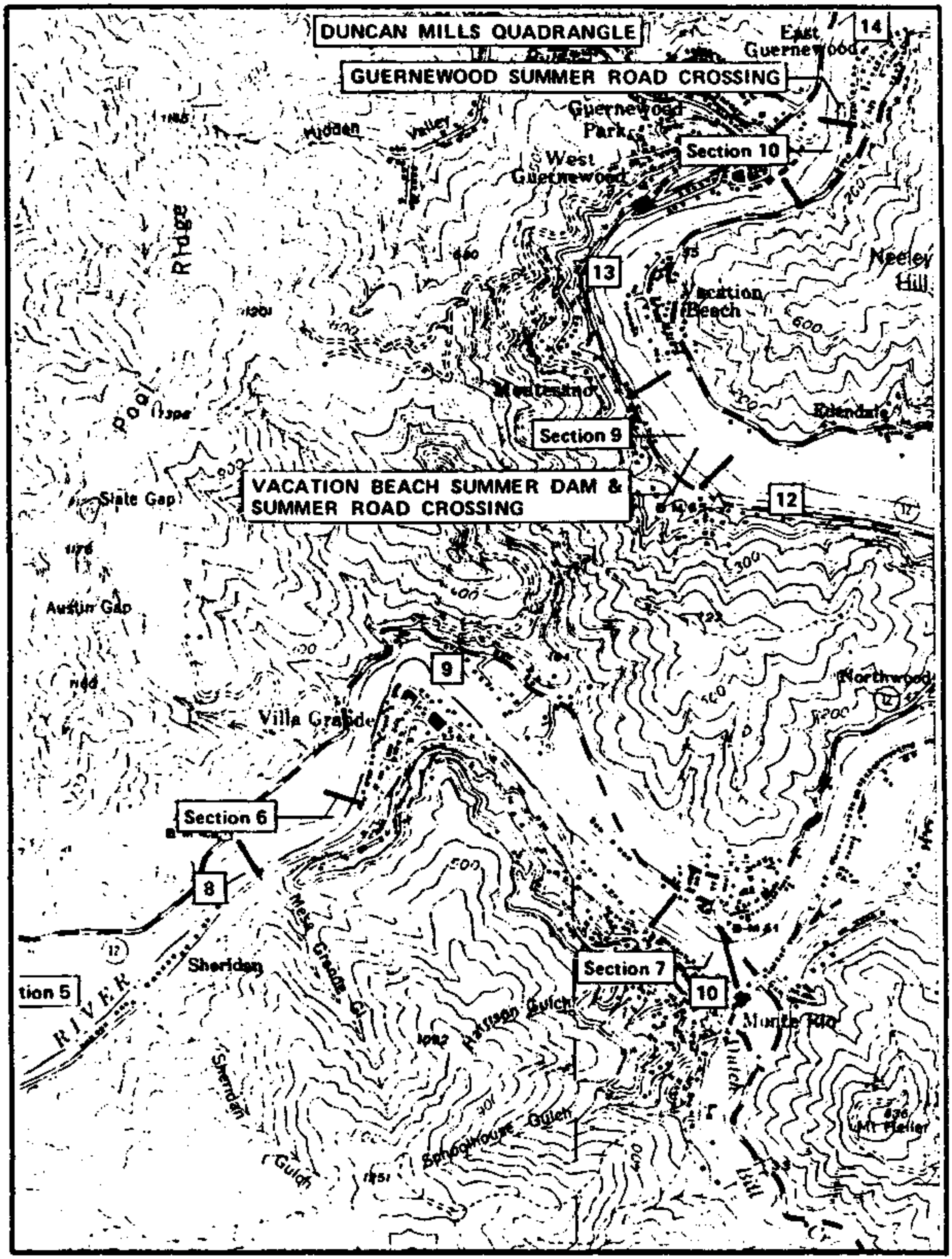
Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



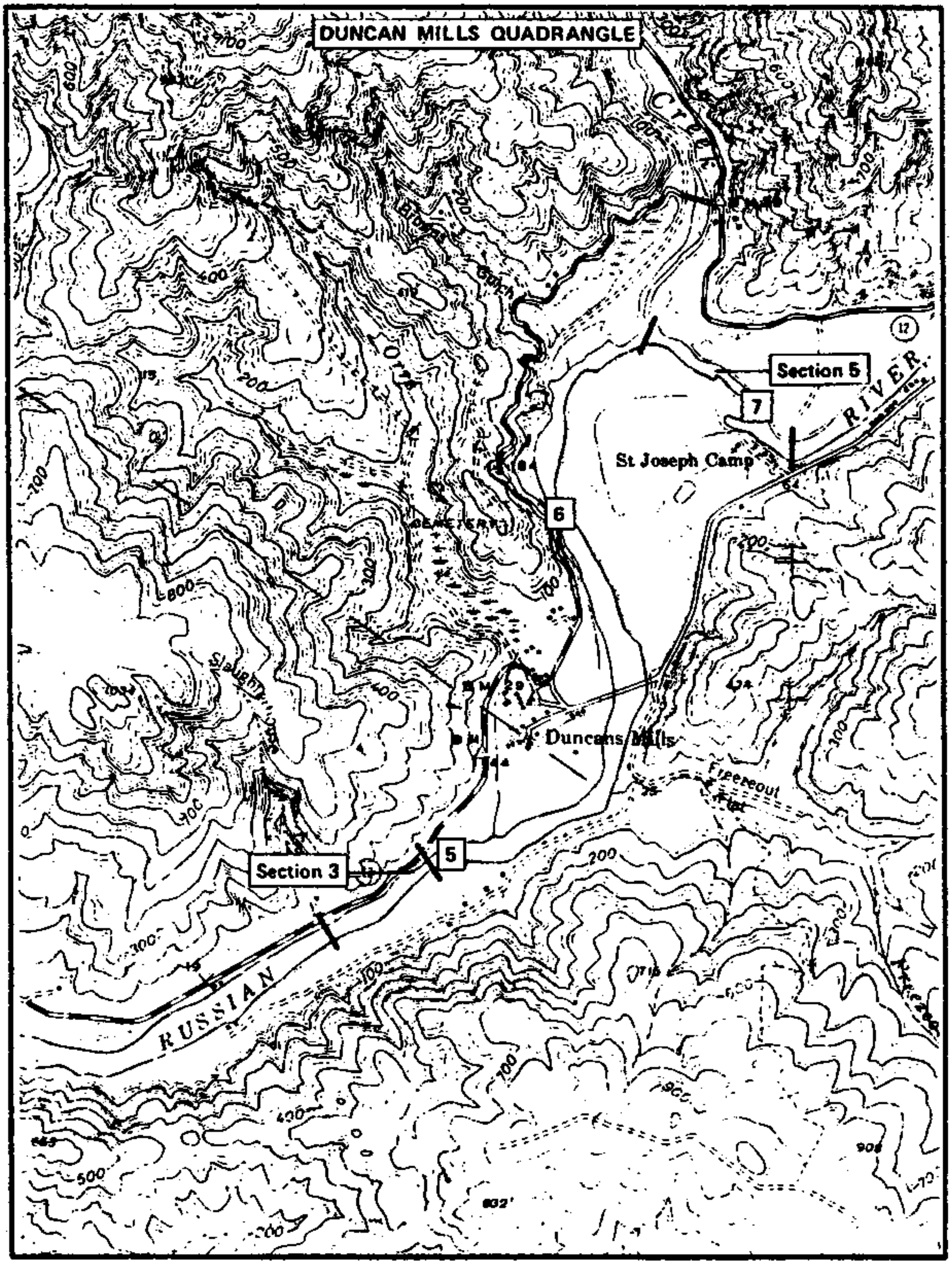
Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



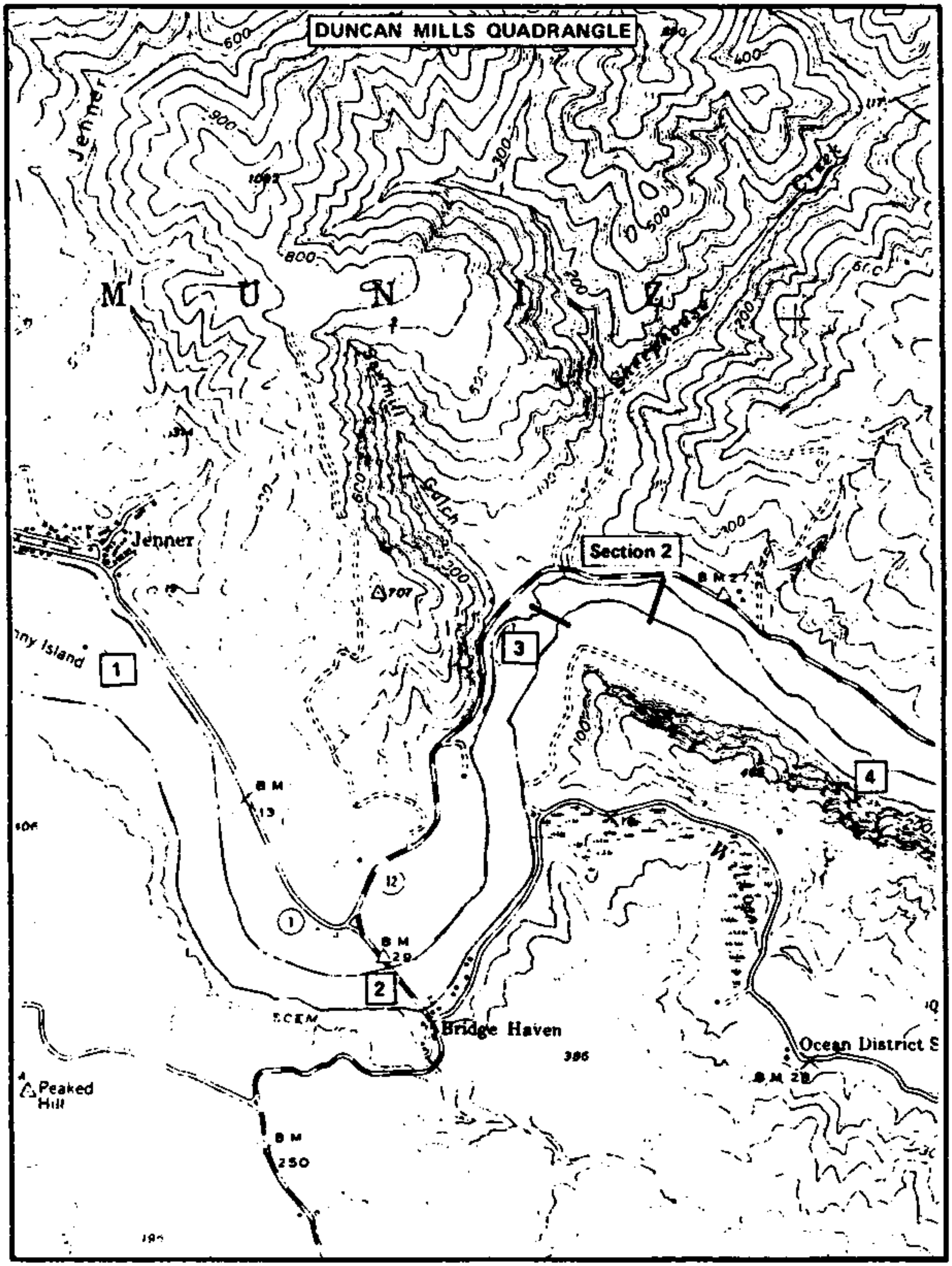
Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



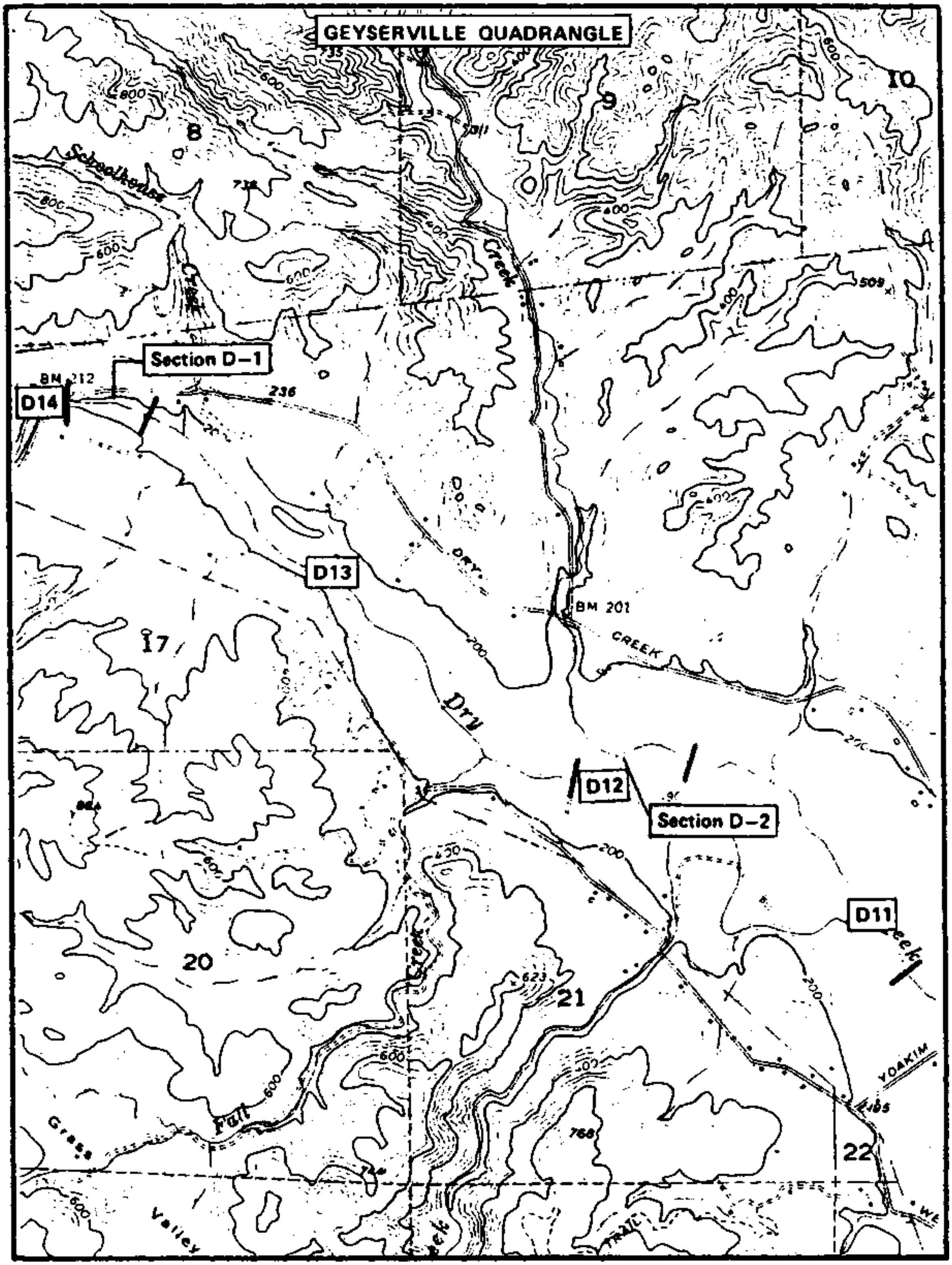
Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



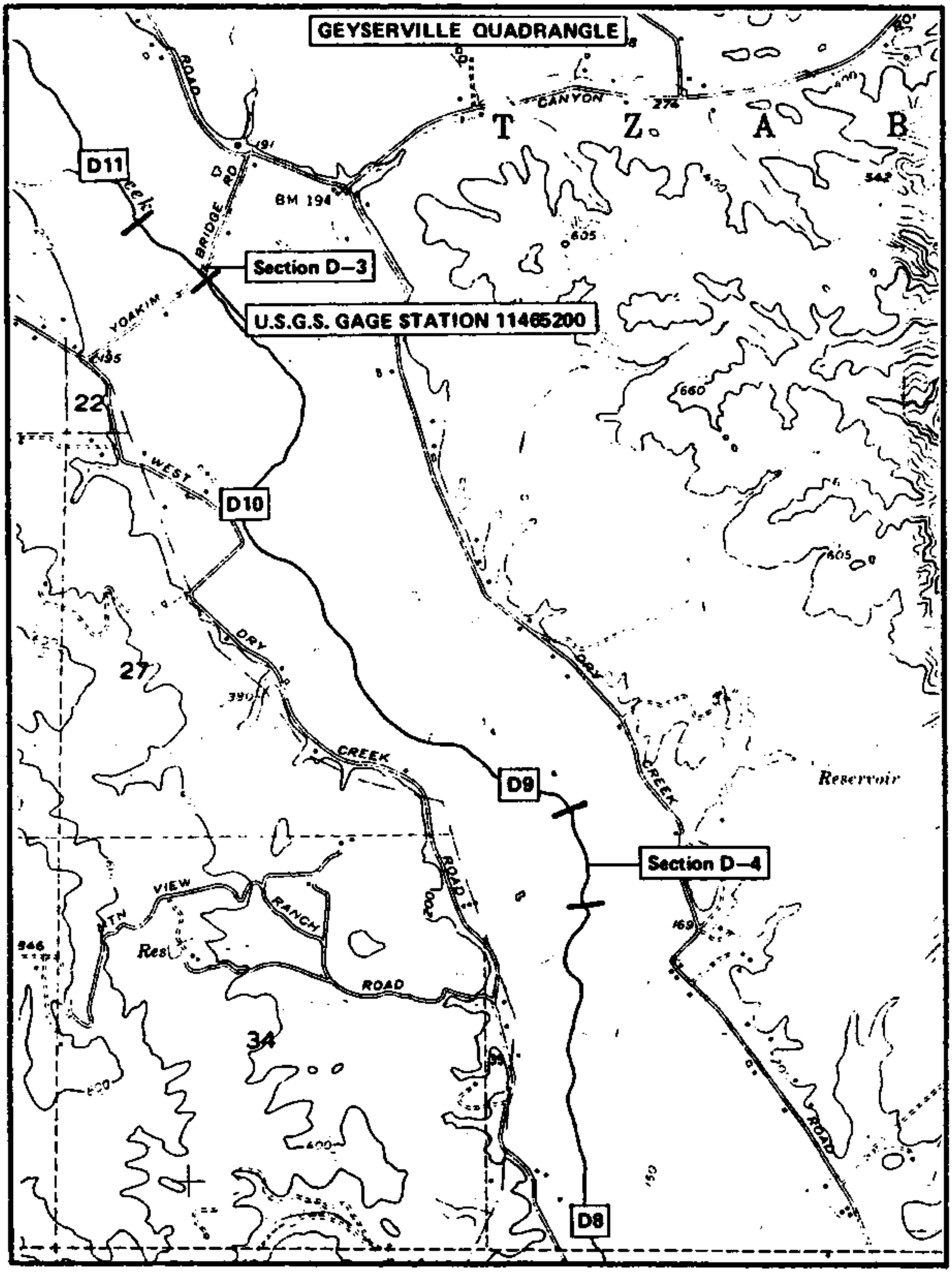
Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek

DRY

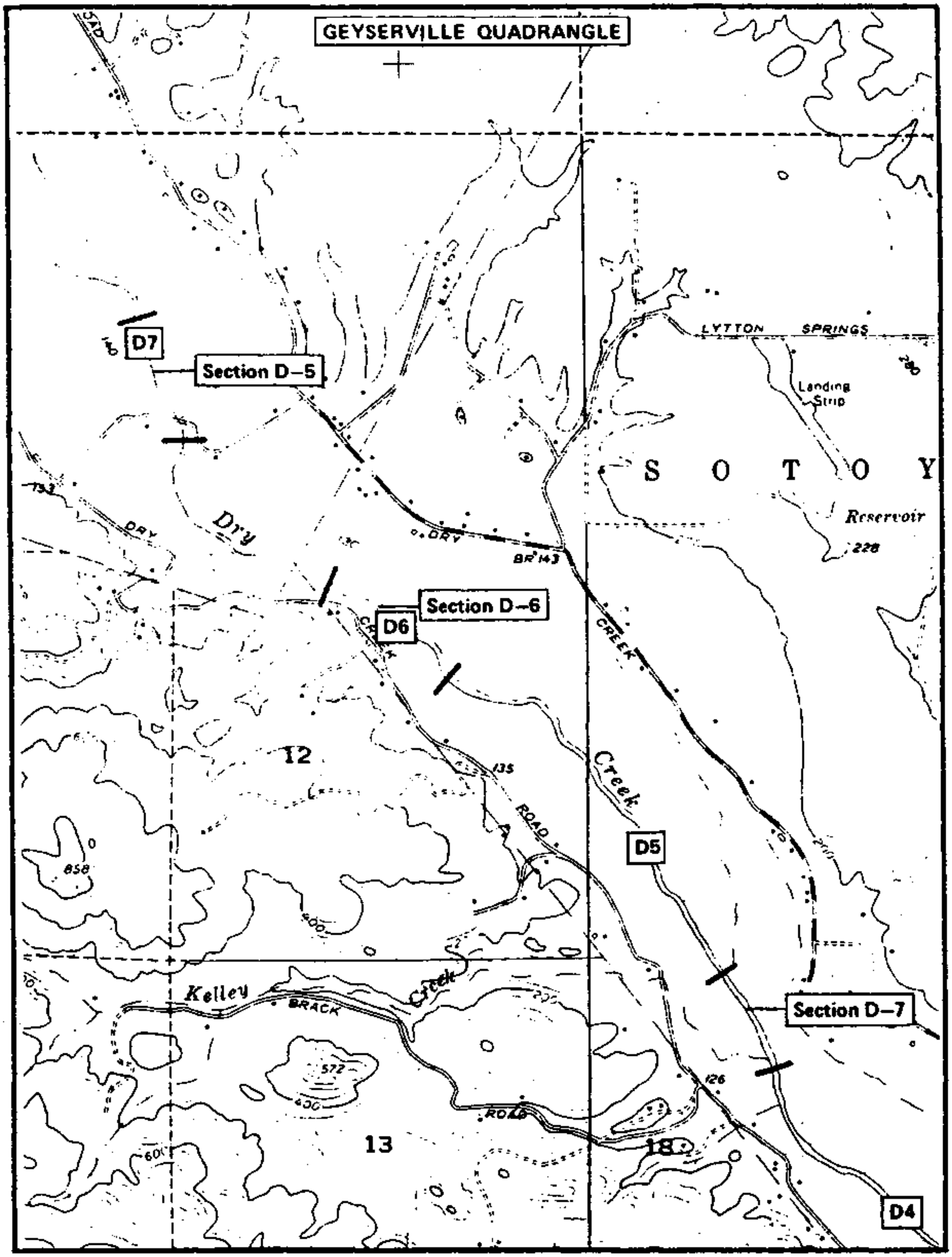
CREEK



Location of Study Sections, Instream Structures and U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek



Location of Study Sections, Instream Structures and
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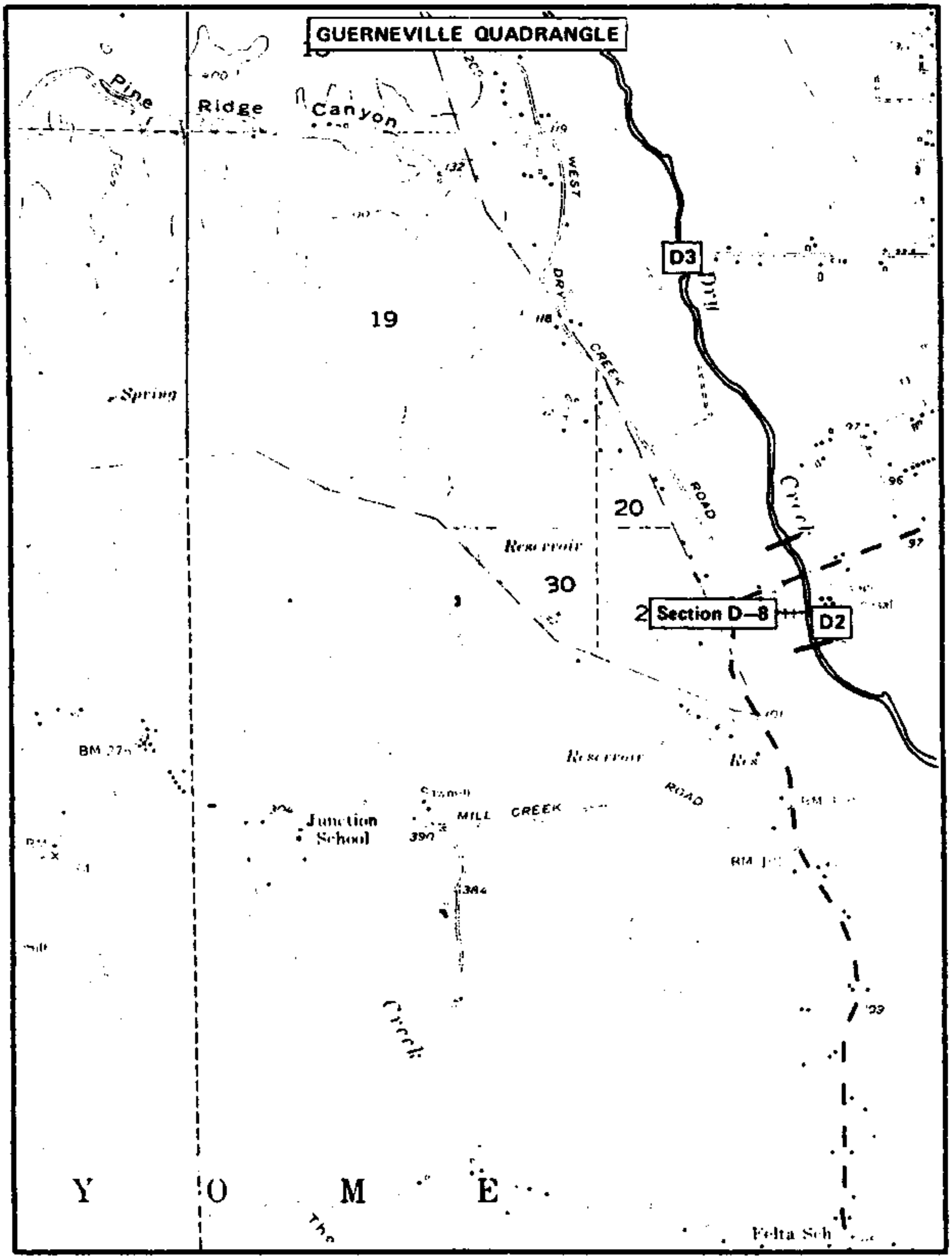


Location of Study Sections, Instream Structures and
U.S.G.S. Gage Stations - Russian River and Lower Dry Creek

Appendix B

Mainstem Russian River and Lower Dry Creek
Instream Structure Data

Source: Literature Search
Agency Archives Inspection
Field Observations

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

STRUCTURE Willow County Water Diversion Dam

LOCATION Russian River Mile 88 (Map Ref. Pg. A-3)

OWNER Willow County Water District

PURPOSE Irrigation and increased flows into well casings

OPERATION Permanent structure

CONSTRUCTION Dam is constructed of rock and slabs of old concrete sidewalks.

FISH PASSAGE East side of spillway is somewhat lower than rest and allows more flow. Migrating fish appear to use this section to a great extent.

REFERENCES California Department of Fish and Game, 1977

Instream Structure Observations and Water Quality
Mainstem

Structure-	Willow County Water Diversion Dam	Date of Observation	5/6/78
Location-	Russian River Mile 88	Observed Flow (cfs)	325 (estimate)

Cross Channel Width (Feet)	122
Dam Height (Feet)	6.7
Spillway Width (Feet)	106
Spillway Height (Feet)	6.7
Spillway Thickness (Feet)	20.0 (irregular)
Depth of Water over Spillway (Feet)	1.5
Spillway Velocity (Surface)	8.0 FPS
Plunge Pool Depth (Feet)	N/A
Maximum Depth Behind Dam (Feet)	N/A
Jumping Distance (vertical-water surface at spillway to water surface below spillway)	5.5 ft

Water quality data on 7/17/78 data form

Water Quality Information	Upstream	Downstream
Turbidity (NTU)		
Dissolved Oxygen (ppm)		
Temperature (°C) at Time of Day Taken		

Water Quality Information at Structure	Surface	Mid-depth	Bottom
Turbidity (NTU)			
Dissolved Oxygen (ppm)			
Temperature (°C) at Time of Day Taken			

Transparency (Feet) ________

Instream Structure Observations and Water Quality
Mainstem

Structure: Willow County Water Diversion Dam

Location: Russian River Mile 88

Date of Observation: 7/17/78

Observed Flow (cfs): 227

Cross Channel Width (Feet)	122
Dam Height (Feet)	6.7
Spillway Width (Feet)	106
Spillway Height (Feet)	6.7
Spillway Thickness (Feet)	20.0 (irregular)
Depth of Water over Spillway (Feet)	1.0
Spillway Velocity (Surface)	7.2 FPS
Plunge Pool Depth (Feet)	5 (estimate)
Maximum Depth Behind Dam (Feet)	6.7
Jumping Distance (vertical-water surface at spillway to water surface below spillway)	6.0 ft.

Water Quality Information	Upstream	Downstream
Turbidity (NTU)	4.0 to 5.0 (est.)	4.0 to 5.0 (est.)
Dissolved Oxygen (ppm)	sample disturbed	sample disturbed
Temperature (°C) at Time of Day Taken	17.0@1320	17.0@1320

Water Quality Information at Structure	Surface	Mid-depth	Bottom
Turbidity (NTU)	4.0 to 5.0 estimate		
Dissolved Oxygen (ppm)	sample disturbed	sample disturbed	sample disturbed
Temperature (°C) at Time of Day Taken	17.0@1340	17.0@1340	17.0@1340
Transparency (Feet)	3.0		

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

STRUCTURE	Cummiskey Station River Ford
LOCATION	Russian River Mile 67 (Map Ref. Pg. A-9)
OWNER	Russel V. Lee
PURPOSE	Summer access
OPERATION	Unknown - summer months
CONSTRUCTION	Consists of gravel and riprap abutments with railroad flat cars and concrete filled caissons.
FISH PASSAGE	Unknown
REFERENCES	California Department of Fish and Game 1975, Form 1603-III-257-75

Instream Structure Observations and Water Quality
Mainstem

Structure: Cummiskey Station River Ford Date of Observation 7/19/78

Location: Russian River Mile 67 Observed Flow (cfs) 238

Cross Channel Width (Feet) 240

Bridge Width (Feet) bridge not installed*

Bridge Height Above Water Surface (Feet) N/A

Number of Channels N/A

Channel Information	Width (Feet)	Depth (Feet)	Surface Velocity (FPS)

Impounded Water Surface Width (Feet) N/A

Flowing Water Surface Width (Feet) 240

Water Quality Data	Upstream	@ Structure	Downstream
Turbidity (NTU)			
Dissolved Oxygem (ppm)			
Water Temperature (°C) at Time of Day Taken			

*Note - There were no instream structures in place at Cummiskey Station.

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

STRUCTURE	Asti Summer Road Crossing
LOCATION	Russian River Mile 56 (Map Ref. Pg. A-12)
OWNER	Sonoma County Public Works Department
PURPOSE	Summer road crossing
OPERATION	Approximately May 15 to October 31
CONSTRUCTION	Four concrete piers are permanently anchored in the river channel. Steel spans are placed on top of these piers in May and a gravel roadway is constructed across the rest of the channel.
FISH PASSAGE	Consists of the channels between the permanent concrete piers.
REFERENCES	Schultz, 1976 Robertson, 1978

Instream Structure Observations and Water Quality
Mainstem

Structure: Asti Summer Road Crossing — Date of Observation: 7/26

Location: Russian River Mile 56 — Observed Flow (cfs): 214

Cross Channel Width (Feet): 570

Bridge Width (Feet): 60

Bridge Height-Above Water Surface (Feet): 4

Number of Channels: 3

Channel Information	Width (Feet)	Depth (Feet)	Surface Velocity (FPS)
Left channel	18.0	1.0	1.62
Middle channel	18.0	4.0	3.05
Right channel	18.0	2.0	1.18

Impounded Water Surface Width (Feet): (no impounded water)

Flowing Water Surface Width (Feet): 54

Water Quality Data	Upstream *	@ Structure	Downstream *
Turbidity (NTU)	N/A	2.4	N/A
Dissolved Oxygem (ppm)	N/A	11.1	N/A
Water Temperature (°C) at Time of Day Taken	N/A	20@0900	N/A

*Note - No impoundment of water was evident; water quality data should not vary either above or below the structure.

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

STRUCTURE	Del Rio Woods Dam
LOCATION	Russian River Mile 35 (Map Ref. Pg. A-16)
OWNER	Del Rio Woods Recreation District
PURPOSE	Summer recreation dam
OPERATION	Approximately Memorial Day to sometime after Labor Day
CONSTRUCTION	Permanent "U" shaped concrete steel and wood spillway anchored in the center of the channel. Gravel dikes constructed in the spring on either side of the permanent structure divert the channel flow over the spillway.
FISH PASSAGE	None available when dam is in place. During the winter the river flows around each side of the permanent structure.
REFERENCES	Schultz, 1976 Morrison, 1978 Harris, 1974

Instream Structure Observations and Water Quality
Mainstem

Structure- Del Rio Woods Dam

Date of Observation 7/26

Location- Russian River Mile 35

Observed Flow (cfs) 198

Cross Channel Width (Feet)	160
Dam Height (Feet)	12.0
Spillway Width (Feet)	30
Spillway Height (Feet)	7.0 (in steps)
Spillway Thickness (Feet)	38.0
Depth of Water over Spillway (Feet)	1.5
Spillway Velocity (Surface)	7.0 FPS (estimate)
Plunge Pool Depth (Feet)	3.5
Maximum Depth Behind Dam (Feet)	11.0 (maximum)
Jumping Distance (vertical-water surface at spillway to water surface below spillway)	2.7 ft. (maximum)

Water Quality Information	Upstream	Downstream
Turbidity (NTU)	0.7	0.9
Dissolved Oxygen (ppm)	10.2	10.0
Temperature (°C) at Time of Day Taken	22.0@1140	22.0@1140

Water Quality Information at Structure	Surface	Mid-depth	Bottom
Turbidity (NTU)	0.7		
Dissolved Oxygen (ppm)	10.2	10.1	10.0
Temperature (°C) at Time of Day Taken	22.0@1200	22.0@1200	22.0@1200
Transparency (Feet)	8.0		

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

<u>STRUCTURE</u>	Healdsburg Dam (War Memorial Dam)
<u>LOCATION</u>	Russian River Mile 32 (Map Ref. Pg. A-16)
<u>OWNER</u>	Sonoma County Regional Parks and Recreation District
<u>PURPOSE</u>	Summer recreation dam
<u>OPERATION</u>	Approximately Memorial Day to sometime after Labor Day
<u>CONSTRUCTION</u>	Permanent concrete sill with wooden floodgates or flashboards which are raised each spring and supported by steel I-beams.
<u>FISH PASSAGE</u>	None available - only passage is to jump the concrete dam. Total barrier when flashboards are in place.
<u>REFERENCES</u>	Schultz, 1976 Morrison, 1978 Harris, 1974

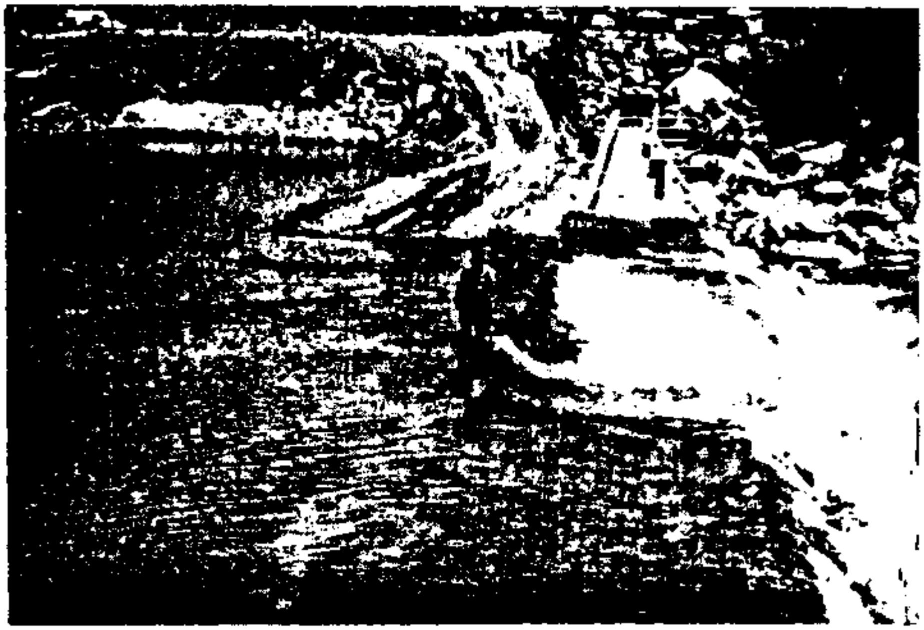
Instream Structure Observations and Water Quality
Mainstem

Structure: Healdsburg Dam

Location: Russian River Mile 32

Date of Observation 4/15/78

Observed Flow (cfs) 1800 (estimate)



Cross Channel Width (Feet)	287
Dam Height (Feet)	5.0
Spillway Width (Feet)	287
Spillway Height (Feet)	5.0
Spillway Thickness (Feet)	N/A
Depth of Water over Spillway (Feet)	1.5
Spillway Velocity (Surface)	8.7 FPS (maximum)
Plunge Pool Depth (Feet)	4 (estimate)
Maximum Depth Behind Dam (Feet)	3 (estimate)
Jumping Distance (vertical-water surface at spillway to water surface below spillway)	5.0 ft.

Water Quality Information — No Information Recorded—Winter Conditions—Dam Not Constructed

	Upstream	Downstream
Turbidity (NTU)		
Dissolved Oxygen (ppm)		
Temperature (°C) at Time of Day Taken		

Water Quality Information at Structure

	Surface	Mid-depth	Bottom
Turbidity (NTU)			
Dissolved Oxygen (ppm)			
Temperature (°C) at Time of Day Taken			

Transparency (Feet) ______

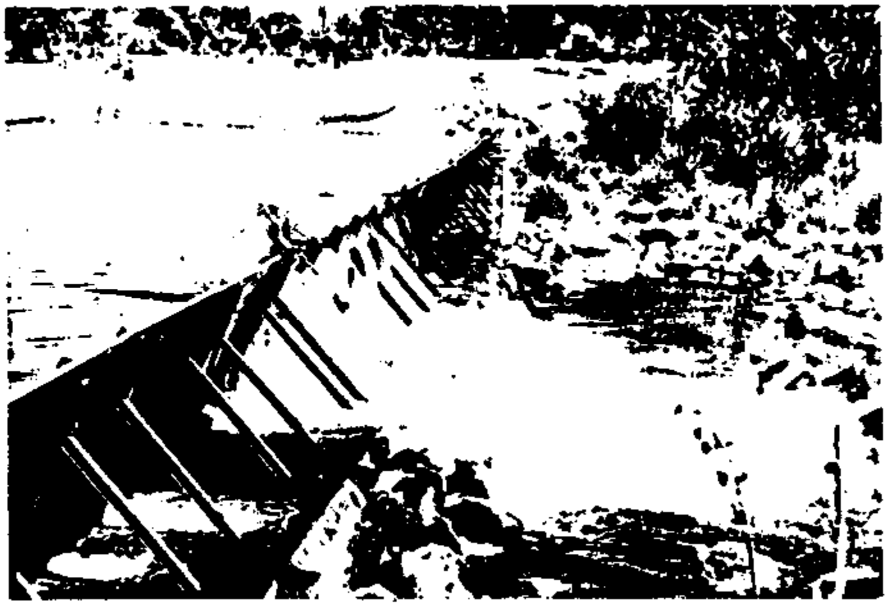
Instream Structure Observations and Water Quality
Mainstem

Structure: Healdsburg Dam

Location: Russian River Mile 32

Date of Observation 7/9/78

Observed Flow (cfs) 196



Cross Channel Width (Feet)	287
Dam Height (Feet)	16.5
Spillway Width (Feet)	37
Spillway Height (Feet)	15.5
Spillway Thickness (Feet)	0.5 (Flashboards)
Depth of Water over Spillway (Feet)	2.0 (estimate)
Spillway Velocity (Surface)	Freefall
Plunge Pool Depth (Feet)	2.5 to 3.0
Maximum Depth Behind Dam (Feet)	11.5
Jumping Distance (vertical-water surface at spillway to water surface below spillway)	12.0

Water Quality Information	Upstream	Downstream
Turbidity (NTU)	1.7	1.7
Dissolved Oxygen (ppm)	9.6	10.8
Temperature (°C) at Time of Day Taken	23.5@1400	23.5@1400

Water Quality Information at Structure	Surface	Mid-depth	Bottom
Turbidity (NTU)	1.7		
Dissolved Oxygen (ppm)	9.6	8.7	9.9
Temperature (°C) at Time of Day Taken	23.5@1415	23.5@1415	23.0@1415

Transparency (Feet) 9.0

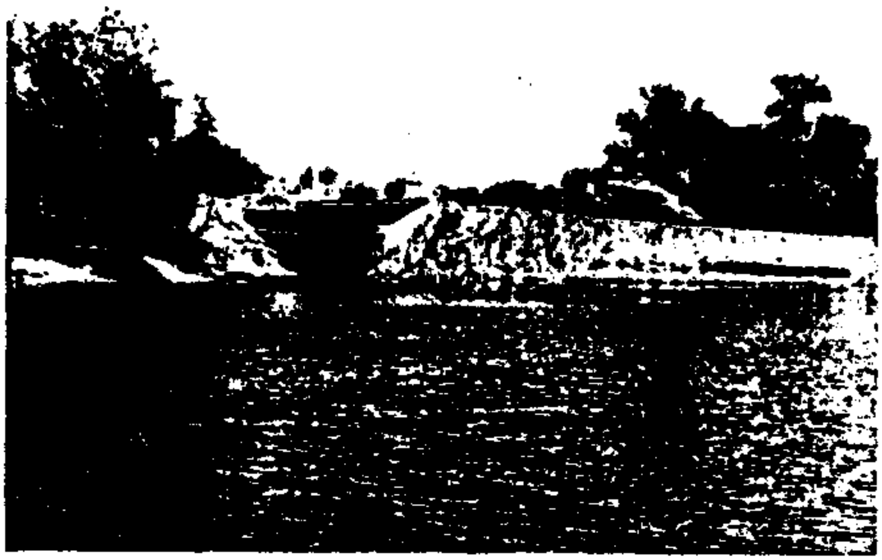
RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

STRUCTURE	Basalt Summer Road Crossing
LOCATION	Russian River Mile 31 (Map Ref. Pg. A-16)
OWNER	Basalt Company
PURPOSE	Summer road crossing
OPERATION	Approximately Memorial Day to sometime after Labor Day
CONSTRUCTION	Permanent concrete abutments on the left side of the river (looking downstream). Gravel road constructed each year channels the river between the abutments.
FISH PASSAGE	Channel between the abutments.
REFERENCES	U.S. Army Corps of Engineers aerial photos

Instream Structure Observations and Water Quality
Mainstem

Structure: Basalt Summer Road Crossing Date of Observation 7/9/78

Location: Russian River Mile 31 Observed Flow (cfs) 196



Cross Channel Width (Feet) 424

Bridge Width (Feet) 50

Bridge Height-Above Water Surface (Feet) 19.2

Number of Channels 2

Channel Information	Width (Feet)	Depth (Feet)	Surface Velocity (FPS)
Left channel	21.0	3.9	3.26
Right channel	21.0	3.5	3.26

Impounded Water Surface Width (Feet) 424

Flowing Water Surface Width (Feet) 42

Water Quality Data	Upstream	@ Structure	Downstream
Turbidity (NTU)	1.7	1.7	0.12
Dissolved Oxygem (ppm)	10.8	10.8	9.5
Water Temperature (°C) at Time of Day Taken	24.0@1500	24.0@1500	23.5@1500

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

STRUCTURE	Two summer dams
LOCATION	Russian River Mile 23 (just above Wohler Bridge) (Map Ref. Pg. A-20)
OWNER	No longer in operation after construction of Wohler Dam
PURPOSE	Unknown
OPERATION	Unknown
CONSTRUCTION	Appeared to be gravel dams with narrow wooden spillways.
FISH PASSAGE	Unknown
REFERENCES	U.S. Army Corps of Engineers aerial photos

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

STRUCTURE	Wohler Dam
LOCATION	Russian River Mile 23 (Map Ref. Pg. A-20)
OWNER	Sonoma County Water Agency
PURPOSE	Utility - water diversion dam for irrigation and municipal water use
OPERATION	Approximately Memorial Day through Labor Day
CONSTRUCTION	Permanent concrete sill with an inflatable dam.
FISH PASSAGE	Two denil fishways are in permanently, one on each side.
REFERENCES	Schultz, 1976 Morrison, 1978

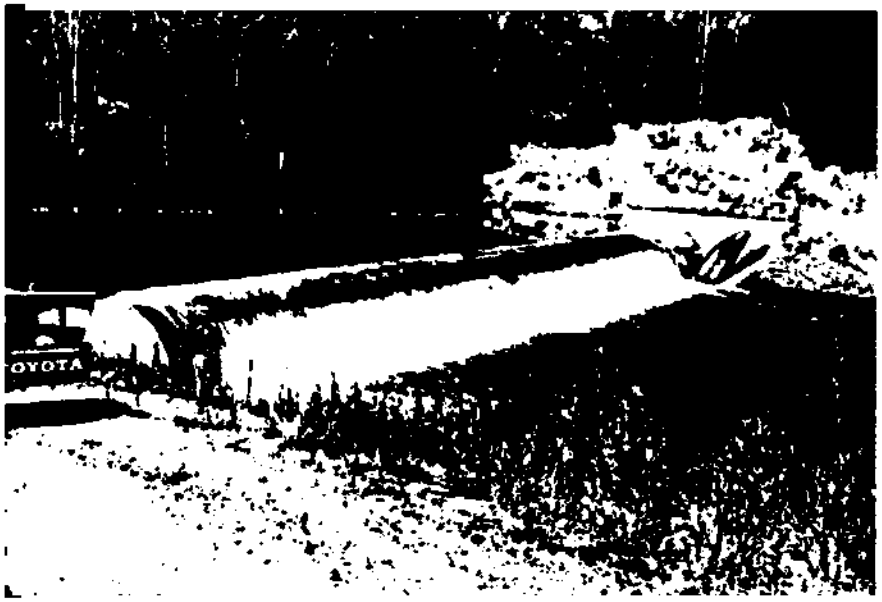
Instream Structure Observations and Water Quality
Mainstem

Structure: Wohler Dam

Location: Russian River 22

Date of Observation: 7/26/78

Observed Flow (cfs): 198



Cross Channel Width (Feet)	190
Dam Height (Feet)	15.0
Spillway Width (Feet)	165
Spillway Height (Feet)	13.0
Spillway Thickness (Feet)	20.0 (inflated)
Depth of Water over Spillway (Feet)	1.0
Spillway Velocity (Surface)	Freefall
Plunge Pool Depth (Feet)	3.0
Maximum Depth Behind Dam (Feet)	11.5
Jumping Distance (vertical-water surface at spillway to water surface below spillway)	8.5 ft. over dam; 2 Denil fishways

Water Quality Information

	Upstream	Downstream
Turbidity (NTU)	1.3	2.1
Dissolved Oxygen (ppm)	10.2	9.7
Temperature (°C) at Time of Day Taken	25.0@1545	25.0@1545

Water Quality Information at Structure

	Surface	Mid-depth	Bottom
Turbidity (NTU)	1.3		
Dissolved Oxygen (ppm)	10.2	9.5	9.4
Temperature (°C) at Time of Day Taken	25.0@1600	24.0@1600	23.5@1600

Transparency (Feet): 7.0

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

STRUCTURE	Mirabel Park (old dam site)
LOCATION	Russian River Mile 22 (Map Ref. Pg. A-21)
OWNER	No longer in operation
PURPOSE	Old dam foundation
OPERATION	No longer in operation
CONSTRUCTION	Jagged wooden piles from an old wooden dam remain in the river.
FISH PASSAGE	Channels between the old wooden piles.
REFERENCES	Schultz, 1976 Harris, 1974

Instream Structure Observations and Water Quality
Mainstem

Structure- Mirabel Park Old Dam Site

Date of Observation 7/25/78

Location- Russian River Mile 22

Observed Flow (cfs) 204

No Data Taken - No Longer an Impoundment

Cross Channel Width (Feet) ______
Dam Height (Feet) ______
Spillway Width (Feet) ______
Spillway Height (Feet) ______
Spillway Thickness (Feet) ______
Depth of Water over Spillway (Feet) ______
Spillway Velocity (Surface) ______
Plunge Pool Depth (Feet) ______
Maximum Depth Behind Dam (Feet) ______
Jumping Distance (vertical-water surface at spillway to water surface below spillway) ______

Water Quality Information	Upstream	Downstream
Turbidity (NTU)		
Dissolved Oxygen (ppm)		
Temperature (°C) at Time of Day Taken		

Water Quality Information at Structure	Surface	Mid-depth	Bottom
Turbidity (NTU)			
Dissolved Oxygen (ppm)			
Temperature (°C) at Time of Day Taken			

Transparency (Feet) ______

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

<u>STRUCTURE</u> Korbel Summer Road Crossing

<u>LOCATION</u> Russian River Mile 17 (Map Ref. Pg. A-23)

<u>OWNER</u> Sonoma County Public Works Department

<u>PURPOSE</u> Summer road crossing

<u>OPERATION</u> Approximately May 15 to October 31

<u>CONSTRUCTION</u> Steel piles were driven 30 feet into bedrock and four 8-foot high concrete piers were constructed as permanent instream structures. Three 20-foot steel spans are laid across the piers each year and a gravel dike is built out to the structure, thus diverting the river to a flow between the piers.

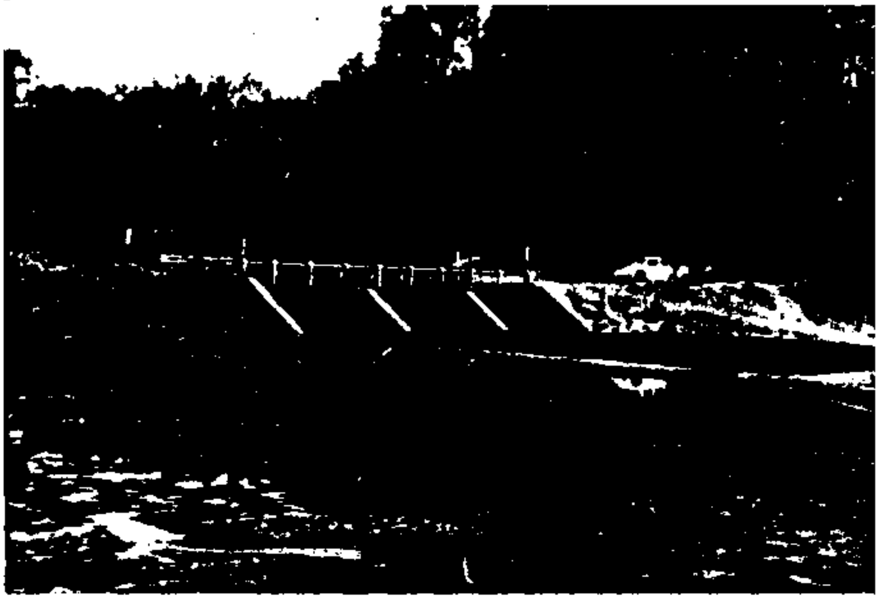
<u>FISH PASSAGE</u> Consists of the channels formed between the permanent concrete piers.

<u>REFERENCES</u> Robertson, 1978

Instream Structure Observations and Water Quality
Mainstem

Structure: Korbel Summer Road Crossing Date of Observation 7/25

Location: Russian River Mile 17 Observed Flow (cfs) 123



Cross Channel Width (Feet) 373

Bridge Width (Feet) 60

Bridge Height-Above Water Surface (Feet) 7.7

Number of Channels 3

Channel Information	Width (Feet)	Depth (Feet)	Surface Velocity (FPS)
Left channel	18.0	1.1	2.11
Middle channel	18.0	1.6	3.20
Right channel	18.0	1.6	3.05

Impounded Water Surface Width (Feet) 200

Flowing Water Surface Width (Feet) 54

Water Quality Data *	Upstream	@ Structure	Downstream
Turbidity (NTU)	N/A	N/A	N/A
Dissolved Oxygem (ppm)	N/A	N/A	N/A
Water Temperature (°C) at Time of Day Taken	N/A	24.5@1100	N/A

*Note - No impoundment was evident except for standing back-water isolated from the free flowing channel.

