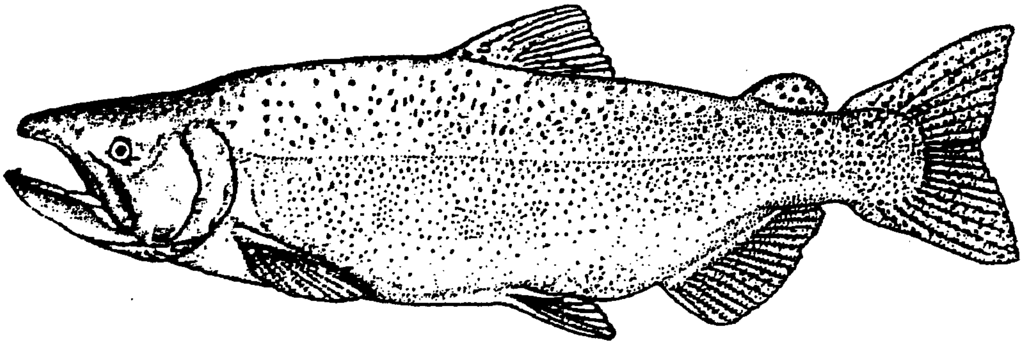
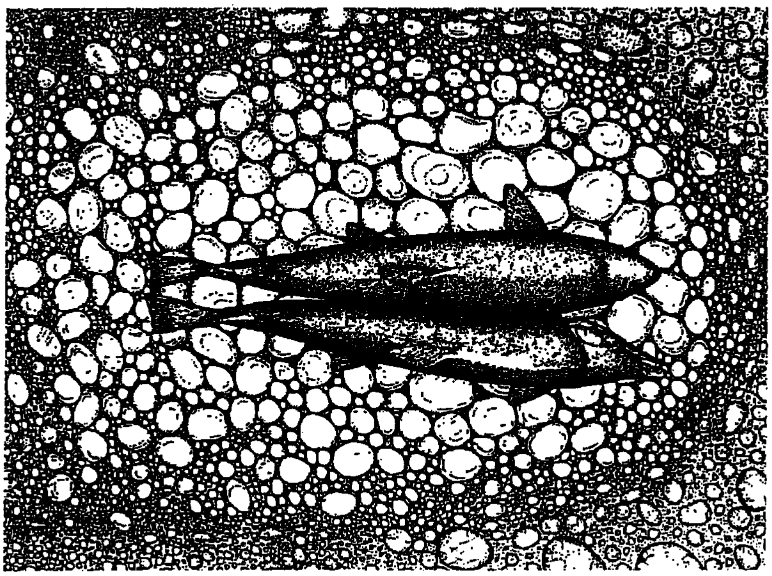
FLOW-HABITAT RELATIONSHIPS FOR STEELHEAD AND FALL, LATE-FALL AND WINTER-RUN CHINOOK SALMON SPAWNING IN THE SACRAMENTO RIVER BETWEEN KESWICK DAM AND BATTLE CREEK





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CVPIA INSTREAM FLOW INVESTIGATIONS
SACRAMENTO RIVER BETWEEN KESWICK DAM AND BATTLE CREEK
STEELHEAD AND FALL, LATE-FALL AND WINTER-RUN CHINOOK SPAWNING

PREFACE

The following is the draft final report for the U. S. Fish and Wildlife Service's investigations on salmonid spawning habitat in the Sacramento River between Keswick Dam and the confluence of Battle Creek. These investigations are part of the Central Valley Project Improvement Act (CVPIA) Instream Flow Investigations, a 7-year effort which began in February, 1995. Title 34, Section 3406(b)(1)(B) of the CVPIA, P.L. 102-575, requires the Secretary of the Interior to determine instream flow needs for anadromous fish for all Central Valley Project controlled streams and rivers, based on recommendations of the U. S. Fish and Wildlife Service after consultation with the California Department of Fish and Game (CDFG). The purposes of these investigations are to provide scientific data to the U. S. Fish and Wildlife Service Central Valley Project Improvement Act Program to assist in developing such recommendations for Central Valley rivers.

To those who are interested, comments and information regarding this report are welcomed. Written comments or information can be submitted to:

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INTRODUCTION

In response to substantial declines in anadromous fish populations, the CVPIA requires the doubling of the natural production of anadromous fish stocks, including the four races (fall, late-fall, winter, and spring runs) of chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*Oncorhynchus mykiss*), and white (*Acipenser transmontanus*) and green (*Acipenser medirostris*) sturgeon. For the Sacramento River, the CVPIA Anadromous Fish Restoration Plan calls for October through April releases from Keswick Dam ranging from 3,250 to 5,500 cfs, with the recommended flow varying with the October 1 carryover storage in Shasta Reservoir (U. S. Fish and Wildlife Service 1995a). In December 1994, the U. S. Fish and Wildlife Service prepared a study proposal to identify the instream flow requirements for anadromous fish in certain streams within the Central Valley of California, including the Sacramento River. The purpose of this study was to produce models predicting the physical habitat availability for fall, late-fall and winter-run chinook salmon and steelhead trout spawning over a range of stream flows. The results of this study are intended to support or revise the flow recommendations above.

To develop a flow regime which will accommodate the habitat needs of anadromous species inhabiting streams it is necessary to determine the relationship between streamflow and habitat availability for each life stage of those species. We are using the models and techniques contained within the Instream Flow Incremental Methodology (IFIM) to establish these relationships. The IFIM is a habitat-based tool developed by the USFWS to assess instream flow problems (Bovee and Bartholow 1996). The decision variable generated by the IFIM is total habitat for each life stage (fry, juvenile and spawning) of each evaluation species (or race as applied to chinook salmon). Habitat incorporates both macro- and microhabitat features. Macrohabitat features include longitudinal changes in channel characteristics, base flow, water quality, and water temperature. Microhabitat features include the hydraulic and structural conditions (depth, velocity, substrate or cover) which define the actual living space of the organisms. The total habitat available to a species/life stage at any streamflow is the area of overlap between available microhabitat and suitable macrohabitat conditions.

The Physical Habitat Simulation (PHABSIM) component of the IFIM, which was used for this modeling, is a collection of computer models designed to quantify the amount of habitat available for different life stages of evaluation species over a range of streamflows. PHABSIM will produce results based on all of the macro- and microhabitat features listed above except water quality and temperature. These features must be incorporated into the total habitat model separately. The results from this report could be combined together with water temperature to produce total spawning habitat in a network analysis, and run on a time series of flows from alternative operational flow regimes to evaluate the effects of the regimes on salmonid spawning habitat in the Sacramento River. Alternatively, the results from this report could be used as one of the inputs to the SALMOD salmonid population model (Kent 1999) to assess the effects of alternative flow regimes on salmonid production. For fall-run chinook salmon, the above analyses will also require the results of our ongoing modeling of fall-run spawning habitat downstream of Battle Creek.

METHODS

Study Site Selection

We have divided the Sacramento River study area into six stream segments (Figure 1), based primarily on hydrology, and secondarily on reservoirs and channel morphometry: Grimes to Colusa (Segment 1); Deer Creek to Red Bluff Diversion Dam (Segment 2); above Lake Red Bluff to Battle Creek (Segment 3); Battle Creek to Cow Creek (Segment 4); Cow Creek to the Anderson-Cottonwood Irrigation District (ACID) Dam (Segment 5); and ACID to Keswick (Segment 6). Segment 1 addresses green and white sturgeon, while the other segments address chinook salmon and steelhead trout. The percentage of the different races of chinook salmon spawning in each segment, based on CDFG aerial redd survey data for 1989-1994, are given in Table 1.

Table 1
Distribution of Fall, Late-fall and Winter-run Chinook Salmon Spawning, 1989-1994

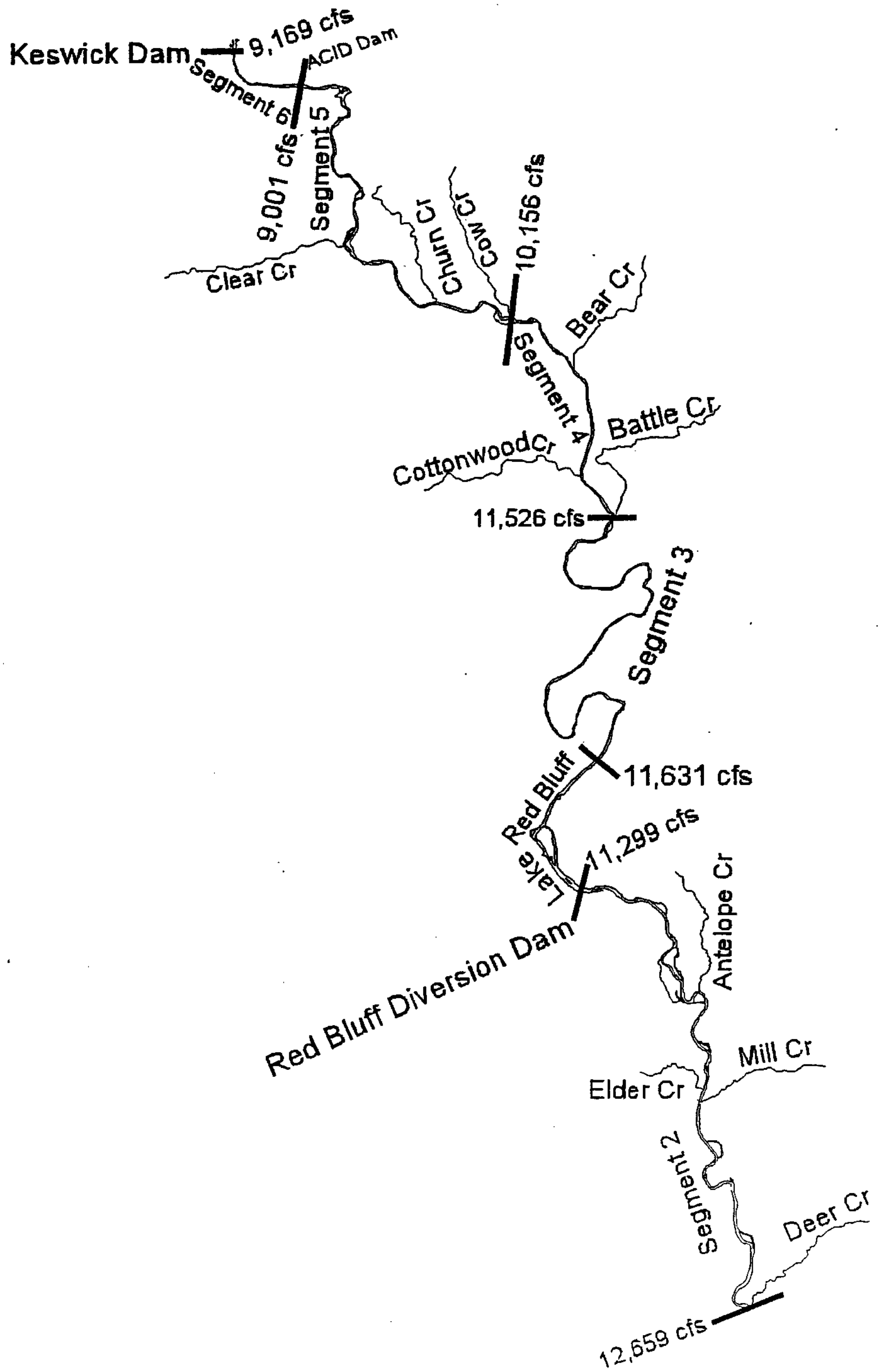
Segment	Fall-run	Late-fall-run	Winter-run
6	8%	24%	2%
5	35%	51%	80%
4	12%	8%	3%
3	15%	7%	9%
2	23%	8%	6%

We placed two sites in Segment 4 and three sites each in Segments 5 and 6. Sites were placed in areas with the heaviest spawning use, based on aerial redd survey data for 1989-1994. Details on study site selection are given in U. S. Fish and Wildlife Service 1999.

Transect Placement

We placed a total of eleven transects in the two sites in Segment 4, a total of nineteen transects in the three sites in Segment 5 and a total of four transects in the three sites in Segment 6. Details on transect placement are given in U. S. Fish and Wildlife Service 1999.

Figure 1
Sacramento River Stream Segments[1]



[1] Flows are the average flows for the period October 1974 to September 1993 at the top of each segment.

Hydraulic and Structural Data Collection

The data collected on each transect included: 1) water surface elevations (WSELs), measured to the nearest 0.01 foot at a minimum of three significantly different stream discharges using standard surveying techniques (differential leveling); 2) wetted streambed elevations determined by subtracting the measured depth from the surveyed WSEL at a measured flow; 3) dry ground elevations to points above bankfull discharge surveyed to the nearest 0.1 foot; 4) mean water column velocities measured at a mid-to-high-range flow at the points where bed elevations were taken; and 5) substrate classification at these same locations and also where dry ground elevations were surveyed. Table 2 gives the substrate codes and size classes used in this study. Details on hydraulic and structural data collection are given in U. S. Fish and Wildlife Service 1999.

Table 2
Substrate Descriptors and Codes

Code	Type	Particle Size (inches)
0.1	Sand/Silt	< 0.1
1	Small Gravel	0.1 - 1
1.2	Medium Gravel	1 - 2
1.3	Medium/Large Gravel	1 - 3
2.3	Large Gravel	2 - 3
2.4	Gravel/Cobble	2 - 4
3.4	Small Cobble	3 - 4
3.5	Small Cobble	3 - 5
4.5	Medium Cobble	4 - 5
4.6	Medium Cobble	4 - 6
6.8	Large Cobble	6 - 8
8	Large Cobble	8 - 12
9	Boulder/Bedrock	> 12

Habitat Suitability Criteria (HSC) Development

We attempted to locate fall, late-fall and winter-run chinook salmon redds in shallow and deep water. We searched for shallow redds on foot and by boat. For all three races of chinook salmon, all of the active redds (those not covered with periphyton growth) within a given mesohabitat unit were measured. Data for shallow redds were collected from an area adjacent to the redd which was judged to have a similar depth and velocity as was present at the redd location prior to redd construction (Gard 1998). This location was generally about two to four feet upstream of the pit of the redd; however it was sometimes necessary to make measurements at a 45 degree angle upstream, to the side, or behind the pit. The data were almost always collected within six feet of the pit of the redd. Depth was recorded to the nearest 0.1 ft and average water column velocity was recorded to the nearest 0.01 ft/s. Measurements were taken with a wading rod and a Marsh-McBirney[R] model 2000 velocity meter or a Price-AA velocity meter equipped with a current meter digitizer. Substrate was visually assessed for the dominant particle size range (i.e., range of 1-2") at three locations: 1) in front of the pit; 2) on the sides of the pit; and 3) in the tailspill. Substrate embeddedness data were not collected because the substrate adjacent to all of the redds sampled was predominantly unembedded.

Location of redds in deep water was accomplished by boat, from the surface visually in 1995 and 1996, using SCUBA divers in 1996, and using underwater video equipment starting in 1997. Water visibility during measurements was at least five feet. The underwater video equipment consists of two cameras mounted on a 75 pound bomb at angles of 45 and 90 degrees. The 75 pound bomb is raised and lowered from our boat using a winch. Two monitors on the boat provide the views from the cameras. A calibrated[1] grid on the 90 degree camera monitor is used to measure the substrate. Base aerial photos provided by CDFG showing the areas where winter-run chinook salmon redds have been observed in past years were used in locating the primary mesohabitat units where surveys were conducted. When searching for redds in deep water using underwater video, a series of parallel runs spaced approximately 50 feet apart in an upstream direction were made within a mesohabitat unit with the boat. After locating a redd in deep water, substrate size was measured using underwater video directly over the redds. Depth and water velocity were measured over the redds using a Price-AA velocity meter attached to a bomb/cable/winch assembly in 1995, and with an Acoustic Doppler Current Profiler (ADCP) starting in 1996. Starting in 1997, the location of all redds (both in shallow and deep water) was recorded with a Global Positioning System (GPS) unit, so that we could ensure that redds were not measured twice[2].

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[1]The grid was calibrated so that, when the camera frame was one foot off the bottom, the smallest grid corresponded to a two-inch substrate, the next largest grid corresponded to a four-inch substrate, etc.

[2] We concluded that redds had been measured twice if all of the following criteria were met: 1) the distance between the redds was less than 13 feet; 2) the depths differed by less than 0.3 feet; 3) the velocities differed by less than 0.5 ft/s; and 4) the substrate was the same.

A technique to adjust depth habitat utilization curves for spawning to account for low availability of deep waters with suitable velocity and substrate (Gard 1998) was applied to fall-run, late-fall-run and winter-run chinook salmon. The technique begins with the construction of multiple sets of HSC, differing only in the suitabilities assigned for optimum depth increments, to determine how the available river area with suitable velocities and substrates varies with depth. Ranges of suitable velocities and substrates are determined from the velocity and substrate HSC curves, with suitable velocities and substrates defined as those with HSC values greater than 0.5. A range of depths is selected for each run, starting at the depth at which the initial depth of HSC reached 1.0, through or just beyond the greatest depth at which there were redds or available habitat. A series of HSC sets are constructed where: (1) all of the sets have the same velocity and substrate HSC curves, with values of 1.0 for the suitable velocity and substrate range with all other velocities and substrates assigned a value of 0.0; and (2) each set has a different depth HSC curve. To develop the depth HSC curves, each HSC set is assigned a different one-foot depth increment within the selected depth range to have an HSC value of 1.0, and the other one-foot depth increments and depths outside of the depth range a value of 0.0 (e.g., 3-4' depth HSC value equal 1.0, < 3' and >4' depths HSC value equals 0.0 for a depth increment of 3-4'). Each HSC set is run in through the *RHABSIM* (Riverine Habitat Simulation, Payne and Associates) program using the calibrated hydraulic decks for all study sites at which HSC data were collected for that run. The resulting habitat output is used to determine the available river area with suitable velocities and substrates for all one-foot depth increments.

To modify the HSC depth curves to account for the low availability of deep water having suitable velocities and substrates, a sequence of linear regressions is used to determine the relative rate of decline of use versus availability with increasing depth. Habitat use by spawning chinook salmon is defined as the number of redds observed in each depth increment for each run. Availability and use are standardized by computing relative availability and use, so that both measures would have a maximum value of 1.0. Relative availability and use are calculated by dividing the availability and use for each depth increment by the largest value of availability or use. To produce linearized values of relative availability and use at the midpoints of the depth increments (i.e., 3.5' for the 3-4' depth increment), we use linear regressions of relative availability and use versus the midpoints of the depth increments. Linearized use is divided by linearized availability for the range of depths where the regression equations predict positive relative use and availability. The resulting use-availability ratio is standardized to that the maximum ratio is 1.0. To determine the depth at which the depth HSC would reach zero (the depth at which the scaled ratios reach zero), we used a linear regression with the scaled ratios versus the midpoint of the depth increments.

fall-run

Surveys for shallow and deep fall-run chinook salmon redds were conducted on October 23 to November 2, 1995, October 28 to November 25, 1996, November 6 to 20, 1997, and October 25 to November 4, 1999, to collect depth, velocity and substrate data. Sacramento River flows (releases from Keswick Reservoir) averaged 5,000 cfs ± 5% from October 10 through November 2, 1995; 5,350 cfs ± 7.5% from October 11 through November 25, 1996; 4,492 ± 10% from October 9 through November 20, 1997; and 6,107 cfs ± 4% from October 7 through November 4, 1999 (Figure 2). Since few fall-run salmon had started constructing redds prior to October 11 each year, these steady flow conditions ensured that the measured depths and velocities were likely the same as those present at the time of redd construction. In addition, many of the measured redds still had adult salmon holding nearby, providing further evidence of recent redd construction. In contrast, only limited fall-run chinook salmon spawning data were collected in 1998, and the 1998 data were not used for criteria development, because releases from Keswick Dam ranged from 5,989 to 14,727 cfs from October 9 through November 20, 1998.

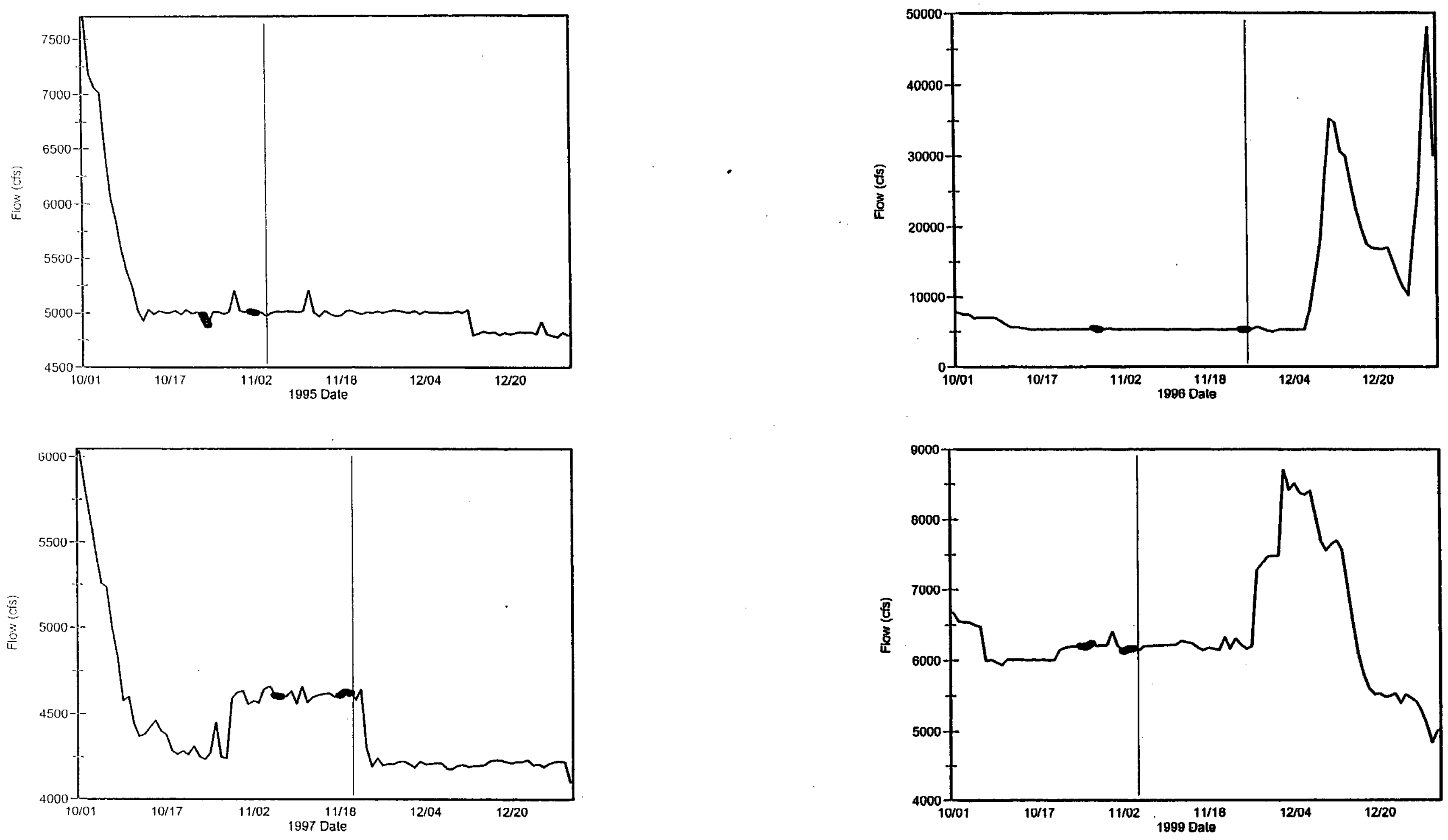
Overall, we collected HSC data on a total of 437 fall-run chinook salmon redds. We spent an equal number of days sampling in shallow (less than 3 feet) and deep areas for our overall fall-run chinook salmon spawning HSC data collection. Thirty-four mesohabitat units were sampled (six Bar Complex (BC) riffles, four BC Runs, two BC Glides, one BC Pool, four Flat Water (FW) Runs, three FW Riffles, ten FW Glides, one FW Pool, one Side Channel (SC) riffle, one SC Run and one Boulder Run). The HSC data had depths ranging from 0.5 to 13.8 feet, velocities ranging from 0.32 to 5.79 ft/s, and substrate sizes ranging from 1-2 inches to 4-6 inches. Based on the criteria in Footnote 2, we concluded that one fall-run redd had been measured twice. We calculated the depth and velocity for this redd as the average of the two measurements.

