ATTACHMENT E

STRANDING REPORT

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EXECUTIVE SUMMARY

The CAWG 3 Study Plan, *Determine Flow Related Physical Habitat in Bypass Reaches,* has the primary objective of identifying how flow affects available habitat for fish species in the bypass reaches below Project facilities (SCE 2001a). Of primarily interest is rearing and spawning habitat for resident trout species, which was described in three previous reports (SCE 2003a, SCE 2004a, and SCE 2004b).

The potential for fish and redd stranding in bypass reaches is also of interest. This report provides supplemental information on the potential for fish and redd stranding between different flow levels in the bypass reaches. It also provides the methods and results of depth suitability analyses on Rock and Bolsillo Creeks, where the food transport evaluation originally planned by the CAWG Transect Selection Team (CTST) provided unrealistic results.

Stranding potential within the project streams is relatively low, because of the steep confined nature of the channels (generally Rosgen Channel types Aa+, A or B) and the steep banks associated with these transects. There are few areas with wide floodplains or substantial bars that would contribute to a substantial amount of stranding. However, even within these types of channels, stranding can occur. To evaluate the potential for stranding, an analysis was conducted for fish in all streams, and for trout redds in streams diverted throughout the year (PHABSIM streams), where information on spawning habitat was available.

Stranding evaluations were conducted separately for fish and redds because fish can move with changing flows, but redds are stationary and much more limited in their distribution. When evaluating stranding potential for fish, the rate of change is the most important consideration. When evaluating the stranding potential for redds, the magnitude of the change in water surface elevation is most important. The analyses were conducted using the transects and models described in previous CAWG technical studies to assess fish habitat (SCE 2003a, SCE 2004a, and SCE 2004b).

The fish stranding analysis evaluated 1) the change in wetted perimeter with flow, and 2) the percentage reduction of that would occur if the flow were reduced by half from a given starting flow[1]. A parallel analysis to the change in wetted perimeter analysis looked that the Potential Stranding Area (PSA) using a method developed by Envirosphere (1988) for the Mokelumne River.

These analyses found that fish stranding potential always decreased with increasing flows. This is an expected result, given the steep, confined characteristics of the project streams. These analyses found that fish stranding potential always decreased with increasing flows. This is an expected result, given the steep, confined characteristics of

[1] This rate of flow change neither reflects current operations or proposed future operations, but is simply a convenient, easily understood flow change to serve as a basis for discussion. The tables in the report allow the reader to see the percentage change in wetted perimeter between any two flows.

the project streams. The PSA analysis used a completely different approach to assess stranding potential, however the results were very similar to the wetted perimeter approach in all streams. In the second analysis, when flows were decreased by half from an given starting flow, the percentage loss in wetted perimeter ranged from 4 to 18 percent in the larger (PHABSIM) streams depending on the stream and starting flow. For most of the seasonally diverted (wetted perimeter) streams, the loss of wetted perimeter when flows were halved ranged from about 10 to 20 percent. However, Tombstone, Adit 8, Ely, and Pitman Creeks had higher losses (up to 51 percent) at some starting flow levels.

The evaluation of redd stranding potential revealed that in several streams there were certain threshold flows that need to be considered in setting flow levels. On several streams, it was clear that the spawning areas available above certain flow levels were perched above the regular channel and would be lost unless flows were maintained at a high level until emergence. A second type of threshold was also observed in a few streams where larger proportions of habitat were lost if flow was reduced below a specific level. With these site-specific caveats, the analysis showed that redd retention was generally quite high even with large reductions in flow. Redd losses of more than 25 percent were uncommon, even assuming extreme changes in flow level and were more often in the 15 to 20% range. These losses are based on relatively conservative criteria (described in Section 3.1.2). These losses are lower where less extreme flow changes are considered and can be reduced through consideration of the thresholds discussed above.

The depth suitability analysis for Rock Creek indicated that less than 25 percent changes in adult rainbow and brown trout habitat occurred with changes in flow both above and below the diversion. In both areas, the about one half to two thirds of the available habitat had suitable depths for adult rainbow and brown trout at any flow level. Adult habitat increased with increasing flow, but the amount of habitat increase was minor. For juvenile and fry trout, the proportion of the habitat with suitable depths exceeded 70 percent and did not vary by more than 20 percent with flow either above or below the diversion.

On Bolsillo Creek habitat was evaluated for brook trout, the only species present. The proportion of habitat with suitable depths for adults varied by less than 20 percent using either the Bovee (1978) or Smith and Aceituno (1987) criteria. The proportion of habitat with suitable depths did increase with flow to about 3 cfs above the diversion and to about 2.4 cfs below the diversion. The proportion of habitat with suitable depths for juvenile brook trout increased by about 30 percent above the diversion and by 80 percent below the diversion. Maximum habitat occurred at the highest flows simulated, but the greatest increase in habitat occurred as flows increased from 1.2 to 1.8 cfs above the diversion and from near 0 to 1.2 cfs below the diversion. The amount of suitable fry habitat was high more than 92 percent, both above and below the diversion.

This report concludes the studies described for flow-related habitat in the CAWG-3 Study Plan (SCE 2001).

1.0
INTRODUCTION

As part of the Big Creek Hydroelectric System Alternative Licensing Process (Big Creek ALP), Southern California Edison (SCE) has agreed to undertake instream flow studies in various project reaches. The instream flow studies include wetted perimeter studies in smaller streams that are seasonally diverted and PHABSIM studies in larger streams that are diverted throughout the year (SCE 2001a). Also undertaken were analyses of passage flows, potential stranding issues, and depth suitability analyses for Rock and Bolsillo creeks (small diverted streams where the wetted perimeter approach could not be applied). All of these studies were developed through extensive consultation with the Combined Aquatics Working Group (CAWG).

The results of the wetted perimeter and passage flow studies conducted in small streams were reported for the upper basin (tributaries of the South Fork San Joaquin River [SFSJR]) in SCE 2003a and for the lower basin (below Mammoth Pool) in SCE 2004a. The results of the PHABSIM and passage studies on larger streams were reported in SCE 2004b. Results of the stranding analysis and depth suitability studies are provided in this supplemental report.

1.1 OBJECTIVES

The instream flow study objectives and methods are described in *CAWG 3 Determine Flow-Related Physical Habitat in Bypass Reaches* (SCE 2001a), referred to as the CAWG 3 Study Plan in the remainder of this document.

The CAWG 3 Study Plan identifies the following objectives for these studies:

> *An instream flow study is proposed to evaluate how flow changes resulting from Project operations may affect native fish and aquatic species in the Big Creek system. This study will help address the management goals and objectives outlined by the CAWG. Microhabitat variables, such as velocities and depths, may be altered by changes in flows in the bypass reaches. This may result in alterations in flow-related habitat, which may affect aquatic populations and/or communities. Rapid changes in flow levels may also result in margin areas of the bypass reaches becoming dewatered, without providing sufficient opportunity for fish to move to secure locations, thereby resulting in stranding. To evaluate these potential effects, the following objectives need be addressed:*
>
> *1. To determine flow-related physical habitat in bypass reaches using:*
>
> - *PHABSIM studies for bypass reaches of diversions that operate year-round or*

- *Wetted Perimeter studies for diversions that operate primarily during the high flow season.*

2. *Determine the potential for stranding for aquatic organisms based on Project operations.*

This report focuses on the second objective above. It also includes the methods and results employed in a depth suitability analysis substituted (with CAWG concurrence) for food transport analyses in Rock and Bolsillo Creeks.

2.0 STUDY ELEMENT STATUS

Study elements and their status are identified below.

Study Element	Status	Outstanding Study Elements
Wetted perimeter studies	SCE 2003a SCE 2004a	Completed
PHABSIM studies	SCE 2004b	Completed
Passage studies	SCE 2003a SCE 2004a SCE 2004b	Completed
HSC verification and development studies	SCE 2004b	Completed
Depth suitability studies for Rock and Bolsillo creeks	This report	Under Review by Plenary
Stranding studies	This report	Under Review by Plenary
Limiting factors analysis and impact evaluation (including time series analysis)	To be completed in coordination with CAWG after approval of relevant CAWG studies	To be completed. Time series analysis to be determined in consultation with the CAWG

3.0 METHODS

3.1 GENERAL APPROACH STRANDING

Stranding potential within the project streams is generally relatively low, because of the steep confined nature of the channels (generally Rosgen Channel types Aa+, A or B) and the steep banks associated with these transects. There are few areas with wide floodplains or substantial bars that would contribute to a substantial amount of stranding. However, even within these types of channels, stranding can occur. To evaluate the potential for stranding, a stranding analysis was conducted.

The stranding analysis was conducted using the channel geometry and stage discharge relationships of the transects used in both PHABSIM and wetted perimeter studies. This information was used in conjunction with the RHABSIM to calculate the wetted perimeter over a series of flows at each transect. The change in wetted perimeter between a starting and ending flow provides an estimate of stranding potential as flows are reduced. A large change in wetted perimeter indicates a relatively larger potential for stranding, while smaller changes correspond to a relatively lower potential for stranding.

Stranding evaluations were conducted separately for fish and redds (specifically trout redds or nests) because fish can move with changing flows, but redds are stationary and much more limited in their distribution. When evaluating stranding potential for fish, the rate of change is the most important consideration. When evaluating the stranding potential for redds, the magnitude of the change in water surface elevation is most important. The analyses for both types of stranding were conducted using the transects and models described in previous CAWG technical studies to assess fish habitat in each study reach (SCE 2003a, SCE 2004a, and SCE 2004b).

3.1.1 FISH STRANDING

The evaluation of fish stranding was conducted for each stream reach using all of the transects developed for the PHABSIM and wetted perimeter studies. This approach provides for an analysis of stranding potential within the reach as a whole, not for individual transects.

The potential for fish stranding was evaluated using two types of information:

1. Change in wetted perimeter with flow (as outlined in the CAWG 3 study plan)

2. Assessment of the change in the cumulative Potential Stranding Area

Wetted perimeter vs. flow functions were developed for each reach within the study streams. These wetted perimeter vs. flow functions were developed as the weighted average of the wetted perimeter functions for the individual transects within the reach.

For streams evaluated with PHABSIM, weighting was based on the proportional representation of channel types and habitat types within the reach, as was done for the PHABSIM analysis. For the small streams, where wetted perimeter studies were conducted, the average wetted perimeter function was a simple average of the individual transects.

Stranding is most likely where the greatest change in wetted perimeter with a change in flow occurs. Stranding is an issue when flows are decreasing, and therefore flow is plotted with the lowest values to the right on the X-axis. To facilitate evaluation of the plot, we tabulated the percentage change in wetted perimeter between different flow levels within the range of extrapolation from the hydraulic models.

The cumulative Potential Stranding Area (cumulative PSA) was also used to evaluate fish stranding potential. This approach was developed by Envirosphere during studies on the lower Mokelumne River (Envirosphere 1988), and assesses stranding potential based on bed slope and substrate composition. In this analysis, the criteria developed in the lower Mokelumne River were used to evaluate stranding potential within each study reach. These criteria indicate that cells with a bed slope of less than 4 percent have the highest potential for stranding and that stranding potential decreases with increasing slope, reaching a value of 0.1 at a bed slope of 10 percent. In this analysis, slope is calculated based on the difference in bed elevations at adjacent measurement points (verticals) along each transect. In the substrate evaluation, the Envirosphere approach rated stranding potential with regard to the size of the dominant substrate. In their coding scheme, all substrates larger than cobble had a relatively high potential for stranding (0.7 or higher). Given that the substrates present in the Big Creek ALP project bypass reaches are predominantly larger than this size, substrate potential for stranding was assumed to be 1.0 in all cells (a conservative assumption). The criteria used in this study are provided in Table CAWG 3-1.

3.1.2 Redd Stranding

For the redd stranding analysis, the areas with suitable conditions for spawning were identified based on the Big Creek ALP spawning criteria (SCE 2004b). These areas were identified at various simulated flow levels. As flow decreases (ramps down), these areas may become dewatered, which may result in increased mortality of eggs and alevins. To evaluate the potential for increased mortality, we calculated the proportion of the spawning area at each initial flow that had a depth greater than 0.1 ft at each successively lower flow level. This assessment criterion is conservative, in that water must be maintained over the redd for it to be considered still viable. In actuality, the egg pocket is below the surface of the substrate and studies have shown that survivorship in even completely dewatered redds can be quite high if there is subsurface inundation or high humidity and suitable temperatures are maintained within the egg pocket (Bjornn and Reiser 1991). The percentage of initially suitable habitat still inundated at the final flow level was tabulated to facilitate evaluation.

3.1.3 EXPLANATION OF STRANDING ANALYSIS RESULTS TABLES

Two tables are provided for each PHABSIM stream reach. The first shows the percent change in wetted perimeter between a starting and final flow, information important for evaluating the potential for stranding fish. Table CAWG 3-2 is an example of this table. The percentage change in wetted perimeter identifies what changes in flow level result in large changes in wetted perimeter. To reduce fish stranding potential, this change in wetted perimeter can be managed by controlling the rate of the flow change. The rate of change is the most important consideration, as fish can move with the water to safe locations and avoid being stranded if the rate of flow change is not so rapid that fish cannot respond in time. To read this table, find the starting flow of interest in the top row of the table. Move down the column with the appropriate starting flow to the row with the appropriate ending flow. The value in this intersection indicates the percentage difference in wetted perimeter between these two flows (i.e., change in habitat amount). This table is also provided for each wetted perimeter streams.

For discussion purposes, we examined the percentage change in habitat when the flow is reduced by one half from any starting flow. This halving of flow levels is an arbitrary choice, selected because it is easy to understand. It does not reflect current operations or recommended ramping rates for the future operations. It is simply used for purposes of this discussion and in evaluating the relative stranding potential in the reach. The reader may examine the percentage change in habitat between any two flow levels.

The second table shows the amount of spawning area remaining when flow is changed from one level to another. Table CAWG 3-3 provides an example of this table type. This table is read in the same manner as described above. The second table is divided into two sections, one showing rainbow trout spawning habitat and the other brown trout spawning habitat. When evaluating flow changes during incubation, the magnitude of the flow change is important, not the rate of change, as the redds are stationary and cannot move to accommodate new flow levels. A table showing the amount of spawning area in relation to flow is not provided for wetted perimeter streams, as spawning habitat was not evaluated. The other species in the project area (hardhead, Sacramento pikeminnow, and Sacramento sucker) are broadcast spawners. For these species, the wetted perimeter functions are the best tool for understanding the potential effects of ramping on their eggs.

The wetted perimeter and cumulative PSA functions are presented graphically. The steeper portion of these curves reflect flow levels where stranding is most likely to occur, as this is where the greatest change in habitat area with flow occurs.

3.2 DEPTH SUITABILITY

The CAWG agreed that a PHABSIM approach to flow evaluation was probably not suitable for the small streams in this basin that are only seasonally diverted. The wetted perimeter method of evaluating instream flows, which was chosen as an alternative for most of these streams, focuses on riffles. But Rock and Bolsillo Creeks have limited riffle and run habitats, so the wetted perimeter analysis used on most of the seasonally diverted tributaries was inappropriate on these streams. For Rock and Bolsillo Creeks, an alternative Food Transport approach was originally suggested by the CAWG Transect Selection Team (CTST), which focused on habitat in pools. It was later discovered that this approach provided unreliable results in analyses conducted on Bolsillo Creek in 2002. The CAWG subsequently approved the use of the depth suitability analysis, as had been applied to small streams during the Vermilion Project relicensing (SCE 2002), in place of the food transport method.

For the depth suitability analysis, the CTST placed transects through pool habitats above and below the diversions on the two creeks. For each transect, a stage discharge relationship was developed using the regression technique in RHABSIM. The cross section profiles were surveyed using standard surveying techniques and input into RHABSIM.

For each transect, the depth was calculated at each station using the surveyed cross sections and stage-discharge relationships. To evaluate the relative depth suitability along each cross section, the Big Creek ALP suitability criteria for rainbow trout and brown trout were employed, as these were developed by the CAWG for use on the Project study streams. For brook trout, the only species observed in Bolsillo Creek, the criteria were drawn from Bovee (1978) and Smith and Aceituno (S&A) (1987), as the CAWG has not developed criteria for this species. The criteria from these sources were used in similar analyses conducted on smaller streams during the Vermilion Project relicensing (SCE 2001b). Bovee (1978) provides criteria for adults only, while Smith and Aceituno (1987) provide criteria for adult, juvenile and fry. For this analysis, depth suitability functions for each species were converted to binary criteria (i.e., either suitable or unsuitable). To create the binary functions, a suitability threshold level of 0.3 was selected. This threshold was based on an analysis of habitat suitability thresholds conducted during Habitat Suitability Criteria transferability testing studies (ENTRIX 1996, Lifton et al. 1998) and discussions with the Instream Flow Group (IFG) (Stalnaker, pers. comm.). These studies suggested that this threshold provides a robust breakpoint between suitable and unsuitable habitat, as defined in the transferability testing methodology of Groshens and Orth (1994). This same threshold was used in the Vermilion Project relicensing (SCE 2001b). The criteria used are presented in Table CAWG 3-2.

The suitability of depths was evaluated within RHABSIM using the binary criteria, creating a depth suitability function in the same manner weighted useable area (WUA) is calculated. The results of this analysis are expressed as a percentage of the cross sections containing habitat of suitable depth at various flow increments. They are presented in both tabular and graphical format. In evaluating these results, consideration of the measurement error associated with field data collection, the error associated with the model, and the ability of aquatic organisms to adapt to a range of conditions indicates:

1. That depth suitability differences of less than 15 percent are likely not biologically important.

2. Differences of 15 to 25 percent may be somewhat important.
3. Differences of 25 percent or more are more likely to be biologically important.

In deeper habitats, such differences may not be important.

4.0 RESULTS

4.1 STRANDING ANALYSIS

Results of the stranding analysis are organized by stream reach and describe the potential stranding effects of flow changes for both fish and redds. As previously described, fish stranding potential in PHABSIM streams was evaluated based on the change in wetted perimeter vs. flow and the change in cumulative PSA vs. flow. Although the approach to assessing stranding potential is quite different, these two indices have very similar patterns. Therefore, we have focused on the wetted perimeter function in our discussion. In wetted perimeter streams, only wetted perimeter was used. The discussions of PHABSIM streams and wetted perimeter streams are presented separately in the following sections.

For each reach, wetted perimeter and cumulative PSA functions are presented graphically. The steeper portion of these curves reflect flow levels where stranding is most likely to occur, as this is where the greatest change in habitat area with flow occurs. The percent change in wetted perimeter between any two flow levels simulated is shown in tabular format. A second table shows the amount of spawning habitat available at the starting flow that is retained at the ending flow (see Section 3.1.3 for an explanation of these tables). These values would be applied during the spawning and incubation season. For rainbow trout, this is from April through mid-July, and for brown trout, this is from October through March.

4.1.1 PHABSIM STREAMS

4.1.1.1 South Fork San Joaquin River

<u>SFSJR - Bear Creek to Florence Lake</u>

This reach (SFSJR RM 22.30 to 27.90) consists of three Rosgen Level I channel types (SCE 2003b). About 70 percent of the reach is classified as a Rosgen B-type channel, with most of the remaining length classified as C-type channel (27.4 percent). G-type channel comprises only a minor portion of the reach (2.8 percent). C-type channels have a broad, less incised profile, a more meandering pattern, and bars are normally present. This type of channel provides a greater opportunity for stranding than B- and G-type channels. Thus about a quarter of the reach has this higher potential for stranding. B- and G-type channels tend to be quite incised and provide less opportunity for stranding, as these channel types typically lack substantial bars. In these channel types, the SFSJR is well confined, with little flood prone area.

The wetted perimeter and cumulative PSA functions decrease approximately linearly with flow (Figure CAWG 3-1). The wetted perimeter function steepens as flows decline below 20 cfs. The cumulative PSA function steepens once flows decline below about

35 cfs. The steeper portion of these curves reflect flow levels where stranding is most likely to occur.

The percent change in wetted perimeter between any two flow levels simulated is shown in Table CAWG 3-2. Reducing the starting flow by one half in this reach generally resulted in a 12 to 18 percent reduction in the wetted perimeter at flows above 100 cfs and 7 to 9 percent at flows less than 80 cfs.

Table CAWG 3-3 shows the amount of spawning habitat available at the starting flow that is retained at the ending flow. For rainbow trout, over 90 percent of the initial spawning habitat was retained over any ramping (or downward flow change) event started at a flow of less than 150 cfs. At a starting flow of 200 cfs, over 81 percent of the habitat was retained, regardless of the final flow, and over 90 percent were retained at ending flows as low as 40 cfs. When a downramping event was initiated at a flow of 300 cfs, retention of this habitat was lower. The majority of habitat available for spawning at 300 cfs was on the margins of the channel, and therefore more readily dewatered. Looking at the starting WUA values, it was apparent that the majority of the potential spawning habitat was located in the lower flow portion of the channel, and that this habitat was not as vulnerable to dewatering. The habitat available at lower flows was not usable at 300 cfs because velocities were too high or depths too great, based on the Big Creek ALP spawning criteria. This pattern also was observed for brown trout spawning. For brown trout, however, the retention of spawning habitat was lower at starting flows of 150 cfs or greater. However, as brown trout spawn during the low flow portion of the year, starting flows of this magnitude are unlikely to occur.

SFSJR - Mono Creek to Bear Creek

This reach (SFSJR RM 18.00 to 22.30) consists of three Rosgen Level I channel types. Over half of this reach (58.9 percent) is classified as B-type channel. The remainder is classified as C-type (20.4 percent) and G-type (20.7 percent) channel (SCE 2003b). As previously discussed, fish are most likely to become stranded in the C-type channel, because of the more extensive bar formation and more gently sloping banks of this channel type. The C-type channel occurs near the Mono Springs Campground. The B- and G-type channels are more incised and have less likelihood of stranding fish.

As was observed in most reaches, the wetted perimeter vs. flow and cumulative PSA vs. flow functions were very similar (Figure CAWG 3-2). For both functions, the potential for stranding was greatest as flows decrease below 30 to 35 cfs. The risk of stranding is substantially reduced at high flows. The percent change in wetted perimeter ranged from 7 to 10 percent when the starting flow was halved, regardless of where the starting flow was found in the range of simulated flows (Table CAWG 3-5).

The amount of rainbow trout spawning habitat retained decreased more rapidly with declining flows than was evident in the reach between Bear Creek and Florence Lake (Table CAWG 3-6). There was little loss of spawning habitat when starting flows were 40 cfs or less. At starting flows of 80 cfs or more, the amount of habitat retained could be substantially less, depending on the ending flow. Much of the suitable spawning area available at flows greater than 100 to 150 cfs becomes disconnected from the wetted channel when flows drop below 60 cfs, indicating that these spawning areas are perched above the low flow channel. The amount of brown trout spawning habitat retained was quite similar to that for rainbow trout, however, consideration of flow changes would be applied in the late fall and winter (October through December) when starting flows are lower, rather than the spring.

South Fork San Joaquin River – downstream of Mono Creek

This section of the South Fork San Joaquin River is comprised of two reaches, Hoffman Creek to Rattlesnake Creek, and Rattlesnake Creek to Mono Creek. This section (SFSJR RM 0 to 18.0) consists of two Rosgen Level I channel types. Over half of this section (63.5 percent) is classified as B-type channel. The remainder is classified as G-type (36.5 percent) channel (SCE 2003b). Fish and redds are less likely to become stranded in these steep sided channel types.

The habitat evaluation for the reaches of the South Fork San Joaquin River downstream of Mono Creek were based upon the transects used for the Mono Creek to Bear Creek reach (SCE 2004 CAWG-3 PHABSIM). The results of the wetted perimeter and redd stranding analysis were similar to those provided for that reach.

4.1.1.2 Bear Creek

Bear Creek below the diversion is entirely composed of Rosgen Level 1 B-type channel (SCE 2003b). The stream is confined by steep bedrock walls along most of its length. There were few bars or lateral areas where fish could become stranded. Spawning habitat also is limited in this reach. This limitation is caused by low availability of spawning gravel (SCE 2004b). Only brown trout have been observed in this portion of Bear Creek (SCE 2004c).

As noted in the reaches previously discussed, the cumulative PSA vs. flow function closely mirrored the wetted perimeter vs. flow function (Figure CAWG 3-3). The greatest potential for stranding occurs as flows decrease below 12.5 cfs, where the wetted perimeter vs. flow function is steepest. At higher flows, the function is much flatter and the stranding potential is substantially lower. The change in wetted perimeter that occurred when flows were reduced by half ranged from about 9 to 16 percent across the range of simulation flows (Table CAWG 3-7).

There appeared to be distinct breaks in the distribution of brown trout spawning habitat. Nearly 40 percent of the spawning habitat available at 125 cfs is lost with a reduction of flow to 100 cfs, indicating perched gravel at this flow. No spawning habitat is lost with flow reductions in the range of 100 to 30 cfs, but about 25 to 30 percent is lost when flows are decreased to 20 cfs (Table CAWG 3-8). A similar situation occurs between 20 and 7 cfs. A final break in spawning habitat is evident between 4 and 7 cfs. Since brown trout spawn during October through December, downramping events are quite unlikely to occur and flows in the lower end of this range are most likely to be present during all water year types.

4.1.1.3 Mono Creek

Mono Creek below the Mono Diversion is primarily a steep, boulder/bedrock stream with Rosgen Level 1 B channels, with a short, low-gradient section through Mono Meadow. Relatively large amounts of spawning gravels were observed in Mono Creek (SCE 2003b). The fish community in Mono Creek was strongly dominated by brown trout, although a few rainbow trout were observed (SCE 2004c). Mono Creek had the most abundant spawning habitat of any stream evaluated (SCE 2004b). The amount of spawning habitat is highest for rainbow trout at 30 cfs and for brown trout at about 20 cfs.

The wetted perimeter vs. flow and cumulative PSA vs. flow functions were again quite similar (Figure CAWG 3-4). The greatest potential for stranding occurs as flows decline below 15 cfs. An 11 to 16 percent change in wetted perimeter was associated with reducing any starting flow by half in this stream (Table CAWG 3-9).

The amount of spawning habitat retained between any set of starting and ending flows was always greater than about 70 percent for both species (Table CAWG 3-10). At starting flows of 20 to 50 cfs, decreasing flows to 15 cfs would retain over 90 percent of the starting WUA. A reduction to 10 cfs would maintain over 80 percent of the starting WUA. At starting flows less than 20 cfs, a flow reduction to 7.5 cfs would retain at least 90 percent of the starting WUA.

4.1.1.4 San Joaquin River

<u>Mammoth Reach</u>

The Mammoth Reach of the San Joaquin River runs through a deep, granitic canyon that extends from Mammoth Pool Dam to the Mammoth Pool Powerhouse (SJR RM 18.30 to 26.70). This reach of the San Joaquin River is a moderately low gradient, boulder/bedrock stream with areas of finer materials. The stream channel consists of Rosgen Level I B- (54 percent) and G-type (46 percent) channels, with B channel types occurring in the lower portion of the reach (SCE 2003b). The river was strongly confined by steep bedrock walls over most of this reach, with little room for expansion, except at an occasional bar. The fish community in this reach was dominated by Sacramento sucker (76 percent of the fish sampled), while rainbow trout and brown trout made up 14 and 10 percent, respectively (SCE 2004c).