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

<u>STRUCTURE</u>	Johnson's Beach Dam
<u>LOCATION</u>	Russian River Mile 14 (Map Ref. Pg. A-24)
<u>OWNER</u>	Russian River Parks and Recreation District
<u>PURPOSE</u>	Recreational summer dam
<u>OPERATION</u>	Approximately Memorial Day to sometime after Labor Day.
<u>CONSTRUCTION</u>	Consists of permanent concrete piers across the river. Wooden flashboards are slid into place between the piers in May and gravel dikes are built up to channel the river over the spillway.
<u>FISH PASSAGE</u>	A denil fishway was installed in 1973 and modified in 1975 to reduce fishway velocities by reducing the slope.
<u>REFERENCES</u>	Schultz, 1976 Morrison, 1978 California Department of Fish and Game, 1978c Robertson, 1978 Harris, 1974

Instream Structure Observations and Water Quality
Mainstem

Structure: Johnson's Beach Dam

Date of Observation 7/24/78

Location: Russian River Mile 14

Observed Flow (cfs) 123

Cross Channel Width (Feet)	210
Dam Height (Feet)	8.0
Spillway Width (Feet)	180
Spillway Height (Feet)	7.0
Spillway Thickness (Feet)	0.5 (Flashboards)
Depth of Water over Spillway (Feet)	1.0
Spillway Velocity (Surface)	Freefall
Plunge Pool Depth (Feet)	5.0
Maximum Depth Behind Dam (Feet)	6.8
Jumping Distance (vertical-water surface at spillway to water surface below spillway)	Denil Fishway

Water Quality Information	Upstream	Downstream
Turbidity (NTU)	4.6	4.8
Dissolved Oxygen (ppm)	11.0	9.3
Temperature (°C) at Time of Day Taken	24.0 @0930	23.0 @0930

Water Quality Information at Structure	Surface	Mid-depth	Bottom
Turbidity (NTU)	4.6		
Dissolved Oxygen (ppm)	11.0	N/A	11.4
Temperature (°C) at Time of Day Taken	24.0 @0945	23.5 @0945	23.5 @0945
Transparency (Feet)	3.0		

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

STRUCTURE — Guernewood Summer Road Crossing

LOCATION — Russian River Mile 13 (Map Ref. Pg. A-25)

OWNER — Sonoma County Public Works Department

PURPOSE — Summer road crossing

OPERATION — Approximately Memorial Day through October. Allowed to wash out with high winter flows.

CONSTRUCTION — Consists of six permanent wood pilings approximately 20 feet high and 20 feet apart on the left side of the channel. A gravel dike constructed in May blocks off the remaining river channel.

FISH PASSAGE — Consists of the channels between the wooden piers.

REFERENCES — Robertson, 1978

Instream Structure Observations and Water Quality
Mainstem

Structure: Guernewood Summer Road Crossing

Location: Russian River Mile 13

Date of Observation 7/25/78

Observed Flow (cfs) 123

Cross Channel Width (Feet) 539

Bridge Width (Feet) 100

Bridge Height Above Water Surface (Feet) 9.0 to 12.0

Number of Channels 5

Channel Information		Width (Feet)	Depth (Feet)	Surface Velocity (FPS)
(Left channel)	1	32.0	5.0	
	2	16.0	9.0	
	3	16.0	7.0	0.82 (average)
	4	16.0	3.7	
	5	16.0	2.0	

Impounded Water Surface Width (Feet) 395

Flowing Water Surface Width (Feet) 96

Water Quality Data	Upstream	@ Structure	Downstream
Turbidity (NTU)	4.6	5.6	4.9
Dissolved Oxygem (ppm)	9.3	9.3	9.9
Water Temperature (°C) at Time of Day Taken	24.5 @1200	24.5 @1200	24.5 @1200

STRUCTURE — Vacation Beach Road Crossing

LOCATION — Russian River Mile 12 (Map Ref. Pg. A-25)

OWNER — Sonoma County Road Department

PURPOSE — Summer road crossing

OPERATION — Approximately Memorial Day to end of October

CONSTRUCTION — Crossing consists of steel piles driven 30 feet into bedrock with four permanent 8-foot high concrete piers on which three 20-foot steel spans are bolted during the summer. Gravel dikes are then constructed out to the structure, thus restricting river flow to the channels between the piers.

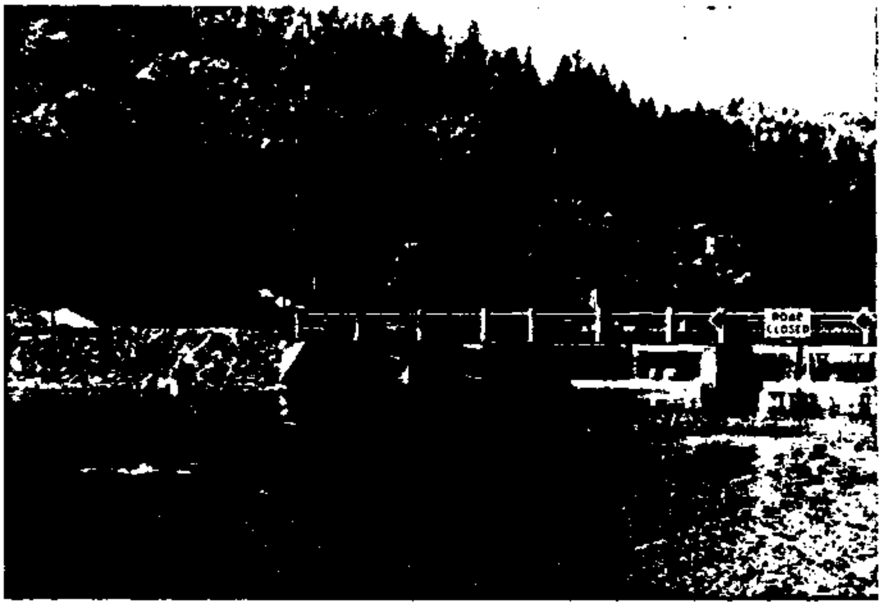
FISH PASSAGE — The river at the bridge is divided into three channels between the concrete piers.

REFERENCES — Schultz, 1976 Morrison, 1978 California Department of Fish and Game, 1978c Robertson, 1978

Instream Structure Observations and Water Quality
Mainstem

Structure: Vacation Beach Summer Road Crossing
Date of Observation: 7/24/78

Location: Russian River Mile 12
Observed Flow (cfs): 123



Cross Channel Width (Feet): 265

Bridge Width (Feet): 60

Bridge Height Above Water Surface (Feet): 5.5

Number of Channels: 3

Channel Information	Width (Feet)	Depth (Feet)	Surface Velocity (FPS)
Left channel	18.0	2.1	
Middle channel	18.0	3.0	2.25 (Average)
Right channel	18.0	2.0	

Impounded Water Surface Width (Feet): 240

Flowing Water Surface Width (Feet): 54

Water Quality Data	Upstream*	@ Structure	Downstream
Turbidity (NTU)	N/A	4.7	N/A
Dissolved Oxygem (ppm)	N/A	10.2	N/A
Water Temperature (°C) at Time of Day Taken	N/A	26.0@1400	N/A

*Note - Turbidity, D.O. and temperature data for upstream and downstream areas are indicated on Vacation Beach Summer Dam data form.

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

STRUCTURE	Vacation Beach Summer Dam
LOCATION	Russian River Mile 12 (Map Ref. Pg. A-25)
OWNER	Russian River Parks and Recreation District
PURPOSE	Recreation
OPERATION	Approximately Memorial Day to sometime after Labor Day
CONSTRUCTION	Permanent concrete foundation with wooden flashboards on hinges that are raised and supported by steel I beams during summer months. Dam is constructed by Russian River Parks and Recreation District.
FISH PASSAGE	A denil fishway was installed at the dam in 1973 and modified in 1975 to reduce fishway velocities.
REFERENCES	Schultz, 1976 Morrison, 1978 California Department of Fish and Game, 1978c Robertson, 1978

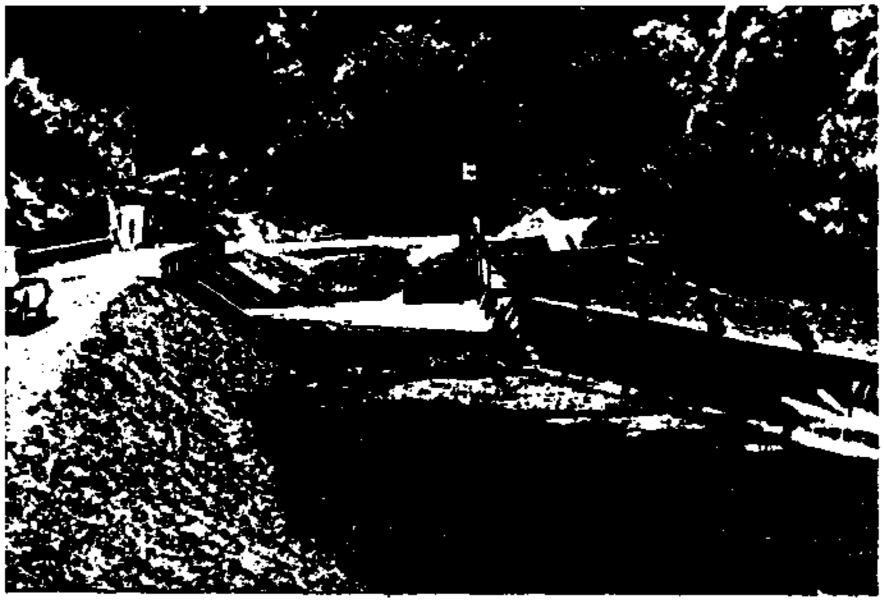
Instream Structure Observations and Water Quality
Mainstem

Structure- Vacation Beach Summer Dam

Date of Observation 7/24/78

Location- Russian River Mile 12

Observed Flow (cfs) 123



Cross Channel Width (Feet)	270
Dam Height (Feet)	8.1
Spillway Width (Feet)	40
Spillway Height (Feet)	7.1
Spillway Thickness (Feet)	0.5 (Flashboards)
Depth of Water over Spillway (Feet)	1.0
Spillway Velocity (Surface)	Freefall
Plunge Pool Depth (Feet)	3.0
Maximum Depth Behind Dam (Feet)	7.0
Jumping Distance (vertical-water surface at spillway to water surface below spillway)	Denil Fishway

Water Quality Information	Upstream	Downstream
Turbidity (NTU)	4.9	4.7
Dissolved Oxygen (ppm)	9.9	10.2
Temperature (°C) at Time of Day Taken	26.0@1350	26.0@1350

Water Quality Information at Structure	Surface	Mid-depth	Bottom
Turbidity (NTU)	4.9		
Dissolved Oxygen (ppm)	9.9	9.7	10.1
Temperature (°C) at Time of Day Taken	26.0@1400	25.5@1400	25.5@1400

Transparency (Feet) 3.0

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

<u>STRUCTURE</u>	Gravel operations
<u>LOCATION</u>	Dry Creek Mile 1 near West Side Road Bridge (Map Ref. pg. A-31)
<u>OWNER</u>	Unknown
<u>PURPOSE</u>	Gravel extraction
<u>OPERATION</u>	Summer months
<u>CONSTRUCTION</u>	Removal of gravel has created deep ponds in the river channel.
<u>FISH PASSAGE</u>	None. River is completely blocked. Appears to go underground and there are large areas of barren gravel with no flow.
<u>REFERENCES</u>	U.S. Army Corps of Engineers aerial photos

RUSSIAN RIVER/DRY CREEK
INSTREAM STRUCTURES

STRUCTURE	Basalt Summer Crossing - Dry Creek
LOCATION	Dry Creek Mile 0 (Map Ref. Pg. A-17)
OWNER	Basalt Company
PURPOSE	Summer access
OPERATION	Approximately Memorial Day to sometime after Labor Day
CONSTRUCTION	Gravel dam with six culverts to allow flow.
FISH PASSAGE	Only through culverts
REFERENCES	U.S. Army Corps of Engineers aerial photos California Department of Fish and Game 1976, Form 1603-III-099-76

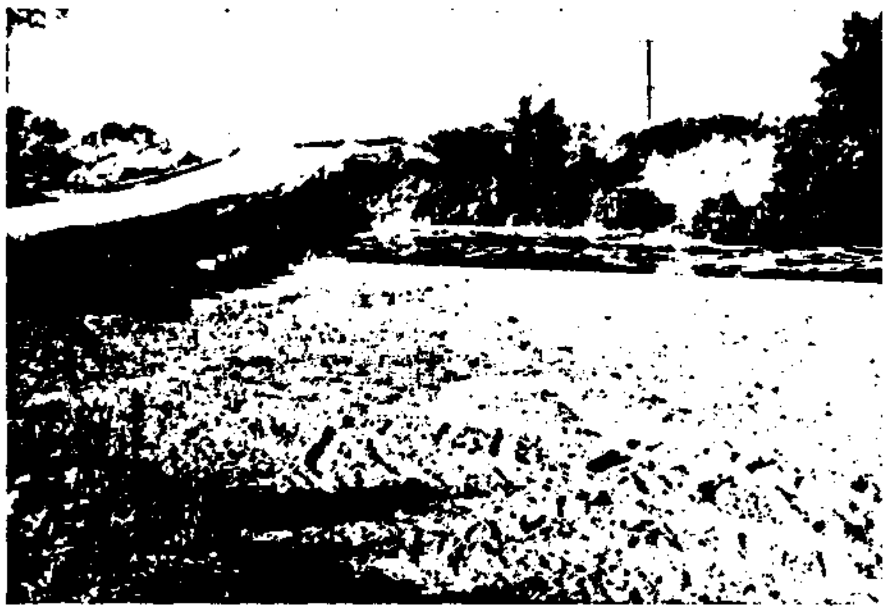
Instream Structure Observations and Water Quality
Dry Creek

Structure: Basalt Summer Crossing

Date of Observation: 7/9/78

Location: Dry Creek Mile 0

Observed Flow (cfs): 0



Cross Channel Width (Feet): 297

Bridge Width (Feet): N/A

Bridge Height Above Water Surface (Feet): 13.7 (top of road)

Number of Channels: 6 culverts *

Channel Information		Width (Feet)	Depth (Feet)	Surface Velocity (FPS)
(left edge of water)	1	3.5	0	0
	2	3.5	0	0
	3	3.5	0	0
	4	3.5	0	0
	5	3.5	0	0
	6	3.5	0	0

Impounded Water Surface Width (Feet): 100

Flowing Water Surface Width (Feet): 32 (below structure)

Water Quality Data	Upstream	@ Structure	Downstream
Turbidity (NTU)	**no data taken		
Dissolved Oxygem (ppm)	no data taken		
Water Temperature (°C) at Time of Day Taken	no data taken		

*Note - Culverts high and dry
**Note - Insufficient water to measure

Appendix C

Fish Habitat Data for Russian River and Dry Creek

Data are organized by study section and river mile and are presented for nursery and spawning habitat observations. Transect cross section profile data for the mainstem and Dry Creek are also presented.

Russian River mainstem spawning habitat observations were made during the period of May 5 through May 18, 1978. Dry Creek spawning habitat observations were made during the period of April 13 through April 15 and on May 15, 1978. Maximum, minimum and average streamflow for these periods is indicated below:

Gage Station	Maximum Streamflow (cfs)	Average Streamflow (cfs)	Minimum Streamflow (cfs)
Hopland	646	416	218
Cloverdale	795	575	285
Healdsburg	1090	839	578
Guerneville	1290	1060	707
Dry Creek	165	124	58

Russian River mainstem and Dry Creek nursery habitat observations were made during the period of July 6 through July 30, 1978. Maximum, minimum and average streamflow for this period is indicated below:

Gage Station	Maximum Streamflow (cfs)	Average Streamflow (cfs)	Minimum Streamflow (cfs)
Hopland	240	216	193
Cloverdale	238	215	193
Healdsburg	246	214	196
Guerneville	299	170	119
Dry Creek	2	<1	<1

Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-2

		Upper Transect	Lower Transect
Section	49		
Section Length (feet)	1320		
River Mite	92		
Habitat Type		riffle-run	pool-run
Water Surface Width (feet)		150	140
Water Temperature (°C) @ Time of Day Taken		13.0 @ 1330	14.0 @ 1420
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:

0.25 2.0 0.5 2.3 0.75 2.3 Distance from Left Edge of Water

Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:

0.25 2.08 0.5 2.33 0.75 2.05 Distance from Left Edge of Water

Water Velocity (FPS) Measured on the Surface at Midstream 2.33

Lower Transect

Water Depth (Feet) at:

0.25 1.0 0.5 0.85 0.75 N/A Distance from Left Edge of Water

Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:

0.25 3.05 0.5 4.14 0.75 N/A Distance from Left Edge of Water

Water Velocity (FPS) Measured on the Surface at Midstream 4.31

Section Habitat

This section is composed primarily of deep willow-lined run habitat. The upper transect is located just above the only example of riffle in this section.

Pool/Riffle Ratio 3:1

Spawning Substrate Observations

The riffle section below the upper transect contains water up to 1.5 feet in depth with good turbulence. Substrate is suitable spawning size with some larger (6 to 12 inch) material. Exposed material along the left edge of the water is suitable for spawning in selected patches. Several Juvenile steelhead were observed and collected in a riffle near the upper transect.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-2

Section	49	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	92		
Habitat Type		run-tail	pool
Water Surface Width (feet)		121	123
Maximum Water Depth (feet)		2.4	2.8
Water Temperature (°C) @ Time of Day Taken		15.0 @ 1110	15.0 @ 1150
Water Transparency (feet)		3.0	3.0
In-Channel Cover (feet)		21	41
In-Channel Vegetative Canopy (feet)		26	26
In-Stream Cover (feet)		15	10
In-Stream Vegetative Canopy (feet)		20	13

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	2.07
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	1.54

Section Pool Quality

Pool and run habitat are good with respect to depth, cover and canopy. Substrate is typically good through the pool habitat sections.

Section Riffle Quality

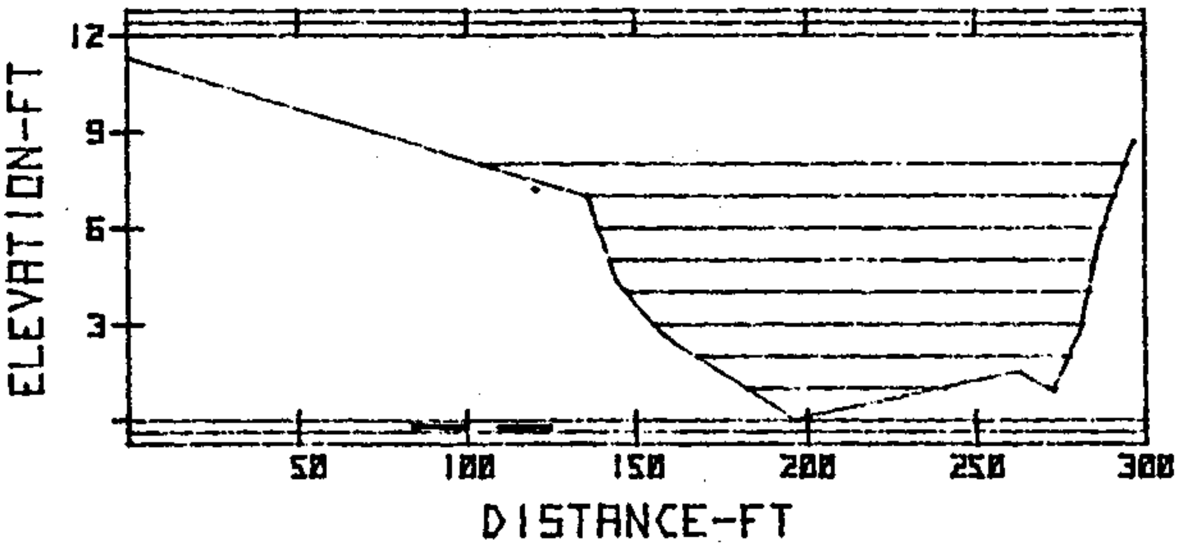
Riffle habitat immediately below the upper transect is good with respect to depth (up to 1.5 feet) and substrate (generally spawning size material).
Invertebrate abundance 100 orgamisms/ft^2.

Pool/Riffle Ratio 3:1

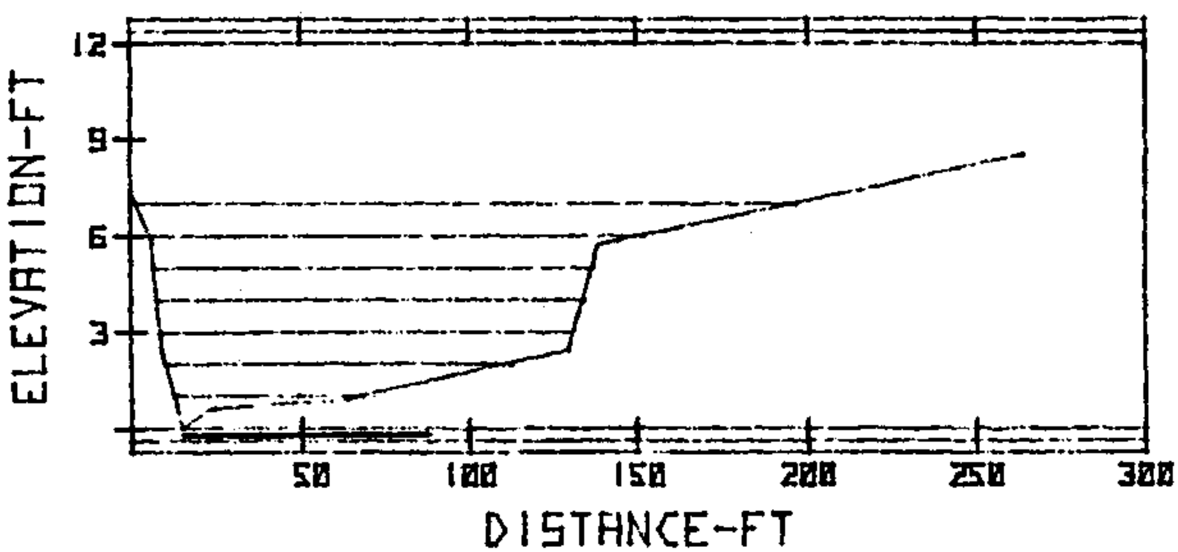
General Section Comments

Juvenile steelhead were collected at the upper transect, indicating potentially satisfactory summer nursery habitat.

RUSSIAN RIVER
CROSS SECTION NUMBER 49
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 49
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-2

		Upper Transect	Lower Transect
Section	48		
Section Length (feet)	1320		
River Mile	90		
Habitat Type		run	pool-run
Water Surface Width (feet)		100	125
Water Temperature (°C) @ Time of Day Taken		14.0 @ 1725	14.0 @ 1645
Water Transparency (feet)		2.0	2.0

Upper Transect

Water Depth (Feet) at:
0.25 0.7 0.5 1.6 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 1.07 0.5 1.83 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.83

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A. 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.28

Section Habitat
Section is composed of pool and deep run habitat.

Pool/Riffle Ratio 100% pool
Spawning Substrate Observations
Very little spawning habitat is available in this section. Just above the upper transect a pool tail is located with potentially usable spawning substrate. Communication with a local fisherman indicated the presence of yearling salmonids in the pool at the lower transect.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-2

		Upper Transect	Lower Transect
Section	48		
Section Length (feet)	1320		
River Mile	90		
Habitat Type		run	pool
Water Surface Width (feet)		80	103
Maximum Water Depth (feet)		3.0	5.7
Water Temperature (°C) @ Time of Day Taken		16.5 @ 1200	15.0 @ 1045
Water Transparency (feet)		3.0	3.0
In-Channel Cover (feet)		7	16
In-Channel Vegetative Canopy (feet)		23	0
In-Stream Cover (feet)		17	1
In-Stream Vegetative Canopy (feet)		28	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 4.92
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 1.03

Section Pool Quality

Pool quality is very good. Much of this section contains habitat greater than 3 feet in depth. Pool substrate is generally fine material. Canopy and cover are generally available on the right edge of water through the upper half of the section and on the left edge of water through the lower half.

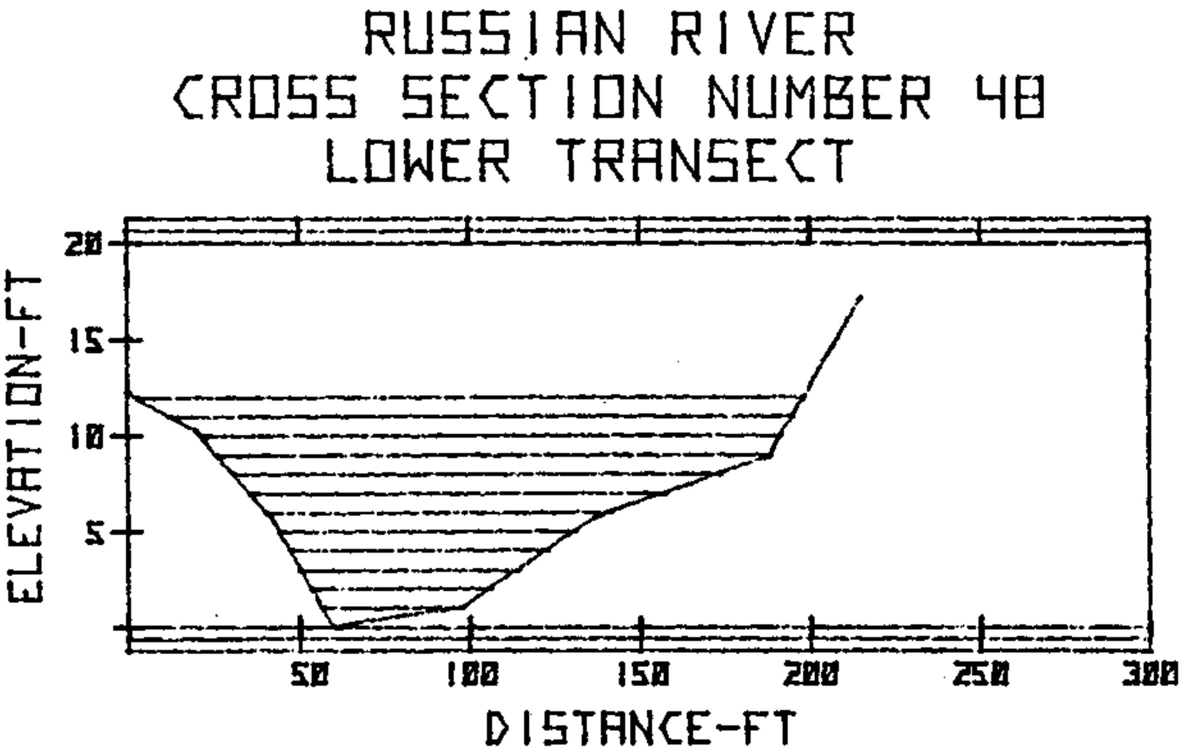
Section Riffle Quality --

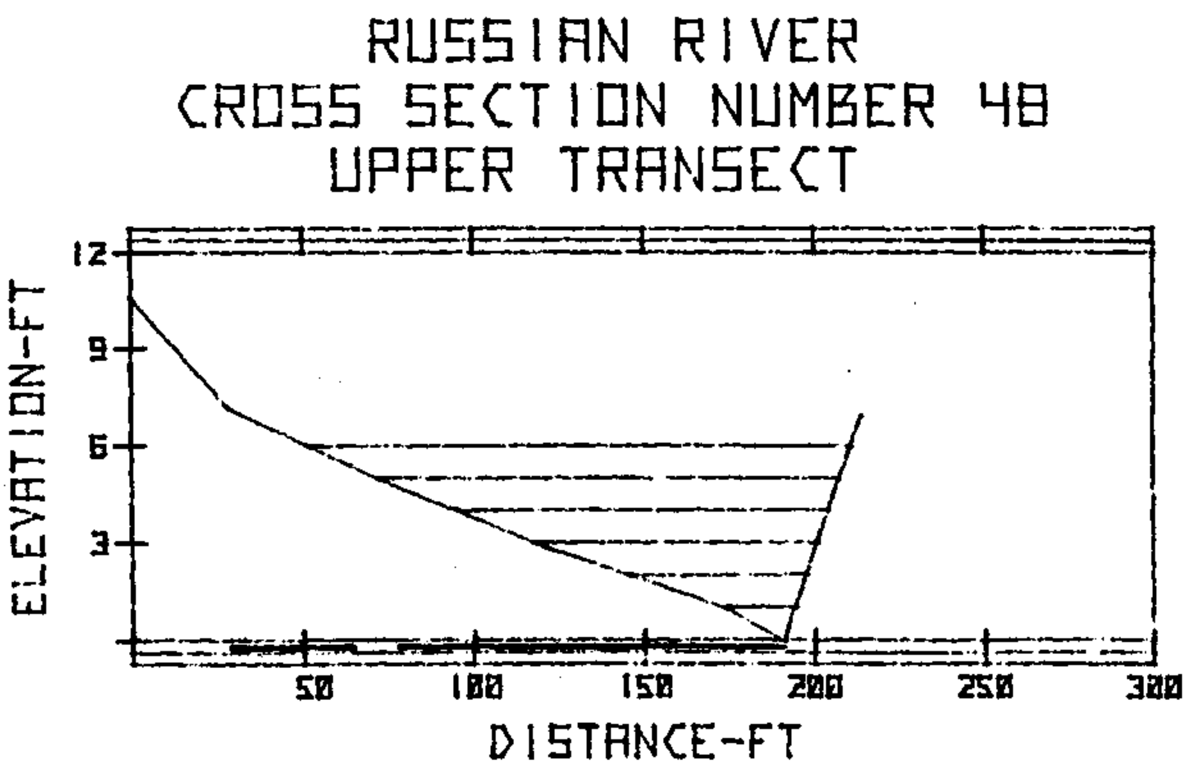
Section 48 contains no riffle habitat. Sixty invertebrates/ft^2 were discovered in the pool tail-riffle above the upper transect.

Pool/Riffle Ratio 100% pool

General Section Comments

Section offers a considerable amount of deep canopy- and cover-sheltered nursery habitat.


RUSSIAN RIVER
CROSS SECTION NUMBER 48
LOWER TRANSECT
ELEVATION-FT
20
15
10
5
50
100
150
200
250
300
DISTANCE-FT


RUSSIAN RIVER
CROSS SECTION NUMBER 48
UPPER TRANSECT
ELEVATION-FT
12
9
6
3
50
100
150
200
250
300
DISTANCE-FT

Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-2

		Upper Transect	Lower Transect
Section	47		
Section Length (feet)	2300		
River Mile	89		
Habitat Type		run-riffle	run-riffle
Water Surface Width (feet)		140	120
Water Temperature (°C) @ Time of Day Taken		11.5 @ 0800	11.5 @ 0830
Water Transparency (feet)		2.5	2.0

Upper Transect

Water Depth (Feet) at:
0.25 1.7 0.5 1.4 0.75 2.2 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 2.95 0.5 2.91 0.75 2.26 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.38

Lower Transect

Water Depth (Feet) at:
0.25 2.2 0.5 1.0 0.75 1.7 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 3.31 0.5 5.38 0.75 3.09 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 6.74

Section Habitat

The majority of this section is a relatively deep, swift, narrow run created by an in-channel gravel operation.
A levee constructed to isolate their work is responsible for the river channelization. Short sections of riffle and pool habitat are available above and below the long run section.

Pool/Riffle Ratio 7.2:1

Spawning Substrate Observations

Two juvenile steelhead were seined from a small riffle below the lower transect. Spawning-size substrate is generally abundant at the mouth of McClure Creek during winter conditions. In addition potentially usable substrate is located at the upper and lower transects.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-2

Section	47	Upper Transect	Lower Transect
Section Length (feet)	2300		
River Mile	39		
Habitat Type		riffle	riffle
Water Surface Width (feet)		139	95
Maximum Water Depth (feet)		4.7	2.9
Water Temperature (°C) @ Time of Day Taken		16.5 @ 1200	15.0 @ 1045
Water Transparency (feet)		3.0	3.0
In-Channel Cover (feet)		7	16
In-Channel Vegetative Canopy (feet)		23	0
In-Stream Cover (feet)		17	1
In-Stream Vegetative Canopy (feet)		28	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 2.76
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 4.24

Section Pool Quality

Runs are prevalent in this section. Pools are located near the upper transect and at the lower transect under the highway bridge. Cover and canopy are very good at each pool location. Maximum depths exceeding 4 feet are available.

Section Riffle Quality

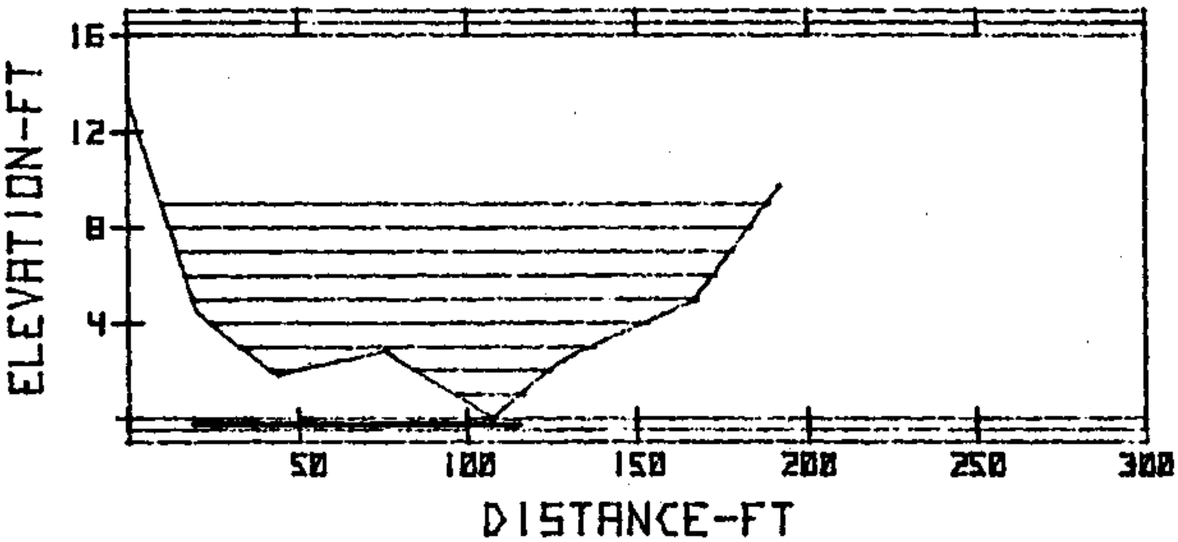
Riffles contain suitable spawning-size substrate and offer a range of depths and velocities. Riffles are generally scarce in this stream section and are not well shoded.

Pool/Riffle Ratio 7.2:1

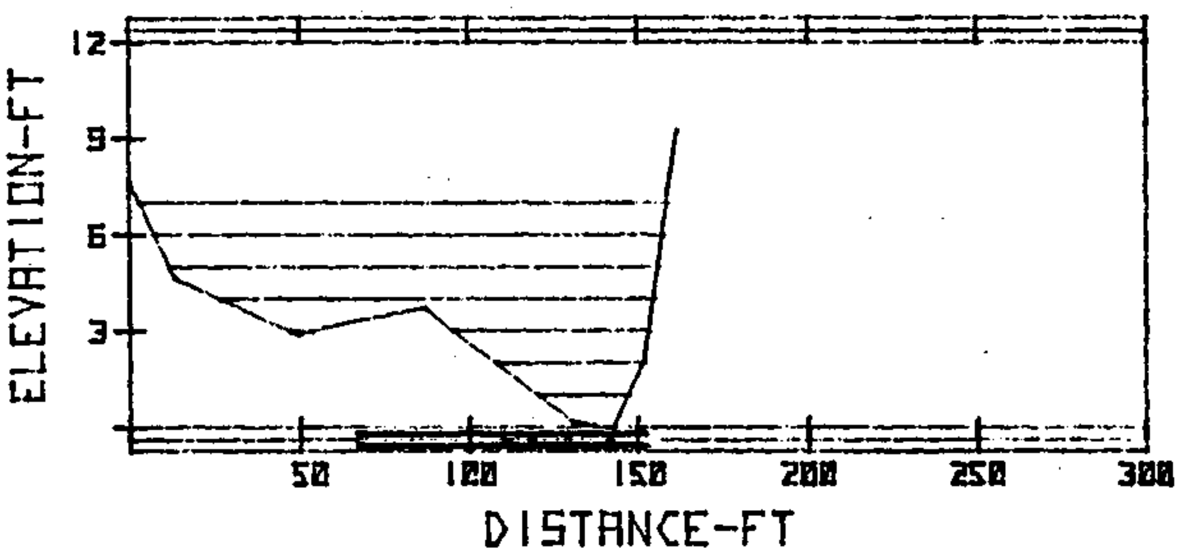
General Section Comments

Canopy is very good on the right edge of the water adjacent to the majority of this river section (run habitat).
An in-channel gravel operation has created most of this run section by constructing a levee to isolate the work. This activity constricts the flow, creating faster, deeper, run habitat. The gravel operation is located at the now-dry mouth of McClure Creek.

RUSSIAN RIVER
CROSS SECTION NUMBER 47
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 47
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-3

Section	46	Upper Transect	Lower Transect
Section Length (feet)	1200		
River Mile	87		
Habitat Type		run	riffle-run
Water Surface Width (feet)		62	63
Water Temperature (°C) @ Time of Day Taken		11.5 @ 1020	11.5 @ 1040
Water Transparency (feet)		2.0	2.0

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.93

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N /A 0.5 N/A 0.75 N/A Distance from Left Edge of
Water Velocity (FPS) Measured on the Surface at Midstream 4.70

Section Habitat

The majority of this section is composed of run habitat with maximum depths greater than 5 feet. Both banks are heavily lined with willow and other riparian vegetation. A stretch of riffle habitat is located at and just above the lower transect.

Pool/Riffle Ratio 2.1:1 S

Spawning Substrate Observations

Riffle section at the lower transect is relatively swift and deep (depth 1 to 3 feet). Substrate is suitable spawning-size material. Elsewhere, very little spawning substrate is available in this section except for a minor amount of exposed material on the gravel bar at the upper transect.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-3

		Upper Transect	Lower Transect
Section	46		
Section Length (feet)	1200		
River Mile	87		
Habitat Type		run	riffle
Water Surface Width (feet)		58	60
Maximum Water Depth (feet)		4.0	3.0
Water Temperature (°C) @ Time of Day Taken		18.5 @ 1610	18.5 @ 1530
Water Transparency (feet)		3.0	3.0
In-Channel Cover (feet)		11	33
In-Channel Vegetative Canopy (feet)		40	32
In-Stream Cover (feet)		1	3
In-Stream Vegetative Canopy (feet)		20	11

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 2.76
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 4.70

Section Pool Quality

The majority of this section is run habitat with the exception of one riffle stretch above the lower transect. Runs are generally well shaded and depths exceeding 5 feet are available.

Section Riffle Quality

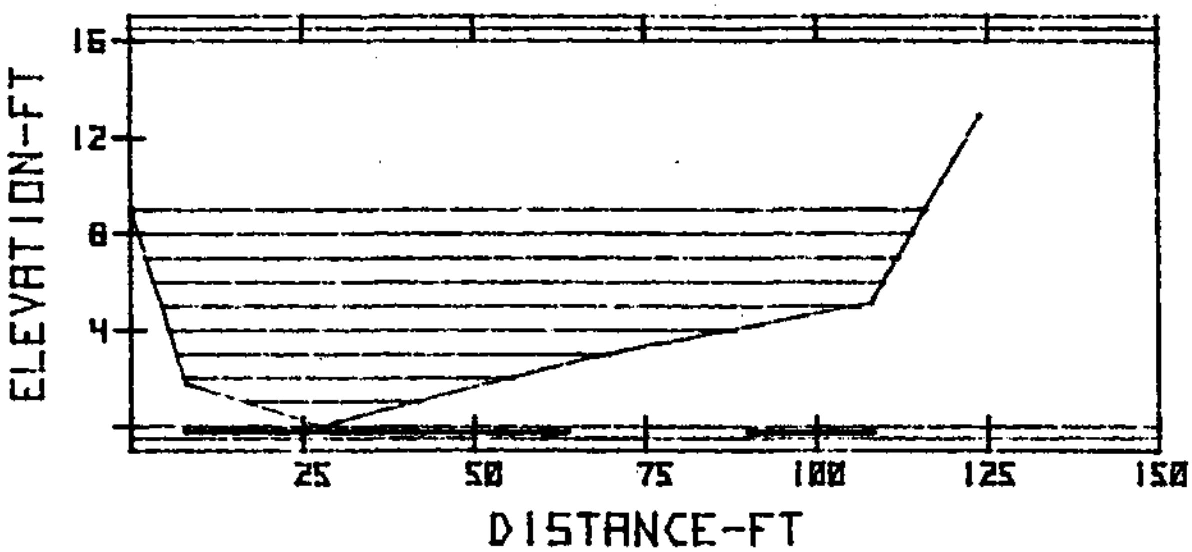
Riffle habitat at the lower transect contains suitable spawning size substrate. In addition, canopy and cover are very good. Depths extend to 3 feet and velocities in the main flow reach a relatively swift 4.70 fps.

Pool/Riffle Ratio 2.1:1

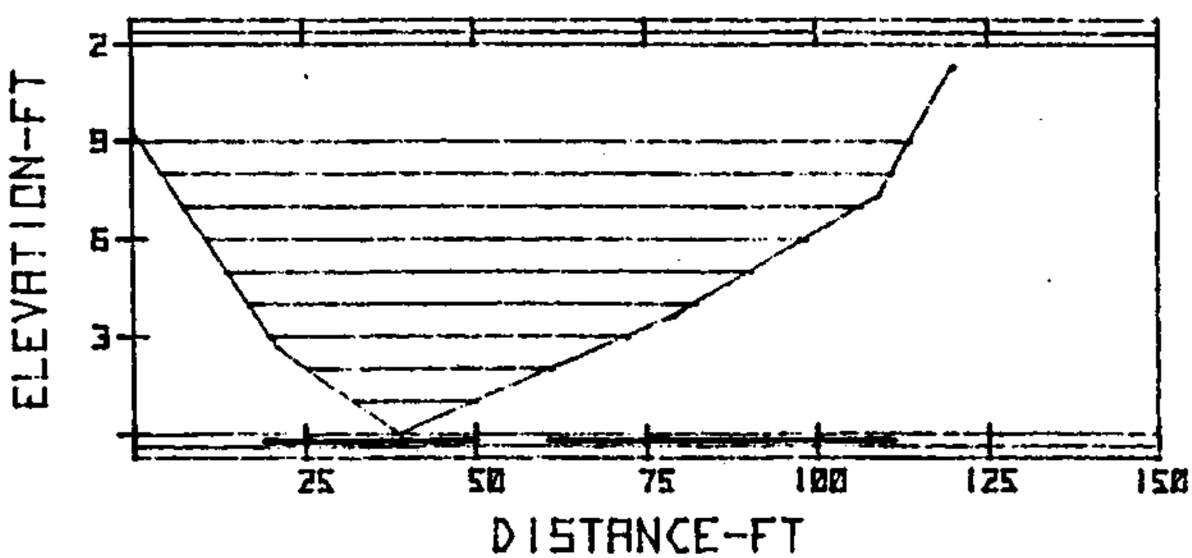
General Section Comments

This section is the most uniform example encountered of run habitat extending practically the length of a stream section. It is also significant in that it contains the greatest amount of riparian vegetation encountered in any sample section. This section is adjacent the Ukiah City Sewage Treatment Plant.

RUSSIAN RIVER
CROSS SECTION NUMBER 46
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 46
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-4

Section	44	Upper Transect	Lower Transect
Section Length (feet)	800		
River Mile	84		
Habitat Type		pool– run	run
Water Surface Width (feet)		80	150
Water Temperature (°C) @ Time of Day Taken		15.0 @ 1420	15.0 @ 1500
Water Transparency (feet)		2.0	2.0

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.92

Lower Transect

Water Depth (Feet) at:
0.25 1.8 0.5 1.6 0.75 1.1 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 2.91 0.5 2.26 0.75 1.58 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 2.51

Section Habitat

The McDonald Creek confluence is at the upper transect; approximately 1 cfs is flowing in McDonald Creek. At the upper transect is pool habitat; run habitat is below the upper transect extending downstream to the riffle at the lower transect.

Pool/Riffle Ratio 4.2:1

Spawning Substrate Observations

Young of the year salmonids were observed at the McDonald Creek confluence in May. Very good spawning substrate is available at the Creek confluence. Potentially usable substrate is also located at the lower transect and on the in-channel island exposed midway in the section.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-4

Section	44	Upper Transect	Lower Transect
Section Length (feet)	800		
River Mile	84		
Habitat Type		pool	riffle
Water Surface Width (feet)		76	134
Maximum Water Depth (feet)		6.0	2.9
Water Temperature (°C) @ Time of Day Taken		15.0 @ 0940	14.5 @ 0830
Water Transparency (feet)		3.0	3.0
In-Channel Cover (feet)		16	19
In-Channel Vegetative Canopy (feet)		33	45
In-Stream Cover (feet)		0	2
In-Stream Vegetative Canopy (feet)		0	15

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 2.11

Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 3.16

Section Pool Quality

The only pool habitat in this section is located at the upper transect. A maximum depth of 6 feet is available in the pool. Very little shading is provided at the observed flow. A stretch of run extends most of the length of this section. Depths are fair and shading is good on the left edge of water.

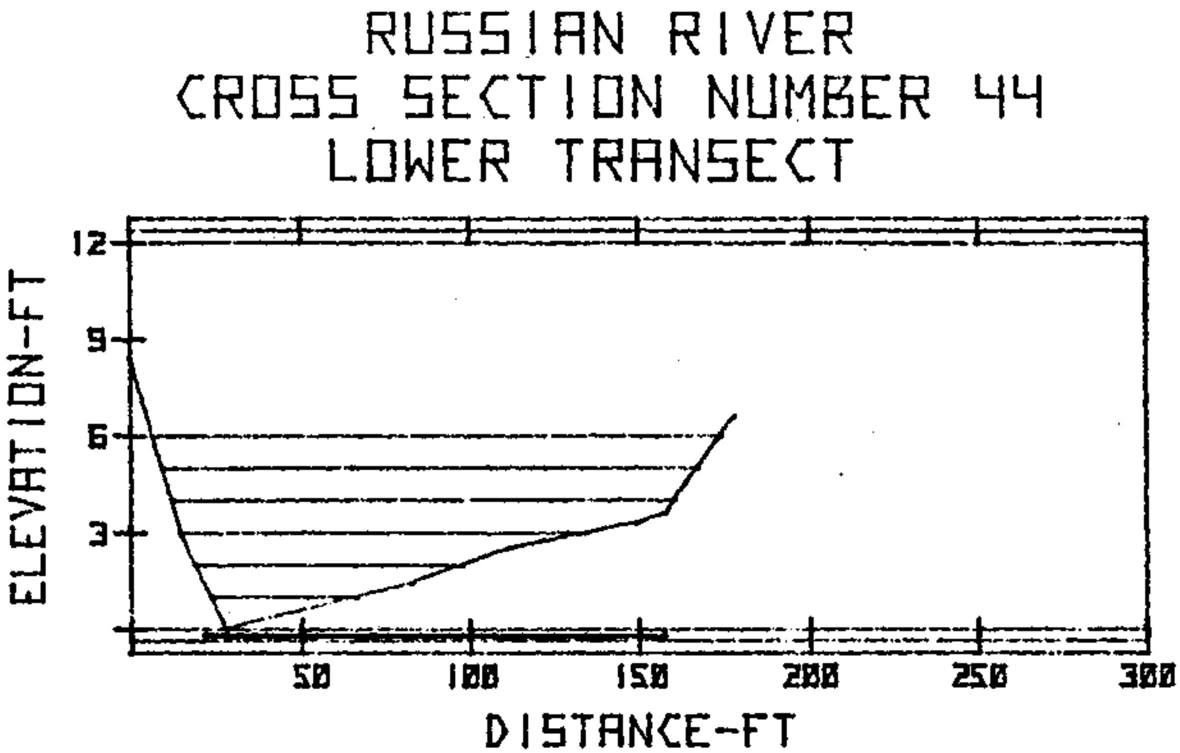
Section Riffle Quality

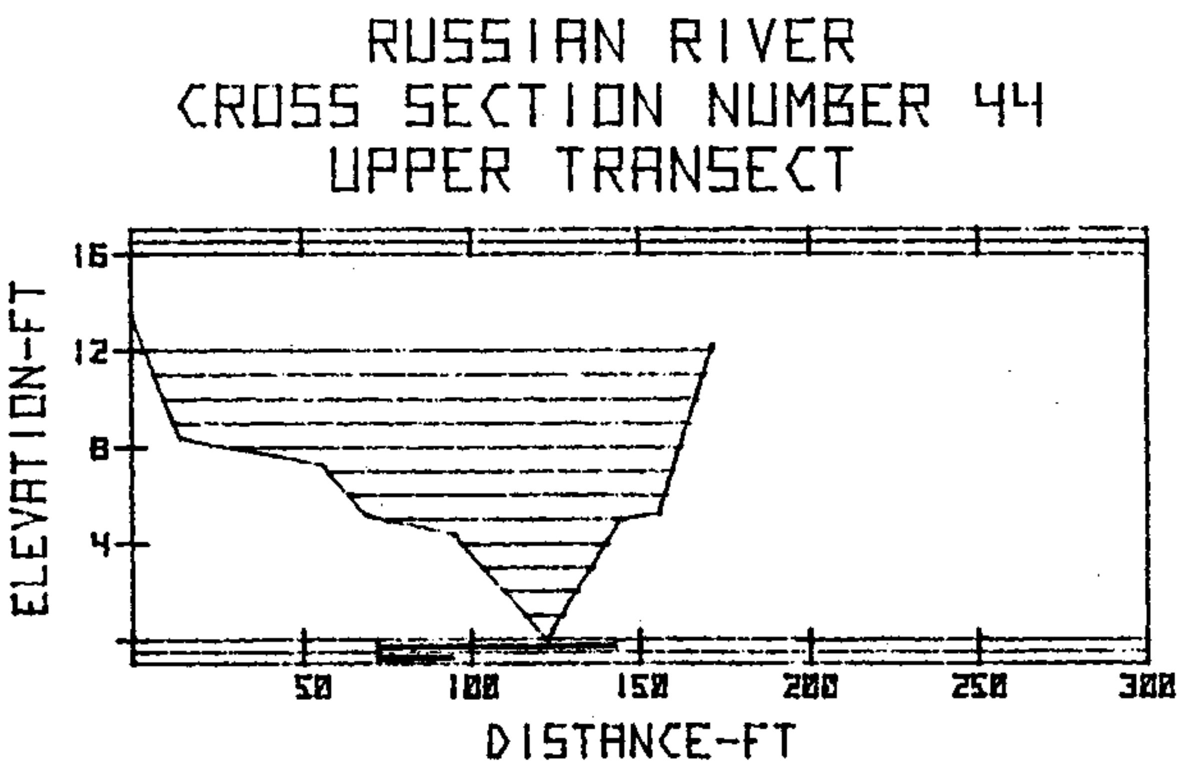
The riffle stretch at the lower transect contains primarily good substrate suitable for spawning, although the concentration of fine material is relatively high. Sixty invertebrates/ft2 were discovered on this riffle.

Pool/Riffle Ratio 4.2:1

General Section Comments

The upper transect is located at the mouth of McDonald Creek. Juvenile salmonids were observed in May. There was no sign of salmonids in July.


RUSSIAN RIVER
CROSS SECTION NUMBER 44
LOWER TRANSECT
ELEVATION-FT
12
9
6
3
50
100
150
200
250
300
DISTANCE-FT


RUSSIAN RIVER
CROSS SECTION NUMBER 44
UPPER TRANSECT
ELEVATION-FT
16
12
8
4
50
100
150
200
250
300
DISTANCE-FT

Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-5

Section	43	Upper Transect	Lower Transect
Section Length (feet)	1500		
River Mile	81		
Habitat Type		run	run
Water Surface Width (feet)		60	83
Water Temperature (°C) @ Time of Day Taken		12.0 @ 0840	12.0 @ 0905
Water Transparency (feet)		2.0	2.5

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 1.7 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 2.65 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.52

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.20

Section Habitat
The entire stream section is a relatively deep run with very good riparian cover and canopy on the left edge of the water.

Pool/Riffle Ratio 100% pool
Spawning Substrate Observations
Instream spawning substrate is poor at the observed flow. However, the exposed gravel bar on the right edge of the water contains considerable spawning substrate that would be potentially usable at higher flows.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-5

Section	43	Upper Transect	Lower Transect
Section Length (feet)	1500		
River Mile	81		
Habitat Type		run	run-tail
Water Surface Width (feet)		58	79
Maximum Water Depth (feet)		2.5	2.7
Water Temperature (°C) @ Time of Day Taken		16.0 @ 1055	16.0 @ 1115
Water Transparency (feet)		3.0	3.0
In-Channel Cover (feet)		26	13
In-Channel Vegetative Canopy (feet)		25	17
In-Stream Cover (feet)		5	3
In-Stream Vegetative Canopy (feet)		12	17

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	4.06
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	2.91

Section Pool Quality

Entire section consists of deep run habitat. Depths are generally greater than 2.5 feet adjacent to the bank on the left edge of the water.