Fall-run chinook salmon HSC for depth and velocity were developed by calculating frequency distributions from the data collected in 1995, 1996, 1997 and 1999 and input into the PHABSIM suitability index curve development program (CURVE). The HSI (Habitat Suitability Index) curves were then computed using exponential smoothing. The curves generated were exported into a spreadsheet and modified by truncating at the slowest/shallowest end, so that the next shallower depth or slower velocity value below the shallowest observed depth or the slowest observed velocity had a SI value of zero; and eliminating points not needed to capture the basic shape of the curves.

Substrate criteria were developed by: 1) determining the number of redds with each substrate code (Table 2); 2) calculating the proportion of redds with each substrate code (number of redds with each substrate code divided by total number of redds); and 3) calculating the HSI value for each substrate code by dividing the proportion of redds in that substrate code by the proportion of redds with the most frequent substrate code.

For fall-run, suitable velocities were between 0.93 and 2.66 ft/s, while suitable substrates were 1-3 to 3-5 inches in diameter (i.e., substrate codes 1.3, 2.3, 2.4, 3.4 and 3.5). The initial HSC showed suitability rapidly decreasing for depths greater than 1.75 feet. This effect was likely due to the low availability of deeper water in the Sacramento River with suitable velocities and substrates rather than a selection by fall-run salmon of only shallow depths for spawning. Subsequently, the depth ranges

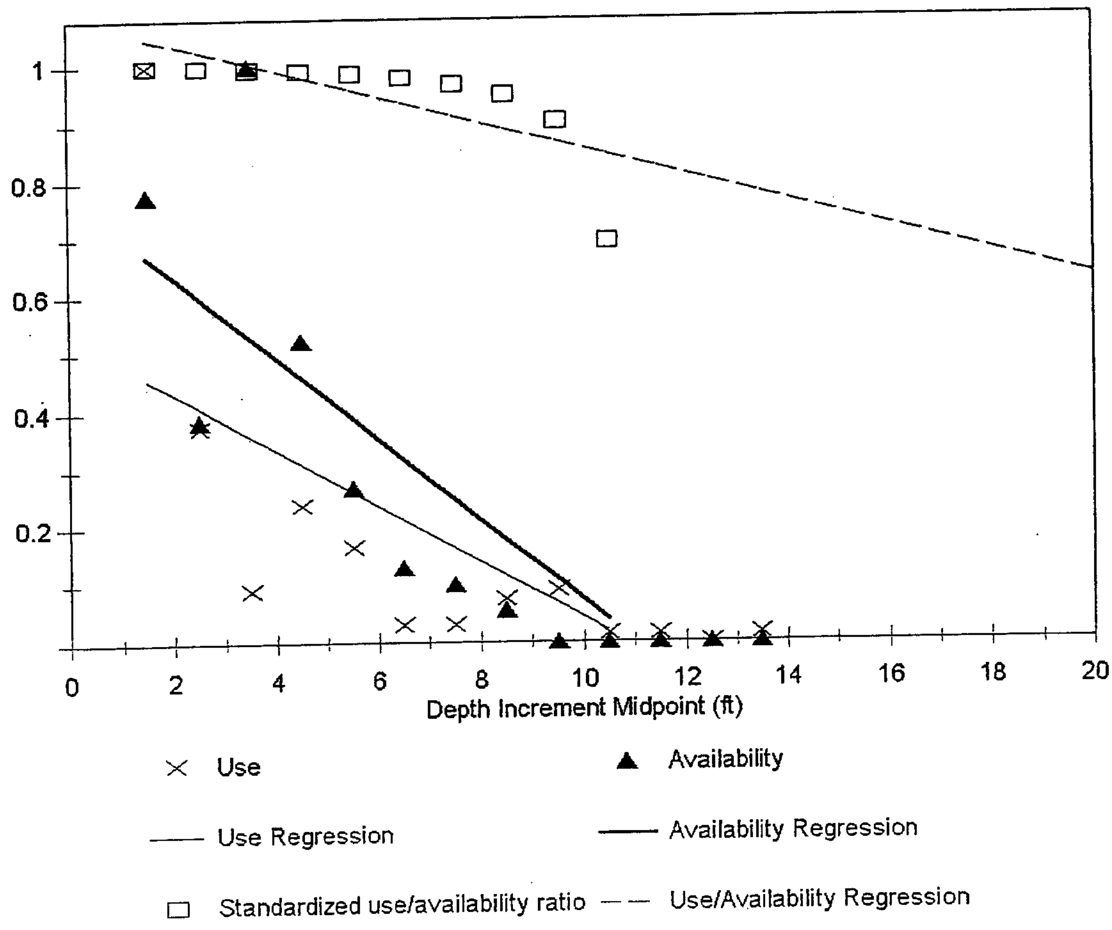
Figure 2
1995 to 1997 and 1999 Keswick Releases During Fall-run Spawning[3]



[3] The thicker lines show the sampling periods, while the vertical line shows the end of the sampling period.

selected for the depth correction were 1 to 14 feet. Availability data was determined using the output of the calibrated hydraulic decks for the seven spawning habitat modeling sites at which HSC data were collected, while redd data from these seven sites were used to assess use. The results of the initial regressions showed that use dropped with increasing depth, but not quite as quickly as availability (Figure 3). The result of the final regression was that the scaled ratio reached zero at 48 feet; thus, the fall-run depth criteria were modified to have a linear decrease in suitability from 1.0 for the greatest depth in the original criteria which had a suitability of 1.0, to a suitability of 0.0 at 48 feet.

Figure 3
Relations Between Relative Availability and Use and Depth for Fall-run[4]



[4] Points are relative use, relative availability, or the standardized ratio of the linearized use to linearized availability. Lines are the results of the linear regressions of the depth increment midpoint versus relative availability, relative use, and the standardized ratio of linearized use to linearized availability.

The final Sacramento River fall-run chinook salmon spawning HSC are shown in Figures 4 to 6 and Appendix A.

Figure 4
Fall-run Chinook Salmon HSI Curve for Depth

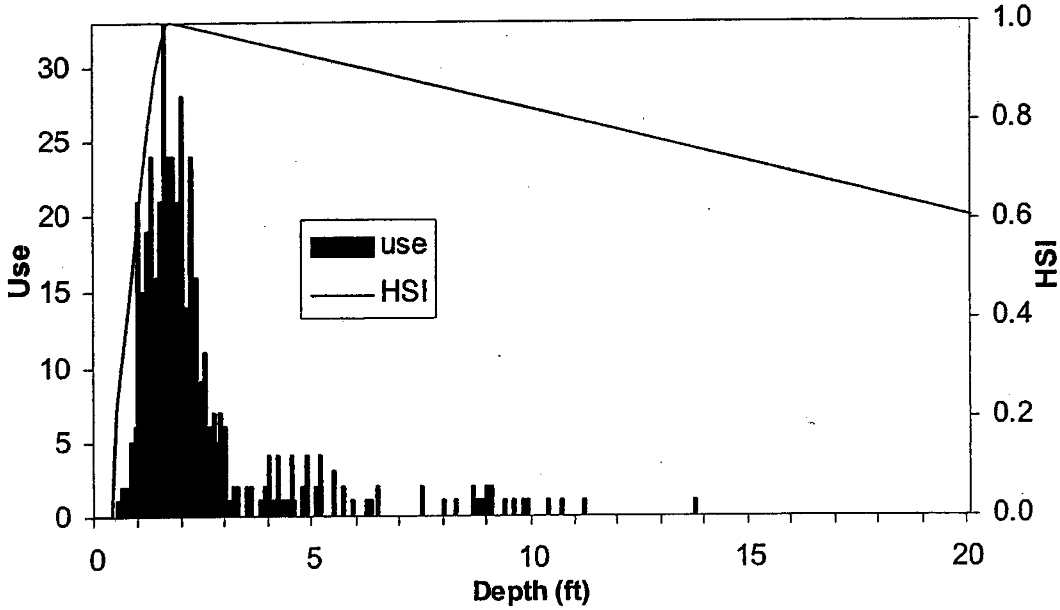


Figure 5
Fall-run Chinook Salmon HSI Curve for Velocity

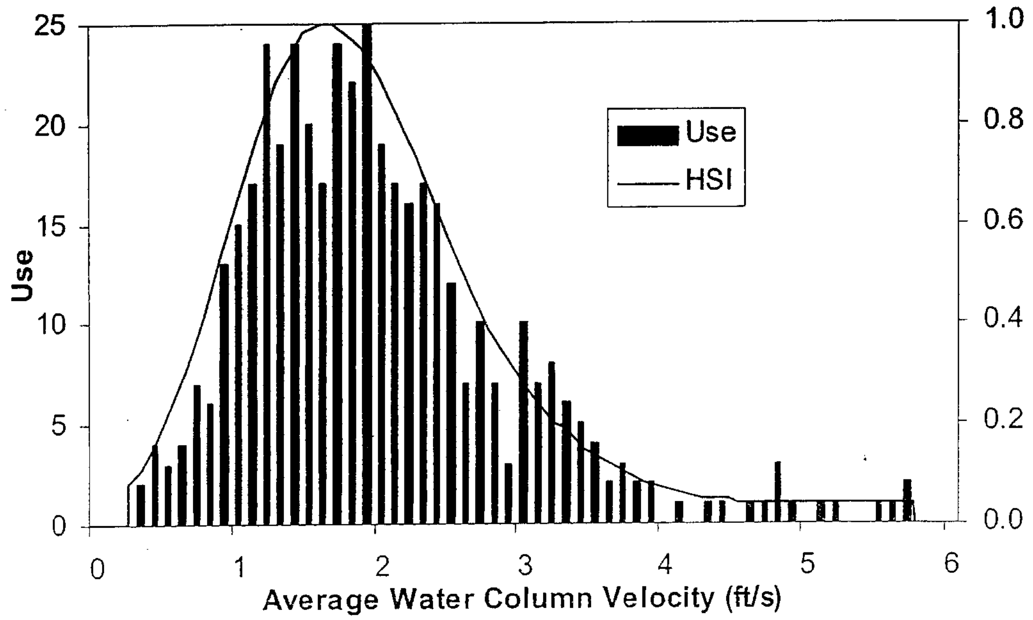
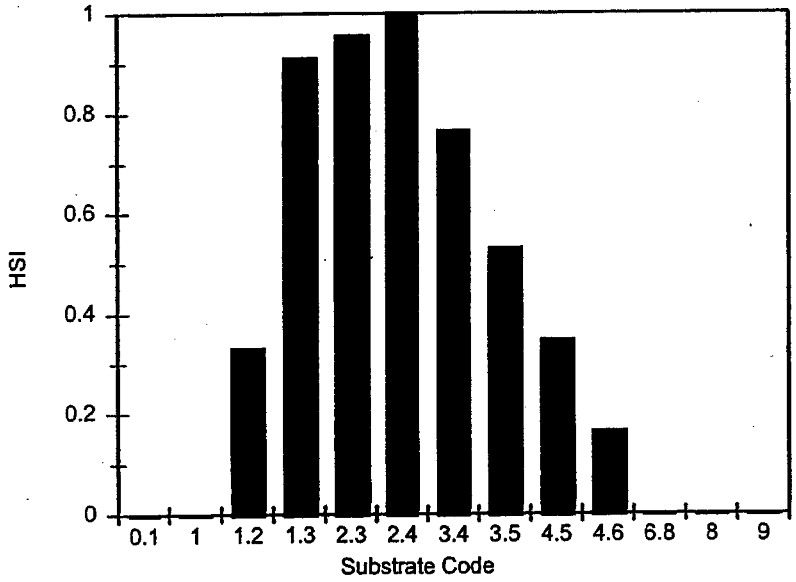


Figure 6
Fall-run Chinook Salmon HSI Curve for Substrate

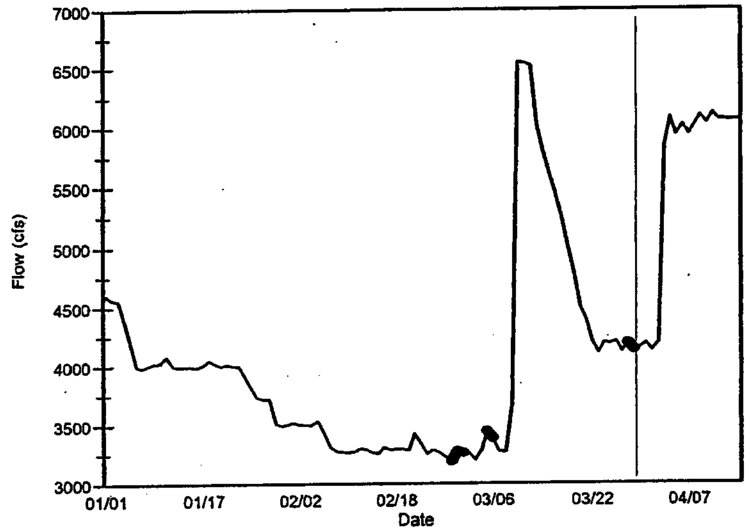


late-fall-run

We were unable to collect late-fall chinook salmon HSC data in 1996 through 2000 due to high turbidity and widely fluctuating flows (5,000 to 55,000 cfs in 1996, 5,080 to 50,274 cfs in 1997, 5,831 to 55,079 cfs in 1998, 5,301 to 29,860 cfs in 1999 and 3,990 to 49,331 cfs in 2000) during the spawning period of this race (from mid-January through mid-April). Surveys for shallow and deep late-fall-run chinook salmon redds were conducted on February 27 to March 29, 2001. The data on all but three redds was collected from February 27 to March 6. Sacramento River flows (releases from Keswick Reservoir) averaged 3,577 cfs, ranging from 3,187 to 4,080 cfs, from January 6 through March 6, 2001. Since few late-fall-run salmon had started constructing redds prior to January 6, these steady flow conditions ensured that the measured depths and velocities were likely the same as present at the time of redd construction. In contrast, flows from March 6 to 29, 2001, ranged from 3,267 to 6,546 cfs (Figure 6), adding a measure of uncertainty to the limited data collected on March 29, 2001, since we can not be certain that the depths and velocities measured were similar to those during redd construction. Due to the small sample size, all of the measurements were used for criteria development.

We collected HSC data on a total of 77 late-fall-run chinook salmon redds. We spent an equal number of days sampling in shallow (less than 3 feet) and deep areas for our late-fall-run chinook salmon spawning HSC data collection. Thirty-one mesohabitat units were sampled (five Bar Complex (BC) riffles, four BC Runs, two BC Glides, two BC Pools, four Flat Water (FW) Runs, two FW Riffles,six FW Glides, one FW Pool, four Side Channel (SC) riffles and one SC Run). The HSC

Figure 7
2001 Keswick Releases During Late-fall-run Spawning[5]



data had depths ranging from 0.3 to 9.7 feet, velocities ranging from 0.32 to 5.84 ft/s, and substrate sizes ranging from 0.1-1 inches to 4-6 inches. Based on the criteria in Footnote 2, we concluded that no late-fall-run redds were measured twice.

Since we were unable to collect 150 observations (the minimum number of observations required to develop criteria), we used the procedure described by Thomas and Bovee (1993) to determine if Sacramento River fall-run chinook salmon criteria would transfer to late-fall-run chinook salmon. The procedure involves two one-sided χ^2 tests (Conover, 1971) using counts of occupied and unoccupied cells in each of three suitability classifications (optimum, useable and unsuitable) to determine if there is non-random selection for optimum habitat over useable habitat, and for suitable (optimum plus useable) over unsuitable habitat. Two null hypotheses are tested: 1) Optimum cells will be occupied in the same proportion as useable cells; and 2) Suitable cells will be occupied in the same proportion as unsuitable cells. For a set of HSC to be considered transferable, both null hypotheses must be rejected at the 0.05 level of significance.

Suitability classifications for depth, mean water column velocity, and substrate for the Sacramento River fall-run chinook salmon criteria were determined as follows. The optimum range for a variable was defined as the interval encompassing the central 50% of the measurements taken on fall-run redds. The

[5]The thicker lines show the sampling periods, while the vertical line shows the end of the sampling period.

suitable range for a variable was defined as the interval containing the central 95%.[6] Thus, the useable range for a variable encompassed the interval between the central 95 and 50 percent of the measured conditions, and the unsuitable range was outside of the central 95%. The optimum ranges were 1.4 to 13.4 feet, 1.38 to 2.46 ft/s, and substrate codes of 1.3 and 2.4. The suitable ranges were 0.9 to 43.4 feet, 0.64 to 4.60 ft/s, and substrate sizes ranging from one to six inches in diameter.

The test procedures require a minimum of 55 occupied and 200 unoccupied cells to avoid either the erroneous acceptance of non-transferable HSC or rejection of transferable HSC (Thomas and Bovee, 1993). As previously mentioned, HSC data were collected from 77 late-fall chinook salmon redds (Figures 8-10). The location of these redds, to be used as the occupied data set, were determined in relation to the established transects using the GPS data. *RHABSIM* was used to simulate cell-by-cell depths and velocities at the average Sacramento River flow present from January 6 through March 6, 2001, (3,577 cfs) for the six sites which were sampled for late-fall-run redds.[7] To derive an unoccupied data set, this output was entered into a spreadsheet along with the substrate classification for each cell. Using the GPS data, the cells which contained redds were identified and deleted from the data set. This left 2,219 unoccupied cells to use in the transferability test.

Composite suitabilities were calculated for each cell. The composite suitability for a cell was classified as optimum if the individual suitabilities for depth, velocity, and substrate were all optimum. If the suitability for any variable was unsuitable, the composite suitability for the cell was classified as unsuitable. A cell was classified as useable if any or all of the variables for the cell fell into the useable category. Data from all sites were combined to obtain counts of occupied and unoccupied cells of unsuitable, useable, or optimum composite suitability. Suitable counts were obtained by combining the optimum and useable counts. The counts were cross classified in two 2 x 2 contingency tables: one to test suitable versus unsuitable classifications and one to test optimum versus useable counts. Test statistics were then calculated from each table using the test statistic for one-sided χ^2 tests given as

$$T = [N^{0.5} (ad-bc)]/[(a+b)(c+d)(a+c)(b+d)]^{0.5}$$

where a = number of occupied optimum (or suitable) cells; b = number of occupied useable (or unsuitable) cells; c = number of unoccupied optimum (or suitable) cells; d = number of unoccupied useable (or unsuitable) cells; and N = total number of cells. The null hypothesis is rejected at the 0.05 level of significance (indicating transferability) if $T \geq 1.6449$.

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[6] The only exception to the above ranges was for depth, where the upper end of the ranges were the depths where the suitability was 0.75 for optimum and 0.1 for suitable.

[7] Conditions were too turbid at the two sites in Segment 4 to search for late-fall-run redds.

Figure 8
Optimum and Suitable Ranges of Velocity HSC Tested Against Late-fall Observations

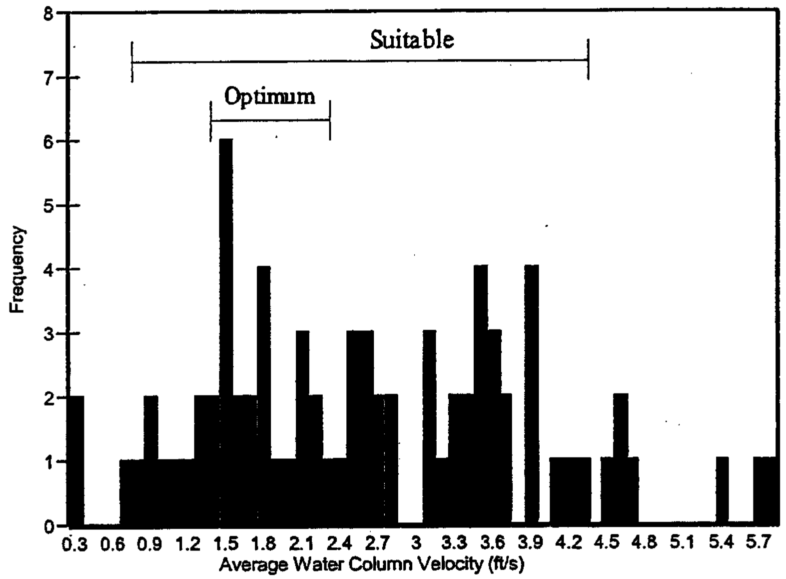


Figure 9
Optimum and Suitable Ranges of Depth HSC Tested Against Late-fall Observations

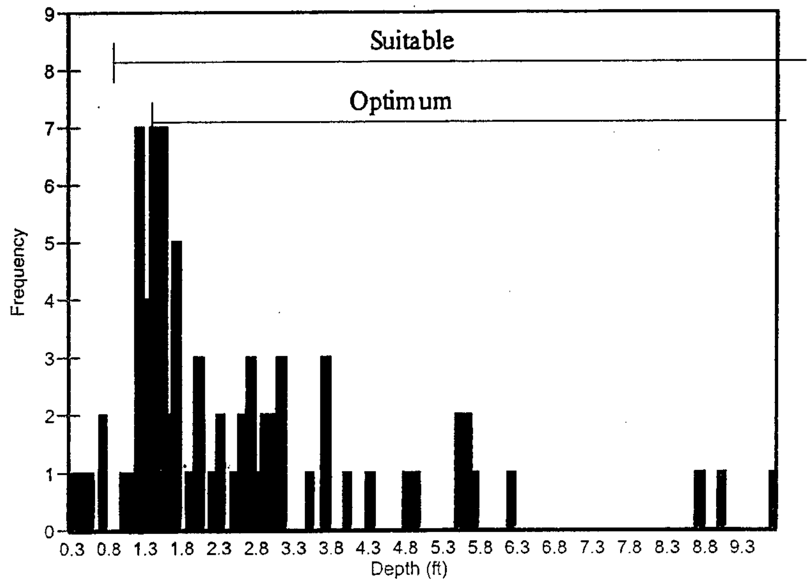
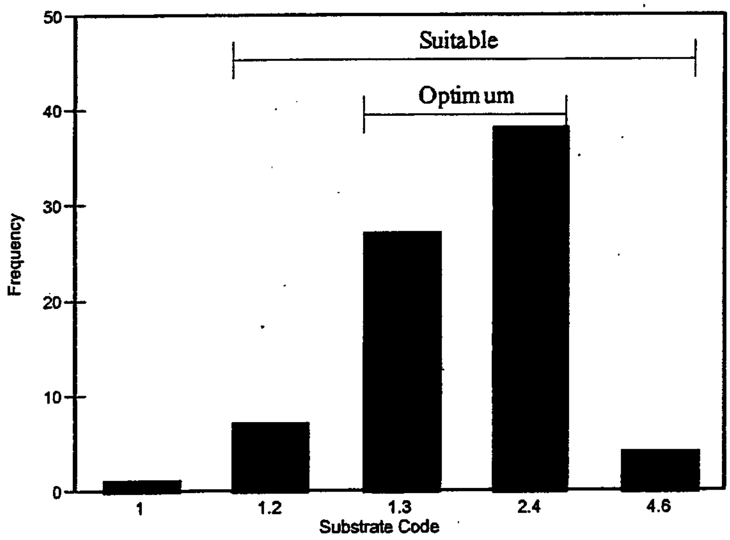


Figure 10
Optimum and Suitable Ranges of Substrate HSC Tested Against Late-fall Observations



The results of the transferability test were that Sacramento River fall-run chinook salmon criteria did not transfer to late-fall-run chinook salmon. While the null hypothesis for the suitable/unsuitable test was rejected ($T = 5.65$, $P = 8 \times 10^{-9}$), the T value for the optimum/useable test (0.63) was far below the rejection level, with a P of 0.27.