The greatest potential for stranding fish occurs as flows are decreased below 50 cfs, the flow range where the wetted perimeter vs. flow function is steepest. The slope of the function is considerably less steep between 50 and 250 cfs, and relatively flat at flows above 200 cfs (Figure CAWG 3-5). The cumulative PSA vs. flow function showed the same pattern. In this reach, reducing flows by 50 percent from any starting flow resulted in a 4 to 7 percent reduction in wetted perimeter (Table CAWG 3-11). This is less than half the change observed in the reaches previously discussed.

Table CAWG 3-12 shows the percent of spawning habitat remaining when flows are reduced from a starting flow to an end flow. At flows greater than 300 cfs, much of the spawning gravel is perched on the banks. Substantial amounts of these gravels become dewatered with relatively small decreases in flow. When flows are reduced from 200 cfs to 40 cfs, about 78 percent of the rainbow trout spawning habitat remains inundated.

When a starting flow of 100 cfs is reduced to 30 cfs, about 82 percent of the initial habitat is retained. At starting flows of 80 cfs or less, an end flow of 30 cfs retains about 90 percent or more of the starting habitat. Reducing the end flow to 25 cfs results in loss of about 10 percent more habitat. Brown trout habitat retention is about 4 to 6 percent less than for rainbow trout for the corresponding flow changes.

Stevenson Reach

The Stevenson Reach of the San Joaquin River (SJR RM 11.20 to 17.00) is a moderate gradient, boulder/bedrock stream with Rosgen Level I G channel type (SCE 2003b). This reach flows through a very narrow bedrock canyon with nearly vertical walls for most of its length. The fish community in this reach was composed of transition zone community species (Moyle 2002), predominantly Sacramento sucker, Sacramento pikeminnow, and hardhead. Rainbow trout represented about 11 percent of the fish collected in the upper end of the reach and were not present in the lower end. Brown trout represented less than 2 percent of the total number of fish collected in both ends of the reach (SCE 2004c).

The greatest potential for fish stranding occurs as flows are decreased below 20 cfs. The wetted perimeter vs. flow and cumulative PSA vs. flow functions were very flat and indicate a low potential for stranding at flows greater than 100 cfs (Figure CAWG 3-6). These functions had an intermediate slope between 20 and 100 cfs. The change in wetted perimeter when the starting flow was reduced by half was relatively small, ranging from 4 to 8 percent over the entire range of simulation flows (Table CAWG 3-13).

The retention of rainbow trout spawning area with flow reductions was lower than observed for other reaches when the starting flow was 250 cfs or more. When the initial flow was between 150 to 40 cfs, at least 79 percent of the starting spawning area was retained when the ending flow was 20 cfs, and at least 88 percent when the ending flow was 30 cfs. Reducing flow to 3 cfs during the spawning season resulted in the loss of more than half the spawning area if the starting flow was more than 10 cfs (Table CAWG 3-14). The same trends were observed for brown trout in this reach.

4.1.1.5 Big Creek

Dam 4 to Powerhouse 2

Big Creek from Dam 4 to Powerhouse 2 (Big Creek RM 6.20 to 1.80) is a moderately steep, bedrock/boulder stream comprised primarily of Rosgen Level 1 A channel, with a small inclusion (5 percent) of B channel. It primarily includes step pool and cascade habitats. However, substantial amounts of pool, riffle and flatwater habitats are present (SCE 2003b). The stream is strongly confined by steep bedrock walls in most areas, although in some areas, the walls were less steep and banks were composed of boulders. Bedrock and boulders were also the predominant substrates throughout the reach.

The greatest potential for stranding occurs as flows decrease below 6 cfs (Figure CAWG 3-7). The potential for stranding becomes progressively lower with increasing starting flows above 6 cfs. Reducing any starting flow by half resulted in a 9 to 15 percent reduction in wetted perimeter, with the percentage being higher at flows greater than 25 cfs than at lower flows (Table CAWG 3-15).

The amount of rainbow trout and brown trout spawning habitat retained exceeded 74 percent for any flow reduction within the range of simulated flows, and was only less than 80 percent when the starting flow of 100 cfs was reduced to less than 3 cfs (Table CAWG 3-16). For rainbow trout, if the starting flow was 80 cfs or less, then over 95 percent of the spawning habitat was retained when the final flow was 3 cfs or more, and over 80 percent was generally retained when the final flow was 2 cfs. The pattern for brown trout was similar.

<u>Dam 5 to Powerhouse 8</u>

Big Creek from Dam 5 to Powerhouse 8 (Big Creek RM 1.70 to 0.00) is a steep, bedrock/boulder stream composed primarily of Rosgen Level 1 A channel, with a smaller component of Aa+ channel at its downstream end. It has mostly step pool and other pool habitats. Only small amounts of riffle and flatwater habitats were observed (SCE 2003b). As in the Big Creek – Dam 4 to Powerhouse 2 reach, this section of stream is strongly confined by steep bedrock walls in most areas and substrates are predominantly bedrock and boulder.

The wetted perimeter vs. flow function for this reach was less steep than that for the reach of Big Creek below Dam 4. The most rapid change in wetted perimeter, and the highest potential for stranding, occurred at flows less than 7 cfs (Figure CAWG 3-8). The percent reduction in wetted perimeter when the starting flow was halved ranged from 5 to 13 percent, with the largest changes occurring at starting flows of 50 cfs or more (Table CAWG 3-17).

The potential to strand redds was higher in this reach with reductions from high flows than in the reach below Dam 4. However, retention was about 75 percent when flows were reduced by three quarters from any starting flow. For rainbow trout, the retention of redds was as low as 57 percent under the largest flow reduction scenarios (Table CAWG 3-18). For brown trout, retention rates were slightly lower than for rainbow trout. At starting flows of 10 cfs or less, redd retention exceeded 80 percent at final flows of 2 cfs for both species.

4.1.1.6 Stevenson Creek

Stevenson Creek from Shaver Lake Dam to the confluence with the San Joaquin River (Stevenson Creek RM 4.25 to 0.00) has a granitic stream channel with a moderate to very steep channel gradient. Much of the stream flows over bedrock. Fifty-one percent of Stevenson Creek is composed of Rosgen Level I Aa+ channel type, with the rest composed of B (30 percent) and A (16 percent) channels and a small section (3 percent) of G channel (SCE 2003b). Only rainbow trout were observed in Stevenson Creek below Shaver Lake (SCE 2004c).

The greatest potential for stranding occurs as flows decline below 6 cfs and decreases gradually with starting flows up to about 35 cfs (Figure CAWG 3-9). The risk of stranding is similar for any given flow reduction at all flows greater than 35 cfs. The wetted perimeter vs. flow function for Stevenson Creek is moderately steep relative to other reaches at these higher flows. Wetted perimeter was reduced by 6 to 20 percent when the flow decreased by 50 percent. Decreases exceeded 10 percent when the starting flow was greater than 25 cfs, and smaller decreases occurred at starting flows less than 25 cfs (Table CAWG 3-19).

In Stevenson Creek, there was a high retention of spawning habitat for rainbow trout at all starting flows, unless the end flow was less than 5 cfs (Table CAWG 3-20). When the end flow remained at 5 cfs or higher, at least 84 percent of the original habitat was retained with starting flows of 100 cfs. When starting flows were less than 60 cfs, over 90 percent of the initial habitat was retained at an end flow of 5 cfs. When the end flow was less than 5 cfs, habitat retention was substantially reduced, unless the starting flow was 7 cfs or less.

4.1.1.7 North Fork Stevenson Creek

North Fork Stevenson Creek is a moderate to steep gradient stream. Natural streamflow is augmented by releases made at Tunnel 7 (North Fork Stevenson Creek RM 3.60). Prior to the operation of the Balsam Meadow Project, water was transferred from Huntington Lake to Shaver Lake through this channel. Currently water from Huntington Lake primarily reaches Shaver Lake through Eastwood Powerhouse. About one fifth of the reach is composed of Rosgen Level 1 C-type channel, which has a higher potential for stranding. About half of the reach downstream of the tunnel outlet is Rosgen Aa+ channel (50.4 percent), with smaller components of B channel (20.2 percent) and C channel (17.1 percent) in the downstream reaches. There are also small components of G-type (8.1 percent) and A-type channels (4.3 percent) near the lake (SCE 2003b). Both rainbow and brown trout have been observed in North Fork Stevenson Creek (SCE 2004c).

The wetted perimeter vs. flow function for North Fork Stevenson Creek was flatter than those for Big Creek or Stevenson Creek. The steepest portion of the function again occurred at the lower end of the flow range, at flows less than 9 cfs (Figure CAWG 3-10). It is at this range of flows that the potential for stranding is greatest. Stranding potential becomes progressively lower with higher flows above 9 cfs. Between 9 and 11 percent of the starting wetted perimeter was lost when flows were reduced by half at any starting flow (Table CAWG 3-21); the narrowest range observed on any project stream.

Retention of rainbow trout redd habitat with flow reductions was large, with over 80 percent of initial habitat being retained as long as flows were not reduced below 5 cfs regardless of initial flow (Table CAWG 3-22). Regardless of starting flow, ending flows of 7.5 cfs retained over 90 percent of initial habitat for rainbow trout spawning. When the end flow is decreased from 5 to 3 cfs, there is an additional 7 to 16 percent loss of habitat at starting flows of 15 cfs or more.

For brown trout, habitat retention rates also were large when ending flows were greater than 5 cfs, with retention rates similar to or slightly lower than for rainbow trout. When the starting flow is 15 cfs or less, an ending flow of 5 cfs provides 95 percent or more habitat retention.

4.1.2 WETTED PERIMETER STREAMS

Wetted perimeter streams are seasonally diverted, typically during the high run-off period starting in March or April and continuing through June or July. The streams generally are not diverted the remainder of the year, and exhibit natural summer base flows. As described in the CAWG 3 Study Plan, evaluation of these streams focused on fish and macroinvertebrates habitat. Spawning habitat was not evaluated. The results presented in this section describe the stranding potential for fish.

Wetted perimeter vs. flow functions for these small streams were presented previously in SCE 2003a and SCE 2004a. The inflection flows for each reach identified in these reports are summarized Table CAWG 3-23. These flows are the average of the flows at the inflection point for all the individual transects in the reach. The change in average wetted perimeter vs. flow for each stream is also visually presented in Figures CAWG 3-11 through 3-22. These functions were obtained by averaging the wetted perimeter at each transect for each flow level. Because of the difference in the derivation of the wetted perimeter function, small discrepancies are observed in the inflection point of the wetted perimeter relationship. The percentage reduction in wetted perimeter between any two flow levels is provided in Tables CAWG 3-24 through 3-35. This was calculated from the average wetted perimeter function described immediately above. Our discussion of the reduction in wetted perimeter reflects a flow decrease of 50% from any starting flow. Again, this is used as a general comparison, and does not reflect either current operations or a recommendation for future operations.

With a few exceptions, the wetted perimeter streams below their diversions are classified as Rosgen Level 1 Channel Type Aa+ (SCE 2003b). These channels are characterized as very steep and incised with predominantly bedrock and boulder substrates. There is a low potential for stranding in this type of channel. Pitman, Rancheria, Crater, and Tombstone creeks all had sections of other channel types, which were not sampled (with the exception of Rancheria Creek) because these sections represented less than 5 percent of the total stream length. Rancheria Creek was predominantly Rosgen G-type channel, with a smaller proportion of Aa+ channel. G-channels are entrenched and gully like and present a low opportunity for stranding. In Rancheria Creek, the substrates in this part of the channel are largely cobble and boulder.

In the discussion that follows, upper basin streams (those tributary to the SFSJR) are discussed first and those tributary to the SJR and Big Creek are discussed second. The divisions follow those in the reports discussing these tributaries: SCE 2003a and SCE 2004a, respectively.

4.1.2.1 Upper Basin Streams

Camp 62 Creek

The wetted perimeter function indicates that the stranding potential for fish is greatest as flows decrease below 1.2 cfs (Figure CAWG 3-11). Stranding potential is more moderate at flows between 1.2 and 10 cfs, and much reduced at starting flows greater than 10 cfs. In terms of percentage change in wetted perimeter with flow, when a starting flow between 25 and 2.4 cfs was halved, it produced a wetted perimeter decrease of 9 to 16 percent (Table CAWG 3-24). Below 2.4 cfs, the wetted perimeter decreased by 20 percent or more, as flows were halved.

Chinquapin Creek

On Chinquapin Creek, stranding potential is greatest as flows decrease below 0.9 cfs. Stranding potential decreases with increasing flows above this level, but becomes constant at flows greater than 2.4 cfs (Figure CAWG 3-12). In terms of percentage change in wetted perimeter with flow, when a starting flow between 15 and 2.7 cfs was halved, it produced a wetted perimeter decrease of less than 10 percent (Table CAWG 3-25). Below 2.7 cfs, the wetted perimeter decreased between 10 and 20 percent as flows were halved.

Crater Creek

The wetted perimeter function indicates that the greatest potential for stranding occurs at flows less than 0.9 cfs, although stranding potential remains relatively high up to 2.4 cfs (Figure CAWG 3-13). The risk of stranding is lower between 2.4 and 20 cfs and decreases further at flows greater than 20 cfs. In terms of percentage change in wetted perimeter with flow, when a starting flow of 35 to 1.2 cfs was halved, it produced a wetted perimeter decrease between 10 and 18 percent (Table CAWG 3-26). Below 1.2 cfs, the wetted perimeter decreased by up to 25 percent as flows were halved.

Hooper Creek

The wetted perimeter function shows that the greatest potential for stranding occurs at flows less than 1.2 cfs (Figure CAWG 3-14). Stranding potential decreases with increasing flow levels above this flow. There would be an 11 to 20 percent decrease in wetted perimeter if flows were reduced by half within the range of simulation flows. The rates of habitat loss are greater above 15 cfs and below 1.2 cfs than in the range between these flows (Table CAWG 3-27).

North Slide Creek

The potential for stranding on North Slide Creek is greatest as flow decreases below flows of 0.5 cfs (Figure CAWG 3-15). This risk decreases with increasing flow above this level. Note, however, that the 0.5 cfs flow is at the top of the normally accepted extrapolation range for the stage-discharge models.

There were three basic patterns in terms of percentage of change in wetted perimeter with flow. At starting flows of 2.0 to 1.0 cfs, wetted perimeter decreased between 13 and 15 percent when flow was decreased by half (Table CAWG 3-28). At starting flows of 0.9 to 0.4 cfs, the wetted perimeter decreased between 18 and 22 percent as flows were halved. Finally, at starting flows of 0.4 cfs or less, the wetted perimeter decreased by 8 to 15 percent when flow was decreased by half.

South Slide Creek

The wetted perimeter function indicates that the stranding potential is greatest as flow decreases below 0.5 cfs (Figure CAWG 3-16). Between 0.5 and 4.5 cfs the risk of stranding is reduced and constant. Stranding risk increases again between 4.5 and 7.5 cfs. The highest percentage decrease in wetted perimeter that occurred when flows were reduced by half (36 percent) occurred at a starting flow of 7.5 cfs (Table CAWG 3-29). Below 5 cfs, the wetted perimeter decreased by 7 to 15 percent as flows were halved. The lowest decrease in wetted perimeter when flows were halved occurred in the flow range of 2.7 to 0.7 cfs, which corresponded to a decrease in wetted perimeter of 10 percent or less.

Tombstone Creek

The stranding potential on Tombstone Creek was greatest at flows between 0.1 and 0.7 cfs and 2.1 and 2.7 cfs (Figure CAWG 3-17). The risk of stranding between 0.7 and 2.1 cfs was lower, and the risk of stranding decreased with increasing flow above 2.7 cfs. The percentage loss of habitat when flows were reduced by half was generally larger than observed on other streams, ranging from about 18 to 51 percent (Table CAWG 3-30). The lowest amount of habitat reduction occurred at the highest flow simulated, while the largest habitat reduction occurred at the lowest simulated flow.

4.1.2.2 Lower Basin Streams

Adit 8 Creek

The wetted perimeter vs. flow curve for Adit 8 Creek is steepest at flows of 0.5 cfs or less. The slope is much lower at flows between 0.5 and 4.5 cfs, and steepens again at flows between 5 and 9 cfs (Figure CAWG 3-18). The increase between 5 and 9 cfs reflects an area where the stream spreads onto its floodplain, which is relatively broad relative to the low flow channel in the area of the transects. In terms of percentage change in wetted perimeter with flow, when a starting flow of 10 to 5.5 cfs was halved, it produced a wetted perimeter decrease between 32 and 56 percent (Table CAWG 3-31). Below 5.5 cfs, the wetted perimeter decreased between 7 and 20 percent, as flows were halved.

Balsam Creek

Stranding potential on Balsam Creek was lowest at flows less than 0.9 cfs and decreased as starting flows increased to about 5 cfs (Figure CAWG 3-19). The percentage decrease in wetted perimeter was 12 to 19 percent when starting flows were decreased by half between 10 and 3.0 cfs. The percentages were greater above and below this flow range, and were greatest (23 to nearly 40 percent) at flows below 2.1 cfs (Table CAWG 3-32).

Ely Creek

The highest stranding potential on Ely Creek occurred as flows declined from starting flows of 0.5 cfs or less (Figure CAWG 3-20). The stranding potential was lower from 0.5 to 3 cfs, and lowest at flows above 3 cfs. In terms of percentage change in wetted perimeter with flow. When a starting flow of 8 to 4 cfs was halved, it produced a wetted perimeter decrease between 21 and 25 percent (Table CAWG 3-33). At starting flows between 3.5 and 1.1 cfs, the wetted perimeter decreased between 25 and 35 percent, as flows were halved. At starting flows of 0.9 to 0.5 cfs, wetted perimeter showed a comparatively lower decrease when flows were halved (16 to 25 percent). However, this pattern was broken at 0.3 cfs where a decrease of half the flow decreased wetted perimeter by about 40 percent.

Pitman Creek

The wetted perimeter function indicates that there is a primary inflection point at 0.6 cfs (Figure CAWG 3-21). Flows below this are those with the greatest potential for stranding. The risk of stranding is reduced between starting flows of 0.7 and 20 cfs. In terms of percentage change in wetted perimeter with flow, when a starting flow of 25 to 9 cfs was halved, it produced a wetted perimeter decrease between 24 and 37 percent (Table CAWG 3-34). At starting flows between 8 and 2.8 cfs, the wetted perimeter decreased between 15 and 19 percent, as flows were halved. Below 2.3 cfs, the wetted perimeter decreased by less than 12 percent as flows were halved.

Rancheria Creek

The wetted perimeter function indicates decreasing stranding potential with increasing starting flows (Figure CAWG 3-22). Risk is greatest at starting flows below 0.9 cfs and lowest at flows greater than 12 cfs. Between 0.9 and 12 cfs, the slope becomes less steep with increasing flow. The percentage change in wetted perimeter when starting flows of 35 to 9 cfs were halved produced a change in wetted perimeter of less than 14 percent (Table CAWG 3-35). With a starting flow of 8 cfs or less, the wetted perimeter decreased between 15 and 20 percent, as flows were halved.

4.2 DEPTH SUITABILITY ANALYSIS

The results of the depth suitability analysis for Rock and Bolsillo Creeks are expressed as a percentage of the cross sections containing suitable depths for adult, juvenile and fry trout (brown and rainbow in Rock, brook in Bolsillo) over a range of simulated flows (0.1 to 15 cfs for Rock Creek 0.1 to 14 cfs for Bolsillo Creek).

4.2.1 ROCK CREEK

Both rainbow and brown trout have been observed in Rock Creek (SCE 2004c).

4.2.1.1 Rock Creek above the Diversion

The CTST selected two step pool transects on Rock Creek above the diversion, SPO-2 and SPO-3. Table CAWG 3-36 and Figure CAWG 3-23 present the depth suitability results for rainbow and brown trout.

For Rock Creek above the diversion, the proportion of habitat with suitable depths was generally similar over the range of flows simulated, varying by less than 25 percent for any species/lifestage over the range of flows simulated.

4.2.1.1.1 Rainbow Trout

Adult: For adult rainbow trout, the proportion of the two transects with suitable depths ranged from 46 to 68 percent, with the maximum suitable percentage occurring at a flow of 1.7 cfs. The greatest change in habitat occurred from 0.1 to 1.7 cfs. At flows greater than 1.7 cfs, the percentage of suitable habitat was relatively constant, ranging from 62 to 68 percent.

Juvenile: For juvenile rainbow trout, the proportion of the transects with suitable depths peaked at 88 percent at a flow of 0.7 cfs, then decreased to 72 percent where it stayed constant from 3.3 to 6 cfs. For flows greater than 6 cfs, the amount of suitable habitat ranged from 70 to 81 percent.

Fry: The proportion of suitable depth for fry rainbow trout was the highest at lower flows, with the maximum percentage of 95 percent occurring at a flow of 0.1 cfs. The percentage of suitable depths decreased between 2.4 and 3.5 cfs, stabilizing between 75 and 80 percent for flows greater than 3.5 cfs.

4.2.1.1.2 Brown Trout

Adult: For the brown trout adults, the proportion of habitat with suitable depths was similar over the range of flows simulated, varying by only nine percent (69 to 78 percent). This difference is biologically insignificant as described in Section 3.2, and any flows within the range simulated would provide similar habitat values.

Juvenile: For juvenile brown trout, the proportion of habitat with suitable depths ranged from 76 to 90 percent, a difference of 14 percent. Based on the criteria described in Section 3.2, this difference is biologically insignificant, and any flows within the range simulated would provide similar habitat values.

Fry: The amount of habitat with suitable depths for brown trout fry varied from 71 to 90 percent. The greatest amount of suitable habitat occurred at flows less than 0.7 cfs. At flows of 1.1 cfs or greater, the amount of suitable depth was generally similar, varying by less than seven percent (from 71 to 78 percent).

4.2.1.2 Rock Creek below the Diversion

The CTST could locate only one suitable transect for sampling on Rock Creek below the diversion for the food availability study initially envisioned. All other pools observed in this reach were plunge pools. These plunge pools were considerably deeper that the pool selected for sampling with their depths controlled by bedrock or boulder sills. These plunge pools maintain their depth even at low flow levels due to these sill-type hydraulic controls. These pools were considered unsuitable for the food availability approach because water flows into these pools vertically, rather than horizontally, and velocity gradients are therefore turbulent and not suited to the food availability analysis.

The transect selected by the CTST was placed through this step pool habitat unit and designated SPO-2. Table CAWG 3-37 and Figure CAWG 3-24 present the depth suitability results for this transect.

The amount of habitat with suitable depths varied more in this location than for Rock Creek above the diversion. Over the range of flows simulated, the amount of habitat with suitable depths varied by 7 to 23 percent depending on species and lifestages, which is considered insignificant to marginally significant by the criteria described in Section 3.2. The greatest amount of variation in the percentage of suitable habitat over the range of simulation flows occurred for adult brown trout.

4.2.1.2.1 Rainbow Trout

Adult: The amount of habitat with suitable depths for adult rainbow trout was relatively constant over the range of simulated flows, ranging from 44 to 63 percent. The proportion of suitable habitat was relatively constant from 0.1 to 6.5 cfs, ranging from 44 to 51 percent. It then increased between 7 and 15 cfs, where 57 to 63 percent of the habitat was suitable, with the highest flow having the greatest proportion of suitable habitat.

Juvenile: The pattern of suitable depth habitat for juvenile rainbow trout was similar to that described for adult rainbow trout, but the proportion of suitable habitat was higher, ranging from 67 to 89 percent. Flows of 7 cfs or greater provided the greatest amount of suitable depths (83 to 88 percent) for this lifestage.

Fry: The amount of suitable habitat for rainbow trout fry ranged from 93 to 100 percent. Given the high suitability values present at all flows, it is unlikely that depth was limiting for fry rainbow trout.

4.2.1.2.2 Brown Trout

Adult: Suitable depths for adult brown trout occurred in over 49 to 72 percent of the transect. The greatest increase in habitat occurred as flows increased from 0.5 to 1.5 cfs. Flows of 1.5 cfs or greater provided the greatest depth suitability for this lifestage, with values of 61 to 71 percent.

Juvenile: For juvenile brown trout, the amount of suitable habitat ranged from 70 to 90 percent. Higher flows provided more habitat with flows of 4.8 to 15 cfs providing suitable habitat over 84 to 90 percent of the transect. Flows less than this provided over 70 percent suitable habitat. It is unlikely depth was limiting to this lifestage.

Fry: Brown trout fry depth suitability ranged from 80 to 100 percent. All flows less than 10 cfs provided suitable depths for more than 90 percent of the area. It is unlikely depth limits habitat for brown trout fry.

4.2.2 BOLSILLO CREEK

Brook trout was the only species present in Bolsillo Creek. As brook trout do not occur in the larger streams where PHABSIM studies were conducted, no brook trout HSC were developed as part of the Big Creek ALP. For this discussion, adult brook trout habitat was evaluated with Bovee and S&A criteria, and juvenile and fry habitat was evaluated with S&A criteria.

4.2.2.1 Bolsillo Creek Above the Diversion

The CTST selected three transects on Bolsillo Creek above the diversion. These were two step pools and one step run transect. Table CAWG 3-38 and Figure CAWG 3-25 present the depth suitability results for these transects.

4.2.2.1.1 Brook Trout

Adult: With Bovee criteria, the proportion of habitat with suitable depths ranged from 70 to 93 percent over the range of flows simulated. The amount of habitat generally increased with flow between 0.3 and 3 cfs reaching 88 percent. At flows greater than 3 cfs, the amount of suitable habitat varied, decreasing to 80 percent at 7.5 cfs, then increasing again to reach its maximum at 14 cfs, where it provided only four percent more habitat than at 3 cfs. A similar amount of habitat was available at all simulated flows greater than 1.8 cfs.

The S&A criteria had a similar pattern (shape) to that of the Bovee depth suitability function, but with a lower proportion of suitable habitat, due to reduced suitabilities for shallower depths. The proportion of habitat with suitable depths ranged from 34 to 56 percent over the range of flows simulated, which was a marginally significant difference from a biological perspective. The amount of habitat generally increased with flow up to 4.5 cfs where it first peaked at 49 percent. At flows greater than 4.5, the amount of suitable habitat varied, decreasing slightly then increasing again to reach its maximum at 14 cfs, where it provided only 8 percent more habitat than at 4.5 cfs.

Juvenile: For juvenile brook trout, the amount of habitat with suitable depth ranged from 40 to 69 percent[2]. The most rapid increase occurred at flow between 1.2 and 1.8 cfs, where the proportion of habitat with suitable depths reached about 56 percent. The proportion of suitable habitat decreased with increasing flow to 3.5 cfs, and then began to climb gradually as flows increased further.

Fry: The percentage of habitat with suitable depth for brook trout fry varied from 92 to 100 percent, with the maximum amount occurring at flows of 0.2 cfs. Given the high amount of suitable habitat, it is unlikely depth was limiting habitat for brown trout fry.