Section Riffle Quality

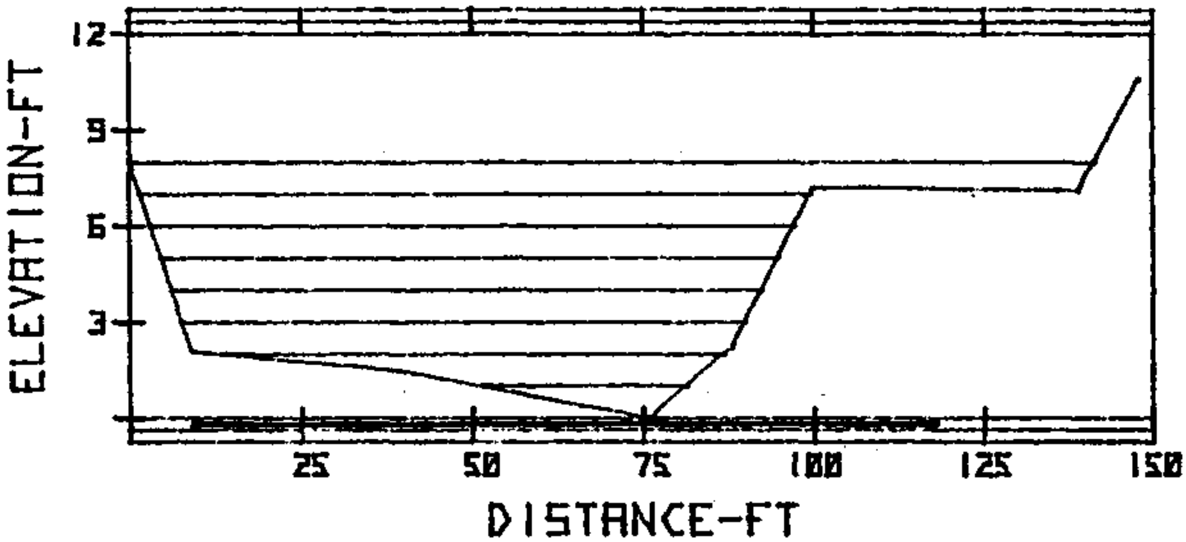
Section contains no riffle habitat

Pool/Riffle Ratio 100% pool

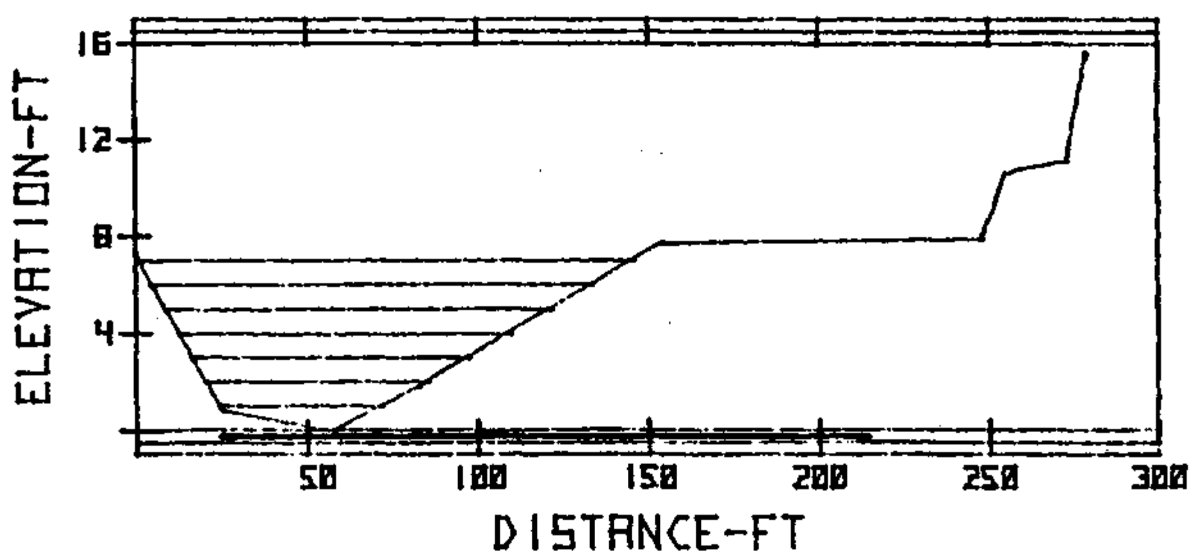
General Section Comments

The section consists of deep run habitat with good left edge riparian cover and canopy. Section water surface width is relatively narrow, providing relatively deep moving water with less surface exposure than usual.

RUSSIAN RIVER
CROSS SECTION NUMBER 43
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 43
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-6			
Section	41	Upper Transect	Lower Transect
Section Length (feet)	825		
River Mite	78		
Habitat Type		riffle	run
Water Surface Width (feet)		145	110
Water Temperature (°C) @ Time of Day Taken		16.0 @ 1715	15.0 @ 1800
Water Transparency (feet)		2.0	2.0

Upper Transect

Water Depth (Feet) at:
0.25 1.0 0.5 0.9 0.75 1.8 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 4.2 0.5 5.06 0.75 4.10 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 7.11

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.41

Section Habitat

The section is composed primarily of deep runs with one stretch of riffle at and just below the upper transect.

Pool/Riffle Ratio 2.8:1

Spawning Substrate Observations

The riffle at the upper transect and the pool tail immediately above the upper transect provide very good, clean, spawning-size substrate. Pockets of exposed suitable size substrate are available at the gravel bar near the left edge of the water.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-6

Section	41	Upper Transect	Lower Transect
Section Length (feet)	825		
River Mile	78		
Habitat Type		pool tail	run
Water Surface Width (feet)		142	70
Maximum Water Depth (feet)		2.0	5.0
Water Temperature (°C) @ Time of Day Taken		18.5 @ 1245	18.0 @ 1155
Water Transparency (feet)		3.0	3.0
In-Channel Cover (feet)		3	8
In-Channel Vegetative Canopy (feet)		11	16
In-Stream Cover (feet)		7	0
In-Stream Vegetative Canopy (feet)		0	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	1.83
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	2.40

Section Pool Quality

Non-riffle habitat is mostly run habitat in this stream section. Runs are deep (4.0 feet maximum depth) and provide good instream cover consisting of submerged branches and rip-rap.

Section Riffle Quality

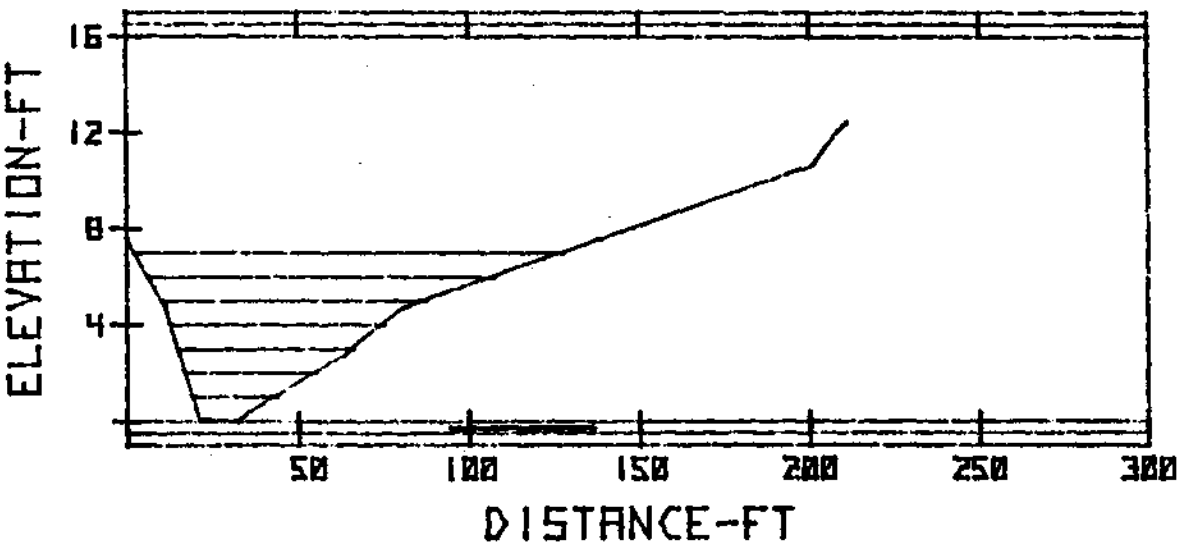
The one riffle in this section is located Just below the upper transect. Depths are on the shallow side (1.0 feet), although limited deep habitat is available. Substrate is optimal salmonid spawning material.

Pool/Riffle Ratio 2.8:1

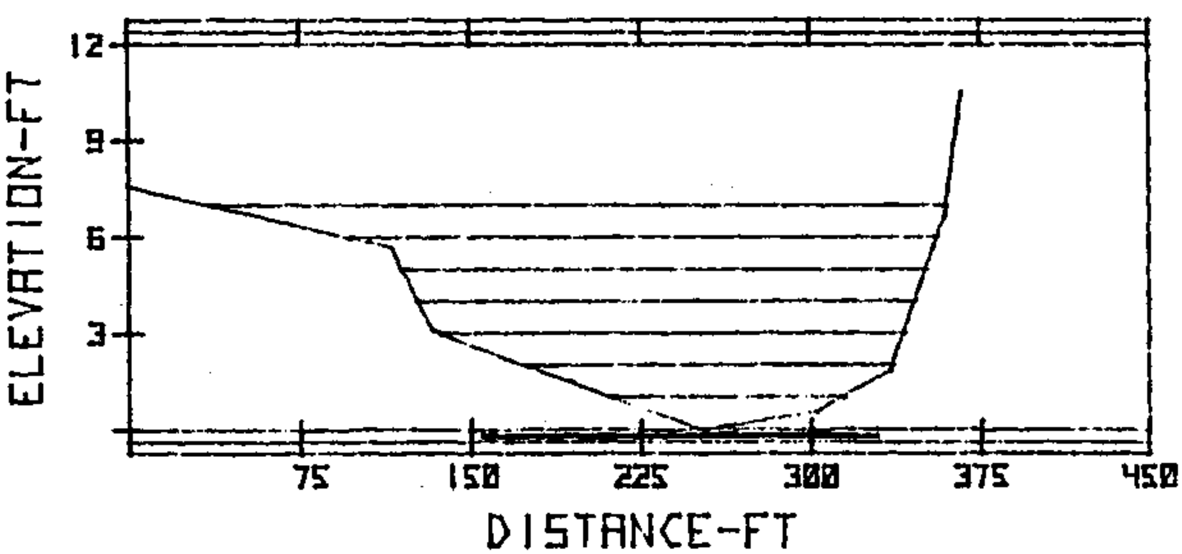
General Section Comments

Section contains good, deep run habitat.

RUSSIAN RIVER
CROSS SECTION NUMBER 41
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 41
UPPER TRANSECT



Fish Habitat Observation
Spawning Habitat
Mainstem

Map Ref. Pg. A-7

Section	40	Upper Transect	Lower Transect
Section Length (feet)	730		
River Mite	75		
Habitat Type		riffle-run	run
Water Surface Width (feet)		85	84
Water Temperature (°C) @ Time of Day Taken		13.5 @ 1100	13.0 @ 1020
Water Transparency (feet)		2.5	2.0

Upper Transect

Water Depth (Feet) at:
0.25 1.1 0.5 2.0 0.75 N/A Distance from Left Edge of
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 3.20 0.5 2.69 0.75 N/A Distance from Left Edge of
Water Velocity (FPS) Measured on the Surface at Midstream 4.52

Lower Transect

Water Depth (Feet) at:
0.2 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.2 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of
Water Velocity (FPS) Measured on the Surface at Midstream 5.48

Section Habitat

Section is composed of deep runs and riffles; pool habitat is absent.

Pool/Riffle Ratio 2.6:1

Spawning Substrate Observations

Instream spawning substrate is very good in riffle sections. Substrate is very clean with respect to content of fine material. Exposed substrate is also very good. The gravel bar on the left edge of water contains potentially usable substrate.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg . A-7

		Upper Transect	Lower Transect
Section	40		
Section Length (feet)	730		
River Mile	75		
Habitat Type		run-tail	pool-run
Water Surface Width (feet)		63	63
Maximum Water Depth (feet)		2.3	3.6
Water Temperature (°C) @ Time of Day Taken		21.0 @ 1505	21.0 @ 1445
Water Transparency (feet)		3.0	3.0
In-Channel Cover (feet)		13	12
In-Channel Vegetative Canopy (feet)		33	25
± In-Stream Cover (feet)		0	0
In-Stream Vegetative Canopy (feet)		3	7

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 4.42
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 2.50

Section Pool Quality

Pool habitat is absent, but a considerable portion of the section is deep run. Right edge of water provides excellent riparian cover and canopy. Run sections contain very good holding water habitat.

Section Riffle Quality

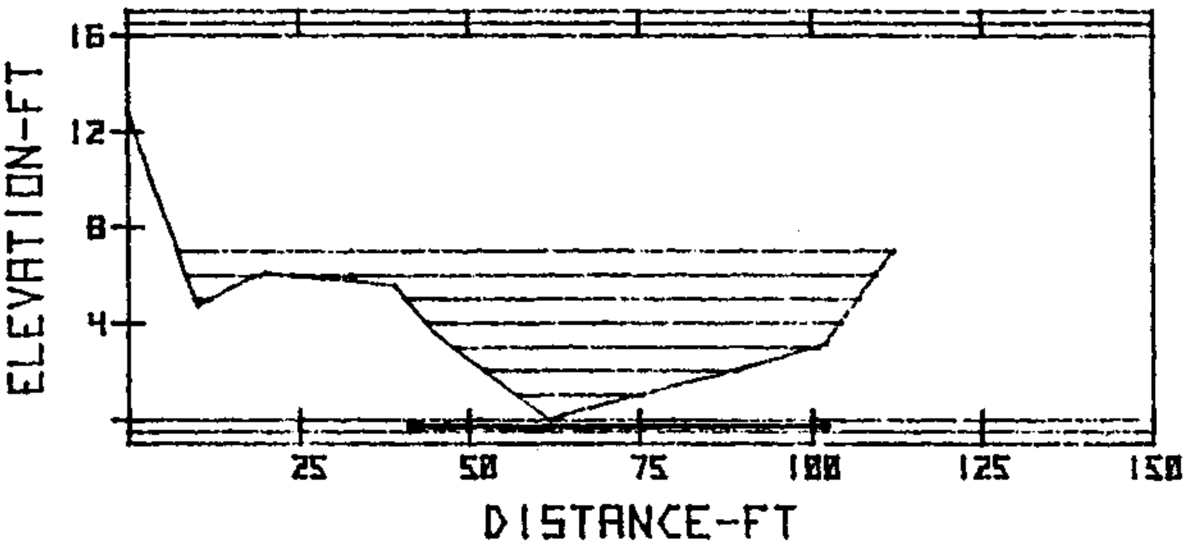
Riffles are generally 0.5 to 2.0 feet in depth and composed of very good size spawning substrate. Canopy is available on the right edge of water.

Pool/Riffle Ratio 2.6:1

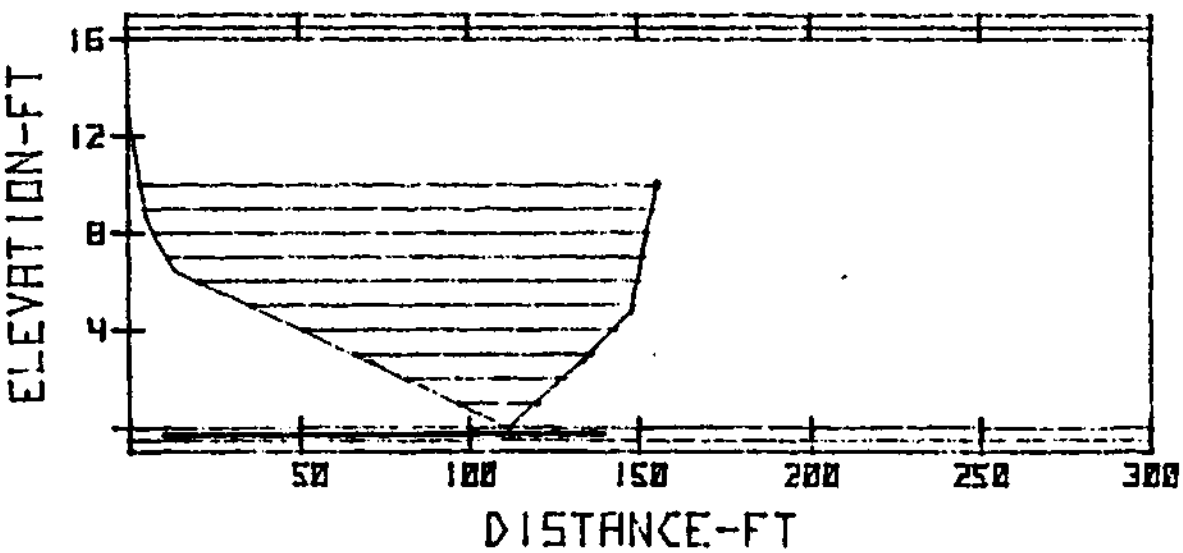
General Section Comments

Section provides (potentially) very good run holding habitat and riffle spawning habitat. Army Corps of Engineers "jack" lines stabilize approximately 600 feet of this section.

RUSSIAN RIVER
CROSS SECTION NUMBER 40
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 40
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

		Upper Transect	Lower Transect
Map Ref. Pg. A-8			
Section	38		
Section Length (feet)	3500		
River Mile	71		
Habitat Type		pool-run	riffle
Water Surface Width (feet)		150	128
Water Temperature (°C) @ Time of Day Taken		14.0 @ 1200	15.0 @ 1300
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.18

Lower Transect

Water Depth (Feet) at:
0.25 0.9 0.5 1.6 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 1.87 0.5 2.54 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 2.76

Section Habitat

Section consists primarily of relatively deep (>2.5 feet) and shallow (<2.5 feet) run habitat with very little riffle and pool habitat. Pools are located Just below the upper transect and just above the lower transect. Riffles exist at the upper transect and midway in the section.

Pool/Riffle Ratio 12.5:1

Spawning Substrate Observations

Instream spawning substrate is good only at the upper transect, although velocities appear restrictive for spawning (see above data). Exposed substrate is generally sub-optimal with respect to size and is often compacted.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-8

Section	38	Upper Transect	Lower Transect
Section Length (feet)	3500		
River Mile	71		
Habitat Type		run	run
Water Surface Width (feet)		46	86
Maximum Water Depth (feet)		2.5	4.5
Water Temperature (°C) @ Time of Day Taken		23.5 @ 1630	22.5 @ 1600
Water Transparency (feet)		3.0	3.0
In-Channel Cover (feet)		7	8
In-Channel Vegetative Canopy (feet)		50	12
In-Stream Cover (feet)		0	3
In-Stream Vegetative Canopy (feet)		0	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	6.00
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	2.15

Section Pool Quality

Pool habitat is limited to two small pools near the upper and lower transects. Depth, cover and canopy are very good in each pool.

Section Riffle Quality

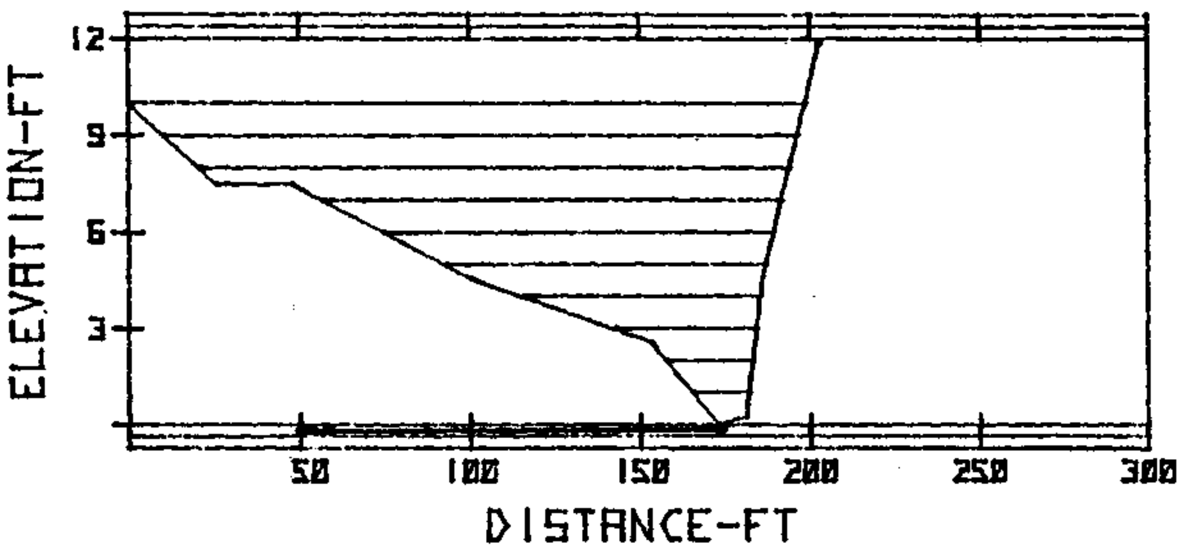
Riffle habitat is limited in this section. Riffle habitat at the upper transect is very good with respect to substrate size. Velocity is rather high due to the narrowness of the channel. The other riffle stretch in mid-section is very shallow and is composed of sub-optimal substrate.

Pool/Riffle Ratio 12.5:1

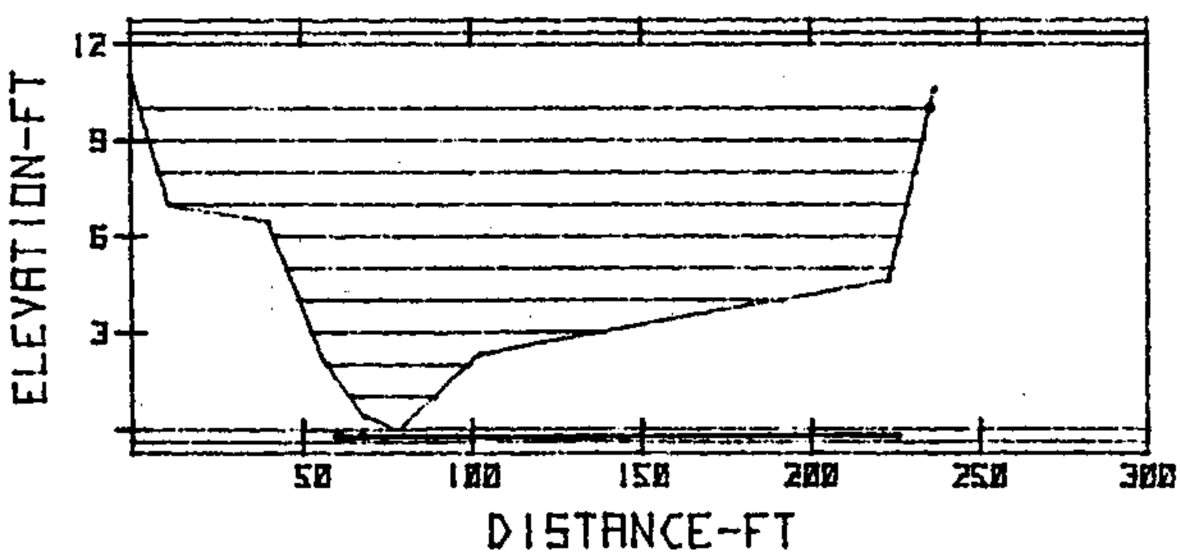
General Section Comments

Section contains predominantly run habitat. Quality varies depending on several variables. Considerable holding habitat with riparian protection is available in this section.

RUSSIAN RIVER
CROSS SECTION NUMBER 38
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 38
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-8

Section	37	Upper Transect	Lower Transect
Section Length (feet)	2520		
River Mile	70		
Habitat Type		run	pool
Water Surface Width (feet)		85	65
Water Temperature (°C) @ Time of Day Taken		15.5 @ 1520	15.5 @ 1400
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 2.6 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 1.54 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 5.56

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.88

Section Habitat
Section composed primarily of deep run, riffle, and rapids habitat. Some pool habitat is available at the lower transect.

Pool/Riffle Ratio 3.8:1
Spawning Substrate Observations
Instream substrate is generally larger than optimal spawning-size material. Instream substrate is typically rubble, boulders and bedrock with a high percentage of fines also. Exposed substrate is similar with the exception of a few isolated pockets of suitable spawning substrate.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-8

		Upper Transect	Lower Transect
Section	37		
Section Length (feet)	2520		
River Mile	70		
Habitat Type		riffle-run	pool
Water Surface Width (feet)		53	59
Maximum Water Depth (feet)		2.5	5.4
Water Temperature (°C) @ Time of Day Taken		17.0 @ 0930	16.5 @ 0850
Water Transparency (feet)		2.5	2.5
In-Channel Cover (feet)		7	35
In-Channel Vegetative Canopy (feet)		12	31
In-Stream Cover (feet)		0	59
In-Stream Vegetative Canopy (feet)		5	10

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	4.20
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	2.87

Section Pool Quality

Pool quality is very good at the lower transect (immediately above Squaw Rock Shoot). The majority of the transect is run, riffle, and rapids habitat. Run sections are basically deep with boulder cover on the bottom. Pool habitat at the lower transect is deep and contains instream bedrock cover.

Section Riffle Quality

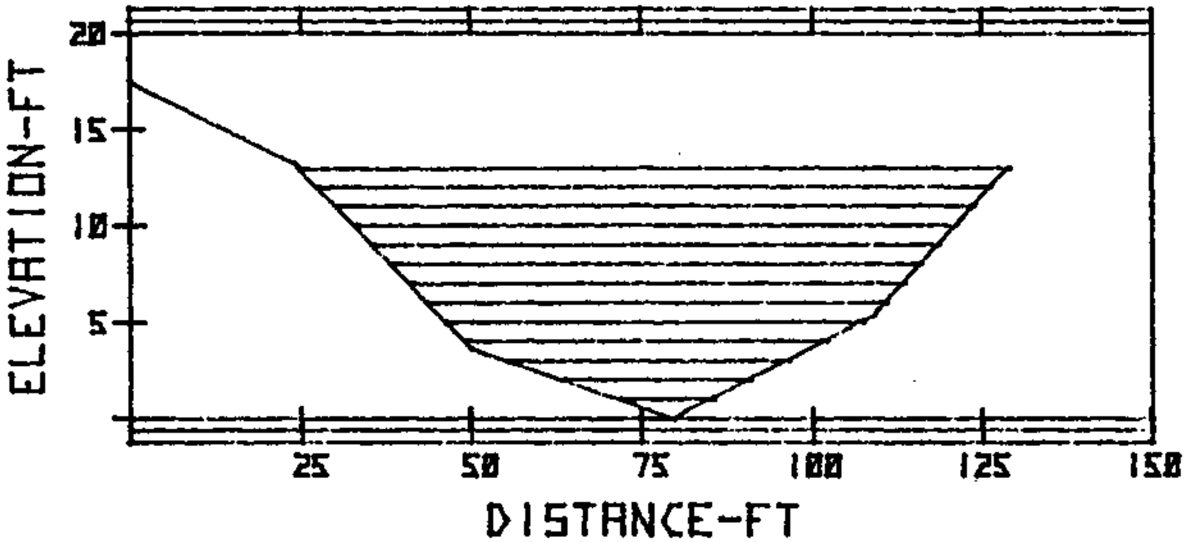
Riffle quality good. Substrate is coarse, providing very Rood instream cover. Depths up to 1.5 feet and bank instream cover are available. Shading is fair to good. One stretch of rapids (245 feet) exists at approximately mid-section.

Pool/Riffle Ratio 3.8:1

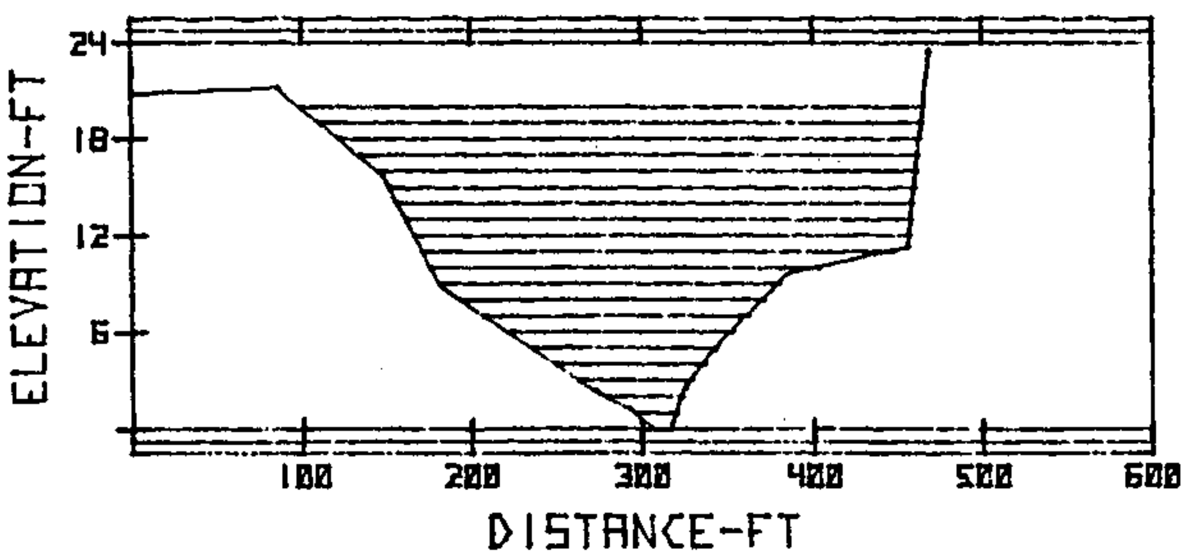
General Section Comments

River begins to descend more rapidly (20-30 feet drop/mile) below this section for a short distance.

RUSSIAN RIVER
CROSS SECTION NUMBER 37
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 37
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-9

		Upper Transect	Lower Transect
Section	36		
Section Length (feet)	2250		
River Mile	67		
Habitat Type		pool	riffle
Water Surface Width (feet)		113	144
Water Temperature (°C) @ Time of Day Taken		16.0 @ 1600	16.0 @ 1630
Water Transparency (feet)		2.0	2.0

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.55

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.70

Section Habitat

Section is composed primarily of run habitat with a few pool and riffle sections. Runs are generally slow moving and contain some deep (>2.5 feet) water near the left edge of water.

Pool/Riffle Ratio 8 : 1

Spawning Substrate Observations

Spawning substrate is available above the lower transect at the mouth of Cummiskey Creek. A summer ford is located immediately below the mouth of the creek. Spawning gravel is very clean at the site of the ford.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg.	A-9
Section	36
Section Length (feet)	2250
River Mile	67

	Upper Transect	Lower Transect
Habitat Type	run	riffle-run
Water Surface Width (feet)	109	123
Maximum Water Depth (feet)	3.0	2.9
Water Temperature (°C) @ Time of Day Taken	18.0 @ 0850	18.0 @ 0915
Water Transparency (feet)	< 4.0	< 4.0
In-Channel Cover (feet)	6	1
In-Channel Vegetative Canopy (feet)	17	10
In-Stream Cover (feet)	7	0
In-Stream Vegetative Canopy (feet)	0	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	2.40
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	N/A

Section Pool Quality

Limited pool habitat is available in this section. The main concentration of pool habitat is located just below the upper transect. Boulders are available instream for cover and maximum depths are generally greater than 4.0 feet.

Section Riffle Quality

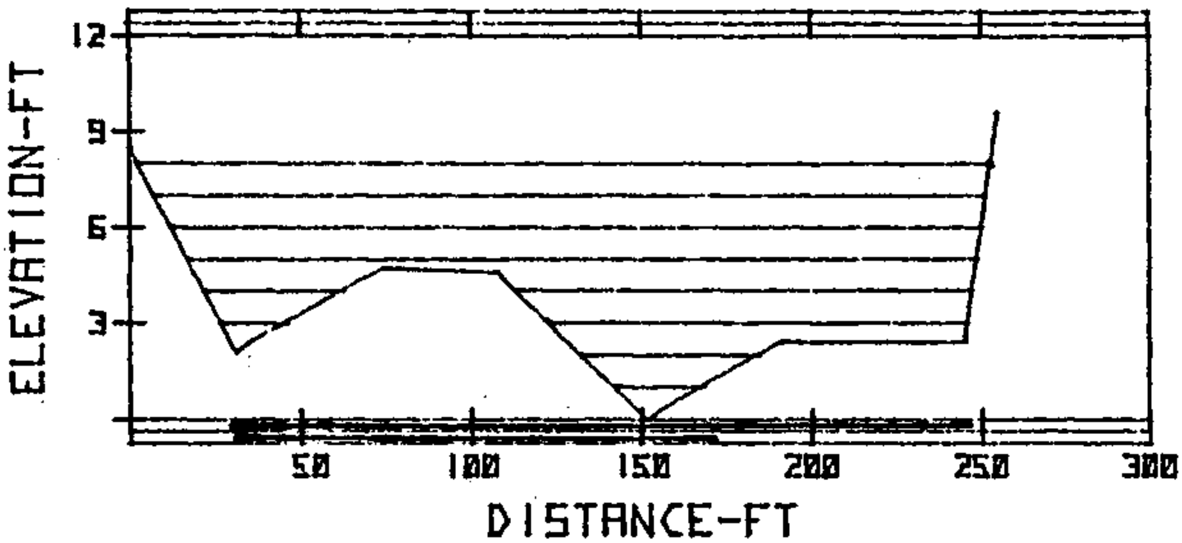
Riffle habitat is variable. A very good quality section of deep riffle (1.5 to 2 feet) exists upstream from the lower transect at the site of the summer ford.

Pool/Riffle Ratio 8:1

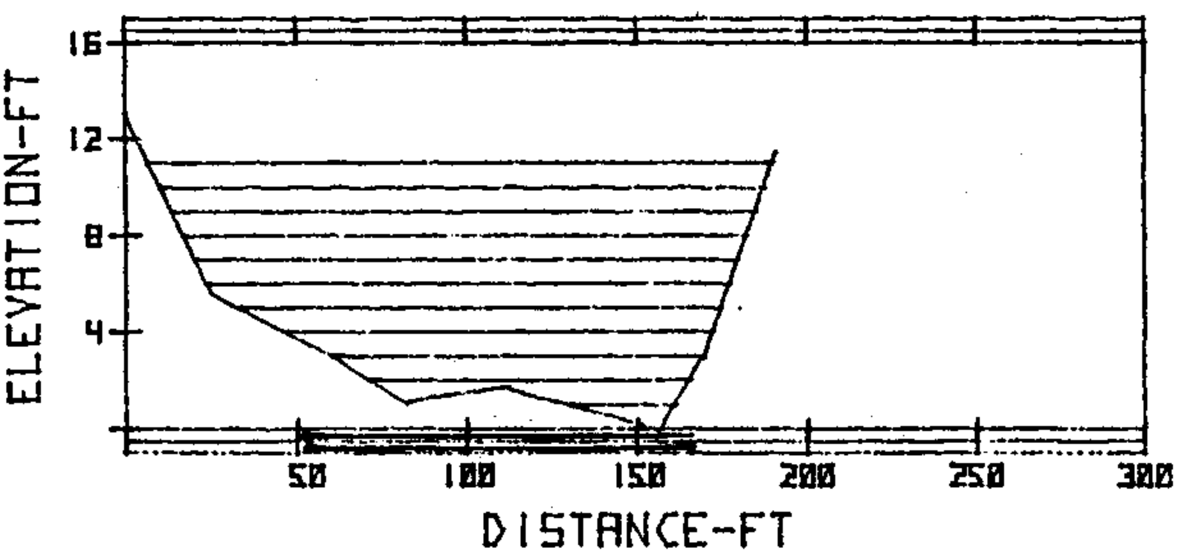
General Section Comments

The summer ford at Cummiskey Creek mouth is also the site of the best spawning habitat in this section. Good pool habitat is available upstream just below the upper transect.

RUSSIAN RIVER
CROSS SECTION NUMBER 36
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 36
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-10

		Upper Transect	Lower Transect
Section	35		
Section Length (feet)	1200		
River Mile	66		
Habitat Type		rapids	pool
Water Surface Width (feet)		70	108
Water Temperature (°C) @ Time of Day Taken		14.0 @ 0840	14.5 @ 0810
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 9.04

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.89

Section Habitat
Section is a series of pools and runs through boulders and bedrock.

Pool/Riffle Ratio 6.5:1
Spawning Substrate Observations
Very little spawning habitat is available.
Most substrate is larger than optimal (boulders-bedrock).

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-10

		Upper Transect	Lower Transect
Section	35		
Section Length (feet)	1200		
River Mile	66		
Habitat Type		rapids	pool
Water Surface Width (feet)		49	108
Maximum Water Depth (feet)		4.0	3.4
Water Temperature (°C) @ Time of Day Taken		18.5 @ 1015	19.5 @ 1120
Water Transparency (feet)		<4.0	<4.0
In-Channel Cover (feet)		60	17
In-Channel Vegetative Canopy (feet)		0	18
In-Stream Cover (feet)		49	108
In-Stream Vegetative Canopy (feet)		0	13

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	5.42
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	2.69

Section Pool Quality

Pool quality is very good. Depths exceed 4 feet in most pools and an abundance of instream cover (boulders and bedrock) is present.

Section Riffle Quality

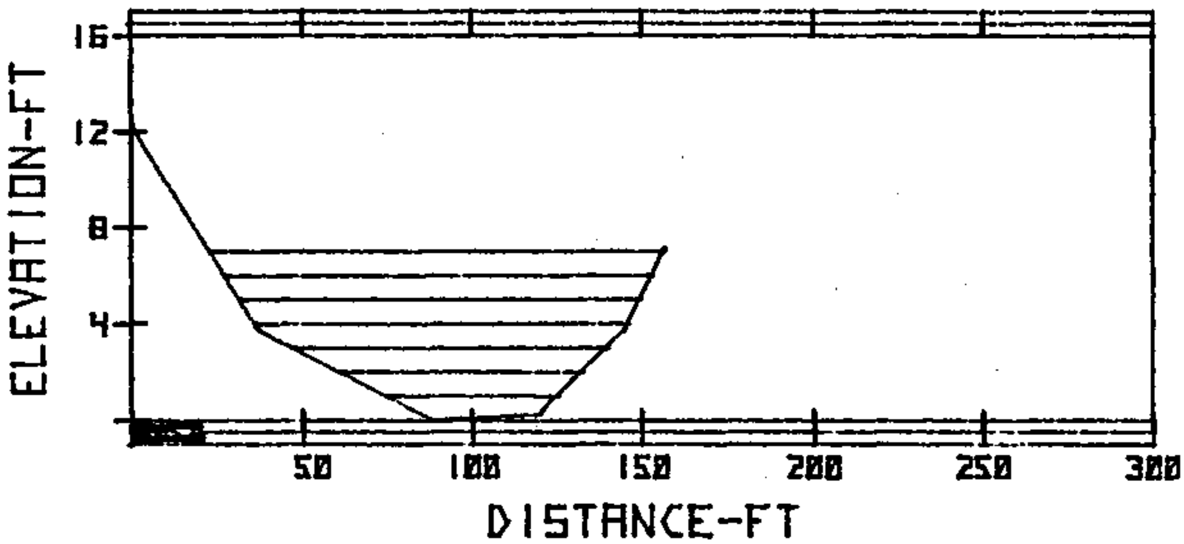
One stretch of rapids exists in this section. All other habitat is pool or run.

Pool/Riffle Ratio 6.5:1

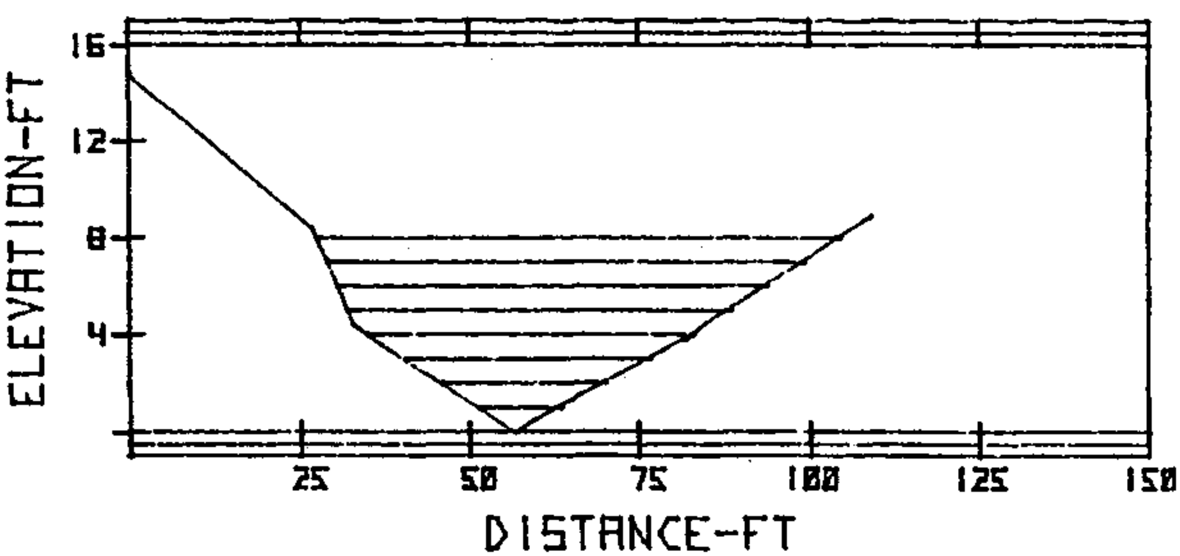
General Section Comments

Section is composed primarily of boulder and bedrock pool and run habitat.

RUSSIAN RIVER
CROSS SECTION NUMBER 35
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 35
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-10

		Upper Transect	Lower Transect
Section	33		
Section Length (feet)	1900		
River Mile	63		
Habitat Type		riffle	pool
Water Surface Width (feet)		175	106
Water Temperature (°C) @ Time of Day Taken		15.0 @ 1020	15.0 @ 0945
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 1.6 0.5 1.6 0.75 1.8 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 3.88 0.5 5.20 0.75 4.63 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 7.15

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.20

Section Habitat
The section contains primarily run habitat with some isolated riffle, rapids and pool habitat.

Pool/Riffle Ratio 9.8:1

Spawning Substrate Observations
The riffle section at the upper transect contains suitable size spawning substrate. Isolated pockets of spawning gravel are available on the left exposed gravel bar, interspersed with patches of in-channel willows.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-10

Section	33	Upper Transect	Lower Transect
Section Length (feet)	1900		
River Mile	63		
Habitat Type		riffle	pool
Water Surface Width (feet)		111	103
Maximum Water Depth (feet)		1.8	5.0
Water Temperature (°C) 9 Time of Day Taken		21.0 @ 1510	21.5 @ 1610
Water Transparency (feet)		4.0	4.0
In-Channel Cover (feet)		55	10
In-Channel Vegetative Canopy (feet)		66	0
In-Stream Cover (feet)		0	2
In-Stream Vegetative Canopy (feet)		0	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	5.71
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	1.22

Section Pool Quality

Runs are predominant in this section except for a large deep pool under the Highway 101 bridge at the lower transect. Runs contain deep segments along the right bank where cover and canopy are available.

Section Riffle Quality

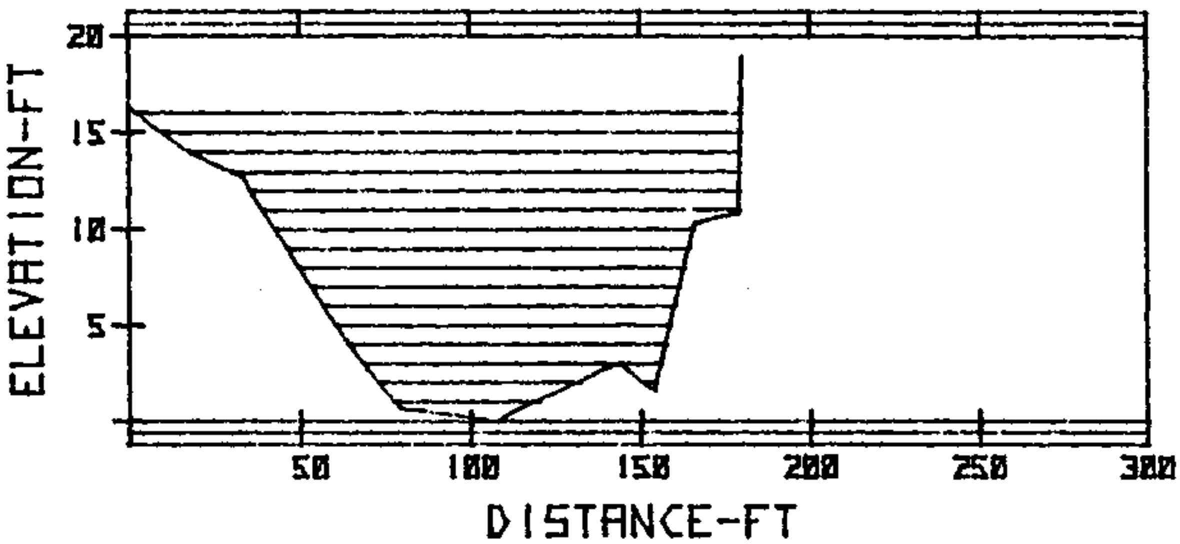
Riffles are not abundant in this section. A short shallow riffle is located at the upper transect and a section of rapids is located just above the lower transect.

Pool/Riffle Ratio 9.8:1

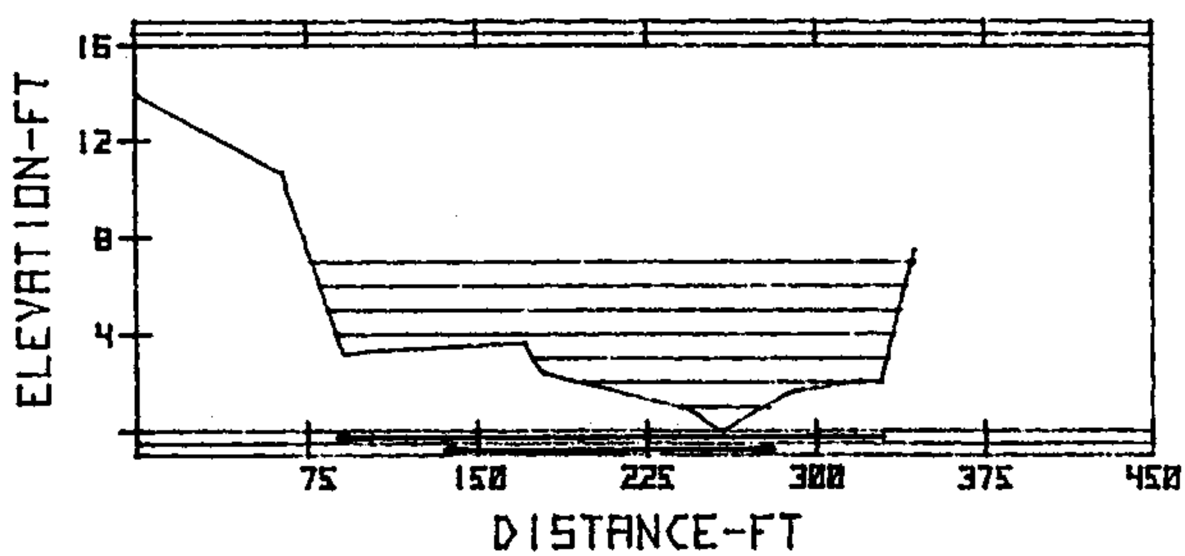
General Section Comments

Section contains a good holding stretch of run located just upstream from a section of rapids.

RUSSIAN RIVER
CROSS SECTION NUMBER 33
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 33
UPPER TRANSECT



Fish Habitat
Observations Spawning
Habitat

Map Ref. Pg. A-11

		Upper Transect	Lower Transect
Section	32		
Section Length (feet)	620		
River Mile	62		
Habitat Type		run	riffle-run
Water Surface Width (feet)		105	--
Water Temperature (°C) @ Time of Day Taken		15.5 @ 1100	16.0 @ 1150
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 2.2 0.5 2.7 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 2.9 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.24

Lower Transect

Water Depth (Feet) at:
0.25 3.2 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 3.3 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.63

Section Habitat
The section is composed primarily of deep runs and riffles.

Pool/Riffle Ratio 3.1:1
Spawning Substrate Observations
The exposed gravel bar on the left edge of water contains spawning size material. A strip approximately 100 feet wide extends the length of the transect, but the content of fine materials is very high.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-11

		Upper Transect	Lower Transect
Section	32		
Section Length (feet)	620		
River Mile	62		
Habitat Type		run	riffle
Water Surface Width (feet)		98	105
Maximum Water Depth (feet)		3.7	2.8
Water Temperature (°C) @ Time of Day Taken		22.0 @ 1340	22.0 @ 1430
Water Transparency (feet)		4.0	4.0
In-Channel Cover (feet)		60	20
In-Channel Vegetative Canopy (feet)		14	50
In-Stream Cover (feet)		7	0
In-Stream Vegetative Canopy (feet)		5	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	1.73
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	2.40

Section Pool Quality

The section is primarily run and riffle habitat. Run quality is good; generally consisting of deep narrow runs with riparian canopy on the right edge of water only.

Section Riffle Quality

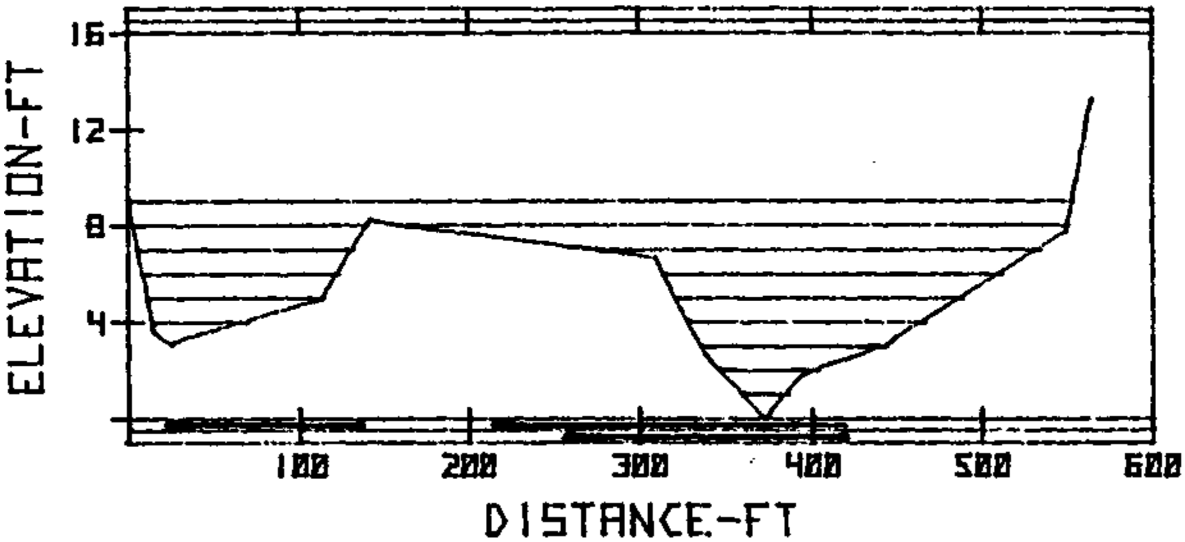
The riffle stretch of this section is good habitat from a depth and velocity standpoint. The substrate contains many fines and the riffle is completely exposed.

Pool/Riffle Ratio 3.1:1

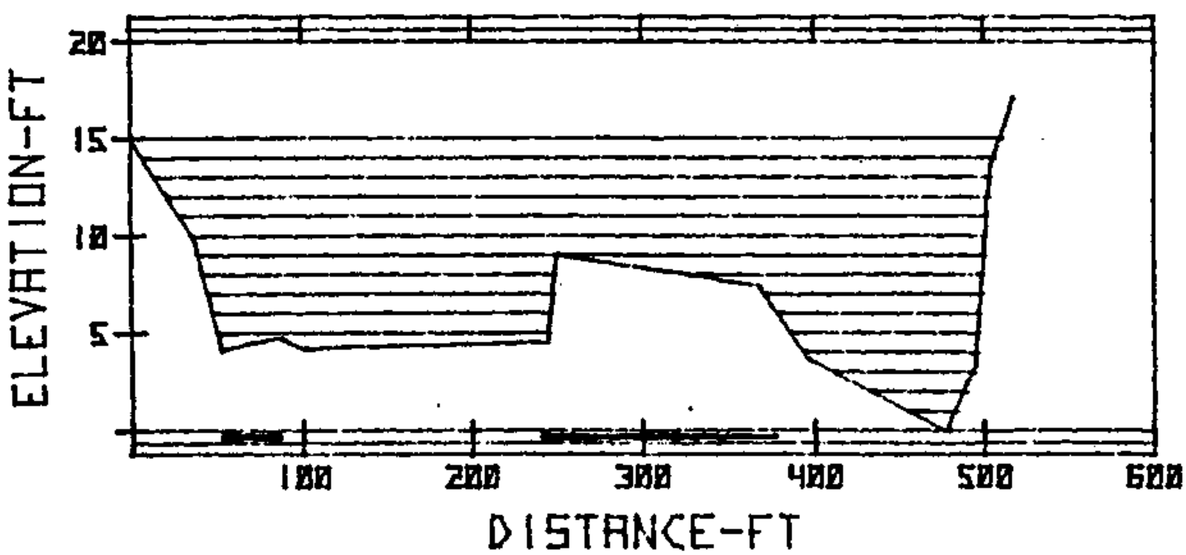
General Section Comments

This section is opposite a large operating gravel company.

RUSSIAN RIVER
CROSS SECTION NUMBER 32
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 32
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-11

		Upper Transect	Lower Transect
Section	31		
Section Length (feet)	1320		
River Mile	61		
Habitat Type		pool	riffle-run
Water Surface Width (feet)		215	180
Water Temperature (°C) @ Time of Day Taken		17.0 @ 1300	17.0 @ 1330
Water Transparency (feet)		2.0	2.0

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 2.7 0.75 2.8 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 1.94 0.75 1.94 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.83

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 2.7 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 4.05 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 5.30

Section Habitat
The section is composed primarily of deep, left bank runs with some riffle habitat.

Pool/Riffle Ratio 0.6:1
Spawning Substrate Observations
Suitable spawning substrate was observed in the pool tail just below the upper transect. Other areas observed contained too high a concentration of fine material for optimal spawning conditions.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-11

		Upper Transect	Lower Transect
Section	31		
Section Length (feet)	1320		
River Mile	61		
Habitat Type		pool	riffle
Water Surface Width (feet)		140	65
Maximum Water Depth (feet)		1.7	2.4
Water Temperature (°C) @ Time of Day Taken		20.5 @ 1145	20.5 @ 1220
Water Transparency (feet)		>4.0	>4.0
In-Channel Cover (feet)		63	9
In-Channel Vegetative Canopy (feet)		98	25
In-Stream Cover (feet)		7	0
In-Stream Vegetative Canopy (feet)		20	2

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 1.90
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 6.52

Section Pool Quality

The section contains mostly run and riffle habitat with the exception of one stretch of pool at the upper transect. Run quality is generally good; depths up to 8 feet exist along the left edge of the water. Cover and canopy are good on the left edge of the water.