We then reviewed HSC data collected by CDFG in 1986 to 1988 on Sacramento River late-fall-run chinook salmon redds to determine if this dataset could be combined with our dataset to produce late-fall-run chinook salmon spawning criteria. CDFG collected data on 140 redds. We eliminated 26 observations where there were incomplete data (no velocities were measured), 13 observations where the flows were unsteady between January 15 and the date of data collection and there were no fish on the redds, and 22 observations collected between December 31 and January 8 with no fish on the redds, leaving 79 observations.[8] We then combined these 79 observations with our 77 observations (for a total of 156 observations) to develop Sacramento River late-fall-run chinook salmon spawning criteria.

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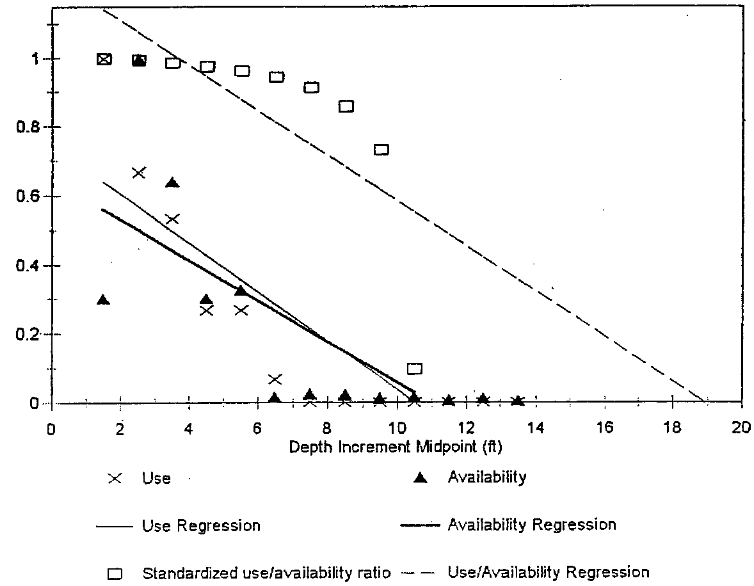
[8] If flows were unsteady between January 15 and the date of data collection, it is possible that the depths and velocities during redd construction were different than those at the time of measurement. However, if fish were on the redd, the redd was constructed recently, and the depths and velocities during redd construction were likely similar to those at the time of measurement. We concluded that redds found early in the late-fall spawning season without fish on the redds were more likely to be fall-run than late-fall-run redds.

Late-fall-run chinook salmon HSC for depth (before depth correction) and velocity were developed from the above dataset of 156 observations using the same methods as for fall-run. Substrate criteria for late-fall-run were developed using the same methods as for fall-run.

For late-fall-run, suitable velocities were between 0.90 and 2.82 ft/s, while suitable substrates ranged from 1-3 to 4-5 inches in diameter (i.e., substrate codes 1.3, 2.3, 2.4, 3.4, 3.5 and 4.5). The initial HSC showed suitability rapidly decreasing for depths greater than 1.73 feet. This effect was likely due to the low availability of deeper water in the Sacramento River with suitable velocities and substrates rather than a selection by late-fall-run salmon of only shallow depths for spawning. Subsequently, the depth ranges selected for the depth correction were 1 to 14 feet. Availability data was determined using the output of the calibrated hydraulic decks for the six spawning habitat modeling sites at which HSC data were collected, while redd data from these six sites were used to assess use. The results of the initial regressions showed that availability dropped with increasing depth, but not quite as quickly as use (Figure 11). The result of the final regression was that the scaled ratio reached zero at 18.9 feet; thus, the late-fall-run depth criteria were modified to have a linear decrease in suitability from 1.0 for the greatest depth in the original criteria which had a suitability of 1.0, to a suitability of 0.0 at 18.9 feet.

Figure 11
Relations Between Relative Availability and Use and Depth for Late-fall-run[9]



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[9]Points are relative use, relative availability, or the standardized ratio of the linearized use to linearized availability. Lines are the results of the linear regressions of the depth increment midpoint versus relative availability, relative use, and the standardized ratio of linearized use to linearized availability.

The final Sacramento River late-fall-run chinook salmon spawning HSC are shown in Figures 12 to 14 and Appendix A.

Figure 12
Late-fall-run Chinook Salmon HSI Curve for Depth

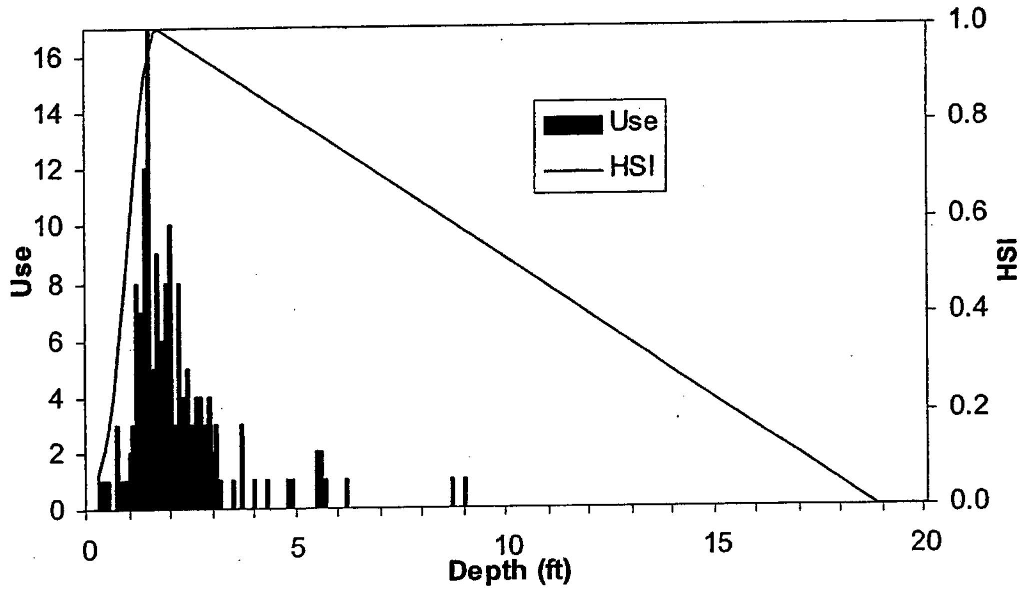


Figure 13
Late-fall-run Chinook Salmon HSI Curve for Velocity

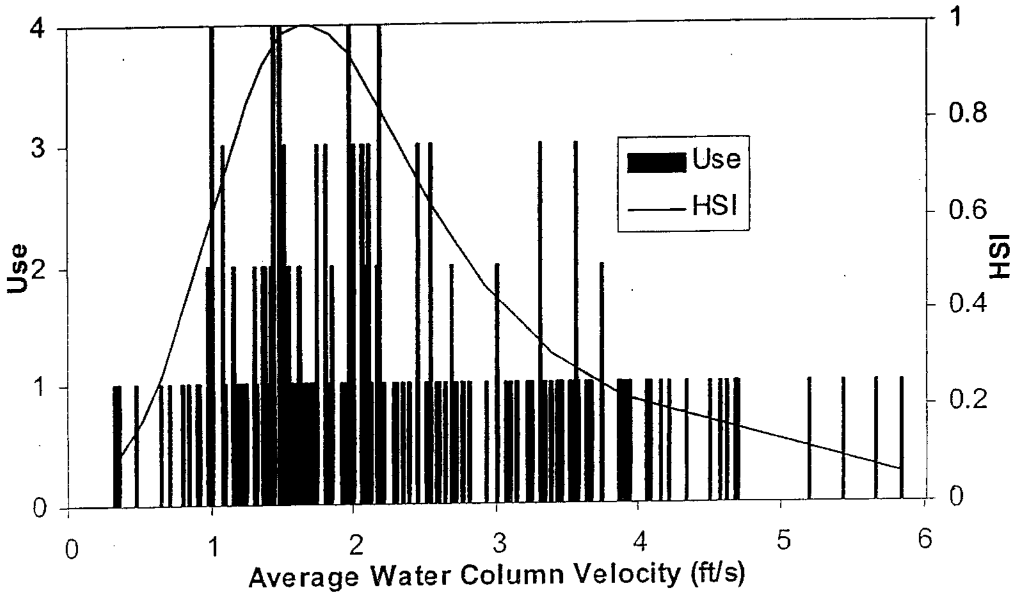
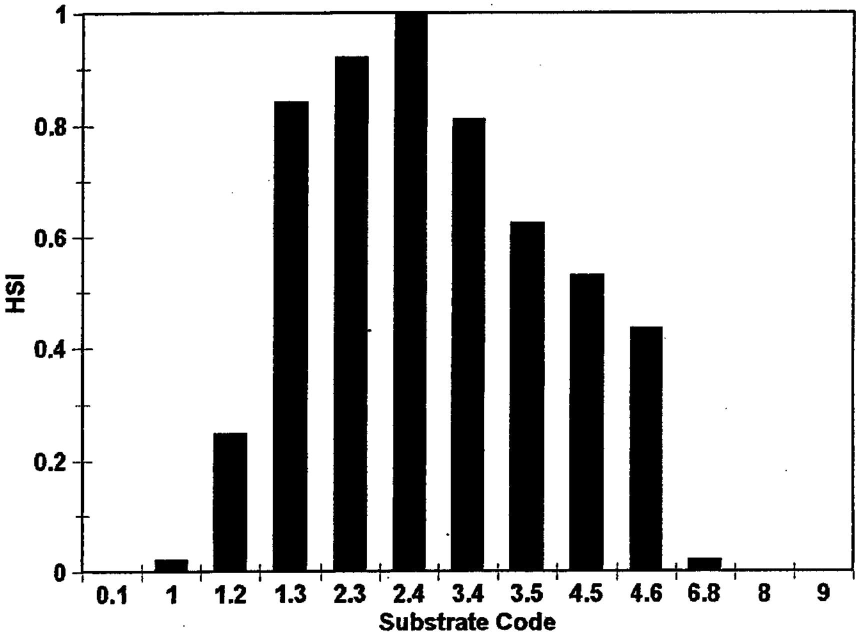


Figure 14
Late-fall-run Chinook Salmon HSI Curve for Substrate



winter-run

Data on shallow winter-run redds were not collected in 1996 due to fluctuating flow conditions. Surveys for deep winter-run redds were conducted on June 3 to 5, 1996, using SCUBA divers; only one winter-run redd was found. Collection of data on winter-run redds was precluded in 1997 due to high turbidity during the winter-run spawning season. Surveys for shallow and deep winter-run chinook salmon redds were conducted on May 26 to June 26, 1998, June 8 to July 15, 1999, June 20 to July 10, 2000, and June 4 to 22, 2001 (Figures 15 to 17). Sacramento River flows (releases from Keswick) in 1998 varied greatly, from 11,345 to 29,899 cfs (Figure 18), from the initiation of winter-run spawning in mid-May through the end of sampling. However, we still feel confident that the depths and velocities measured in 1998 were similar to those during redd construction for the following reasons: 1) most (70%) of the redds measured had fish digging or holding on the redd; 2) the 30,000 cfs flow in late-May moved enough gravel to eliminate any signs of existing redds; and 3) fish were observed holding and not spawning at 20,000 cfs in early June (only one redd was found during that period); thus it appears that most winter-run waited to spawn until the flows stabilized around 15,000 cfs in mid-June. Sacramento River flows varied considerably, from 8,496 to 13,959 cfs in 1999, from 8,000 to 14,865 cfs in 2000, and from 6,049 to 14,669 cfs in 2001, from the initiation of winter-run spawning in mid-April throughthe end of sampling in each of these years (Figure 18). Unfortunately, this adds a measure of uncertainty to HSC developed from this data, since we can not be certain that

Figure 15
Depths of Winter-run Redds Measured in 1998, 1999, 2000 and 2001

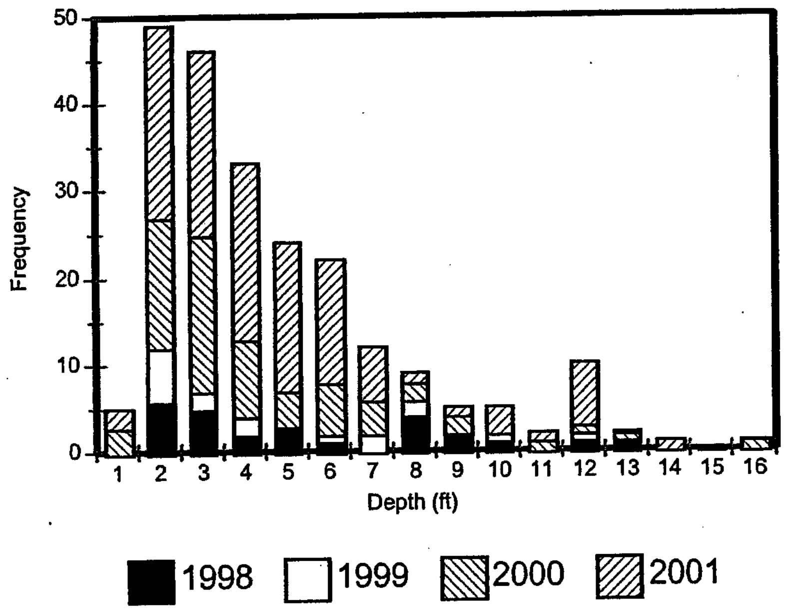


Figure 16
Velocities of Winter-run Redds Measured in 1998, 1999, 2000 and 2001

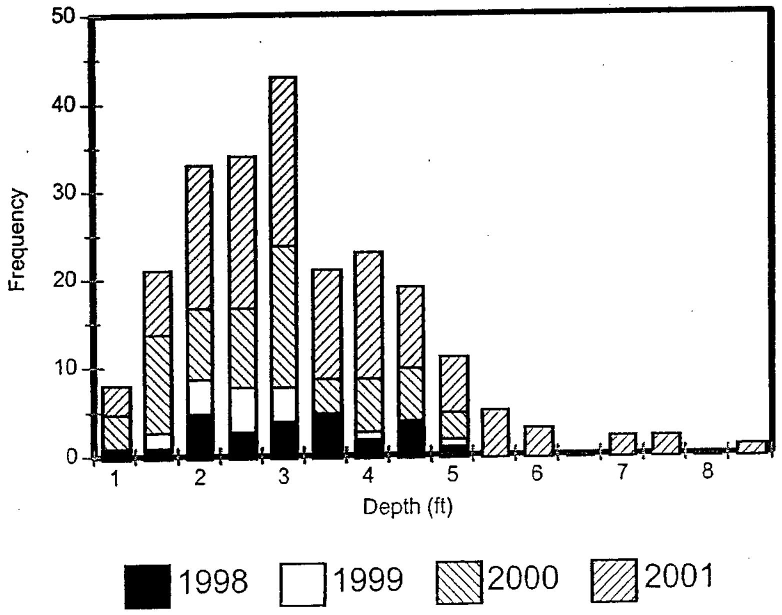
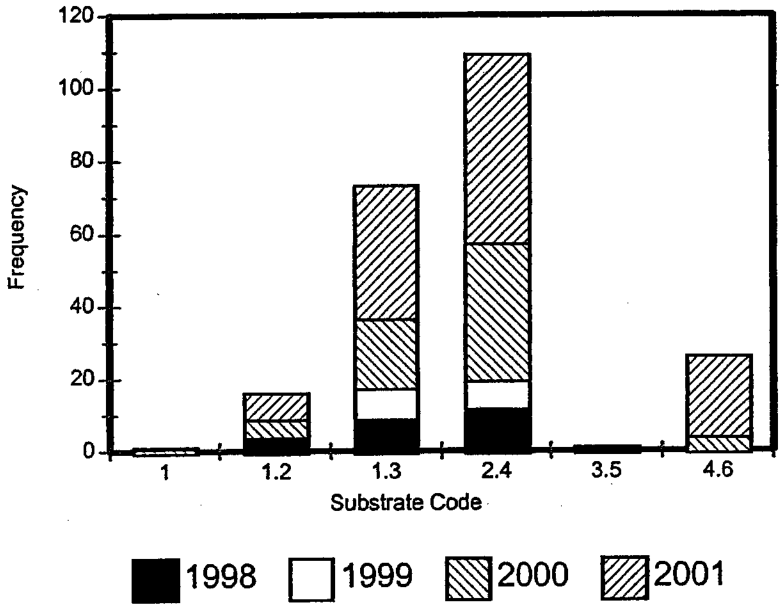


Figure 17

Substrate Codes of Winter-run Redds Measured in 1998, 1999, 2000 and 2001

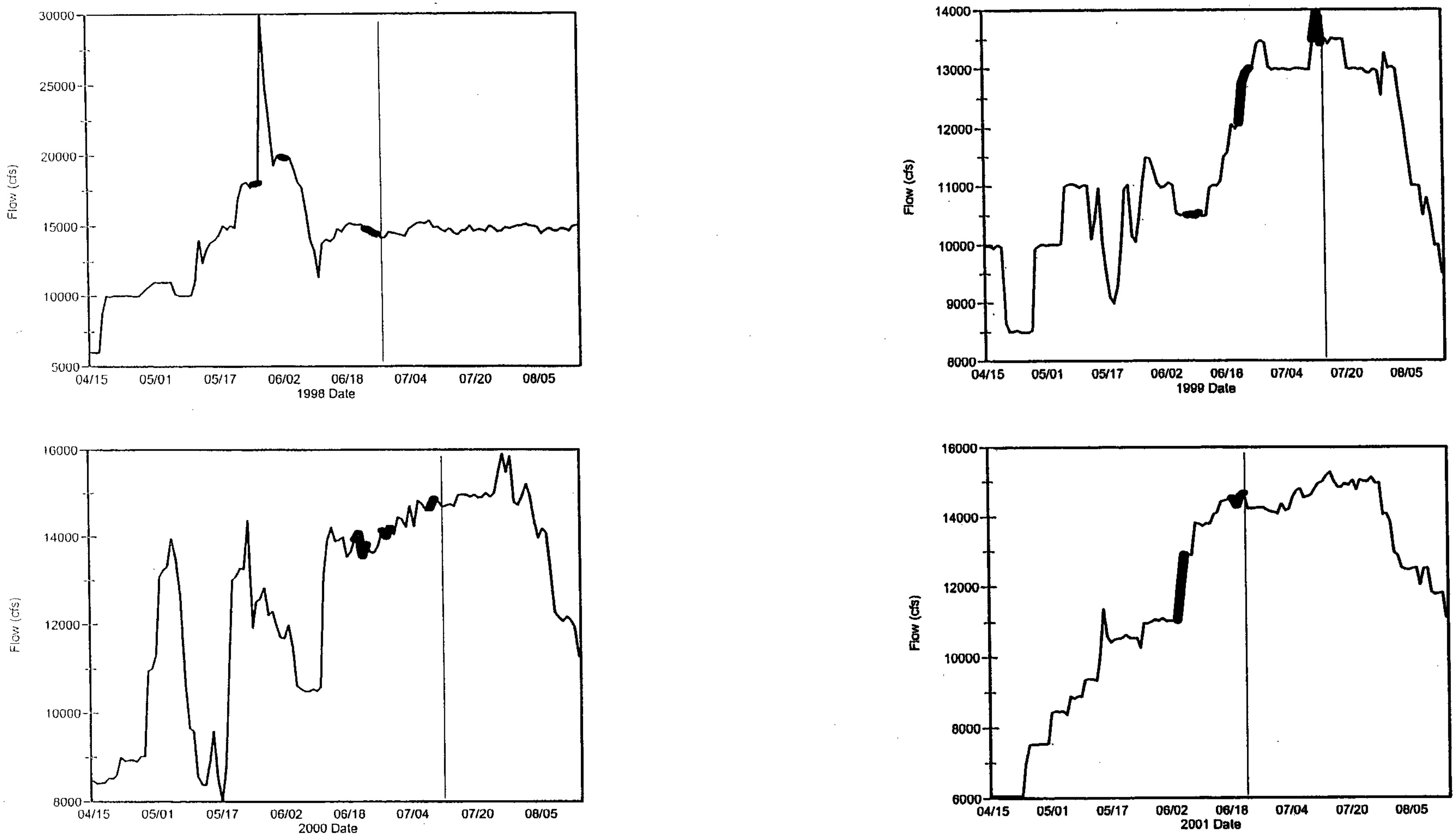


the depths and velocities measured were similar to those during redd construction. However, due to the low population numbers of winter-run, it is necessary to use data from these years despite the uncertainty in these data.