4.2.2.2 Bolsillo Creek below the Diversion

Five transects were placed on Bolsillo Creek below the diversion by the CTST: three in step pools and two in runs. Table CAWG 3-39 and Figure 3-26 present the depth suitability results for these transects. This area showed a much greater response to flow than any of the other areas where the depth suitability technique was applied.

4.2.2.2.1 Brook Trout

Adult: The amount of habitat with suitable depths for adult brook trout using the Bovee Criteria ranged from 66 to 98 percent. The amount of habitat generally increased with flow until it reached 2.2 cfs. It stabilized there varying only by about two percent until flow reached 8.5 cfs. The proportion of habitat with suitable depths then declined as flow increases further.

With S&A criteria, none of the depths were suitable until flow reached 0.3 cfs. The most rapid increase in the proportion of habitat with suitable depth occurred as flows increased from 0.3 to 2.4 cfs, but habitat continued to increase more gradually from 3.0 to 6.5 cfs. Flows greater than 6.5 cfs provided similar amounts of habitat with suitable depth, with an increase of six percent at the highest flow. About 15 percent more habitat had suitable depths at a flow of 14 cfs than at 3.5 cfs.

Juvenile: The amount of habitat with suitable depths for juvenile brook trout ranged from 5 to 85 percent, with the maximum value occurring at 9.5 cfs. The most rapid increase occurred over flows from 0.1 to 1.2 cfs, but habitat continued to increase more

[2] Bovee (1978) does not provide criteria for brook trout juveniles or fry.

gradually with flow, up to 9.5 cfs. The proportion of habitat with suitable depths varied by less than 10 percent at flows greater than 3.5 cfs.

Fry: The proportion of habitat with suitable depth for brook trout fry was relatively constant from 0.1 to 5 cfs, ranging from 96 to 100 percent, and then declined with increasing flow. Given the large amount of suitable habitat at all flows, it is unlikely that depth was limiting for brown trout fry.

5.0
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PERSONAL COMMUNICATIONS

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STRANDING REPORT TABLES

Table CAWG 3-1. Potential Stranding Analysis Criteria used for the Big Creek ALP PHABSIM Streams (from Envirosphere 1988).

Depth	Stranding Potential
0	1
0.2	1
0.5	0
100	0

Slope	Stranding Potential
0	1
3.99	1
4	0.8
4.99	0.8
5	0.6
5.99	0.6
6	0.4
6.99	0.4
7	0.3
7.99	0.3
8	0.2
8.99	0.2
9	0.1
100	0.1

Velocity not used in analysis and substrate assumed to have a stranding potential of 1.0.

Table CAWG 3-2. Percent Change in Wetted Perimeter Between Two Flows for South Fork San Joaquin River - Bear Creek to Florence Lake Reach.

	Start Flow[1] (cfs)																												
Start Flow[1]	300	275	250	225	200	175	150	125	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	18	16	14	12
WP[2]	69.4	67.5	65.3	63.7	61.3	59.0	57.0	54.9	51.8	51.0	50.4	49.9	49.4	48.9	48.3	47.6	46.9	46.2	45.8	45.4	45.0	44.4	43.4	42.3	41.4	40.9	40.4	39.8	39.2
End Flow[3] (cfs)																													
300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
275	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
250	6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
225	8	6	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	12	9	6	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
175	15	13	10	7	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150	18	16	13	10	7	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
125	21	19	16	14	10	7	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100	25	23	21	19	16	12	9	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
95	26	24	22	20	17	14	11	7	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
90	27	25	23	21	18	15	12	8	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
85	28	26	24	22	19	15	13	9	4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	29	27	24	22	19	16	13	10	5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	30	28	25	23	20	17	14	11	6	4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	30	29	26	24	21	18	15	12	7	5	4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
65	31	30	27	25	22	19	17	13	8	7	6	5	4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	32	31	28	26	24	21	18	15	10	8	7	6	5	4	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
55	33	32	29	27	25	22	19	16	11	9	8	7	6	5	4	3	1	-	-	-	-	-	-	-	-	-	-	-	-
50	34	32	30	28	25	22	20	17	12	10	9	8	7	6	5	4	2	1	-	-	-	-	-	-	-	-	-	-	-
45	35	33	30	29	26	23	20	17	12	11	10	9	8	7	6	5	3	2	1	-	-	-	-	-	-	-	-	-	-
40	35	33	31	29	27	24	21	18	13	12	11	10	9	8	7	5	4	3	2	1	-	-	-	-	-	-	-	-	-
35	36	34	32	30	28	25	22	19	14	13	12	11	10	9	8	7	5	4	3	2	1	-	-	-	-	-	-	-	-
30	37	36	34	32	29	26	24	21	16	15	14	13	12	11	10	9	7	6	5	4	3	2	-	-	-	-	-	-	-
25	39	37	35	34	31	28	26	23	18	17	16	15	14	13	12	11	10	8	8	7	6	5	3	-	-	-	-	-	-
20	40	39	37	35	33	30	27	25	20	19	18	17	16	15	14	13	12	10	10	9	8	7	5	2	-	-	-	-	-
18	41	39	37	36	33	31	28	25	21	20	19	18	17	16	15	14	13	11	11	10	9	8	6	3	1	-	-	-	-
16	42	40	38	37	34	31	29	26	22	21	20	19	18	17	16	15	14	12	12	11	10	9	7	4	2	1	-	-	-
14	43	41	39	38	35	33	30	27	23	22	21	20	19	19	18	16	15	14	13	12	11	10	8	6	4	3	2	-	-
12	44	42	40	39	36	34	31	29	24	23	22	22	21	20	19	18	16	15	14	14	13	12	10	7	5	4	3	2	-
10	45	43	41	40	38	35	33	30	26	25	24	23	22	22	21	19	18	17	16	16	15	14	12	10	7	6	5	4	2

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-3. Percent of Trout Redd Area Remaining between Starting and Ending Flow Levels in SF San Joaquin River - Bear Creek to Florence Lake.

A. Rainbow Trout

		Start Flow[1] (cfs)								
		300	**200**	**150**	**100**	**80**	**60**	**40**	**30**	**25**
	Starting WUA[2]	*523*	*675*	*904*	*1911*	*2586*	*3257*	*3689*	*3657*	*3539*
End Flow[3] (cfs)	**300**	-	-	-	-	-	-	-	-	-
	200	94	-	-	-	-	-	-	-	-
	150	85	98	-	-	-	-	-	-	-
	100	73	93	100	-	-	-	-	-	-
	80	73	93	100	100	-	-	-	-	-
	60	69	92	99	100	100	-	-	-	-
	40	69	92	99	100	100	100	-	-	-
	30	67	89	97	99	99	100	100	-	-
	25	66	86	94	98	98	99	100	100	-
	20	66	86	94	98	98	99	100	100	100
	15	63	83	92	97	98	99	100	100	100
	11	62	81	90	94	95	95	96	97	98

B. Brown Trout

		Start Flow[1] (cfs)								
		300	**200**	**150**	**100**	**80**	**60**	**40**	**30**	**25**
	Starting WUA[2]	*396*	*399*	*516*	*1025*	*1506*	*2372*	*3280*	*3580*	*3625*
End Flow[3] (cfs)	**300**	-	-	-	-	-	-	-	-	-
	200	91	-	-	-	-	-	-	-	-
	150	75	95	-	-	-	-	-	-	-
	100	54	83	98	-	-	-	-	-	-
	80	54	83	98	100	-	-	-	-	-
	60	47	77	95	100	100	-	-	-	-
	40	47	77	95	100	100	100	-	-	-
	30	45	73	92	98	99	99	100	-	-
	25	45	72	89	95	97	98	99	100	-
	20	45	72	89	95	97	98	99	100	100
	15	41	67	85	94	96	98	99	100	100
	11	40	66	82	92	93	95	96	97	98

[1] Start Flow : Flow, in cfs, at which the ramping begins
[2] WUA : Weighted Usable Area, in square feet per 1,000 feet, at the starting flow
[3] End Flow : Flow, in cfs, at end of ramping event

Table CAWG 3-4. CAWG Criteria- Depth Analysis for Bolsillo and Rock Creeks.

Rainbow Trout - CAWG Criteria

Life Stage: Adult

Velocity (fps)	Suitability	Depth (ft)	Suitability
0	1	0	0
100	1	1.03	0
		1.04	1
		100	1

Life Stage: Juvenile

Velocity (fps)	Suitability	Depth (ft)	Suitability
0	1	0	0
100	1	0.53	0
		0.54	1
		3.14	1
		3.15	0
		100	0

Life Stage: Fry

Velocity (fps)	Suitability	Depth (ft)	Suitability
0	1	0	0
100	1	0.11	0
		0.12	1
		2.6	1
		2.61	0
		100	0

Brown Trout - CAWG criteria

Life Stage: Adult

Velocity (fps)	Suitability	Depth (ft)	Suitability
0	1	0	0
100	1	0.77	0
		0.78	1
		100	1

Life Stage: Juvenile

Velocity (fps)	Suitability	Depth (ft)	Suitability
0	1	0	0
100	1	0.46	0
		0.47	1
		3.58	1
		3.59	0
		100	0

Life Stage: Fry

Velocity (fps)	Suitability	Depth (ft)	Suitability
0	1	0	0
100	1	0.11	0
		0.12	1
		2.25	1
		2.26	0
		100	0

Brook Trout - Smith and Aceituno criteria

Life Stage: Adult

Velocity (fps)	Suitability	Depth (ft)	Suitability
0	1	0	0
100	1	0.81	0
		0.82	1
		100	1

Life Stage: Juvenile

Velocity (fps)	Suitability	Depth (ft)	Suitability
0	1	0	0
100	1	0.62	0
		0.63	1
		2.84	1
		2.85	0
		100	0

Life Stage: Fry

Velocity (fps)	Suitability	Depth (ft)	Suitability
0	1	0	0
100	1	0.03	0
		0.04	1
		2.02	1
		2.03	0
		100	0

Brook Trout - Bovee criteria

Life Stage: Adult

Velocity (fps)	Suitability	Depth (ft)	Suitability
0	1	0	0
100	1	0.24	0
		0.25	1
		100	1

Table CAWG 3-5. Percent Change in Wetted Perimeter Between Two Flows for South Fork San Joaquin River - Mono Crossing to Bear Creek Reach.

End Flow[3] (cfs)	Start Flow[1] (cfs)																												
Start Flow[1]	**300**	**275**	**250**	**225**	**200**	**175**	**150**	**125**	**100**	**95**	**90**	**85**	**80**	**75**	**70**	**65**	**60**	**55**	**50**	**45**	**40**	**35**	**30**	**25**	**20**	**18**	**16**	**14**	**12**
WP[2]	74.0	72.9	71.8	70.8	69.6	68.3	67.0	65.6	63.1	62.8	62.4	62.1	61.7	61.3	60.8	60.2	59.7	59.2	58.4	57.7	56.8	55.9	54.5	52.9	50.9	50.1	49.2	48.5	47.5
300	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
275	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
250	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
225	4	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	6	4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
175	8	6	5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150	9	8	7	5	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
125	11	10	9	7	6	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100	15	13	12	11	9	8	6	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
95	15	14	13	11	10	8	6	4	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
90	16	14	13	12	10	9	7	5	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
85	16	15	14	12	11	9	7	5	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	17	15	14	13	11	10	8	6	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
75	17	16	15	13	12	10	9	7	3	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	18	17	15	14	13	11	9	7	4	3	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
65	19	17	16	15	14	12	10	8	5	4	4	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	19	18	17	16	14	13	11	9	5	5	4	4	3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
55	20	19	18	16	15	13	12	10	6	6	5	5	4	3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
50	21	20	19	17	16	15	13	11	7	7	6	6	5	5	4	3	2	1	-	-	-	-	-	-	-	-	-	-	-
45	22	21	20	19	17	16	14	12	9	8	8	7	7	6	5	4	3	3	1	-	-	-	-	-	-	-	-	-	-
40	23	22	21	20	18	17	15	13	10	9	9	8	8	7	6	6	5	4	3	1	-	-	-	-	-	-	-	-	-
35	25	23	22	21	20	18	17	15	11	11	10	10	9	9	8	7	6	6	4	3	2	-	-	-	-	-	-	-	-
30	26	25	24	23	22	20	19	17	14	13	13	12	12	11	10	9	9	8	7	5	4	2	-	-	-	-	-	-	-
25	29	27	26	25	24	23	21	19	16	16	15	15	14	14	13	12	11	11	9	8	7	5	3	-	-	-	-	-	-
20	31	30	29	28	27	25	24	22	19	19	18	18	18	17	16	15	15	14	13	12	10	9	7	4	-	-	-	-	-
18	32	31	30	29	28	27	25	24	21	20	20	19	19	18	18	17	16	15	14	13	12	10	8	5	2	-	-	-	-
16	33	32	31	30	29	28	27	25	22	22	21	21	20	20	19	18	18	17	16	15	13	12	10	7	3	2	-	-	-
14	35	34	32	32	30	29	28	26	23	23	22	22	21	21	20	19	19	18	17	16	15	13	11	8	5	3	2	-	-
12	36	35	34	33	32	30	29	28	25	24	24	23	23	22	22	21	20	20	19	18	16	15	13	10	7	5	4	2	-
10	38	37	36	35	34	32	31	30	27	26	26	26	25	25	24	23	23	22	21	20	19	17	15	13	9	8	6	5	3

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-6. Percent of Trout Redd Area Remaining between Starting and Ending Flow Levels in SF San Joaquin River - Mono to Bear.

A. Rainbow Trout

		Start Flow [1] (cfs)								
		300	**200**	**150**	**100**	**80**	**60**	**40**	**30**	**25**
	Starting WUA [2]	*194*	*212*	*215*	*249*	*224*	*184*	*179*	*172*	*167*
End Flow [3] (cfs)	**300**	-	-	-	-	-	-	-	-	-
	200	93	-	-	-	-	-	-	-	-
	150	93	99	-	-	-	-	-	-	-
	100	74	90	99	-	-	-	-	-	-
	80	70	87	98	99	-	-	-	-	-
	60	64	77	85	86	92	-	-	-	-
	40	38	47	56	62	75	94	-	-	-
	30	25	26	39	51	66	88	99	-	-
	25	20	22	34	45	60	83	95	99	-
	20	18	22	33	45	59	83	95	99	100
	17	18	22	33	45	59	83	95	99	100
	12	18	21	30	41	55	77	89	94	96

B. Brown Trout

		Start Flow [1] (cfs)								
		300	**200**	**150**	**100**	**80**	**60**	**40**	**30**	**25**
	Starting WUA [2]	*192*	*211*	*200*	*227*	*218*	*186*	*180*	*179*	*180*
End Flow [3] (cfs)	**300**	-	-	-	-	-	-	-	-	-
	200	92	-	-	-	-	-	-	-	-
	150	92	99	-	-	-	-	-	-	-
	100	70	84	98	-	-	-	-	-	-
	80	67	81	96	99	-	-	-	-	-
	60	61	74	87	88	91	-	-	-	-
	40	34	41	53	60	72	92	-	-	-
	30	23	21	31	43	57	81	98	-	-
	25	19	17	26	38	51	75	93	98	-
	20	16	17	24	37	50	74	93	98	100
	17	16	17	24	37	50	74	93	98	100
	12	16	17	23	33	46	69	87	93	95

[1] Start Flow : Flow, in cfs, at which the ramping begins
[2] WUA : Weighted Usable Area, in square feet per 1,000 feet, at the starting flow
[3] End Flow : Flow, in cfs, at end of ramping event

Table CAWG 3-7. Percent Change in Wetted Perimeter Between Two Flows for Bear Creek.

End Flow[3] (cfs)	Start Flow[1] (cfs)																												
Start Flow[1]	**125**	**100**	**90**	**80**	**70**	**60**	**50**	**45**	**40**	**35**	**30**	**25**	**20**	**17.5**	**15**	**12.5**	**10**	**9**	**8**	**7**	**6**	**5**	**4.5**	**4**	**3.5**	**3**	**2.5**	**2**	**1.5**
WP[2]	46.6	44.8	44.0	43.4	42.5	41.4	40.3	39.6	38.4	37.5	36.4	34.9	33.3	32.5	31.7	30.4	28.7	28.1	27.5	26.6	25.5	24.6	24.3	23.9	23.5	23.1	22.5	21.5	20.1
125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
90	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	7	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	9	5	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	11	8	6	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	13	10	8	7	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	15	12	10	9	7	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	17	14	13	11	9	7	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	19	16	15	13	12	9	7	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	22	19	17	16	14	12	10	8	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	25	22	21	20	18	16	14	12	9	7	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	28	26	24	23	21	20	17	16	13	11	8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17.5	30	27	26	25	23	22	19	18	15	13	11	7	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	32	29	28	27	25	24	22	20	18	16	13	9	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12.5	35	32	31	30	28	27	25	23	21	19	16	13	9	7	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	38	36	35	34	32	31	29	28	25	24	21	18	14	12	9	6	-	-	-	-	-	-	-	-	-	-	-	-	-
9	40	37	36	35	34	32	30	29	27	25	23	19	16	14	11	8	2	-	-	-	-	-	-	-	-	-	-	-	-
8	41	39	38	37	35	34	32	31	29	27	25	21	18	16	13	10	4	2	-	-	-	-	-	-	-	-	-	-	-
7	43	41	40	39	37	36	34	33	31	29	27	24	20	18	16	13	7	5	3	-	-	-	-	-	-	-	-	-	-
6	45	43	42	41	40	38	37	36	34	32	30	27	23	22	19	16	11	9	7	4	-	-	-	-	-	-	-	-	-
5	47	45	44	43	42	41	39	38	36	34	32	29	26	24	22	19	14	12	10	7	3	-	-	-	-	-	-	-	-
4.5	48	46	45	44	43	41	40	39	37	35	33	30	27	25	23	20	15	14	12	9	5	2	-	-	-	-	-	-	-
4	49	47	46	45	44	42	41	40	38	36	34	32	28	27	25	21	17	15	13	10	6	3	1	-	-	-	-	-	-
3.5	50	48	47	46	45	43	42	41	39	37	35	33	30	28	26	23	18	16	14	12	8	5	3	2	-	-	-	-	-
3	51	49	48	47	46	44	43	42	40	39	37	34	31	29	27	24	20	18	16	13	10	6	5	3	2	-	-	-	-
2.5	52	50	49	48	47	46	44	43	42	40	38	36	33	31	29	26	22	20	18	16	12	9	7	6	4	3	-	-	-
2	54	52	51	50	49	48	47	46	44	43	41	38	35	34	32	29	25	24	22	19	16	13	11	10	8	7	4	-	-
1.5	57	55	54	54	53	51	50	49	48	46	45	42	40	38	36	34	30	28	27	24	21	18	17	16	14	13	10	6	-
1	60	59	58	57	56	55	54	53	52	51	49	47	44	43	42	39	35	34	33	30	27	25	24	22	21	20	18	14	8

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-8. Percent of Trout Redd Area Remaining between Starting and Ending Flow Levels in Bear Creek.

A. Brown Trout

		Start Flow [1] (cfs)										
		125	**100**	**80**	**60**	**40**	**30**	**20**	**15**	**10**	**7**	**4**
	Starting WUA [2]	*22*	*18*	*18*	*18*	*16*	*15*	*19*	*19*	*16*	*15*	*13*
End Flow [3] (cfs)	**125**	-	-	-	-	-	-	-	-	-	-	-
	100	61	-	-	-	-	-	-	-	-	-	-
	80	61	100	-	-	-	-	-	-	-	-	-
	60	61	100	100	-	-	-	-	-	-	-	-
	40	61	100	100	100	-	-	-	-	-	-	-
	30	61	100	100	100	100	-	-	-	-	-	-
	20	42	72	72	72	75	92	-	-	-	-	-
	15	42	72	72	72	75	92	100	-	-	-	-
	10	42	72	72	72	75	92	100	100	-	-	-
	7	42	72	72	72	75	92	100	100	100	-	-
	4	21	29	30	33	42	62	73	81	92	98	-
	1	21	29	30	33	42	62	73	81	92	98	100

[1] Start Flow : Flow, in cfs, at which the ramping begins
[2] WUA : Weighted Usable Area, in square feet per 1,000 feet, at the starting flow
[3] End Flow : Flow, in cfs, at end of ramping event

Table CAWG 3-9. Percent Change in Wetted Perimeter Between Two Flows for Mono Creek.

	Start Flow[1] (cfs)																												
Start Flow[1]	**175**	**150**	**125**	**100**	**90**	**80**	**70**	**60**	**50**	**40**	**35**	**30**	**25**	**20**	**15**	**14**	**13**	**12**	**11**	**10**	**9.5**	**9**	**8.5**	**8**	**7.5**	**7**	**6.5**	**6**	**5.5**
WP[2]	46.0	44.3	42.2	39.8	38.7	37.8	36.8	36.0	34.9	33.1	32.0	31.0	29.7	28.4	27.1	26.8	26.5	26.2	25.8	25.4	25.0	24.9	24.7	24.4	24.1	23.7	23.4	23.0	22.6
End Flow[3] (cfs)																													
175	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
125	8	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100	13	10	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
90	16	13	8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	18	15	10	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	20	17	13	8	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	22	19	15	10	7	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	24	21	17	12	10	8	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	28	25	21	17	15	12	10	8	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	30	28	24	20	17	15	13	11	8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	33	30	26	22	20	18	16	14	11	6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	35	33	29	25	23	21	19	17	15	10	7	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	38	36	33	29	27	25	23	21	19	14	11	8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	41	39	36	32	30	28	26	25	22	18	15	13	9	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	42	39	36	33	31	29	27	25	23	19	16	14	10	6	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	42	40	37	33	32	30	28	26	24	20	17	15	11	7	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
12	43	41	38	34	32	31	29	27	25	21	18	16	12	8	4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
11	44	42	39	35	33	32	30	28	26	22	20	17	13	9	5	4	3	1	-	-	-	-	-	-	-	-	-	-	-
10	45	43	40	36	35	33	31	29	27	23	21	18	15	11	6	5	4	3	2	-	-	-	-	-	-	-	-	-	-
9.5	46	43	41	37	35	34	32	30	28	24	22	19	16	12	8	7	5	4	3	1	-	-	-	-	-	-	-	-	-
9	46	44	41	38	36	34	32	31	29	25	22	20	16	12	8	7	6	5	3	2	1	-	-	-	-	-	-	-	-
8.5	46	44	42	38	36	35	33	31	29	25	23	20	17	13	9	8	7	6	4	3	2	1	-	-	-	-	-	-	-
8	47	45	42	39	37	35	34	32	30	26	24	21	18	14	10	9	8	7	5	4	2	2	1	-	-	-	-	-	-
7.5	48	45	43	39	38	36	34	33	31	27	25	22	19	15	11	10	9	8	6	5	4	3	2	1	-	-	-	-	-
7	48	46	44	40	39	37	35	34	32	28	26	23	20	16	12	11	10	9	8	6	5	5	4	3	2	-	-	-	-
6.5	49	47	45	41	40	38	36	35	33	29	27	25	21	18	14	13	12	11	9	8	7	6	5	4	3	2	-	-	-
6	50	48	45	42	41	39	37	36	34	31	28	26	23	19	15	14	13	12	11	9	8	8	7	6	5	3	2	-	-
5.5	51	49	46	43	42	40	38	37	35	32	29	27	24	20	16	16	15	13	12	11	10	9	8	7	6	5	3	2	-
5	52	50	47	44	43	41	40	38	36	33	31	28	25	22	18	17	16	15	14	12	11	11	10	9	8	6	5	3	2

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-10. Percent of Trout Redd Area Remaining between Starting and Ending Flow Levels in Mono Creek.

A. Rainbow Trout

		Start Flow[1] (cfs)									
		175	125	100	75	50	40	30	20	15	10
	Starting WUA[2]	*973*	*1186*	*1435*	*1851*	*2400*	*2663*	*2825*	*2708*	*2435*	*1967*
End Flow[3] (cfs)	175	-	-	-	-	-	-	-	-	-	-
	125	100	-	-	-	-	-	-	-	-	-
	100	100	100	-	-	-	-	-	-	-	-
	75	97	99	100	-	-	-	-	-	-	-
	50	96	99	99	100	-	-	-	-	-	-
	40	93	96	97	98	100	-	-	-	-	-
	30	92	95	97	98	100	100	-	-	-	-
	20	88	92	91	93	95	96	98	-	-	-
	15	85	89	85	88	91	92	95	99	-	-
	10	78	82	77	76	82	84	87	94	98	-
	9	78	81	76	76	81	83	87	94	97	100
	7.5	75	78	73	70	77	79	83	90	95	99

B. Brown Trout

		Start Flow[1] (cfs)									
		175	125	100	75	50	40	30	20	15	10
	Starting WUA[2]	*549*	*714*	*969*	*1395*	*2076*	*2434*	*2755*	*2795*	*2626*	*2296*
End Flow[3] (cfs)	175	-	-	-	-	-	-	-	-	-	-
	125	98	-	-	-	-	-	-	-	-	-
	100	98	100	-	-	-	-	-	-	-	-
	75	91	98	100	-	-	-	-	-	-	-
	50	91	97	99	99	-	-	-	-	-	-
	40	86	92	95	98	100	-	-	-	-	-
	30	85	91	94	97	100	100	-	-	-	-
	20	80	86	86	91	95	96	98	-	-	-
	15	77	83	80	85	91	92	95	99	-	-
	10	73	77	71	73	81	83	87	94	98	-
	9	73	76	71	72	80	82	86	93	97	100
	7.5	71	75	69	68	76	78	82	90	95	99

[1] Start Flow : Flow, in cfs, at which the ramping begins
[2] WUA : Weighted Usable Area, in square feet per 1,000 feet, at the starting flow
[3] End Flow : Flow, in cfs, at end of ramping event

Table CAWG 3-11. Percent Change in Wetted Perimeter Between Two Flows for San Joaquin River - Mammoth Reach.