Section Riffle Quality

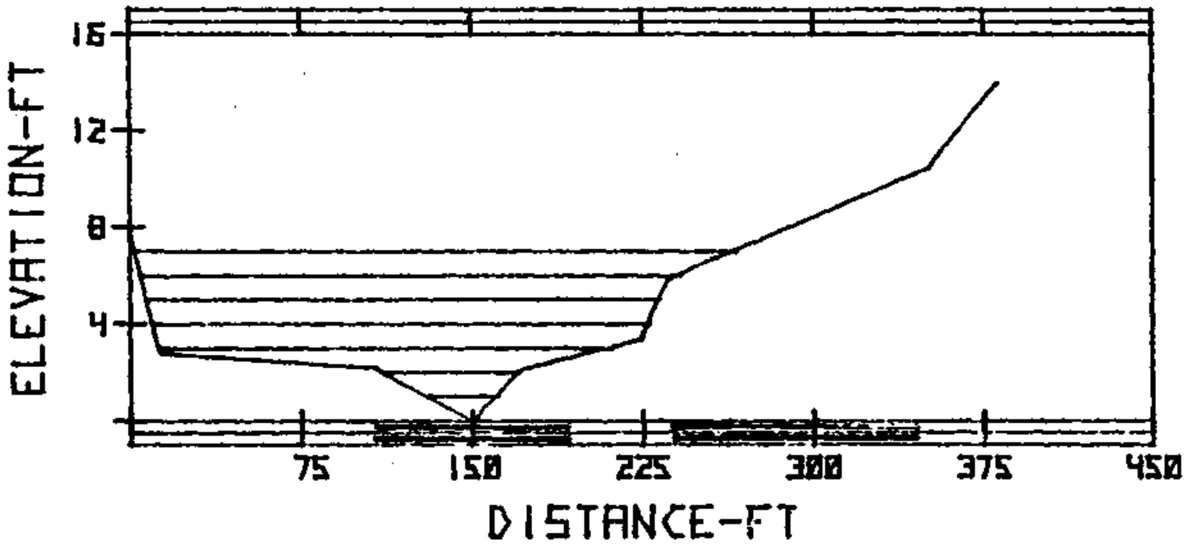
Riffle quality is variable in this section primarily because of the range of riffle depths. Substrate is generally coarse material.

Pool/Riffle Ratio 0.6:1

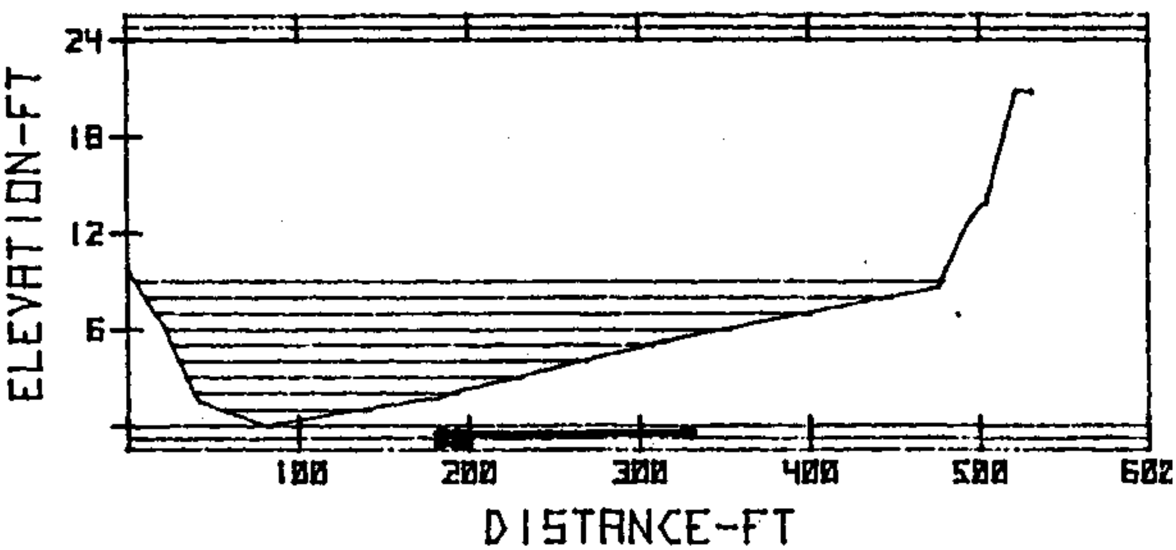
General Section Comments

The section is narrow, resulting in deep, fast-moving water. Less surface area is exposed at the run and more surface area is covered by riparian vegetation.

RUSSIAN RIVER
CROSS SECTION NUMBER 31
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 31
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-12

		Upper Transect	Lower Transect
Section	30		
Section Length (feet)	820		
River Mite	57		
Habitat Type		riffle	pool-run
Water Surface Width (feet)		160	85
Water Temperature (°C) @ Time of Day Taken		18.5 @ 1700	20.0 @ 1640
Water Transparency (feet)		2.0	2.0

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 2.6 0.75 1.6 Distance from Left Edge of
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 2.34 0.75 1.98 Distance from Left Edge of
Water Velocity (FPS) Measured on the Surface at Midstream 2.87

Lower Transect

Water Depth (Feet) at:
0.2 2.1 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.2 0.18 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.69

Section Habitat
The section contains riffle, run, and pool habitat. The main flowing channel is against bedrock on the right edge of the river channel.

Pool/Riffle Ratio 0.6:1
Spawning Substrate Observations
Spawning habitat is suitable in riffle stretches of this section from a substrate size standpoint. Exposed gravel bar substrate on the left edge of the water is also of suitable spawning size.

Fish Habitat Observations Nursery Habitat Mainstem

Map Ref. Pg. A-12

		Upper Transect	Lower Transect
Section	30		
Section Length (feet)	1320		
River Mile	57		
Habitat Type		N/A	pool-run
Water Surface Width (feet)		N/A split channel	lt.-20 rt.-81 (main chnl.)
Maximum Water Depth (feet)		N/A	rt.-2.2 lt.-4.0
Water Temperature (°C) @ Time of Day Taken		N/A	20.0 @ 1015
Water Transparency (feet)		N/A	4.0
In-Channel Cover (feet)		N/A	45
In-Channel Vegetative Canopy (feet)		N/A	35
In-Stream Cover (feet)		N/A	23
In-Stream Vegetative Canopy (feet)		N/A	9

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	N/A
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	lt.-3.81 rt.-1.35

Section Pool Quality

The pool section at the lower transect contains good habitat with respect to depth and bedrock cover on the right edge of the water.

Section Riffle Quality

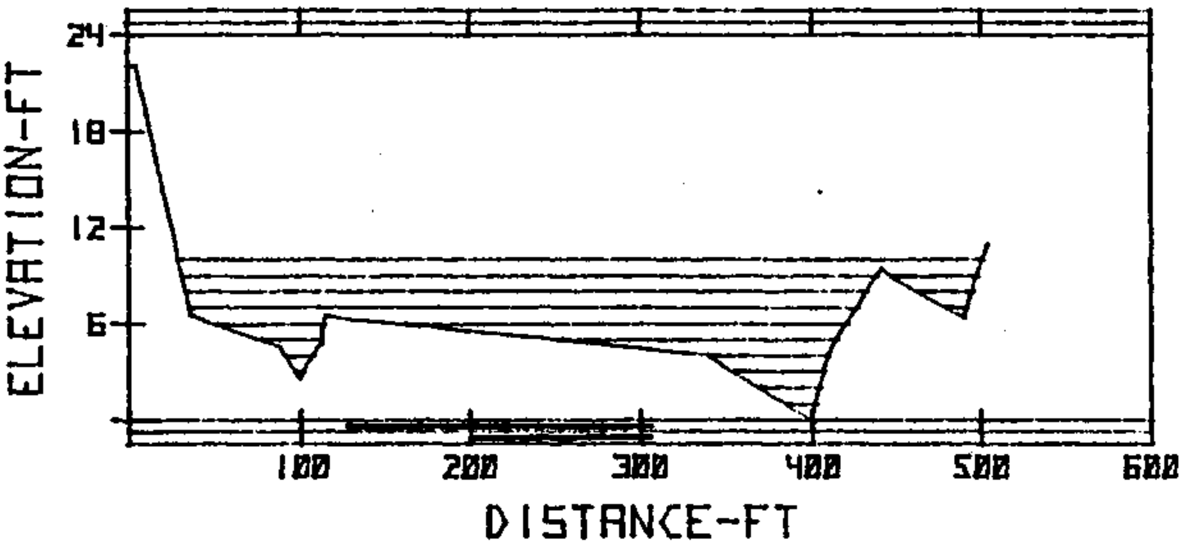
Riffle quality is good. Substrate is suitable for spawning and relatively free of fine material. Forty invertebrates/ft2 of riffle substrate were found.

Pool/Riffle Ratio 0.6:1

General Section Comments

The upper transect was eliminated because the transect was disturbed by construction of the summer Asti road crossing.

RUSSIAN RIVER
CROSS SECTION NUMBER 30
LOWER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-13

Section	29	Upper Transect	Lower Transect
Section Length (feet)	3000		
River Mile	53		
Habitat Type		pool tail	riffle-run
Water Surface Width (feet)		200	110
Water Temperature (°C) @ Time of Day Taken		15.0 @ 0930	15.5 @ 0900
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 0.9 0.5 1.4 0.75 1.9 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 2.11 0.5 2.75 0.75 3.26 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.26

Lower Transect

Water Depth (Feet) at:
0.2 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.2 N/A 0.5 N/A 0 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.50

Section Habitat
Runs and riffles are predominant in this section. Depth and velocity are good. The channel is very exposed. The section is opposite one of the larger mainstem gravel extraction operations.

Pool/Riffle Ratio 3.4:1
Spawning Substrate Observations
Riffles contain generally good spawning habitat in this section. The substrate is clean and of suitable spawning size. A wide expanse of exposed substrate exists at this section. The majority of it contains too great a percentage of fines or is compacted.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-13

		Upper Transect	Lower Transect
Section	29		
Section Length (feet)	3000		
River Mile	53		
Habitat Type		riffle	run
Water Surface Width (feet)		162	96
Maximum Water Depth (feet)		1.2	3.4
Water Temperature (°C) @ Time of Day Taken		19.0 @ 0935	19.0 @ 0815
Water Transparency (feet)		> 4.0	>4.0
In-Channel Cover (feet)		22	8
In-Channel Vegetative Canopy (feet)		30	12
In-Stream Cover (feet)		2	8
In-Stream Vegetative Canopy (feet)		2	6

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	4.20
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	1.83

Section Pool Quality

Pool quality is good. Depths are up to 3 feet, velocity and turbulence are fairly good and the substrate is mostly coarse material. Runs are more abundant than pools in this section.

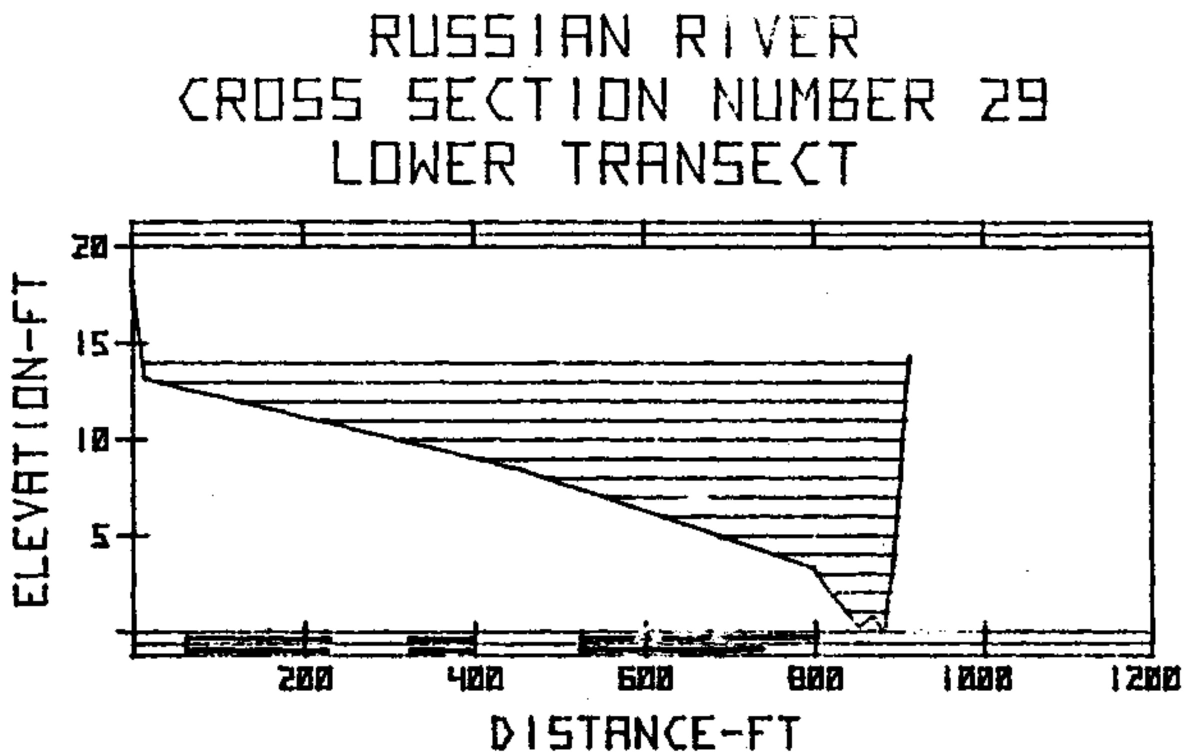
Section Riffle Quality

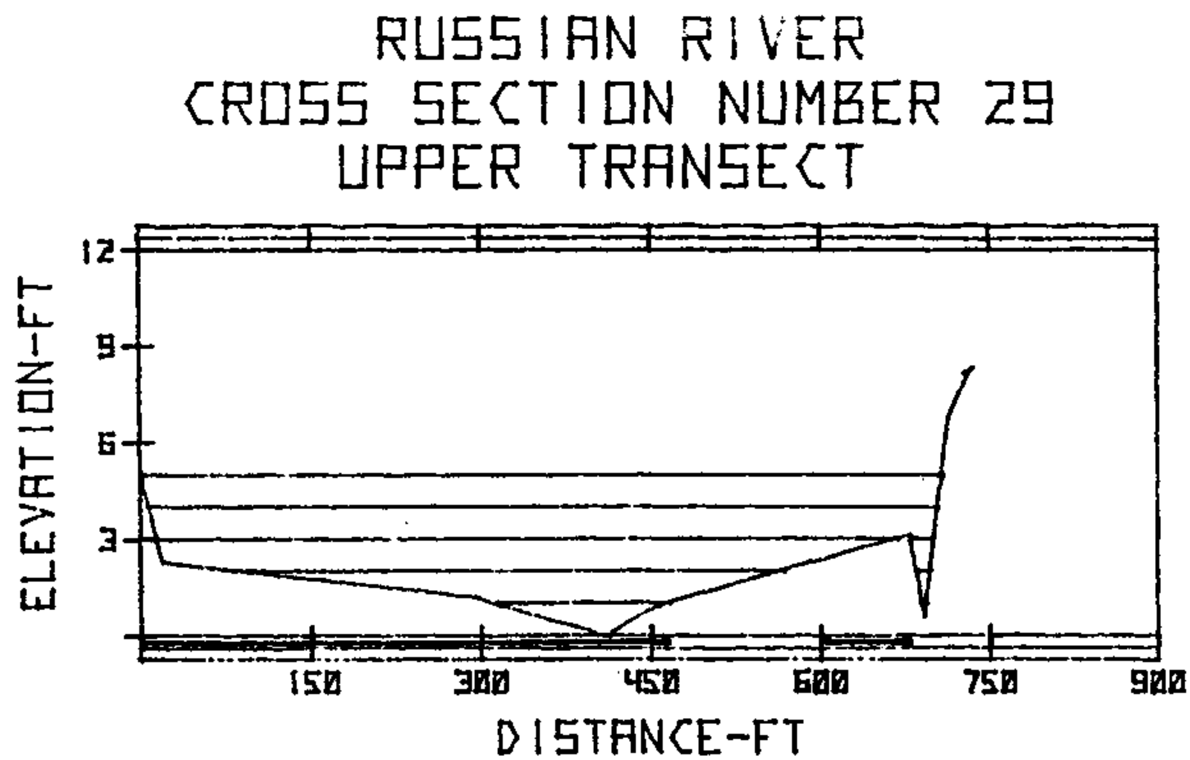
Riffles are generally good quality with clean substrate. Exposure is excessive.

Pool/Riffle Ratio 3.4:1

General Section Comments

The water surface is exposed in this section.
The section is opposite a large gravel extraction operation.


RUSSIAN RIVER
CROSS SECTION NUMBER 29
LOWER TRANSECT
ELEVATION-FT
20
15
10
5
200
400
600
800
1000
1200
DISTANCE-FT


RUSSIAN RIVER
CROSS SECTION NUMBER 29
UPPER TRANSECT
ELEVATION-FT
12
9
6
3
150
300
450
600
750
900
DISTANCE-FT

Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-13

		Upper Transect	Lower Transect
Section	28		
Section Length (feet)	1860		
River Mile	52		
Habitat Type		run	run
Water Surface Width (feet)		160	55
Water Temperature (°C) @ Time of Day Taken		19.5 @ 1445	20.0 @ 1515
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 2.66

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.31

Section Habitat

The section is composed of run and deep riffle habitat. Little pool habitat is available. Depth through most of the section is good (30% of section is greater than 2.5 feet deep).

Pool/Riffle Ratio 2.4:1

Spawning Substrate Observations

Very good spawning habitat is located under the highway bridge in the wet channel. Exposed substrate under the highway bridge is very good King Salmon spawning substrate. Most exposed substrate is severely altered by gravel extraction.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-13

		Upper Transect	Lower Transect
Section	28		
Section Length (feet)	1860		
River Mile	52		
Habitat Type		pool-run	riffle
Water Surface Width (feet)		12A	50
Maximum Water Depth (feet)		4.0	2.0
Water Temperature (°C) @ Time of Day Taken		25.5 @ 1630	26.0 @ 1700
Water Transparency (feet)		>4.0	>4.0
In-Channel Cover (feet)		47	6
In-Channel Vegetative Canopy (feet)		47	10
In-Stream Cover (feet)		4	6
In-Stream Vegetative Canopy (feet)		0	3

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 1.31

Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 2.80

Section Pool Quality

Pool habitat is isolated in this section below the upper transect and just above the lower transect. Depths are good but exposure is poor. Instream cover is fair and little shading is available.

Section Riffle Quality

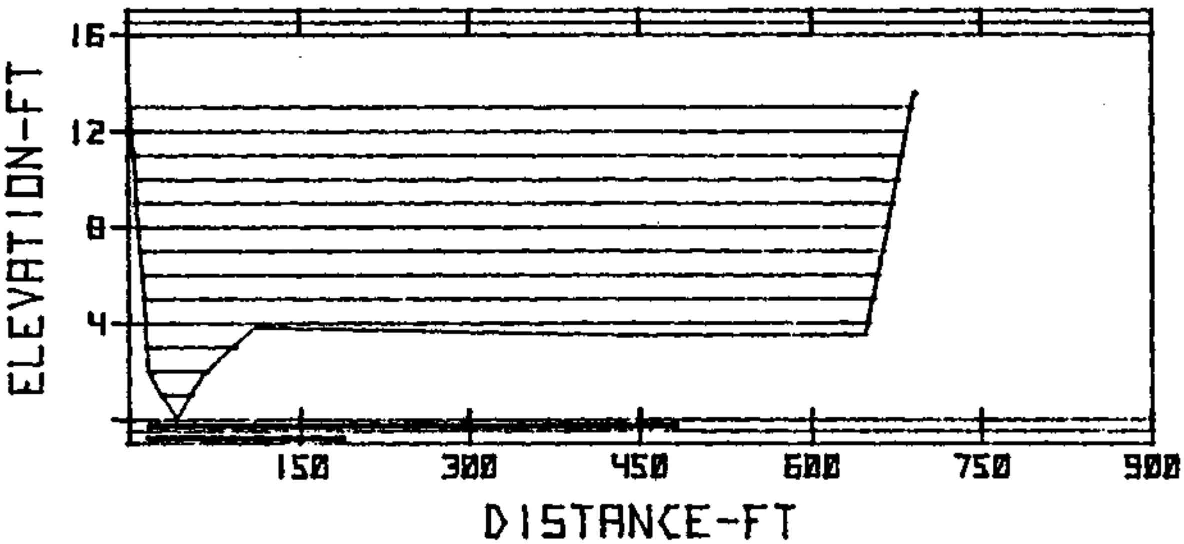
Very good riffle habitat is located below the upper transect under the highway bridge. Depths of 0.5 to 4.0 feet are available. Substrate up to 12 inches is available.

Pool/Riffle Ratio 2.4:1

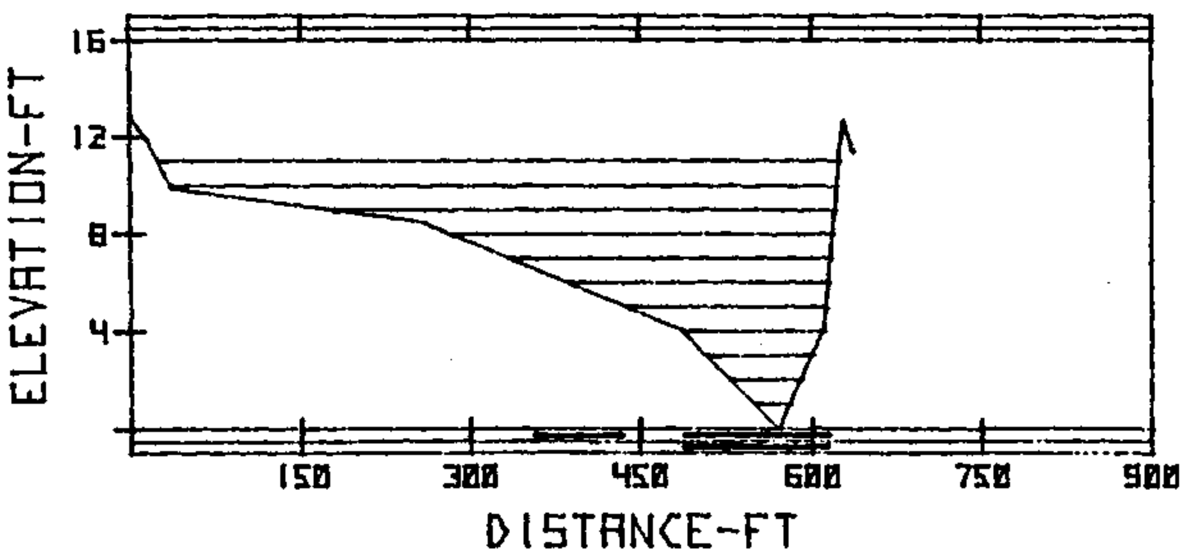
General Section Comments

A very extensive gravel operation exists on the right side of the channel. Mass excavation on one extensive plane is progressing downstream from just below the highway bridge.

RUSSIAN RIVER
CROSS SECTION NUMBER 28
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 28
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

		Upper Transect	Lower Transect
Map Ref. Pg. A-14			
Section	27		
Section Length (feet)	2000		
River Mile	49		
Habitat Type		pool tail	riffle
Water Surface Width (feet)		180	150
Water Temperature (°C) @ Time of Day Taken		15.5 @ 1021	16.0 @ 1045
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 0.8 0.5 1.8 0.75 2.4 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 1.73 0.5 2.57 0.75 3.55 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 2.78

Lower Transect

Water Depth (Feet) at:
0.25 0.7 0.5 1.8 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 3.7 0.5 3.92 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 6.14

Section Habitat
The channel is wide and generally exposed. The upper third of the section is run habitat consisting of shallow water with fine substrate. The lower two thirds of the section is riffle and pool habitat.

Pool/Riffle Ratio 3.7:1
Spawning Substrate Observations
Very good spawning habitat (riffle) is located midway in the section. In addition, the exposed substrate on the left edge of the channel contains considerable clean spawning-size material.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-14

		Upper Transect	Lower Transect
Section	27		
Section Length (feet)	2000		
River Mile	49		
Habitat Type		pool tail	run
Water Surface Width (feet)		134	144
Maximum Water Depth (feet)		1.9	2.7
Water Temperature (°C) @ Time of Day Taken		24.0 @ 1500	24.5 @ 1545
Water Transparency (feet)		>4.0	>4.0
In-Channel Cover (feet)		3	21
In-Channel Vegetative Canopy (feet)		5	25
In-Stream Cover (feet)		0	2
In-Stream Vegetative Canopy (feet)		0	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 1.43
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 1.15

Section Pool Quality

Pool habitat is good near the lower transect. Considerable instream cover (branches, tree trunks) is available, but the canopy is mostly poor. Pool habitat is lacking elsewhere in this section.

Section Riffle Quality

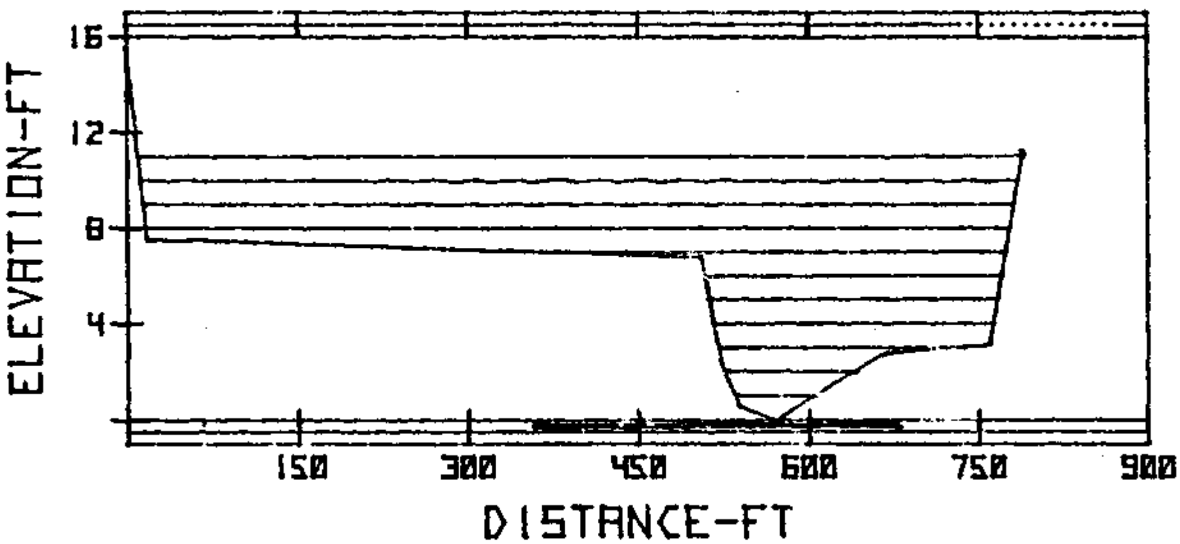
Riffle quality is good. Depths extend to 1.5 feet; turbulence cover is good; and substrate is coarse (4-8 inches). No cover or canopy is available. The benthic invertebrate count is 36 individuals/ft^2.

Pool/Riffle Ratio 3.7:1

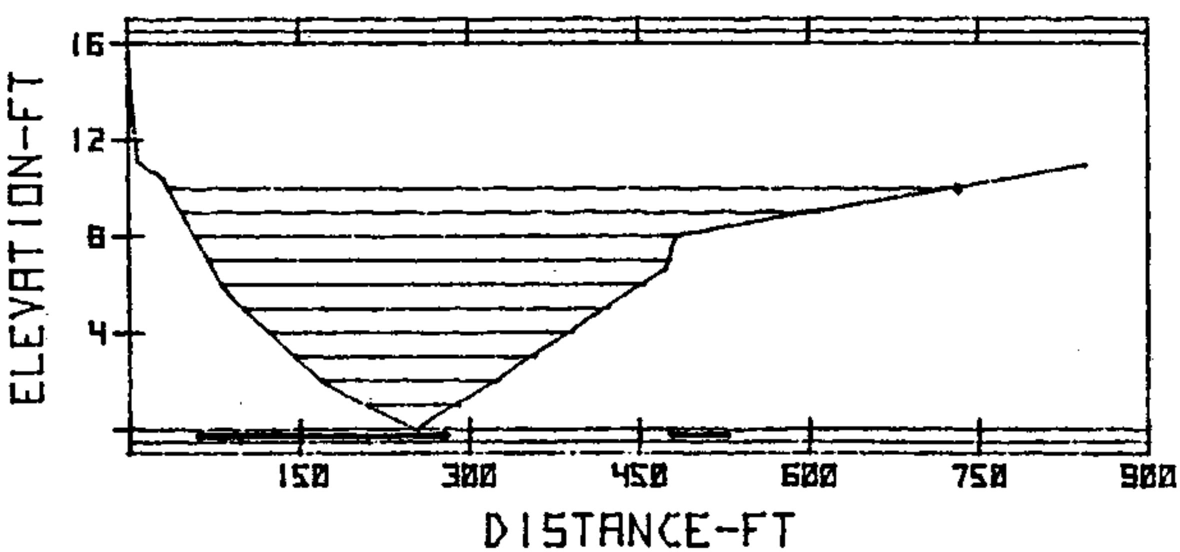
General Section Comments

The section is very exposed. Good spawning gravel is available. Limited deep pool habitat is available.

RUSSIAN RIVER
CROSS SECTION NUMBER 27
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 27
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

		Upper Transect	Lower Transect
Map Ref. Pg. A-14, A-15			
Section	26		
Section Length (feet)	1800		
River Mile	46		
Habitat Type		run	run
Water Surface Width (feet)		92	90
Water Temperature (°C) @ Time of Day Taken		16.5 @ 1150	17.0 @ 1230
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 5.64

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 2.7 0.75 1.3 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 1.75 0.75 2.61 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.83

Section Habitat
This section contains very good pool and riffle habitat. Cover and canopy are present. Three main spawning riffles exist in this section.

Pool/Riffle Ratio 1.8:1
Spawning Substrate Observations
Very good spawning habitat is available in this section. Approximately 70% of this section is available for spawning from a substrate standpoint.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-14, A-15

		Upper Transect	Lower Transect
Section	26		
Section Length (feet)	1800		
River Mile	46		
Habitat Type		riffle-run	pool
Water Surface Width (feet)		71	68
Maximum Water Depth (feet)		2.5	3.4
Water Temperature (°C) @ Time of Day Taken		24.0 @ 1330	24.0 @ 1410
Water Transparency (feet)		>4.0	>4.0
In-Channel Cover (feet)		21	43
In-Channel Vegetative Canopy (feet)		24	15
In-Stream Cover (feet)		0	15
In-Stream Vegetative Canopy (feet)		0	15

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 1.90

Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 2.40

Section Pool Quality

Pool quality is very good. Depths up to 8 to 10 ft, undercut banks, submerged willow trunks, and good canopy are present in this section.

Section Riffle Quality

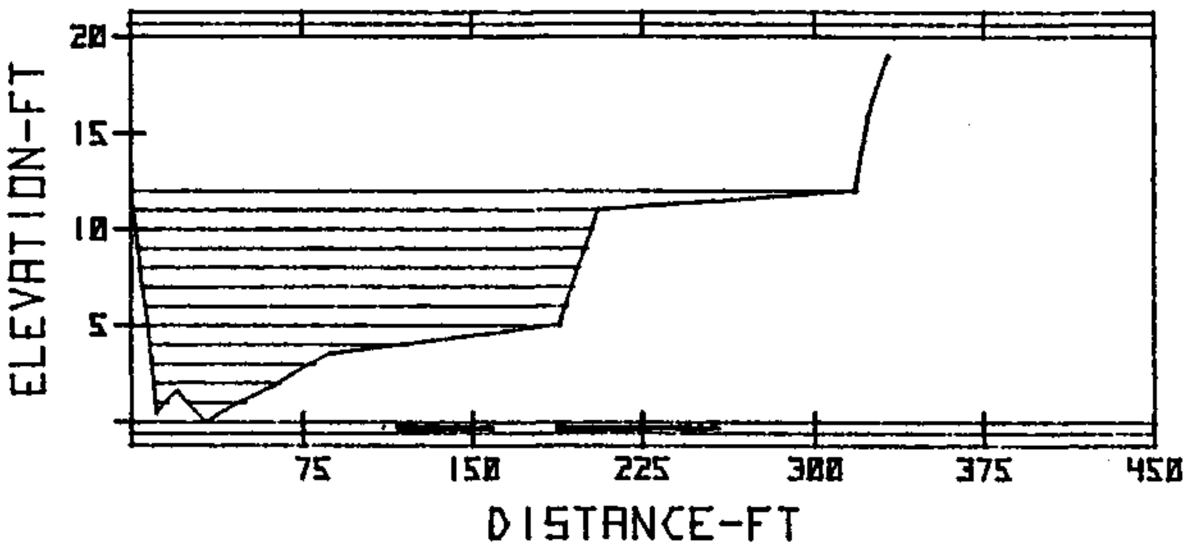
Riffle habitat is very good. The substrate is of spawning size and relatively free of fine material. Good riffle depth and velocity are present.

Pool/Riffle Ratio 1.8:1

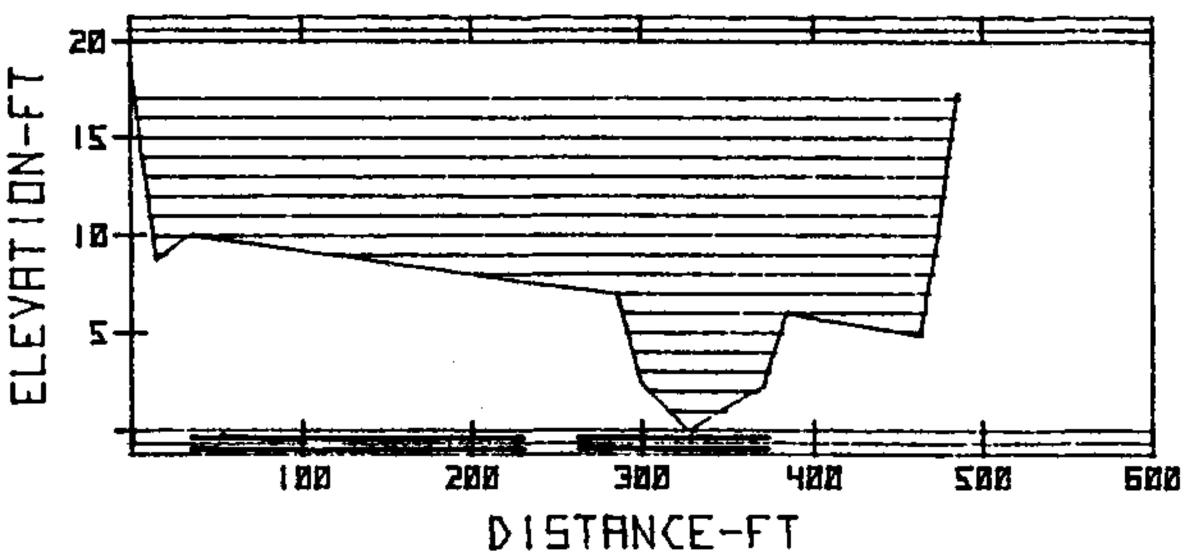
General Section Comments

This section contained the best pool and riffle habitat observed from the mouth upstream to this point. Large (2 ft long) squawfish (Ptychocheilus grandis) were observed.

RUSSIAN RIVER
CROSS SECTION NUMBER 26
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 26
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-15

Section	22	Upper Transect	Lower Transect
Section Length (feet)	1000		
River Mile	36		
Habitat Type		riffle	riffle-run
Water Surface Width (feet)		160	68
Water Temperature (°C) @ Time of Day Taken		20.5 @ 1700	20.0 @ 1620
Water Transparency (feet)		2.0	2.0

Upper Transect

Water Depth (Feet) at:
0.25 1.5 0.5 2.7 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 2.30 0.5 3.39 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 6.46

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 5.02

Section Habitat
The section is composed primarily of run and riffle habitat. The upper transect is riffle-run habitat. Sections of run and riffle habitat exist between the transects. The lower transect is run habitat.

Pool/Riffle Ratio 2.3:1
Spawning Substrate Observations
Instream substrate is suitable in patches at the upper and lower transects. The riffle section just above the lower transect contains potentially usable substrate. Isolated, exposed pockets of spawning gravel exist on the left bank at the lower transect.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-15

Section	22	Upper Transect	Lower Transect
Section Length (feet)	1000		
River Mile	36		
Habitat Type		pool-run	riffle-run
Water Surface Width (feet)		85	63
Maximum Water Depth (feet)		3.4	3.3
Water Temperature (°C) @ Time of Day Taken		22.0 @ 1130	21.5 @ 1005
Water Transparency (feet)		>4.0	>4.0
In-Channel Cover (feet)		35	18
In-Channel Vegetative Canopy (feet)		85	45
In-Stream Cover (feet)		6	6
In-Stream Vegetative Canopy (feet)		25	8

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	0.82
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	2.43

Section Pool Quality

The section is primarily run habitat. Good riparian cover exists on both banks. Some deep (2.5 feet) slots are available near the edges of the water. The lower half of the section is more exposed than the upper half.

Section Riffle Quality

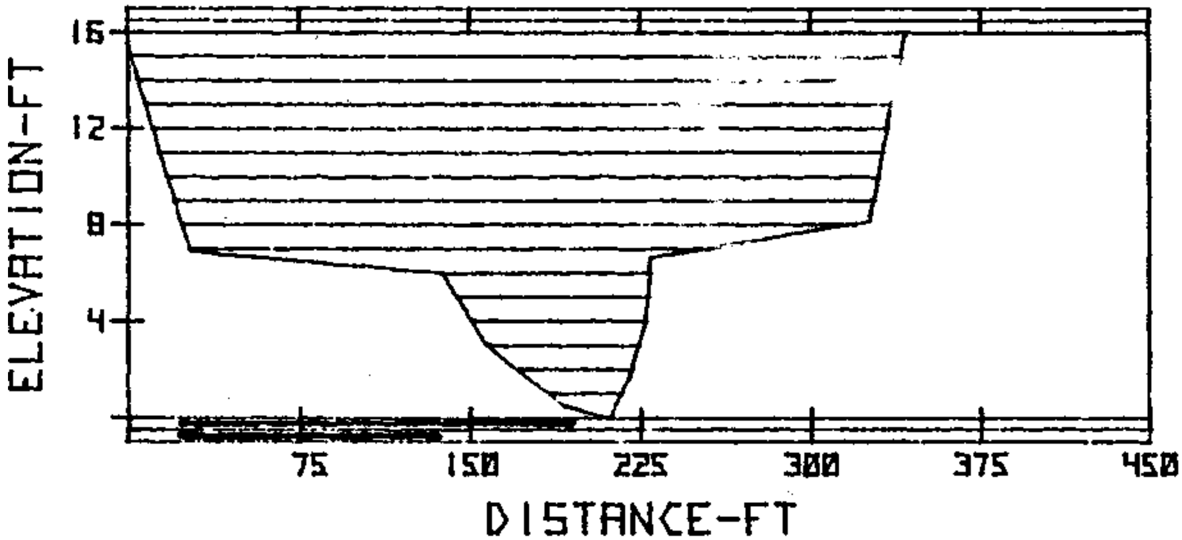
Riffle habitat is good. Depths are available up to 1.5 feet; the water surface is turbulent and the substrate is coarse (to 12 inches). Shading is available on the banks.

Pool/Riffle Ratio 2.3:1

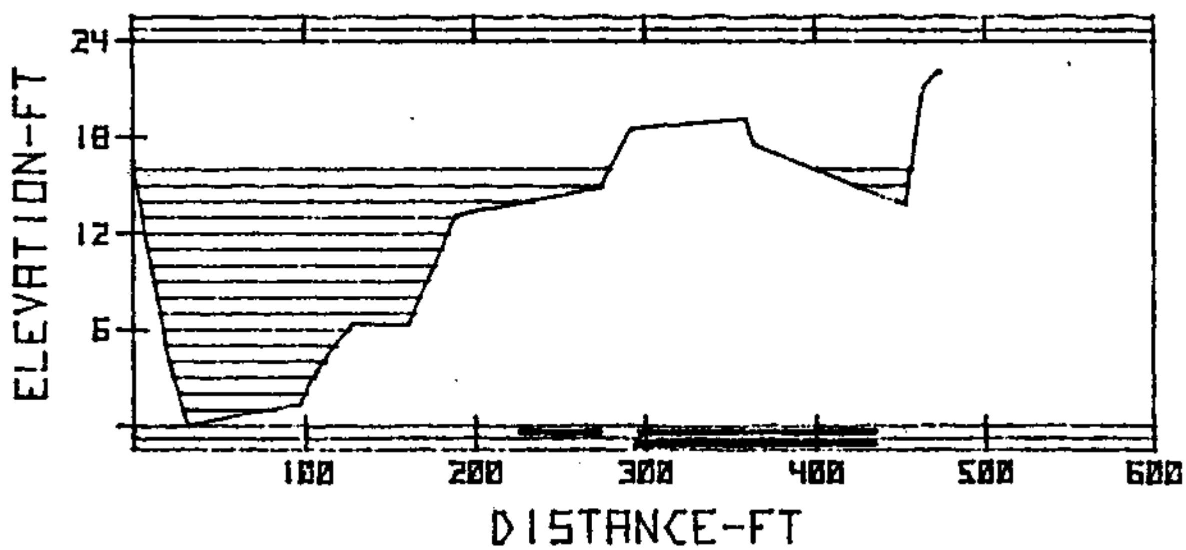
General Section Comments

Substrate through the run stretches is generally fine and poor with respect to invertebrate abundance. The section is narrow compared to most sections.

RUSSIAN RIVER
CROSS SECTION NUMBER 22
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 22
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-16

Section	21	Upper Transect	Lower Transect
Section Length (feet)	750		
River Mile	34		
Habitat Type		riffle-run	Pool-tail
Water Surface Width (feet)		130	178
Water Temperature (°C) @ Time of Day Taken		18.0 @ 0830	18.0 @ 0900
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 2.0 0.75 1.6 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 1.43 0.75 2.91 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.43

Lower Transect

Water Depth (Feet) at:
0.25 2.0 0.5 3.0 0.75 3.0 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 2.07 0.5 2.34 0.75 1.9 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.86

Section Habitat
Riffle habitat is located immediately below the upper transect. Run and pool habitat complete the section.

Pool/Riffle Ratio 8.4:1
Spawning Substrate Observations
Spawning-size substrate is located at the upper transect through the riffle section and into the run section. Exposed substrate on the right edge of channel is generally composed of fine material.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-16

Section	21	Upper Transect	Lower Transect
Section Length (feet)	750		
River Mile	34		
Habitat Type		riffle	run
Water Surface Width (feet)		119	109
Maximum Water Depth (feet)		N/A	2.7
Water Temperature (°C) @ Time of Day Taken		21.0 @ 0805	21.5 @ 0915
Water Transparency (feet)		>4.0	>4.0
In-Channel Cover (feet)		100	45
In-Channel Vegetative Canopy (feet)		3C	90
In-Stream Cover (feet)		3	2
In-Stream Vegetative Canopy (feet)		15	2

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 3.37
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 1.47

Section Pool Quality

Section pool habitat is good. Bedrock cover and depths greater than 5 feet are available on the left bank of the pool section. Healdsburg dam influence probably extends up to this section.

Section Riffle Quality

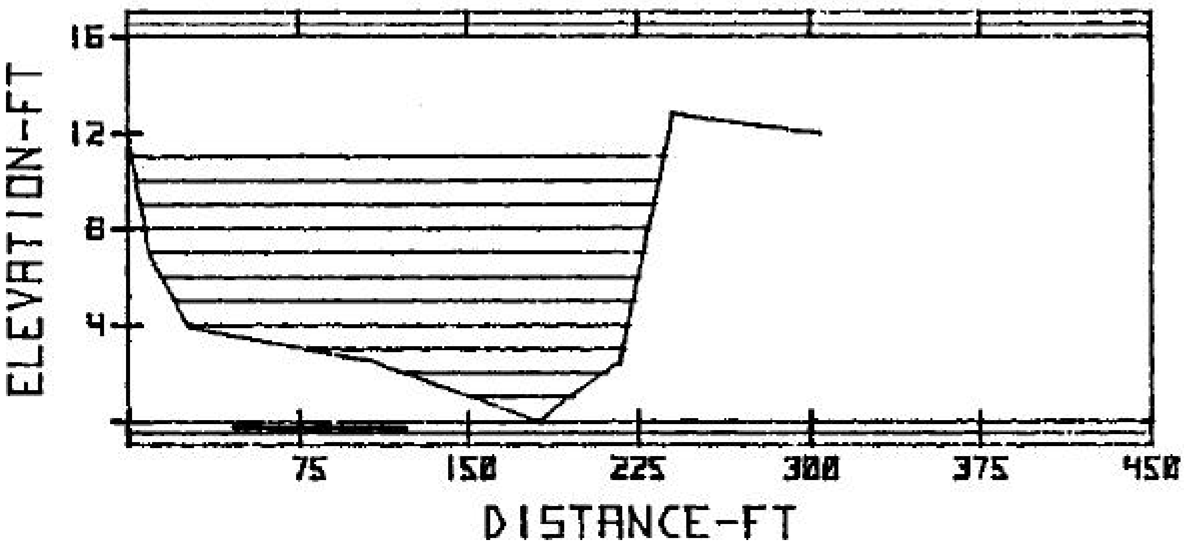
Riffle habitat is relatively deep (2.5 feet) and has good left bank cover and canopy. Undercut bank habitat is available on the left edge of the water through the riffle section below the upper transect.

Pool/Riffle Ratio 8.4:1

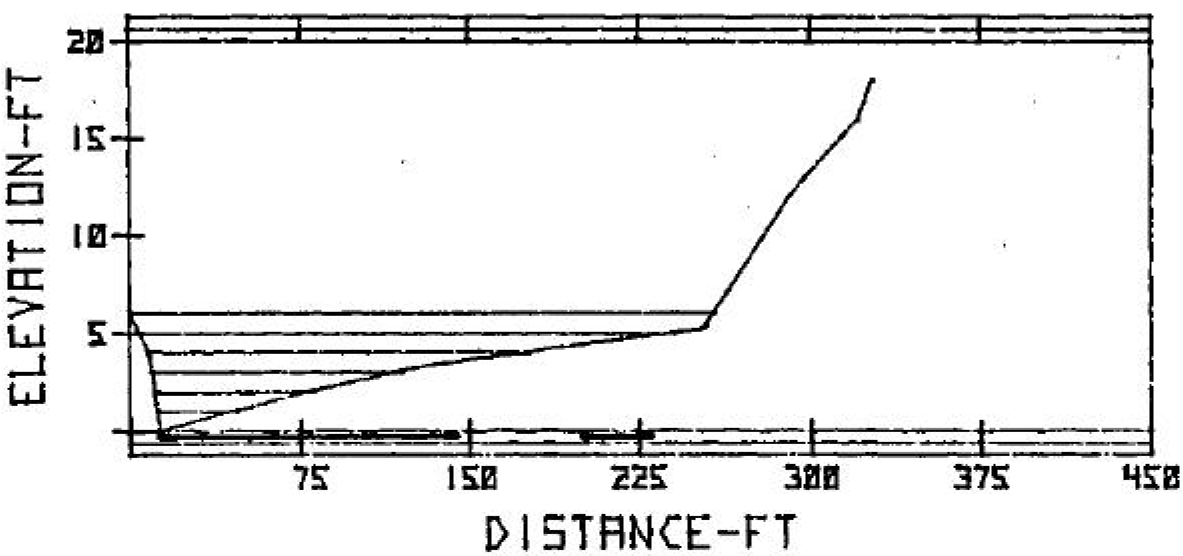
General Section Comments

Riffle and pool habitat is relatively good quality. Juvenile steelhead are reportedly caught in one deep pool section by a local angler.

RUSSIAN RIVER
CROSS SECTION NUMBER 21
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 21
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-16, A-17

		Upper Transect	Lower Transect
Section	19		
Section Length (feet)	2000		
River Mile	30		
Habitat Type		pool	riffle
Water Surface Width (feet)		150	80
Water Temperature (°C) @ Time of Day Taken		19.0 @ 1200	17.5 @ 1100
Water Transparency (feet)		2.5	3.0

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 2.72

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 1.0 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 4.24 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 7.04

Section Habitat

The section is composed primarily of run and riffle habitat. Deep runs with bank protection are available.

Pool/Riffle Ratio 4 : 1

Spawning Substrate Observations

Riffle habitat near the lower transect is suitable for spawning from a substrate standpoint. The exposed gravel bar (left edge of channel) contains considerable usable spawning habitat. The mouth of Dry Creek enters at the lower transect.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-16, A-17

		Upper Transect	Lower Transect
Section	19		
Section Length (feet)	2000		
River Mile	30		
Habitat Type		riffle	riffle
Water Surface Width (feet)		66	59
Maximum Water Depth (feet)		3.0	2.3
Water Temperature (°C) @ Time of Day Taken		24.0 @ 1625	24.0 @ 1515
Water Transparency (feet)		>4.0	>4.0
In-Channel Cover (feet)		9.0	3.0
In-Channel Vegetative Canopy (feet)		28.0	0
In-Stream Cover (feet)		2.0	3.0
In-Stream Vegetative Canopy (feet)		3.0	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 2.11
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 3.33

Section Pool Quality

Very little pool habitat is available in this section, and run habitat is predominant. Run quality is generally good. Depth is generally greater than 2.5 feet and the right edge of the water offers good cover and canopy.

Section Riffle Quality

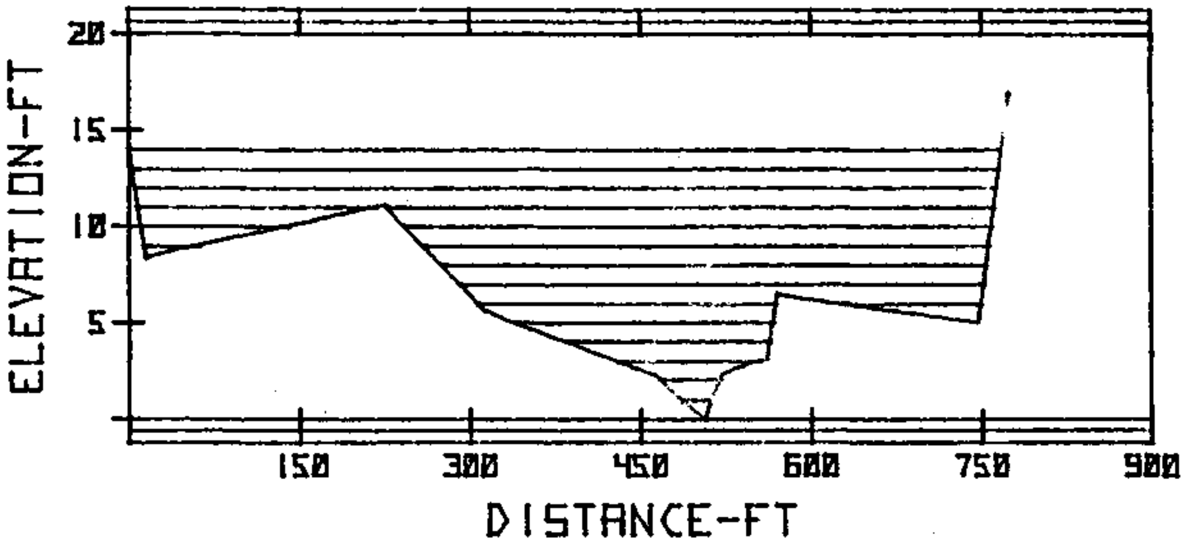
The riffles are exposed but possess good protective substrate (1-6 inch material). Invertebrate sampling produced 48 organisms/ft^2.

Pool/Riffle Ratio 4:1

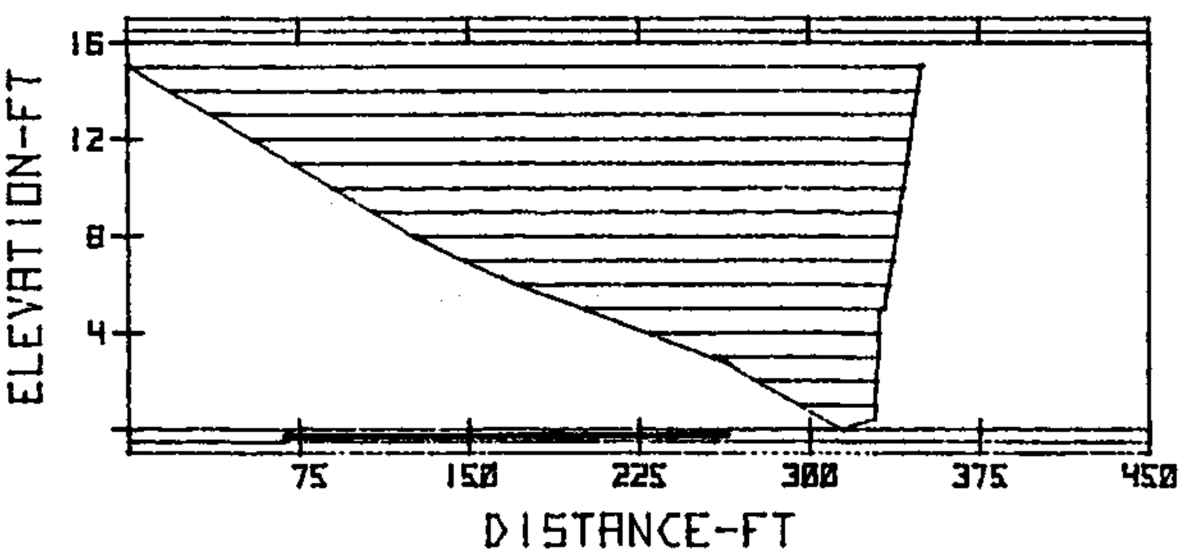
General Section Comments

The section contains good nursery and holding habitat based on availability of shading, water depth, velocity, and invertebrate presence.