We collected HSC data on a total of 227 winter-run chinook salmon redds. We spent an equal number of days sampling in shallow (less than 3 feet) and deep areas for our winter-run chinook salmon spawning HSC data collection. Fifty-seven mesohabitat units were sampled (seventeen Bar Complex (BC) riffles, five BC Runs, four BC Glides, two BC Pools, five Flat Water (FW) Runs, three FW Riffles, eleven FW Glides, one FW Pool, six Side Channel (SC) riffles, one SC Run, one SC Pool and one Boulder Run). The HSC data had depths ranging from 1.2 to 15.6 feet, velocities ranging from 0.87 to 8.48 ft/s, and substrate sizes ranging from 0.1-1 inches to 4-6 inches. Based on the criteria in Footnote 2, we concluded that three winter-run redds had been measured twice. We used the earlier measurement as the depth and velocity for these redds, since it should be closer to the depth and velocity at the time of redd construction.

Winter-run chinook salmon HSC for depth (before depth correction) and velocity were developed from the data collected in 1996, 1998, 1999, 2000 and 2001 using the same methods as for fall-run. Substrate criteria for winter-run were developed using the same methods as for fall-run.

Figure 18
1998 to 2001 Keswick Releases During Winter-run Spawning[10]

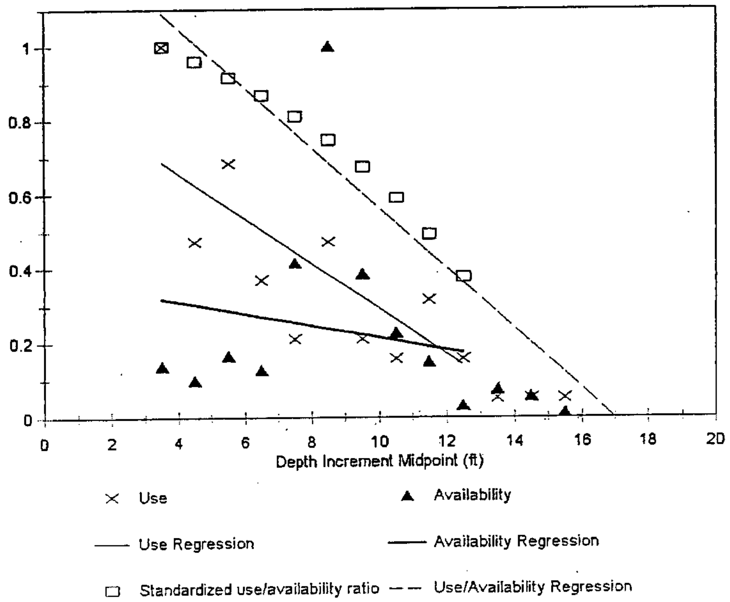


[10]The thicker lines show the sampling periods, while the vertical line shows the end of the sampling period.

For winter-run, suitable velocities were between 1.54 and 4.10 ft/s, while suitable substrates were 1-3 to 3-5 inches in diameter (i.e, substrate codes 1.3, 2.3, 2.4, 3.4 and 3.5). The initial HSC showed suitability rapidly decreasing for depths greater than 3.13 feet. This effect was likely due to the low availability of deeper water in the Sacramento River with suitable velocities and substrates rather than a selection by winter-run salmon of only shallow depths for spawning. Subsequently, the depth ranges selected for the depth correction were 3 to 16 feet. Availability data was determined using the output of the calibrated hydraulic decks for the six spawning habitat modeling sites at which HSC data were collected, while redd data from these six sites were used to assess use. The results of the initial regressions showed that availability dropped with increasing depth, but not quite as quickly as use (Figure 19). The result of the final regression was that the scaled ratio reached zero at 17.0 feet; thus, the winter-run depth criteria were modified to have a linear decrease in suitability from 1.0 for the greatest depth in the original criteria which had a suitability of 1.0, to a suitability of 0.0 at 17.0 feet.

The final Sacramento River winter-run chinook salmon spawning HSC are shown in Figures 20 to 22 and Appendix A.

Figure 19
Relations Between Relative Availability and Use and Depth for Winter-run[11]



[11]Points are relative use, relative availability, or the standardized ratio of the linearized use to linearized availability. Lines are the results of the linear regressions of the depth increment midpoint versus relative availability, relative use, and the standardized ratio of linearized use to linearized availability.

Figure 20
Winter-run Chinook Salmon HSI Curve for Depth

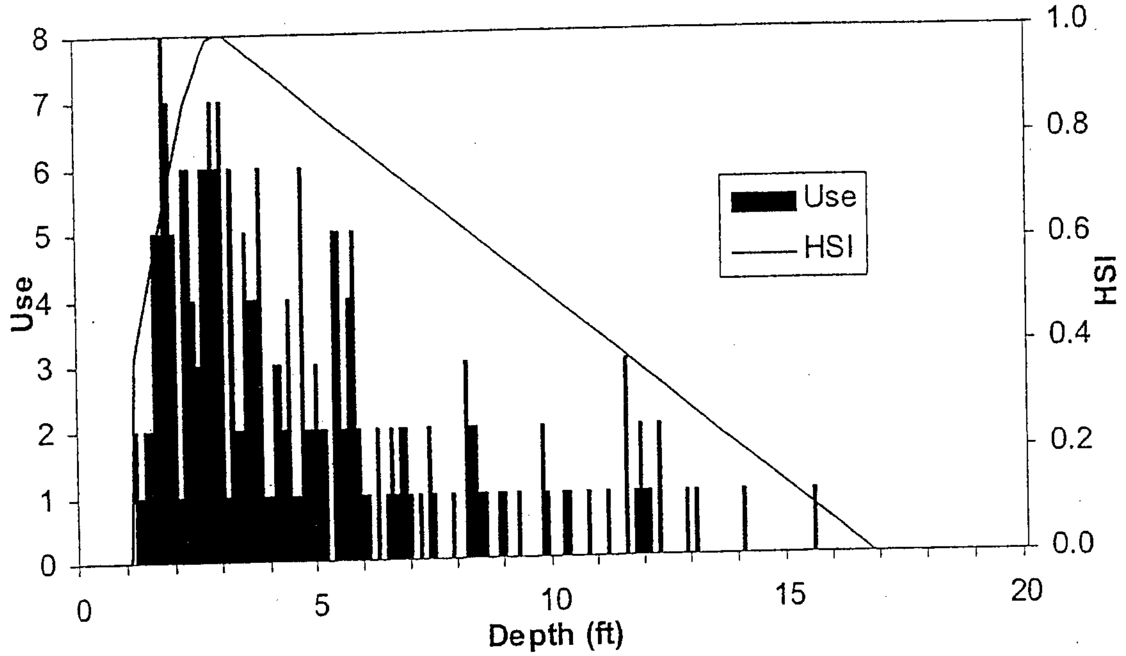


Figure 21
Winter-run Chinook Salmon HSI Curve for Velocity

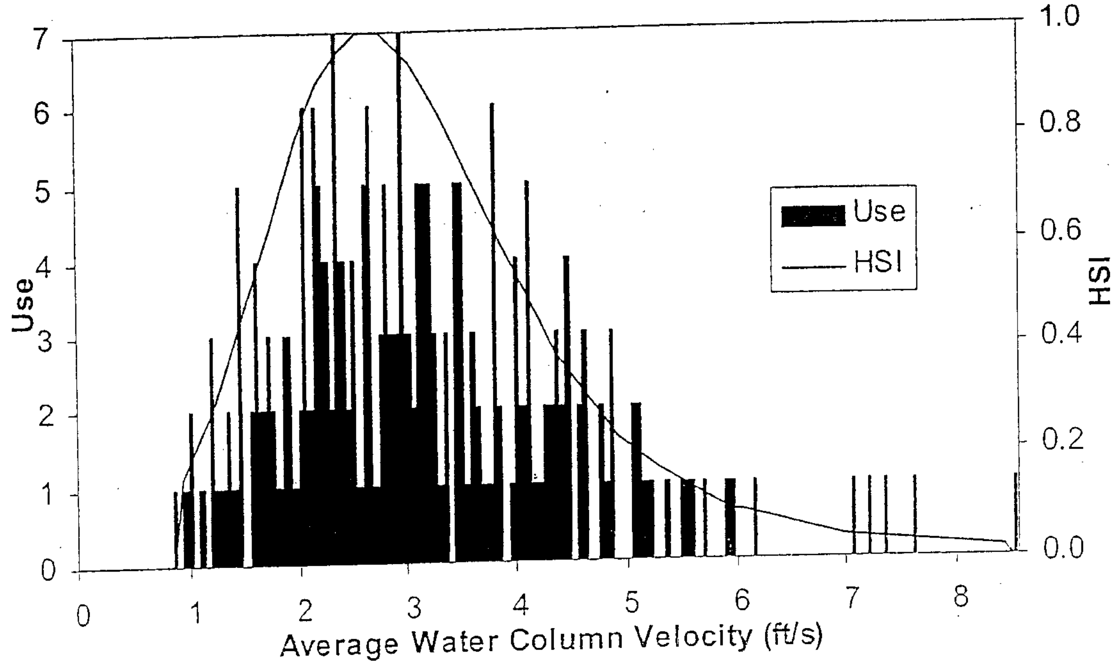
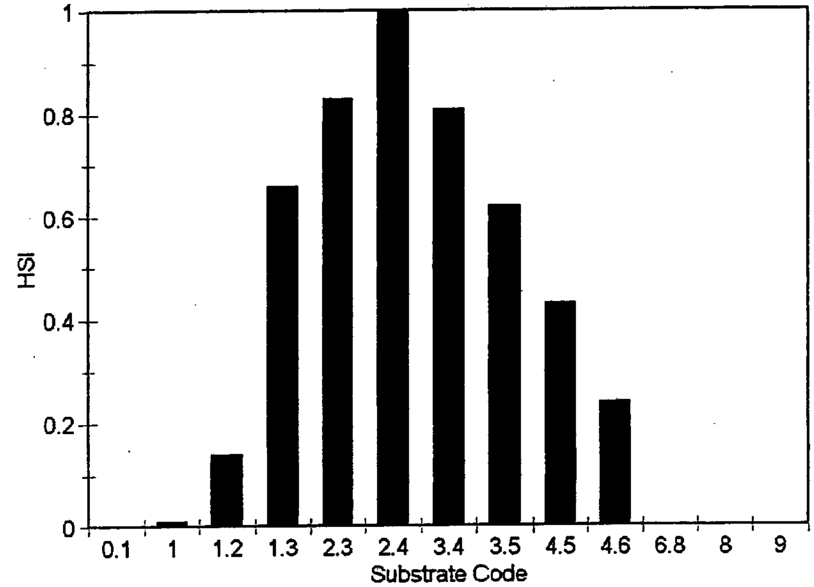


Figure 22
Winter-run Chinook Salmon HSI Curve for Substrate



spring-run

We did not collect HSC data for spring-run chinook salmon, since very few spring-run redds (less than 15 per year) were observed from 1989-1993, while no spring run redds were observed in 1994, during CDFG aerial redd counts (U. S. Fish and Wildlife Service 1995b). There is not even enough spring-run spawning in the mainstem Sacramento River to collect data to see if criteria for other races would transfer to spring-run. Fish that are identified as spring-run in the mainstem Sacramento River are likely hybrid spring & fall-run, that exhibit the migration timing of spring-run and the spawning timing of fall-run (Frank Fisher, CDFG, personal communication). Geographic separation is necessary to avoid hybridization of spring-run and fall-run chinook salmon due to the large overlap in their spawning period. This separation is not available in the main-stem Sacramento River. Spring-run chinook salmon are thought to be primarily a tributary spawner and it has proven impossible to differentiate those that do spawn in the mainstem from fall-run adults present at the same time (U. S. Fish and Wildlife Service 1996). Spring-run chinook salmon criteria are not available from streams similar to the Sacramento River. Based on the above, we are not modeling spring-run chinook salmon habitat. If there is an interest in spawning flows in September, we would suggest consideration of the habitat modeling results for the other chinook salmon races.

steelhead

We did not collect HSC data for steelhead trout because very few steelhead trout redds have been observed in CDFG aerial redd surveys and because we would be unable to distinguish a steelhead redd from a resident rainbow trout redd. Due to interest in steelhead spawning in the mainstem Sacramento River, we have used steelhead trout HSC criteria from the lower American River (U. S. Fish and Wildlife Service 2000) to model steelhead trout habitat in the mainstem Sacramento River. Since we were unable to conduct a transferability test to determine whether the lower American River steelhead trout HSC would transfer to the Sacramento River, we suggest that the habitat modeling results for steelhead trout should be considered with caution.

The Lower American River steelhead trout HSC are shown in Figures 23 to 25 and Appendix A.

Figure 23
Steelhead Trout HSI Curve for Depth

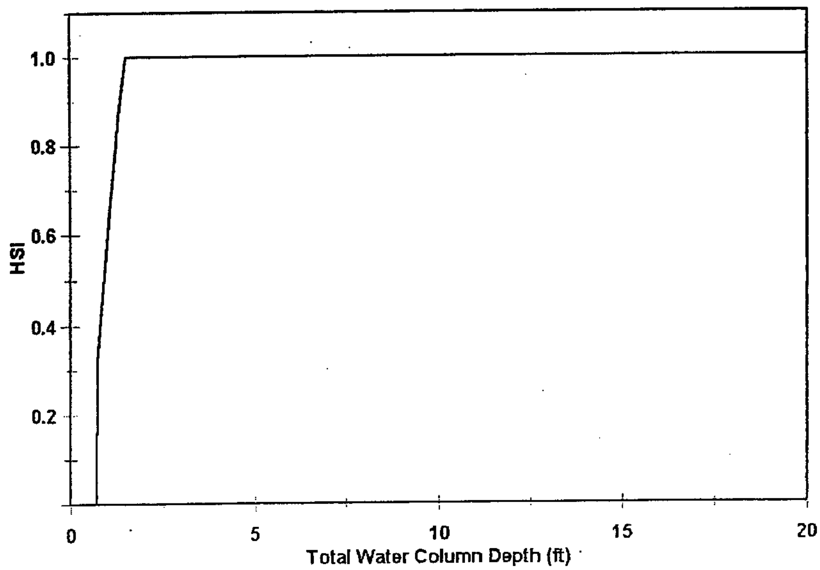


Figure 24
'Steelhead Trout HSI Curve for Velocity

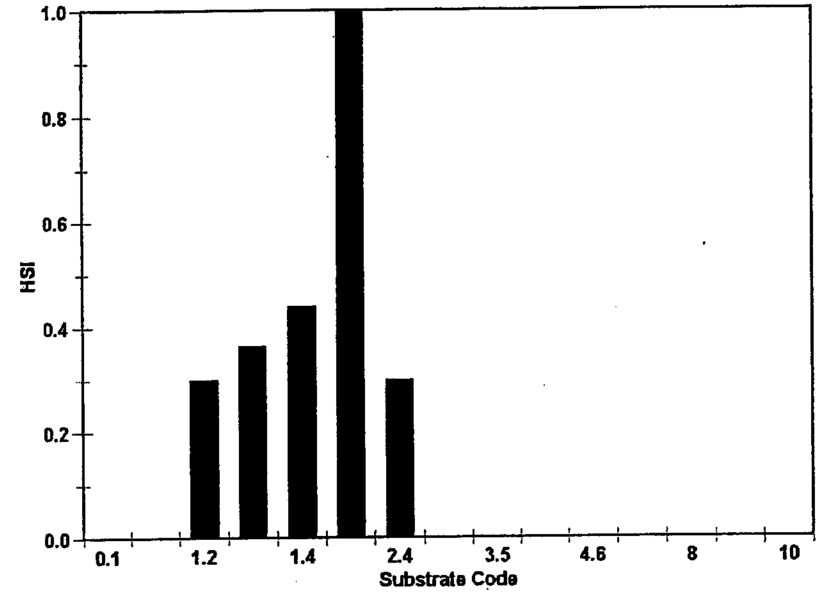
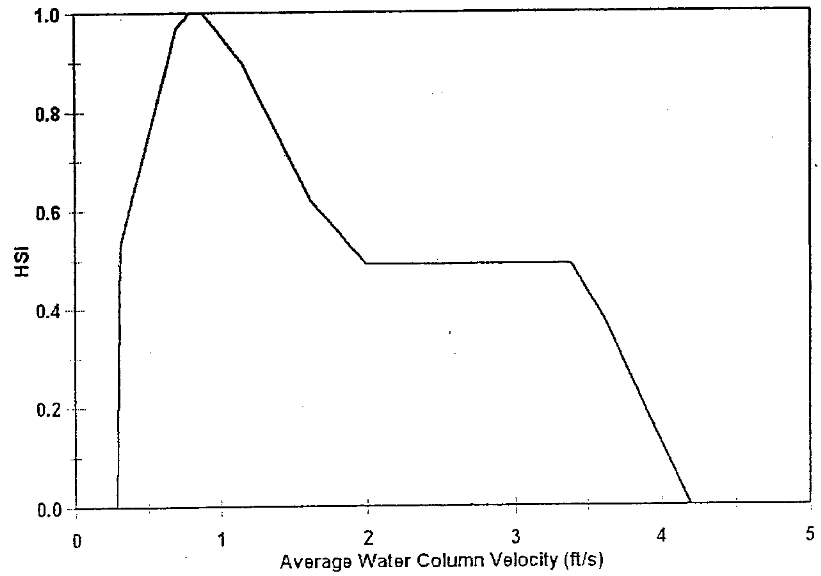


Figure 25
Steelhead Trout HSI Curve for Substrate



Hydraulic Model Construction and Calibration

Calibrated *RHABSIM* decks were created to simulate depths and velocities[12] at each of the 34 transects between Keswick Dam and Battle Creek for 30 simulation flows: 3,250 to 5,500 cfs by 250 cfs increments; 5,500 to 8,000 cfs by 500 cfs increments; 8,000 to 15,000 cfs by 1,000 cfs increments; and 15,000 to 31,000 cfs by 2,000 cfs increments. For the sites in Segment 6, separate calibrated *RHABSIM* decks were created for two conditions: 1) with the ACID Dam boards in; and 2) with the ACID Dam boards out. Details on hydraulic model construction and calibration are given in U. S. Fish and Wildlife Service 1999.

Habitat Simulation

The final step in the process was to simulate available habitat for each transect. An input file was created containing the digitized HSC in Appendix A. The *RHABSIM* version of the HABTAE program was used to compute WUA for each transect for the above 30 simulation flows. The WUA values calculated for each transect and criteria set are contained in Appendix B.

The WUA values for each transect from Appendix B of this report were entered into a spreadsheet and multiplied by the river length for each transect in Table 3 to generate the WUA (square feet) for each transect at each simulation flow. The resulting WUA for the transects in each segment were summed and then multiplied by the ratios in Table 4 to generate the total WUA for fall, late-fall and winter-run chinook salmon and steelhead trout spawning in each segment.

RESULTS

The flow-habitat relationships for fall, late-fall and winter-run chinook salmon and steelhead trout spawning in Segments four through six of the Sacramento River are shown in Figures 26 to 29 and Appendix C. The results from the three segments could be combined together with water temperature to produce total spawning habitat in a network analysis, and run on a time series of flows from alternative operational flow regimes to evaluate the effects of the regimes on salmonid spawning habitat in the Sacramento River. Alternatively, the results from the three segments could be used as one of the inputs to the SALMOD salmonid population model (Kent 1999) to assess the effects of alternative flow regimes on salmonid production. For fall-run chinook salmon, the above analyses will also require the results of our ongoing modeling of fall-run spawning habitat in Segments 2 and 3.

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[12] The calibrated *RHABSIM* decks also include substrate data for the transects.

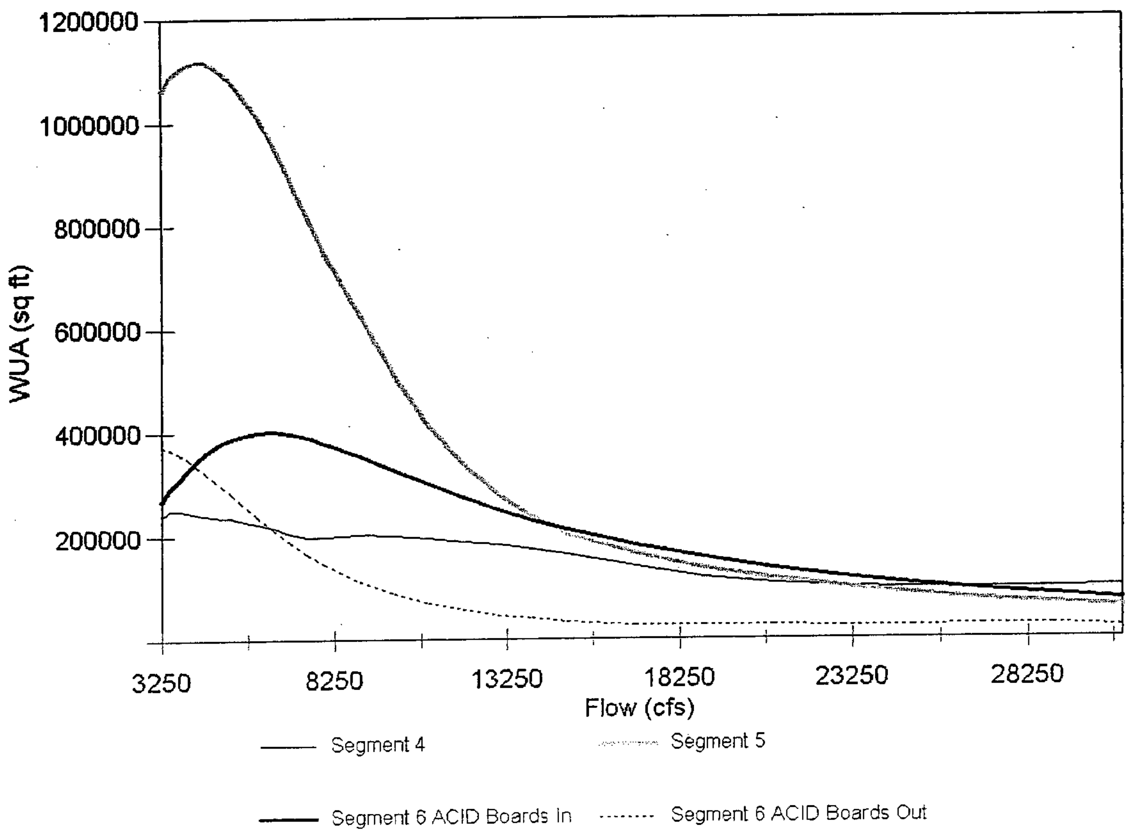
Table 3
River Lengths Represented by Transects in This Study