End Flow[3] (cfs)	Start Flow[1] (cfs)																												
Start Flow[1]	**500**	**450**	**400**	**350**	**300**	**275**	**250**	**225**	**200**	**175**	**150**	**125**	**100**	**90**	**80**	**70**	**60**	**50**	**45**	**40**	**35**	**30**	**25**	**20**	**18**	**16**	**14**	**12**	**11**
WP[2]	100.0	99.3	98.3	97.2	96.0	95.2	94.3	93.6	92.8	91.8	90.7	89.1	87.2	86.1	85.2	84.1	82.9	81.5	80.9	79.8	79.0	77.7	76.5	75.2	74.6	74.0	73.4	72.6	72.1
500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
450	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
400	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
350	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
300	4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
275	5	4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
250	6	5	4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
225	6	6	5	4	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	7	7	6	5	3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
175	8	8	7	6	4	4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150	9	9	8	7	6	5	4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
125	11	10	9	8	7	6	6	5	4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100	13	12	11	10	9	8	8	7	6	5	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
90	14	13	12	11	10	9	9	8	7	6	5	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	15	14	13	12	11	11	10	9	8	7	6	4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	16	15	15	14	12	12	11	10	9	8	7	6	4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	17	17	16	15	14	13	12	11	11	10	9	7	5	4	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
50	19	18	17	16	15	14	14	13	12	11	10	8	6	5	4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
45	19	19	18	17	16	15	14	14	13	12	11	9	7	6	5	4	2	1	-	-	-	-	-	-	-	-	-	-	-
40	20	20	19	18	17	16	15	15	14	13	12	10	8	7	6	5	4	2	1	-	-	-	-	-	-	-	-	-	-
35	21	20	20	19	18	17	16	16	15	14	13	11	9	8	7	6	5	3	2	1	-	-	-	-	-	-	-	-	-
30	22	22	21	20	19	18	18	17	16	15	14	13	11	10	9	8	6	5	4	3	2	-	-	-	-	-	-	-	-
25	24	23	22	21	20	20	19	18	18	17	16	14	12	11	10	9	8	6	5	4	3	2	-	-	-	-	-	-	-
20	25	24	24	23	22	21	20	20	19	18	17	16	14	13	12	11	9	8	7	6	5	3	2	-	-	-	-	-	-
18	25	25	24	23	22	22	21	20	20	19	18	16	14	13	12	11	10	8	8	7	6	4	2	1	-	-	-	-	-
16	26	25	25	24	23	22	22	21	20	19	18	17	15	14	13	12	11	9	9	7	6	5	3	2	1	-	-	-	-
14	27	26	25	25	24	23	22	22	21	20	19	18	16	15	14	13	11	10	9	8	7	6	4	2	2	1	-	-	-
12	27	27	26	25	24	24	23	22	22	21	20	18	17	16	15	14	12	11	10	9	8	7	5	3	3	2	1	-	-
11	28	27	27	26	25	24	24	23	22	21	20	19	17	16	15	14	13	12	11	10	9	7	6	4	3	3	2	1	-
10	29	28	27	26	26	25	24	24	23	22	21	20	18	17	16	15	14	12	12	10	10	8	7	5	4	3	3	2	1

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-12. Percent of Trout Redd Area Remaining between Starting and Ending Flow Levels in San Joaquin River - Mammoth Reach.

A. Rainbow Trout

		Start Flow[1] (cfs)										
		500	**400**	**300**	**200**	**100**	**80**	**60**	**50**	**40**	**30**	**25**
	Starting WUA[2]	*1430*	*1347*	*1117*	*1071*	*961*	*950*	*847*	*760*	*676*	*587*	*546*
End Flow[3] (cfs)	**500**	-	-	-	-	-	-	-	-	-	-	-
	400	89	-	-	-	-	-	-	-	-	-	-
	300	83	79	-	-	-	-	-	-	-	-	-
	200	73	73	98	-	-	-	-	-	-	-	-
	100	40	46	77	95	-	-	-	-	-	-	-
	80	35	41	74	94	100	-	-	-	-	-	-
	60	33	39	70	90	99	100	-	-	-	-	-
	50	30	33	64	85	95	97	99	-	-	-	-
	40	28	31	60	78	91	94	98	100	-	-	-
	30	26	29	52	65	82	89	96	100	100	-	-
	25	24	27	49	58	73	79	86	90	94	99	-
	10	14	15	28	30	46	57	68	74	81	89	93

B. Brown Trout

		Start Flow[1] (cfs)										
		500	**400**	**300**	**200**	**100**	**80**	**60**	**50**	**40**	**30**	**25**
	Starting WUA[2]	*1414*	*1415*	*1272*	*1198*	*1148*	*1131*	*1052*	*943*	*817*	*685*	*631*
End Flow[3] (cfs)	**500**	-	-	-	-	-	-	-	-	-	-	-
	400	88	-	-	-	-	-	-	-	-	-	-
	300	82	80	-	-	-	-	-	-	-	-	-
	200	69	72	96	-	-	-	-	-	-	-	-
	100	38	44	70	91	-	-	-	-	-	-	-
	80	32	39	66	89	100	-	-	-	-	-	-
	60	28	35	61	83	98	100	-	-	-	-	-
	50	25	28	54	78	93	97	99	-	-	-	-
	40	23	26	51	71	87	92	97	99	-	-	-
	30	20	24	44	58	76	83	92	96	99	-	-
	25	20	23	43	54	68	75	83	89	92	98	-
	10	14	14	24	26	40	50	62	69	77	87	92

[1] Start Flow : Flow, in cfs, at which the ramping begins
[2] WUA : Weighted Usable Area, in square feet per 1,000 feet, at the starting flow
[3] End Flow : Flow, in cfs, at end of ramping event

Table CAWG 3-13. Percent Change in Wetted Perimeter Between Two Flows for San Joaquin River - Stevenson Reach.

	Start Flow[1] (cfs)																												
Start Flow[1]	350	300	275	250	225	200	175	150	125	100	90	80	70	60	50	40	30	20	15	12.5	10	9	8	7	6	5	4.5	4	3.5
WP[2]	93.5	92.5	91.9	91.3	90.6	89.9	88.7	87.2	85.7	84.2	83.5	82.7	81.8	80.6	79.2	77.8	76.1	73.7	72.1	70.9	68.5	67.3	66.6	65.9	65.3	64.7	64.3	63.7	63.2
End Flow[3] (cfs)																													
350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
300	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
275	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
250	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
225	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
200	4	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
175	5	4	4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150	7	6	5	5	4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
125	8	7	7	6	5	5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100	10	9	8	8	7	6	5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
90	11	10	9	9	8	7	6	4	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	12	11	10	9	9	8	7	5	4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	13	12	11	10	10	9	8	6	5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	14	13	12	12	11	10	9	8	6	4	4	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	15	14	14	13	13	12	11	9	8	6	5	4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	17	16	15	15	14	13	12	11	9	8	7	6	5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	19	18	17	17	16	15	14	13	11	10	9	8	7	6	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-
20	21	20	20	19	19	18	17	15	14	12	12	11	10	8	7	5	3	-	-	-	-	-	-	-	-	-	-	-	-
15	23	22	22	21	20	20	19	17	16	14	14	13	12	11	9	7	5	2	-	-	-	-	-	-	-	-	-	-	-
12.5	24	23	23	22	22	21	20	19	17	16	15	14	13	12	11	9	7	4	2	-	-	-	-	-	-	-	-	-	-
10	27	26	26	25	24	24	23	21	20	19	18	17	16	15	14	12	10	7	5	3	-	-	-	-	-	-	-	-	-
9	28	27	27	26	26	25	24	23	22	20	19	19	18	17	15	14	12	9	7	5	2	-	-	-	-	-	-	-	-
8	29	28	28	27	27	26	25	24	22	21	20	20	19	17	16	14	13	10	8	6	3	1	-	-	-	-	-	-	-
7	30	29	28	28	27	27	26	24	23	22	21	20	19	18	17	15	13	11	8	7	4	2	1	-	-	-	-	-	-
6	30	29	29	28	28	27	26	25	24	22	22	21	20	19	18	16	14	11	9	8	5	3	2	1	-	-	-	-	-
5	31	30	30	29	29	28	27	26	25	23	23	22	21	20	18	17	15	12	10	9	6	4	3	2	1	-	-	-	-
4.5	31	31	30	30	29	29	28	26	25	24	23	22	21	20	19	17	16	13	11	9	6	4	3	3	2	1	-	-	-
4	32	31	31	30	30	29	28	27	26	24	24	23	22	21	20	18	16	14	12	10	7	5	4	3	2	1	1	-	-
3.5	32	32	31	31	30	30	29	27	26	25	24	24	23	22	20	19	17	14	12	11	8	6	5	4	3	2	2	1	-
3	33	32	32	31	31	30	29	28	27	26	25	24	23	22	21	19	18	15	13	12	8	7	6	5	4	3	2	2	1

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-14. Percent of Trout Redd Area Remaining between Starting and Ending Flow Levels in San Joaquin River - Stevenson Reach.

A. Rainbow Trout

		Start Flow[1] (cfs)										
		350	**250**	**150**	**100**	**80**	**60**	**40**	**30**	**20**	**10**	**7**
	Starting WUA[2]	*275*	*292*	*296*	*310*	*322*	*289*	*276*	*238*	*173*	*89*	*72*
End Flow[3] (cfs)	**350**	-	-	-	-	-	-	-	-	-	-	-
	250	100	-	-	-	-	-	-	-	-	-	-
	150	82	81	-	-	-	-	-	-	-	-	-
	100	82	81	100	-	-	-	-	-	-	-	-
	80	79	78	95	99	-	-	-	-	-	-	-
	60	77	76	94	98	100	-	-	-	-	-	-
	40	77	76	94	90	88	97	-	-	-	-	-
	30	77	76	94	90	88	97	100	-	-	-	-
	20	70	69	80	79	79	88	95	98	-	-	-
	10	67	66	75	72	72	79	85	86	89	-	-
	7	61	62	72	67	67	74	80	79	81	99	-
	3	33	34	45	42	40	43	41	40	47	78	86

B. Brown Trout

		Start Flow[1] (cfs)										
		350	**250**	**150**	**100**	**80**	**60**	**40**	**30**	**20**	**10**	**7**
	Starting WUA[2]	*281*	*319*	*342*	*333*	*348*	*328*	*350*	*316*	*251*	*134*	*85*
End Flow[3] (cfs)	**350**	-	-	-	-	-	-	-	-	-	-	-
	250	100	-	-	-	-	-	-	-	-	-	-
	150	81	77	-	-	-	-	-	-	-	-	-
	100	81	77	100	-	-	-	-	-	-	-	-
	80	80	74	96	98	-	-	-	-	-	-	-
	60	77	72	92	95	98	-	-	-	-	-	-
	40	77	72	92	95	92	97	-	-	-	-	-
	30	77	72	92	95	92	97	100	-	-	-	-
	20	69	65	77	82	80	86	94	98	-	-	-
	10	68	63	74	76	74	79	87	90	92	-	-
	7	62	58	70	71	69	74	82	84	85	99	-
	3	33	32	45	46	43	44	39	38	42	58	77

[1] Start Flow : Flow, in cfs, at which the ramping begins
[2] WUA : Weighted Usable Area, in square feet per 1,000 feet, at the starting flow
[3] End Flow : Flow, in cfs, at end of ramping event

Table CAWG 3-15. Percent Change in Wetted Perimeter Between Two Flows for Big Creek - Below Dam 4.

End Flow[3] (cfs)	Start Flow[1] (cfs)																												
Start Flow[1]	**100**	**90**	**80**	**70**	**60**	**50**	**45**	**40**	**35**	**30**	**25**	**20**	**18**	**16**	**14**	**12**	**10**	**9**	**8**	**7**	**6**	**5**	**4.5**	**4**	**3.5**	**3**	**2.5**	**2**	**1.5**
WP[2]	44.8	43.8	42.7	41.4	39.9	38.8	38.1	37.2	35.7	34.3	32.9	31.6	30.9	30.3	29.5	28.6	27.7	27.3	26.7	26.2	25.6	25.0	24.6	24.3	23.9	23.4	22.8	22.0	21.1
100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
90	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	8	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	11	9	7	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	13	11	9	6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	15	13	11	8	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	17	15	13	10	7	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	20	18	16	14	10	8	6	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	23	22	20	17	14	12	10	8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	26	25	23	20	17	15	14	11	8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	29	28	26	24	21	19	17	15	12	8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	31	29	28	25	22	20	19	17	13	10	6	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	32	31	29	27	24	22	21	19	15	12	8	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	34	33	31	29	26	24	23	21	18	14	11	7	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	36	35	33	31	28	26	25	23	20	17	13	9	7	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	38	37	35	33	30	28	27	25	22	19	16	12	10	8	6	3	-	-	-	-	-	-	-	-	-	-	-	-	-
9	39	38	36	34	32	30	28	27	24	20	17	14	12	10	7	5	2	-	-	-	-	-	-	-	-	-	-	-	-
8	40	39	37	35	33	31	30	28	25	22	19	15	14	12	9	7	4	2	-	-	-	-	-	-	-	-	-	-	-
7	42	40	39	37	34	33	31	30	27	24	21	17	15	14	11	9	6	4	2	-	-	-	-	-	-	-	-	-	-
6	43	42	40	38	36	34	33	31	28	25	22	19	17	15	13	11	8	6	4	2	-	-	-	-	-	-	-	-	-
5	44	43	41	40	37	36	34	33	30	27	24	21	19	18	15	13	10	8	7	5	2	-	-	-	-	-	-	-	-
4.5	45	44	42	40	38	36	35	34	31	28	25	22	20	19	16	14	11	10	8	6	4	1	-	-	-	-	-	-	-
4	46	45	43	41	39	37	36	35	32	29	26	23	21	20	18	15	12	11	9	7	5	3	1	-	-	-	-	-	-
3.5	47	45	44	42	40	38	37	36	33	30	28	24	23	21	19	17	14	12	11	9	7	4	3	2	-	-	-	-	-
3	48	47	45	44	41	40	39	37	34	32	29	26	24	23	21	18	16	14	12	11	9	6	5	4	2	-	-	-	-
2.5	49	48	47	45	43	41	40	39	36	34	31	28	26	25	23	20	18	16	15	13	11	9	8	6	4	3	-	-	-
2	51	50	48	47	45	43	42	41	38	36	33	30	29	27	25	23	21	19	18	16	14	12	11	10	8	6	4	-	-
1.5	53	52	50	49	47	45	45	43	41	38	36	33	32	30	28	26	24	22	21	19	17	15	14	13	11	10	7	4	-
1	56	55	53	52	50	49	48	46	44	42	40	37	36	34	32	30	28	27	26	24	22	20	19	18	17	15	13	9	6

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-16. Percent of Trout Redd Area Remaining between Starting and Ending Flow Levels in Big Creek Below Dam 4.

A. Rainbow Trout

	Start Flow[1] (cfs)									
	100	**80**	**60**	**40**	**30**	**20**	**14**	**10**	**7**	**5**
Starting WUA[2]	*125*	*130*	*145*	*169*	*182*	*181*	*171*	*149*	*116*	*84*
End Flow[3] (cfs)										
100	-	-	-	-	-	-	-	-	-	-
80	100	-	-	-	-	-	-	-	-	-
60	90	100	-	-	-	-	-	-	-	-
40	90	100	100	-	-	-	-	-	-	-
30	88	98	100	100	-	-	-	-	-	-
20	88	98	100	100	100	-	-	-	-	-
14	88	98	100	100	100	100	-	-	-	-
10	86	96	98	98	98	100	100	-	-	-
7	86	96	98	98	98	100	100	100	-	-
5	86	96	98	98	98	100	100	100	100	-
3	86	96	98	98	98	100	100	100	100	100
2	74	80	79	80	81	82	82	83	87	91

B. Brown Trout

	Start Flow[1] (cfs)									
	100	**80**	**60**	**40**	**30**	**20**	**14**	**10**	**7**	**5**
Starting WUA[2]	*94*	*99*	*122*	*156*	*180*	*197*	*201*	*194*	*167*	*137*
End Flow[3] (cfs)										
100	-	-	-	-	-	-	-	-	-	-
80	100	-	-	-	-	-	-	-	-	-
60	85	99	-	-	-	-	-	-	-	-
40	85	99	100	-	-	-	-	-	-	-
30	82	98	100	100	-	-	-	-	-	-
20	82	98	100	100	100	-	-	-	-	-
14	82	98	100	100	100	100	-	-	-	-
10	81	95	97	98	98	100	100	-	-	-
7	81	95	97	98	98	100	100	100	-	-
5	81	95	97	98	98	100	100	100	100	-
3	81	95	97	98	98	100	100	100	100	100
2	76	86	83	81	83	84	85	85	89	92

[1] Start Flow : Flow, in cfs, at which the ramping begins
[2] WUA : Weighted Usable Area, in square feet per 1,000 feet, at the starting flow
[3] End Flow : Flow, in cfs, at end of ramping event

Table CAWG 3-17. Percent Change in Wetted Perimeter Between Two Flows for Big Creek - Below Dam 5.

	Start Flow[1] (cfs)																												
Start Flow[1]	100	90	80	70	60	50	45	40	35	30	25	20	18	16	14	12	10	9	8	7	6	5	4.5	4	3.5	3	2.5	2	1.5
WP[2]	41.7	41.0	40.4	39.7	38.7	37.2	36.2	35.5	34.6	34.0	33.3	32.3	31.8	31.2	30.7	30.2	29.6	29.3	29.0	28.6	28.2	27.5	27.2	26.9	26.6	26.2	25.8	25.4	24.9
End Flow[3] (cfs)																													
100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
90	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	7	6	4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	11	9	8	6	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	13	12	10	9	6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	15	14	12	11	8	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	17	15	14	13	10	7	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	18	17	16	14	12	9	6	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	20	19	18	16	14	10	8	6	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	23	21	20	19	17	13	11	9	7	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	24	22	21	20	18	14	12	10	8	6	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	25	24	23	21	19	16	14	12	10	8	6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	26	25	24	23	21	17	15	13	11	10	8	5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	28	26	25	24	22	19	17	15	13	11	9	6	5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	29	28	27	25	23	20	18	16	14	13	11	8	7	5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
9	30	28	27	26	24	21	19	17	15	14	12	9	8	6	5	3	1	-	-	-	-	-	-	-	-	-	-	-	-
8	30	29	28	27	25	22	20	18	16	15	13	10	9	7	6	4	2	1	-	-	-	-	-	-	-	-	-	-	-
7	31	30	29	28	26	23	21	19	17	16	14	11	10	9	7	5	4	2	1	-	-	-	-	-	-	-	-	-	-
6	32	31	30	29	27	24	22	21	19	17	15	13	11	10	8	7	5	4	3	1	-	-	-	-	-	-	-	-	-
5	34	33	32	31	29	26	24	22	21	19	17	15	14	12	10	9	7	6	5	4	2	-	-	-	-	-	-	-	-
4.5	35	34	33	32	30	27	25	23	22	20	18	16	15	13	12	10	8	7	6	5	4	1	-	-	-	-	-	-	-
4	35	34	33	32	30	28	26	24	22	21	19	17	15	14	12	11	9	8	7	6	4	2	1	-	-	-	-	-	-
3.5	36	35	34	33	31	28	26	25	23	22	20	18	16	15	13	12	10	9	8	7	5	3	2	1	-	-	-	-	-
3	37	36	35	34	32	30	28	26	24	23	21	19	18	16	15	13	12	11	10	8	7	5	4	3	2	-	-	-	-
2.5	38	37	36	35	33	30	29	27	25	24	22	20	19	17	16	14	13	12	11	10	8	6	5	4	3	1	-	-	-
2	39	38	37	36	34	32	30	28	27	25	24	21	20	19	17	16	14	13	12	11	10	8	6	6	5	3	2	-	-
1.5	40	39	38	37	36	33	31	30	28	27	25	23	22	20	19	18	16	15	14	13	12	10	8	8	7	5	4	2	-
1	42	41	41	40	38	35	34	32	31	29	28	26	24	23	22	21	19	18	17	16	15	13	12	11	10	8	7	5	3

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-18. Percent of Trout Redd Area Remaining between Starting and Ending Flow Levels in Big Creek below Dam 5.

A. Rainbow Trout

End Flow [3] (cfs)	Start Flow [1] (cfs) 100	80	60	40	30	20	14	10	8	5
Starting WUA [2]	*638*	*698*	*755*	*808*	*823*	*874*	*826*	*676*	*572*	*400*
100	-	-	-	-	-	-	-	-	-	-
80	100	-	-	-	-	-	-	-	-	-
60	96	98	-	-	-	-	-	-	-	-
40	87	91	97	-	-	-	-	-	-	-
30	87	91	97	100	-	-	-	-	-	-
20	72	78	86	90	95	-	-	-	-	-
14	61	67	75	81	89	98	-	-	-	-
10	61	67	75	81	87	95	99	-	-	-
8	60	66	74	80	84	87	90	94	-	-
5	60	64	70	72	75	76	80	86	92	-
3	57	61	67	69	72	72	76	83	88	97
2	57	61	67	69	72	72	76	83	88	97

B. Brown Trout

End Flow [3] (cfs)	Start Flow [1] (cfs) 100	80	60	40	30	20	14	10	8	5
Starting WUA [2]	*468*	*539*	*608*	*672*	*664*	*679*	*704*	*658*	*577*	*451*
100	-	-	-	-	-	-	-	-	-	-
80	100	-	-	-	-	-	-	-	-	-
60	93	96	-	-	-	-	-	-	-	-
40	80	89	97	-	-	-	-	-	-	-
30	80	89	97	100	-	-	-	-	-	-
20	62	72	83	89	92	-	-	-	-	-
14	54	63	72	77	85	97	-	-	-	-
10	54	63	72	77	84	96	99	-	-	-
8	53	61	70	76	84	94	94	95	-	-
5	53	61	70	72	78	86	86	88	92	-
3	50	58	66	69	75	83	83	86	90	97
2	50	58	66	69	75	83	83	86	90	97

[1] Start Flow : Flow, in cfs, at which the ramping begins
[2] WUA : Weighted Usable Area, in square feet per 1,000 feet, at the starting flow
[3] End Flow : Flow, in cfs, at end of ramping event

Table CAWG 3-19. Percent Change in Wetted Perimeter Between Two Flows for Stevenson Creek.

End Flow[3] (cfs)	Start Flow[1] (cfs)																												
Start Flow[1]	**125**	**100**	**90**	**80**	**70**	**60**	**50**	**45**	**40**	**35**	**30**	**25**	**20**	**18**	**16**	**14**	**12**	**10**	**9**	**8**	**7**	**6**	**5.5**	**5**	**4.5**	**4**	**3.5**	**3**	**2.5**
WP[2]	39.8	37.1	35.9	34.6	33.4	32.0	30.8	30.2	29.5	28.8	28.0	27.1	26.0	25.5	24.9	24.4	23.8	23.3	22.9	22.6	22.3	21.9	21.8	21.6	21.4	21.2	20.9	20.6	20.1
125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
100	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
90	10	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	13	7	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	16	10	7	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	20	14	11	7	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	23	17	14	11	8	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	24	19	16	13	10	6	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	26	21	18	15	12	8	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	28	23	20	17	14	10	7	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	30	25	22	19	16	13	9	7	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	32	27	24	21	19	15	12	10	8	6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	35	30	28	25	22	19	16	14	12	10	7	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	36	31	29	26	24	20	17	16	14	11	9	6	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	37	33	30	28	25	22	19	17	15	13	11	8	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	39	34	32	29	27	24	21	19	17	15	13	10	6	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	40	36	34	31	29	25	23	21	19	17	15	12	8	6	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-
10	41	37	35	33	30	27	24	23	21	19	17	14	10	8	7	4	2	-	-	-	-	-	-	-	-	-	-	-	-
9	42	38	36	34	31	28	25	24	22	20	18	15	12	10	8	6	4	2	-	-	-	-	-	-	-	-	-	-	-
8	43	39	37	35	32	29	27	25	23	21	19	17	13	11	9	7	5	3	1	-	-	-	-	-	-	-	-	-	-
7	44	40	38	36	33	30	28	26	25	23	20	18	14	13	11	9	7	5	3	2	-	-	-	-	-	-	-	-	-
6	45	41	39	37	34	31	29	27	26	24	22	19	16	14	12	10	8	6	4	3	1	-	-	-	-	-	-	-	-
5.5	45	41	39	37	35	32	29	28	26	24	22	20	16	15	13	11	9	7	5	4	2	1	-	-	-	-	-	-	-
5	46	42	40	38	35	32	30	28	27	25	23	20	17	15	13	12	9	7	6	4	3	2	1	-	-	-	-	-	-
4.5	46	42	40	38	36	33	31	29	27	26	23	21	18	16	14	12	10	8	7	5	4	2	2	1	-	-	-	-	-
4	47	43	41	39	37	34	31	30	28	26	24	22	19	17	15	13	11	9	8	6	5	3	3	2	1	-	-	-	-
3.5	47	44	42	40	37	35	32	31	29	27	25	23	20	18	16	14	12	10	9	8	6	5	4	3	2	1	-	-	-
3	48	45	43	41	38	36	33	32	30	29	26	24	21	19	18	16	14	12	10	9	8	6	6	5	4	3	2	-	-
2.5	49	46	44	42	40	37	35	33	32	30	28	26	23	21	19	18	16	14	12	11	10	8	7	7	6	5	4	2	-
2	51	47	45	43	41	39	36	35	34	32	30	28	25	23	21	20	18	16	15	13	12	11	10	9	8	7	6	5	3

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-20. Percent of Trout Redd Area Remaining between Starting and Ending Flow Levels in Stevenson Creek.

A. Rainbow Trout

		Start Flow [1] (cfs)									
		125	**100**	**80**	**60**	**40**	**30**	**20**	**10**	**7**	**5**
	Starting WUA [2]	*262*	*282*	*316*	*415*	*641*	*667*	*767*	*702*	*531*	*382*
End Flow [3] (cfs)	**125**	-	-	-	-	-	-	-	-	-	-
	100	100	-	-	-	-	-	-	-	-	-
	80	99	100	-	-	-	-	-	-	-	-
	60	99	100	100	-	-	-	-	-	-	-
	40	99	100	100	100	-	-	-	-	-	-
	30	99	100	100	100	100	-	-	-	-	-
	20	99	100	100	100	100	100	-	-	-	-
	10	89	92	95	97	99	100	100	-	-	-
	7	89	92	95	97	99	100	100	100	-	-
	5	84	87	88	93	98	99	100	100	100	-
	3	51	53	56	62	59	61	69	77	86	95
	2	38	38	38	42	37	40	51	60	72	83

[1] Start Flow : Flow, in cfs, at which the ramping begins
[2] WUA : Weighted Usable Area, in square feet per 1,000 feet, at the starting flow
[3] End Flow : Flow, in cfs, at end of ramping event

Table CAWG 3-21. Percent Change in Wetted Perimeter Between Two Flows for North Fork Stevenson Creek.