RUSSIAN RIVER
CROSS SECTION NUMBER 19
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 19
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-18

		Upper Transect	Lower Transect
Section	18		
Section Length (feet)	1700		
River Mile	29		
Habitat Type		riffle-run	riffle
Water Surface Width (feet)		65	120
Water Temperature (°C) @ Time of Day Taken		19.5 @ 1315	19.0 @ 1400
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 2.5 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 1.98 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.98

Lower Transect

Water Depth (Feet) at:
0.25 3.0 0.5 2.4 0.75 1.4 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 3.47 0.5 2.22 0.75 2.01 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 2.65

Section Habitat
The section is primarily run and riffle habitat.

Pool/Riffle Ratio N/A
Spawning Substrate Observations
Spawning-size substrate is available through this entire section, although the quantity of fine material is high and potentially damaging to successful spawning.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-18

		Upper Transect	Lower Transect
Section	18		
Section Length (feet)	1700		
River Mile	29		
Habitat Type		run	riffle-run
Water Surface Width (feet)		60	102
Maximum Water Depth (feet)		3.1	2.1
Water Temperature (°C) @ Time of Day Taken		23.5 @ 1125	23.0 @ 1020
Water Transparency (feet)		> 4.0	>4.0
In-Channel Cover (feet)		10	87
In-Channel Vegetative Canopy (feet)		45	95
In-Stream Cover (feet)		2	0
In-Stream Vegetative Canopy (feet)		0	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 2.43
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 2.11

Section Pool Quality

The section is composed primarily of shallow runs and riffles. Very little pool habitat is available.

Section Riffle Quality

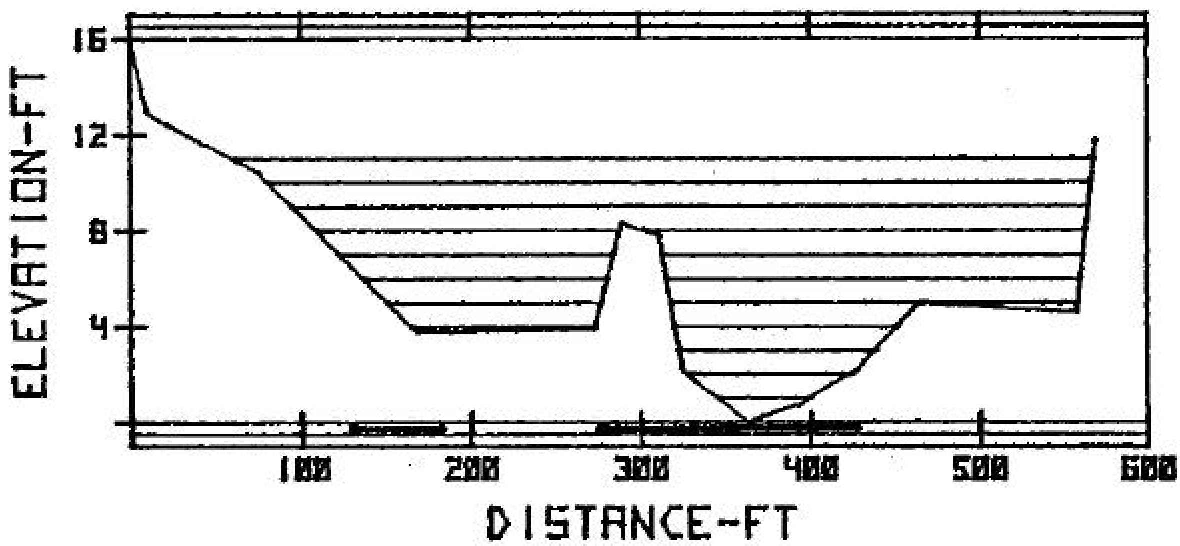
All riffles are shallow (2.5 feet) and greatly exposed. The substrate is generally less than 2-inch material.

Pool/Riffle Ratio N/A

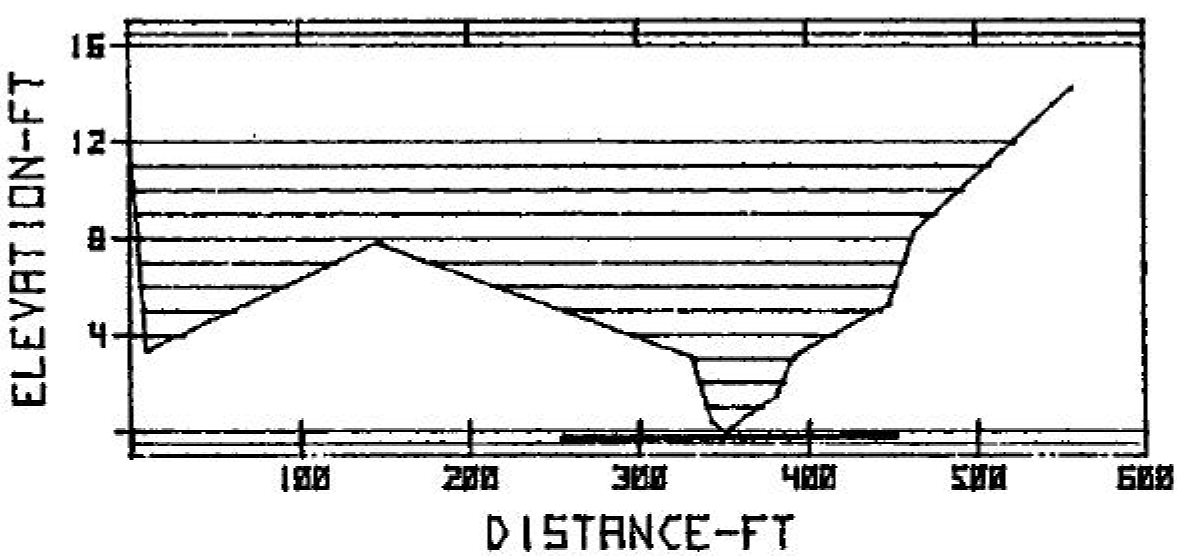
General Section Comments

The section is exposed and shallow. Very little instream cover and canopy is present.

RUSSIAN RIVER
CROSS SECTION NUMBER 18
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 18
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-19

Section	16	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	24		
Habitat Type		pool	pool
Water Surface Width (feet)		190	240
Water Temperature (°C) @ Time of Day Taken		17.0 @ 0900	17.0 @ 0945
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream <1.0

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 3.1 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 0.56 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 0.783

Section Habitat
The section is inundated by Wohler Dam. The entire section is pool-like with surface velocities of 1.0 fps.

Pool/Riffle Ratio 100% pool
Spawning Substrate Observations
The exposed sediment is mostly less than 1 inch in size.
The submerged sediment is very silty.
Section spawning suitability is poor.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-19

		Upper Transect	Lower Transect
Section	16		
Section Length (feet)	1320		
River Mile	24		
Habitat Type		pool (inundated)	pool (inundated)
Water Surface Width (feet)		162	221
Maximum Water Depth (feet)		7.0	7.4
Water Temperature (°C) @ Time of Day Taken		24.0 @ 1335	24.0 @ 1250
Water Transparency (feet)		>4.0	>4.0
In-Channel Cover (feet)		22	5
In-Channel Vegetative Canopy (feet)		30	15
In-Stream Cover (feet)		5	0
In-Stream Vegetative Canopy (feet)		10	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	N/A
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	0.38

Section Pool Quality

The entire section is pool-like. The flow is very slow (1.0 fps), with *a* maximum depth of 7.0 feet. Some cover and canopy are available on the right edge of the water.

Section Riffle Quality

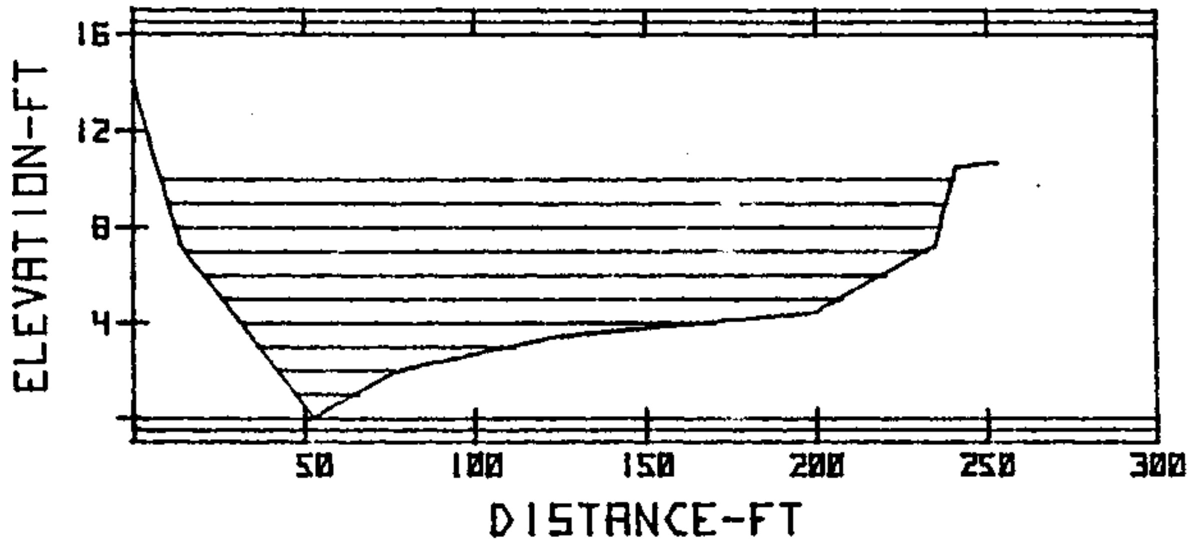
No riffle habitat.

Pool/Riffle Ratio 100% pool

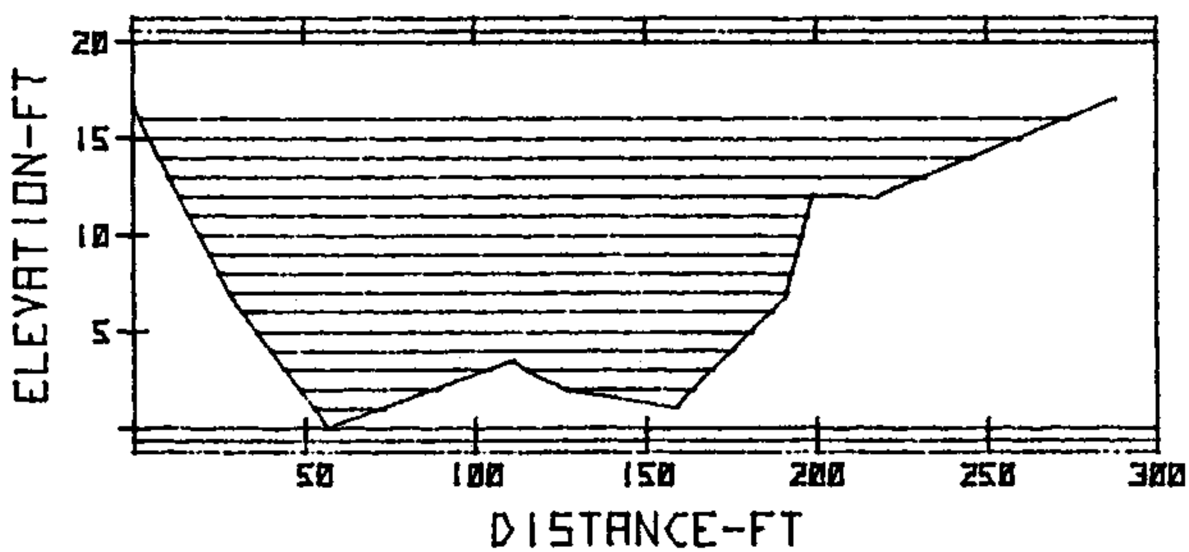
General Section Comments

Wohler Dam inundates this stretch of river.

RUSSIAN RIVER
CROSS SECTION NUMBER 16
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 16
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-21

Section	14	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	22		
Habitat Type		pool	riffle
Water Surface Width (feet)		105	68
Water Temperature (°C) @ Time of Day Taken		18.0 @ 1100	18.0 @ 1130
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.00

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 2.1 0.75 1.0 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 3.51 0.75 1.66 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 6.50

Section Habitat

Most of this section is pool-run habitat with the exception of a short stretch of riffle at the lever transect. This is the site of an old dam no longer installed (Mirabel Park Dam).

Pool/Riffle Ratio N/A

Spawning Substrate Observations

Spawning substrate is available near the lower transect Instream and on the right edge of the channel. Instream substrate contains less fine material than the exposed gravel bar on the right edge of the water.

Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-22			
Section	13	Upper Transect	Lower Transect
Section Length (feet)	1400		
River Mile	19		
Habitat Type		pool	riffle
Water Surface Width (feet)		230	80
Water Temperature (°C) @ Time of Day Taken		18.5 @ 1320	18.5 @ 1400
Water Transparency (feet)		2.5	2.5

Upper Transect

Water Depth (Feet) at:
0.25 N/A 05 1.5 0.75 0.7 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 05 0.75 0.75 1.47 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 0.86

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 2.3 0.75 1.0 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 2.54 0.75 3.42 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.33

Section Habitat
The upper two thirds of the section is composed of pool-run habitat. The lower third of the section is composed of riffle-run habitat, with in-channel vegetation present.

Pool/Riffle Ratio 1.8
Spawning Substrate Observations
Spawning substrate of suitable size is available near the lower transect on the right edge of the channel. The content of fine material (sand and silt) is 35% at the lower transect.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-22
Section 13
Section Length (feet) 1400
River Mile 19

	Upper Transect	Lower Transect
Habitat Type	pool	riffle
Water Surface Width (feet)	84	111
Maximum Water Depth (feet)	4.6	4.6
Water Temperature (°C) @ Time of Day Taken	25.0 @ 1435	25.0 @ 1510
Water Transparency (feet)	3.0	3.0
In-Channel Cover (feet)	27	1
In-Channel Vegetative Canopy (feet)	31	9
In-Stream Cover (feet)	4	2
In-Stream Vegetative Canopy (feet)	4	12

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 1.07
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 4.05

Section Pool Quality

Pool habitat composes most of this section. Pools are slow (1.0 fps) with poor transparency (2.5 feet) and silty bottoms. The upper transect is located just below a recreational beach. Good riparian cover and canopy are present on both banks just below the upper transect and extending downstream.

Section Riffle Quality

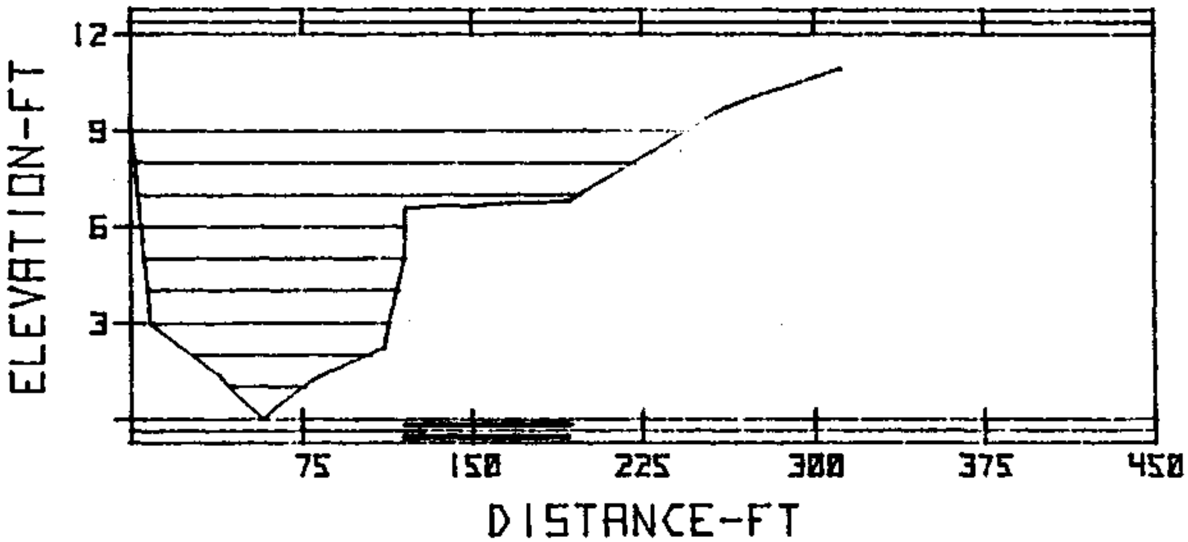
A short riffle stretch exists near the lower transect. The water channel splits through in-channel willow growth, creating the riffle. Cover and canopy are good.

Pool/Riffle Ratio 1.8

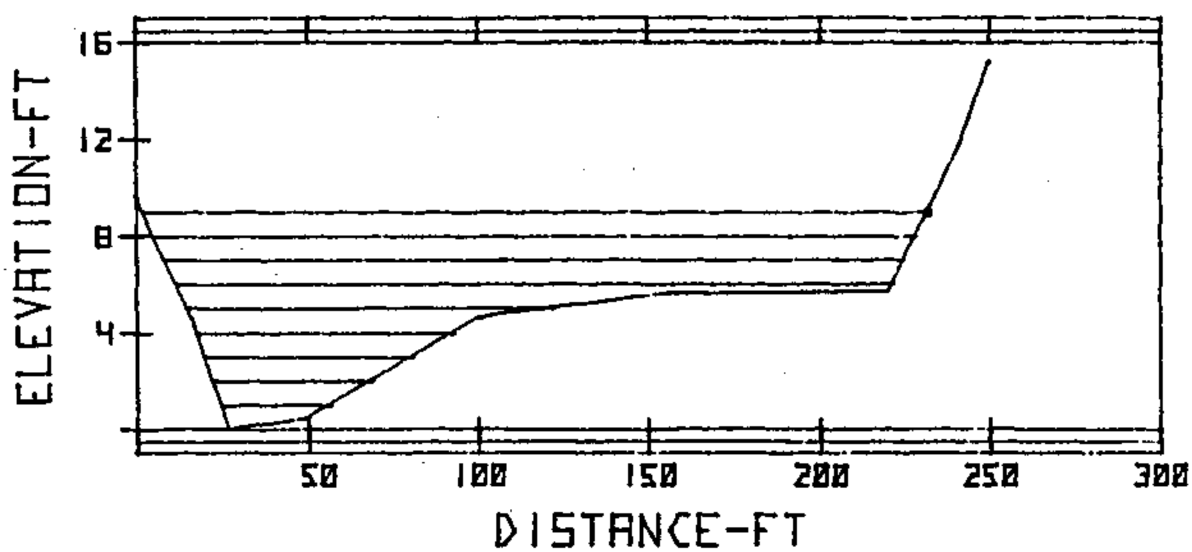
General Section Comments

Personal communication. The lower transect is located at the site of an old gravel extraction operation. The width of the channel is related to a "widening" effect from gravel extraction.

RUSSIAN RIVER
CROSS SECTION NUMBER 13
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 13
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-23

		Upper Transect	Lower Transect
Section	12		
Section Length (feet)	1250		
River Mile	17		
Habitat Type		pool	riffle
Water Surface Width (feet)		300 split channel	lt.-45 rt.-60
Water Temperature (°C) @ Time of Day Taken		19.0 @ 1500	19.0 @ 1505
Water Transparency (feet)		2.0	2.0

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 2.9 0.75 2.3 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 0.96 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.29

Lower Transect (Split channel)

Water Depth (Feet) at:
0.25 N/A .05 N/A 0.75 2.2 main channel Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A .05 ____ 0.75 3.37 main channel Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.67 main channel

Section Habitat

The upper quarter of the section is pool-like, breaking into a deep riffle-run downstream to the lower transect. The Korbel summer road crossing is constructed between the upper and lower transects in the summer.

Pool/Riffle Ratio N/A

Spawning Substrate Observations

Spawning substrate is generally lacking in the upper quarter of this section. Below this point spawning size substrate becomes more available, especially within the flowing channel. Exposed material in the lower three quarters of the section is usable for spawning.

Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-23

Section	11	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mite	16		
Habitat Type		pool	pool
Water Surface Width (feet)		N/A	118
Water Temperature (°C) @ Time of Day Taken		19.5 @ 1630	19.5 @ 1600
Water Transparency (feet)		2.0	2.0

Upper Transect

Water Depth (Feet) at:
0.25 3.0 0.5 3.9 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 0.78 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 0.86

Lower Transect

Water Depth (Feet) at:
0.25 1.7 0.5 3.7 0.75 N/A Distance from Left Edge of
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 0.86 0.5 1.47 0. N/A Distance from Left Edge of
Water Velocity (FPS) Measured on the Surface at Midstream 1.47

Section Habitat
The section is composed completely of pool-run habitat.

Pool/Riffle Ratio 100% pool
Spawning Substrate Observations
Considerable spawning size substrate is available throughout this section on the left side of the channel. Sand and silt content exceed 50% within this section.

Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-25			
Section	10	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	11		
Habitat Type	split:	lt. run rt. riffle	pool
Water Surface Width (feet)		lt. 55 rt. 150	125
Water Temperature (°C) @ Time of Day Taken		18.0 @ 0900	18.0 @ 0950
Water Transparency (feet)		1.5	2.0

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 1.1 riffle 0.75 1.0 riffle Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 2.76 0.75 1.22 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 2.57 (riffle):
2.84 (run)

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 3.9 0.75 2.0 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 0.71 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 0.89

Section Habitat

The section is composed of run and riffle sections with limited pool habitat at the lower transect. The channel is split from the upper transect through approximately half of the section. Riffle areas are located in the right channel.

Pool/Riffle Ratio N/A

Spawning Substrate Observations

Suitable spawning size substrate is distributed in the right channel at the upper transect. Some usable material is available in exposed pockets on the right edge of the water between transects. Construction of Guernewood summer road crossing eliminates the right channel flow.

Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-25

Section	9	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	12		
Habitat Type		pool tail	riffle
Water Surface Width (feet)		148	160
Water Temperature (°C) @ Time of Day Taken		18.5 @ 1130	18.0 @ 1100
Water Transparency (feet)		1.5	1.5

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 3.0 0.75 1.9 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at.
0.25 N/A 0.5 N/A 0.75 1.07 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.14

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 2.9 0.75 1.6 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 3. 05 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 5.89

Section Habitat
The section is composed primarily of run habitat with a section of riffle near the lower transect.

Pool/Riffle Ratio N/A
Spawning Substrate Observations
Potentially usable spawning size substrate is available on the right edge of the water from the upper transect downstream towards the location of the summer structure (Vacation Beach Dam). This gravel is inundated in the summer.

Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-25

		Upper Transect	Lower Transect
Section	7		
Section Length (feet)	1350		
River Mile	10		
Habitat Type		pool	pool-run
Water Surface Width (feet)		215	60
Water Temperature (°C) @ Time of Day Taken		19.0 @ 1245	19.5 @ 1300
Water Transparency (feet)		2.0	2.0

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 2.6 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 1.38 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.69

Lower Transect

Water Depth (Feet) at:
0.25 2.4 0.5 2.9 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 1.94 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.26

Section Habitat

Pool habitat is located at the upper transect, followed by a short riffle and then a run to the end of the section.

Pool/Riffle Ratio N/A

Spawning Substrate Observations

The substrate at and just below the upper transect contains greater than 60% sand and silt. Relatively cleaner substrate is available downstream at the lower transect, where sand and silt content is approximately 35%.

Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-25

		Upper Transect	Lower Transect
Section	6		
Section Length (feet)	1900		
River Mile	8		
Habitat Type		pool	pool
Water Surface Width (feet)		220	N/A
Water Temperature (°C)@ Time of Day Taken		19.5 @ 1345	N/A
Water Transparency (feet)		1.5	1.5

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 3.7 0.75 2.4 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 0.38 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream N/A

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream N/A

Section Habitat
This section is composed primarily of pool run habitat.

Pool/Riffle Ratio 100% pool
Spawning Substrate Observations
The substrate is sub-optimal for spawning. An exposed gravel bar at the upper transect contains greater than 50% sand and silt.

Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-26			
Section	5	Upper Transect	Lower Transect
Section Length (feet)	N/A		
River Mile	6		
Habitat Type		pool	pool
Water Surface Width (feet)		240	255
Water Temperature (°C) @ Time of Day Taken		20.0 @ 1445	20.0 @ 1500
Water Transparency (feet)		2.5	N/A

Upper Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N /A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream N/A

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 3.5 0.75 3.0 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 1.00 0.75 1.31 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.03

Section Habitat

The majority of this section is composed of run habitat. Austin Creek enters at the lower transect. The upper transect is composed of a deep pool with bedrock outcropping on the left edge of water.

Pool/Riffle Ratio N/A

Spawning Substrate Observations

Potentially usable substrate is located at and immediately below Austin Creek mouth. In addition, an exposed gravel bar on the left edge of the channel (opposite Austin Creek) is potentially usable.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-26

			Upper Transect	Lower Transect
Section	5	(Upper transect spot check)		
Section Length (feet)	N/A			
River Mile	6			
Habitat Type			pool	
Water Surface Width (feet)			N/A	
Maximum Water Depth (feet)			42.0	
Water Temperature (°C) @ Time of Day Taken			see below	
Water Transparency (feet)			N/A	
In-Channel Cover (feet)			N/A	
In-Channel Vegetative Canopy (feet)			0	
In-Stream Cover (feet)			N/A	
In-Stream Vegetative Canopy (feet)			0	

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) <1.0
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) N/A

Section Pool Quality

Upper transect: Consists of very deep pool. Maximum depth recorded – 42 feet. Bedrock outcrops on the left edge of the water; potentially usable cover. No canopy was present at this transect.

Section Riffle Quality

N/A

Pool/Riffle Ratio N/A

General Section Comments

This section was revisited to check the temperature profile and conductivity.

Temperature profile with depth (temperatures recorded at 1400)

Surface = 26.0°C
20 feet deep = 19.0°C
42 feet deep = 17.5°C

Conductivity at 42 feet = 6000µmhos, indicating slightly saline water at the bottom of the pool

Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-26

Section	3	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	5		
Habitat Type		run	pool
Water Surface Width (feet)		148	360
Water Temperature (°C) @ Time of Day Taken		20.0 @ 1040	19.5 @ 1020
Water Transparency (feet)		2.0	2.0

Upper Transect

Water Depth (Feet) at:
0.25 2.4 0.5 4.2 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 0.75 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.38

Lower Transect

Water Depth (Feet) at:
0.25 3.9 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 0.64 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 0.68

Section Habitat

This section is composed primarily of pool habitat with faster moving run habitat near the upper transect.

Pool/Riffle Ratio 100% Pool

Spawning Substrate Observations

Pockets of suitable sized substrate are available on the exposed gravel bar on the left side of the channel. The majority of the exposed substrate is too small for spawning.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-26

		Upper Transect	Lower Transect
Section	3		
Section Length (feet)	1320		
River Mile	5		
Habitat Type		pool	pool
Water Surface Width (feet)			
Maximum Water Depth (feet)		N/A	N/A
Water Temperature (°C) @ Time of Day Taken			
Water Transparency (feet)			
In-Channel Cover (feet)			
In-Channel Vegetative Canopy (feet)			
In-Stream Cover (feet)			
In-Stream Vegetative Canopy (feet)			

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) ______
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) ______

Section Pool Quality

River mouth closure creates a pool extending at least up through this section and river mile 5.

Section Riffle Quality

Pool/Riffle Ratio 100% pool

General Section Comments

No data recorded. This section is inundated by river mouth closure.

Fish Habitat Observations
Spawning Habitat
Mainstem

Map Ref. Pg. A-27

		Upper Transect	Lower Transect
Section	2		
Section Length (feet)	1320		
River Mile	3		
Habitat Type		pool	pool
Water Surface Width (feet)		N/A	N/A
Water Temperature (°C) @ Time of Day Taken		19.0 @ 0930	18.0 @ 0915
Water Transparency (feet)		2.0	2.5

Upper Transect

Water Depth (Feet) at:
0.25 3.8 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 0.40 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream <1.0

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of
Water Velocity (FPS) Measured 0.5 ft.
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of
Water Velocity (FPS) Measured on the Surface at Midstream <1.0

Section Habitat
The entire section is pool-like habitat. Velocities are less than 1.0 fps on the surface. No riffle habitat is available.

Pool/Riffle Ratio 100% pool
Spawning Substrate Observations
Very little spawning size substrate is available.
Exposed substrate is generally less than 1 inch in size.

Fish Habitat Observations
Nursery Habitat
Mainstem

Map Ref. Pg. A-27

Section	2	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	3		
Habitat Type		pool	pool
Water Surface Width (feet)		533	263
Maximum Water Depth (feet)		13.0	25+
Water Temperature (°C) @ Time of Day Taken		21.0 @ 0930	21.0 @ 0815
Water Transparency (feet)		3.0	3.0
In-Channel Cover (feet)		15	23
In-Channel Vegetative Canopy (feet)		14	15
In-Stream Cover (feet)		6	84
In-Stream Vegetative Canopy (feet)		23	9

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) < 1.0
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) < 1.0

Section Pool Quality

The entire section is wide, slow moving and pool-like. The maximum depth is greater than 25 feet. Water temperature decreases with depth: 21° @ surface, 17.5°C @ 25 feet deep.

Section Riffle Quality

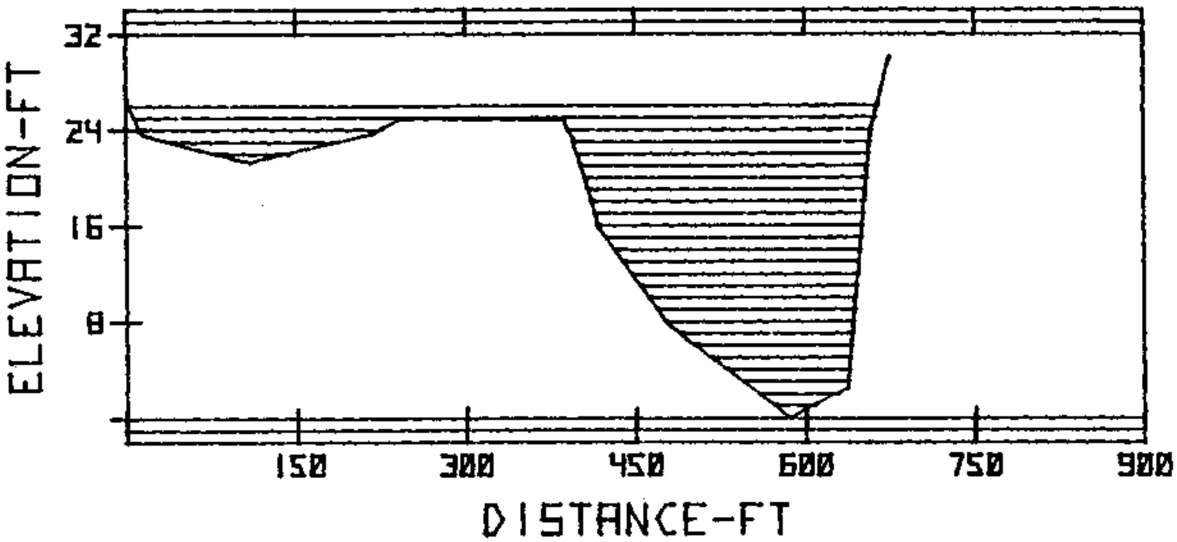
No riffle habitat available in this section.

Pool/Riffle Ratio 100% pool

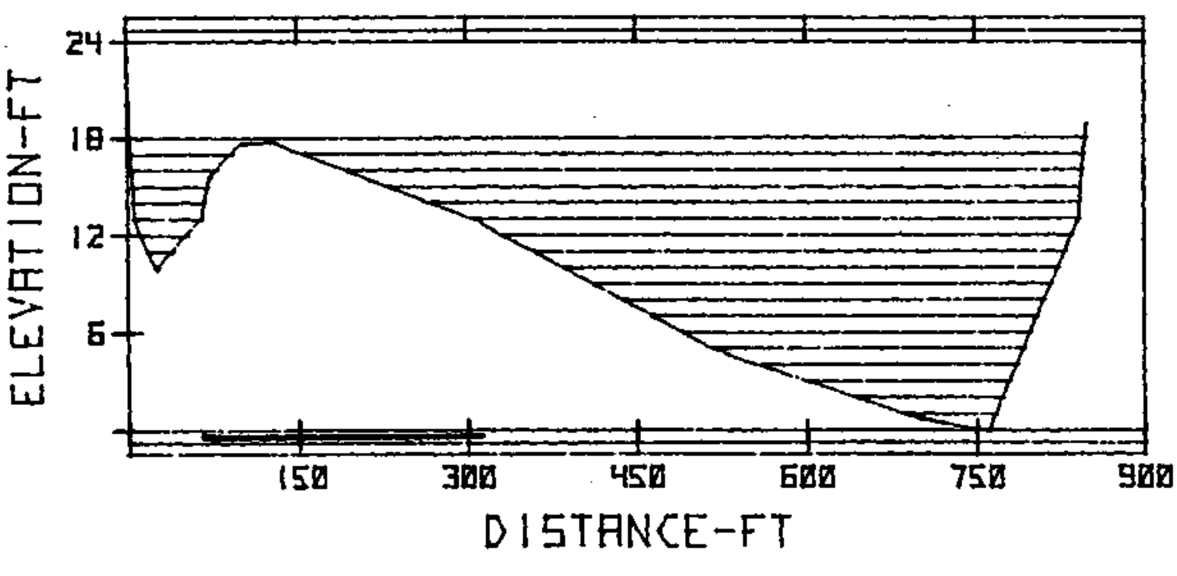
General Section Comments

This section is affected by tidal patterns and general coastal influence.

RUSSIAN RIVER
CROSS SECTION NUMBER 2
LOWER TRANSECT



RUSSIAN RIVER
CROSS SECTION NUMBER 2
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Dry Creek

		Upper Transect	Lower Transect
Map Ref. Pg.	A-28		
Section	D-1		
Section Length (feet)	1320		
River Mile	13		
Habitat Type		pool	riffle
Water Surface Width (feet)		98	84
Water Temperature (°C) @ Time of Day Taken		13.0 @ 1000	13.0 @ 1035
Water Transparency (feet)		3.0	3.0

Upper Transect

Water Depth (Feet) at:
0.25 2.9 0.5 0.9 0.75 1.4 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 1.47 0.5 1.65 0.75 1.18 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.50

Lower Transect

Water Depth (Feet) at:
0.25 1.1 0.5 1.8 0.75 0.6 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft.
0.25 3.20 0.5 3.02 0.75 0.95 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.66

Section Habitat
Section is composed primarily of riffles and runs. Limited pool habitat is available at the upper transect.

Pool/Riffle Ratio 9 : 1
Spawning Substrate Observations
Instream and exposed substrate it generally smaller than optimal with respect to spawning. Pockets of suitable size material are available.

Fish Habitat Observation
Nursery Habitat
Dry Creek

Map Ref. Pg. A-28

		Upper Transect	Lower Transect
Section	D-1		
Section Length (feet)	1320		
River Mile	13		
Habitat Type		pool	riffle
Water Surface Width (feet)		80	37
Maximum Water Depth (feet)		2.1	0.7
Water Temperature (°C) @ Time of Day Taken		19.0 @ 0835	20.0 @ 0950
Water Transparency (feet)		>3.0	>3.0
In-Channel Cover (feet)		0	20
In-Channel Vegetative Canopy (feet)		30	20
In-Stream Cover (feet)		0	0
In-Stream Vegetative Canopy (feet)		5	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 0.24
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 0.86

Section Pool Quality

With the exception of the pool at the upper transect, this section is without pool habitat. Available pool habitat is shallow and exposed.

Section Riffle Quality

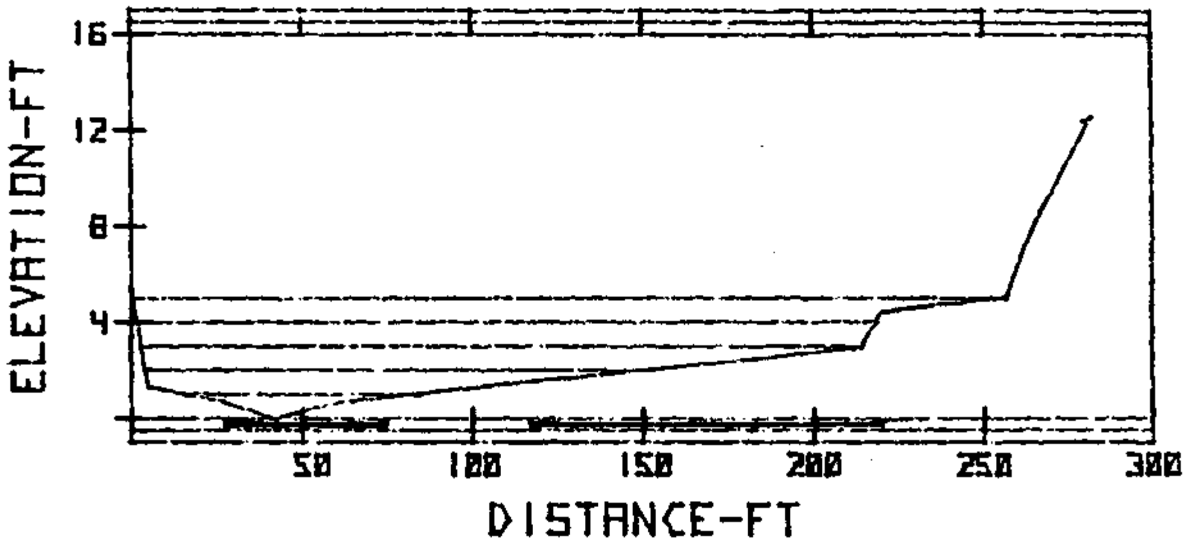
Riffles are very shallow and almost dry (Depths 3 to 4 inches).

Pool/Riffle Ratio 9:1

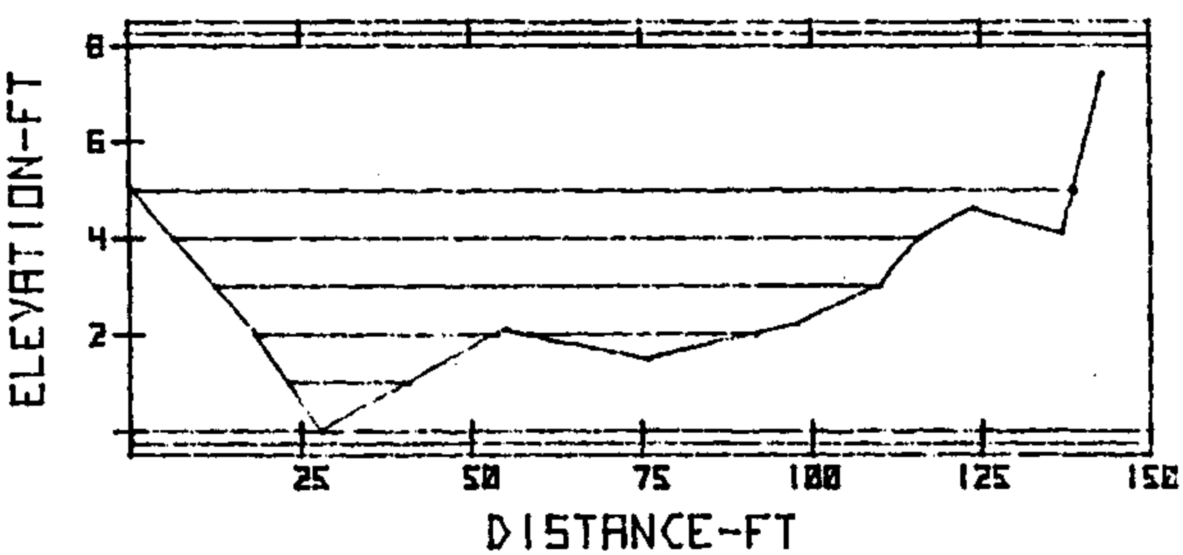
General Section Comments

Section is very shallow and exposed. Filamentous algae is abundant in shallow water areas and benthos is scarce. Juvenile rough fish are abundant.

DRY CREEK
CROSS SECTION NUMBER D 1
LOWER TRANSECT



DRY CREEK
CROSS SECTION NUMBER D 1
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Dry Creek

Map Ref. Pg. A-28

		Upper Transect	Lower Transect
Section	D-2		
Section Length (feet)	1320		
River Mile	11		
Habitat Type		riffle	pool-run
Water Surface Width (feet)		100	55
Water Temperature (°C) @ Time of Day Taken		15.0 @ 1245	15.0 @ 1310
Water Transparency (feet)		>3.0	>3.0

Upper Transect

Water Depth (Feet) at:
0.25 1.0 0.5 1.3 0.75 0.5 Distance from Left Edge of
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 2.65 0.5 3.24 0.75 2.41 Distance from Left Edge of
Water Velocity (FPS) Measured on the Surface at Midstream 3.66

Lower Transect

Water Depth (Feet) at:
0.25 1.9 0.5 1.8 0.75 1.9 Distance from Left Edge of
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 2.01 0.5 3.02 0.75 2.15 Distance from Left Edge of
Water Velocity (FPS) Measured on the Surface at Midstream 2.87

Section Habitat
This section is narrower than most Dry Creek sections, creating relatively deep, swift water.

Pool/Riffle Ratio 1 : 1
Spawning Substrate Observations
A considerable amount of exposed substrate is available in this stream section. Approximately 40Z of it is potentially usable from a size standpoint. Instream riffle substrate is relatively clean although it consists primarily of the lower range of acceptable spawning substrate.

Fish Habitat Observation
Nursery Habitat
Dry Creek

Map Ref. Pg. A-28

Section	D-2	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	11		
Habitat Type		riffle	pool
Water Surface Width (feet)		45	40
Maximum Water Depth (feet)		1.0	1.8
Water Temperature (°C) @ Time of Day Taken		25.0 @ 1545	25.0 @ 1615
Water Transparency (feet)		>3.0	>3.0
In-Channel Cover (feet)		20	30
In-Channel Vegetative Canopy (feet)		35	70
In-Stream Cover (feet)		5	2
In-Stream Vegetative Canopy (feet)		18	15

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 1.15
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 0.42

Section Pool Quality

Section contains relatively good pool and run habitat. Depth and riparian shelter are better than average Dry Creek habitat.

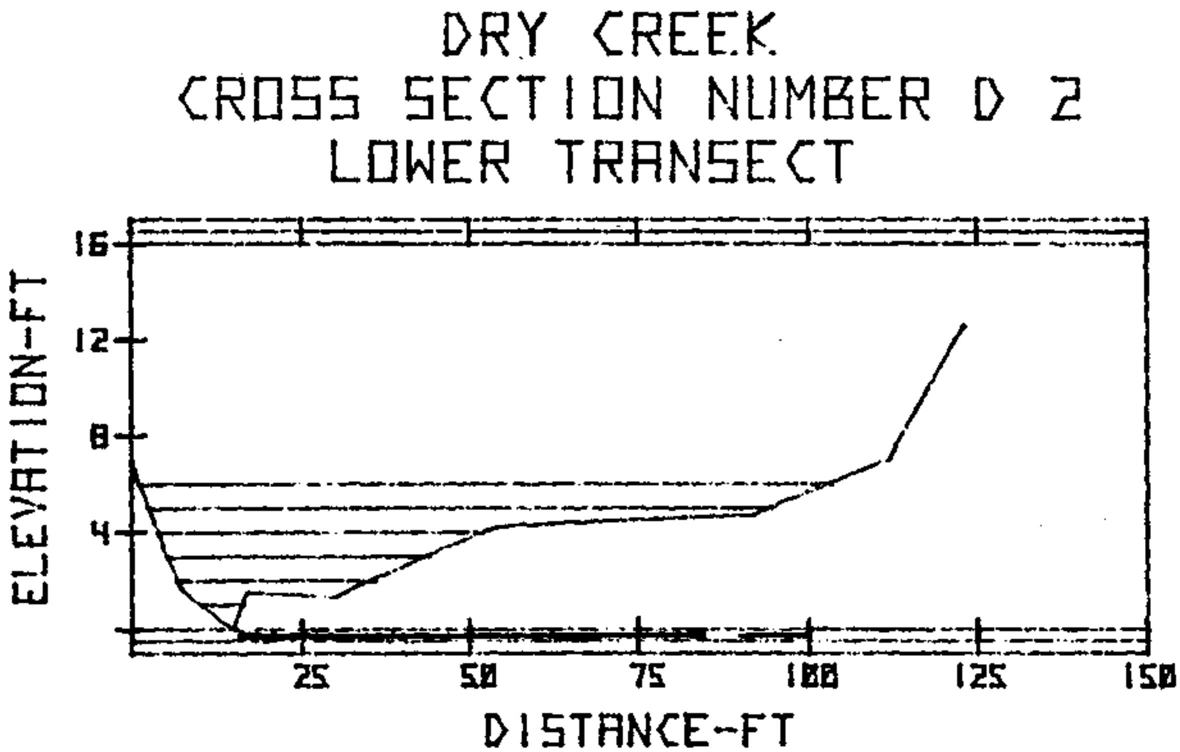
Section Riffle Quality

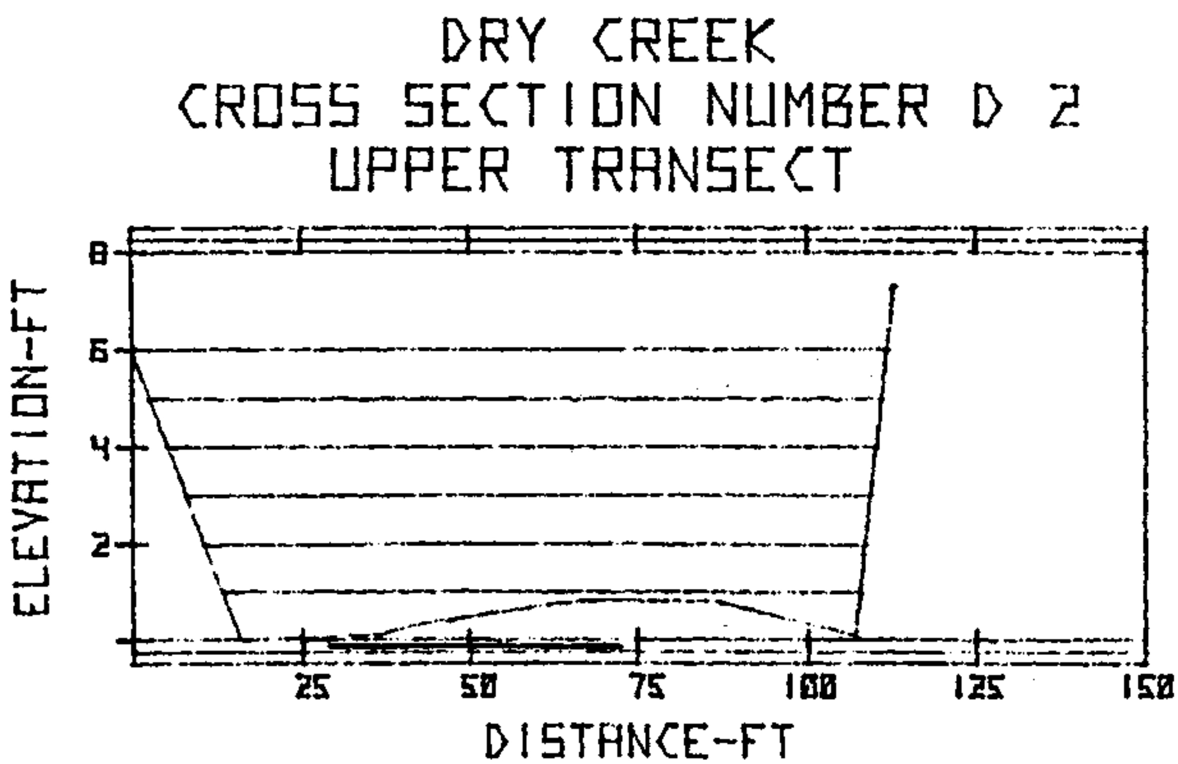
Riffle quality varies depending primarily on depth and shading. Some relatively deep (1.0 feet) and well shaded habitat is available.

Pool/Riffle Ratio 1:1

General Section Comments

Section water width is relatively narrow, creating better depth and riparian shelter.


DRY CREEK
CROSS SECTION NUMBER D 2
LOWER TRANSECT
ELEVATION-FT
16
12
8
4
25
50
75
100
125
150
DISTANCE-FT


DRY CREEK
CROSS SECTION NUMBER D 2
UPPER TRANSECT
ELEVATION-FT
8
6
4
2
25
50
75
100
125
150
DISTANCE-FT

Fish Habitat Observations
Spawning Habitat
Dry Creek

Map Ref. Pg.	A-29		
Section	D-3	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	10		
Habitat Type		riffle	riffle
Water Surface Width (feet)		115	51
Water Temperature (°C) @ Time of Day Taken		13.0 @ 1440	13.0 @ 1440
Water Transparency (feet)		>3.0	>3.0

Upper Transect

Water Depth (Feet) at:

0.25 1.3 0.5 1.7 0.75 1.1 Distance from Left Edge of Water

Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:

0.25 2.22 0.5 2.15 0.75 1.35 Distance from Left Edge of Water

Water Velocity (FPS) Measured on the Surface at Midstream 2.41

Lower Transect

Water Depth (Feet) at:

0.25 2.3 0.5 1.3 0.75 0.6 Distance from Left Edge of Water

Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:

0.25 3.47 0.5 3.02 0.75 1.79 Distance from Left Edge of Water

Water Velocity (FPS) Measured on the Surface at Midstream 4.38

Section Habitat

Section is composed primarily of run habitat. Riffles are located at the upper and lower transects and just above the lower transect.

Pool/Riffle Ratio 2:1

Spawning Substrate Observations

Usable size substrate is available primarily on the left edge of water through the upper three fourths of the transect. A good spawning riffle is located just above the lower transect. Most of the exposed substrate contains a relatively high concentration of fines.

Fish Habitat Observation
Nursery Habitat
Dry Creek

Map Ref. Pg. A-29

		Upper Transect	Lower Transect
Section	D-3		
Section Length (feet)	1320		
River Mile	10		
Habitat Type		pool	riffle
Water Surface Width (feet)		75	23
Maximum Water Depth (feet)		0.7	1.2
Water Temperature (°C) @ Time of Day Taken		22.0 @ 1425	22.0 @ 1335
Water Transparency (feet)		>3.0	>3.0
In-Channel Cover (feet)		10	20
In-Channel Vegetative Canopy (feet)		45	30
In-Stream Cover (feet)		5	2
In-Stream Vegetative Canopy (feet)		15	4

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 1.0
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 1.51

Section Pool Quality

Pool habitat is generally shallow and exposed. Water is very clear and no surface turbulence is available for cover.

Section Riffle Quality

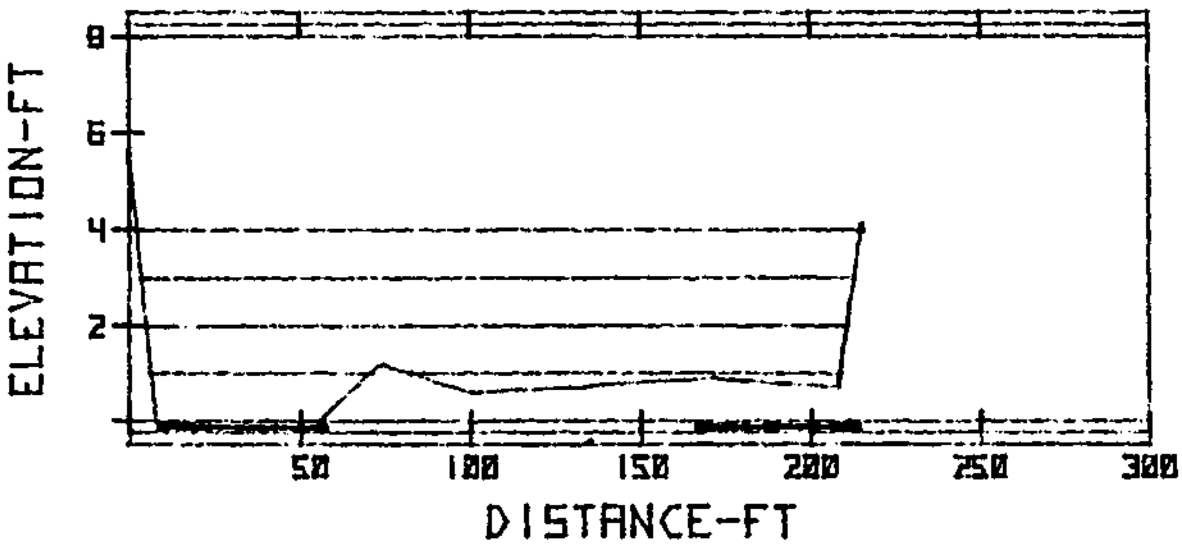
Riffles are very shallow with the exception of the lower transect riffle. Thirty-five invertebrates/ft2 were sampled at the lower transect. Filamentous algae is prevalent in most riffles.