Site	XS	Length (feet)
Salt Creek	1	221
Upper Lake Redding	1	805
Upper Lake Redding	2	285
Lower Lake Redding	1	510
Bridge Riffle	1	195
Bridge Riffle	2	74
Bridge Riffle	3	68
Posse Grounds	1 LC	26
Posse Grounds	2 LC	52
Posse Grounds	3 LC	62
Posse Grounds	4 LC	10
Posse Grounds	5 LC	10
Posse Grounds	6 LC	73.5
Posse Grounds	7 LC	79
Posse Grounds	8 LC	10
Posse Grounds	1 RC	32
Posse Grounds	2 RC	37
Posse Grounds	3 RC	67.5
Posse Grounds	4 RC	70
Posse Grounds	5 RC	38.5
Posse Grounds	6 RC	50.5
Posse Grounds	7 RC	61
Posse Grounds	8 RC	304.5
Posse Grounds	9	419
Posse Grounds	10	145
Above Hawes Hole	1	125
Above Hawes Hole	2	99.5
Above Hawes Hole	3	116.5
Above Hawes Hole	4	75
Above Hawes Hole	5	165
Above Hawes Hole	6	252
Powerline Riffle	1	46
Powerline Riffle	2	62
Powerline Riffle	3	62
Powerline Riffle	4	73
Powerline Riffle	5	117
Powerline Riffle	6	80
Price Riffle	1	335
Price Riffle	2	265
Price Riffle	3 MC	148
Price Riffle	4 MC	137
Price Riffle	5 MC	135
Price Riffle	3 SC	56
Price Riffle	4 SC	85
Price Riffle	5 SC	75

Table 4
Ratio of Total Redds in Segment to Redds in Modeling Sites[13]

Segment	Fall-run	Late-fall-run	Winter-run
6	1.22	1.22	2.2
5	4.65	3.19	4.79
4	3.23	4.81	1.5

Figure 26
Fall-run Chinook Salmon Spawning Flow-Habitat Relationships



13 Calculated from CDFG 1989-1994 aerial redd count data.

Figure 27
Late-fall-run Chinook Salmon Spawning Flow-Habitat Relationships

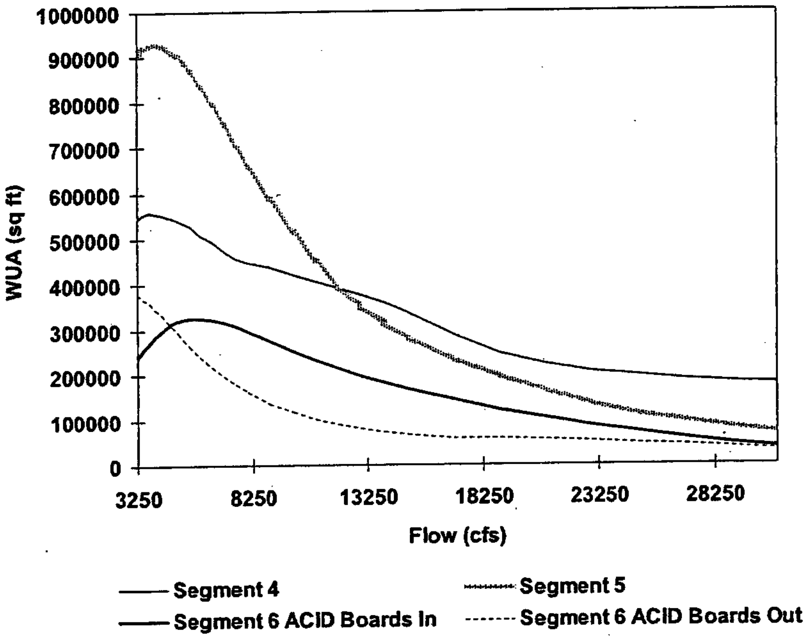


Figure 28
Winter-run Chinook Salmon Spawning Flow-Habitat Relationships

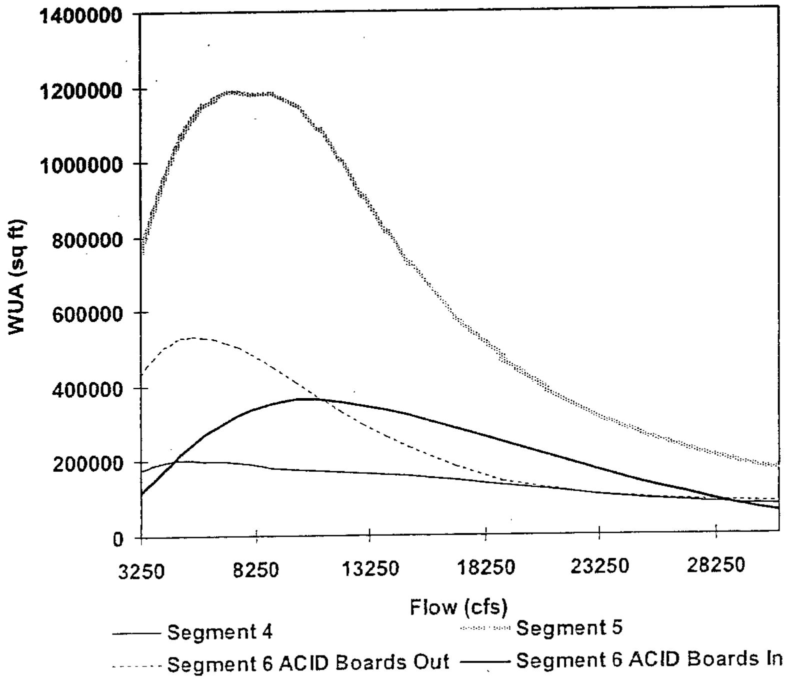
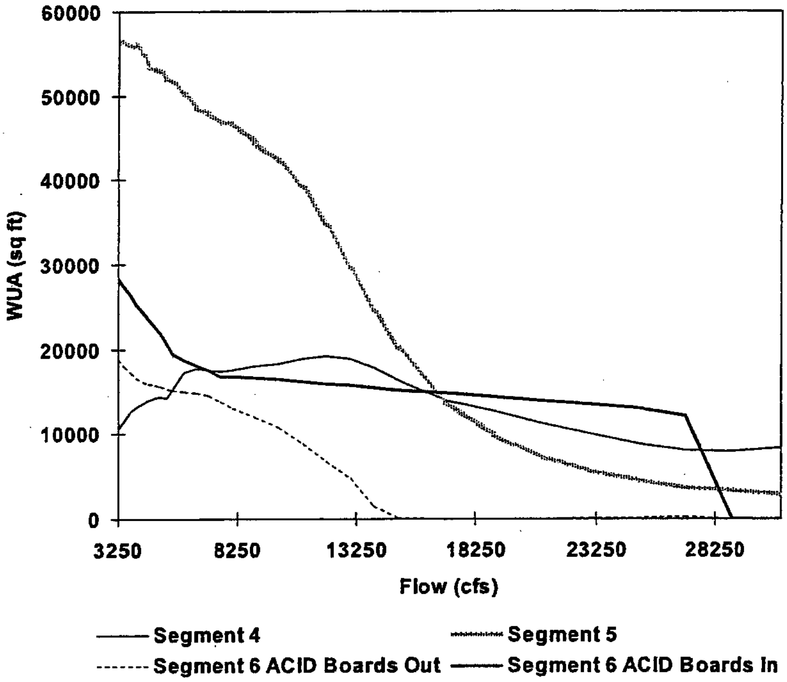


Figure 29
Steelhead Trout Spawning Flow-Habitat Relationships



The flow-habitat relationships presented in this report differ from the flow-habitat relationships found in an earlier instream flow study on the Sacramento River (California Department of Water Resources 1993). The differences between the results of the two studies can primarily be attributed to the following: 1) the earlier study used preference HSC (calculated by dividing use by availability), as opposed to the use HSC used in this report; 2) the earlier study did not apply the method used in this report for correcting depth HSC for availability; and 3) transects for the earlier study were placed using a representative reach approach, as opposed to only placing transects in high-spawning-use areas, as was employed in this report. While preference HSC and a representative reach approach were the accepted approaches when the California Department of Water Resources study was conducted, they are no longer the recommended approaches for instream flow studies (Bovee and Bartholow 1996).

REFERENCES

Bovee, K.D. and J.M. Bartholow. 1996. IFIM phase III study implementation. Pages 138-185 in K.D. Bovee, editor. The Complete IFIM: A Coursebook for IF 250. U.S. Geological Survey, Fort Collins, CO.

California Department of Water Resources. 1993. Upper Sacramento River habitat modeling progress report, end of phase I. California Department of Water Resources, Red Bluff, CA.

Conover, W. J. 1971. Practical Nonparametric Statistics. Wiley, New York. p 493.

Gard, M. 1998. Technique for adjusting spawning depth habitat utilization curves for availability. Rivers: 6(2):94-102.

Kent, J. J. 1999. Application and sensitivity analysis of a salmonid population model for the Sacramento River, California. Master's Thesis, Colorado State University, Fort Collins, CO.

Thomas, J. A. and K. D. Bovee. 1993. Application and testing of a procedure to evaluate transferability of habitat suitability criteria. Regulated Rivers: Research & Management 8: 285-294.

U. S. Fish and Wildlife Service. 1995a. Working paper on restoration needs: habitat restoration actions to double natural production of anadromous fish in the Central Valley of California. Volume 1. May 9, 1995. Prepared for the U. S. Fish and Wildlife Service under the direction of the Anadromous Fish Restoration Program Core Group. Stockton, CA.

U. S. Fish and Wildlife Service. 1995b. Identification of the instream flow requirements for anadromous fish in the streams within the Central Valley of California. Annual Progress Report Fiscal Year 1995. U. S. Fish and Wildlife Service, Sacramento, CA.

U. S. Fish and Wildlife Service. 1996. Identification of the instream flow requirements for anadromous fish in the streams within the Central Valley of California. Annual Progress Report Fiscal Year 1996. U. S. Fish and Wildlife Service, Sacramento, CA.

U. S. Fish and Wildlife Service. 1999. Hydraulic modeling of chinook salmon spawning sites in the Sacramento River between Keswick Dam and Battle Creek. U. S. Fish and Wildlife Service, Sacramento, CA.

U. S. Fish and Wildlife Service, 2000. Effects of the January 1997 flood on flow-habitat relationships for steelhead and fall-run chinook salmon spawning in the Lower American River. U. S. Fish and Wildlife Service, Sacramento, CA.

APPENDIX A

FINAL SACRAMENTO RIVER FALL, LATE-FALL AND WINTER-RUN CHINOOK SALMON AND STEELHEAD TROUT SPAWNING HSC

FALL-RUN CHINOOK SALMON SPAWNING HSC

Water Depth (ft)	SI Value
0.00	0
0.40	0
0.50	0.22
0.62	0.30
0.78	0.41
0.93	0.54
1.08	0.67
1.24	0.79
1.39	0.89
1.54	0.96
1.70	1.00
1.85	1.00
48	0
100	0

Water Velocity (ft/s)	SI Value
0.00	0
0.31	0
0.32	0.08
0.40	0.11
0.52	0.17
0.72	0.30
0.85	0.41
0.97	0.54
1.23	0.78
1.36	0.88
1.55	0.98
1.68	1.00
1.75	1.00
1.88	0.97
1.94	0.95
2.07	0.89
2.33	0.73
2.58	0.55
2.84	0.39
3.10	0.27
3.29	0.20
3.36	0.19
3.48	0.15
3.93	0.08
4.32	0.05
4.51	0.05
4.58	0.04
5.79	0.04
5.8	0
100	0

Substrate Composition	SI Value
0.1	0
1	0
1.2	0.33
1.3	0.91
2.3	0.96
2.4	1.00
3.4	0.76
3.5	0.53
4.5	0.35
4.6	0.16
6.8	0
100	0

LATE-FALL-RUN CHINOOK SALMON SPAWNING HSC

Water Depth (ft)	SI Value
0.00	0
0.29	0
0.30	0.07
0.44	0.12
0.55	0.17
0.66	0.24
0.98	0.52
1.30	0.82
1.41	0.90
1.63	0.99
1.73	1.00
18.9	0
100	0

Water Velocity (ft/s)	SI Value
0	0
0.31	0
0.32	0.08
0.53	0.18
0.66	0.27
1.24	0.83
1.37	0.92
1.50	0.98
1.63	1.00
1.70	1.00
1.83	0.98
1.96	0.94
2.54	0.63
2.93	0.45
3.38	0.31
3.90	0.22
5.84	0.06
5.85	0
100	0

Substrate Composition	SI Value
0	0
0.1	0
1	0.02
1.2	0.25
1.3	0.84
2.3	0.92
2.4	1.00
3.4	0.81
3.5	0.62
4.5	0.53
4.6	0.44
6.8	0.02
8	0
100	0

WINTER-RUN CHINOOK SALMON SPAWNING HSC

Water Depth (ft)	SI Value
0.0	0
1.1	0
1.2	0.39
1.7	0.65
2.3	0.87
2.6	0.96
2.8	0.99
3.0	1.00
3.1	1.00
17.0	0
100	0

Water Velocity (ft/s)	SI Value
0.00	0
0.86	0
0.95	0.16
1.24	0.30
1.99	0.80
2.18	0.90
2.37	0.96
2.56	1.00
2.75	1.00
3.03	0.94
3.32	0.84
4.35	0.39
4.92	0.23
5.30	0.17
5.96	0.09
6.05	0.09
7.00	0.04
8.42	0.02
8.49	0
100	0

Substrate Composition	SI Value
0.1	0
1	0.01
1.2	0.14
1.3	0.66
2.3	0.83
2.4	1.00
3.4	0.81
3.5	0.62
4.5	0.43
4.6	0.24
6.8	0
100	0

STEELHEAD TROUT SPAWNING HSC

Water Velocity (ft/s)	SI Value	Water Depth (ft)	SI Value	Substrate Composition	SI Value
0.00	0	0.00	0	0.1	0
0.29	0	0.70	0	1	0
0.31	0.53	0.73	0.32	1.2	0.30
0.70	0.97	1.30	0.87	2.3	1.00
0.79	1.00	1.51	1.00	2.4	0.30
0.88	1.00	100.00	1.00	3.4	0
1.14	0.90			100.0	0
1.61	0.62				
2.00	0.49				
3.39	0.49				
3.61	0.38				
4.20	0				
100.00	0				

APPENDIX B
TRANSECT HABITAT MODELING RESULTS

Salt Creek Study Site

Boards in at ACID Dam

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	68.0	48.5	20.3	7.0
3500	68.1	47.6	21.6	6.5
3750	67.5	46.1	22.6	6.1
4000	66.0	44.3	23.4	5.8
4250	64.1	42.3	24.0	5.6
4500	61.6	40.0	24.5	5.4
4750	58.8	37.7	24.7	5.1
5000	55.8	35.5	24.7	4.7
5250	52.7	33.2	24.6	4.5
5500	49.6	30.9	24.4	4.5
6000	43.3	26.7	23.4	4.5
6500	37.4	23.0	22.2	4.4
7000	32.1	19.8	20.8	4.4
7500	27.2	17.0	19.3	4.4
8000	23.1	14.6	17.7	4.4
9000	16.6	10.7	14.3	4.2
10000	12.0	8.0	11.2	3.7
11000	8.8	6.1	8.5	2.9
12000	6.6	4.7	6.3	2.2
13000	5.1	3.7	4.6	1.3
14000	4.0	2.9	3.2	0.7
15000	3.3	2.3	2.2	0.3
17000	2.6	1.5	0.9	0.0
19000	2.3	0.9	0.2	0.0
21000	1.8	0.5	0.0	0.0
23000	1.4	0.2	0.0	0.0
25000	0.9	0.1	0.0	0.0
27000	0.5	0.0	0.0	0.0
29000	0.0	0.0	0.0	0.0
31000	0.0	0.0	0.0	0.0

Boards out at ACID Dam

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	68.8	50.9	23.0	6.9
3500	68.4	49.7	24.5	6.5
3750	67.2	48.0	25.8	6.1
4000	65.2	45.9	26.7	5.7
4250	62.7	43.6	27.5	5.5
4500	59.7	41.2	28.1	5.4
4750	56.4	38.7	28.4	5.3
5000	53.1	36.2	28.5	5.2
5250	49.7	33.7	28.5	5.1
5500	46.2	31.3	28.2	4.9
6000	39.6	26.9	27.2	4.5
6500	33.5	23.2	25.7	4.5
7000	28.1	19.9	24.0	4.5
7500	23.5	17.1	22.2	4.4
8000	19.7	14.7	20.3	4.2
9000	13.7	10.9	16.5	3.8
10000	9.8	8.3	13.1	3.1
11000	7.1	6.3	10.1	2.3
12000	5.3	5.1	7.6	1.4
13000	4.2	4.0	5.7	0.7
14000	3.4	3.3	4.1	0.3
15000	2.9	2.7	2.9	0.1
17000	2.5	1.8	1.4	0.0
19000	1.8	1.2	0.6	0.0
21000	1.3	0.7	0.2	0.0
23000	0.9	0.4	0.0	0.0
25000	0.4	0.2	0.0	0.0
27000	0.0	0.0	0.0	0.0
29000	0.0	0.0	0.0	0.0
31000	0.0	0.0	0.0	0.0

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 6 (cfs).

Upper Lake Redding Study Site Cross-Section 1

Boards in at ACID Dam					Boards out at ACID Dam				
Flow	Fall-run	Late-fall-run	Winter-run	Steelhead	Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	142.9	129.4	33.5	18.0	3250	238.7	239.7	124.9	12.0
3500	155.5	139.7	38.1	17.5	3500	237.4	235.9	135.5	11.4
3750	167.2	149.1	42.4	17.0	3750	233.6	230.6	145.2	10.9
4000	178.1	157.7	46.6	16.4	4000	228.0	223.7	154.0	10.6
4250	188.4	165.6	51.0	15.8	4250	220.9	216.2	161.3	10.2
4500	197.7	172.2	55.5	15.2	4500	213.3	208.1	167.3	10.0
4750	205.3	177.0	60.2	14.6	4750	205.2	199.9	172.2	9.7
5000	211.9	180.7	64.8	14.1	5000	195.5	190.5	176.5	9.6
5250	217.2	183.4	69.2	13.5	5250	186.5	181.7	179.2	9.5
5500	221.3	184.9	73.3	13.0	5500	177.3	173.3	181.2	9.5
6000	227.3	185.6	81.0	12.1	6000	158.7	157.3	183.5	9.5
6500	228.8	183.0	87.8	11.3	6500	141.3	143.1	183.6	9.4
7000	227.1	178.5	93.8	10.8	7000	124.5	130.1	181.8	9.4
7500	222.7	172.4	99.2	10.3	7500	109.3	118.2	178.8	9.3
8000	216.1	165.6	103.8	9.9	8000	95.7	107.7	174.0	9.1
9000	200.3	149.7	110.1	9.3	9000	73.2	89.8	161.7	8.8
10000	181.7	132.9	113.1	9.2	10000	57.0	76.4	148.3	8.4
11000	163.0	117.9	113.1	9.2	11000	43.9	65.5	133.8	7.9
12000	145.4	104.5	110.8	9.1	12000	35.2	56.9	120.1	7.2
13000	128.9	92.6	106.9	9.1	13000	27.7	50.5	106.6	6.0
14000	113.6	82.1	102.3	9.1	14000	23.0	45.2	94.3	4.6
15000	100.8	73.2	96.5	9.1	15000	18.9	40.7	83.1	3.1
17000	79.9	58.1	83.2	9.0	17000	13.7	34.3	63.5	0.8
19000	64.8	46.2	69.4	9.0	19000	10.8	29.4	48.1	0.0
21000	53.4	37.3	56.2	8.9	21000	9.5	25.0	37.4	0.0
23000	45.0	29.8	43.2	8.8	23000	8.6	20.8	28.8	0.0
25000	38.6	23.4	31.4	8.6	25000	8.2	17.2	22.7	0.0
27000	33.7	17.8	20.6	8.4	27000	7.6	13.8	18.3	0.0
29000	30.3	12.9	11.0	8.2	29000	7.1	10.9	14.8	0.0
31000	26.7	8.7	3.1	7.8	31000	5.7	7.7	11.9	0.0

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 6 (cfs).

Upper Lake Redding Study Site Cross-Section 2

Boards in at ACID Dam

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	198.4	172.9	52.9	21.0
3500	214.4	185.5	59.7	20.3
3750	228.4	195.9	66.1	19.6
4000	242.2	206.1	72.8	18.8
4250	254.3	214.2	79.5	18.0
4500	264.1	220.5	86.4	17.3
4750	272.2	224.7	93.4	16.6
5000	278.5	227.3	99.5	16.0
5250	282.8	228.6	105.6	15.3
5500	286.4	229.1	111.7	14.7
6000	289.4	226.2	122.1	13.7
6500	286.4	220.3	131.4	12.9
7000	280.0	212.1	139.3	12.4
7500	270.8	202.7	145.7	11.9
8000	260.0	192.3	151.2	11.5
9000	235.4	170.4	156.9	11.1
10000	209.2	149.6	158.3	11.1
11000	185.0	131.3	155.0	11.1
12000	162.0	115.2	149.5	11.1
13000	142.0	101.2	142.0	11.1
14000	124.2	89.2	133.3	11.0
15000	109.7	78.8	123.3	11.0
17000	86.2	61.5	102.3	11.0
19000	70.2	48.3	81.8	10.9
21000	57.7	38.1	62.3	10.7
23000	49.0	29.3	43.7	10.4
25000	42.5	21.7	27.7	10.1
27000	37.6	15.2	14.4	9.6
29000	33.3	9.6	4.0	9.1
31000	29.6	5.1	0.0	8.5

Boards out at ACID Dam

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	292.6	286.5	198.7	13.6
3500	286.8	279.7	210.0	13.1
3750	279.4	271.4	219.9	12.6
4000	270.5	261.8	227.9	12.3
4250	260.5	252.2	234.3	12.1
4500	249.7	241.7	240.1	11.8
4750	238.7	231.3	244.7	11.6
5000	227.1	220.2	248.3	11.5
5250	216.3	210.2	250.4	11.5
5500	204.5	200.3	252.0	11.5
6000	182.2	181.6	252.4	11.5
6500	161.4	164.5	250.4	11.5
7000	142.2	149.6	246.2	11.3
7500	124.5	136.2	240.4	11.1
8000	109.5	124.2	232.7	10.8
9000	84.0	103.9	214.6	10.1
10000	65.3	88.3	195.3	9.3
11000	50.8	76.2	175.3	8.4
12000	40.7	66.2	156.3	7.4
13000	32.6	58.9	138.4	6.1
14000	26.9	52.6	121.9	4.6
15000	22.5	47.4	106.8	3.2
17000	16.5	39.7	81.5	0.9
19000	13.3	33.7	61.4	0.0
21000	12.1	28.4	47.4	0.0
23000	11.2	23.7	36.6	0.0
25000	9.2	18.5	28.3	0.0
27000	8.7	14.8	22.7	0.0
29000	7.5	11.3	18.2	0.0
31000	5.7	8.2	14.6	0.0

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 6 (cfs).