	Start Flow[1] (cfs)																												
Start Flow[1]	**80**	**70**	**60**	**50**	**45**	**40**	**35**	**30**	**25**	**20**	**17.5**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8.5**	**8**	**7.5**	**7**	**6.5**	**6**	**5.5**	**5**	**4.5**	**4**	**3.5**
WP[2]	41.1	40.3	39.5	38.4	37.8	37.2	36.6	35.7	34.8	33.7	32.9	32.1	31.7	31.1	30.7	30.4	29.9	29.5	29.2	29.0	28.7	28.5	28.2	27.9	27.5	27.3	26.9	26.5	26.0
End Flow[3] (cfs)																													
80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	7	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	8	6	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	9	8	6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	11	9	7	5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	13	11	9	7	6	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	15	14	12	9	8	6	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	18	17	15	12	11	10	8	6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17.5	20	18	17	14	13	12	10	8	6	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	22	20	19	16	15	14	12	10	8	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	23	21	20	17	16	15	13	11	9	6	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	24	23	21	19	18	16	15	13	11	8	5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	25	24	22	20	19	17	16	14	12	9	7	4	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	26	25	23	21	20	18	17	15	13	10	8	5	4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	27	26	24	22	21	20	18	16	14	11	9	7	5	4	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
9	28	27	25	23	22	21	19	18	15	12	10	8	7	5	4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
8.5	29	28	26	24	23	22	20	18	16	13	11	9	8	6	5	4	2	1	-	-	-	-	-	-	-	-	-	-	-
8	30	28	27	24	23	22	21	19	17	14	12	10	9	7	6	5	3	2	1	-	-	-	-	-	-	-	-	-	-
7.5	30	29	27	25	24	23	22	20	18	15	13	11	9	8	7	5	4	3	2	1	-	-	-	-	-	-	-	-	-
7	31	29	28	26	25	24	22	20	18	15	13	11	10	8	7	6	5	3	3	2	1	-	-	-	-	-	-	-	-
6.5	32	30	29	27	26	24	23	21	19	16	14	12	11	9	8	7	6	4	4	3	2	1	-	-	-	-	-	-	-
6	32	31	29	27	26	25	24	22	20	17	15	13	12	10	9	8	7	5	4	4	3	2	1	-	-	-	-	-	-
5.5	33	32	30	28	27	26	25	23	21	18	16	14	13	11	10	9	8	7	6	5	4	3	2	1	-	-	-	-	-
5	34	32	31	29	28	27	25	24	22	19	17	15	14	12	11	10	9	7	7	6	5	4	3	2	1	-	-	-	-
4.5	35	33	32	30	29	28	27	25	23	20	18	16	15	14	13	12	10	9	8	7	6	6	5	4	2	1	-	-	-
4	36	34	33	31	30	29	28	26	24	21	20	18	16	15	14	13	12	10	9	9	8	7	6	5	4	3	2	-	-
3.5	37	36	34	32	31	30	29	27	25	23	21	19	18	17	15	15	13	12	11	10	10	9	8	7	6	5	3	2	-
3	38	37	36	34	33	32	30	29	27	24	23	21	20	18	17	16	15	14	13	12	11	11	10	9	8	7	5	4	2

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-22. Percent of Trout Redd Area Remaining between Starting and Ending Flow Levels in NF Stevenson Creek.

A. Rainbow Trout

		Start Flow[1] (cfs)								
		80	**60**	**40**	**30**	**20**	**15**	**10**	**7.5**	**5**
	Starting WUA[2]	*87*	*112*	*145*	*167*	*187*	*197*	*200*	*194*	*167*
End Flow[3] (cfs)	**80**	-	-	-	-	-	-	-	-	-
	60	100	-	-	-	-	-	-	-	-
	40	99	100	-	-	-	-	-	-	-
	30	99	100	100	-	-	-	-	-	-
	20	99	100	99	99	-	-	-	-	-
	15	96	97	97	98	99	-	-	-	-
	10	96	96	94	94	97	98	-	-	-
	7.5	93	93	91	91	95	98	99	-	-
	5	80	85	86	88	94	97	99	100	-
	3	64	73	77	80	86	90	94	96	98

B. Brown Trout

		Start Flow[1] (cfs)								
		80	**60**	**40**	**30**	**20**	**15**	**10**	**7.5**	**5**
	Starting WUA[2]	*68*	*83*	*107*	*128*	*152*	*165*	*173*	*175*	*165*
End Flow[3] (cfs)	**80**	-	-	-	-	-	-	-	-	-
	60	100	-	-	-	-	-	-	-	-
	40	98	100	-	-	-	-	-	-	-
	30	98	100	100	-	-	-	-	-	-
	20	93	97	99	99	-	-	-	-	-
	15	92	95	97	97	99	-	-	-	-
	10	92	95	95	95	96	98	-	-	-
	7.5	88	91	93	92	94	97	99	-	-
	5	69	78	82	85	90	95	99	100	-
	3	54	62	69	74	81	86	93	95	97

[1] Start Flow : Flow, in cfs, at which the ramping begins
[2] WUA : Weighted Usable Area, in square feet per 1,000 feet, at the starting flow
[3] End Flow : Flow, in cfs, at end of ramping event

Table CAWG 3-23. Flow at Inflection Points for Wetted Perimeter Streams, Below Diversions.

Site Name	Flow
Upper Basin Streams	
Camp 62	0.8
Chinquapin	0.8
Crater	0.8
Hooper	1.3
North Slide	0.4
South Slide	0.7
Tombstone	0.9
Lower Basin Streams	
Adit 8	0.4
Balsam	0.6
Ely	0.5
Pitman	0.5
Rancheria	0.4

Table CAWG 3-24. Percent Change in Wetted Perimeter Between Two Flows for Camp 62 Creek Below Diversion.

End Flow[3] (cfs) \ Start Flow[1] (cfs)	25	20	17.5	15	12.5	10	7.5	5	4.5	4	3.5	3	2.7	2.4	2.1	1.8	1.5	1.2	0.9	0.7	0.5	0.3
WP[2]	*13.2*	*12.6*	*12.3*	*12.1*	*11.8*	*11.5*	*10.5*	*9.7*	*9.4*	*9.2*	*9.0*	*8.7*	*8.5*	*8.3*	*8.1*	*7.9*	*7.7*	*7.4*	*6.3*	*6.0*	*5.5*	*4.8*
20	5																					
17.5	7	2																				
15	9	4	2																			
12.5	11	6	4	2																		
10	13	9	7	5	2																	
7.5	21	17	15	13	11	9																
5	27	23	22	20	18	16	8															
4.5	29	25	23	22	20	18	10	2														
4	30	27	25	24	22	20	12	5	3													
3.5	32	29	27	26	24	22	14	7	5	3												
3	34	31	30	28	26	25	17	10	8	6	3											
2.7	36	33	31	30	28	26	19	12	10	8	5	2										
2.4	37	34	33	31	30	28	21	14	12	10	8	4	2									
2.1	39	36	35	33	32	30	23	17	15	12	10	7	5	3								
1.8	40	37	36	35	33	31	25	18	17	14	12	9	7	5	2							
1.5	42	39	38	36	35	33	27	21	19	17	14	12	10	7	5	3						
1.2	44	41	40	38	37	35	29	23	22	20	17	14	13	10	8	6	3					
0.9	52	50	49	48	47	45	40	35	33	32	30	27	26	24	22	20	18	15				
0.7	55	53	52	51	49	48	43	38	37	35	33	31	30	28	26	24	22	20	5			
0.5	58	56	55	54	53	52	47	43	42	40	39	37	35	34	32	30	28	26	13	8		
0.3	64	62	61	60	59	58	54	50	49	48	46	45	44	42	41	39	37	35	24	20	13	
0.1	78	76	76	75	75	74	72	69	69	68	67	66	65	64	63	62	61	60	53	50	46	38

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-25. Percent Change in Wetted Perimeter Between Two Flows for Chinquapin Creek Below Diversion.

	Start Flow[1] (cfs)																		
Start Flow[1]	**15**	**12.5**	**10**	**7.5**	**5**	**4.5**	**4**	**3.5**	**3**	**2.7**	**2.4**	**2.1**	**1.8**	**1.5**	**1.2**	**0.9**	**0.7**	**0.5**	**0.3**
WP[2]	*12.0*	*11.7*	*11.4*	*11.0*	*10.6*	*10.5*	*10.4*	*10.4*	*10.2*	*10.1*	*10.0*	*9.8*	*9.6*	*9.3*	*8.9*	*8.4*	*7.9*	*7.1*	*6.2*
End Flow[3] (cfs)																			
15																			
12.5	2																		
10	5	3																	
7.5	8	6	3																
5	11	9	6	4															
4.5	12	10	7	4	1														
4	13	11	8	5	2	1													
3.5	13	11	9	6	3	2	1												
3	15	12	10	7	4	3	2	1											
2.7	15	13	11	8	5	4	3	2	1										
2.4	16	14	12	9	6	5	4	4	2	1									
2.1	18	16	14	11	8	7	6	5	4	3	2								
1.8	20	18	15	13	10	9	8	7	6	5	4	2							
1.5	22	20	18	16	12	12	11	10	9	8	7	5	3						
1.2	25	23	21	19	16	15	14	14	12	12	10	9	7	4					
0.9	29	28	26	23	21	20	19	19	17	17	16	14	12	9	6				
0.7	34	33	31	29	26	25	25	24	23	22	21	20	18	16	12	7			
0.5	41	39	38	36	33	33	32	31	31	30	29	28	26	24	21	16	10		
0.3	48	47	45	44	42	41	41	40	39	39	38	37	36	33	31	27	21	13	
0.1	64	63	62	61	59	59	59	58	58	57	57	56	55	54	52	49	45	39	30

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-26. Percent Change in Wetted Perimeter Between Two Flows for Crater Creek Below Diversion.

		Start Flow[1] (cfs)																							
	Start Flow[1]	**35**	**30**	**25**	**20**	**17.5**	**15**	**12.5**	**10**	**7.5**	**5**	**4.5**	**4**	**3.5**	**3**	**2.7**	**2.4**	**2.1**	**1.8**	**1.5**	**1.2**	**0.9**	**0.7**	**0.5**	**0.3**
	WP[2]	*17.5*	*17.0*	*16.5*	*15.9*	*15.3*	*14.5*	*13.7*	*13.0*	*12.3*	*11.6*	*11.4*	*11.2*	*11.1*	*10.8*	*10.5*	*10.3*	*10.0*	*9.7*	*9.3*	*8.0*	*8.9*	*8.0*	*6.6*	*6.0*
End Flow[3] (cfs)	**30**	3																							
	25	6	3																						
	20	9	6	3																					
	17.5	13	10	7	4																				
	15	17	15	12	9	5																			
	12.5	22	20	17	14	11	6																		
	10	26	24	21	18	15	10	5																	
	7.5	30	28	25	23	20	15	10	5																
	5	34	32	30	27	24	20	15	11	6															
	4.5	35	33	31	28	26	21	17	12	7	1														
	4	36	34	32	30	27	23	18	14	9	3	2													
	3.5	37	35	33	31	28	24	19	15	10	5	3	2												
	3	39	37	35	33	30	26	21	17	13	7	6	4	3											
	2.7	40	38	36	34	31	27	23	19	15	9	8	6	5	2										
	2.4	41	40	37	35	33	29	25	21	16	11	10	8	7	4	2									
	2.1	43	41	39	37	35	31	27	23	19	14	12	11	9	7	5	3								
	1.8	45	43	41	39	37	34	29	26	22	17	15	14	13	10	8	6	4							
	1.5	47	46	44	42	40	36	32	29	25	20	19	17	16	14	12	10	7	4						
	1.2	49	48	46	44	42	39	35	31	28	23	22	20	19	17	15	13	11	7	4					
	0.9	51	50	48	46	44	41	37	34	31	26	25	24	23	20	19	17	14	11	8	4				
	0.7	54	53	51	50	48	45	41	38	35	31	30	29	28	25	24	22	20	17	13	10	6			
	0.5	62	61	60	59	57	55	52	49	46	43	42	41	40	39	37	36	34	32	29	26	23	18		
	0.3	66	65	64	63	61	59	56	54	52	49	48	47	46	45	43	42	40	38	36	33	30	26	10	
	0.1	73	72	71	70	69	67	65	63	61	58	58	57	56	55	54	53	52	50	48	46	44	40	27	19

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-27. Percent Change in Wetted Perimeter Between Two Flows for Hooper Creek Below Diversion.

		Start Flow[1] (cfs)																					
	Start Flow[1]	**25**	**20**	**17.5**	**15**	**12.5**	**10**	**7.5**	**5**	**4.5**	**4**	**3.5**	**3**	**2.7**	**2.4**	**2.1**	**1.8**	**1.5**	**1.2**	**0.9**	**0.7**	**0.5**	**0.3**
	WP[2]	*13.0*	*12.5*	*12.1*	*11.3*	*10.5*	*10.0*	*9.3*	*8.6*	*8.3*	*8.1*	*8.0*	*7.7*	*7.4*	*7.1*	*6.9*	*6.8*	*6.6*	*6.3*	*6.0*	*5.7*	*5.1*	*4.9*
End Flow[3] (cfs)	**20**	4																					
	17.5	7	4																				
	15	14	10	7																			
	12.5	19	16	13	6																		
	10	23	20	17	11	5																	
	7.5	29	26	23	17	12	7																
	5	34	32	29	24	19	14	8															
	4.5	37	34	32	27	22	18	11	4														
	4	38	35	33	28	23	19	12	5	1													
	3.5	38	36	34	29	24	20	14	6	3	1												
	3	41	38	36	31	27	23	17	10	6	5	4											
	2.7	43	41	39	34	30	26	20	14	10	9	8	4										
	2.4	45	43	41	37	32	29	23	17	13	12	11	8	4									
	2.1	47	45	43	38	34	31	25	19	16	15	13	10	6	3								
	1.8	48	46	44	40	36	32	27	21	18	17	16	12	8	5	2							
	1.5	50	48	46	42	38	34	29	23	21	19	18	15	11	8	6	3						
	1.2	52	50	48	44	40	37	32	26	23	22	21	18	15	11	9	7	4					
	0.9	54	52	50	46	43	40	35	30	27	26	25	22	18	15	13	11	8	4				
	0.7	56	54	53	49	46	43	38	33	31	30	29	26	23	20	18	15	13	9	5			
	0.5	61	59	57	54	51	49	45	40	38	37	36	33	30	28	26	24	22	19	15	10		
	0.3	63	61	60	57	54	51	48	43	41	40	39	37	34	32	30	28	26	23	19	15	5	
	0.1	70	69	68	65	63	61	58	54	53	52	51	49	47	45	44	42	40	38	35	32	24	20

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-28. Percent Change in Wetted Perimeter Between Two Flows for North Slide Creek Below Diversion.

End Flow[3] (cfs)	Start Flow[1] (cfs)																			
Start Flow[1]	**2**	**1.8**	**1.6**	**1.4**	**1.2**	**1**	**0.9**	**0.8**	**0.7**	**0.6**	**0.5**	**0.4**	**0.3**	**0.25**	**0.20**	**0.15**	**0.10**	**0.08**	**0.06**	**0.04**
WP[2]	*6.4*	*6.2*	*6.0*	*5.8*	*5.6*	*5.4*	*5.3*	*5.2*	*5.0*	*4.8*	*4.6*	*4.2*	*3.8*	*3.6*	*3.4*	*3.2*	*3.0*	*2.9*	*2.8*	*2.6*
1.8	2																			
1.6	5	3																		
1.4	9	7	4																	
1.2	12	10	7	3																
1	15	13	10	6	3															
0.9	17	15	12	8	5	2														
0.8	19	17	14	11	8	5	3													
0.7	21	20	17	13	11	8	6	3												
0.6	24	23	20	17	14	11	9	7	4											
0.5	28	26	24	21	18	15	14	11	8	5										
0.4	34	32	30	27	25	22	20	18	16	12	8									
0.3	40	39	37	34	32	30	28	26	24	21	17	10								
0.25	44	42	40	38	36	34	32	30	28	25	22	15	5							
0.2	46	45	43	41	39	37	35	34	32	29	25	19	10	5						
0.15	49	48	46	44	42	40	39	37	35	33	29	23	15	10	6					
0.1	53	52	50	48	47	45	44	42	40	38	35	29	21	17	13	8				
0.08	55	54	52	50	49	47	46	44	43	40	37	32	24	20	16	11	4			
0.06	57	56	54	52	51	49	48	46	45	43	40	35	27	23	19	15	7	4		
0.04	59	58	56	55	53	52	51	49	48	45	43	38	31	27	23	19	12	9	5	
0.02	62	61	60	58	57	55	54	53	52	50	47	43	36	33	29	25	19	16	13	8

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-29. Percent Change in Wetted Perimeter Between Two Flows for South Slide Creek Below Diversion.

End Flow[3] (cfs)	Start Flow[1] (cfs)																						
Start Flow[1]	7.5	5	4.5	4	3.5	3	2.7	2.5	2.4	2.3	2.2	2.1	2	1.9	1.8	1.7	1.6	1.5	1.2	0.9	0.7	0.5	0.3
WP[2]	*8.1*	*5.8*	*5.4*	*5.3*	*5.1*	*4.9*	*4.7*	*4.7*	*4.6*	*4.6*	*4.6*	*4.5*	*4.5*	*4.5*	*4.4*	*4.4*	*4.4*	*4.3*	*4.2*	*4.1*	*3.9*	*3.8*	*3.5*
5	28																						
4.5	33	7																					
4	35	10	3																				
3.5	37	13	7	4																			
3	40	17	10	7	4																		
2.7	42	19	13	10	7	3																	
2.5	42	20	14	11	8	4	1																
2.4	43	21	15	12	9	5	2	1															
2.3	43	21	15	13	9	6	3	2	1														
2.2	44	22	16	13	10	6	4	2	2	1													
2.1	44	22	17	14	11	7	4	3	2	1	1												
2	45	23	17	14	11	8	5	4	3	2	1	1											
1.9	45	23	18	15	12	8	6	4	4	3	2	1	1										
1.8	45	24	18	16	13	9	6	5	4	4	3	2	1	1									
1.7	46	25	19	16	13	10	7	6	5	4	4	3	2	2	1								
1.6	46	25	20	17	14	10	8	7	6	5	4	4	3	2	2	1							
1.5	47	26	20	18	15	11	9	7	7	6	5	5	4	3	2	2	1						
1.2	48	28	23	20	17	14	11	10	9	9	8	7	7	6	5	4	4	3					
0.9	50	30	25	23	20	17	14	13	12	12	11	10	10	9	8	8	7	6	3				
0.7	51	32	27	25	22	19	17	16	15	14	14	13	12	12	11	10	10	9	6	3			
0.5	53	35	30	28	25	22	20	19	18	18	17	17	16	15	15	14	13	13	10	7	4		
0.3	56	39	35	32	30	27	25	24	23	23	22	22	21	21	20	19	19	18	15	13	10	6	
0.1	63	49	45	43	41	38	37	36	35	35	34	34	33	33	32	32	31	31	29	26	24	21	15

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-30. Percent Change in Wetted Perimeter Between Two Flows for Tombstone Creek Below Diversion.

	Start Flow[1] (cfs)															
Start Flow[1]	**7.5**	**5**	**4.5**	**4**	**3.5**	**3**	**2.7**	**2.4**	**2.1**	**1.8**	**1.5**	**1.2**	**0.9**	**0.7**	**0.5**	**0.3**
WP[2]	*11.7*	*10.4*	*10.1*	*9.8*	*9.4*	*8.9*	*8.5*	*7.9*	*6.8*	*6.2*	*5.7*	*5.1*	*4.5*	*4.1*	*3.4*	*2.6*
End Flow[3] (cfs)																
5	11															
4.5	13	3														
4	16	6	3													
3.5	20	10	7	4												
3	24	15	12	9	5											
2.7	27	18	16	13	9	4										
2.4	32	24	22	19	16	11	7									
2.1	42	35	33	30	27	23	20	14								
1.8	47	41	39	37	34	30	27	22	9							
1.5	51	45	44	42	39	36	33	28	17	8						
1.2	56	51	49	48	45	42	40	35	25	17	10					
0.9	62	57	56	54	52	49	47	43	34	28	21	12				
0.7	65	61	60	58	56	54	52	48	40	34	28	20	9			
0.5	71	67	66	65	63	61	60	57	50	45	40	33	24	16		
0.3	78	75	74	73	72	71	69	67	62	58	54	49	42	36	24	
0.1	89	88	87	87	86	86	85	84	81	80	78	75	72	69	63	51

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-31. Percent Change in Wetted Perimeter Between Two Flows for Adit 8 Creek Below Diversion.

End Flow[3] (cfs) / Start Flow[1] (cfs)	10	9	8	7	6	5.5	5	4.5	4	3.5	3	2.7	2.4	2.1	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.5	0.3
WP[2]	*9.1*	*8.8*	*7.7*	*6.5*	*5.6*	*5.0*	*4.2*	*3.9*	*3.7*	*3.6*	*3.5*	*3.4*	*3.3*	*3.1*	*3.1*	*3.0*	*3.0*	*2.9*	*2.8*	*2.8*	*2.7*	*2.5*	*2.2*
9	3																						
8	15	13																					
7	28	26	15																				
6	39	37	28	15																			
5.5	45	43	35	24	10																		
5	54	53	46	36	25	16																	
4.5	57	56	50	41	31	23	7																
4	59	58	52	43	34	26	11	4															
3.5	61	60	54	45	36	28	14	8	3														
3	62	61	55	47	38	31	17	11	7	3													
2.7	63	62	56	48	39	32	19	12	8	5	2												
2.4	63	62	57	49	41	34	20	14	10	7	4	2											
2.1	65	64	59	52	44	37	25	19	15	12	9	7	5										
1.9	66	65	60	53	45	38	26	20	17	14	11	9	7	2									
1.7	67	66	61	54	46	39	27	22	18	15	12	11	9	4	2								
1.5	67	66	61	55	47	41	29	23	20	17	14	12	11	5	4	2							
1.3	68	67	62	56	48	42	31	25	22	19	16	14	13	8	6	4	2						
1.1	69	68	63	57	49	43	32	27	23	21	18	16	15	10	8	6	4	2					
0.9	69	69	64	58	50	44	34	28	25	22	20	18	16	12	10	8	7	4	2				
0.7	70	69	65	59	52	46	35	30	27	25	22	20	19	14	13	11	9	7	5	3			
0.5	72	72	67	62	55	50	40	35	32	30	27	26	24	20	19	17	15	13	12	9	7		
0.3	75	75	71	66	60	55	46	42	39	37	35	34	32	29	27	26	24	23	21	19	17	11	
0.1	80	80	77	73	68	64	57	54	52	50	48	47	46	43	42	41	40	38	37	35	33	29	20

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-32. Percent Change in Wetted Perimeter Between Two Flows for Balsam Creek Below Diversion.

	Start Flow[1] (cfs)																								
Start Flow[1]	12	11	10	9	8	7	6	5.5	5	4.5	4	3.5	3	2.7	2.4	2.1	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.5	0.3
WP[2]	*12.3*	*11.8*	*11.0*	*10.4*	*10.0*	*9.8*	*9.6*	*9.5*	*9.4*	*9.1*	*8.8*	*8.3*	*7.9*	*7.8*	*7.6*	*7.3*	*7.1*	*6.9*	*6.6*	*6.2*	*6.6*	*6.2*	*4.9*	*4.2*	*2.8*
End Flow[3] (cfs)																									
11	4																								
10	10	7																							
9	16	12	6																						
8	18	15	9	3																					
7	20	17	11	6	2																				
6	22	19	13	8	4	2																			
5.5	23	20	14	9	5	3	1																		
5	24	21	15	10	7	4	2	1																	
4.5	26	23	18	12	10	7	5	4	3																
4	28	25	20	15	12	10	8	7	6	3															
3.5	32	30	24	20	17	15	13	12	11	8	6														
3	36	33	28	24	21	19	17	17	16	13	10	5													
2.7	37	34	30	25	23	21	19	18	17	15	12	7	2												
2.4	38	36	31	27	24	22	21	20	19	16	14	9	4	2											
2.1	40	38	33	29	27	25	23	23	22	19	17	12	7	5	3										
1.9	42	40	36	32	29	28	26	25	24	22	20	15	11	9	7	4									
1.7	44	42	38	34	32	30	28	28	27	24	22	18	13	11	10	7	3								
1.5	46	44	40	36	34	32	31	30	30	27	25	21	17	15	13	10	7	4							
1.3	50	48	44	41	39	37	36	35	34	32	30	26	22	21	19	16	13	10	7						
1.1	54	52	48	45	43	42	41	40	40	38	36	32	28	27	25	23	20	17	14	8					
0.9	57	55	51	48	47	45	44	44	43	41	39	36	32	31	30	27	25	22	19	13	6				
0.7	60	59	56	53	51	50	49	48	48	46	45	41	38	37	36	33	31	29	26	21	14	8			
0.5	66	65	62	60	58	57	57	56	56	54	53	50	47	46	45	43	41	39	37	32	26	22	15		
0.3	77	76	74	73	72	71	71	70	70	69	68	66	64	64	63	62	60	59	57	54	50	47	42	32	
0.1	82	82	80	79	78	78	77	77	77	76	76	74	73	72	72	71	70	69	67	65	62	60	56	48	23

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-33. Percent Change in Wetted Perimeter Between Two Flows for Ely Creek Below Diversion.

		Start Flow[1] (cfs)																				
	Start Flow[1]	**8**	**7**	**6**	**5.5**	**5**	**4.5**	**4**	**3.5**	**3**	**2.7**	**2.4**	**2.1**	**1.9**	**1.7**	**1.5**	**1.3**	**1.1**	**0.9**	**0.7**	**0.5**	**0.3**
	WP[2]	*11.7*	*11.1*	*10.5*	*10.2*	*9.8*	*9.5*	*9.1*	*8.7*	*8.3*	*7.9*	*7.4*	*7.0*	*6.5*	*6.0*	*5.6*	*5.1*	*4.7*	*4.4*	*4.0*	*3.6*	*3.0*
End Flow[3] (cfs)	**7**	5																				
	6	10	5																			
	5.5	13	8	3																		
	5	16	11	6	3																	
	4.5	19	15	10	7	4																
	4	22	18	13	10	7	4															
	3.5	25	22	17	14	11	8	4														
	3	29	25	21	18	16	12	9	5													
	2.7	32	29	25	22	20	17	13	9	5												
	2.4	36	33	29	27	24	21	18	15	10	6											
	2.1	40	37	34	31	29	26	23	20	16	12	6										
	1.9	44	41	38	36	34	31	28	25	21	17	12	6									
	1.7	49	46	43	41	39	37	34	31	28	24	19	14	8								
	1.5	52	50	47	45	43	41	39	36	33	29	25	20	14	7							
	1.3	56	54	51	49	48	46	44	41	38	35	31	26	21	14	8						
	1.1	60	58	55	54	52	50	48	46	43	40	37	33	28	22	16	9					
	0.9	62	60	58	57	55	54	52	49	47	44	41	37	33	27	21	14	6				
	0.7	65	64	61	60	59	57	56	54	51	49	46	42	38	33	28	21	14	8			
	0.5	69	68	66	65	64	62	61	59	57	54	52	48	45	40	36	30	24	18	11		
	0.3	74	73	71	70	69	68	67	66	64	62	60	57	54	50	46	42	36	32	26	16	
	0.1	86	86	85	84	84	83	82	82	81	80	79	77	76	73	71	69	66	64	61	55	47

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-34. Percent Change in Wetted Perimeter Between Two Flows for Pitman Creek Below Diversion

	Start Flow[1] (cfs)																												
Start Flow[1]	**25**	**20**	**18**	**16**	**14**	**12**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3.8**	**3.5**	**3.3**	**3**	**2.8**	**2.5**	**2.3**	**2**	**1.8**	**1.6**	**1.4**	**1.2**	**0.9**	**0.7**	**0.5**	**0.3**
WP[2]	*18.1*	*17.0*	*15.8*	*14.8*	*13.2*	*12.0*	*10.7*	*10.1*	*9.4*	*9.0*	*8.5*	*8.1*	*7.6*	*7.5*	*7.3*	*7.2*	*7.0*	*6.9*	*6.7*	*6.5*	*6.3*	*6.1*	*6.0*	*5.8*	*5.7*	*5.5*	*5.2*	*4.9*	*4.5*
End Flow[3] (cfs)																													
20	6																												
18	13	7																											
16	18	13	6																										
14	27	22	16	11																									
12	34	30	24	19	9																								
10	41	37	32	27	19	11																							
9	44	41	36	32	24	16	6																						
8	48	45	40	36	29	21	12	6																					
7	51	47	43	39	32	25	16	11	5																				
6	53	50	46	42	35	29	20	15	9	5																			
5	55	52	49	45	39	33	24	20	14	9	5																		
4	58	55	52	49	42	37	29	25	19	15	11	6																	
3.75	59	56	53	49	43	38	30	26	21	17	13	8	2																
3.5	59	57	54	50	45	39	32	27	22	18	14	9	4	2															
3.25	60	58	54	51	46	40	33	29	24	20	16	11	5	4	2														
3	61	59	55	52	47	41	34	30	25	21	18	13	7	6	4	2													
2.75	62	60	57	54	48	43	36	32	27	23	20	15	10	8	6	5	3												
2.5	63	61	58	55	49	44	38	34	29	25	22	17	12	10	9	7	5	3											
2.25	64	62	59	56	51	46	39	36	31	27	24	20	15	13	11	10	8	5	3										
2	65	63	60	57	52	48	41	38	33	30	26	22	17	16	14	13	11	8	6	3									
1.8	66	64	61	59	54	49	43	39	35	32	28	24	19	18	16	15	13	11	8	6	3								
1.6	67	65	62	60	55	50	44	41	37	33	30	26	22	20	19	17	15	13	11	8	5	3							
1.4	68	66	63	61	56	52	46	42	38	35	32	28	24	22	21	19	17	15	13	11	8	5	2						
1.2	69	67	64	62	57	53	47	44	40	37	34	30	25	24	23	21	19	17	15	13	10	7	5	2					
0.9	70	68	65	63	59	55	49	46	42	39	36	33	28	27	26	24	23	21	18	16	13	11	9	6	4				
0.7	71	69	67	65	60	56	51	48	45	41	39	35	31	30	29	27	26	24	22	19	17	14	12	10	8	4			
0.5	73	71	69	67	63	59	54	51	48	45	42	39	35	34	33	31	30	28	26	24	21	19	17	15	13	9	6		
0.3	75	74	72	70	66	63	58	55	52	50	47	45	41	40	39	37	36	34	33	31	29	27	25	23	21	17	14	9	
0.1	79	78	76	75	72	69	65	63	60	58	56	54	51	50	49	48	47	45	44	42	40	39	37	35	34	31	28	24	17

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-35. Percent Change in Wetted Perimeter Between Two Flows for Rancheria Creek Below Surge Chamber.