Pool/Riffle Ratio 2:1

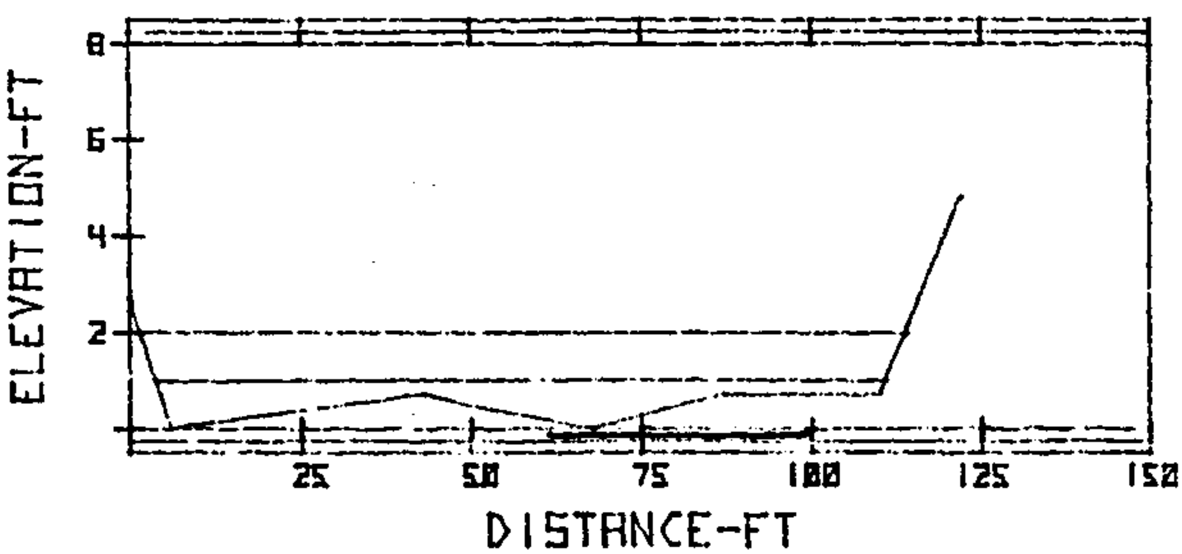
General Section Comments

Juvenile rough fish are numerous. Most of the section is very exposed although shading is available where flows are along the right bank.

DRY CREEK
CROSS SECTION NUMBER D 3
LOWER TRANSECT



DRY CREEK
CROSS SECTION NUMBER D 3
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Dry Creek

Map Ref. Pg. A-29

		Upper Transect	Lower Transect
Section	D-4		
Section Length (feet)	1320		
River Mile	8		
Habitat Type		pool tail	riffle
Water Surface Width (feet)		70	85
Water Temperature (°C) @ Time of Day Taken		16.5 @ 0845	17.0 @ 0915
Water Transparency (feet)		>3.0	>3.0

Upper Transect

Water Depth (Feet) at:
0.25 0.7 0.5 0.8 0.75 0.7 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 2.04 0.5 2.07 0.75 1.83 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.66

Lower Transect

Water Depth (Feet) at:
0.25 0.6 0.5 N/A 0.75 0.6 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 2.94 0.5 N/A 0.75 2.11 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.23

Section Habitat

Section is composed of riffle, run and pool habitat. The channel is relatively wide, but good cover and canopy are available on the left edge of the water.

Pool/Riffle Ratio 2:1

Spawning Substrate Observations

A considerable amount of spawning sire substrate is available on the exposed gravel bar on the right side of the channel. Instream riffle substrate is generally less coarse than the exposed material.

Fish Habitat Observation
Nursery Habitat
Dry Creek

Map Ref. Pg. A-29

		Upper Transect	Lower Transect
Section	D-4		
Section Length (feet)	1320		
River Mile	8		
Habitat Type		pool tail	riffle
Water Surface Width (feet)		64	65
Maximum Water Depth (feet)		0.7	0.7
Water Temperature (°C) @ Time of Day Taken		18.5 @ 0828	20.0 @ 0930
Water Transparency (feet)		>3.0	>3.0
In-Channel Cover (feet)		20	35
In-Channel Vegetative Canopy (feet)		50	40
In-Stream Cover (feet)		0	2
In-Stream Vegetative Canopy (feet)		0	11

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 2.57
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 1.75

Section Pool Quality

Section pool quality is relatively poor in the upper third of the section because of a complete lack of riparian vegetation. Where flow is along the left bank, habitat is better because of increased instream cover and canopy.

Section Riffle Quality

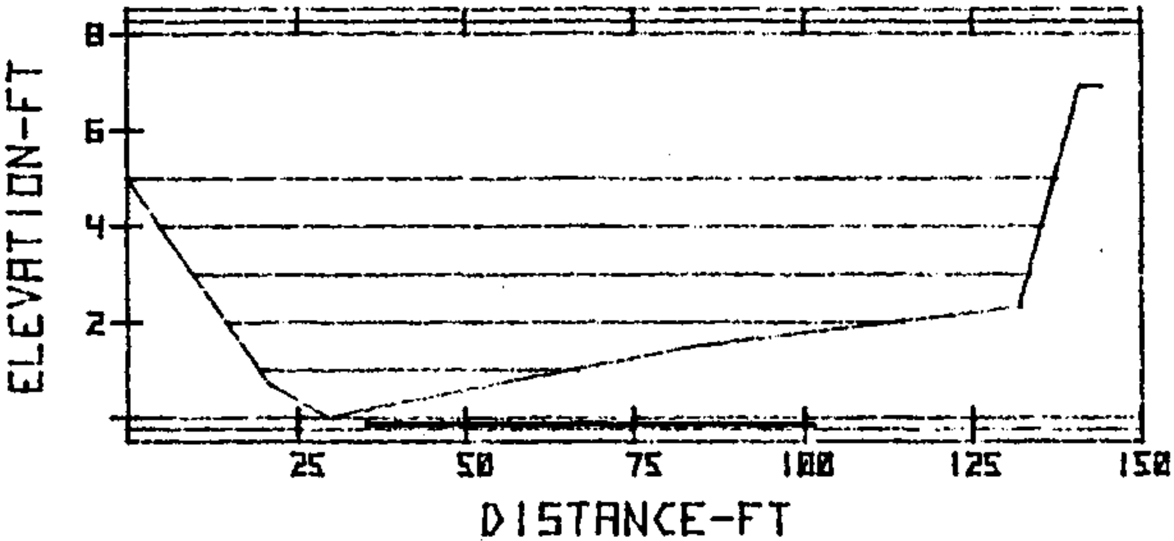
Riffles are, in general, too shallow and composed of smaller than optimal substrate. Seventy invertebrates/ft2 were collected.

Pool/Riffle Ratio 2:1

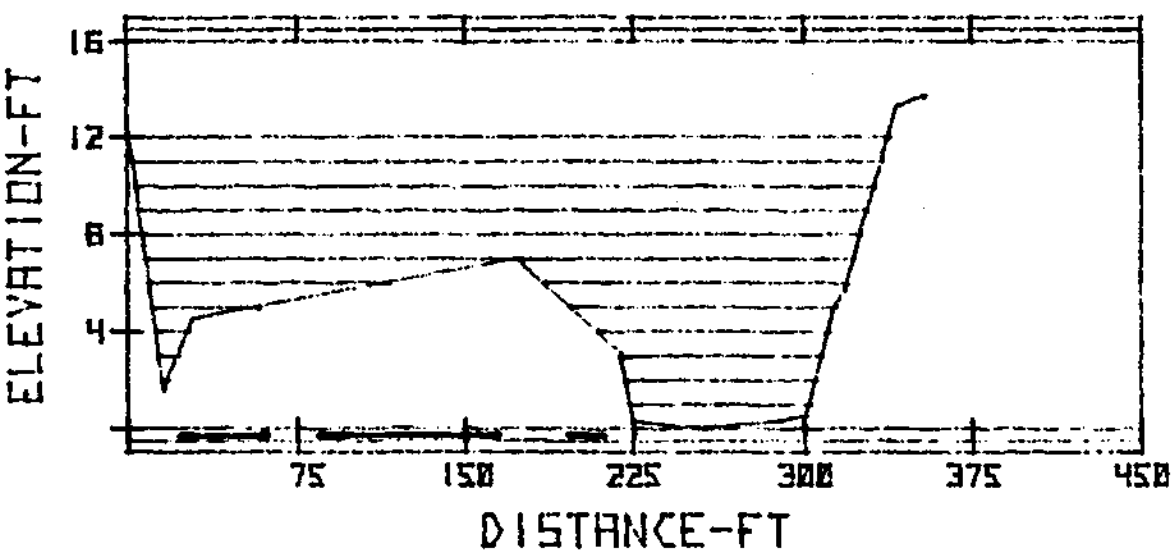
General Section Comments

Most of this stream section contains good riparian-associated stream habitat only on the left edge of water. Exposed portions of this section are shallow and relatively less valuable as nursery habitat.

DRY CREEK
CROSS SECTION NUMBER D 4
LOWER TRANSECT



DRY CREEK
CROSS SECTION NUMBER D 4
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Dry Creek

Map Ref. Pg. A-30

		Upper Transect	Lower Transect
Section	D-5		
Section Length (feet)	1320		
River Mile	6		
Habitat Type		riffle-run	rapids
Water Surface Width (feet)		100	55
Water Temperature (°C) @ Time of Day Taken		15.0 @ 1640	15.0 @ 1705
Water Transparency (feet)		>3.0	>3.0

Upper Transect

Water Depth (Feet) at:
0.25 0.8 0.5 1.1 0.75 1.0 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 2.15 0.5 2.40 0.75 2.19 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 2.30

Lower Transect

Water Depth (Feet) at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 N/A 0.5 N/A 0.75 N/A Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 4.74

Section Habitat

Good riparian vegetation is available in this section. Riffle habitat is available primarily in the lower third of this section. The upper two thirds of this section is primarily run habitat.

Pool/Riffle Ratio 2.5:1

Spawning Substrate Observations

The main concentration of potentially usable spawning substrate is located above the lower transect on the left edge of water. Isolated patches of usable substrate are located in the riffles.

Fish Habitat Observation
Nursery Habitat
Dry Creek

Map Ref. Pg. A-30

			Upper Transect	Lower Transect
Section	D-5			
Section Length (feet)	1320			
River Mile	6			
Habitat Type			pool	riffle
Water Surface Width (feet)		rt. chnl. / lt. chnl.	61 / 20	47
Maximum Water Depth (feet)			2.1	2.9
Water Temperature (°C) @ Time of Day Taken			21.5 @ 1030	22.0 @ 1110
Water Transparency (feet)			>3.0	>3.0
In-Channel Cover (feet)			20	10
In-Channel Vegetative Canopy (feet)			25	30
In-Stream Cover (feet)			15	0
In-Stream Vegetative Canopy (feet)			20	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 1.47
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 0.53

Section Pool Quality

Pool quality is fair to poor except where flow is shaded along a bank. Depths are generally 6 to 12 inches with an occasional 2 to 3 foot deep pocket.

Section Riffle Quality

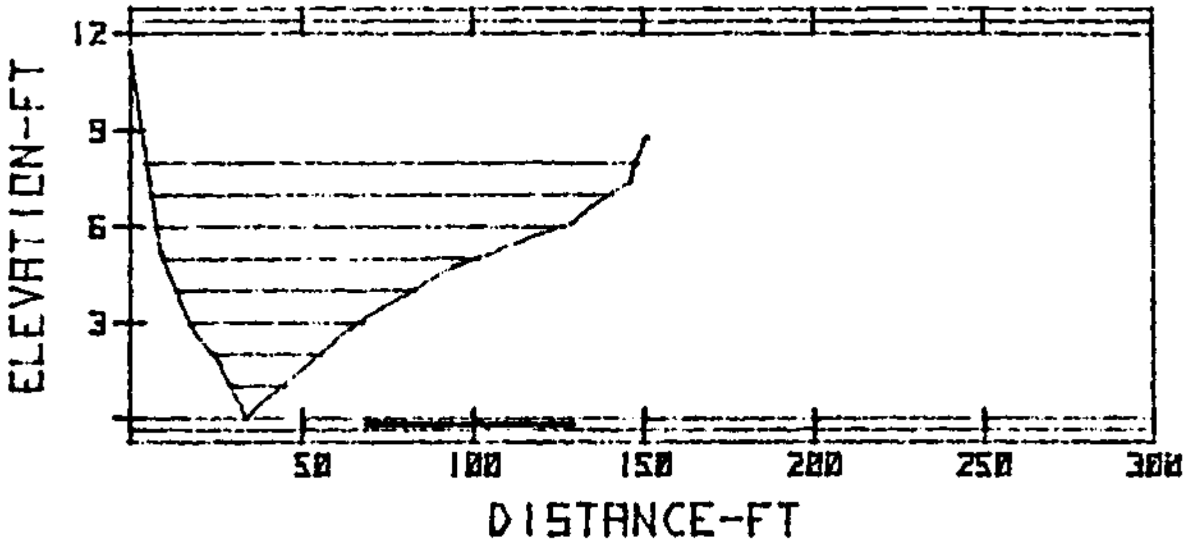
Riffle quality is fair to poor except where depths are greater, e.g. near the lower transect. Sixty-five invertebrates/ft^2 were collected Just above the lower transect.

Pool/Riffle Ratio 2.5:1

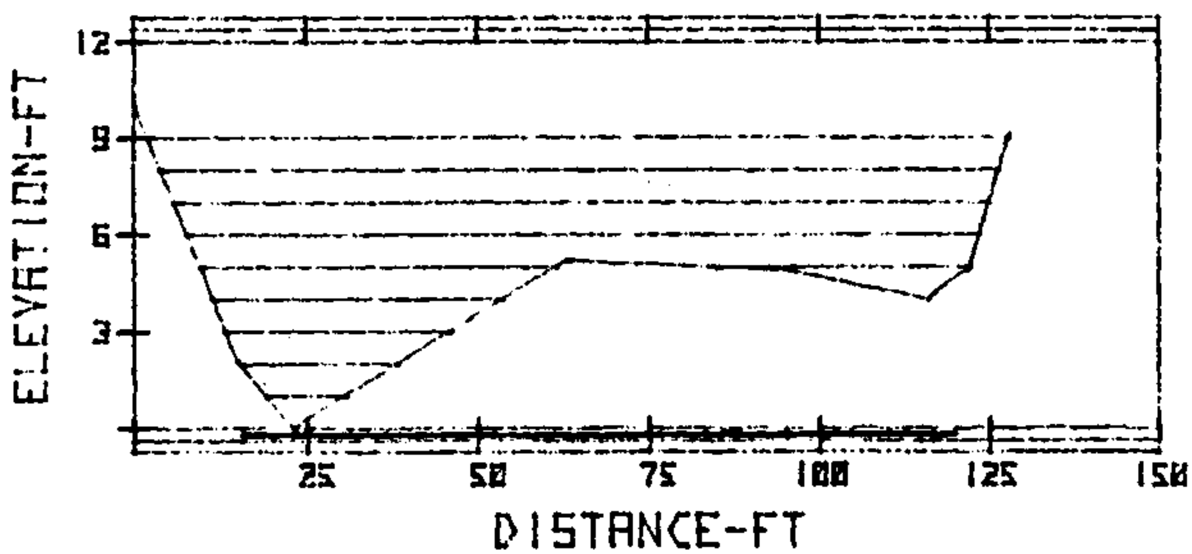
General Section Comments

Riparian vegetation is good to very good except for occasional bare patches. The upper half of this section is relatively narrow, creating more shading.

DRY CREEK
CROSS SECTION NUMBER D 5
LOWER TRANSECT



DRY CREEK
CROSS SECTION NUMBER D 5
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Dry Creek

		Upper Transect	Lower Transect
Map Ref. Pg.	A-30		
Section	D-6		
Section Length (feet)	1320		
River Mile	6		
Habitat Type		pool-run	run
Water Surface Width (feet)		68	57
Water Temperature (°C) @ Time of Day Taken		17.0 @ 1000	18.0 @ 1025
Water Transparency (feet)		>3.0	>3.0

Upper Transect

Water Depth (Feet) at:
0.25 0.7 0.5 1.3 0.75 1.1 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 2.2 0.5 2.6 0.75 2.7 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 2.8

Lower Transect

Water Depth (Feet) at:
0.25 1.8 0.5 1.7 0.75 1.6 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 0.96 0.5 1.54 0.75 1.62 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.43

Section Habitat

This section contains good riparian vegetation, but the flow is generally in the exposed center of the channel. Very little bank flow is available.

Pool/Riffle Ratio 3:1

Spawning Substrate Observations

Spawning-size substrate is available in patches on most of the exposed gravel bar sections. Instream substrate is also potentially usable. A general characteristic of most substrate in this section is a relatively high percentage of silt and sand.

Fish Habitat Observation
Nursery Habitat
Dry Creek

Map Ref. Pg. A-30

Section	D-6	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	6		
Habitat Type		pool tail	run
Water Surface Width (feet)		55	36
Maximum Water Depth (feet)		0.9	0.5
Water Temperature (°C) @ Time of Day Taken		23.0 @ 1310	24.0 @ 1340
Water Transparency (feet)		> 3.0	>3.0
In-Channel Cover (feet)		20	15
In-Channel Vegetative Canopy (feet)		15	10
In-Stream Cover (feet)		2	0
In-Stream Vegetative Canopy (feet)		0	0

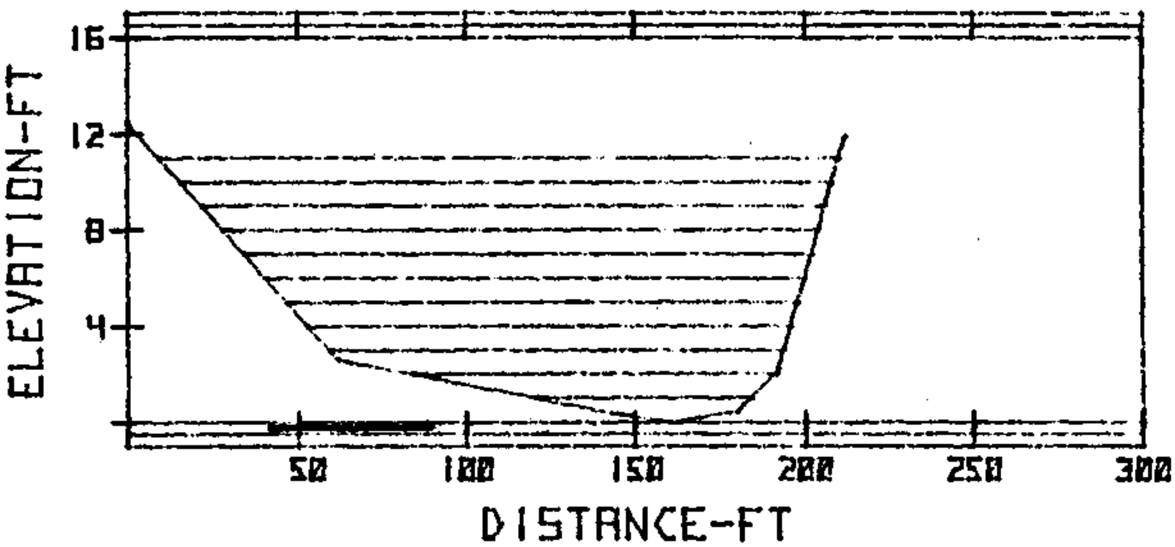
Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 0.46
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 0.86

Section Pool Quality
Pool habitat is fair to poor depending primarily on the amount of shading and cover present. Some relatively deep (2- to 3-foot) pools are available.

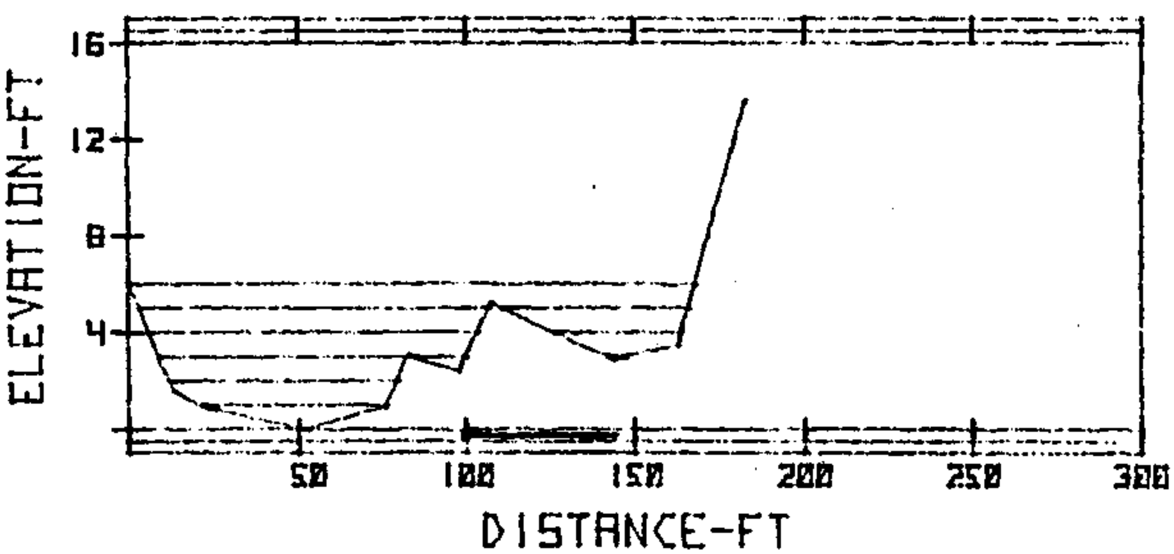
Section Riffle Quality
Riffles are generally too shallow and exposed. Filamentous algae is very prevalent. Sixty invertebrates/ft2 were collected.

Pool/Riffle Ratio 3:1
General Section Comments
A greater percentage of this section is exposed (in comparison with upstream Dry Creek sections).

DRY CREEK
CROSS SECTION NUMBER D 6
LOWER TRANSECT



DRY CREEK
CROSS SECTION NUMBER D 6
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Dry Creek

Map Ref. Pg. A-30			
Section	D-7	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	4		
Habitat Type		riffle-run	riffle
Water Surface Width (feet)		180 (2 channel combined width)	67
Water Temperature (°C) @ Time of Day Taken		19.0 @ 1115	20.0 @ 1140
Water Transparency (feet)		>3.0	> 3.0

Upper Transect

Water Depth (Feet) at:
0.25 0.5 0.5 0.5 0.75 0.4 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 1.11 0.5 1.47 0.75 1.31 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.47

Lower Transect

Water Depth (Feet) at:
0.25 1.6 0.5 0.5 0.75 0.7 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 0.89 0.5 3.23 0.75 2.73 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.23

Section Habitat
In-channel substrate stability is poor in this section. Exposure is considerable and the channel is very vide.

Pool/Riffle Ratio 3:1
Spawning Substrate Observations
Because of the width of this section, there is a considerable amount of exposed substrate on both sides of the flow. Approximately 602 of this material is suitable for spawning from a size standpoint. The concentration of fine material varies.

Fish Habitat Observation
Nursery Habitat
Dry Creek

Map Ref. Pg. A-30

Section	D-7	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	4		
Habitat Type		riffle	riffle
Water Surface Width (feet)		56 (3 channel combined width	65
Maximum Water Depth (feet)		1.0	1.5
Water Temperature (°C) @ Time of Day Taken		20.5 @ 0900	20.5 @ 0815
Water Transparency (feet)		>3.0	>3.0
In-Channel Cover (feet)		20	15
In-Channel Vegetative Canopy (feet)		10	20
In-Stream Cover (feet)		0	3
In-Stream Vegetative Canopy (feet)		0	12

Water Velocity (FPS) in Midstream at the Surface (Upper Transect)	1.47
Water Velocity (FPS) in Midstream at the Surface (Lower Transect)	1.31

Section Pool Quality

Pool habitat is practically absent in this section. Existing pool pockets are completely exposed and relatively shallow.

Section Riffle Quality

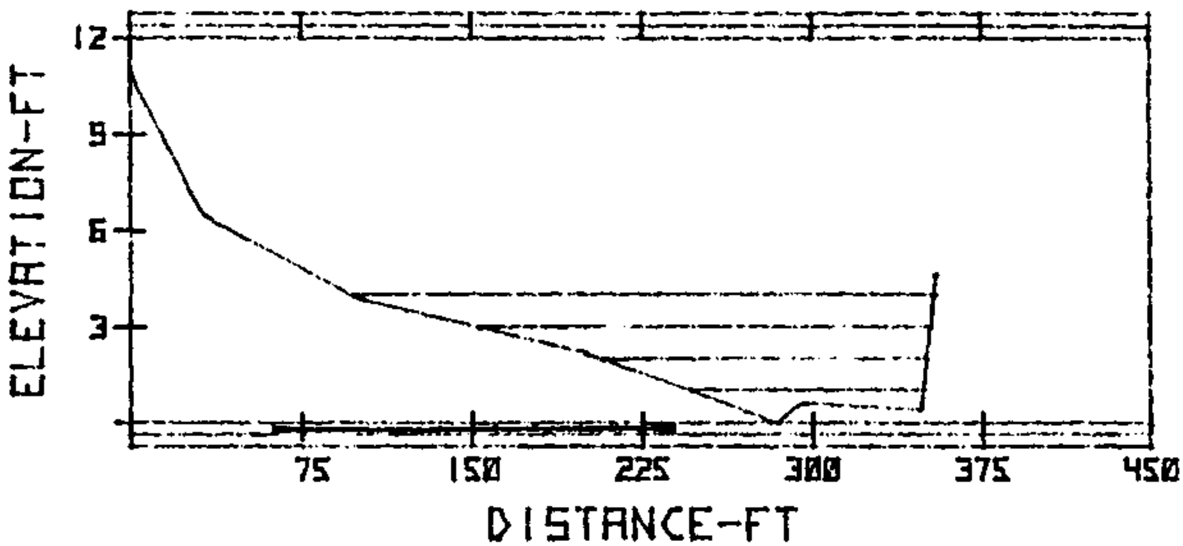
Riffle habitat is typically very shallow and exposed. Eighty-seven invertebrates/ft^2 were collected.

Pool/Riffle Ratio 3 : 1

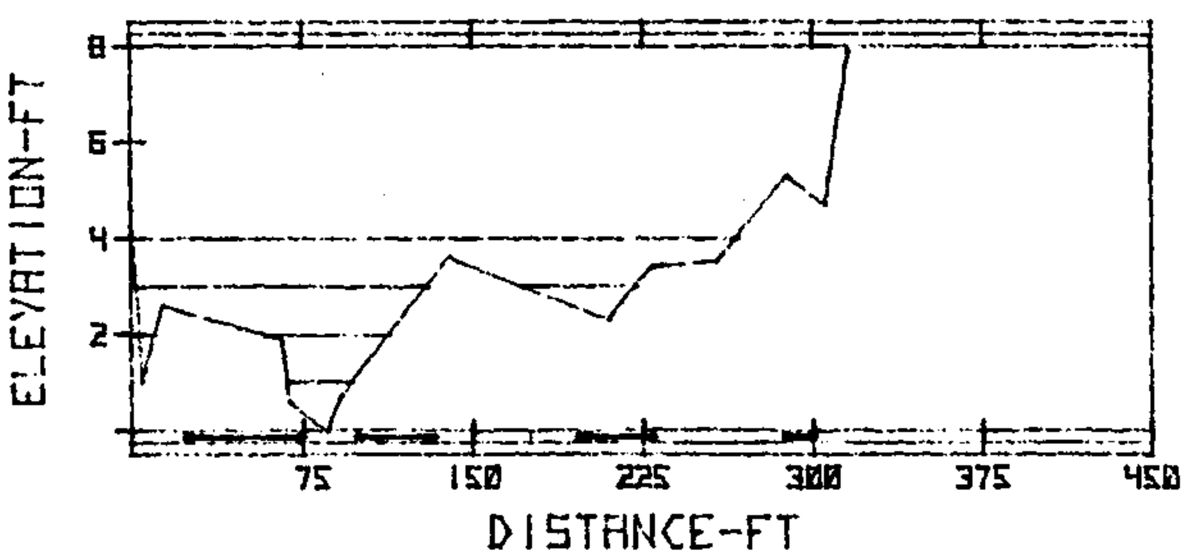
General Section Comments

This section is very exposed and wide.

DRY CREEK
CROSS SECTION NUMBER D 7
LOWER TRANSECT



DRY CREEK
CROSS SECTION NUMBER D 7
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Dry Creek

Map Ref. Pg. A-31			
Section	D-8	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	2		
Habitat Type		riffle	riffle
Water Surface Width (feet)		168	48
Water Temperature (°C) @ Time of Day Taken		23.0 @ 1415	24.0 @ 1435
Water Transparency (feet)		> 3.0	>3.0

Upper Transect

Water Depth (Feet) at:
0.25 0.3 0.5 0.3 0.75 1.1 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 0.96 0.5 1.29 0.75 2.83 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.29

Lower Transect

Water Depth (Feet) at:
0.25 1.2 05 1.8 0.75 1.1 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 2.22 05 2.94 0.75 2.71 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 3.26

Section Habitat
This section is wide and flat; flow is shallow and very exposed. A large, operating gravel extraction firm is located adjacent to this section.

Pool/Riffle Ratio 2 : 1
Spawning Substrate Observations
Instream gravel extraction has occurred historically in this stream section. Relatively less coarse material was observed in this section. Isolated patches of suitable size spawning substrate are available.

Fish Habitat Observation
Nursery Habitat
Dry Creek

Map Ref. Pg. A-31

Section	D-8	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	2		
Habitat Type		riffle	riffle
Water Surface Width (feet)		67	23
Maximum Water Depth (feet)		0.5	0.7
Water Temperature (°C) @ Time of Day Taken		22.0 @ 1010	23.0 @ 1030
Water Transparency (feet)		>3.0	>3.0
In-Channel Cover (feet)		5	6
In-Channel Vegetative Canopy (feet)		2	25
In-Stream Cover (feet)		0	0
In-Stream Vegetative Canopy (feet)		0	0

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 1.26
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 1.15

Section Pool Quality

Pools are typically shallow and very exposed in this stream section. Considerable filamentous algae is present in the shallow, slow flowing stretches of the section.

Section Riffle Quality

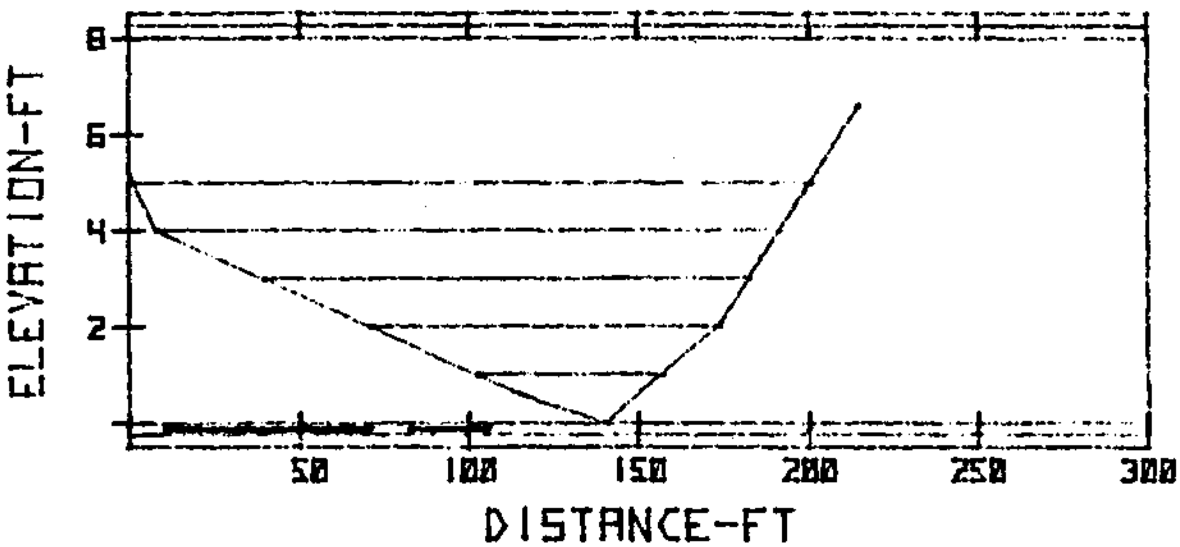
Riffle quality is poor in this section. Exposure is excessive, depths are shallow, and stream substrate is less coarse than in upstream sections. Twenty-five invertebrates/ft^2 were sampled.

Pool/Riffle Ratio 2:1

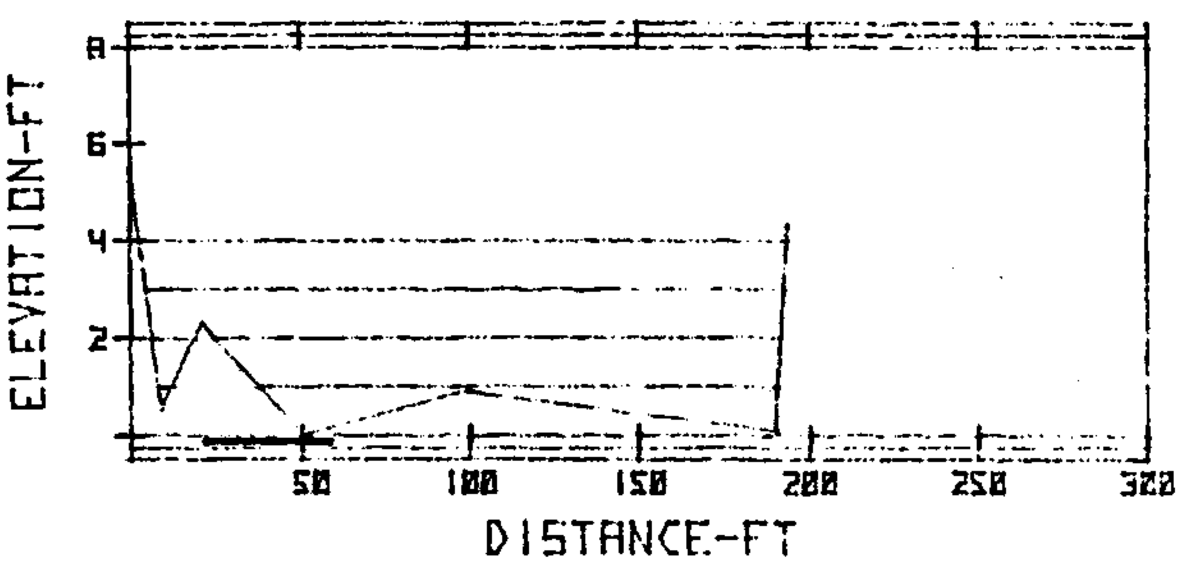
General Section Comments

The section is located opposite a gravel extraction company at West Side Road Bridge.

DRY CREEK
CROSS SECTION NUMBER D 8
LOWER TRANSECT



DRY CREEK
CROSS SECTION NUMBER D 8
UPPER TRANSECT



Fish Habitat Observations
Spawning Habitat
Dry Creek

Map Ref. Pg. A-17			
Section	D-9	Upper Transect	Lower Transect
Section Length (feet)	1320		
River Mile	0		
Habitat Type		riffle	riffle
Water Surface Width (feet)		125	55
Water Temperature (°C) @ Time of Day Taken		25.5 @ 1615	25.0 @ 1350
Water Transparency (feet)		>3.0	>3.0

Upper Transect

Water Depth (Feet) at:
0.25 0.9 0.5 0.5 0.75 1.4 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
0.25 3.55 0.5 5.03 0.75 1.73 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 5.03

Lower Transect

Water Depth (Feet) at:
0.25 1.6 0.5 1.4 0.75 1.8 Distance from Left Edge of Water
Water Velocity (FPS) Measured 0.5 ft. Above the Substrate at:
025 1.69 0.5 2.04 0.75 1.47 Distance from Left Edge of Water
Water Velocity (FPS) Measured on the Surface at Midstream 1.90

Section Habitat
This section is typically very exposed with a wide channel. Selected deep pools and runs are available.

Pool/Riffle Ratio 1:1
Spawning Substrate Observations
Substrate generally contains too high a concentration of fine material to be considered optimal for spawning.
A considerable amount of potentially usable material exists in this section despite the high concentration of fines.

Fish Habitat Observation
Nursery Habitat
Dry Creek

Map Ref. Pg. A-17

		Upper Transect	Lower Transect
Section	D-9		
Section Length (feet)	1320		
River Mile	0		
Habitat Type		riffle	pool
Water Surface Width (feet)		33	37
Maximum Water Depth (feet)		0.3	1.5
Water Temperature (°C) @ Time of Day Taken		29.0 @ 1545	28.5 @ 1505
Water Transparency (feet)		>3.0	> 3.0
In-Channel Cover (feet)		11	20
In-Channel Vegetative Canopy (feet)		21	20
In-Stream Cover (feet)		0	10
In-Stream Vegetative Canopy (feet)		0	5

Water Velocity (FPS) in Midstream at the Surface (Upper Transect) 0.93
Water Velocity (FPS) in Midstream at the Surface (Lower Transect) 0.75

Section Pool Quality

Isolated, exposed pool habitat is available in this section. The pool habitat of the lower transect is affected if not created, by the summer road crossing Just downstream at the mouth of Dry Creek.

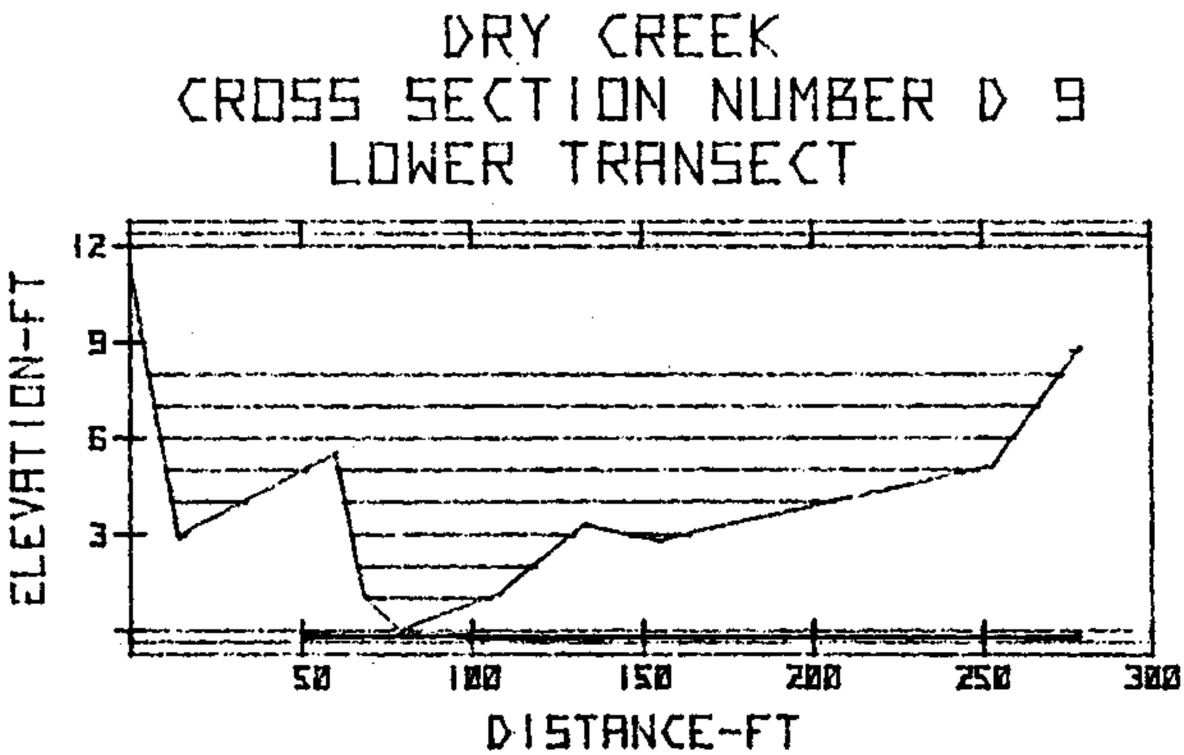
Section Riffle Quality

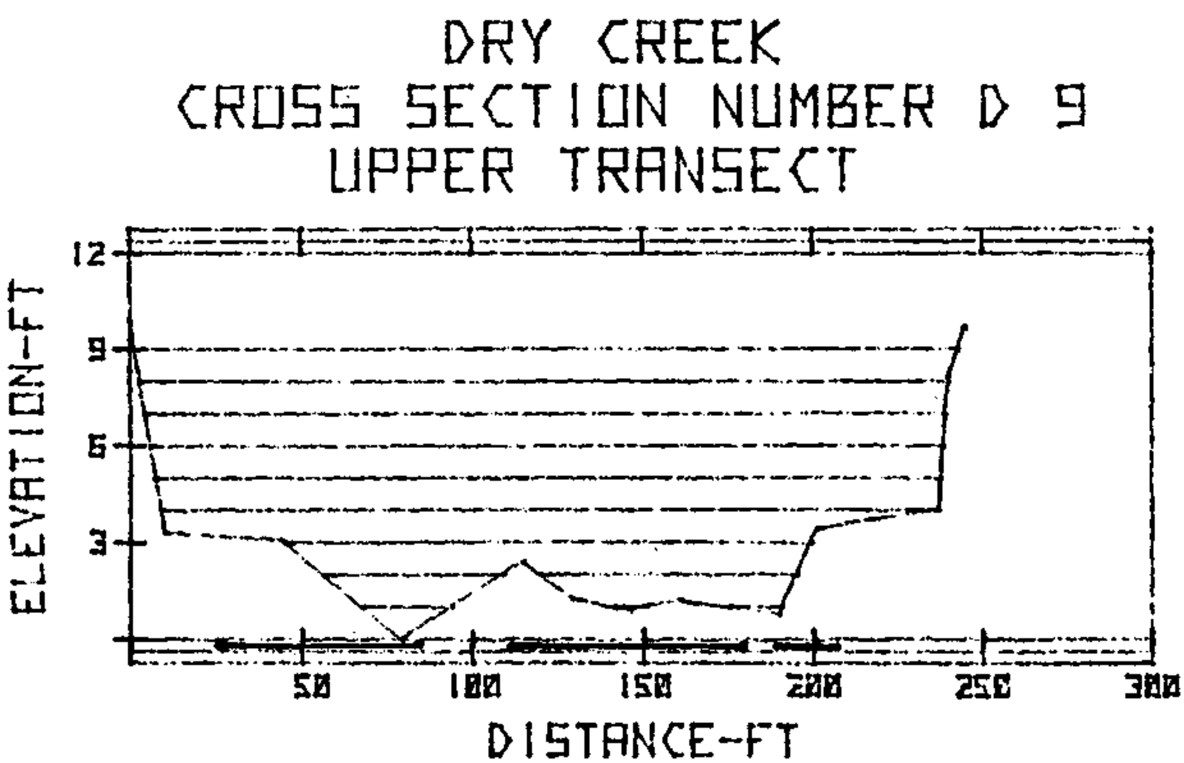
Riffles are very shallow in this section. Very little canopy and cover are available. Twenty-five invertebrates/ft^2 were collected.

Pool/Riffle Ratio 1 : 1

General Section Comments

Many juvenile rough fish were present, even at the observed temperatures. Considerable filamentous algae was present near the mouth of an unnamed creek just below the lower transect.


DRY CREEK
CROSS SECTION NUMBER D 9
LOWER TRANSECT
ELEVATION-FT
12
9
6
3
50
100
150
200
250
300
DISTANCE-FT


DRY CREEK
CROSS SECTION NUMBER D 9
UPPER TRANSECT
ELEVATION-FT
12
9
6
3
50
100
150
200
250
300
DISTANCE-FT

Appendix D

U.S. Geological Survey

Russian River Drainage Basin Gage Station Locations

RUSSIAN RIVER DRAINAGE BASIN GAGE STATIONS

Station 11461000
RUSSIAN RIVER NEAR UKIAH, CA

PERIOD OF RECORD. — August 1911 to September 1913, October 1952 to current year. Monthly discharge only for some periods, published in WSP 1315-B.

GAGE. -- Water-stage recorder. Altitude of gage is 600 ft (183 m), from topographic map. Prior to October 1952, nonrecording gage at bridge 20 ft (6 m) upstream at different datum. Oct. 1, 1952, to Nov. 8, 1971, water-stage recorder at site 0.6 mi (1.0 km) upstream at different datums.

REMARKS. -- Records good. No regulation. Diversions above station for irrigation of about 1,000 acres (4.05 km^3).

AVERAGE DISCHARGE. -- 26 years, 181 ft^3/s (5.126 m^3/s), 131,100 acre-ft/yr (162 hm^3/yr).

EXTREMES FOR PERIOD OF RECORD. -- Maximum discharge, 18,900 ft^3/s (535 m^3/s) Dec. 21, 1955, gage height, 19.0 ft (5.79 m) site and datum then in use; no flow at times in 1911, 1952-53, 1960-61, 1964-65, 1970-73, 1975-76, 1976-77.

Station 11461500
EAST FORK RUSSIAN RIVER NEAR CALPELLA, CA

WATER-DISCHARGE RECORDS

PERIOD OF RECORD. --October 1941 to current year. Monthly discharge only for some periods, published in WSP 1315-B.

GAGE. -- Water-stage recorder. Datum of gage is 787.87 ft (240.143 m) above mean sea level. Prior to May 28, 1957, at site 1.3 mi (2.1 km) downstream at different datum. May 28, 1957, to Apr. 5, 1966, at site 0.4 mi (0.6 km) downstream at same datum.

REMARKS. -- Records good. Flow greatly affected by diversion from Eel River through Potter Valley powerhouse (station 11471000). Diversion for irrigation of about 8,000 acres (32.4 km^2) above station.

RUSSIAN RIVER DRAINAGE BASIN GAGE STATIONS
(Continued)

AVERAGE DISCHARGE. -- 35 years, 339 ft^3/s (9.600 m^3/s), 245,600 acre-ft/yr (303 hm^3/yr).

EXTREMES FOR PERIOD OF RECORD. --Maximum discharge, 18,700 ft^3/s (530 m^3/s) Dec. 22, 1964, gage height, 20.21 ft (6.160 m) site then in use; minimum daily, 2.0 ft^3/s (0.058 m^3/s) July 18, 1977.

WATER-QUALITY RECORDS

PERIOD OF RECORD. --Water years 1951-58, 1964 to current year. CHEMICAL ANALYSES: Water years 1951-58, 1973 to current year. WATER TEMPERATURES: Water years 1964 to current year. SEDIMENT RECORDS: Water years 1964, 1967-68. TURBIDITY: Water years 1964-71.

PERIOD OF DAILY RECORD. --WATER TEMPERATURES: March 1964 to current year. SEDIMENT RECORDS: March to September 1964, October 1966 to September 1968.

INSTRUMENTATION. -- Temperature recorder since August 1965.

EXTREMES FOR PERIOD OF DAILY RECORD. --WATER TEMPERATURES: Maximum (water years 1966, 1968-76), 29.0°C Aug. 11, 1971, July 1, 1972; minimum (water years 1966-67, 1969-70, 1972-76), 2.0°C Dec. 12, 1962.

Station 11461800
LAKE MENDOCINO NEAR UKIAH, CA

PERIOD OF RECORD. -- November 1958 to present.

GAGE. -- Water-stage recorder. Datum of gage is at mean sea level (levels by Corps of Engineers).

REMARKS.-- Reservoir is formed by earthfill dam; storage began in November 1958. Capacity, 122,900 acre-ft (152 hm^3) between elevations 637.0 ft (194.16 m), invert of outlet tunnel and 764.8 ft (233.11 m), spillway crest, above mean sea level. Storage affected by diversions from Eel River through Potter Valley powerhouse (station 11471000). Water is released down East Fork Russian River for irrigation and recreation use. Records given herein represent total contents.

EXTREMES FOR PERIOD OF RECORD. -- Maximum contents, 128,700 acre-ft ($159.19\ hm^3$) Dec. *22,* 1964, elevation 768.17 (231.96 m); minimum, 12,081 acre-ft ($14.94\ hm^3$) Nov. 3, 1977, elevation, 687.17 ft (209.5 m).

Station 11462000
EAST FORK RUSSIAN RIVER NEAR UKIAH, CA

WATER-DISCHARGE RECORDS

PERIOD OF RECORD. -- August 1911 to September 1913, October 1951 to June 1956, October 1957 to current year.

GAGE. -- Water-stage recorder and concrete control. Datum of gage is 614.41 ft (187.272 m) above mean sea level. Prior to October 1951, nonrecording gage at site 0.5 mi (0.8 km) upstream at different datum. October 1951 to June 1956, water-stage recorder at site 1.0 mi (1.6 km) upstream at different datum.

REMARKS. -- Records good. Flow affected by diversion from Eel River through Potter Valley powerhouse (station 11471000) and since November 1958 by storage in Lake Mendocino (station 11461800) 500 ft (152 m) upstream. Diversions above station for irrigation of about 8,000 acres ($32.4\ km^2$).

AVERAGE DISCHARGE (unadjusted). -- 7 years (water years 1912-13, 1952-55, 1958). 356 ft^3/s ($10.08\ m^3/s$), 257,900 acre-ft/yr ($318\ hm^3/yr$); 17 years (water years 1960-76), 354 ft^3/s ($10.03\ m^3/s$), 256,500 acre-ft/yr ($316\ hm^3/yr$).

EXTREMES FOR PERIOD OF RECORD (Prior to regulation by Lake Mendocino). -- Maximum discharge, 13,300 ft^3/s ($377\ m^3/s$) Dec. 21, 1955, gage height, 16.86 ft (5.139 m) site and datum then in use, from rating curve extended above 1,700 ft^3/s ($48.1\ m^3/s$) on basis of maximum flow at station upstream which was defined to 8,600 ft^3/s ($244\ m^3/s$); no flow Aug. 13-15, 1913. 1957 to current year: Maximum discharge, 6,500 ft^3/s ($183.9\ m^3/s$) Jan. 24, 1970, gage height, 10.84 ft (3.304 m); minimum daily, 0.02 ft^3/s ($0.001\ m^3/s$) Apr. 17, 1973.

RUSSIAN RIVER DRAINAGE BASIN GAGE STATIONS
(Continued)

WATER-QUALITY RECORDS

PERIOD OF RECORD. -- Water years 1953-55, 1964-68, 1973 to current year. CHEMICAL ANALYSES: Water years 1953-55, 1973 to current year. WATER TEMPERATURES: Water years 1953-55, 1965-68, 1973 to current year. SEDIMENT RECORDS: Water years 1953-55, 1964-68.

PERIOD OF DAILY RECORD. --WATER TEMPERATURES: December 1952 to March 1955, October 1964 to September 1968, October 1972 to current year.
SEDIMENT RECORDS: December 1952 to March 1955, January 1964 to September 1968.

INSTRUMENTATION. -- Temperature recorder since October 1972.

EXTREMES FOR PERIOD OF DAILY RECORD. --WATER TEMPERATURES (water years 1973-74, 1976): Maximum, 22.5°C on several days in 1973; minimum, 7.0°C Jan. 14, 1973.

Station 11462500
RUSSIAN RIVER NEAR HOPLAND, CA

WATER-DISCHARGE RECORDS

PERIOD OF RECORD. -- October 1939 to current year. Monthly discharge only for some periods, published in WSP 1315-B.

GAGE. -- Water-stage recorder. Datum of gage is 497.61 ft (151.672 m) above mean sea level. Prior to Sept. 9, 1943, nonrecording gage at same site and datum.

REMARKS. -- Records good. Diversions for irrigation of about 11,800 acres (47.8 km^2) above station. Flow also affected by diversion into basin (see REMARKS for East Fork Russian River stations) and since November 1958 by storage in Lake Mendocino (station 11461800) 15 mi (24 km) upstream.

AVERAGE DISCHARGE. -- 37 years, 727 ft^3/s (20.59 m^3/s), 526,700 acre-ft/yr (649 hm^3/yr).

EXTREMES FOR PERIOD OF RECORD. -- Maximum discharge, 45,000 ft^3/s (1,270 m^3/s) Dec. 22, 1955, gage height, 27.00 ft (8.230 m); minimum daily, 9.1 ft^3/s (0.26 m^3/s) April 20, 1977.

EXTREMES OUTSIDE PERIOD OF RECORD. -- Flood in December 1937 reached a stage of 30.0 ft (9.14 m), from floodmarks.

WATER-QUALITY RECORDS

PERIOD OF RECORD. -- Water years 1951 to current year. CHEMICAL ANALYSES: Water years 1951-66. WATER TEMPERATURES: Water years 1965 to current year.

PERIOD OF DAILY RECORD. --WATER TEMPERATURES: September 1965 to current year.

INSTRUMENTATION. -- Temperature recorder since September 1965.

EXTREMES FOR PERIOD OF DAILY RECORD. --WATER TEMPERATURES: Maximum (water years 1966, 1969, 1972-76), 24.0°C on several days in 1969 and 1973; minimum (water years 1966-68, 1970, 1972-76), 5.0°C Feb. 2, Dec. 16, 1972, Jan. 31 to Feb. 2, 1975.

Section 11463000
RUSSIAN RIVER NEAR CLOVERDALE, CA

PERIOD OF RECORD. -- July 1951 to current year.

GAGE. -- Water-stage recorder. Altitude of gage is 350 ft (107 m), from topographic map. Prior to July 30, 1970, at site 0.2 mi (0.3 km) upstream at different datum.

REMARKS. -- Records good. Diversions for irrigation of about 15,300 acres (61.9 km^2) above station. Flow also affected by diversion into basin (see REMARKS for East Fork Russian River stations) and since November 1958 by storage in Lake Mendocino (station 11461800) 28 mi (45 km) upstream.

AVERAGE DISCHARGE. -- 25 years, 305 ft^3/s (8.723 m^3/s), 723,100 acre-ft/yr (892 hm^3/yr).

EXTREMES FOR PERIOD OF RECORD. -- Maximum discharge, 55,200 ft^3/s (1,560 m^3/s) Dec. 22, 1964, gage height, 31.60 ft (9.632 m) site and datum then in use; minimum daily, 12 ft^3/s (0.35 m^3/s) April 22, 1977.

Section 11463900
MAACAMA CREEK NEAR KELLOGG, CA

PERIOD OF RECORD. -- Occasional low-flow measurements and annual maximum, water years 1958-60, December 1960 to current year.