Lower Lake Redding Study Site

Boards in at ACID Dam

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	68.1	60.0	12.3	5.6
3500	73.7	64.5	14.0	5.4
3750	78.9	68.8	15.7	5.3
4000	84.0	72.9	17.5	5.1
4250	88.6	76.4	19.2	4.9
4500	92.3	79.3	20.9	4.7
4750	95.8	82.1	22.6	4.6
5000	99.0	84.6	24.2	4.6
5250	101.7	86.8	25.7	4.6
5500	103.9	89.0	27.3	4.5
6000	107.6	92.8	30.2	4.4
6500	110.2	95.7	32.8	4.4
7000	112.2	98.3	35.8	4.4
7500	113.7	100.4	39.6	4.2
8000	114.9	102.4	41.7	4.3
9000	116.5	106.0	46.7	4.5
10000	118.3	109.7	51.3	4.8
11000	119.8	112.3	55.1	4.9
12000	120.4	113.8	57.4	5.0
13000	120.8	114.1	59.3	4.9
14000	120.2	113.1	61.5	4.7
15000	119.3	111.1	63.5	4.6
17000	115.3	104.7	64.9	4.4
19000	109.2	96.1	65.0	4.2
21000	101.7	86.4	64.8	3.9
23000	93.7	76.4	63.4	3.6
25000	85.3	66.7	60.9	3.3
27000	76.9	58.1	57.8	3.1
29000	69.1	50.4	54.2	2.9
31000	61.9	43.5	50.2	2.7

Boards out at ACID Dam

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	32.9	49.8	65.0	4.2
3500	28.9	45.3	61.5	3.8
3750	25.6	41.7	58.0	3.4
4000	23.0	38.7	54.1	2.8
4250	20.9	36.1	50.3	2.4
4500	19.2	33.9	46.6	2.1
4750	18.0	32.0	43.3	1.9
5000	16.9	30.4	40.3	1.8
5250	16.1	28.9	37.6	1.7
5500	15.5	27.5	34.8	1.5
6000	14.6	25.2	30.4	1.3
6500	14.0	23.3	27.0	1.2
7000	13.7	21.7	24.1	1.1
7500	12.5	19.5	21.6	1.1
8000	12.3	17.9	19.9	1.1
9000	12.3	16.5	17.5	1.1
10000	12.9	16.0	15.9	1.1
11000	13.3	15.5	15.1	1.1
12000	12.9	14.7	15.0	1.1
13000	12.7	14.5	15.4	1.1
14000	12.2	14.5	15.6	1.0
15000	11.5	14.4	15.8	0.9
17000	12.2	16.9	17.2	0.5
19000	17.7	26.9	18.0	0.3
21000	19.8	34.4	27.5	0.1
23000	20.4	36.0	31.7	0.0
25000	22.4	36.6	37.3	0.0
27000	26.2	38.8	41.5	0.2
29000	27.4	39.4	46.8	0.3
31000	24.6	36.3	49.9	0.5

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 6 (cfs).

Bridge Riffle Study Site Cross-Section 1

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	87.5	96.1	51.2	4.2
3500	88.3	96.1	56.4	4.0
3750	88.0	95.0	61.4	3.8
4000	86.9	93.2	65.6	3.6
4250	85.1	90.9	69.4	3.5
4500	82.8	88.3	72.9	3.4
4750	80.1	85.6	75.7	3.3
5000	77.1	82.6	78.2	3.2
5250	73.6	79.4	80.4	3.2
5500	70.1	76.0	82.1	3.1
6000	63.4	69.9	84.0	3.0
6500	56.3	63.7	84.7	3.0
7000	50.1	58.0	84.2	3.0
7500	44.2	53.0	82.8	3.0
8000	38.8	48.5	80.5	2.9
9000	30.1	41.1	74.7	2.6
10000	25.4	36.8	69.5	2.3
11000	21.8	32.9	64.5	2.0
12000	18.5	29.2	59.3	1.8
13000	16.0	26.1	54.3	1.7
14000	13.9	23.4	49.8	1.6
15000	12.1	21.2	45.5	1.5
17000	9.5	17.4	37.9	1.3
19000	7.6	14.6	31.4	1.1
21000	6.3	12.1	26.1	0.8
23000	5.3	10.2	21.8	0.6
25000	3.9	8.2	18.1	0.4
27000	3.1	6.5	14.9	0.2
29000	2.6	5.7	12.4	0.1
31000	2.3	4.9	10.4	0.0

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Bridge Riffle Study Site Cross-Section 2

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	42.7	48.0	29.9	2.3
3500	44.7	50.4	32.4	2.5
3750	46.1	52.5	33.8	2.7
4000	47.4	54.2	38.7	2.8
4250	48.9	55.8	41.3	2.8
4500	49.4	56.4	43.1	2.8
4750	48.9	55.9	44.6	2.9
5000	48.2	55.5	47.9	2.9
5250	47.0	54.5	50.1	2.9
5500	45.4	52.8	51.3	2.9
6000	41.8	49.1	52.6	2.9
6500	38.6	45.7	54.1	2.8
7000	35.3	42.7	55.0	2.7
7500	32.3	40.1	54.1	2.6
8000	29.6	38.1	53.2	2.6
9000	24.7	33.8	50.0	2.4
10000	21.6	31.5	51.7	2.3
11000	19.1	29.0	50.3	2.3
12000	16.7	26.4	47.0	2.1
13000	15.1	24.4	43.9	1.9
14000	13.8	22.7	40.5	1.7
15000	12.6	21.0	36.9	1.5
17000	11.7	18.9	30.0	1.1
19000	11.0	17.0	24.6	1.1
21000	10.5	15.6	20.5	1.0
23000	10.4	14.2	17.2	0.9
25000	10.5	13.4	14.5	0.9
27000	10.7	12.6	12.5	0.8
29000	10.4	11.7	10.8	0.8
31000	10.5	10.8	9.5	0.8

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Bridge Riffle Study Site Cross-Section 3

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	10.2	19.7	4.7	1.2
3500	11.4	21.0	5.0	1.3
3750	12.7	22.4	5.2	1.3
4000	14.2	23.8	5.5	1.3
4250	15.8	25.3	5.9	1.4
4500	17.3	26.7	6.4	1.4
4750	18.9	28.2	7.1	1.4
5000	20.3	29.5	7.7	1.4
5250	22.2	31.4	8.5	1.5
5500	23.5	32.5	9.0	1.5
6000	25.6	34.2	10.1	1.4
6500	27.5	35.7	11.9	1.4
7000	28.2	35.7	13.2	1.4
7500	28.1	35.1	14.6	1.4
8000	27.4	34.2	16.2	1.3
9000	24.1	30.5	18.8	1.4
10000	21.2	27.7	22.4	1.6
11000	18.1	24.3	25.0	1.6
12000	15.5	21.5	26.0	1.5
13000	13.5	19.2	25.6	1.4
14000	11.9	17.4	24.0	1.4
15000	10.7	15.9	22.3	1.3
17000	8.9	13.6	19.1	1.2
19000	7.7	11.8	16.3	1.1
21000	6.9	10.5	13.9	1.1
23000	6.7	9.8	12.0	1.3
25000	6.9	9.4	10.4	1.3
27000	6.6	8.5	9.1	1.2
29000	6.6	8.0	7.9	1.3
31000	6.7	7.5	6.9	1.3

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Posse Grounds Study Site Cross-Section 1

	Left Channel					Right Channel			
Flow	Fall-run	Late-fall-run	Winter-run	Steelhead	Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	30.4	34.0	13.0	2.7	3250	0.4	1.7	1.4	0.0
3500	30.4	34.9	14.7	2.6	3500	0.4	1.5	1.1	0.0
3750	30.5	36.1	16.2	2.6	3750	0.3	1.5	1.0	0.0
4000	30.1	36.1	17.7	2.5	4000	0.5	1.5	0.8	0.0
4250	29.4	36.1	19.3	2.4	4250	0.9	2.0	0.8	0.0
4500	28.4	35.8	21.1	2.0	4500	1.2	2.4	0.7	0.0
4750	27.7	35.5	23.2	1.9	4750	1.6	3.0	0.6	0.0
5000	27.4	35.6	25.0	1.8	5000	2.1	3.6	0.5	0.0
5250	26.2	34.7	26.6	1.8	5250	2.4	4.0	0.6	0.0
5500	26.1	34.6	28.8	1.7	5500	3.0	4.8	0.6	0.0
6000	24.3	35.0	30.6	1.7	6000	3.6	5.6	0.7	0.0
6500	24.5	35.1	31.9	1.7	6500	4.4	6.4	0.8	0.0
7000	25.2	35.6	32.7	1.7	7000	4.9	6.8	0.9	0.0
7500	25.5	35.8	35.1	1.7	7500	5.6	7.8	1.0	0.0
8000	26.0	37.6	36.4	1.6	8000	6.1	8.4	1.0	0.0
9000	21.6	36.4	37.6	1.5	9000	7.5	10.0	1.7	0.0
10000	17.4	34.5	38.8	1.3	10000	9.6	12.1	1.8	0.8
11000	14.7	34.0	50.8	1.2	11000	10.9	13.4	2.2	0.9
12000	12.0	31.6	50.5	1.1	12000	12.1	14.5	2.6	1.0
13000	9.6	28.6	48.8	1.0	13000	13.3	15.6	3.0	1.2
14000	7.7	25.2	44.5	0.7	14000	15.6	17.7	3.4	1.9
15000	6.5	22.6	40.6	0.6	15000	16.8	18.8	3.7	2.0
17000	4.8	17.9	32.2	0.4	17000	19.1	20.7	4.5	2.2
19000	3.9	13.7	24.4	0.3	19000	21.1	22.3	5.0	2.4
21000	2.9	9.8	18.3	0.2	21000	22.9	23.6	5.6	2.6
23000	2.1	6.8	14.0	0.1	23000	24.5	24.7	6.1	2.7
25000	1.6	5.0	10.8	0.0	25000	25.9	25.5	6.5	2.8
27000	0.9	3.3	8.2	0.0	27000	27.0	26.3	7.0	2.8
29000	0.5	1.9	6.4	0.0	29000	28.0	26.8	7.5	2.8
31000	0.5	1.5	5.0	0.0	31000	29.0	27.1	8.3	2.9

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Posse Grounds Study Site Cross-Section 2

Left Channel					Right Channel				
Flow	Fall-run	Late-fall-run	Winter-run	Steelhead	Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	42.7	31.7	11.4	4.8	3250	0.1	1.8	1.0	0.0
3500	44.7	33.7	12.7	5.1	3500	0.1	1.7	0.9	0.0
3750	46.1	36.3	14.1	5.6	3750	0.1	1.6	0.8	0.0
4000	47.4	38.6	16.3	5.8	4000	0.1	1.5	0.7	0.0
4250	48.9	40.5	18.1	5.9	4250	0.1	1.5	0.6	0.0
4500	49.4	42.4	20.5	5.8	4500	0.1	1.4	0.6	0.0
4750	48.9	43.7	23.0	5.8	4750	0.2	1.6	0.5	0.0
5000	48.2	45.1	24.8	5.8	5000	0.3	1.7	0.5	0.0
5250	47.0	45.8	26.1	5.9	5250	0.4	2.0	0.4	0.0
5500	45.4	46.3	27.2	6.0	5500	0.5	2.3	0.4	0.0
6000	41.8	46.9	29.5	6.3	6000	0.9	3.3	0.3	0.0
6500	38.6	46.4	31.3	6.3	6500	1.3	4.4	0.3	0.0
7000	35.3	45.3	33.5	6.3	7000	1.8	5.9	0.3	0.0
7500	32.3	43.9	35.2	6.1	7500	2.3	7.2	0.4	0.0
8000	29.6	42.0	36.5	5.8	8000	2.8	8.6	0.5	0.0
9000	24.7	52.7	52.3	4.2	9000	4.6	12.0	1.0	0.5
10000	21.6	47.1	53.7	3.6	10000	7.1	15.8	1.2	1.3
11000	19.1	44.4	56.4	3.5	11000	9.6	19.6	1.7	1.8
12000	16.7	41.5	57.6	3.5	12000	11.5	22.2	2.3	2.0
13000	15.1	38.4	57.1	3.4	13000	13.1	24.7	3.1	2.1
14000	13.8	35.2	55.3	3.4	14000	14.8	26.8	3.8	2.1
15000	12.6	32.5	53.1	3.4	15000	16.3	28.5	4.2	2.1
17000	11.7	27.1	47.7	3.2	17000	19.2	31.2	8.3	2.1
19000	11.0	22.1	42.7	3.0	19000	21.3	33.0	9.5	2.0
21000	10.5	18.7	37.5	2.7	21000	23.0	34.2	10.5	1.9
23000	10.4	15.7	32.6	2.5	23000	24.4	34.8	11.3	1.8
25000	10.5	12.7	28.6	2.3	25000	25.4	35.0	12.1	1.7
27000	10.7	10.9	24.7	2.1	27000	26.2	34.8	12.8	1.6
29000	10.4	9.3	21.1	1.9	29000	26.8	34.5	13.4	1.6
31000	10.5	8.2	18.0	1.6	31000	27.1	33.8	13.8	1.5

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Posse Grounds Study Site Cross-Section 3

	Left Channel					Right Channel			
Flow	Fall-run	Late-fall-run	Winter-run	Steelhead	Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	10.2	25.2	10.8	2.4	3250	0.2	2.2	1.9	0.0
3500	11.4	25.1	12.1	2.0	3500	0.2	2.0	1.6	0.0
3750	12.7	25.0	14.1	2.1	3750	0.2	1.9	1.4	0.0
4000	14.2	25.6	15.2	2.0	4000	0.2	1.6	1.2	0.0
4250	15.8	25.4	16.1	2.0	4250	0.1	1.2	1.1	0.0
4500	17.3	25.9	16.8	2.3	4500	0.1	1.1	1.0	0.0
4750	18.9	26.1	17.5	2.5	4750	0.2	1.3	0.9	0.0
5000	20.3	26.3	18.1	3.0	5000	0.3	1.6	0.8	0.0
5250	22.2	26.7	18.8	3.2	5250	0.5	2.1	0.7	0.0
5500	23.5	26.8	19.7	3.4	5500	0.8	2.7	0.7	0.0
6000	25.6	27.9	20.8	3.9	6000	1.3	4.4	0.8	0.0
6500	27.5	28.4	21.4	4.5	6500	1.9	6.1	1.1	0.0
7000	28.2	29.2	23.1	5.0	7000	2.6	7.9	1.3	0.0
7500	28.1	30.3	24.5	5.3	7500	3.0	9.0	1.6	0.0
8000	27.4	31.3	25.2	5.4	8000	3.2	9.6	1.9	0.0
9000	24.1	28.8	33.0	4.4	9000	3.7	10.6	2.8	0.0
10000	21.2	24.9	32.9	3.8	10000	3.9	11.0	3.6	0.0
11000	18.1	21.4	30.3	2.8	11000	4.2	11.6	3.9	0.0
12000	15.5	18.1	26.4	1.5	12000	4.5	12.3	4.0	0.0
13000	13.5	15.3	22.4	0.6	13000	4.6	12.5	4.1	0.0
14000	11.9	13.0	18.6	0.1	14000	4.9	13.3	4.0	0.0
15000	10.7	11.6	17.2	0.0	15000	5.1	13.6	4.0	0.0
17000	8.9	9.2	14.1	0.0	17000	5.3	14.2	3.9	0.0
19000	7.7	7.2	11.2	0.0	19000	5.6	14.7	3.7	0.0
21000	6.9	4.9	8.6	0.0	21000	5.8	15.2	3.5	0.0
23000	6.7	3.0	6.6	0.0	23000	6.1	15.7	3.3	0.0
25000	6.9	2.1	5.3	0.0	25000	6.4	16.0	3.3	0.0
27000	6.6	1.6	4.1	0.0	27000	6.6	16.3	3.3	0.0
29000	6.6	1.4	3.3	0.0	29000	6.8	16.6	3.4	0.0
31000	6.7	1.1	2.6	0.0	31000	7.1	16.8	3.5	0.0

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Posse Grounds Study Site Cross-Section 4

	Left Channel					Right Channel			
Flow	Fall-run	Late-fall-run	Winter-run	Steelhead	Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	21.1	50.2	6.9	0.6	3250	0.1	0.6	0.0	0.0
3500	23.6	54.8	9.0	0.6	3500	0.1	0.9	0.0	0.0
3750	25.9	58.6	10.9	0.9	3750	0.4	1.2	0.0	0.0
4000	28.4	61.7	12.9	0.9	4000	0.6	2.0	0.1	0.0
4250	30.5	64.4	15.0	0.9	4250	1.0	3.0	0.2	0.0
4500	32.2	66.4	17.1	0.9	4500	1.6	4.1	0.3	0.0
4750	33.8	67.6	19.2	0.9	4750	2.1	5.4	0.9	0.0
5000	35.0	68.3	21.2	1.1	5000	2.4	6.6	1.3	0.0
5250	36.2	69.1	23.8	1.1	5250	2.7	7.8	1.9	0.0
5500	36.8	69.1	26.5	1.1	5500	3.1	8.9	2.6	0.0
6000	37.3	68.5	30.5	1.4	6000	3.7	10.8	4.1	0.0
6500	38.4	68.6	34.3	1.5	6500	4.3	12.6	5.0	0.0
7000	37.7	66.8	37.6	1.5	7000	4.8	14.4	6.3	0.0
7500	40.1	67.3	40.1	1.6	7500	5.6	16.8	7.3	0.0
8000	41.4	66.8	43.1	1.8	8000	6.7	19.9	8.0	0.0
9000	48.1	67.4	45.6	2.1	9000	9.5	28.2	9.8	0.0
10000	49.0	65.7	45.9	2.3	10000	12.6	37.3	12.0	0.0
11000	45.4	61.8	46.0	2.7	11000	15.0	43.8	14.2	0.0
12000	38.0	55.1	48.0	3.0	12000	16.7	47.8	16.3	0.0
13000	30.3	48.5	52.1	3.1	13000	17.6	49.8	18.3	0.0
14000	23.3	41.7	50.6	3.0	14000	18.1	50.1	20.0	0.0
15000	19.0	36.8	49.9	2.2	15000	18.1	49.2	21.3	0.0
17000	12.6	27.7	43.6	0.2	17000	17.4	46.3	23.2	0.0
19000	9.4	21.2	35.9	0.0	19000	16.4	42.6	24.1	0.0
21000	7.2	15.4	28.9	0.0	21000	15.2	39.0	24.4	0.0
23000	5.2	10.6	22.9	0.0	23000	14.1	35.6	24.4	0.0
25000	2.9	6.3	18.4	0.0	25000	13.0	32.7	24.0	0.0
27000	2.2	5.1	14.7	0.0	27000	12.1	30.3	23.6	0.0
29000	1.8	4.3	11.9	0.0	29000	11.3	28.2	23.0	0.0
31000	1.5	3.6	9.8	0.0	31000	10.6	26.4	22.4	0.0

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Posse Grounds Study Site Cross-Section 5

Left Channel					Right Channel				
Flow	Fall-run	Late-fall-run	Winter-run	Steelhead	Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	13.7	32.4	4.9	2.2	3250	0.0	0.4	0.0	0.0
3500	15.8	35.9	6.0	2.4	3500	0.0	0.4	0.0	0.0
3750	18.0	39.2	7.1	3.3	3750	0.0	0.5	0.0	0.0
4000	20.1	42.6	8.2	3.5	4000	0.0	0.5	0.0	0.0
4250	22.3	45.7	9.8	3.6	4250	0.0	0.5	0.0	0.0
4500	24.8	48.9	11.5	3.8	4500	0.1	0.8	0.0	0.0
4750	27.6	52.0	13.2	4.1	4750	0.3	1.1	0.0	0.0
5000	30.5	54.8	14.9	4.2	5000	0.6	2.1	0.0	0.0
5250	32.9	57.3	16.5	4.2	5250	1.2	3.2	0.0	0.0
5500	35.1	59.4	18.3	4.3	5500	1.9	4.8	0.1	0.0
6000	40.0	63.5	21.6	4.7	6000	3.4	8.6	0.4	0.0
6500	44.1	66.6	25.4	5.0	6500	4.9	12.8	1.5	0.0
7000	47.9	68.4	28.6	5.0	7000	6.2	16.9	3.5	0.0
7500	51.0	69.5	31.2	6.0	7500	7.3	20.4	5.7	0.0
8000	52.9	70.0	34.2	6.2	8000	8.5	23.9	7.4	0.0
9000	68.5	82.3	46.4	6.7	9000	9.8	28.3	9.6	0.0
10000	68.9	80.7	54.0	6.7	10000	12.1	35.3	13.2	0.0
11000	67.0	78.3	62.7	6.7	11000	13.9	40.3	16.0	0.0
12000	61.5	72.3	69.3	6.5	12000	14.6	41.8	18.4	0.0
13000	52.6	63.5	73.0	5.8	13000	14.6	41.4	20.0	0.0
14000	42.8	54.5	74.0	5.2	14000	14.3	39.9	21.3	0.0
15000	33.9	46.6	72.9	4.9	15000	13.8	38.2	22.0	0.0
17000	20.8	34.2	64.9	4.4	17000	12.6	34.6	22.6	0.0
19000	12.6	25.6	52.7	3.4	19000	11.5	31.0	22.3	0.0
21000	7.9	19.6	40.3	2.0	21000	10.4	28.0	21.9	0.0
23000	5.1	14.4	29.5	0.6	23000	9.4	25.4	21.3	0.0
25000	3.5	11.1	21.3	0.0	25000	8.6	23.2	20.6	0.0
27000	2.9	8.4	15.4	0.0	27000	7.9	21.4	19.9	0.0
29000	2.4	5.9	11.1	0.0	29000	7.2	19.8	19.3	0.0
31000	2.4	4.5	8.2	0.0	31000	6.7	18.5	18.7	0.0

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Posse Grounds Study Site Cross-Section 6