	Start Flow[1] (cfs)																												
Start Flow[1]	**35**	**30**	**25**	**20**	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5.5**	**5**	**4.5**	**4**	**3.5**	**3**	**2.5**	**2**	**1.7**	**1.5**	**1.3**	**1.1**	**0.9**	**0.7**	**0.5**
WP[2]	*21.6*	*21.2*	*20.8*	*20.4*	*19.8*	*19.7*	*19.5*	*19.2*	*18.8*	*18.4*	*18.1*	*17.7*	*17.3*	*16.6*	*16.3*	*16.1*	*15.7*	*15.0*	*14.5*	*14.0*	*13.4*	*12.2*	*11.6*	*11.3*	*10.9*	*10.4*	*10.0*	*9.5*	*8.5*
End Flow[3] (cfs)																													
30	2																												
25	4	2																											
20	6	4	2																										
15	8	7	4	3																									
14	9	7	5	3	1																								
13	10	8	6	4	2	1																							
12	11	10	8	6	3	3	2																						
11	13	11	10	8	5	5	4	2																					
10	15	13	11	9	7	7	6	4	2																				
9	16	15	13	11	9	8	7	6	4	2																			
8	18	17	15	13	11	10	9	8	6	4	2																		
7	20	19	17	15	13	12	11	10	8	6	5	2																	
6	23	22	20	18	16	16	15	13	12	10	8	6	4																
5.5	24	23	21	20	18	17	16	15	13	11	10	8	5	2															
5	26	24	23	21	19	19	18	16	15	13	11	9	7	3	2														
4.5	27	26	24	23	21	20	19	18	16	15	13	11	9	5	4	2													
4	31	29	28	26	25	24	23	22	20	19	17	15	13	10	8	7	5												
3.5	33	32	30	29	27	27	26	25	23	21	20	18	16	13	11	10	8	3											
3	35	34	33	31	29	29	28	27	25	24	23	21	19	16	14	13	11	6	3										
2.5	38	37	36	34	33	32	31	30	29	27	26	24	23	19	18	17	15	11	8	5									
2	44	42	41	40	38	38	37	36	35	34	33	31	29	26	25	24	22	18	16	13	9								
1.7	46	45	44	43	41	41	40	39	38	37	36	34	33	30	29	28	26	22	20	17	13	5							
1.5	48	47	46	45	43	43	42	41	40	39	38	36	35	32	31	30	28	25	22	20	16	8	3						
1.3	50	49	48	47	45	45	44	43	42	41	40	39	37	35	34	32	31	27	25	22	19	11	7	4					
1.1	52	51	50	49	47	47	47	46	45	43	42	41	40	37	36	35	34	30	28	26	22	15	11	8	4				
0.9	54	53	52	51	50	49	49	48	47	46	45	44	42	40	39	38	36	33	31	29	25	18	14	11	8	4			
0.7	56	55	54	53	52	52	51	51	50	49	48	46	45	43	42	41	40	37	34	32	29	22	18	16	13	9	5		
0.5	61	60	59	58	57	57	56	56	55	54	53	52	51	49	48	47	46	43	41	39	36	30	27	25	22	18	15	10	
0.3	65	64	64	63	62	62	61	61	60	59	58	57	56	54	54	53	52	50	48	46	44	38	35	33	30	27	24	20	11

[1] Start Flow: Flow, in cfs, at which the ramping begins
[2] WP: Wetted Perimeter, in feet, at the starting flow
[3] End Flow: Flow, in cfs, at end of ramping event

Table CAWG 3-36. Percent of habitat with suitable depth in Rock Creek Above Diversion.

	Rainbow Trout			Brown Trout		
Flow (cfs)	Adult	Juvenile	Fry	Adult	Juvenile	Fry
0.1	46.02	82.25	95.10	68.60	82.25	89.90
0.3	49.37	79.75	91.13	77.87	87.14	87.96
0.5	49.03	81.44	90.72	76.55	88.77	90.17
0.7	60.05	87.56	90.01	75.51	87.56	89.47
0.9	60.98	86.09	88.74	74.24	88.74	80.82
1.1	64.67	82.50	88.41	73.50	86.82	71.46
1.3	63.96	81.59	87.58	73.39	85.87	70.82
1.5	63.17	82.96	91.50	72.34	84.64	74.98
1.7	68.07	81.89	90.33	71.41	83.56	74.13
1.9	67.46	79.30	89.01	70.58	82.59	73.38
2.1	66.74	78.45	88.37	69.83	81.70	71.29
2.4	67.37	77.31	93.59	70.90	80.52	76.75
2.7	66.49	76.30	92.09	69.97	79.47	77.06
3.0	65.70	75.39	84.68	71.61	78.52	77.33
3.3	65.09	72.06	83.16	74.82	77.79	77.54
3.5	64.87	71.82	79.16	75.21	77.53	77.62
3.8	64.76	71.69	79.20	75.08	77.45	77.66
4.0	64.65	71.58	79.23	74.96	77.33	77.70
4.3	64.50	71.41	79.20	74.78	76.09	77.67
4.5	64.18	71.05	78.95	74.40	77.57	77.42
4.8	63.87	70.70	78.71	74.05	79.06	77.19
5.0	64.60	70.38	78.49	73.70	78.71	76.97
5.5	64.37	69.83	76.56	75.31	78.06	74.91
6.0	63.85	69.80	76.18	74.70	76.03	74.55
6.5	63.21	72.74	76.89	73.95	80.54	75.27
7.0	62.64	72.11	76.43	73.29	80.52	74.82
8.0	63.48	75.71	76.10	72.09	87.90	74.52
9.0	62.61	74.64	78.16	71.02	89.79	76.61
10.0	66.90	81.21	77.76	70.31	88.19	76.22
15.0	67.87	73.14	77.73	73.48	87.67	77.73

Table CAWG 3-37. Percent of habitat with suitable depth in Rock Creek Below Diversion.

	Rainbow Trout			Brown Trout		
Flow (cfs)	**Adult**	**Juvenile**	**Fry**	**Adult**	**Juvenile**	**Fry**
0.1	51.76	69.83	92.62	51.76	73.81	92.62
0.3	49.41	66.66	95.09	49.41	74.81	95.09
0.5	48.64	73.67	94.67	48.64	73.67	94.67
0.7	48.08	72.85	96.50	52.66	72.85	96.50
0.9	47.63	72.18	98.17	55.57	72.18	98.17
1.1	47.24	71.61	98.19	55.12	71.61	98.19
1.3	46.90	71.10	97.79	54.72	71.10	97.79
1.5	46.60	70.65	97.42	62.87	70.65	97.42
1.7	46.32	70.24	97.09	62.50	70.24	97.09
1.9	46.07	69.87	96.79	62.15	69.87	96.79
2.1	45.83	69.52	96.51	61.84	77.85	96.51
2.4	45.51	69.04	97.12	61.40	77.35	97.12
2.7	45.21	68.60	99.99	61.00	76.90	99.99
3.0	44.94	68.20	100.00	60.71	76.48	100.00
3.3	44.73	68.23	100.00	64.25	76.15	100.00
3.5	44.53	75.84	100.00	67.34	75.84	100.00
3.8	44.34	75.55	100.00	67.31	75.55	100.00
4.0	44.16	75.27	100.00	67.04	75.27	100.00
4.3	46.56	75.01	100.00	66.79	75.01	100.00
4.5	47.98	74.73	99.99	66.52	79.08	99.99
4.8	47.79	74.47	99.94	66.27	84.25	99.94
5.0	49.24	74.25	99.90	66.06	84.78	99.90
5.5	50.58	74.06	99.81	65.86	84.55	99.81
6.0	50.42	73.87	99.73	65.66	84.33	99.73
6.5	50.50	80.46	99.66	65.48	84.13	99.66
7.0	57.98	83.94	99.58	65.31	83.94	99.58
8.0	57.68	83.58	99.38	64.99	83.58	99.38
9.0	57.40	83.25	99.16	64.69	88.65	98.83
10.0	57.15	82.95	98.96	64.42	90.00	86.52
15.0	63.30	88.62	99.37	71.62	88.62	79.57

Table CAWG 3-38. Percent of habitat with suitable depth in Bolsillo Creek Above Diversion.

	Brook Trout- S&A			Brook Trout- Bovee		
Flow (cfs)	Adult	Juvenile	Fry	Adult	Juvenile	Fry
0.1	34.05	45.96	98.61	73.95	0.00	0.00
0.2	35.61	43.33	99.95	75.28	0.00	0.00
0.3	36.60	40.19	97.22	69.84	0.00	0.00
0.5	37.74	43.35	99.49	74.37	0.00	0.00
0.7	36.44	45.28	99.48	74.15	0.00	0.00
0.9	35.43	45.96	98.10	76.60	0.00	0.00
1.2	34.07	44.19	98.20	77.24	0.00	0.00
1.5	36.28	50.99	98.26	78.73	0.00	0.00
1.8	36.81	55.78	97.22	85.62	0.00	0.00
2.2	37.49	54.45	94.28	84.59	0.00	0.00
2.4	37.18	53.99	93.04	85.98	0.00	0.00
2.7	38.73	53.25	92.14	87.14	0.00	0.00
3.0	39.36	52.58	93.53	88.11	0.00	0.00
3.5	40.52	51.39	93.98	86.19	0.00	0.00
4.0	44.54	52.11	93.17	87.42	0.00	0.00
4.5	48.67	55.34	93.98	87.58	0.00	0.00
5.0	47.61	55.42	93.20	85.70	0.00	0.00
5.5	46.81	57.77	94.66	84.25	0.00	0.00
5.9	46.25	57.41	94.51	83.24	0.00	0.00
6.0	46.10	57.73	94.45	82.97	0.00	0.00
6.5	45.45	58.48	94.22	81.81	0.00	0.00
7.0	44.88	59.15	93.95	80.78	0.00	0.00
7.5	44.41	59.74	93.99	80.42	0.00	0.00
8.0	44.62	59.17	94.57	81.78	0.00	0.00
8.5	45.40	58.59	94.84	81.36	0.00	0.00
9.0	47.69	63.16	94.48	82.45	0.00	0.00
9.5	48.89	64.62	94.50	83.54	0.00	0.00
10.0	48.62	64.26	95.09	84.18	0.00	0.00
12.0	53.28	68.17	93.99	90.80	0.00	0.00
14.0	56.16	68.75	94.09	92.73	0.00	0.00

Table CAWG 3-39. Percent of habitat with suitable depth in Bolsillo Creek Below Diversion.

	Brook Trout- S&A			Brook Trout- Bovee		
Flow (cfs)	Adult	Juvenile	Fry	Adult	Juvenile	Fry
0.1	0.00	5.26	97.87	66.13	0.00	0.00
0.2	0.00	12.76	98.75	74.07	0.00	0.00
0.3	0.65	20.48	98.68	80.40	0.00	0.00
0.5	7.99	37.70	98.26	73.60	0.00	0.00
0.7	13.71	37.68	96.04	72.71	0.00	0.00
0.9	20.40	41.76	99.99	80.17	0.00	0.00
1.2	31.98	55.76	100.00	82.49	0.00	0.00
1.5	36.04	57.90	99.90	88.17	0.00	0.00
1.8	40.72	59.48	99.50	87.60	0.00	0.00
2.2	47.83	58.10	99.85	94.97	0.00	0.00
2.4	54.67	57.89	99.93	95.56	0.00	0.00
2.7	54.34	65.10	99.90	96.52	0.00	0.00
3.0	54.04	67.64	99.88	96.11	0.00	0.00
3.5	59.60	74.64	99.91	95.46	0.00	0.00
4.0	63.68	75.91	99.99	95.19	0.00	0.00
4.5	65.35	75.37	99.97	96.28	0.00	0.00
5.0	64.69	75.45	99.91	97.94	0.00	0.00
5.5	63.83	76.47	98.14	96.50	0.00	0.00
5.9	64.99	76.46	96.04	96.28	0.00	0.00
6.0	64.82	76.26	96.05	96.08	0.00	0.00
6.5	68.88	75.33	89.98	95.81	0.00	0.00
7.0	69.11	78.75	89.64	97.38	0.00	0.00
7.5	70.30	82.41	88.10	96.72	0.00	0.00
8.0	69.52	84.49	88.05	96.07	0.00	0.00
8.5	69.52	84.82	87.65	95.42	0.00	0.00
9.0	68.77	83.93	79.21	94.89	0.00	0.00
9.5	69.64	84.88	79.71	94.20	0.00	0.00
10.0	68.50	83.48	77.16	92.81	0.00	0.00
12.0	69.37	81.59	75.52	88.77	0.00	0.00
14.0	75.04	77.24	68.43	88.39	0.00	0.00

STRANDING REPORT FIGURES

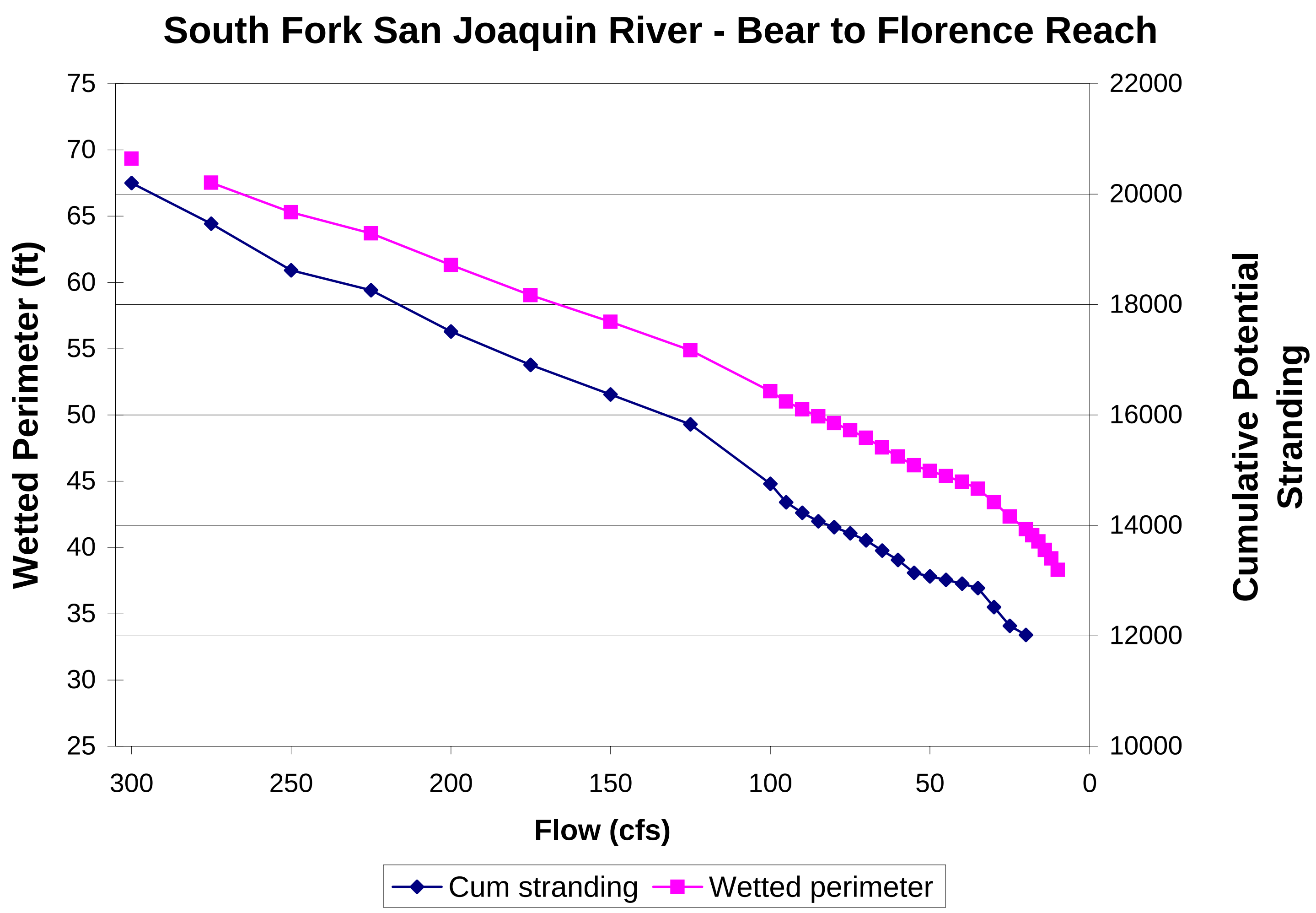


Figure CAWG 3-1. Change in Wetted Perimeter and Cumulative Stranding Potential for South Fork San Joaquin River - Bear Creek to Florence Lake Reach.

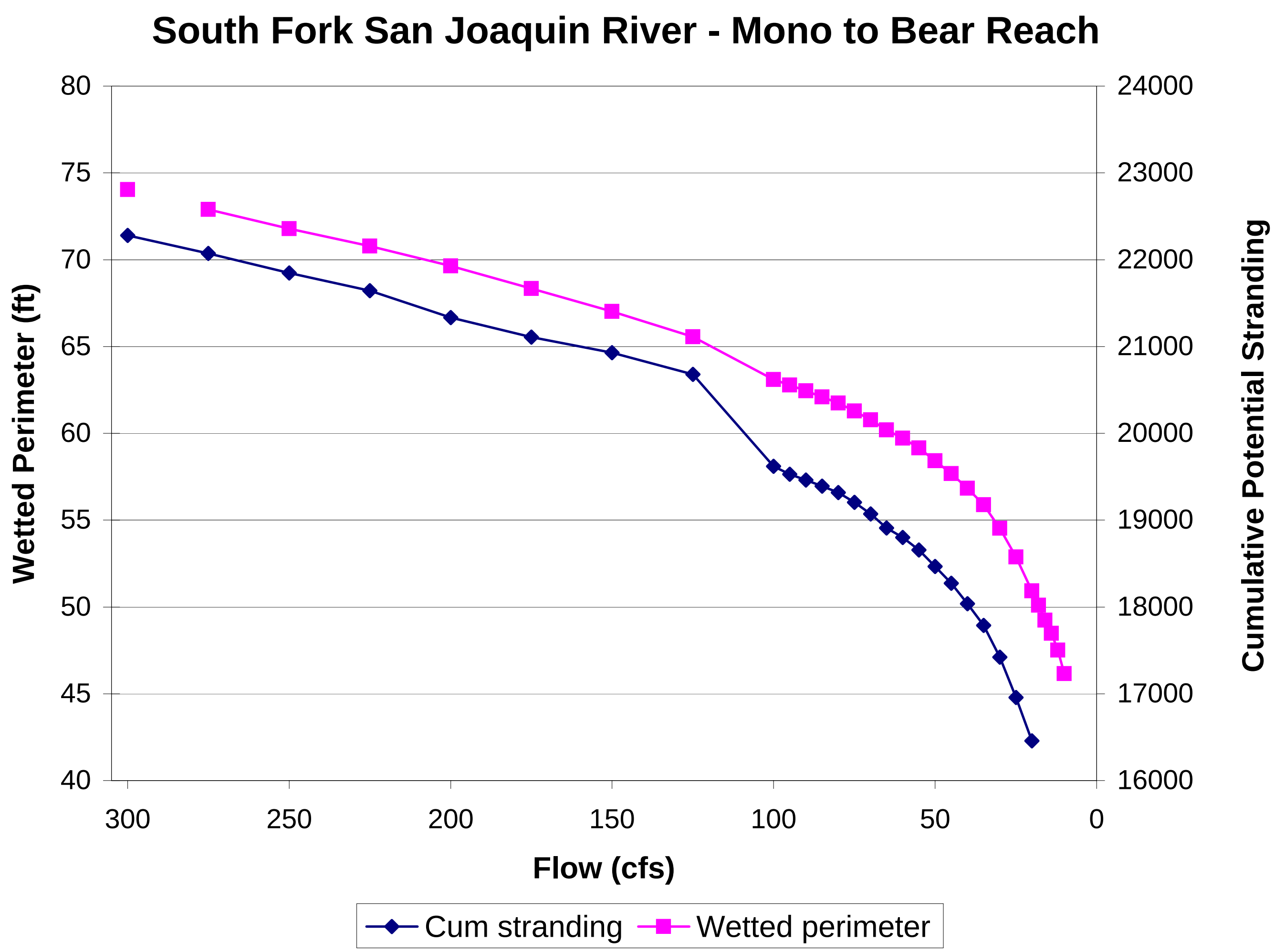


Figure CAWG 3-2. Change in Wetted Perimeter and Cumulative Stranding Potential for South Fork San Joaquin River - Mono Crossing to Bear Creek Reach.

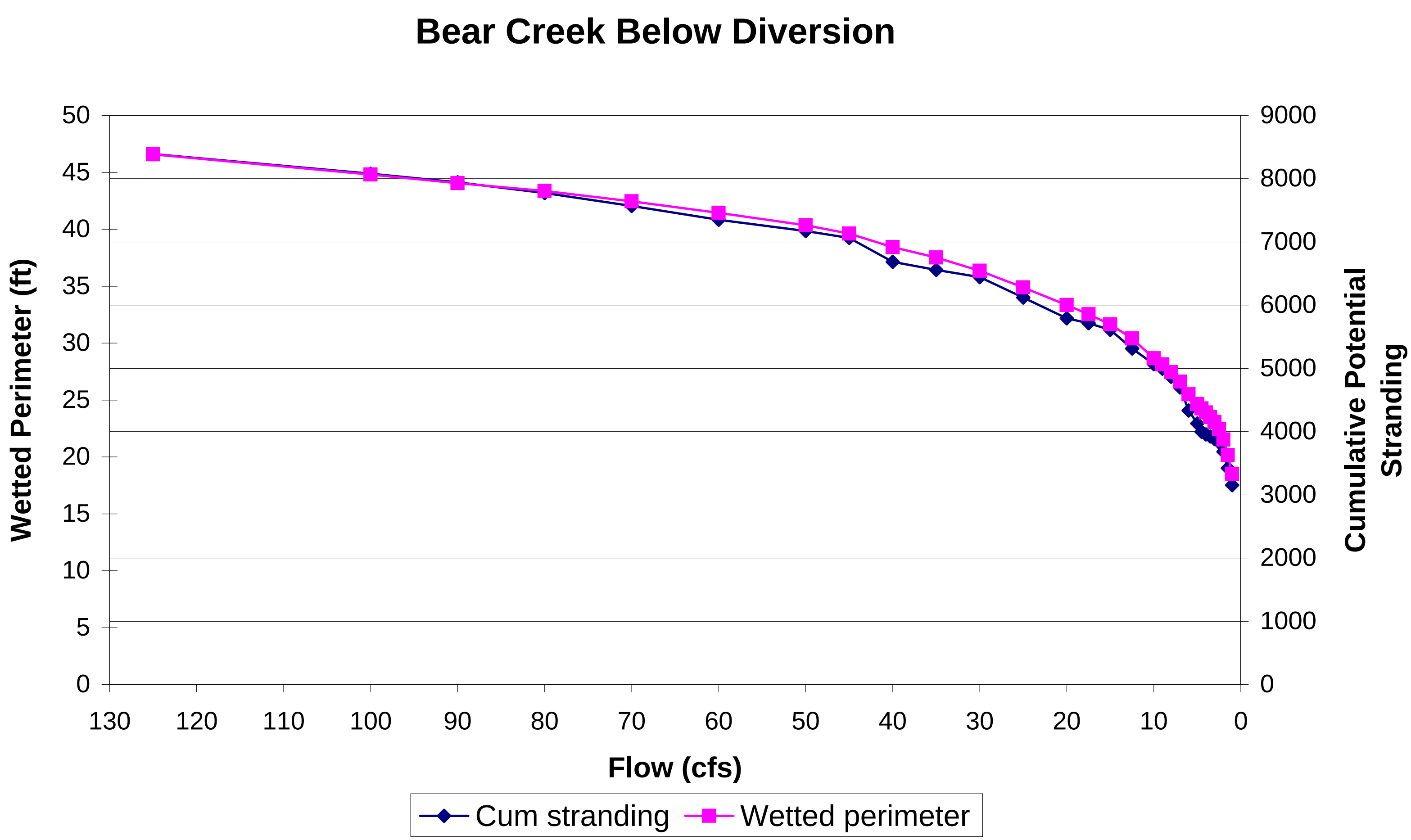


Figure CAWG 3-3. Change in Wetted Perimeter and Cumulative Stranding Potential for Bear Creek Below Diversion.