GAGE. -- Water-stage recorder. Datum of gage is 188.91 ft (57.580 m) above mean sea level. Prior to Dec. 20, 1960, crest-stage gage only at site 700 ft (213 m) upstream at different datum.

REMARKS. -- Records good. No regulation or diversion above station.

AVERAGE DISCHARGE. -- 15 years (water years 1962-76), 86.7 ft^3/s (2.455 m^3/s), 62,810 acre-ft/yr (77.4 hm^3/yr).

EXTREMES FOR PERIOD OF RECORD. -- Maximum discharge, 8,920 ft^3/s (253 m^3/s), Dec. 22, 1964, gage height, 17.56 ft (5.352 m); no flow for many days in 1964, 1968, 1976, 1977 (July 4 to Sept. 28).

Station 11464000
RUSSIAN RIVER NEAR HEALDSBURG, CA

WATER-DISCHARGE RECORDS

PERIOD OF RECORD. -- October 1939 to current year. Monthly discharge only for some periods, published in WSP 1315-B.

GAGE. -- Water-stage recorder. Datum of gage is 77.01 ft (23.473 m) above mean sea level.

REMARKS. -- Records good. Several diversions for irrigation of about 17,800 acres (72.0 km^2) above station. Flow also affected by diversion into basin (see REMARKS for East Fork Russian River stations) and since November 1958 by storage in Lake Mendocino (station 11461800) 63 mi (101 km) upstream.

RUSSIAN RIVER DRAINAGE BASIN GAGE STATIONS
(Continued)

AVERAGE DISCHARGE. -- 37 years, 1,442 ft^3/s (40.84 m^3/s), 1,045,000 acre-ft/yr (1.29 km^3/yr).

EXTREMES FOR PERIOD OF RECORD. -- Maximum discharge, 71,300 ft^3/s (2,020 m^3/s) Dec. 23, 1964, gage height, 27.00 ft (8.230 m); maximum gage height, 30.0 ft (9.14 m) Feb. 28. 1940; minimum daily discharge, 17 ft^3/s (0.49 m^3/s) April 20, 1977.

EXTREMES OUTSIDE PERIOD OF RECORD. -- Flood of December 1937 reached a stage of 30.8 ft (9.39 m) from floodmarks.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD. -- Water years 1951 to current year. CHEMICAL ANALYSIS: Water years 1951-66. WATER TEMPERATURES: Water years 1966 to current year.

PERIOD OF DAILY RECORD. --WATER TEMPERATURES: October 1965 to current year.

INSTRUMENTATION. -- Temperature recorder since October 1965.

EXTREMES FOR PERIOD OF DAILY RECORD. --WATER TEMPERATURES: Maximum (water years 1966-68, 1970, 1972-76), 28.0°C July 13, 14, 1972; minimum (water years 1966-69, 1972-76), 5.0°C Dec. 10, 11, 1972.

Station 11464400
DRY CREEK NEAR YORKVILLE, CA

PERIOD OF RECORD. -- October 1973 to current year.

GAGE. -- Water-stage recorder and crest-stage gage. Altitude of gage is 500 ft (152 m), from topographic map.

REMARKS. -- Records good except those for period of no gage-height record, which are fair. No regulation or diversion above station.

EXTREMES FOR PERIOD OF RECORD. -- Maximum discharge, 15,400 ft^3/s (436 m^3/s) Jan. 16, 1974, gage height, 13.50 ft (4.115 m); minimum daily, no flow (August 5 through August 25, 1977).

Station 11464500
DRY CREEK NEAR CLOVERDALE, CA

WATER-DISCHARGE RECORDS

PERIOD OF RECORD. -- October 1941 to current year. Monthly discharge only for some periods, published in WSP 1315-B.

GAGE. -- Water-stage recorder. Datum of gage is 304.04 ft (92.671 m) above mean sea level.

REMARKS. -- Records good. No regulation or diversion above station.

AVERAGE DISCHARGE. -- 35 years, 162 ft^3/s (4.588 m^3/s), 117,400 acre-ft/yr (145 hm^3/yr).

EXTREMES FOR PERIOD OF RECORD. -- Maximum discharge, 18,100 ft^3/s (513 m^3/s) Dec. 22, 1964, gage height, 18.09 ft (5.514 m); minimum, 0.08 ft^3/s (0.002 m^3/s) August 18, 1977.

EXTREMES OUTSIDE PERIOD OF RECORD. -- Flood in December 1937 reached a stage of about 18 ft (5.5 m), from floodmarks.

WATER-QUALITY RECORDS

PERIOD OF DAILY RECORD. --WATER TEMPERATURES: May 1965 to current year.

INSTRUMENTATION. -- Temperature recorder since May 1965.

EXTREMES FOR PERIOD OF DAILY RECORD. --WATER TEMPERATURES: Maximum (water years 1966, 1968-76), 33.5 C Aug. 6, 7, 1966; minimum (water years 1967-76), 2.0°C Dec. 10, 1972.

Station 11464860
WARM SPRINGS CREEK NEAR ASTI, CA

PERIOD OF RECORD. -- October 1973 to current year.

GAGE. -- Water-stage recorder. Altitude of gage is 625 ft (191 m), from topographic map.

REMARKS. -- Records good. No regulation or diversion above station.

EXTREMES FOR PERIOD OF RECORD. -- Maximum discharge, 2,230 ft^3/s (63.2 m^3/s) Jan. 16, 1974, gage height, 9.66 ft (2.944 m); minimum daily, no flow, July 13 to September 6, 1977.

Station 11465200
DRY CREEK NEAR GEYSERVILLE, CA

WATER-DISCHARGE RECORDS

PERIOD OF RECORD. -- October 1959 to current year.

GAGE. -- Water-stage recorder. Datum of gage is 158.40 ft (48.280 m) above mean sea level. Prior to Oct. 1, 1964, at datum 2.00 ft (0.610 m) higher. Oct. 1, 1964, to Apr. 8, 1976, at datum 1.00 ft (0.305 m) higher.

REMARKS. -- Records good except those for period of no gage-height record, which are fair. No regulation; small diversions above station for orchard irrigation of about 1,200 acres (4.80 km^2) in summer.

AVERAGE DISCHARGE. -- 17 years, 327 ft^3/s (9.261 m^3/s), 236,900 acre-ft/yr (292 hm^3/yr).

EXTREMES FOR PERIOD OF RECORD. -- Maximum discharge, 32,400 ft^3/s (918 m^3/s) Jan. 31, 1963, gage height, 18.50 ft (5.639 m) present datum; minimum daily, no flow at times including October 1 to November 14, 1976 and June 22 to September 30, 1977.

WATER-QUALITY RECORDS

PERIOD OF RECORD. -- Water years 1964 to current year.
CHEMICAL ANALYSES: Water years 1971 to current year.
WATER TEMPERATURES: Water years 1964 to current year.
SEDIMENT RECORDS: Water years 1964 to current year.
TURBIDITY: Water years 1964 to current year.

RUSSIAN RIVER DRAINAGE BASIN GAGE STATIONS (Continued)

PERIOD OF DAILY RECORD. –
WATER TEMPERATURES: March 1964 to current year.
SEDIMENT RECORDS: March 1964 to current year.

INSTRUMENTATION. -- Temperature recorder since November 1964.

REMARKS. -- Where no maximum or minimum is shown, temperature is once-daily reading.

EXTREMES FOR PERIOD OF DAILY RECORD. --WATER TEMPERATURES: Maximum (water years 1965-75), 26.5°C Aug. 11, 1971, Aug. 23, 1974; minimum (water years 1965-66, 1968-76), 3.5°C Jan. 3, 1974.
SEDIMENT CONCENTRATIONS: Maximum daily mean, 15,000 mg/L (estimated) Dec. 22, 1964; minimum daily mean, no flow for many days in 1964, 1966, 1970-76.
SEDIMENT DISCHARGE: Maximum daily, 830,000 tons (753,000 tons), estimated, Dec. 22, 1964; minimum daily, 0 tons (0 tons) on many days in 1964, 1966, 1968-76).

Station 11467000
RUSSIAN RIVER NEAR GUERNEVILLE, CA
(National stream-quality accounting network station)

WATER-DISCHARGE RECORDS

PERIOD OF RECORD. -- October 1939 to current year. Monthly discharge only for some periods, published in WSP 1315-B. Prior to October 1954, published as "at Guerneville."

GAGE. -- Water-stage recorder. Altitude of gage is 20 ft (6.1 m), from topographic map. Prior to Oct. 1, 1954, nonrecording gage at bridge 5.3 mi (8.5 km) downstream at datum 8.58 ft (2.615 m) lower. Oct. 1, 1954, to Oct. 23, 1974, at site 0.7 mi (1.1 km) downstream at datum 2.75 ft (0.838 m) lower. Supplementary water-stage recorder 2.1 mi (3.4 km) downstream used during periods of low flow 1948-54.

REMARKS. -- Records good. Many diversions above station for irrigation of about 29,000 acres (117 km^2). Flow also affected by diversion into basin (see REMARKS for East Fork Russian River stations), since November 1958 by storage in Lake Mendocino (station 11461800) 77 mi (124 km^2) upstream and by diversion at Wohler pumping plant beginning in May 1959.

AVERAGE DISCHARGE. -- 37 years, 2,309 ft^3/s (65.39 m^3/s), 1,673,000 acre-ft/yr (2.06 km^3/yr).

EXTREMES FOR PERIOD OF RECORD. -- Maximum discharge, 93,400 ft^3/s (2,650 m^3/s) Dec. 23, 1964, gage height, 49.6 ft (15.12 m) from floodmarks, site and datum then in use; maximum gage height, 49.7 ft (15.15 m) Dec. 23, 1955, from floodmarks, site and datum then in use; minimum daily discharge, 0.75 ft^3/s (0.02 m^3/s) May 6, 1977.

WATER-QUALITY RECORDS

PERIOD OF RECORD. -- Water years 1951 to current year.
CHEMICAL ANALYSES: Water years 1951 to current year. Published as "at Guerneville" in 1961-65.
SPECIFIC CONDUCTANCE: Water years 1974 to current year.
WATER TEMPERATURES: Water years 1964 to current year.
SEDIMENT RECORDS: Water years 1966 to current year.
TURBIDITY: Water years 1967 to current year.

PERIOD OF DAILY RECORD. –
SPECIFIC CONDUCTANCE: October 1973 to current year.
WATER TEMPERATURES: January 1964 to current year.
SEDIMENT RECORDS: April to September 1967, October 1969 to current year.

INSTRUMENTATION. -- Specific conductance recorder since October 1973, at site 0.7 mi (1.1 km) downstream. Temperature recorder since January 1964.

REMARKS. -- Where no maximum or minimum is shown, temperature is once-daily reading.

EXTREMES FOR PERIOD OF DAILY RECORD. --SPECIFIC CONDUCTANCE: Maximum, 400 micromhos July 8, 9, 1974; minimum, 57 micromhos Nov. 4, 1973. WATER TEMPERATURES: Maximum, 29.5°C June 26, 1973; minimum (water years 1966-71, 1975-76), 4.5°C Dec. 15, 1967, Jan. 12, 1968.

SEDIMENT CONCENTRATIONS (water years 1970-76): Maximum daily mean, 2,350 mg/L Jan. 16, 1974; minimum daily mean, 3 mg/L on several days in 1972 and 1973. SEDIMENT DISCHARGE (water years 1970-76): Maximum daily 316,000 tons (287,000 tons) Jan. 16, 1974; minimum daily, 1,3 tons (1.2 tons) Sept. 23, 1972,Aug. 30, 1976.

U.S. GOVERNMENT PRINTING OFFICE: 1980-690-060/18

APPENDIX G

COMMENTS AND RESPONSES

FINAL REPORT NORTHERN CALIFORNIA STREAMS
INVESTIGATION RUSSIAN RIVER BASIN STUDY

APPENDIX G

COMMENTS AND RESPONSES

MARCH 1982

Contents	Page

INTRODUCTION

The comments contained in this appendix were received following public distribution of the draft report on the Northern California Streams Investigation - Russian River Basin Study in December 1980. However, not all comments received are included in this appendix. In general, comments which did not specifically address the draft study report were omitted. This included several items of correspondence and some statements made at the January 8, 1981 Final Public Meeting on the study. These items are included in the transcript of the meeting (Northern California Streams Investigation - Russian River Basin Study Record of Public Meeting; January 8, 1981) published separately by the Corps of Engineers San Francisco District and released in August 1981. All comments received following distribution of the draft report, both written and verbal, were evaluated and considered during the preparation of the Final Report on the Russian River Basin Study.

APPENDIX FORMAT

Each item of correspondence is reproduced in full with major comments and questions of fact indexed by reference number. Each item of correspondence is followed by responses from the Corps of Engineers also indexed by reference number. Near the end of the appendix are comments paraphrased from statements made at the final public meeting on the study, and associated Corps responses. Where a comment resulted in revision of the draft report, the revision is noted and its location in the final report identified.

Letter No.	Date	Issue No.	Commenter/Issue	Comment/Response Page
			FEDERAL AGENCIES	
1	3/6/81		U.S. Department of the Interior-Fish and Wildlife Service	G-7/G-9
		1-1	Fishery Improvement	G-7/G-9
		1-2	Tributary Fish Populations	G-7/G-9
		1-3	Water Temperature	G-7/G-9
		1-4	Riparian Vegetation	G-7/G-9
		1-5	Willow County Dam and Basalt Crossing	G-7/G-9
		1-6	Recreation Survey	G-7/G-9
		1-7	Willow County Dam and Basalt Crossing	G-7/G-9
		1-8	Bank Stabilization	G-8/G-9
		1-9	Corps Regulatory Authority	G-8/G-9
		1-10	Summer Dam Management Plan C	G-8/G-10
			STATE AGENCIES	
2	2/2/81		California Department of Transportation	G-ll/G-11
		2-1	Gravel Mining	G-ll/G-11
3	12/19/80		California Department of Conservation- Division of Mines and Geology	G-12/G-12
		3-1	Channel Degradation	G-12/G-12
4	3/4/81		The Resources Agency of California	G-13/G-17
		4-1	Boating Hazards	G-13/G-17
		4-2	Recreational Boating	G-13/G-17
		4-3	Gravel Mining	G-13/G-17
		4-4	Inter-Basin Water Allocation	G-13/G-17
		4-5	Water Diversion Rights	G-14/G-17
		4-6	Russian River Tributaries	G-14/G-17
		4-7	Eel River Diversions	G-14/G-18
		4-8	Chinook Salmon	G-14/G-18
		4-9	Mendocino County Gravel Mining	G-14/G-18
		4-10	Channel Stabilization	G-14/G-18
		4-11	Summer Steelhead	G-14/G-18

INDEX TO REVIEW COMMENTS AND CORPS RESPONSES

Letter No.	Date	Issue No.	Commenter/Issue	Comment/Response Page
		7-1	Lake Mendocino Specifications	G-24/G-28
		7-2	Rohnert Park	G-24/G-28
		7-3	Sonoma County Flood Control	G-24/G-28
		7-4	Inconsistency	G-24/G-28
		7-5	Maintenance of Bank Stabilization Measures	G-24/G-28
		7-6	Dry Creek Sedimentation Study	G-25/G-28
		7-7	Salmonid Population Estimates	G-25/G-28
		7-8	Salmonid Habitat Losses	G-25/G-29
		7-9	Vacation and Johnson Beach Fish Ladders	G-25/G-29
		7-10	Sonoma County Water Supply Diversions	G-25/G-29
		7-11	Warm Springs Dam Impacts	G-26/G-29
		7-12	Coyote Dam Flow Release Agreement	G-26/G-29
		7-13	Salmonid Population Estimates	G-26/G-29
		7-14	Salmonid Population Estimates	G-26/G-29
		7-15	Salmonid Population Estimates	G-26/G-29
		7-16	Healdsburg Dam Fish Ladder	G-26/G-29
		7-17	Healdsburg Dam Fish Ladder	G-26/G-29
		7-18	Healdsburg Dam Fish Ladder	G-26/G-30
		7-19	Healdsburg Dam Fish Ladder	G-26/G-30
		7-20	Summer Dam Impacts	G-26/G-30
		7-21	Wohler Dam	G-26/G-30
		7-22	Coyote and Warm Springs Dams Releases	G-26/G-30
		7-23	Sediment Transport Modeling	G-27/G-30
			INTERESTED PARTIES	
8	1/22/81		California Trout	G-31/G-33
		8-1	Juvenile Steelhead	G-31/G-33
		8-2	Fish Population Inventories	G-31/G-33
		8-3	Summer Dams On Tributaries	G-31/G-33
		8-4	Geothermal Fish Impacts	G-31/G-33
		8-5	Native Fisheries	G-31/G-33
		8-6	Native Fisheries	G-31/G-33
		8-7	Fish Population Estimates	G-31/G-33
		8-8	King Salmon	G-31/G-33
		8-9	Steelhead Habitat	G-32/G-33
		8-10	American Shad	G-32/G-33
		8-11	Unregistered Water Diversions	G-32/G-33
		8-12	Eel River Diversions	G-32/G-34
		8-13	Steelhead Fishery Value	G-32/G-34
		8-14	Fish Habitat Values	G-32/G-34
		8-15	Fish Habitat Inventories	G-32/G-34

INDEX TO REVIEW COMMENTS AND CORPS RESPONSES

COMMENT LETTER 1

United States Department of the Interior

FISH AND WILD LIFE SERVICE

Division of Ecological Services
2800 Cottage Way, Room E-2727
Sacramento, California 95825

March 6, 1981

District Engineer San Francisco
District, Corps of Engineers 211 Main
Street San Francisco, California
94105

Dear Sir:

We have reviewed the Northern California Streams Investigation, Draft Interim Report, Russian River Basin Study. He offer the following comments pursuant to the authority, and in accordance with the provisions, of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The Intent of the interim report 1s to fulfill a request by the House Committee on Public Works to examine the subjects of water quality, and environmental protection and enhancement. Six Issues in the Russian River Basin were specifically addressed, as follows:

1. Gravel mining and sediment Influx. 2. Channel improvements and stabilization. 3. Summer and recreational type dams. 4. Sandbar closure of the mouth of the river. 5. Land use and floodplain management. 6. Operation of existing structures on the river and tributaries.

Our primary concerns center on items 1, 2, and 3 which involve adverse impacts on anadromous fishes. Although we stated many of our concerns in a planning aid letter of May 6, 1980, we believe the significance of the issues justifies additional comment.

II. Problem identification

1-1 Page 33, paragraph 2. The statement is made that recreation areas in the study area have only local drawing power and that public access to the river is limited. For this reason, we believe it is important to consider that improvement of the Russian River fishery and fishing access might provide 1-1 greater local economic benefits than general recreational activities such as swimming and canoeing which require summer dams. We are not certain if this type of Issue can, or should, be resolved at only the local or State level. The anadromous fishes are a highly important resource that contributes to the economy of several States and thus may necessitate Federal involvement.

Page 33, paragraph 4. We would encourage and support Installation of a multiple outlet intake at Coyote Dam if the project is enlarged. This type of Intake would improve the quality of water releases by decreasing turbidity and by possibly providing more suitable temperatures for salmonids in the river below.

1-2 Page 37, paragraphs 2 and 3. The statements here imply the importance of the headwater tributaries to juvenile salmonid production. Exact information is not available, but we suspect that many summer dams on these headwaters pose a serious threat to the fishery. Steps should be taken to provide better regulation of the small summer dams on the tributaries. The success of efforts to improve the basin fishery through minimum flow releases into the mainstem will be severely diminished if the adverse impacts caused by summer dams on the tributaries continues.

1-3 Page 41, paragraph 6. The data collected on the water temperature differences above and below the simmer dams is not adequate to indicate the cumulative temperature effects of the dams. More data is needed to support any statement suggesting that no long-term, adverse water quality impacts occur due to the dams.

III. Formulation of Plans

1-4 Page 73, paragraph 3. We do not agree with the statement that... "removal of riparian vegetation and prevention of its establishment is insignificant." Any activity that disrupts riparian vegetation and results in its absence over the long term is a significant impact. The paucity of riparian vegetation along the river is a factor that has lowered the quality of habitat for the salmonid fishery.

1-5 Page 73, paragraph 6. The passage problems with Willow County water diversion dam and the Basalt summer road crossing should not be deleted from further consideration, as stated. These problems may be of lesser importance at this time, but they nevertheless are an impediment to improving the steelhead fishery up to the base of Coyote Dam. It is well known that a substantial run of adult steelhead reached the base of the dam in years past. The opportunity to reestablish a good run of steelhead to the upper reaches of the East Fork should not be foreclosed by barriers such as Willow County Diversion Dam. This dam and its associated problems should be studied further.

1-6 Page 74, paragraph 4. The recreational use survey, as stated, was based on minimal background data. No real determination has been made of the use attributed only to facilities created by the summer dams. Many of the recreation types such as sunbathing, camping, fishing, picnicking, hunting, horseback riding and hiking could occur without the dams. A more detailed recreational study including a with- and without-dam evaluation should be performed.

1-7 Page 88, paragraph 6. Plan C should also incorporate improvement of the Willow County Diversion Dam by appropriate fish passage facilities. This dam constitutes a barrier to fish passage. There are Important spawning and rearing areas on the mainstem Russian, West Fork Russian and East Fork Russian above the dam. The dam in its present state most likely has adverse Impacts on both adult and juvenile fish during migration periods.

The Basalt summer road crossing should not be deleted from further study because the crossing is likely a barrier to salmonids and surely one for shad. This crossing will Impede establishment of salmon and steelhead runs in connection with the Warm Springs Project, slated for operation in 1982. Water flow regimes will change at that time and Dry Creek will no longer be dry throughout the summer.

V. Study Conclusion

Page 117, paragraph 2. We support the Corps' proposal to study gravel mining and sediment problems in the basin.

1-8 Page 117, paragraph 4. There have been several bank stabilization projects at various locations on the Russian River, and there are ongoing bank stabilization demonstration projects in other areas of the State. We believe it 1s appropriate for the Corps to undertake a more detailed study to assess bank erosion problems, alternative treatments, means to Improve fish and wildlife habitat, and impacts on fish and wildlife caused by channelization in the basin. We would support any additional studies of bank stabilization and channel improvement in relation to fish and wildlife habitat.

1-9 Page 118. paragraph 2. We do not agree with the statement that there is no Federal interest or responsibility respecting summer dams. The regulatory authority over installation of summer dams under section 10 of the Rivers and Harbors Act of 1899, and Section 404 of Public Law 92-500, should be exercised as necessary by the Corps to insure that environmental impact issues are resolved. The efforts of the U.S. Fish and Wildlife Service and the National Marine Fisheries Service to improve and protect the anadromous fishery should complement the Corps' administration of these regulations.

Page 119, paragraph 5. We would encourage the Sonoma County Water Agency to consider an alternative flow release schedule to provide optimum flows for the salmonid fishery in Dry Creek during the early post-project period (1982-1990) when unallocated water is available. These supplemental interim flows would complement the fishery improvement efforts in Dry Creek and generate valuable data on fishery production relative to instream flow.
We would support any of the studies listed in #1-6 to fill data gaps in knowledge of the basin.

V. Recommendations

1-10 Page 122, paragraphs 1 and 2. We agree with many of the recommendations as stated, but do not believe that the issue of summer dams has been adequately addressed. We agree that alternative C represents a reasonable choice which may resolve some of the adverse Impacts on the fisheries. This will depend on how well State and local agencies can coordinate efforts to prepare a workable management plan. If this effort falls, then the issue will remain a major problem to the basin fisheries.

It would be appropriate for the Corps to retain an Interest 1n the regulation of summer dams in case State and local Interests cannot reach agreement.

We also believe, as stated earlier, that the Corps should undertake a more detailed study on bank stabilization problems.

We hope these comments will be of assistance to you. Please contact Gary Taylor at (916) 484-4731 1f there are questions concerning these comments.

Sincerely,

James J. McKevitt
Field Supervisor

cc: Director, CDFG, Sacramento, CA
Reg. Mgr., Region III, Yountville,
CA NMFS, Tiburon, CA

RESPONSE LETTER 1

COMMENT LETTER 1. U.S. Department of the Interior - Fish and Wildlife Service

1-1 Issue : Fishery Improvement

It is noted in Sections III and IV of the draft and final reports that improvement of the Russian River fishery could result in significant benefits to the basin's economy. However, the magnitude of these benefits is difficult to estimate due to the scarcity of data on the river's fish populations and their recreational utilization.

The Corps of Engineers presently has no authority to specifically undertake improvement of the Russian River anadromous fishery. However, this does not preclude participation by other Federal agencies in such improvement, or participation by the Corps should special authority be provided by Congress. The emphasis placed in the report on local and State participation in this area is due to on-going involvement by local and State water agencies in managing the natural resources of the Russian River basin. Several of these resources, such as flow releases for instream use, and gravel extraction, are related to the viability of the basin's anadromous fishery.

1-2 Issue: Tributary Fish Populations

The potential adverse impacts on the Russian River anadromous fishery of summer dams on the river's tributaries is noted in Section II.C.3.b. of the Final Report.

1-3 Issue: Water Temperature

The discussion of water quality as related to summer dams in Section II.C.3.b. of the Final Report has been changed to reflect the need for more data. Statements in Sections III.B.4. and IV.A.1. have also been changed to indicate that conclusions regarding the effect of summer dams on water quality are based on existing data.

1-4 Issue: Riparian Vegetation

Section III.A.2.b. of the Final Report has been changed to note possible adverse impacts of removal of riparian vegetation on salmonid habitats in the river system.

RESPONSE LETTER 1

1-5 Issue: Willow County Dan and Basalt Crossing

The discussion in Section III.A.2.b. of the Willow County water diversion dam and the Basalt summer road crossing has been rewritten in the Final Report explaining why they were not studied in more detail. The summer dams on the lower Russian River were considered to represent greater fish passage problems than the Willow County dam and the Basalt crossing.

It is noted in the Final Report that these barriers have some adverse impacts on the basin's fishery, particularly the American shad population. These impacts may become more significant once Warm Springs Dam is operational and if a summer steelhead population is established in the basin. There is no reason to delete these barriers from future studies of the Russian River fisheries, though at the present time no funding is available for the Corps to conduct such additional studies.

1-6 Issue: Recreation Survey

while a detailed analysis of recreation use at specific facilities associated with the summer dams was not conducted, an effort was made to assess recreation activity in areas directly impacted by the dams. Section III.A.2.c. has been changed in the Final Report to indicate that certain recreational activities would take place in the basin even without summer dams. Additional detailed Corps recreational studies on the Russian River are not possible at this time due to lack of funding. However this does not preclude future recreational studies of the Russian River by other parties.

1-7 Issue: Willow County Dam and Basalt Crossing

See response to Comment No. 1-5.

1-8 Issue: Bank Stabilization

Section V.B. of the Final Report has been changed to reflect the need for, and public interest in, additional Corps studies of bank stabilization along the Russian River. It is also noted that such studies would require specific authorization and funding from Congress.

1-9 Issue: Corps Regulatory Authority

Section V.C. of the Final Report has been changed to mention the Corps' continuing regulatory authority over summer dams on the Russian River under Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act. However, the Congressional resolution authorizing the Russian River Basin Study did not give the Corps specific responsibility for maintaining or improving the Russian River fishery, nor for managing summer dams on the river.

RESPONSE LETTER 1

1-10 Issue: Summer Dam Management Plan C

Section III.B.3.c. of the Final Report has been changed to note Fish and Wildlife Service support for Alternative C. The various summer dam management plans are presented for consideration for implementation by local governments. The Corps presently is not authorized to initiate or implement any such plans. The Corps, however, does have continuing regulatory authority over installation and removal of summer dams on the Russian River under Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act. A recommendation for additional Corps studies of bank stabilization along the Russian is included in Section V.B. of the Final Report (see Response to Comment No. 1-8).

COMMENT LETTER 2

STATE OF CALIFORNIA—BUSINESS AND TRANSPORTATION AGENCY

EDMUND G. BROWN JR., Governor

DEPARTMENT OF TRANSPORTATION
1120 N STREET
SACRAMENTO, CALIFORNIA 95814
(916) 445-4400

February 2, 1981

Paul Bazilwich, Jr.
Colonel, CE
District Engineer
U.S. Corps of Engineers 211
Main Street
San Francisco, CA 94105

Dear Sir:

In reply to your letter of December 5, 1980 requesting comments on your Draft Interim Report on the Russian River Basin Study, Caltrans has the following comment:

2-1 The gravel mining operations in the Russian River have, in some instances, lowered the riverbed to a point where the structural integrity of some State highway bridges is being affected. Caltrans urges that an aggregate resources management plan be adopted to assure adequate regulations that will preclude damage to properties in riverbed environs due to aggregate mining.

Sincerely,

J. T. KASSEL
Chief, Office of Planning and Design

RESPONSE LETTER 2

COMMENT LETTER 2. California Department of Transportation

2-1 Issue: Gravel Mining

A discussion of gravel depletion near several State highway bridges crossing the Russian River and its tributaries has been added to Section II.C.1.b. of the Final Report. Included are cases of streambed degradation near the Highway 101 bridge across the Russian River south of Hopland and the Highway 20 bridge across Cold Creek just above Lake Mendocino.

Sonoma County has proposed an Aggregate Resources Management Plan aimed at assuring future aggregate resources for the county while minimizing environmental impacts and land use conflicts. In addition both Sonoma and Mendocino counties have operated "use" permit systems for gravel mining for many years. These systems were expanded in the 1970's to include environmental impacts as dictated by the California Environmental Quality Act and California Surface Mining and Reclamation Act.

These and other permit programs regulating gravel extraction in the Russian River basin (including Army Corps of Engineers, State Department of Fish and Game, North Coast Regional Water Quality Control Board, and State Division of Water Rights) are discussed in detail in Appendix A to the Final Report. This appendix is essentially unchanged from the Draft Report.

- State of California COMMENT LETTER 3 The Resources Agency

M e m o r a n d u m

To : U.S. Army Engineer District, San Francisco
Corps of Engineers San Francisco

Date: December 19, 1980

Telephone: ATSS ( )
( )

From : **Department of Conservation**
Division of Mines and Geology –
San Francisco 94111

Subject: Russian River Basin Study Draft Interim Report December 1980

3-1 The CDMG has reviewed the subject document and wishes to make the following comments:

1) Stream channel degredation downstream from dams, channel improvements and other manmade structures should be addressed. These structures increase the velocity and erosive energy of the stream.

2) With respect to the continuing study of gravel mining-related stream channel erosion, CDMG Special Report 134, "Erosion Along Dry Creek, Sonoma County, California" (Cleveland and Kelley, 1977) might be helpful.

If the CDMG may provide further assistance, please call Charles Armstrong at (415) 557-1420.

Charles F. Armstrong
CHARLES F. ARMSTRONG
Engineering Geologist 976
San Francisco District

APPROVED:

James F. Davis
JAMES F. DAVIS
State Geologist

CFAA/clz

RESPONSE LETTER 3

COMMENT LETTER 3. California Department of Conservation - Division of Mines and Geology

3-1 Issue: Channel Degradation

See response to Comment No. 1-8 regarding additional studies of bank stabilization along the Russian River.
A special study of sediment movement and erosion in the Dry Creek basin was initiated by the Corps in late 1980. The study will include effects of Warn Springs Dan on the aggregate resources of the creek. The study is mentioned in Sections II.C.1.c. and V.A. of both the Draft and Final reports. The Final report was changed to note Congressional authorization of the special study which occurred subsequent to publication of the Draft Report.

OFFICE OF THE SECRETARY
RESOURCES BUILDING
1416 NINTH STREET
95814
(916) 445-5656

Department of Conservation
Department of Fish and Game
Department of Navigation and Ocean Development
Department of Parks and Recreation
Department of Water Resources

EDMUND G. BROWN JR.
GOVERNOR OF
CALIFORNIA

Air Resources Board
Colorado River Board
San Francisco Bay Conservation and Development Commission
Solid Waste Management Board
State Lands Commission
State Reclamation Board
State Water Resources Control Board
Regional Water Quality Control Boards
Energy Resources Conservation and Development Commission

THE RESOURCES AGENCY OF CALIFORNIA
SACRAMENTO, CALIFORNIA

MAR 4 - 1981

Colonel Paul Bazilwich, District Engineer
San Francisco District
U.S. Army Corps of Engineers
211 Main Street
San Francisco, CA 94105

Dear Colonel Bazilwich:

The State of California has reviewed your "Northern California Streams Investigation, Draft Interim Report, Russian River Basin Study", transmitted by Notice of Intent (SCH 81011408) and submitted to the Office of Planning and Research (State Clearinghouse) in the Governor's Office. This review fulfills the requirements under Part II of the U. S. Office of Management and Budget Circular A-95 and the National Environmental Policy Act of 1969.

The State's review has been coordinated with the Departments of Conservation, Fish and Game, Boating and Waterways, Parks and Recreation, Water Resources, and Transportation; the State Water Resources Control Board, and the California Coastal Zone Conservation Commission.

4-1 RECREATION

Section II.C.2., Channel Improvements and Stabilization (page 27)

It is recommended the final draft of the Russian River Basin Study propose for future studies or action the removal of those stabilization works creating a hazard to boaters as noted on page 29.

4-2 Section III.A.2.c., Recreational Analysis, 1) Benefits of Small Dams (page 74)

It is recommended the final report explore further the positive and negative impacts the summer dams have on "downstream float-trip boating". In some cases portage signs and safe and convenient portage trails may be needed at these sites, particularly at the permanent Willow County Water Diversion Dam.

COMMENT LETTER 4

Colonel Paul Bazilwich, District Engineer
Page 2

In addition to summarizing canoeing recreation on pages 21, 22 and 74, perhaps this subject could be further addressed by covering other boating issues affecting the basin which include: future use and demands, access opportunities and problems, and sanitation needs.

4-3 RIVER MANAGEMENT

Gravel Mining and Sediment Influx

We agree that further study is necessary to determine the effects of sediment movement, erosion, gravel mining and channel stabilization on the Russian River. However, the effects of gravel mining on the ground water recharge also should be considered.
A report prepared by the Sonoma County Planning Department in February 1980, "Draft EIR, Aggregate Resources Management Study", is referred to on page 26 and should be included in the Bibliography.

Channel Improvements and Stabilization, and Summer and Recreational Type Dams

We agree with the conclusion that the channel improvements and stabilization problems and the management of summer and recreational dams should be the responsibility of the local agencies.

Land Use Related to Floodplain Management

Based on the information contained in the report, we agree that the responsibility of providing the data on floodplain usage and other land applications in the Russian River Basin has been satisfied.

4-4 Operation of Existing Structures on the Russian and Tributaries

We recommend that the Corps remain an active participant in the resolution of the water allocation problems in the Eel and Russian Rivers. With the Warm Springs Dam scheduled to be operational by 1983, the Corps should take an interest in the conjunctive operation of Lake Mendocino and Lake Sonoma. Such operation may be necessary to reduce the deficiencies expected to occur beyond the year 2000 as described in the "Water Action Plan for the Russian River Service Area" by our Department.

Colonel Paul Bazilwich, District Engineer
Page 3

Use of Study Data and Future Data Requirements

He agree with the conclusion that more data are needed to resolve the resources problems in the Russian River Basin and that a coordinated data-gathering effort by local, State and Federal agencies would reduce the deficiency.

4-5 WATER RIGHTS

The report should note that the State Water Resources Control Board also exercises a role in the regulations of the diversion and use of water in the Russian River and Lakes Mendocino and Sonoma. Any diversion or use of water that does not conform to the terms and conditions of existing permits or license, or which constitutes a new diversion or use of water, is subject to the Board's review and approval.

WILDLIFE

4-6 We find that the report is a good summary of presently available Information on the resources, problems, and some possible solutions to the problems of the mainstem Russian River and Dry Creek.

As a basin study, however, the report is deficient in that superficial treatment is given to the resources and problems of the hundreds of miles of tributary streams; streams which are the source of the resource value in the mainstem. As a regional planning document, the report is of value as a compilation of various general data on resources and problems, but its potential use will be restricted to general planning due to the lack of hard data on specific problems and specific solution options for those problems.

The report concludes that further study is needed on the topics of gravel mining, channel stabilization, and impacts on fish of summer recreational dams which is beyond the scope of the basin study authorization. We agree that all three of these topics deserve further field study. Specific comments on the report follow:

4-7 Page 11, Environmental Setting

This section should contain a statement to the effect that water originating in the Eel River and entering Lake Mendocino via the Pacific Gas and Electric Company's transbasin diversion contains a heavy suspended sediment load. Throughout much of the winter and spring this sediment: discolors the stored water and depresses the biological productivity of Lake Mendocino; and upon release of

Colonel Paul Bazilwich, District Engineer
Page 4

thin water into the Russian River maintains a condition of high turbidity which depresses the salmon and steelhead fishery.

Page 16, paragraph A

4-8 Chinook salmon are native to the Russian River.

Page 23, Gravel Mining

4-9 Although the gravel mining associated problems on the Russian River may be the most severe in Sonoma County, there are serious problems on the mainstem and Forsythe Creek in Mendocino County.

Page 27, Channel Improvements

4-10 This section needs to include a discussion of the various channel stabilization devices which have been used on the Russian River and the successes and/or failures associated with each device.

Page 3A, Fisheries Resource

4-11 Summer steelhead have been introduced into the Russian River duo to the significant difference between the life cycles of winter and summer steelhead, the summer steelhead race should be discussed separately. As various impacts on fish populations are developed later in the report, each should be evaluated for its Impact on summer steelhead as well as winter steelhead, coho and chinook salmon and American shad.

Page 37, paragraph 3

4-12 American shad currently ascend the river only as far as the Healdsburg Dan; prior to the construction of the dam, the shad were able to reach the Ukiah area in some years.

Page 39, paragraph 4

4-13 Although the tributary streams provide many more miles of habitat than does the mainstem, the value of the mainstem to the production of anadromous fishes cannot be understated. The mainstem provides the migration route, some spawning area (of particular value in dry years when the fish may not be able to ascend the tributary streams), and nursery area for salmon and steelhead. The mainstem also provides virtually all the spawning area for the American shad.

Page 42, paragraph 2

4-14 Winter passage problems exist at the Healdsburg Dam due to the degradation of the streambed below the dam's foundation. At low flow, passage may be prevented altogether; at higher flows passage may only be delayed as the fish attempt to Jump the barrier. Summer steelhead introduced into the Russian River in the spring of 1980 may also be affected by the summer dams. In contrast to the winter steelhead, these fish are expected to enter the river between April and early July, hold over through the summer in deep, cool pools of the upper river, then spawn in the winter. The lack of fishways at Healdsburg and Del Rio Woods may stop the upstream migration of these fish and prevent their establishment.

Page 45, paragraph 4; and page 47, paragraph 7

4-15 The Healdsburg summer dam may also affect the Immigration of summer steelhead.

Page 54, paragraphs 3 and 5

4-16 The development of a salmon/steelhead fishery in Dry Creek below Warm Springs Dam is questionable at this time. Stream conditions will be enhanced and fish will probably be abundant; however, opposition has been expressed to the opening of Dry Creek to fishing.

Page 55, Problems and Opportunities

4-17 Once a year, during periods of low flow, the discharge from Lake Mendocino is totally cut off for several hours to permit an inspection of the outlet tunnel and valve. The Impact of this flow interruption has never been evaluated but may have a significant detrimental impact on fish populations in the east branch and upper mainstem Russian River. An assessment of the impacts of this flow cutoff should be made.

Page 60, paragraph 5

4-18 The second sentence should be changed to "Optimum nursery resting habitat was found..." The fourth sentence should be changed to "This streamflow appears..."

Page 72, Fisheries Resources Effects

4-19 Include a discussion of the effects on summer steelhead.

Page 76, Fishery Benefits

4-20 The Introduction or Sumner steelhead may greatly increase the fishery recreational use of the Russian River.

Page 83, ASSESSMENT AND EVALUATION OF DETAILED PLANS

4-21 Throughout this section the pressure of summer steelhead in the Russian River should be considered in the evaluation of the alternative plans for handling the summer dams. It should also bc pointed out that recently Salmon Unlimited, the Mendocino County Board of Supervisors, and others have expressed concern over the lack or, and need for, a fishery at Healdsburg.

Page 86, paragraph A

4-22 How were the percent increases to the salmon/steelhead and shad fisheries derived? Even if the benefit to the salmon/steelhead fishery is only 1 percent, the benefit to the fish populations is very likely to be considerably greater as a result of reducing the delays in passage caused by Healdsburg Dam.

Page 100, paragraph 2

4-23 The comment that 60°F is the upper tolerance level for salmonid fishes is incorrect. Paul Kubicek, Pacific Gas and Electric

Page 114, ENVIRONMENTAL ASSESSMENT

4-24 Again, summer steelhead should be included.

Appendix A, GRAVEL MINING

4-25 This section discusses the permit processes of Sonoma County, the Department of Fish and Game, the Regional Water Quality Control Board, and the Corps. of Engineers. The gravel mining permit process of Mendocino County should also be discussed.

Page B-1, Steelhead

4-26 Summer steelhead were introduced to the Russian River in 1980; a second plant will be made in the spring of 1981. The summer differ from the winter steelhead in that they will migrate

Colonel Paul Bazilwich, District Engineer
Page 7

into the river during April through early July to hold over in deep, cool pools through the summer months. The spawning or both races will occur in the late winter and early spring.

Page B-3, paragraph 5

4-27 At one time shad were able to migrate up the Russian River as far as Ukiah.

Page C-11

Change the reference to "Philip Baker, Warden" to "Philip Baker, Associate Fishery Biologist".

Appendix F, page 67, paragraph 6

This statement on the lack of silver salmon and steelhead in Dry
4-28 Creek should Include supporting material on the year of the sur-
vey, drought conditions existing or recently experienced, and the
extent of the observation efforts. These data are essential to
the interpretation of the report.

Page 83, Healdsburg Dam

It should be added that even under the best conditions the passage
of salmonid fishes may be delayed for some time due to the
4-29 difficulty of Jumping the dam sill. It should also be pointed out
that at the time of construction the sill of the Healdsburg Dam
was at grade; in the years since, the streambed below the dam has
degraded by up to 18 feet, it may still be degrading causing the
passage problems to become worse.

Appendix F, page 93, Nursery Habitat

This section is very misleading. It is stated and shown graphi-
cally that nursery habitat peaks at 20 cfs. Then, almost as an
afterthought, adds that the 20 cfs habitat peaking applies only to
resting areas and that total nursery habitat would probably be
4-30 increased by increasing the flow above the present level due to
reduced temperatures.

Department of Fish and Game personnel are available to discuss our concerns in more detail. To arrange a meeting, the project sponsor or applicant should contact Mr. Bill Cox, Fishery Biologist,

Colonel Paul Bazilwich, District Engineer
Page 8

8699 Mill Station Road, Sebastopol, California 95472, telephone (707) 823-1001; or Mr. Wendy Jones, Fishery Biologist, 540 Zinfandel Street, Ukiah, California 95482, telephone (707) 468-1104.

Thank you for the opportunity to review and comment.

Sincerely,

James W. Burns
Assistant Secretary
for Resources

cc: Director of Management Systems
State Clearinghouse
Office of Planning and Research
1400 Tenth Street Sacramento,
CA 95814
SCH 81011408

COMMENT LETTER 4. The Resources Agency of California

4-1 Issue: Boating Hazards

The maintenance of Corps bank stabilization works along the Russian River is a local responsibility under agreements reached with Sonoma and Mendocino counties prior to construction of these facilities. However, this does not preclude assessment of this problem in any future studies of recreation or bank works along the Russian River. In this regard, Section V.B. of the Final Report has been changed to reflect the need for, and public interest in, additional Corps studies of bank stabilization along the Russian (see Response to Comment Ho. 1-8).

4-2 Issue: Recreational Boating

Additional Corps studies of boating or other recreational activities on the Russian River are not possible at this time due to lack of funding. However this does not preclude future recreational studies of the Russian by other parties.

4-3 Issue: Gravel Mining

A special study of sediment movement and erosion in the Dry Creek basin was initiated by the Corps in late 1980. Sediment movement, erosion, gravel mining, groundwater recharge and channel stabilization were some of the issues raised by basin residents at a public workshop held on the study in early 1981. This study is attempting to address these concerns using currently available data on the basin and its land and water resources (see Response to Comment No. 3-1).
Section V.B. of the Final Report has been changed to reflect the need for, and public interest in, additional Corps studies of bank stabilization structures along the Russian River (see Response to Comment No. 1-8). The bibliography in the Final Report has been changed to include Sonoma County's February 1980 "Draft EIR, Aggregate Resources Management Study."

4-4 Issue: Inter-Basin Water Allocation

The Corps of Engineers is an active participant in the Eel-Russian River Commission which is studying water allocation between the Eel and Russian River basins. The Commission was primarily established to address this issue because of the pending Relicensing of the Potter Valley powerhouse by the Federal Energy Regulatory Commission. Operation of the powerhouse depends on diversions from the Eel River to the Russian River basin.

The Corps is actively involved in the operation of Lake Mendocino as it will be in the operation of Lake Sonoma once the project is complete. However, this involvement extends only to preserving the projects' flood control and recreation capabilities. The operation of these reservoirs for water supply purposes is strictly the responsibility of local governments by virtue of their sharing in the construction costs of the projects.

A joint use study of Lakes Sonoma, Mendocino and Pillsbury is being conducted by the California Department of Water Resources, Central District. A similar study of Lakes Sonoma and Mendocino was done by the Sonoma County Water Agency. The state study is examining opportunities for optimizing operation of the three reservoirs to meet projected year 2000 water demands in both the Russian and Eel River basins. This study was not mentioned in the Draft Report but is mentioned in Section II.C.6.a. of the Final Report.

4-5 Issue: Water Diversion Rights

Section II.C.6.a of the Final Report has been changed to include discussion of the role of the State Water Resources Control Board in regulating water use in the Russian River basin.

4-6 Issue: Russian River Tributaries

The importance of Russian River tributary streams as fish habitat is recognized in Section II.C.3. and III.B.6. of the Final Report. The State of California expressed concern early in the study that summer dams on the river may inhibit migration of fish to and from spawning and nursery habitats in these tributaries. In keeping with these concerns and study funding limitations, investigation of fishery resources during the basin study was limited to the Russian River mainstem and Dry Creek.

Section V.G. of the Draft and Final reports discusses the use of data developed during the study. It is also noted in this section that analysis of specific basin resource problems. These deficiencies are identified and ways in which they can be eliminated are briefly discussed.

RESPONSE LETTER 1

4-7 Issue: Eel River Diversions

A discussion of this subject is included in Section III.C.1. of the Final Report. A similar discussion was included in the Draft Report.

4-8 Issue: Chinook Salmon

The statement in Section II.B.1.f. of the Draft Report that chinook salmon were introduced to the Russian River has been stricken from the Final Report.

4-9 Issue: Mendocino County Gravel Mining

A discussion of streambank and channel erosion problem in the Mendocino County portion of the Russian River basin has been added to Section II.C.1.b. of the Final Report.

4-10 Issue: Channel Stabilization

The discussion of channel stabilization Matures in this Section (II.C.2.) is deemed adequate. This section of the Final Report has not been changed from the Draft version.

4-11 Issue: Summer Steelhead

Discussion of the summer steelhead strain recently planted in the Russian River has been added to Sections II, III, IV and Appendix B of the Final Report. The impacts on this strain of the various summer dam management measures presented in the Final Report are evaluated qualitatively in Sections III and IV. Quantitative assessment of impacts on this strain was not presented because a viable population has not yet become established in the basin.

4-12 Issue: American Shad

A statement to this effect has been added to Section II.C.3.b. of the Final Report.

4-13 Issue: Russian River Mainstem Fishery Value

Section II.C.3. of the Draft Report discussed the value of the Russian River mainstem as a migration route and spawning and nursery habitat for anadromous fish. This discussion has been retained in the Final Report.

RESPONSE LETTER 4

4-14 Issue: Healdsburg Dam

The fish passage problems at Healdsburg Dam are discussed in Section II.C.3.b. of the Draft and Final reports. A discussion of the summer steelhead introduced to the Russian River has been added to this section of the Final Report.

4-15 Issue: Summer Steelhead

Mention of the potential impact of the dam on summer steelhead migration has been added to Section II.C.3. of the Final Report.

4-16 Issue: Dry Creek Fishery

Section II.C.6.a. of the Final Report has been changed to incorporate a discussion of possible development of a salmon/steelhead fishery in Dry Creek following completion of Harm Springs Dam. Also added is a discussion of the issue of public access to Dry Creek for fishing and other activities.

4-17 Issue: Lake Mendocino Inspection

The Corps annually notifies the California Department of Fish and Game and the Sonoma County Hater Agency of the date of the Coyote Dam outlet works inspection. Such coordination has been conducted each year since the dam became operational in 19S9. Representatives of the Department of Fish and Game have been present during several of these inspections to observe changes in the streambed of the east branch and upper mainstem at the Russian River. However, no formal report has been produced on the impact of the annual inspection on fish populations in the Russian River.

4-18 Issue: Sentence Structure

These changes have been made in Section II.C.6.b. of the Final Report.

4-19 Issue: Summer Steelhead

This discussion has been added to Section III.A.2.b. of the Final Report.

4-20 Issue: Summer Steelhead

A statement to this effect has been added to Section II.A.2.c. of the Final Report.

4-21 Issue: Summer Steelhead

Section III.B. of the Final Report has been amended to include qualitative assessment of impacts of the various summer dam management measures discussed therein on summer steelhead in the Russian River. This section in the Final Report also mentions the support expressed by Salmon Unlimited and the Mendocino County Board of Supervisors for provision of fish passage facilities at Healdsburg Dam.

4-22 Issue: Fishery Benefits

The predicted increases in anadromous fish populations in the Russian River basin due to addition of fish passage structures at Healdsburg and Del Rio Woods dams were based on information contained in the literature and opinions of fisheries specialists familiar with the Russian River. Because of the subjective nature of this analysis it was assumed that increases in anadromous fish populations would cause corresponding (in terms of magnitude) increases in fishing success in the basin.

4-23 Issue: Salmonid Temperature Tolerance

Section III.C.2. and the Bibliography of the Final Report have been changed to include the reference by Kubicek and Price (1976).

4-24 Issue: Summer Steelhead

See response to Comment No. 4-11.

4-25 Issue: Mendocino County Mining Permits

Appendix A to the Final Report has been changed to incorporate mention of Mendocino County's gravel mining permit system and the "Surface Mining and Reclamation Ordinance" adopted by the county in 1979.

4-26 Issue: Summer Steelhead

This information on summer steelhead in the Russian River has been added to Appendix B to the Final Report.

4-27 Issue: American Shad

A statement to this effect has been added to Appendix B to the Final Report.

RESPONSE LETTER 4

4-28 Issue: Dry Creek Fish Populations

Information on the period and extent of the anadromous fish nursery habitat observations conducted is presented in Sections III and IV.B. of Appendix F. Data on hydrologic conditions in Dry Creek during these observations is presented in these same sections as well as Section V.A. of Appendix F.

4-29 Issue: Healdsburg Dm

This information on Healdsburg Dam has been added to Section I.E. of the Final Report.

4-30 Issue: Salmonid Nursery Habitat

The relationship between optimum flows for salmonid nursery habitat in terms of resting space, and optimum flows for nursery habitat in terms of water temperature, is discussed in more detail in Section III.C.2.d. of the Final Report.

COMMENT LETTER 5

TELEPHONE:
(707) 468-4221

COUNTY OF MENDOCINO BOARD
OF SUPERVISORS COURTHOUSE
UKIAH, CALIFORNIA 96482

February 2, 1981

Colonel Paul Bazilwich, Jr.
U.S. Army Corps of Engineers
San Francisco District
211 Main Street
San Francisco, CA 94105

Re: Russian River Basin Study Draft Report

Dear Colonel Bazilwich:

5-1 The Mendocino County Board of Supervisors, along with its staff and consultant, have reviewed the December draft report of the Russian River Basin Study. We would like the following comments to be addressed in the final report you are preparing.

1. Coyote Dam: Effects and Mitigation

The impacts of the construction of Coyote Dam on the anadromous fish losses of the East Fork of the Russian River are inadequately discussed. Those local residents familiar with the pre-project conditions believe that more than 35 miles of salmonid habitat were lost. No permanent measures have yet been taken by the Corps for mitigating this loss, despite the mandate of Section 95 of PL 93-252 of March 1974.

The County does not believe the Warm Springs fish hatchery on Dry Creek is going to fully mitigate the fishery loss to the Upper Russian River basin. Possible solutions which the Corps should seriously evaluate are an egg-taking station and rearing ponds below Coyote Dam. It is the Corps' responsibility, with assistance from the Calif. Dept. of Fish and Game, to develop and implement adequate fishery compensation for Coyote Dam.

5-2 2. Bank Stabilization

Improvement in stabilizing eroding banks along the Upper Russian River below Coyote Dam is a major county concern. The original bank stabilization structures constructed by the Corps were built in 1958-1972 and are now quite old. The County does not believe that total responsibility for bank protection should lie with the County (p. 28). The Corps should continue to provide technical and financial assistance as part of the mitigation for the effects of Coyote Dam.

COMMENT LETTER 5

3. Optimum Flow Releases for Fisheries

5-3 It is not clear how the "optimum salmonid spawning flows" of Table 13 were calculated (p. 109) for the mainstem of the Russian River. What is the basis for the 200 cfs optimum flow for the Russian River at Hopland? Contrary to the statement on page 108, these "optimum spawning flows" are greater than the SCWA and CDFG agreement for minimum releases.

4. County Population

5-4 The population figures in Table 1 are out-of-date and available data was not incorporated. The 1975 estimated population (DOF. E-150) was 57,417. The 1980 preliminary Census for Mendocino County is 66,751 while the General Plan Draft estimated the 1960 population to be 69,493 based on housing unit data. The Planning Department estimates 31,031 people in the Russian River Basin portion in 1980.