	Left Channel					Right Channel			
Flow	Fall-run	Late-fall-run	Winter-run	Steelhead	Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	14.3	31.3	3.4	1.7	3250	1.2	3.2	0.0	0.0
3500	17.2	36.5	4.2	2.2	3500	1.4	3.6	0.0	0.0
3750	20.9	41.7	5.7	2.5	3750	1.4	3.9	0.6	0.0
4000	25.0	46.9	7.3	3.1	4000	1.3	4.2	1.7	0.0
4250	29.5	52.3	8.8	3.4	4250	1.3	4.3	2.0	0.0
4500	34.0	57.4	10.2	3.7	4500	1.4	4.5	2.3	0.0
4750	38.5	62.3	11.8	4.3	4750	1.5	4.6	2.4	0.0
5000	42.8	66.9	14.3	5.0	5000	1.6	5.4	2.6	0.0
5250	47.3	71.5	17.5	5.4	5250	1.9	6.0	2.6	0.0
5500	51.5	75.3	19.8	5.5	5500	2.5	6.9	2.7	0.0
6000	58.4	80.7	24.5	5.6	6000	3.3	9.6	3.5	0.0
6500	62.9	82.9	29.7	5.6	6500	5.0	13.8	4.2	0.0
7000	64.9	82.7	36.6	5.9	7000	6.8	19.1	6.3	0.0
7500	64.0	80.6	45.6	5.9	7500	8.6	23.9	7.4	0.0
8000	60.8	76.0	50.9	5.9	8000	10.1	28.4	10.0	0.0
9000	85.2	99.5	83.4	6.2	9000	11.9	34.7	17.0	0.0
10000	68.0	83.8	94.3	6.2	10000	10.7	32.9	21.9	0.0
11000	51.7	69.3	100.1	6.2	11000	8.7	28.4	24.7	0.0
12000	38.1	57.0	99.8	6.2	12000	6.9	24.2	25.7	0.0
13000	27.8	47.3	95.1	6.0	13000	5.6	21.0	25.4	0.0
14000	20.2	39.7	86.8	5.3	14000	4.6	18.6	24.3	0.0
15000	14.9	33.9	76.9	4.1	15000	3.8	16.6	22.8	0.0
17000	8.5	26.0	55.2	1.3	17000	2.8	13.8	19.7	0.0
19000	5.6	20.5	37.5	0.1	19000	2.3	11.9	17.1	0.0
21000	4.7	15.8	25.4	0.0	21000	1.9	10.6	14.9	0.0
23000	3.7	10.8	17.1	0.0	23000	1.6	9.5	13.1	0.0
25000	2.6	5.9	11.9	0.0	25000	1.4	8.7	11.6	0.0
27000	1.0	2.0	8.2	0.0	27000	1.2	8.1	10.4	0.0
29000	0.1	0.6	6.0	0.0	29000	1.1	7.5	9.3	0.0
31000	0.0	0.2	4.3	0.0	31000	1.1	7.1	8.5	0.0

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Posse Grounds Study Site Cross-Section 7

Left Channel

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	4.8	6.9	0.0	6.4
3500	6.1	8.8	0.0	7.1
3750	7.5	10.9	0.2	7.6
4000	9.1	13.2	0.8	8.8
4250	11.2	16.1	1.1	9.5
4500	13.2	19.0	1.8	9.8
4750	15.2	21.9	2.4	9.8
5000	17.3	24.8	3.2	9.7
5250	19.4	27.6	4.2	9.6
5500	21.3	30.3	5.3	9.4
6000	24.9	35.0	7.5	8.9
6500	27.6	38.3	9.8	8.4
7000	29.3	40.0	12.4	8.1
7500	30.0	40.2	15.1	8.0
8000	47.7	56.7	22.4	11.5
9000	47.3	53.7	29.8	10.6
10000	44.1	48.8	36.3	10.1
11000	39.9	43.6	41.2	9.8
12000	34.9	38.2	43.6	9.7
13000	29.2	32.8	43.7	9.4
14000	23.7	27.9	42.0	8.9
15000	18.8	23.6	38.9	8.2
17000	11.4	17.2	31.6	6.8
19000	6.8	12.8	24.0	4.6
21000	4.1	9.3	17.5	2.2
23000	2.6	6.5	12.2	0.8
25000	1.7	4.6	8.4	0.2
27000	1.3	3.5	5.9	0.0
29000	1.3	2.4	4.2	0.0
31000	0.4	1.0	2.8	0.0

Right Channel

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	0.0	0.7	0.0	0.0
3500	0.0	0.7	0.0	0.0
3750	0.0	0.7	0.0	0.0
4000	0.0	0.6	0.0	0.0
4250	0.0	0.6	0.0	0.0
4500	0.0	0.8	0.0	0.0
4750	0.2	1.2	0.0	0.0
5000	0.6	2.1	0.0	0.0
5250	1.2	3.2	0.0	0.0
5500	1.9	5.2	0.0	0.0
6000	3.9	10.1	0.0	0.0
6500	6.0	16.1	0.9	0.0
7000	7.8	21.4	3.0	0.0
7500	8.8	24.5	5.1	0.0
8000	9.1	25.7	6.7	0.0
9000	8.4	23.9	9.9	0.0
10000	7.2	20.9	12.5	0.0
11000	6.1	18.3	14.3	0.0
12000	5.2	16.2	14.8	0.0
13000	4.5	14.4	14.5	0.0
14000	3.9	13.0	14.0	0.0
15000	3.4	11.8	13.5	0.0
17000	2.7	10.0	12.3	0.0
19000	2.2	8.6	11.3	0.0
21000	1.9	7.7	10.4	0.0
23000	1.6	7.0	9.5	0.0
25000	1.4	6.4	8.8	0.0
27000	1.3	5.9	8.2	0.0
29000	1.2	5.5	7.7	0.0
31000	1.0	5.2	7.2	0.0

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Posse Grounds Study Site Cross-Section 8

Left Channel					Right Channel				
Flow	Fall-run	Late-fall-run	Winter-run	Steelhead	Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	5.9	8.5	0.1	2.6	3250	0.0	0.6	0.0	0.0
3500	7.5	10.7	0.2	2.9	3500	0.0	0.6	0.0	0.0
3750	8.9	12.6	0.2	3.1	3750	0.0	0.6	0.0	0.0
4000	10.5	14.7	1.3	3.2	4000	0.0	0.6	0.0	0.0
4250	12.5	17.1	2.6	3.4	4250	0.0	0.6	0.0	0.0
4500	14.3	19.2	3.4	3.5	4500	0.0	0.8	0.0	0.0
4750	16.1	21.5	4.4	3.6	4750	0.2	1.1	0.0	0.0
5000	18.0	23.7	5.2	3.6	5000	0.4	2.3	0.0	0.0
5250	19.8	25.8	6.1	3.6	5250	1.6	4.5	0.0	0.0
5500	21.6	27.7	7.0	3.7	5500	2.9	6.8	0.0	0.0
6000	25.2	31.5	9.6	3.8	6000	4.5	11.6	0.3	0.0
6500	28.7	34.4	12.1	3.9	6500	5.5	14.9	1.5	0.0
7000	31.7	36.5	15.2	4.0	7000	5.5	16.4	6.2	0.0
7500	33.9	38.0	17.8	3.9	7500	5.0	16.0	8.0	0.0
8000	35.6	39.3	20.4	4.1	8000	4.2	14.6	9.3	0.0
9000	40.9	44.1	27.4	5.0	9000	2.8	11.4	10.6	0.0
10000	43.3	45.9	31.8	5.2	10000	1.9	9.3	11.1	0.0
11000	46.7	49.0	36.5	5.5	11000	1.4	7.9	10.7	0.0
12000	49.2	51.4	40.1	5.5	12000	1.2	6.9	9.7	0.0
13000	49.6	51.4	43.7	5.1	13000	0.9	6.1	8.6	0.0
14000	47.6	48.9	46.2	4.6	14000	0.7	5.5	7.6	0.0
15000	43.5	44.8	47.8	4.1	15000	0.6	5.1	6.8	0.0
17000	32.5	35.0	48.8	3.4	17000	0.5	4.5	5.4	0.0
19000	21.9	26.0	46.1	3.2	19000	0.4	4.0	4.5	0.0
21000	13.7	18.9	40.1	2.9	21000	0.4	3.6	3.8	0.0
23000	8.4	14.0	32.6	2.4	23000	0.4	3.3	3.2	0.0
25000	4.8	10.1	25.0	1.5	25000	0.4	3.0	2.8	0.0
27000	3.1	7.9	18.6	0.6	27000	0.3	2.8	2.5	0.0
29000	2.3	6.5	13.1	0.0	29000	0.3	2.6	2.3	0.0
31000	1.8	5.1	9.5	0.0	31000	0.3	2.5	2.2	0.0

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Posse Grounds Study Site Cross-Section 9

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	126.0	190.9	66.4	5.6
3500	132.1	195.4	75.2	5.4
3750	136.1	197.0	83.7	5.1
4000	138.4	196.4	91.8	4.8
4250	139.1	193.7	99.8	4.6
4500	138.1	189.4	106.9	4.4
4750	135.9	183.8	113.8	4.2
5000	132.8	177.5	119.6	4.0
5250	129.0	170.8	124.3	3.9
5500	124.5	163.8	128.6	3.8
6000	114.6	149.7	134.9	3.6
6500	103.5	135.6	139.1	3.6
7000	92.5	122.5	140.7	3.5
7500	81.7	110.3	140.4	3.5
8000	71.6	99.4	138.3	3.5
9000	54.6	81.5	130.1	3.4
10000	43.7	69.2	119.1	3.4
11000	35.2	59.9	107.2	3.2
12000	29.0	52.5	95.8	2.9
13000	24.1	46.6	84.7	2.6
14000	20.4	41.7	74.7	2.2
15000	17.5	37.6	65.6	1.9
17000	13.7	30.7	50.6	1.3
19000	11.2	24.8	39.2	0.8
21000	9.2	19.3	30.7	0.6
23000	7.4	14.5	24.3	0.4
25000	5.9	10.8	19.5	0.3
27000	5.1	8.4	15.8	0.2
29000	4.4	6.6	12.9	0.2
31000	3.5	5.1	10.7	0.1

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Posse Grounds Study Site Cross-Section 10

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	103.7	134.0	44.8	6.3
3500	111.4	141.1	52.0	6.0
3750	117.5	145.5	59.2	5.7
4000	121.9	147.7	66.5	5.4
4250	124.8	148.1	73.8	5.1
4500	126.1	146.9	80.0	4.9
4750	126.2	144.5	86.3	4.6
5000	125.1	141.2	91.5	4.4
5250	123.1	137.2	96.2	4.3
5500	120.3	132.7	100.4	4.2
6000	113.2	123.1	107.2	3.9
6500	104.5	112.9	112.2	3.8
7000	95.1	103.0	115.3	3.7
7500	85.6	93.6	116.5	3.6
8000	76.2	84.8	116.2	3.6
9000	59.5	69.9	111.9	3.5
10000	47.2	58.7	104.1	3.5
11000	37.7	50.2	94.9	3.3
12000	30.5	43.3	85.4	3.1
13000	24.8	37.8	76.1	2.7
14000	20.6	33.4	67.2	2.3
15000	17.3	29.6	59.1	1.8
17000	12.6	23.8	45.1	1.1
19000	9.8	18.7	34.4	0.7
21000	7.9	14.6	26.2	0.5
23000	6.4	10.9	20.3	0.4
25000	4.9	7.9	15.9	0.4
27000	4.2	5.8	12.5	0.3
29000	2.5	3.4	9.9	0.2
31000	2.1	2.8	8.0	0.2

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Above Hawes Hole Study Site Cross-Section 1

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	96.0	132.7	111.7	4.6
3500	93.0	129.7	112.4	4.2
3750	89.6	126.9	112.5	4.1
4000	85.7	123.9	111.9	3.7
4250	82.7	121.2	110.9	3.5
4500	80.8	119.6	109.6	3.2
4750	78.2	117.5	108.1	3.0
5000	77.5	116.0	106.2	2.9
5250	76.7	113.8	103.9	2.9
5500	76.8	113.7	102.7	3.0
6000	77.5	112.7	97.9	2.9
6500	83.0	112.4	96.2	3.1
7000	85.1	111.1	91.3	3.1
7500	85.9	109.6	87.4	3.1
8000	84.2	107.6	87.8	3.3
9000	81.2	106.9	100.0	3.5
10000	67.7	97.7	119.7	3.7
11000	51.7	84.3	121.7	3.8
12000	38.2	71.1	117.7	3.4
13000	28.5	60.2	109.9	2.8
14000	22.0	51.8	100.1	2.1
15000	16.7	44.8	89.2	1.4
17000	12.1	36.5	72.3	0.5
19000	9.8	30.2	56.4	0.0
21000	8.5	25.5	44.8	0.0
23000	6.9	20.2	36.0	0.0
25000	5.8	15.7	29.7	0.0
27000	5.2	13.4	25.1	0.0
29000	4.6	10.6	21.2	0.0
31000	4.0	9.2	18.1	0.0

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Above Hawes Hole Study Site Cross-Section 2

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	127.4	158.3	96.8	7.0
3500	133.8	164.7	101.3	6.9
3750	139.0	170.0	104.7	6.8
4000	144.7	175.0	106.9	6.8
4250	150.5	179.9	110.4	6.7
4500	156.9	184.3	113.9	6.4
4750	162.1	187.6	117.7	6.3
5000	166.5	190.5	121.8	6.3
5250	170.5	194.0	126.1	6.3
5500	173.1	195.9	129.8	6.4
6000	180.4	198.8	137.4	6.3
6500	185.2	199.8	144.7	6.2
7000	182.8	197.1	153.7	6.4
7500	176.7	192.4	164.6	6.6
8000	166.8	184.0	171.2	6.7
9000	143.4	166.6	192.8	7.0
10000	116.8	146.4	203.4	7.2
11000	93.8	127.3	202.7	7.1
12000	75.6	109.8	194.5	6.8
13000	61.9	96.8	182.6	5.8
14000	51.5	85.5	168.8	4.5
15000	44.1	77.0	153.9	3.3
17000	35.5	66.0	130.3	2.4
19000	30.2	57.2	109.6	1.8
21000	26.4	49.9	94.0	1.5
23000	23.4	43.3	81.4	1.2
25000	19.8	37.1	70.7	1.0
27000	16.9	30.9	62.0	0.7
29000	15.5	27.8	55.0	0.6
31000	13.8	24.3	48.6	0.5

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Above Hawes Hole Study Site Cross-Section 3

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	218.4	238.6	185.0	9.4
3500	221.3	241.5	190.0	9.2
3750	223.7	243.0	194.2	8.8
4000	224.2	242.7	198.8	8.8
4250	226.1	243.2	203.2	8.5
4500	226.6	241.4	207.4	8.2
4750	225.3	239.2	211.6	8.2
5000	222.4	236.2	215.4	8.3
5250	217.1	230.2	217.1	8.1
5500	210.4	223.5	217.8	8.2
6000	195.3	210.5	224.2	8.2
6500	174.6	193.4	223.5	8.2
7000	152.7	176.3	224.1	8.1
7500	130.7	159.4	223.7	8.0
8000	109.8	143.3	221.4	7.9
9000	81.4	121.4	217.1	7.9
10000	61.2	103.5	203.9	7.3
11000	48.4	90.6	186.8	5.7
12000	39.2	79.6	167.6	3.8
13000	32.2	71.6	147.1	2.1
14000	27.0	63.5	128.7	1.5
15000	23.6	57.0	112.5	1.1
17000	20.8	49.0	94.0	0.7
19000	18.5	41.5	79.3	0.6
21000	16.5	34.9	67.7	0.5
23000	13.1	28.7	58.5	0.5
25000	11.3	23.4	50.7	0.4
27000	9.7	19.7	44.1	0.3
29000	8.6	16.7	38.7	0.3
31000	6.7	13.8	34.3	0.2

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Above Hawes Hole Study Site Cross-Section 4

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	117.0	149.2	90.1	8.1
3500	126.3	157.8	93.3	8.9
3750	135.8	166.2	96.8	9.1
4000	146.8	176.2	100.0	9.3
4250	155.9	184.2	103.4	9.3
4500	164.5	191.2	107.4	9.1
4750	172.1	197.1	111.1	8.9
5000	177.9	201.5	116.5	8.6
5250	182.6	204.2	121.6	8.3
5500	184.3	204.7	125.2	7.8
6000	183.4	200.6	133.5	7.1
6500	174.4	190.0	140.6	6.5
7000	161.8	176.8	147.1	6.1
7500	145.7	161.6	151.7	5.9
8000	129.3	146.6	155.6	5.8
9000	99.6	121.1	161.6	5.6
10000	76.1	99.8	159.4	5.5
11000	58.7	83.8	151.5	5.2
12000	45.7	70.8	139.9	4.8
13000	36.6	61.6	125.7	3.9
14000	29.7	53.7	111.1	2.9
15000	24.3	47.2	97.0	1.8
17000	19.3	40.0	76.7	0.7
19000	16.2	34.4	61.8	0.5
21000	14.5	29.3	50.7	0.5
23000	12.6	24.3	42.3	0.5
25000	11.2	20.2	35.8	0.4
27000	10.1	16.8	30.6	0.4
29000	7.4	12.7	26.3	0.4
31000	5.9	9.5	22.9	0.3

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Above Hawes Hole Study Site Cross-Section 5

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	186.0	197.9	159.5	8.2
3500	182.8	195.7	168.1	8.4
3750	179.5	193.6	176.1	8.8
4000	175.4	190.5	181.4	9.4
4250	169.9	186.5	184.8	9.5
4500	165.6	184.0	189.4	9.8
4750	160.3	180.3	192.9	9.8
5000	155.1	176.5	195.5	9.8
5250	148.7	171.6	196.6	9.8
5500	143.3	167.5	197.6	9.7
6000	130.9	157.7	195.6	9.3
6500	117.5	147.2	190.0	8.5
7000	105.0	136.0	182.8	7.7
7500	93.4	125.5	174.5	6.9
8000	82.4	114.9	165.0	6.2
9000	65.1	97.2	149.9	5.3
10000	52.4	83.6	133.9	4.3
11000	43.4	72.2	118.6	3.6
12000	37.2	63.1	103.8	2.9
13000	32.5	55.7	90.2	2.3
14000	27.9	48.5	78.0	1.7
15000	24.5	43.6	67.1	1.3
17000	20.6	36.5	53.8	0.9
19000	18.3	32.2	44.4	0.8
21000	16.1	28.1	38.0	0.6
23000	14.7	24.7	33.1	0.5
25000	12.9	22.2	29.7	0.4
27000	11.2	20.1	26.9	0.4
29000	9.8	17.5	24.2	0.3
31000	7.9	14.6	21.9	0.3

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Above Hawes Hole Study Site Cross-Section 6

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	174.1	189.9	127.1	9.4
3500	174.7	190.4	136.5	9.5
3750	174.3	189.9	144.7	9.5
4000	172.3	188.1	152.0	9.2
4250	170.2	186.3	158.3	8.8
4500	167.8	184.1	163.9	8.4
4750	163.6	180.6	168.6	8.5
5000	159.9	177.2	172.5	8.4
5250	155.2	173.6	174.9	8.2
5500	150.8	169.4	176.7	8.1
6000	143.0	160.4	178.5	7.7
6500	134.2	151.7	180.1	7.3
7000	124.3	142.8	178.2	7.4
7500	114.4	133.6	174.5	7.0
8000	104.4	124.8	169.4	6.6
9000	85.5	109.7	166.2	6.0
10000	67.3	94.5	155.5	5.5
11000	51.8	80.7	142.5	5.0
12000	40.6	69.3	127.9	4.1
13000	32.5	60.3	112.4	3.1
14000	26.9	52.9	97.9	2.2
15000	23.0	47.0	85.4	1.6
17000	18.2	37.3	65.9	0.9
19000	14.9	29.0	51.4	0.6
21000	10.9	21.6	40.8	0.4
23000	8.2	16.6	32.8	0.3
25000	6.0	13.0	27.0	0.2
27000	5.3	11.1	22.4	0.2
29000	4.6	9.3	18.6	0.1
31000	4.1	8.4	15.5	0.1

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Powerline Riffle Study Site Cross-Section 1

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	15.6	36.3	70.3	1.6
3500	14.5	34.5	65.6	1.4
3750	13.8	33.5	62.4	1.3
4000	13.1	32.1	58.3	1.1
4250	12.7	31.2	55.5	1.0
4500	12.2	30.0	52.1	0.9
4750	11.8	29.1	49.5	0.8
5000	11.3	28.0	46.9	0.7
5250	11.0	27.1	44.5	0.6
5500	10.8	26.3	42.5	0.6
6000	10.5	24.8	38.6	0.6
6500	10.2	23.4	35.2	0.5
7000	9.8	21.7	32.1	0.5
7500	9.5	20.2	29.6	0.5
8000	9.2	18.8	27.0	0.6
9000	8.5	16.0	23.4	0.6
10000	8.1	13.8	20.8	0.6
11000	7.7	12.7	19.2	0.5
12000	7.4	11.4	17.8	0.5
13000	7.3	10.3	16.5	0.5
14000	6.9	9.7	15.4	0.5
15000	6.9	8.9	14.4	0.4
17000	6.6	7.8	12.6	0.4
19000	6.2	6.7	11.1	0.3
21000	5.9	6.2	9.9	0.3
23000	5.8	5.6	8.9	0.3
25000	5.5	5.2	8.0	0.3
27000	5.0	4.5	7.3	0.3
29000	4.8	4.2	6.7	0.2
31000	4.7	3.9	6.1	0.2

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 4 (cfs).

Powerline Riffle Study Site Cross-Section 2

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	17.1	40.9	60.3	1.3
3500	16.3	39.9	57.5	1.1
3750	15.8	39.3	55.2	1.0
4000	15.3	38.5	52.8	0.9
4250	15.0	37.9	50.5	0.8
4500	14.6	37.0	48.0	0.8
4750	14.3	36.3	46.0	0.7
5000	14.0	35.7	44.2	0.7
5250	13.7	35.0	42.9	0.6
5500	13.4	34.1	41.4	0.6
6000	12.7	32.5	39.2	0.5
6500	11.9	30.4	36.7	0.4
7000	11.2	28.2	34.5	0.4
7500	10.2	25.8	32.3	0.3
8000	9.4	23.6	30.2	0.3
9000	7.9	19.4	26.6	0.3
10000	6.8	16.3	23.2	0.3
11000	5.5	13.9	20.6	0.3
12000	4.9	11.6	18.6	0.3
13000	4.5	10.2	16.9	0.3
14000	4.3	9.2	15.4	0.3
15000	4.2	8.5	14.1	0.3
17000	3.9	7.0	12.1	0.3
19000	3.4	5.7	10.4	0.2
21000	3.1	4.4	9.1	0.2
23000	2.8	3.7	7.9	0.2
25000	2.6	3.2	7.0	0.2
27000	2.6	3.1	6.2	0.2
29000	2.6	3.0	5.5	0.2
31000	2.9	3.3	5.3	0.2

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 4 (cfs).

Powerline Riffle Study Site Cross-Section 3

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	53.4	90.5	138.0	4.2
3500	51.3	87.9	134.5	4.3
3750	50.5	86.1	131.0	4.5
4000	49.3	83.8	125.8	4.3
4250	49.5	83.1	122.3	4.2
4500	49.4	82.3	120.0	3.9
4750	49.5	81.7	118.3	3.7
5000	49.4	80.9	115.6	3.5
5250	49.0	79.5	113.0	3.3
5500	47.8	77.4	109.9	3.0
6000	44.5	72.2	104.7	2.6
6500	40.1	66.2	98.7	2.2
7000	36.0	60.7	94.1	1.9
7500	32.1	55.6	88.8	1.7
8000	28.9	51.3	84.7	1.5
9000	23.4	43.5	76.0	1.3
10000	19.1	37.1	67.1	1.1
11000	16.0	31.6	59.2	1.0
12000	13.9	27.9	53.2	0.9
13000	12.0	24.6	47.7	0.8
14000	9.9	21.2	42.8	0.7
15000	8.3	18.1	38.4	0.6
17000	6.6	13.7	31.2	0.5
19000	5.2	10.4	25.6	0.3
21000	4.3	8.3	21.0	0.2
23000	3.5	6.4	17.2	0.1
25000	2.8	4.9	14.3	0.1
27000	2.3	4.1	11.9	0.1
29000	1.8	3.2	10.0	0.1
31000	1.7	2.6	8.4	0.1

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 4 (cfs).