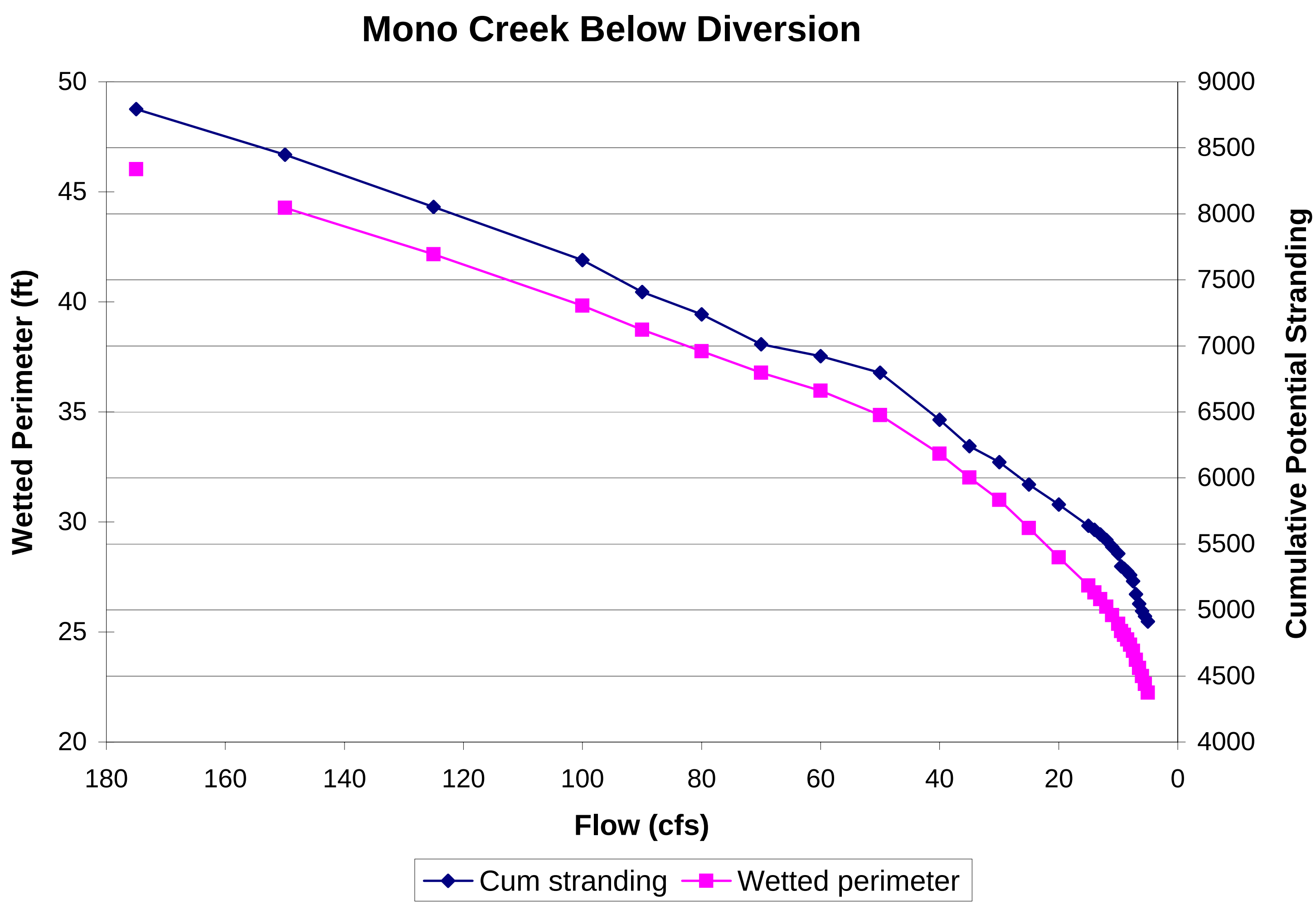


Figure CAWG 3-4. Change in Wetted Perimeter and Cumulative Stranding Potential for Mono Creek Below Diversion.

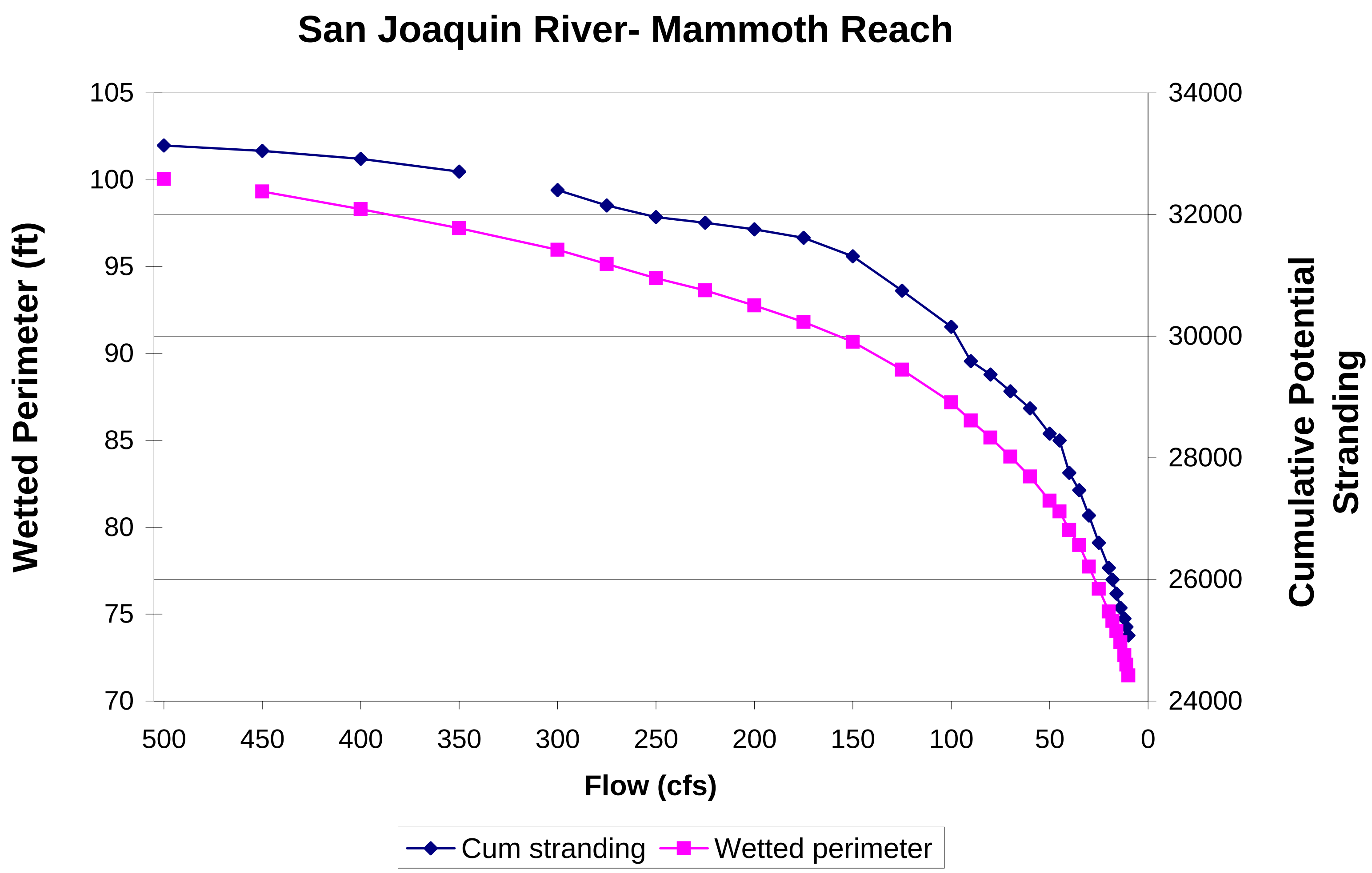


Figure CAWG 3-5. Change in Wetted Perimeter and Cumulative Stranding Potential for San Joaquin River- Mammoth Reach.

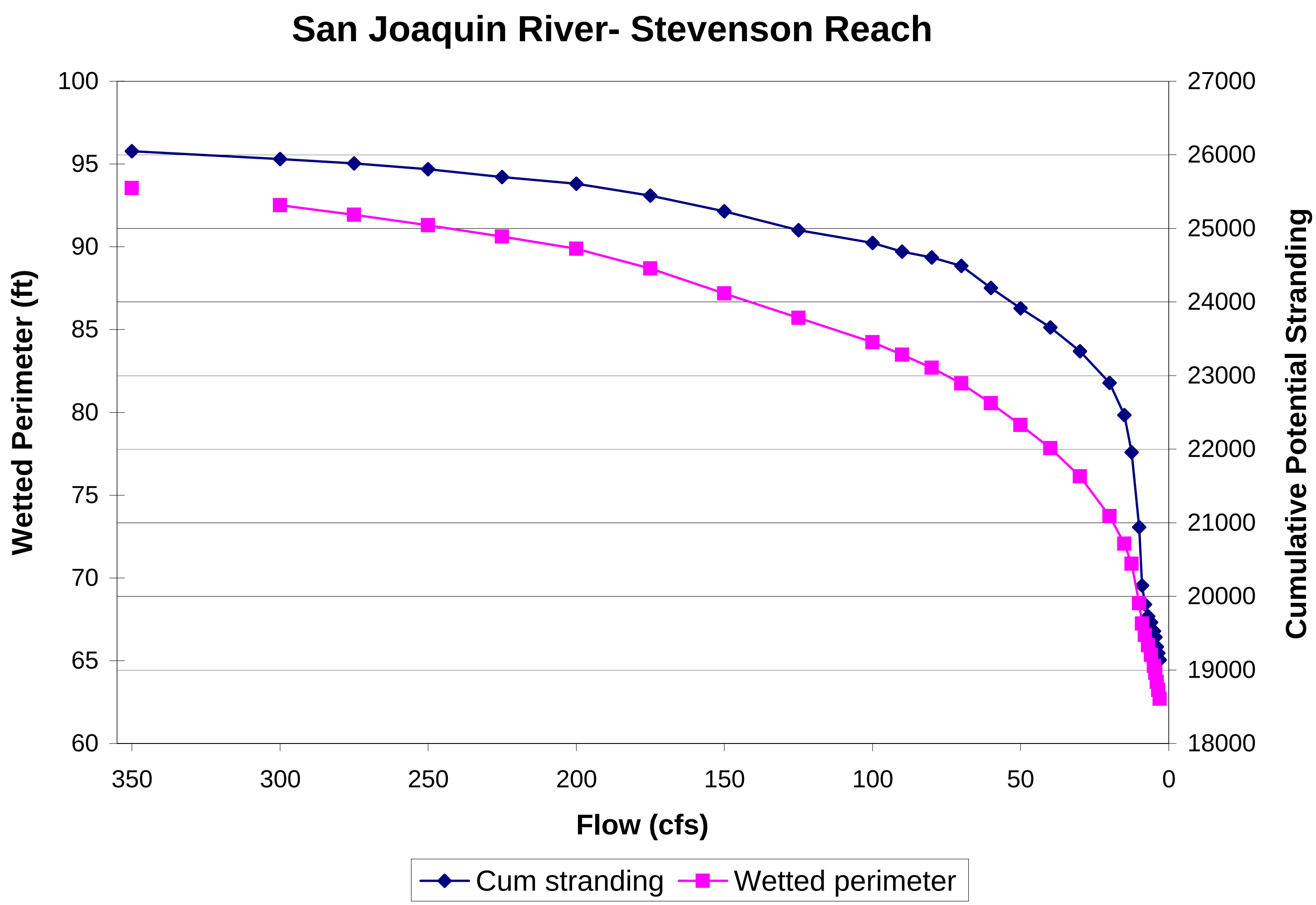


Figure CAWG 3-6. Change in Wetted Perimeter and Cumulative Stranding Potential for San Joaquin River- Stevenson Reach.

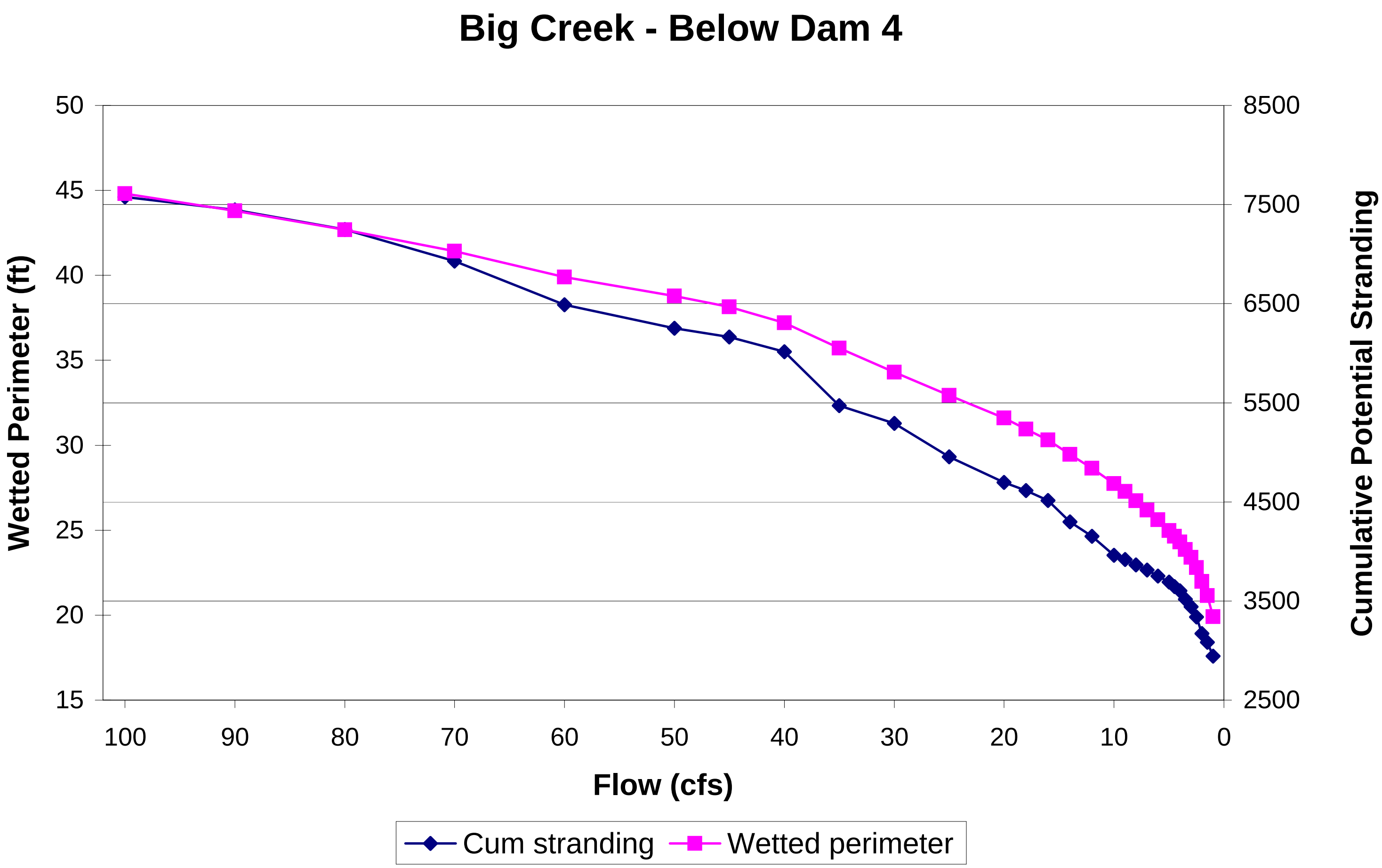


Figure CAWG 3-7. Change in Wetted Perimeter and Cumulative Stranding Potential for Big Creek Below Dam 4.

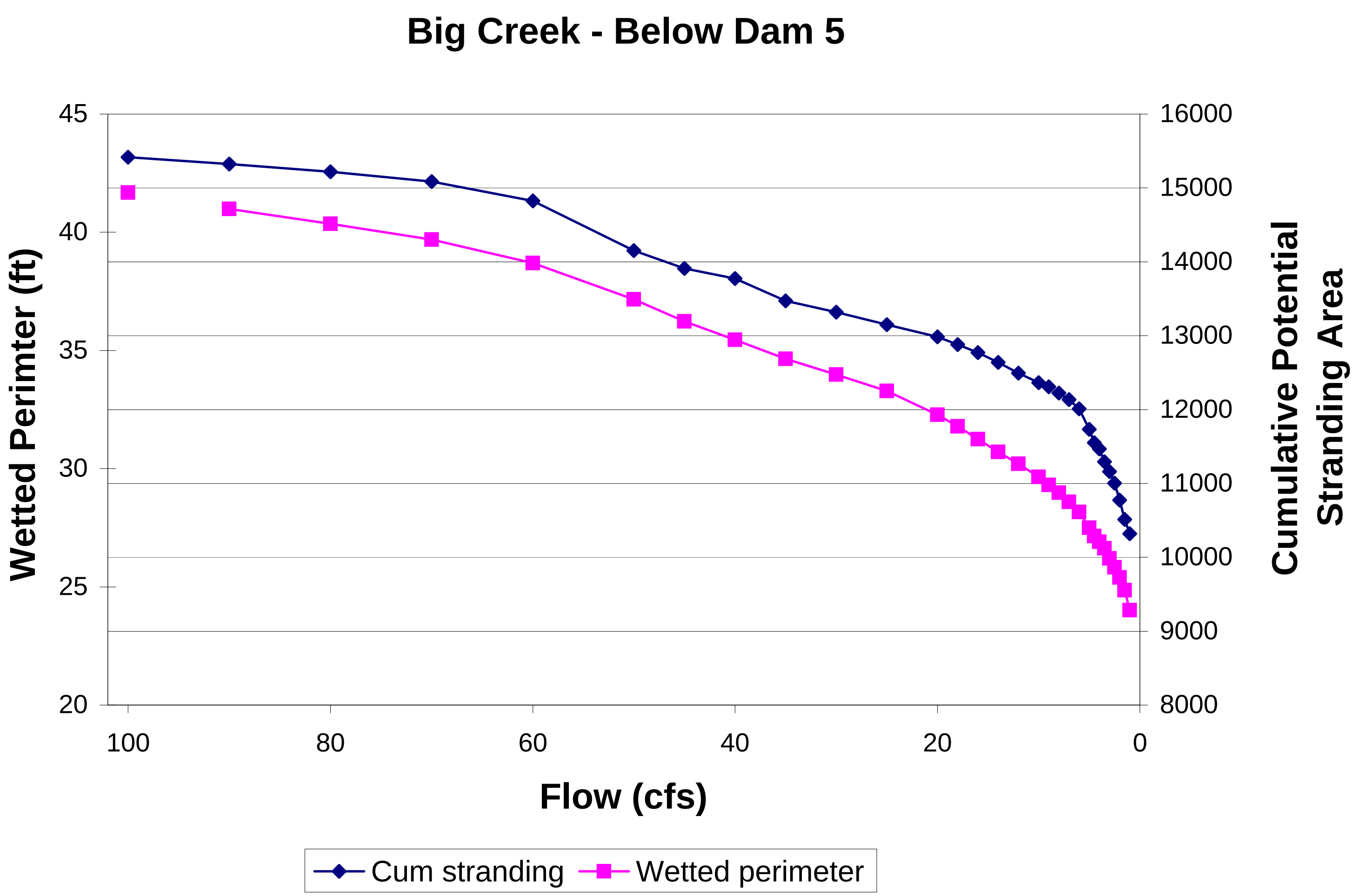


Figure CAWG 3-8. Change in Wetted Perimeter and Cumulative Stranding Potential for Big Creek Below Dam 5.

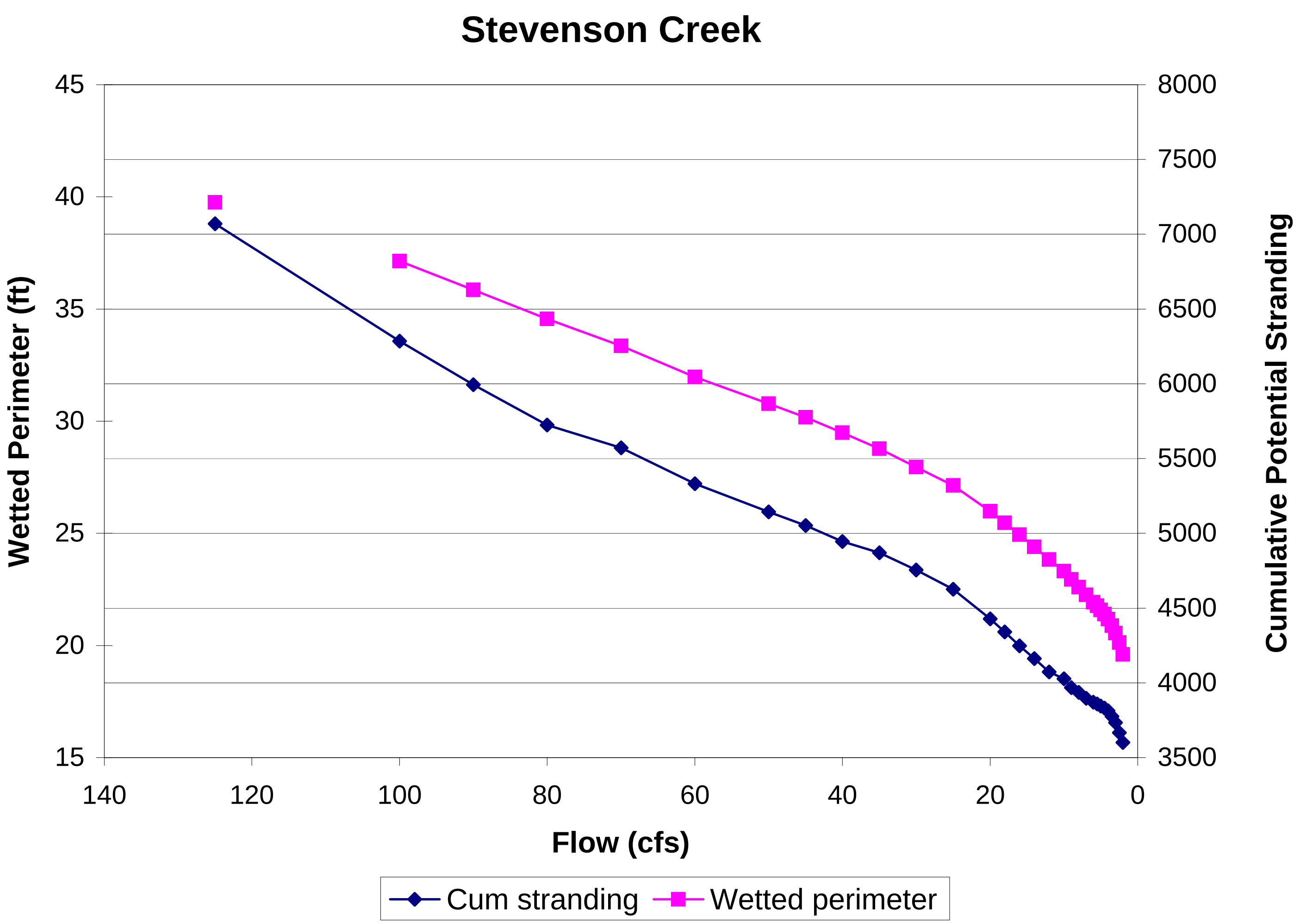


Figure CAWG 3-9. Change in Wetted Perimeter and Cumulative Stranding Potential for Stevenson Creek.

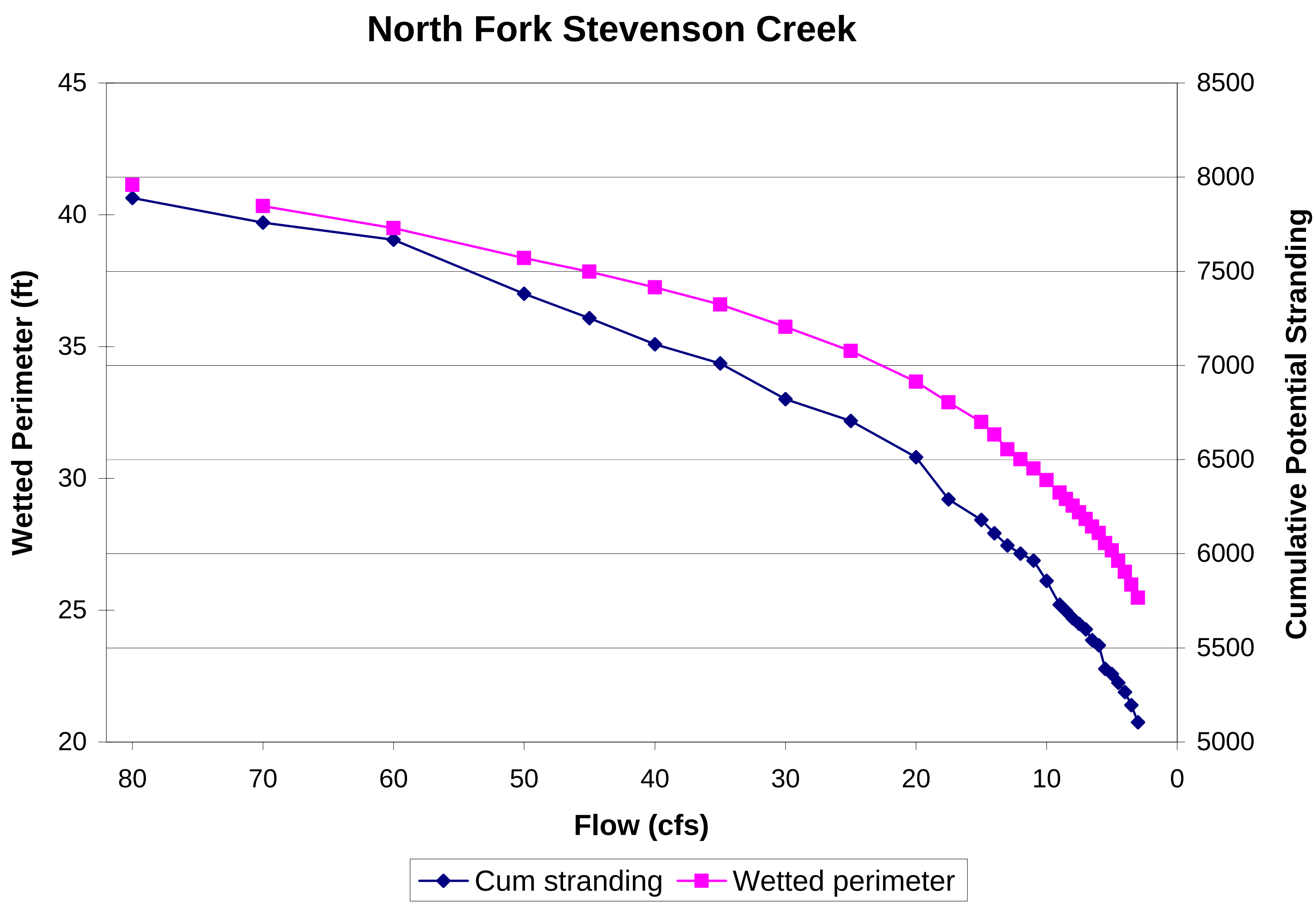


Figure CAWG 3-10. Change in Wetted Perimeter and Cumulative Stranding Potential for North Fork Stevenson Creek.