5. Sediment Influx and Gravel Mining

The study did not adequately address sediment influx and transport or gravel mining in the flood plain, as the 1972 U.S. House of Representatives resolution directed. The study's results pertain primarily to Sonoma County with little useful information for Mendocino County. While the Corps did offer the County the use of its HEC-6 computer model, the statements in the text (p. 27 and 117) do not accurately describe the situation.

5-5 The County was given only two weeks to respond to the Corps' offer. While staff was trying to find out what the computer model could do for us, the deadline expired and the County was told the offer no longer held. A more cooperative approach to helping the County in its information needs would have been desirable. Assistance other than a computer model requiring large quantities of unavailable data should have been offered. The County has instead contracted with the Calif. Dept. of Water Resources for an Upper Russian River Gravel and Erosion Study to provide us with the data we need.

Enclosed is an up-to-date map of the gravel operations in the Upper Russian River drainage, based on County permit records for 1973-80. Please correct your maps (Plates 3 and 4). The Planning Department would like to have the gravel mining and sediment Influx data gathered by the Corps, as offered on page 120.

6. Land Use and Flood Plain Maps

The Planning Department would also like to obtain the land use data developed in the study: the original land use quads from which Tables 14-24 were reproduced; and statistical tables and printouts for each sub-basin and quadrangle in Mendocino County.

Thank you for this opportunity to comment on your draft report.

Sincerely,

James Eddie

James Eddie
Chairman

JE/SS/aa Enclosure

COMMENT LETTER 5. Countv of Mendocino

5-1 Issue: Coyote Dam Fish Mitigation
Both the Draft and Final reports mention, in Sections II.C.3.a. and II.C.6.a., that approximately 35 miles of anadromous salmonid spawning and nursery habitat were eliminated by the construction of Coyote Dam and Lake Mendocino. However, the exact magnitude of the impacts of the project on the Russian River fisheries is not known.

The Corps of Engineers is authorized to compensate for damage to these fisheries attributable to the dam and reservoir by Section 95 of Public Law 93-251 dated March 7, 1974 (Water Resources Development Act of 1974). The Corps has indicated it will respond to this authority once the California Department of Fish and Came and/or the U.S. Fish and Wildlife Service provide information on the extent of fish losses attributable to the dam project, and possible mitigative measures. The Fish and Wildlife Service provided some input on this topic in January 1982. This input is presently being evaluated by the Corps.

5-2 Issue: Bank Stabilization

The 1936 Flood Control Act mandated that maintenance of Corps of Engineers bank stabilization measures be the responsibility of the projects' local non-Federal sponsors. The Corps constructed bank stabilization measures along the Russian River from 1962 to 1972 as part of the Coyote Dam/Lake Mendocino project. These measures generally succeeded in preventing or reducing bank erosion associated with regulation of flows on the Russian River by Coyote Dam. However, certain of these structures have been damaged or destroyed since 1972 and renewed bank erosion has occurred in some areas. A discussion to this effect is included in Section II.C.2. of the Draft and Final reports.
Repair of some of these Corps works was evaluated since 1972 under the provisions of Public Law 84-99(PL 99). This statute created an annual fund for flood fighting and repair of flood control works threatened or destroyed by flood. This authority is predicated on the proposed repair work being economically feasible. Several PL 99 projects were constructed along the Russian between 1962 and 1972. However, damaged bank works evaluated since 1972 did not show this feasibility and thus could not be repaired under this statute. This was mentioned in Section II.C.2. of the Draft and Final reports.

RESPONSE LETTER 5

The Corps has studied other bank erosion problems along the Russian under Section 14 of the Flood Control Act of 1946 and Section 205 of the Flood Control Act of 1948. Section 14 authorizes emergency bank protection works to prevent flood damage to public facilities. Section 205 authorizes construction of small flood control projects without specific authorization by Congress. Both these authorities allow construction only if shown to be economically feasible. Up to now the projects evaluated along the Russian River under these authorities did not show this feasibility.

Russian River under the authorities mentioned above. In addition, Mendocino and Sonoma County, as well as the U.S. Fish and Wildlife Service and the Resources Agency of California, have expressed the desire for expanded Federal involvement in evaluating bank erosion problems along the Russian. The Corps recognizes this position and the Final Report on the Basin Study concludes that such additional involvement is warranted. However, no funds remain for any such investigation under the present Russian River Basin Study authorization. Thus additional Corps studies of bank erosion and stabilization along the Russian River would require specific authority and funding from Congress. These conclusions are noted in Sections II.C.2.c. and V.B. of the Final Report.

The Corps of Engineers, under Public Law 93-251, Section 55, can also provide technical and engineering assistance to non-Federal public interests in developing structural and non-structural methods of preventing damages attributable to shore and streambank erosion. A discussion of this assistance is contained in Section V.G. of the Final Report.

5-3 Issue: Optimum Salmonid Flows
"Optimum salmonid spawning flows" were determined during the in-depth investigation of fish habitat and barriers to fish migration conducted during the Basin Study. This is noted in Section III.C.2.d. of both the Draft and Final reports. This investigation is documented in Appendix F of the report. Essentially these flows were based on documented environmental requirements for spawning during the months of salmonid reproduction in the Russian River. The "optimum spawning flows" are greater than the values in the 1959 Sonoma County Water Agency/California Department of Fish and Came agreement for minimum flow releases from Coyote Dam. However, the statement in the Draft Report referred to in this comment read that the minimum releases are greater than "optimum nursery flows." This statement has been retained in the Final Report.

RESPONSE LETTER 5

5-4 Issue: Population

Table 1 in the Final Report has been modified to incorporate these data.

5-5 Issue: Sediment Movement and Gravel Mining

The Russian River Basin Study Phase I Report released by the Corps in December, 1976 proposed interagency involvement in defining the nature of sediment influx, transport and turbidity in the Russian River. The U.S. Geological Survey would have provided major input to this investigation.

Unfortunately, soon after release of the Phase I Report, the Corps and other agencies participating in the study underwent significant internal re-organization and re-ordering of priorities. Because of this the proposed interagency study of sediment and turbidity in the Russian River was never initiated.

This issue was addressed to some degree by the Pacific Gas and Electric Company in its "Application for Certificate of Conformance with Water Quality Standards, Potter Valley Project", filed in September 1978. The California Department of Hater Resources, Central District also discussed the turbidity problem in the Russian in its "Water Action Plan for the Russian River Service Area" published in May 1960. The involvement of these parties in the Russian River turbidity issue is mentioned in Sections II.C.3.a. and III.C.1. of the Final Report.

The primary direction of Corps investigation of gravel mining during the Basin Study was toward assisting Sonoma County in the development of its Aggregate Resources Management Plan. The Corps offered similar assistance to Mendocino County during the course of the study. A presentation to this effect was made before the Mendocino County Board of Supervisors in October 1978. A formal letter regarding this assistance was sent to the Board in January 1979, followed by a phone call in March and another letter in April. The County was granted an extension to May 1979 for response to these inquiries. When no response was received by this time the offer was considered expired. However, this does not mean Mendocino County cannot become involved in any future Corps studies of sedimentation in the Russian River basin. Sections II.C.2.a. and V.A. of the Final Report have been amended to note the County's involvement with the California Department of Water Resources.

Plate 3 of the Final Report has been changed to incorporate Mendocino County's recent information on gravel operations in the upper Russian River basin.

COMMENT LETTER 6

Monte Rio Recreation and Park District

19578 Redwood Drive
MONTE RIO, CALIFORNIA
TELEPHONE 707 865-1176
95462

January 8, 1981

U.S. Army Corps of Engineers, San Francisco District
ATTN: SPNED-PW (Russian River)
Gentlemen:

6-1 Our interest in The Russian River Basin Study lies in the area of temporary summer dams. On March 1, 1978 we made application for such a dam, composed of gravel and a fish-way, which was given the No. 11563-44. This application was withdrawn on June 18, 1980, on the advice of Mr. Paul Portch, of your office, because of the time it was taking for the Calif. Dept. of Fish and Game to give it's final approval. We made a similar application to the Calif. Dept. of Fish and Game and signed an Agreement for Streambed Alteration on January 30, 1979 which contained a condition that a "comprehensive, independent study... is completed and the results show that the project will not have any significant detrimental impacts. The DFG agreed to prepare the parameters of the study. The project was given the number Notification III-223-78. On March 7, 1979 DFG advised that there would be a delay in the preparation of the study plan. The location of the dam is about 300 feet downstream from the confluence with Austin Creek.

We have reviewed the document Evaluation of Fish Habitat and Barriers to Fish Migration and some other inputs. We cannot find anything that could be considered "detrimental" to the gravel dam we propose.

We therefore request that a summation be prepared as a part of the Final Report which addresses the impact of our proposed project. DFG's main interest is in effect on American Shad.

For your information our District operates a boat launching ramp at Monte Rio. The total investment for all facilities connected with the ramp is about $200,000.00. Unfortunately use of the ramp in the summer time is restricted because of low water in the River. If we could raise the water level close to what it is when the sand-bar at Jenner closes the River we would satisfy all requirements for use of the River from River Mile 6.3 to 12.8.

The people in the area and the thousands of summer visitors, including fishermen, stand to benefit from the dam. In fact, we have testimonials from fishermen who used the River in the years when the dam was in place that the fishing was greatly improved.

Request your assistance in providing information which will eliminate DFG fears about American Shad.

Sincerely,

Lyle C. Maritzen
Director

RESPONSE LETTER 6

COMMENT LETTER 6. Monte Rio Recreation and Park District

6-1 Issue: Summer Dam Impacts

Within the scope of funds available for the remainder of the Russian River Basin Study, it is not possible for the Corps to initiate investigation of the Park District's proposal for a new summer dam on the river. Such investigation would require specific authorization and funding from Congress.
The information developed during the Basin Study regarding summer dams on the Russian River is available for use by the Park District. However, for specific information on design, installation and removal of such dams the District should contact either the California Department of Fish and Game or the U.S. Fish and Wildlife Service.

SONOMA COUNTY WATER AGENCY
Chapter 994 of the Statutes of 1949, as Amended
2425 CLEVELAND AVENUE
P.O. BOX 11505
SANTA ROSA, CA 95406
(707) 526-5370

January 30, 1981

FILE: 49-0-1 RR Basin Study

U. S. Army Corps of Engineers
San Francisco District
Attention: SPNED-PW (Russian River)
211 Main Street
San Francisco, CA 94105

The following comments are made on your Russian River Basin Study in response to your announcement of public meeting dated December 8, 1980. An initial comment it should be noted that the report generally does not cite the sources of its information. This makes it very difficult for the reader to judge the accuracy of the Information presented or to determine the assumptions made or the age of the data. Regardless of the weakness of the data, once it is published, it will be considered credible by many readers.

Specific comments are as follows:

	Page	Paragraph	Comment
7-1	11	4	Coyote Dam storage is given as 120,000 acre feet. This should be 122,500. Lake Mendocino surface area is given as 2,000 acres (presumably for recreation purposes)— this would require 137,000 A.F. of storage! Approximate surface areas are 1810 acres with encroachment into the flood pool to 90,000 A.F., 1733 acres at top of conservation pool (72,300 A.F.), and 1498 acres at 50,000 A.F. (still considered desirable for recreation).
7-1	15	3	Listing of major drought years - should 1944 have been 1934, which appears to be drier.
7-2	18	4	Page A-3 of the report states that "The Santa Rosa-Rohnert Park-Sebastopol urban area is within the basin.", yet Rohnert Park is not included in the listing of principal communities, nor is it shown on Figure 1 (page 12) although the much smaller community of Cotati is.

COMMENT LETTER 7

	Page	Paragraph	Comment
7-2	19	Table 1	Again, Rohnert Park with a population of about 23,000 is not included in the listing. In addition, since the 1980 census has now been taken, it would seem the table should he updated to include that information, e.g., Sonoma County has about 40,000 more people than shown. If the report is to be used as a planning tool, it should present the most up-to-date information possible.
	19	Last	ABAG has updated their population projections for Sonoma County in a report, published as "Projections 79". Although this should probably be included in the tabulation on page 20, the projections are close to the DOF E-150 estimates used and would not significantly change the report.
	28	2	The Sonoma County Water Agency maintains about 4 miles of low flow drainage channel from a point midway between River Road and Guerneville Road through Occidental Road. It is incorrect to say we conduct a program of sediment and debris removal.
7-3			The Central Sonoma Watershed Project includes flood control channel improvements on tributaries of Santa Rosa Creek such as Piner Creek, Paulin Creek, Brush Creek and tributaries, Spring Creek and Matanzas Creek. It further includes flood detention reservoirs on Paulin Creek, Brush Creek, Matanzas Creek and one off-stream reservoir for Santa Rosa Creek and Spring Creek.
			It is incorrect to say CSWP reaches from the Laguna to the Santa Rosa Civic Center Complex as there is channel work beyond that point as well as the detention reservoirs.
7-4	29	1	The statements in the last sentence as to Dry Creek erosion and future channel improvements do not appear to agree with the last sentence of the first full paragraph on page 28.
7-5	30	2,4 & 5	Comments regarding the lack of inspection and maintenance by the Sonoma County Water Agency are totally Inaccurate. The Agency annually Inspects the entire reach of river along which the Corps has Installed stabilization works. The poor design of bank protection devices, i.e., jacklines, imposed upon the Agency by the Corps, against our recommendations, on a "jacks or nothing" basis resulted in maintenance deficiencies in excess of our financial ability to rectify. The failure of the design should have been obvious to the Corps early in the stabilization program as many of the jacklines had to be replaced, some twice, in the

COMMENT LETTER 7

Corps of Engineers January 30, 1981
Attn: SPNED-PW (Russian River)
Page 3

	Page	Paragraph	Comment
	30	2,4 & 5 (Cont.)	first few years. The jack failures not only leave the area unprotected which they were intended to protect, but often swing out into the channel and force the river into the opposite bank causing erosion where none would have otherwise occurred. House Document 585 (letter from the Secretary of the Army, letter from the Chief of Engineers, Corps of Engineers, and a survey of Russian River) estimated maintenance costs for the proposed project between river miles 32 and 63 at approximately $6,000 per year. The actual average maintenance costs since that time is approximately $60,000 with costs some years exceeding $120,000. By Board resolution DR 30220 dated July 21, 1970, and again by letter dated May 4, 1978, the Agency requested the Corns to reevaluate the effectiveness of the Russian River bank stabilization project between river mile 42 and 62. Since rock riprap is the only bank protective measure which we have found effective, we have attempted to replace jacklines as they fail with rock. Since limited budgets do not insure restoration of all failures each year we prioritize and repair those areas most in need. By letter dated January 31, 1978, the Agency requested assistance from the Corps for extensive damage to seven sites containing flood control works along the river resulting from the floods of early January. In August of that year the Corps responded that four of the sites were not eligible for assistance but that three of the sites were being considered. The Corps responded in February 1979 that the damage was so extensive that none of the sites had an acceptable cost-benefit ratio. In cooperation with the owners, the Agency provided some rock stabilization at two of the three sites. The erosion just above Geyserville bridge which the Corps estimated would cost in excess of $1,000,000 to repair is beyond Agency budget capability.
7-6	31 27 117 & 118 122	2 6 3 & 1 2	Sentence regarding funding and initiation in late <u>1980</u> of Corns' special study on erosion and gravel mining should be updated in final report, since it is already 1981.
7-7	34	4	Estimates of steelhead and salmon runs are evidently (see FERC pg. 2-50) based on 1972 reports of K.R. Anderson --

COMMENT LETTER 7

Corps of Engineer January 30, 1981
Attn: SPNED-PW (Russian River) Page 4

	Page	Paragraph	Comment
	34	4 (Cont.)	Check of '72 report indicates figures were taken from a 1969 F&G report; further check indicates 1969 figures may have been based on a 1966 report of a 1965 F&G survey.' Are these figures still valid? Shouldn't this report reflect current studies underway? Even the original 1966 report stated *"The estimates* (of steelhead and salmon population) *are preliminary and are intended to serve primarily as a basis for further studies."* The 1969 report reiterated this by *saying "an inventory is needed on both the salmon and steelhead resources as we do not know how many of these anadromous fishes use this drainage system.......reasonable estimates have been made, but more detailed knowledge is needed in order to manage this resource effectively."* If the statistical information 1; this outdated, can the needs of the fishery be established until current studies are completed?
7-8	39	4	If the inventory figures have not changed (see above), on what basis has it been determined that extensive losses of habitat have occurred due to summer dams, etc.?
7-9	47	7	Implies that Fish & Game paid for the fish ladders at Vacation and Johnson Beaches. According to Phil Guidotti (of the Russian River Recreation & Park District), F&G designed the fish ladders (one required revision only two years later), but only paid for one-half the cost of the Vacation Beach installation. The other half, and the entire cost of the Johnson's Beach facility, was paid for by the Russian River District. He stated they do not have a copy of the report — the Corps should solicit comments from these recreation districts since they are so vitally concerned with the summer dam issue.
	51	4	States there are "several" homes and resorts along the Russian River. Page 15 in a nearly identical sentence says a "significant number" which is certainly more than "several".
7-10	53	4	In this instance, as well as in others in the report, reference is made to our Wohler intake — this should probably be augmented to read Wohler "and Mirabel" intakes to reflect both diversion points. This sentence also emphasizes our diversion and implies that we use the greater portion of Coyote releases --our diversions vs. agricultural and instream uses should be put in perspective.

COMMENT LETTER 7

	Page	Paragraph	Comment
7-11	56& 57	Fig.3&4	Hydrologic analyses , on which these figures are based, include the period from 1915 to 1964. Since the drought of 1976/77 affects previous estimates of dry year yield, shouldn't this analysis also be updated to include the recent drought years?
	58 104 106	4 5 1	Minimum release required from Coyote is 25 cfs, not 30 as stated.
	59	1	"Water Permit" should more accurately read "Appropriative Water Right Permit".
7-12	59 106	3 1	The statement "According to this agreement" implies that the 150 cfs minimum in the river through the confluence with Dry Creek" is contained in our original 1959 FAG agreement. This does not reflect the actual wording of the 1959 agreement.
7-13	76ft 77	6& Table 7	As stated in the report, the steelhead catch and angler-day figures are based on data estimated from a 1971/72 creel census. Comparison from 1965 figures (reported on page 78) is as follows:

	1965	1971/72
Steelhead catch	12.000	5,062
Angler-Days	60,000	53,151
Angler-Days/Fish	5.0	10.5

With the significant changes apparent above in only 6 years, it seems further studies are required to assess any change in the last 10 years before dollar values are assigned and operational plans devised.

	Page	Paragraph	Comment
7-14	78 79	4 Table 10	The data given in Table 10 is based on 1965 estimates with no change. Again, updated studies should be done to assess changes in the past 16 years.
7-15	80& 81		American shad and warmwater fishery data, again, are based on estimates made in 1969 and 1970......
	80	4	(Line 4) states estimates are "based on data that are generally at least 5 years old." This was true 1n 1976 when the Phase 1 report was published, but should probably now read "at least 10 years old."
	80		(Last sentence) Wohler Dam was constructed in 1975 rather than 1976.
7-16	82	3	The Agency and the Department of Fish and Game both agreed that their design would cost $100,000 to build.

COMMENT LETTER 7

	Page	Paragraph	Comment
7-17	82	5	Healdsburg Dam in its down position presently offers a barrier separating the spawning areas of the salmonoids and the American shad. Since the shad are free spawners and arc able to utilize the river below Healdsburg Dam as they have successfully been doing for the last 20 years and since a fish passage structure which would pass them above Healdsburg Dam would permit them to compete with the salmonoids for the available habitat, such a structure would be of dubious value. Should a Denil fishway be constructed to assist the salmonoids in negotiating Healdsburg Dam in its down position, consideration should be given to constructing it on a slope sufficient to discourane American shad migration, i.e., 6:1.
7-18	83& 87	2,3 & 6	Estimates of annual installation, removal and maintenance costs are far too low on Healdsburg Dam. For example, there would be 132 feet of ladder to install and remove each year for the up position of the dam if constructed on an 8:1 slope. The permanent ladder section for the down position could be expected to receive considerable damage during winter floods.
7-19	93 43	6 3	Implies that costs of installing a fish ladder at Healdsburg Dam are the responsibility of the Agency -- this is not the cast.
7-20	94		(Last two sentences) .... If, as the report states, summer dams have insignificant impact on water quality, etc., and the only significant detriment is as a harrier to fish, then these two sentences do not quite add up. If it is not clear that the interferences with the movement of anadromous fish ... associated with .... summer dams...are the limiting factor in the fishery" then how can it be said their removal would have the greatest benefit?
7-21	95	2	Proposed removal of the Agency's rubber dam at Wohler! This dam should not be considered in the category of "sunnier recreational dams" -- it is for water supply, has a fish ladder, and can be raised and lowered to meet practically any streamflow condition. We question the $1,500,000 cost for substitute facilities without proof that such facilities could accomplish the same purpose. Nor is any mention made of the $1,500,000 the Agency has already spent to build the dam.
7-22	101	1 & 2	Recommends that "flow releases...from Coyote or Warm Springs... should consider the magnitude of flows necessary to reduce temperatures to acceptable levels" (for salmonoid nursery habitat). If, as stated, "lowering of the temperature...is rather modest and...not sufficient to convert the river into a salmonoid habitat area" then assessment of adverse impacts on recreation and water supply should be carefully balanced against any releases for temperature-lowering purposes.

COMMENT LETTER 7

Corps of Engineers
Attn: SPNED-PW (Russian River)

January 31, 1981
Page 7

Page	Paragraph	Comment
101	1 & 2 (Cont.)	We could not seem to "match up" the discharge and temperature data given 1n Table 12, page 102, with USGS records, but since this is a "generalized" analysis, it probably doesn't matter.
103	4	(Line 2) Statement "April to October" should read "April through October".
117	2	The County has not decided to use the computer model for gravel mining management. The Board of Supervisors rejected the proposal.
121		...lists the data deficiencies which exist and recommends further studies which should be made. He agree wih the need for undated studies (particularly on the fishery) and further question the validity of some conclusions reached in this report without those further studies.

7-23

Thank you for the opportunity to comment on this report.

ROBERT F. BEACH
General Manager

RFB/ph

COMMENT LETTER 7

SONOMA COUNTY WATER AGENCY

M E M O R A N D U M

RUSSIAN RIVER BASIN STUDY - DRAFT INTERIM REPORT

TYPOGRAPHICAL ERRORS NOTED:

Page	Paragraph	
11	3	Big "Sulfur" Creek should read Big "Sulphur".
17	4	"wiers" should be "weirs".
18	4	"Sebastapol" should be "Sebastopol".
19	Table 1	"
55	4	"Agnecy" should be "Agency".
86	Last	7th line .- "nd" should he "and".
99	1	3rd line - "pools" should be "pool".
104	3	"scarse" should be "scarce"
A-6	5	"riparion" should be "riparian"
A-7	1	" " " "

COMMENT LETTER 7. Sonoma County Water Agency

7-1 Issue: Lake Mendocino Specifications

These corrections are included in Section II.B.1. of the Final Report.

7-2 Issue: Rohnert Park

Rohnert Park has been added to Figure 1 and Table 1 of the Final Report. Table 1 has also been amended to include preliminary data from the 1980 Census.

7-3 Issue: Sonoma County Flood Control

Section II.C.2. of the Final Report has been changed to include these corrections.

7-4 Issue: Inconsistency

The statements in Section II.C.2.a. of the Draft Report regarding channel improvement structures along Dry Creek have been changed in the Final Report. The channel works presently being constructed are addressing existing channel and bank erosion problems. Continuing monitoring of the Creek channel is aimed at detecting future problems should they develop.

7-5 Issue: Maintenance of Bank Stabilization Measures

Section II.C.2.b. of the Final Report has been rewritten removing misinformation regarding Sonoma County's maintenance of Corps-constructed bank protection measures along the Russian River. However, some clarification is called for regarding the selection of these measures.

The use of jacklines by the Corps for bank stabilization along the Russian was dictated by several factors. These works were installed between 1962 and 1972 as part of the Coyote Dam/Lake Mendocino project. The bank measures were not originally an authorized component of the project and their construction was funded from the project's operation and maintenance budget. As such, funds for these works were limited. Among the several bank stabilization measures evaluated, jacklines provided the greatest benefit to cost ratio.

Sonoma County's early concerns regarding the success of these jacklines in stabilizing the banks of the Russian River were addressed by the Corps during the early 1970's. Several jacklines were removed and others modified. At one bank protection site near Asti rip-rap was added to supplement the jacklines.

With regard to bank erosion just upstream of Geyserville Bridge, the Corps evaluated this problem under the provisions of Section 14 of the Flood Control Act of 1946. Section 14 authorizes emergency bank protection works to prevent flood damage to public facilities, if economically feasible. This feasibility could not be shown for the Geyserville Bridge site. This is stated in Section II.C.1.b. of both the Draft and Final reports. It should be noted that the integrity of Geyserville Bridge and associated State Highway 128 is to some degree a responsibility of the California Department of Transportation.

Along with Sonoma County, Mendocino County, the U.S. Fish and Wildlife Service and the Resources Agency of California have expressed the desire for expanded Federal involvement in evaluating bank erosion problems along the Russian River. For a discussion of this potential future involvement see the response to Comment No. 5-2.

7-6 Issue: Dry Creek Sedimentation Study

These references have been changed to reflect initiation in late 1980 of a special Corps study of sedimentation in the Dry Creek basin.

7-7 Issue: Salmonid Population Estimates

The estimates of anadromous fish populations included in the Basin Study Report are based on the best data available. The California Department of Fish and Game and the U.S. Fish and Wildlife Service, both of which reviewed the Draft Study Report, have indicated agreement with this statement. It is noted in Section III.A.2.c. of both the Draft and Final Reports that these data are about 10 years old and often incomplete.

Most parties concerned with the Russian River fisheries, both public and private, acknowledge that additional fisheries surveys and data are needed to determine the status of salmon and steelhead populations in the Russian River basin. This is noted in the Draft and Final Reports, Section V.G.

Current studies of fisheries resources in the Russian River basin were not advanced enough to warrant detailed discussion in the Final Report. The U.S. Fish and Wildlife Service in January 1982 provided some information on fisheries losses in the basin attributable to the construction of Coyote Dam, but no new data collection was involved in this effort. Sonoma County recently conducted an appraisal of what studies are needed to assess fish populations in the basin, but decided not to enter into any such studies.

7-8 Issue: Salmonid Habitat Losses

It has not been irrefutably determined that extensive losses of fish habitat have occurred in the Russian River due to summer dams. Section II.C.3.a. of the Draft and Final reports states that "... indications are that extensive losses of habitat, particularly steelhead habitat, occurred (in the basin) subsequent to 1962." The reports further state that the establishment of summer dams in the Russian River basin is only one of the factors contributing to these losses.

7-9 Issue: Vacation and Johnson Beach Fish Ladders

Section II.C.3.c. of the Final Report has been corrected to incorporate this information on the Johnson Beach and Vacation Beach fish ladders.

7-10 Issue: Sonoma County Water Supply Diversions

Section II.C.6. and other instances in the Final Report where Sonoma County's water supply diversions are mentioned have been corrected to include the Mirabel intake. Section II.C.6. has also been amended to include a discussion of municipal and agricultural water diversions as well as in-stream uses.

G-29 7-11 Issue: Warm Springs Dam Impacts

The purpose of these figures is to illustrate in general the effect of the Warm Springs project on flows in Dry Creek and the Russian River, not to present specific impacts of the project on these flows. The 1915 to 1964 period of record is sufficient for this purpose.

7-12 Issue: Coyote Dam Flow Release Agreement

Section II.C.6.b. of the Final Report has been changed to include the correct wording of the 1959 agreement.

7-13 Issue: Salmonid Population Estimates

It is agreed that additional fisheries surveys and data are needed to determine the status of salmonid populations in the Russian River basin. This is noted in the Draft and Final reports, Section V.G. However, it was felt the Russian River Basin Study Report would be incomplete without some recommendations for alternative ways to manage summer dams on the Russian. It was further felt these recommendations should consider, as much as possible, the economic impacts of the alternatives. An integral part of these impacts is the effect on commercial and recreational fishing.

The estimates of anadromous fish populations included in the Basin Study Report are based on the best data currently available. For a discussion of possible future fisheries studies in the Russian River basin, see the response to Comment No. 7-7.

7-14 Issue: Salmonid Population Estimates

See response to Comment No. 7-13.

7-15 Issue: Salmonid Population Estimates

See response to Comment No. 7-13.

7-16 Issue: Healdsburg Dam Fish Ladder

This correction has been made to Section III.A.3. of the Final Report.

7-17 Issue: Healdsburg Dam Fish Ladder

As illustrated in Appendix B (Anadromous Fish Life History Data) to the Draft and Final reports, the chronological life stage activities and other environmental parameters for shad are significantly different from those for steelhead and king and silver salmon. Thus there would be minimal competition between the species for common resources in the Russian River basin.

The U.S. Fish and Wildlife Service and the California Department of Fish and Game have indicated that significant fishery benefits could be realized from the re-establishment of a viable American shad population throughout the Russian River basin. American shad constitute a valuable and highly utilized fishery in many eastern U.S. rivers. Prior to construction of Healdsburg Dam shad were known to migrate a* far up-river as Ukiah.

RESPONSE LETTER 7

7-18 Issue: Healdsburg Dan Fish Ladder

After conversations with the Sonoma County Water Agency these estimates were updated in Section II.B.2.b. of the Final Report.

7-19 Issue: Healdsburg Dam Fish Ladder

See response to Comment No. 7-20.

7-20 Issue: Summer Dam Impacts

These references have been clarified in the Final Report.

7-21 Issue: Wohler Dam

Consideration of removal of Wohler Dam has been deleted from the Final Report.

7-22 Issue: Coyote and Warm Springs Dams Releases

Section III.C.1. of the Final Report has been changed to indicate the need to balance benefits against the costs to recreation, water supplies, etc. of increased releases from the Coyote or Warm Springs project for temperature control for salmonid production.

7-23 Issue: Sediment Transport Modeling

This correction has been made in Section V.A. of the Final Report.

COMMENT LETTER 8

CALIFORNIA TROUT

January 22, 1981 Colonel Paul Bazilwich, Jr. CE
District Engineer, U.S. Corps of Engineers
211 Main Street
San Francisco, CA 94105

Dear Colonel:

California Trout has reviewed the 1980 Draft Interim Report (DIR) of the Russian River Basin Study with some disappointment. The document is vague, replete with generalities we already know, and describes few specific problems or recommended solutions. Nevertheless we offer the following comments:

While the DIR covers many of the fishery habitat parameters and problems of the mainstem Russian River and Lower Dry Creek, the report fails to address adequately a proclaimed major "refined planning objective" (b, pg. 9) "To provide data on the environmental, economic and social impacts of small summer recreational dams established annually on the Russian River mainstem and tributaries, for use in future programs for managing these dams."
We wish to emphasize the word TRIBUTARIES here. On pg. 39 the DIR states, "California Department of Fish and Game data (table 6.) indicate that 84% of the basin's habitat is in the tributaries Thus, it appears that the largest contribution to anadromous fish production in the Russian River basin comes from the tributary system." For example, (pg. 31), ".... the majority of the small tributary dams are not (documented)" and the bulk of the 200 small dams are on these very tributaries.
In discussing the impact of small dams the DIR docs not acknowledge the fact that the vast majority of juvenile steelhead remain in the streams for two years O_1 'or sometimes three) before smolting
8-1 and thus are subject to many more hazards than salmon which remain for much shorter periods.
Appendix B (B-l) is vague on this point.

By focusing on the mainstem Russian and Lower Dry Creek the DIR missed the primary objective target by failing to adequately inventory spawning and rearing on habitat in actual use by
8-2 anadromous salmonids. Fish population inventories of both juvenile and adult salmonids are glaringly
absent, and it is noteworthy (pg. 37) that during summer months juvenile salmonids, mostly steelhead, are found in the headwaters of tributary streams.

Section 404 permit authority encompasses the entire Russian River, Austin, Mill g? Mark West, Maacama, Big Sulpher and Forsythe Creeks and the East Fork Russian. Serious questions arise, for
8-3 example, concerning the impact of the 32

COMMENT LETTER 8

summer dams on Austin Creek (Appendix F, Table II-2), a major salmonid spawning and rearing tributary. Juvenile salmonids here are trapped between dams and are extremely vulnerable to angling, yet angling is permitted by regulation. In our judgment, to optimize smolt production from depressed populations, these and similar dams on tributaries, and angling therein for summer "trout" (baby steelhead) should be stringently regulated if not prohibited. Attempts to negotiate this with local residents has met with varying result, and the California DF&G currently is studying the problem. We all need the result of that study.

Further detailed assessment of damage to habitat and fish from isothermal opora - lions, especially on Big Sulpher Creek is needed. Likewise, we have serious reservations concerning the fishery impacts from channelization. In some instances meanders may be highly desirable for fish and for anglers.

Angling is not considered in the DIR except briefly in relation to turbidity, yet a "fishery" by
8-5 definition consists for fish, habitat, and fishermen. Among other problems, heavy increases in
angling pressure can be expected if and when Warm Springs Dam Hatchery is successfully operated (which remains to be seen). Should this occur, native fish populations will be severely impacted and further decimated from their already precarious state. These native, naturally produced fish are our primary concern in these comments. The hatchery must be supplemental, not harmful.

Naturally produced, wild winter-run steelhead comprise the bulk of anadromous fish in the Russian
8-6 River drainage. They are prized sport fish of highest quality and are eagerly sought by anglers
despite obvious, tragic reduction in the runs. Prior to construction of Coyote Dam the Russian was, indeed, one of America's blue ribbon steelhead streams, world famous. Experienced anglers fully agree that the runs today are but a fraction of their former size. By comparison, silver salmon constitute a relatively minor resource while king salmon are completely foreign, a non-native species poorly adapted to this river system. Another non-native species, American Shad, became plentiful at one time but are today a mere remnant of their former abundance.

We believe the estimate of 57,000 spawning steelhead in the Russian River drainage (pg. 34) is a
8-7 gross over-estimate. There also is no documentable basis for the estimate of 6,000 steelhead using
Dry Creek. No scientific, acceptable fish population inventories, using modern techniques, have been done on either the mainstem or Dry Creek. There are no hard data to support these estimates. It is generally agreed that all North Coast steelhead and salmon populations have declined drastically over the past 20 years, but there are no firm figures, past or present, for the Russian River. Population figures for silver salmon (5500) and shad (11,000 to 22,000) also are highly questionable and have no reliable documentation. For estimates of silver salmon populations there were no carcass counts.

King salmon are not native to the Russian River (except for "strays") and all attempts by DF&G to
8-8 introduce them have failed. California Trout opposes the plan to devote extensive Warm Springs
Hatchery facilities to rear 1,000,000 king salmon. The 101. 5 miles of stream channel "used" by king salmon (Table 6.) is totally false, "Enhancing" the fishery by injecting this volume of hatchery fish into the system may have deleterious effects on naturally produced fish which, among other problems this

District Engineer, CE
1/22/81

page three

will create, will not be able to withstand the impact of intensified angling.

California Trout's major goal is the protection and restoration of wild salmonids and their natural habitat. Efforts toward this by various agencies should not be diverted by the operation of Warm Springs Hatchery. The basic importance of the tributary system in fish production, including the remains of Dry Creek, must always bc remembered and this habitat protected and restored by a program of long-range planning with adequate funding. Meanwhile, the success and ultimate impacts of the hatchery cannot be assessed for some years. Hatcheries never must be allowed to supplant or interfere with natural production potential.

8-9 Although "suitable" for spawning and rearing (pg. 40) are the 19 miles of river between Hopland and Coyote Dam actually used today by steelhead for spawning and rearing?

Shad runs may never be restored until all barriers are removed. With few exceptions (e.g. , the mere 11 shad in two months observed at Vacation beach Dam in 1973) the studies presented on
8-10 fish passage are based on estimates and established criteria rather than actual observations about the ability of downstream migrating juvenile shad and salmonids to pass some of the barriers, e.g. , Wohler Dam fishway. There is a dirth of hard data.

8-11 A problem entirely omitted from the DIR is the multiple, non-registered, non-metered water diversions from both the mainstem and tributaries. Neither the State Water Resources Control Board nor DWR have complete inventories of all
impact of these diversions on salmonids may he disastrous, but all agencies avoid this problem because of the possible social, economic and political implications. The Basin Study will be incomplete without investigation and measurement of all water diversions in the system.

Even though "the turbidity problems. . . .due to the inflow of highly turbid Eel River water....will not be addressed in this report," a timely reminder is appropriate: millions of taxpayers' dollars are being spent to study, mitigate and enhance a fishery in which angling has been impossible during much of
8-12 the winter steelhead season due to this turbidity. The major source of this unmitigated pollution is a poorly constructed USFS road along Corbin Creek in the Eel River drainage. Corbin Creek's watershed must be rehabilitated forthwith.

A value of $10.40 per angler-day for steelhead (Table 9) is extremely low. Today the average Russian River steelhead angler, driving from the Bay Area, would spend more than this on
8-13 gasoline alone. A modest motel room is not available for this amount. We also question the accuracy of the 5,062 steelhead catch which would be extraordinarily high today.

Dollar values of anadromous fishery habitat should be estimated in the Russian River Basin. Figures for this recently have been calculated and reported by USFS for several North Coast
8-14 watersheds. Total dollar value of the entire fishery would be much higher than those presented in the DIR if values of both fish and habitat are included.

District Engineer, CE
1/22/81
page four

Much detail is presented in Appendix F on habitat, habitat requirements and parameters; however there is a singular paucity of data on actual use of the habitat by salmonids. Fish population inventories are lacking, and the most crucial question of actual smolt production and escape is not addressed or quantified. For example, instream structures are listed and described but their impact on fish production and passage is not discussed or documented. No redd counts have been done in the mainstem or tributaries. Though Tables III-1.2, and 3
8-15 describe spawning habitat in the mainstem, no evidence is presented showing that spawning occurs here. "Potential" habitat in the mainstem and Lower Dry Creek is described whereas the most productive habitat, in the tributaries, is not addressed as to existing, observable, documented smolt production.

In summary, the DIR and Appendix F fail to adequately assess factual impacts facing natural production of anadromous salmonids and shad, the most important source of this valuable resource in the Russian River Basin.

Sincerely,

Richard H. May

Richard H. May
President

cc: RR Flyfishers, Inc.
DFG R 3

COMMENT LETTER 8. California Trout

8-1 Issue: Juvenile Steelhead

Section II.C.3.b. of the Final Report has been amended to include this information.

8-2 Issue: Fish Population Inventories

The estimates of anadromous fish populations included in the Basin Study Report are based on the beat data currently available. For a discussion of possible future fisheries studies in the Russian River basin, see the response to Comment No. 7-7.

For a discussion of why fish habitat in the Russian River tributaries was not studied in more detail during the Basin Study, see the response to Comment No. 4-6. Section V.C. of the Draft and Final reports notes that further studies of the resources of the Russian River basin should include assessment of fish populations and habitat in the tributary streams.

8-3 Issue: Summer Dams on Tributaries

Section II.C.3.b. of the Final Report has been amended to mention the possible impact on juvenile salmonids of numerous summer dams on the Russian River tributaries.

8-4 Issue: Geothermal Fish Impacts

It is agreed that further study of fish populations and habitat in the tributaries of the Russian River, including Big Sulphur Creek, is needed. This is noted in Section V.C. of the Draft and Final reports.

Regarding further studies of bank and channel stabilization along the Russian River, refer to the response to Comment No. 5-2. Any such new Corps study or studies would include assessment of fisheries impacts.

8-5 Issue: Native Fisheries

One goal of the Warm Springs fish hatchery is to provide mitigation for fish habitat losses attributable to the construction of Warm Springs Dam and Lake Sonoma. The hatchery will Also provide enhancement of the Russian River steelhead, king salmon and silver salmon populations. In no way is the hatchery intended to adversely affect the basin's native fish populations.

8-6 Issue: Native Fisheries

California Department of Fish and Game personnel have indicated that, according to conversations with long-time residents of the Russian River basin, king salmon were seen as far up-river as Coyote Valley in the 1920's and 30's. There are also indications that similar native king salmon populations exist or existed at one time in other northern California coastal streams such as the Garcia River and Ten-Mile River.

8-7 Issue: Fish Population Estimates

See responses to Comments Nos. 5-1, 7-7 and 7-13.

8-8 Issue: King Salmon

With regard to the history of king salmon in the Russian River basin, refer to the response to Comment No. 8-6. The figures on king salmon use of stream channel in the Russian River drainage were presented by the Department of Fish and Game in a 1972 report to the Federal Power Commission on the re-licensing of the Potter Valley powerhouse (see Table 6, Draft and Final Russian River Basin Study reports). For a discussion of the purposes of the Warm Springs fish hatchery, see the response to Comment No. 8-5.

8-9 Issue: Steelhead Habitat
It is not known how much of this area is presently used by steelhead for spawning and rearing.

8-10 Issue: American Shad

It is agreed that available data on fish passage at small dams on the Russian River is inadequate for in-depth assessment of the effectiveness of the fish passage structures. This is noted in the Draft and Final Reports, Section V.G.

8-11 Issue: Unregistered Water Diversions

A discussion of the problem of unmetered and unregistered water diversions in the Russian River basin has been added to Section II.C.6.a. of the Final Report. However, a survey and documentation of these diversions is beyond the scope of funds remaining for the Russian River Basin Study.

8-12 Issue: Eel River Diversions

Section III.C.1. of the Final Report has been changed to include a discussion of land use practices above Lake Pillsbury.

8-13 Issue: Steelhead Fishery Value

The value of $10.40 per angler-day used in the Basin Study report for steelhead sport fishing My not include all associated peripheral costs. This is noted in Section III.A.2.c. of the Final Report.

The Unit Day Value Method for evaluating recreation costs and benefits My not be as accurate as other methods noted in the Water Resources Council's Principles, Standards and Procedures for Planning Water and Related Land Resources ("Principles and Standards") in effect during the final stages of the Basin Study. The other methods noted in the Principles and Standards were the Travel Cost Method and the Contingent Valuation (Survey) Method. However, the Unit Day method still provides a basis for comparison of alternative resource management plans in the Russian River basin.

The estimated steelhead sport fishery catch noted in Table 9 of the Draft and Final reports is the best estimate currently available. For further discussion of this point see the response to Comment No. 7-7.

8-14 Issue: Fish Habitat Values

Analysis of the value of fish habitat in the Russian River basin may be a beneficial exercise. However, such values cannot be included with the unit day values used throughout the basin study to assess the basin's fishery recreation benefits. This would violate the guidelines of the Water Resources Council's Principles and Standards in effect during the final stages of the study. Re-computation of fishery benefits using habitat values is beyond the scope of funds remaining for the Russian River Basin Study.

8-15 Issue: Fish Habitat Inventories

A comprehensive inventory of current fish populations in the Russian River mainstem and its tributaries is the major requirement for accurate assessment of the basin's fishery resources. This data deficiency is noted in Section V.C. of both the Draft and Final reports. For discussion of possible future studies of the Russian River fisheries refer to the response to Comment No. 7-7.

The response to Comment No. 4-6 discusses the extent to which fish habitat in the Russian River tributary streams was addressed during the Basin Study. Section V.C. of the Draft and Final reports notes that any further studies of the resources of the Russian River basin should include assessment of fish populations and habitat in the tributary streams.

COMMENT LETTER 9

PACIFIC GAS AND ELECTRIC COMPANY

77 BEALE Street • SAN FRANCISCO. CALIFORNIA 94106 • (415) (sic) • TWX 910 (sic)

March 5, 1981

U.S. Army Corps of Engineers
San Francisco District
211 Main Street
San Francisco, CA 94105

Attention SPNED-PW (Russian River)

Gentlemen:

Subject: <u>Russian River Basin Study Draft Report</u>

Thank you for the opportunity to review your draft report. Our comments, listed below, are limited to those aspects of the report that relate to the Potter Valley Project.

9-1 <u>Page 33, Paragraph 4; Page 99, Paragraph 5; Page 100, Paragraph 1:</u>

The turbidity problem in the Russian River is not being studied as part of the Potter Valley Fisheries Study. Although, to our knowledge, there are no parties currently studying this problem, previous studies have been conducted. Two sources of turbidity information for the Russian River are: "Turbidity and Suspended Sediment Transport in the Russian River Basin, California," J.R. Ritter and W.M. Brown, USGS, 1971, and "Application for Certificate of Conformance with Water Quality Standards, Potter Valley Project" by P G and E, filed with the California Regional Water Quality Control Board, North Coast Region, in September, 1978. Should you wish to review these studies and are unable to obtain copies, please contact us.

<u>Page 37, Paragraph 6; Page 39, Paragraph 1-3; Page 4, Paragraph 4:</u>

Operation of the Potter Valley Project has increased flows in the Russian River since 1907. No mention is made concerning the beneficial effects that these flows have had on fisheries habitat in the Russian River.

9-2

<u>Page 39, Paragraph 5:</u>

Data from our Potter Valley Fisheries Study does <u>not</u> "suggest that up to 80 percent of
9-3 the spawning salmon used tributary streams as opposed to the mainstem." In fact, our data indicate that the mainstem is probably used more heavily than tributary streams.

COMMENT LETTER 9

If you have any questions regarding these comments, please, call Polly Boissevain, of my staff, at 781-4211, Extension 3077.

Sincerely,

RESPONSE LETTER 9

COMMENT LETTER 9. Pacific Gas and   r

9-1 Issue: Turbidity In the Russian River

The Misunderstanding regarding investigation of turbidity in the Russian River during the Potter Valley Fisheries Study has been corrected in the Final Report (Sections II.C.3.a. and III.C.1.).

9-2 Issue: Eel River Diversions

Section II.C.3.a. of the Final Report has been changed to mention the likelihood that the Eel River diversions made more spawning and nursery habitat available in the east fork of the Russian River and the mainstem downstream of the confluence.

9-3 Issue: Potter Valley Fisheries Study

Section II.C.3.a. of the Final Report has been changed to correct this error.

COMMENT LETTER 10

DUNCAN MILLS CALIFORNIA
February 6, 1981

Paul Bazilwich, Jr., Colonel
U.S. Army Corps of Engineers
San Francisco District
ATTN: SPNED-PW (Russian River)
211 Main Street
San Francisco, CA 94105

Dear Sir:

10-1 Concerning your Draft Report of the Russian River Area Basin Study... generally, it is well done. Our compliments!

However, we question your conclusion concerning the mouth of the River. On page 118 of the draft report it reads:

"Construction or structural improvements providing year around safe passage through the mouth of the Russian River has not been proven to be in the Federal interest. Improving fish passage through the preservation of an open channel entrance would have little or no effect on the Russian River Fishery. Therefore, no further studies of maintaining year around free passage through the mouth of the river are necessary at the Federal level at this time."

Agreed, there are many determining factors involved with fish migration. But to conclude that a closed river mouth has "little or no effect" on fishery we believe requires more study!

We, the Russian River Sportsmen's Club, Inc., ask that a new study of the river mouth be initiated for the 1981 fiscal year.

Sincerely,

Darrell E. Sukovitzen
President, Russian River Sportsmen's Club, Inc.

Executive Committee: Margaret Porter, Amy Ryan, Dorothy Watson, Bill Porter

Board of Directors: Russ Watson, David Waterman, Linda Pallari, Bonnie Fecteau, [illegible], Jay Dry, Paul Fecteau

Representing all the Members of the R.R.S.C., Inc.

RESPONSE LETTFR 10

COMMENT LETTER 10. Russian River

10-1 Issue: Mouth of the Russian River

The mouth of the Russian River may not always provide adequate fish passage. However, the Corps is of the opinion that addressing this issue would be inadvisable at the present time because of serious economic and environmental considerations. Given the rising costs of materials and labor, it is highly unlikely construction and maintenance of a year-around open channel at the mouth would be economically feasible. Keeping the mouth open would also raise major environmental questions, considering the nature of the off-shore structures that would be required and their potential impacts on the Russian River estuary.

COMMENT LETTER 11

Sonoma County TOMORROW

p. o. box 3121 santa rosa california 95402

February 7, 1981

Col. Paul Bazilwich, Jr., District Engineer Corps of Engineers 211 Main Street San Francisco, CA 94105

Dear Col. Bazilwich

The Russian River Basin Study serves a valuable purpose by furnishing background data and focusing attention on unresolved problems in the Russian River area.

The most serious problem pointed out in the study is degredation of the fishery from the construction of summer dams. Most of these dams are on the tributaries, where fish habitat is located. Which of these dams should be eliminated and alternative operations of those allowed to remain should receive immediate attention by the Sonoma County Water Agency Board of Directors/Board of Supervisors, with public hearings. Also the operation of snail dams on the win river, such as Healdsburg Dam and Wohler.

A serious problem not discussed in the report on the Corps' study is the completely unregulated and unregistered water diversions from both the Russian River main stem and its tributaries. These
11-1 diversions (some or many without a permit?) are reducing the habitat for fish and could cause water shortages in the event of a drought, or early triggering of Warm Springs Dam water. The diversions need to be measured and regulated. This matter also should receive attention from the SCWA/Bd. of Supervisors.

Although the Corps postpones correction of turbidity in the Russian River from diversions from the Eel until the enlargement of Coyote Dam is studied, the source of this turbidity should be recognized and action started to correct the problem — poorly constructed roads along Corbin Creek in the Eel River drainage for timbering.

Coordination of releases from Coyote Dam and Warm Springs Dam to ensure adequate water in the middle reaches of the Russian River seems to be progressing satisfactorily between SCWA and Fish and Game. However, we believe there should be public review of any proposed agreement (or alternatives) before a contract is signed.

A large interested public is concerned about the management of the Russian River resources and full public involvement is warranted in correcting the past problems. Sonoma County Tomorrow is one of these groups long Involved in water resource issues. We appreciate the opportunity to comment on the Corps' Basin Study and hope the Board of Directors of the Water Agency and Corps will follow up to correct present problems, with interested groups and persons Informed and given the opportunity to participate.

Sincerely, Iva Warner
Iva Warner, Executive Director

copies to: SCWA and *FK*

RESPONSE LETTER 11

COMMENT LETTER 11. Sonoma County Tomorrow

11-1 Issue: Unregistered and Eel River Diversions

A discussion of the problem of unmetered unregistered water diversions in the Russian River basin has been added to Section II.C.6.a. of the Final Report. Section III.C.1. of the Final Report has been changed to include a discussion of land use practices above Lake Pillsbury.

COMMENT LETTER 12

Final Public Meeting Attendees

The following comments were paraphrased from statements made at the final public meeting on the Northern California Streams Investigation - Russian River Basin Study. The meeting was held on January 8, 1981 in Santa Rosa, California. The complete transcript of these statements is included in the Northern California Streams Investigation - Russian River Basin Study Record of Public Meeting: January 8, 1981. This document was published separately by the Corps of Engineers San Francisco District and released in August 1981.

The purpose of this meeting was to discuss the draft final report on the study and to receive public comments. The attendees to the meeting raised several questions regarding the study. Some of these were answered at the meeting while others are included in the correspondence discussed elsewhere in this appendix. The following comments were not specifically addressed at the meeting and did not appear in written statements reproduced in this appendix.

William Johnson, Citizens for Community Improvement

12-1 The Russian River Basin Study did not adequately address the issue of bank stabilization problems along the Russian River, including areas [illegible] bank works have degraded.

12-2 Sedimentation at the mouth of the [illegible] meandering and bank erosion along the Russian River estuary. Therefore the channel through the mouth is not always adequate in terms of flow capacity.

Lyle Maritsen, Monte Rio Recreation and Park District

12-3 The Final Report on the Russian River Basin Study should include a discussion of the optimal design of a summer dam and an associated fish passage device.

Iva Warner, Sonoma County Tomorrow

12-4 The final report should include discussion of turbidity problems in the Russian River due to the design of Coyote Dam and diversions of turbid Eel River water into the east fork of the Russian River. The final report should also assess the fishery in the tributaries of the Russian River.

RESPONSE LETTER 12

COMMENTS: Final Public Meeting Attendees

12-1 Issue: Bank Stabilization

See response to Comment No. 5-2.

12-2 Issue: Mouth of the Russian River

The mouth of the Russian River may not always provide a channel adequate to prevent flooding, meandering and bank erosion along the Russian River estuary. However, the Corps is of the opinion that addressing this issue is inadvisable at the present time (see the response to Comment No. 10-1).

12-3 Issue: Summer Dam Design

Information on the design of these structures would best be obtained from the appropriate State and Federal agencies with expertise in fish and wildlife management in the Russian River basin. These include the California Department of Fish and Game and the U.S. Fish and Wildlife Service.

12-4 Issue: Russian River Turbidity and Tributary Fish Habitat

[illegible] discussed in Sections II.C.3.a., [illegible] and III.C.1. of the Draft and Final reports. It is noted in Sections II.C.3.a. and III.C.1. that should any studies be done on expanding Lake Mendocino, consideration will be given to installing a multiple outlet structure at Coyote Dam to reduce turbid water discharges. Section III.C.1. of the final report has also been amended to include a discussion of land use practices above Lake Pillsbury.

The importance of fish habitat in the tributaries to the Russian River is recognized in Sections II.C.3.a., II.C.4.a. and III.B.6. of the Draft and Final reports. For a discussion of why fish habitat in the Russian River tributaries was not studied in more detail during the Basin Study, see the response to Comment No. 4-6.

Streams Investigation

DA, South Pacific Division, Corps of Engineers, 630 Sansome Street,
Room 1216, San Francisco, California 94111 21 April 1982

TO: CDR USACE (DAEN-CWP) WASH DC 20314

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

HOMER JOHNSTONE
Brigadier General, USA
Commanding

Mendocino County Water Agency
Courthouse
Ukiah CA 95482
(707)463-4589