Powerline Riffle Study Site Cross-Section 4

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	161.0	188.9	228.7	10.2
3500	155.2	185.4	234.9	10.3
3750	149.1	181.2	237.8	10.2
4000	143.4	177.4	243.7	10.1
4250	137.9	173.4	248.0	10.0
4500	131.2	168.0	247.7	9.8
4750	123.8	161.1	245.1	9.5
5000	117.3	154.9	243.4	9.1
5250	110.0	148.2	240.1	8.6
5500	103.0	141.3	236.1	8.1
6000	89.9	128.5	227.2	7.2
6500	78.4	116.9	216.6	6.3
7000	68.2	106.9	205.0	5.3
7500	59.2	97.5	192.1	4.4
8000	52.0	89.4	179.9	3.8
9000	40.8	75.9	156.1	3.0
10000	33.3	65.0	133.7	2.5
11000	28.2	56.0	114.2	2.1
12000	24.9	50.1	101.8	1.8
13000	22.6	44.7	90.4	1.5
14000	20.4	39.8	80.4	1.2
15000	18.9	36.3	71.9	0.9
17000	15.0	27.6	58.5	0.7
19000	12.0	21.5	48.5	0.5
21000	9.6	16.6	40.3	0.4
23000	7.9	13.6	33.8	0.4
25000	6.8	11.2	28.6	0.3
27000	5.2	8.9	24.2	0.2
29000	4.3	6.8	20.5	0.2
31000	3.6	5.7	17.5	0.2

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 4 (cfs).

Powerline Riffle Study Site Cross-Section 5

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	165.7	198.7	263.3	10.3
3500	157.1	191.1	266.2	10.5
3750	148.3	183.2	266.6	10.5
4000	139.0	174.7	264.2	10.6
4250	130.9	166.7	260.9	10.5
4500	123.5	159.5	258.7	10.3
4750	116.6	153.1	255.0	10.0
5000	109.2	146.1	249.9	9.6
5250	102.4	139.6	244.4	9.2
5500	96.0	133.4	238.6	8.6
6000	83.8	121.5	225.8	7.4
6500	72.7	110.4	211.9	6.2
7000	62.9	100.6	197.3	5.2
7500	55.1	92.4	183.5	4.4
8000	49.0	85.4	170.4	3.8
9000	39.5	73.5	145.1	3.1
10000	33.2	63.7	123.6	2.5
11000	29.6	56.7	107.1	2.0
12000	27.3	51.6	94.9	1.7
13000	25.2	46.5	84.8	1.6
14000	23.2	42.0	76.2	1.4
15000	22.4	38.2	68.7	1.4
17000	19.4	30.7	57.1	1.2
19000	14.9	22.6	47.7	1.1
21000	12.6	17.1	40.5	0.9
23000	9.8	13.1	34.6	0.8
25000	8.4	10.4	29.7	0.7
27000	6.6	8.2	25.5	0.6
29000	5.3	6.7	21.9	0.5
31000	4.6	5.8	19.0	0.5

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 4 (cfs).

Powerline Riffle Study Site Cross-Section 6

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	158.0	193.6	206.6	3.4
3500	149.2	184.2	211.2	3.3
3750	141.1	175.3	213.5	3.2
4000	133.8	167.0	214.1	3.1
4250	126.1	158.9	213.4	3.0
4500	118.4	150.8	211.8	2.9
4750	112.0	143.7	209.6	2.8
5000	105.7	136.8	206.8	2.8
5250	99.3	130.0	203.3	2.7
5500	93.9	124.2	199.6	2.6
6000	83.9	112.9	190.6	2.6
6500	75.5	103.5	181.1	2.5
7000	67.8	95.2	170.9	2.4
7500	60.9	87.8	160.5	2.4
8000	55.0	81.6	150.5	2.3
9000	45.5	71.3	131.3	2.2
10000	38.1	62.5	114.4	2.1
11000	32.9	55.7	101.0	2.0
12000	29.6	50.4	90.6	2.0
13000	27.0	45.6	81.4	1.9
14000	24.6	41.4	73.3	1.8
15000	22.8	37.6	66.5	1.7
17000	19.2	30.3	54.6	1.4
19000	14.8	23.1	44.8	1.1
21000	11.8	17.6	37.2	0.9
23000	10.0	14.5	31.2	0.8
25000	8.3	12.0	26.1	0.7
27000	7.3	10.2	21.9	0.7
29000	6.5	8.6	18.4	0.7
31000	5.7	7.5	15.6	0.6

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 4 (cfs).

Price Riffle Study Site Cross-Section 1

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	21.6	48.5	47.8	0.9
3500	23.1	49.7	47.7	1.0
3750	24.8	50.9	47.1	1.0
4000	27.0	51.9	47.5	1.1
4250	28.4	52.9	47.1	1.1
4500	30.0	54.0	47.7	1.4
4750	32.6	55.3	48.1	1.5
5000	35.5	56.7	48.4	1.5
5250	38.3	57.7	49.2	1.7
5500	40.6	59.4	51.1	1.9
6000	43.3	60.9	52.1	2.1
6500	44.5	61.1	55.8	2.2
7000	44.1	59.9	61.5	2.3
7500	43.9	58.7	63.2	2.3
8000	44.2	57.9	64.4	2.6
9000	42.7	55.6	64.1	2.8
10000	45.2	56.6	69.9	2.9
11000	48.2	59.5	72.1	3.3
12000	50.8	62.2	74.7	3.5
13000	52.5	63.7	76.7	3.4
14000	51.5	62.5	78.4	3.2
15000	48.9	58.4	78.6	3.0
17000	41.7	50.5	77.1	2.4
19000	37.0	45.5	72.7	2.1
21000	36.4	45.5	67.4	2.0
23000	39.7	48.8	63.1	2.2
25000	44.2	52.8	60.7	2.3
27000	48.5	56.4	60.5	2.3
29000	53.2	59.6	61.8	2.4
31000	57.7	62.4	62.8	3.0

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 4 (cfs).

Price Riffle Study Site Cross-Section 2

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	4.8	9.4	1.8	0.2
3500	6.5	11.6	4.6	0.4
3750	7.0	14.0	7.3	0.5
4000	7.5	16.8	10.0	0.7
4250	9.6	19.5	13.6	0.8
4500	10.5	21.8	16.4	0.8
4750	12.1	24.9	24.1	1.0
5000	13.4	26.8	27.8	1.1
5250	14.8	28.7	29.9	1.1
5500	15.7	29.9	31.1	1.1
6000	17.5	32.0	36.9	1.2
6500	19.2	34.0	41.3	1.2
7000	21.2	35.4	44.0	1.0
7500	23.5	38.9	46.8	1.3
8000	33.3	46.2	48.7	1.4
9000	56.7	66.9	55.3	2.3
10000	64.5	73.5	64.2	2.6
11000	66.8	76.8	79.6	2.7
12000	67.4	77.6	88.2	2.8
13000	67.2	77.3	93.7	3.0
14000	65.5	76.4	99.0	3.4
15000	61.4	73.8	108.4	3.5
17000	51.1	65.2	110.9	3.5
19000	41.8	56.4	104.3	3.0
21000	35.4	49.2	95.0	2.5
23000	30.8	43.4	84.5	1.9
25000	26.6	38.1	73.7	1.4
27000	23.7	34.0	64.9	1.1
29000	21.4	30.5	57.2	1.1
31000	19.6	27.5	50.8	1.2

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 4 (cfs).

Price Riffle Study Site Cross-Section 3

	Main Channel					Side Channel			
Flow	Fall-run	Late-fall-run	Winter-run	Steelhead	Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	33.5	59.4	27.0	1.1	3250	0.0	0.0	0.0	0.0
3500	36.1	63.3	29.8	1.4	3500	0.0	0.0	0.0	0.0
3750	37.7	66.0	39.3	1.6	3750	0.0	0.0	0.0	0.0
4000	38.9	69.0	47.0	1.8	4000	0.0	0.0	0.0	0.0
4250	39.8	71.6	52.3	1.8	4250	0.0	0.0	0.0	0.0
4500	40.9	72.4	54.2	1.8	4500	0.0	0.0	0.0	0.0
4750	41.4	73.4	57.0	1.8	4750	0.0	0.0	0.0	0.0
5000	40.9	72.4	58.2	1.7	5000	0.0	0.0	0.0	0.0
5250	40.6	72.3	59.5	1.7	5250	0.0	0.0	0.0	0.0
5500	39.5	71.4	60.2	1.7	5500	0.0	0.2	0.0	0.0
6000	35.6	65.5	57.9	1.7	6000	0.8	0.6	0.0	0.0
6500	36.7	65.1	63.6	1.7	6500	1.7	1.3	0.0	0.0
7000	33.7	62.9	65.6	1.6	7000	3.3	2.6	0.0	0.9
7500	34.7	60.8	68.1	1.7	7500	6.1	4.2	0.0	2.4
8000	33.9	59.7	68.4	1.7	8000	8.7	6.6	0.0	4.0
9000	33.5	55.8	69.5	2.4	9000	14.1	12.2	1.5	7.8
10000	28.6	51.2	68.2	3.2	10000	18.7	17.5	5.7	9.3
11000	23.1	46.1	69.9	3.5	11000	21.4	20.5	8.5	9.9
12000	17.6	40.9	69.5	3.5	12000	21.8	20.7	11.2	10.1
13000	14.7	36.4	64.3	2.8	13000	20.8	19.8	13.6	10.0
14000	11.8	32.5	58.7	1.9	14000	19.4	18.6	16.0	9.7
15000	10.1	30.4	55.4	1.2	15000	17.4	17.1	17.9	9.2
17000	8.3	26.2	48.7	0.3	17000	12.9	13.5	19.1	7.4
19000	7.6	22.8	43.0	0.2	19000	9.3	10.6	18.0	6.2
21000	7.3	20.1	37.6	0.2	21000	6.8	8.4	16.2	4.6
23000	5.7	16.9	33.8	0.1	23000	4.9	6.7	14.2	2.9
25000	5.2	15.6	30.3	0.1	25000	3.5	5.3	12.1	1.9
27000	5.9	14.6	27.0	0.0	27000	2.6	4.4	10.2	1.4
29000	5.3	13.6	24.5	0.1	29000	2.0	3.6	8.4	1.2
31000	5.8	13.2	23.8	0.1	31000	1.5	3.0	7.0	1.0

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 4 (cfs).

Price Riffle Study Site Cross-Section 4

	Main Channel					Side Channel			
Flow	Fall-run	Late-fall-run	Winter-run	Steelhead	Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	33.9	82.5	76.0	0.0	3250	0.0	0.0	0.0	0.0
3500	43.7	87.0	75.3	0.0	3500	0.0	0.0	0.0	0.0
3750	45.2	89.0	76.7	0.9	3750	0.0	0.0	0.0	0.0
4000	45.9	89.5	76.3	1.4	4000	0.0	0.0	0.0	0.0
4250	46.6	89.4	75.3	1.9	4250	0.0	0.0	0.0	0.0
4500	48.1	90.5	83.0	2.3	4500	0.0	0.0	0.0	0.0
4750	48.6	90.4	84.7	2.7	4750	0.0	0.0	0.0	0.0
5000	50.1	91.2	84.8	3.1	5000	0.0	0.0	0.0	0.0
5250	51.0	91.1	84.4	3.3	5250	0.0	0.0	0.0	0.0
5500	51.8	91.1	84.1	3.4	5500	0.2	0.2	0.0	3.9
6000	52.7	91.1	85.0	3.6	6000	1.1	0.8	0.0	10.1
6500	53.7	89.3	84.2	3.6	6500	2.3	1.8	0.2	11.7
7000	52.8	86.6	83.0	3.6	7000	3.7	2.8	0.5	11.6
7500	51.0	83.1	81.8	3.7	7500	4.7	3.6	0.9	10.2
8000	49.0	80.4	80.3	3.7	8000	5.2	3.9	1.3	9.1
9000	49.8	75.9	77.4	3.5	9000	5.0	3.8	1.9	5.9
10000	50.3	70.7	74.1	4.1	10000	4.4	3.5	2.2	5.0
11000	48.4	66.8	70.0	4.2	11000	4.6	3.7	2.2	6.1
12000	45.3	62.4	71.7	4.1	12000	6.1	5.0	2.2	7.7
13000	41.4	57.9	72.2	4.1	13000	8.8	7.5	2.5	10.0
14000	38.3	54.1	70.6	3.7	14000	12.2	10.6	2.9	10.6
15000	35.0	49.3	67.2	3.4	15000	15.1	13.1	3.8	9.8
17000	30.4	41.7	60.2	2.7	17000	17.8	14.9	5.6	8.2
19000	27.6	36.5	54.0	2.0	19000	17.7	14.4	7.6	7.8
21000	25.6	33.0	48.7	1.8	21000	16.8	13.5	9.3	7.3
23000	23.7	29.8	44.1	1.8	23000	15.0	12.1	10.1	6.9
25000	22.1	26.7	40.3	1.7	25000	12.8	10.6	10.3	6.6
27000	20.9	24.6	37.0	1.7	27000	10.6	9.1	10.2	6.4
29000	19.8	22.7	34.3	1.7	29000	8.7	7.7	9.9	6.3
31000	19.0	21.3	32.1	1.7	31000	7.1	6.6	9.3	6.2

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 4 (cfs).

Price Riffle Study Site Cross-Section 5

Main Channel					Side Channel				
Flow	Fall-run	Late-fall-run	Winter-run	Steelhead	Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	54.1	86.0	53.6	0.7	3250	0.0	0.0	0.0	0.0
3500	75.6	102.9	67.2	2.0	3500	0.0	0.0	0.0	0.0
3750	82.7	111.7	84.1	3.3	3750	0.0	0.0	0.0	0.0
4000	84.6	113.4	88.5	3.6	4000	0.0	0.0	0.0	0.0
4250	85.2	113.4	93.3	3.9	4250	0.0	0.0	0.0	0.0
4500	85.1	114.3	100.8	4.2	4500	0.0	0.0	0.0	0.0
4750	83.7	113.7	105.0	4.7	4750	0.0	0.0	0.0	0.0
5000	81.6	111.7	107.4	5.0	5000	0.0	0.1	0.0	0.0
5250	80.2	110.8	110.2	5.1	5250	0.5	0.6	0.0	0.0
5500	78.4	109.1	111.9	5.0	5500	2.0	1.5	0.0	0.0
6000	74.4	104.7	115.4	4.8	6000	5.5	4.2	0.0	3.8
6500	70.2	100.5	119.6	4.6	6500	9.2	7.4	0.0	6.7
7000	65.2	95.4	119.6	4.3	7000	11.8	9.8	1.7	9.1
7500	60.1	89.7	118.6	4.0	7500	13.1	11.2	4.2	10.7
8000	54.9	83.9	117.1	3.6	8000	13.0	11.4	5.7	12.3
9000	46.4	72.6	111.8	2.8	9000	10.8	10.2	7.9	13.4
10000	38.0	64.1	103.4	2.4	10000	8.1	8.5	9.0	13.2
11000	35.5	57.5	95.6	2.0	11000	6.4	7.2	9.3	12.6
12000	30.3	51.3	88.1	2.3	12000	5.2	6.3	9.1	11.1
13000	25.2	45.5	79.3	2.2	13000	4.5	5.8	8.5	9.0
14000	21.6	40.2	74.5	2.2	14000	4.1	5.4	7.6	6.7
15000	18.5	36.5	69.9	2.0	15000	4.0	5.5	6.7	5.8
17000	15.6	30.6	57.6	1.2	17000	5.8	6.4	5.3	7.9
19000	11.4	24.7	49.6	1.2	19000	6.6	7.1	5.3	9.0
21000	8.6	20.4	44.9	0.8	21000	6.2	6.6	5.3	8.9
23000	7.3	16.6	38.5	0.3	23000	5.5	5.7	5.0	8.1
25000	5.5	13.3	32.9	0.2	25000	4.7	4.6	4.5	6.3
27000	4.5	10.3	28.4	0.1	27000	4.2	3.8	3.9	5.1
29000	3.2	8.1	24.9	0.1	29000	3.8	3.4	3.4	4.6
31000	3.0	7.3	22.5	0.1	31000	3.5	3.0	2.9	4.2

Data in above table is Weighted Useable Area (1000 square feet per 1000 feet of stream) for the criteria sets in Appendix A. Flow is the flow in Segment 4 (cfs).

APPENDIX C
SEGMENT HABITAT MODELING RESULTS

Segment 6

	Boards in at ACID Dam					Boards out at ACID Dam			
Flow	Fall-run	Late-fall-run	Winter-run	Steelhead	Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	270,032	237,610	116,167	28,363	3250	375,185	379,735	429,895	18,868
3500	291,481	254,664	131,117	27,403	3500	369,294	370,515	452,555	17,968
3750	310,913	269,782	145,139	26,359	3750	360,613	359,726	472,646	17,206
4000	329,185	283,841	159,186	25,340	4000	349,861	347,178	489,309	16,656
4250	345,857	296,054	173,379	24,400	4250	337,431	334,237	502,376	16,196
4500	360,026	305,911	187,825	23,479	4500	324,345	320,615	512,778	15,899
4750	371,729	313,207	202,542	22,689	4750	310,929	307,089	520,784	15,736
5000	381,584	318,707	216,309	21,933	5000	295,795	292,329	527,339	15,608
5250	389,128	322,560	229,560	20,583	5250	281,787	278,602	530,408	15,324
5500	394,940	324,955	242,344	19,503	5500	267,332	265,392	531,666	15,213
6000	402,479	325,867	265,269	18,780	6000	238,971	240,559	530,567	15,035
6500	402,936	322,068	285,477	18,076	6500	212,633	218,488	524,946	14,823
7000	398,857	315,553	303,741	17,582	7000	187,815	198,654	515,044	14,547
7500	390,949	306,845	320,852	16,868	7500	164,746	180,184	502,414	13,851
8000	380,353	297,148	334,025	16,819	8000	145,025	164,057	486,255	13,000
9000	355,525	275,107	352,713	16,693	9000	112,443	137,524	448,582	11,971
10000	328,028	252,949	362,558	16,475	10000	89,353	117,927	409,301	10,746
11000	301,319	232,960	363,440	16,164	11000	70,967	102,165	368,726	8,839
12000	275,817	214,758	357,429	15,893	12000	58,177	89,421	331,222	6,782
13000	252,503	198,120	347,125	15,684	13000	47,574	80,176	295,616	4,732
14000	230,618	182,798	335,311	15,433	14000	40,449	72,592	262,933	1,469
15000	212,257	169,035	320,527	15,211	15000	34,322	66,140	233,271	168
17000	180,882	143,992	284,745	14,845	17000	27,457	58,490	183,538	56
19000	156,613	122,203	247,223	14,444	19000	26,729	57,652	144,171	6
21000	136,269	103,773	211,298	14,004	21000	26,207	56,020	126,907	0
23000	119,909	87,044	175,042	13,534	23000	25,276	51,175	109,520	93
25000	106,003	72,054	141,307	12,994	25000	25,297	46,151	99,796	212
27000	94,152	58,916	110,363	12,225	27000	26,791	42,840	93,205	311
29000	84,330	47,366	82,801	0	29000	26,629	39,149	90,132	0
31000	75,028	37,383	61,815	0	31000	22,886	32,999	86,217	0

Data in above table is Weighted Useable Area (square feet) for the criteria sets in Appendix A. Flow is the flow in Segment 6 (cfs).

Segment 5

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	1,060,254	904,196	762,874	56,646
3500	1,085,498	920,027	817,225	56,358
3750	1,102,762	928,583	867,944	56,010
4000	1,111,935	930,681	914,675	55,934
4250	1,116,004	928,294	957,292	54,782
4500	1,115,944	922,604	997,050	53,597
4750	1,107,002	911,741	1,033,947	53,191
5000	1,095,095	899,911	1,066,923	52,759
5250	1,077,903	885,580	1,092,582	52,108
5500	1,057,793	869,773	1,114,575	51,586
6000	1,011,437	835,045	1,147,734	50,092
6500	953,181	794,044	1,170,307	48,544
7000	884,437	749,082	1,185,875	47,868
7500	810,879	701,749	1,188,273	46,727
8000	741,356	658,183	1,181,131	46,834
9000	622,890	586,678	1,185,244	44,421
10000	506,644	513,931	1,149,537	42,202
11000	411,553	450,885	1,083,702	39,108
12000	337,874	395,994	998,784	34,695
13000	280,937	351,650	904,647	29,449
14000	237,510	313,426	810,873	24,520
15000	204,562	282,412	722,589	20,114
17000	164,153	236,060	583,212	13,770
19000	138,146	198,277	471,098	9,890
21000	117,355	165,398	386,115	7,363
23000	100,242	137,221	320,440	5,749
25000	85,337	114,341	270,336	4,588
27000	75,889	98,067	230,577	3,808
29000	67,493	84,590	198,492	3,397
31000	59,809	74,103	172,693	3,073

Data in above table is Weighted Useable Area (square feet) for the criteria sets in Appendix A. Flow is the flow in Segment 5 (cfs).

Segment 4

Flow	Fall-run	Late-fall-run	Winter-run	Steelhead
3250	239,932	542,493	176,537	10,439
3500	250,329	553,352	181,662	11,433
3750	249,900	557,016	188,156	12,571
4000	247,231	555,220	191,255	13,124
4250	245,118	552,447	193,504	13,491
4500	242,225	549,193	197,149	13,899
4750	240,152	546,152	200,511	14,310
5000	237,800	539,950	200,890	14,325
5250	235,664	533,989	200,751	14,323
5500	232,590	527,758	200,508	15,183
6000	223,953	509,223	198,676	17,313
6500	217,069	492,986	198,723	17,704
7000	206,520	472,912	197,386	17,488
7500	198,947	455,868	194,041	17,422
8000	198,336	446,979	189,642	17,528
9000	203,395	438,015	180,372	18,029
10000	199,804	420,461	174,649	18,341
11000	195,743	406,960	171,988	18,861
12000	189,909	392,905	169,677	19,207
13000	184,149	377,346	164,944	18,872
14000	175,453	359,029	160,904	17,782
15000	164,454	336,562	158,578	16,355
17000	140,621	289,044	147,445	14,018
19000	119,701	248,273	134,927	12,779
21000	108,033	222,878	121,688	11,266
23000	102,327	207,187	109,168	10,035
25000	99,365	196,370	98,313	8,830
27000	98,525	188,595	90,084	8,064
29000	98,535	182,403	83,872	7,889
31000	100,448	179,137	79,104	8,363

Data in above table is Weighted Useable Area (square feet) for the criteria sets in Appendix A. Flow is the flow in Segment 4 (cfs).