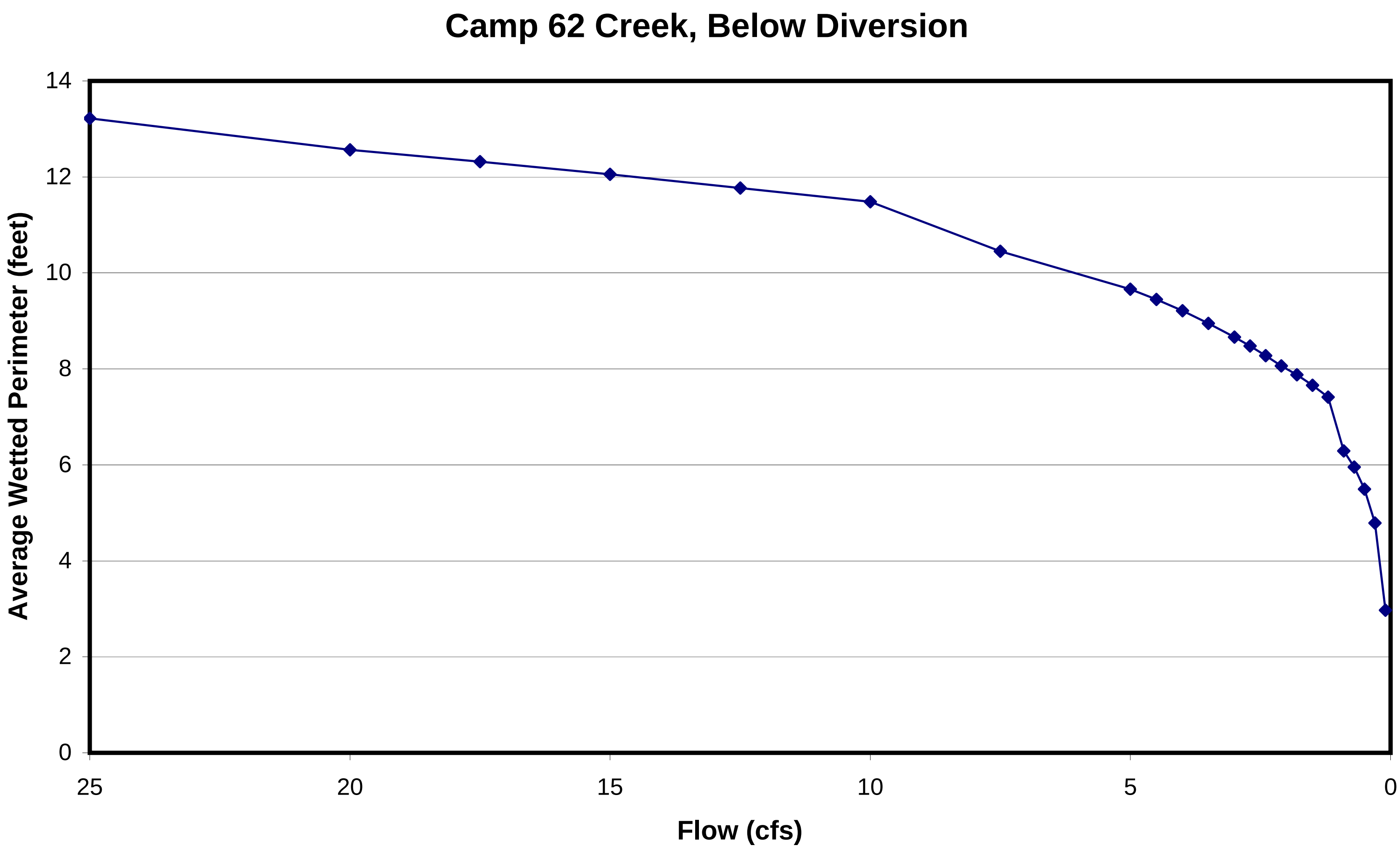


Figure CAWG 3-11. Average Wetted Perimeter versus Flow Functions for Camp 62 Creek.

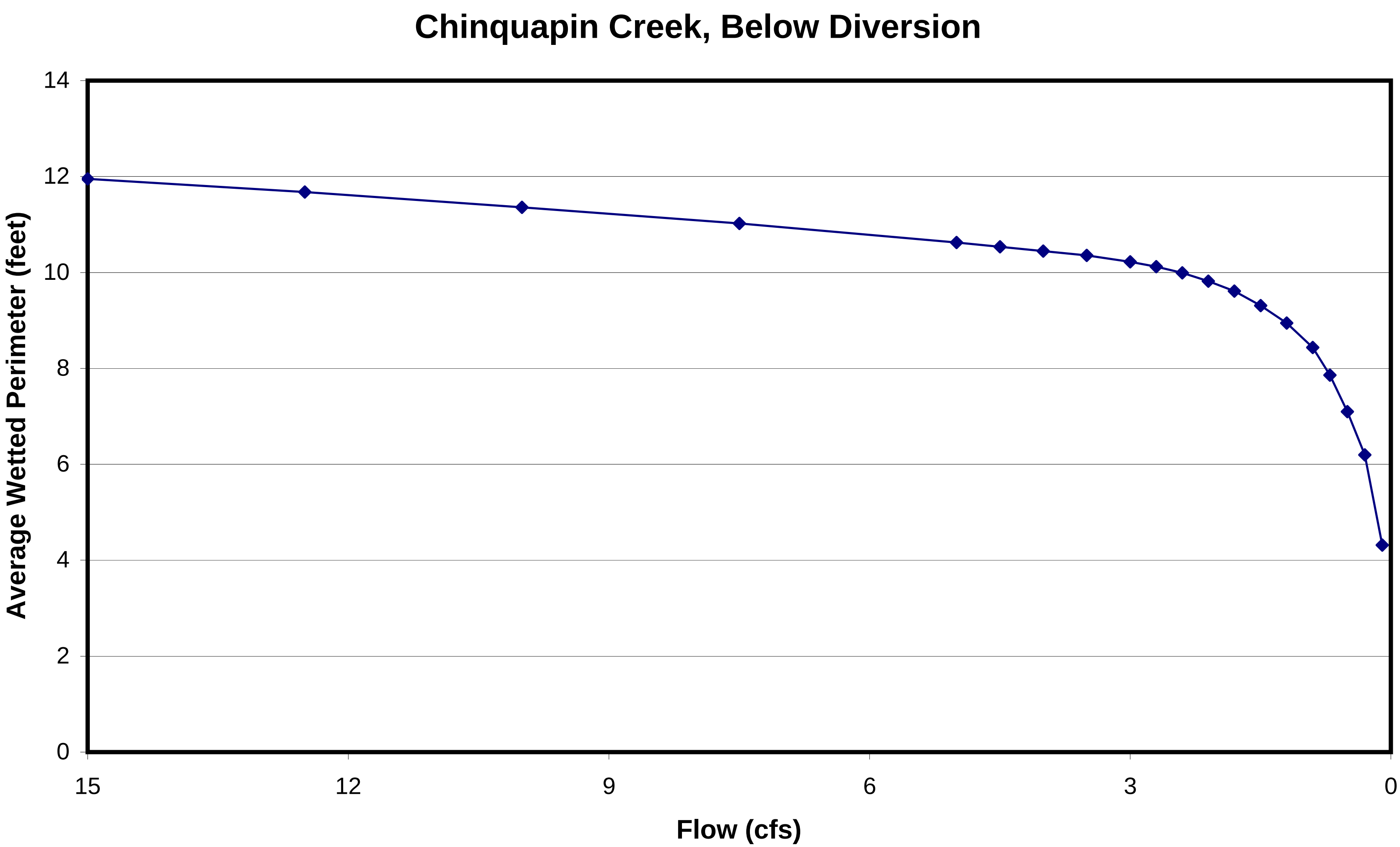


Figure CAWG 3-12. Average Wetted Perimeter versus Flow Functions for Chinquapin Creek.

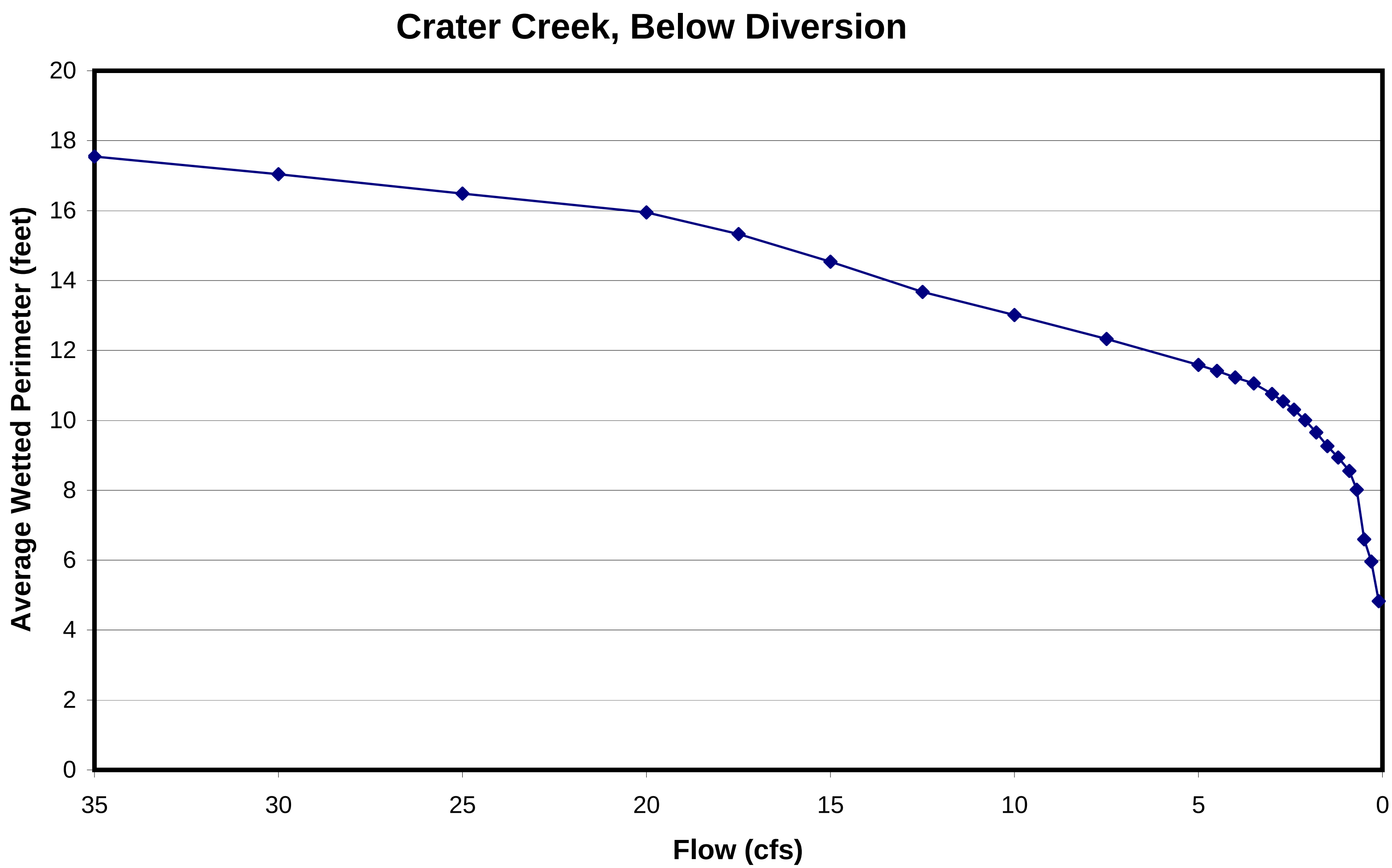


Figure CAWG 3-13. Average Wetted Perimeter versus Flow Functions for Crater Creek.

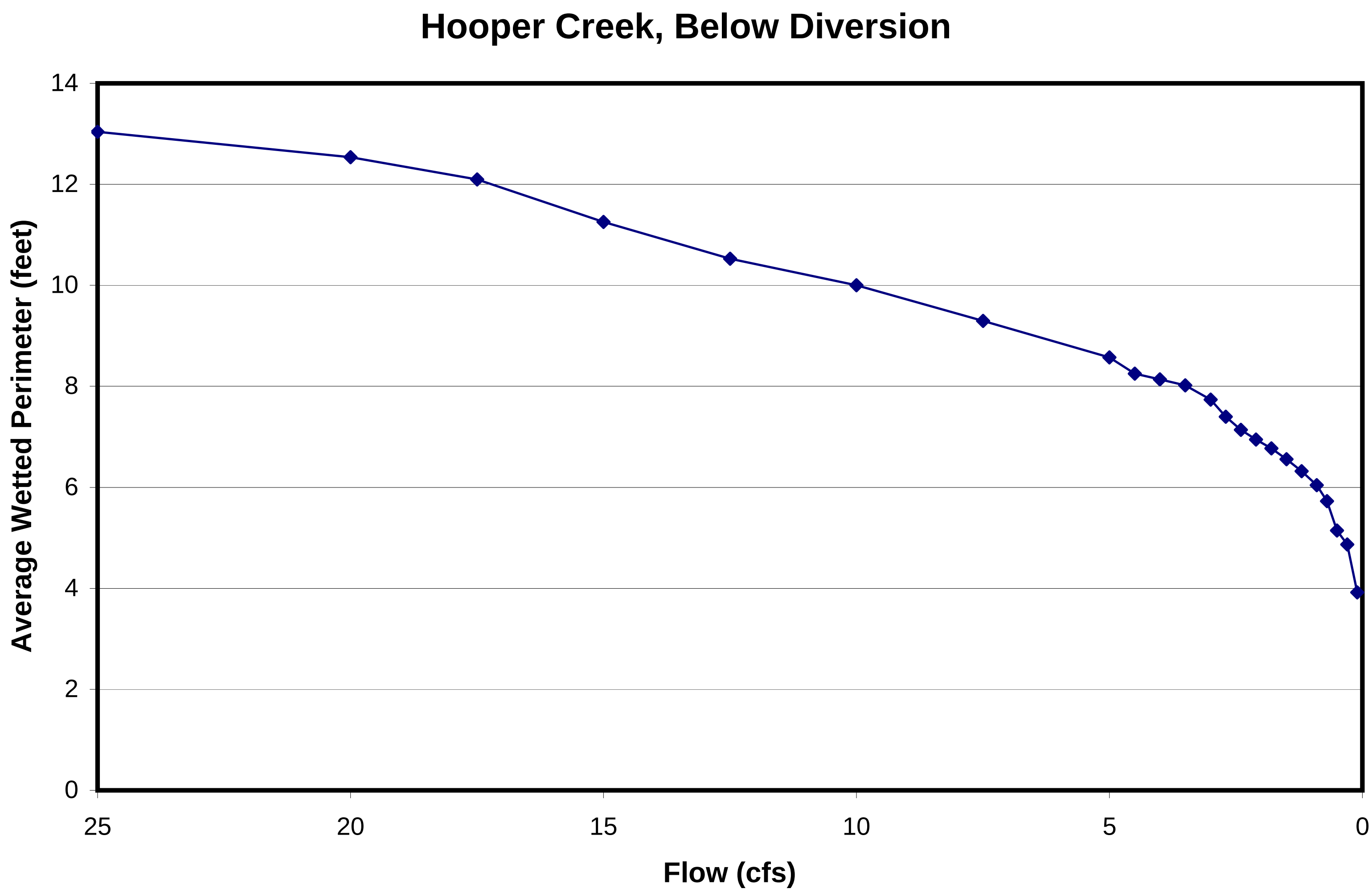


Figure CAWG 3-14. Average Wetted Perimeter versus Flow Functions for Hooper Creek.

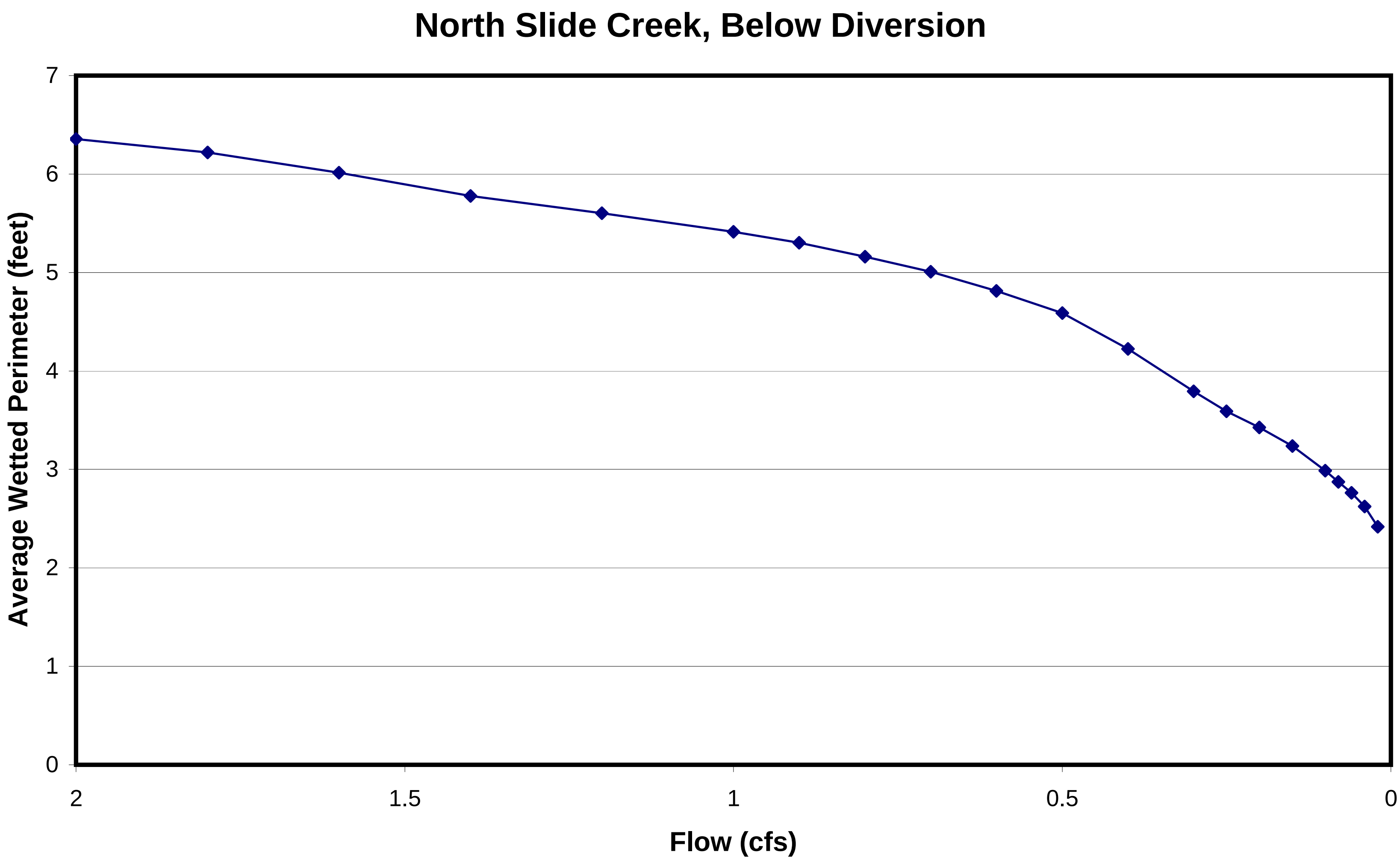


Figure CAWG 3-15. Average Wetted Perimeter versus Flow Functions for North Slide Creek.

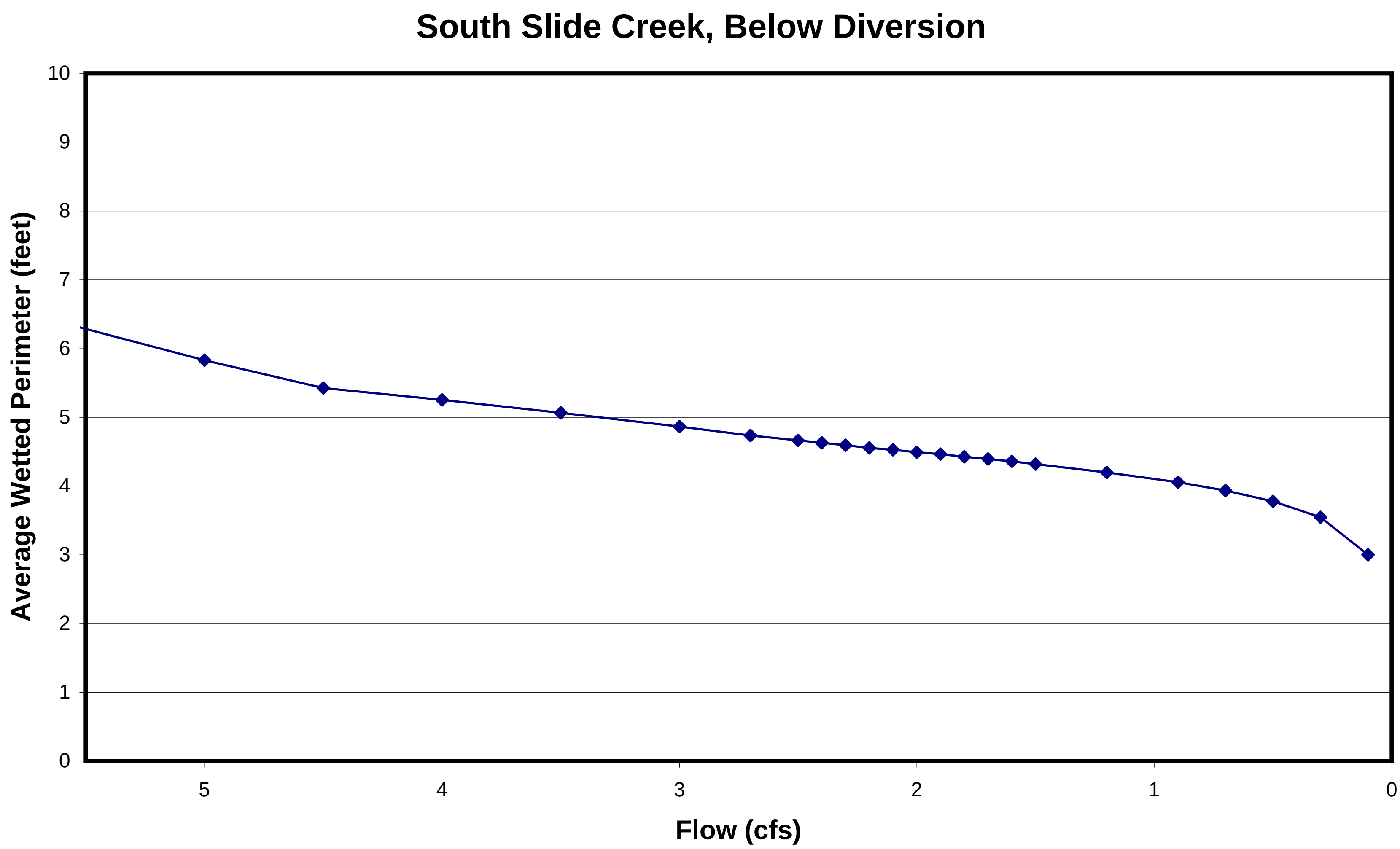


Figure CAWG 3-16. Average Wetted Perimeter versus Flow Functions for South Slide Creek.

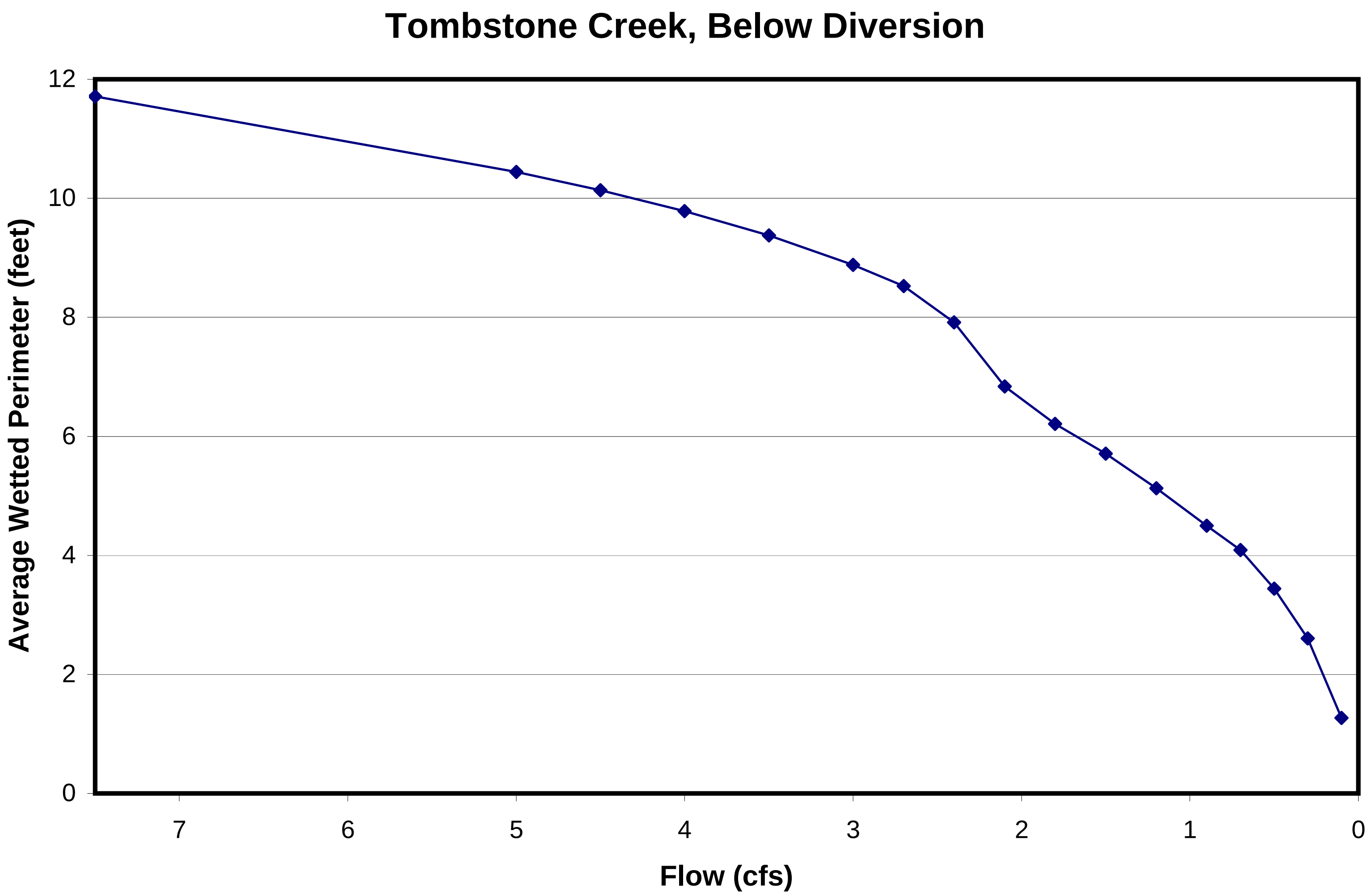


Figure CAWG 3-17. Average Wetted Perimeter versus Flow Functions for Tombstone Creek.

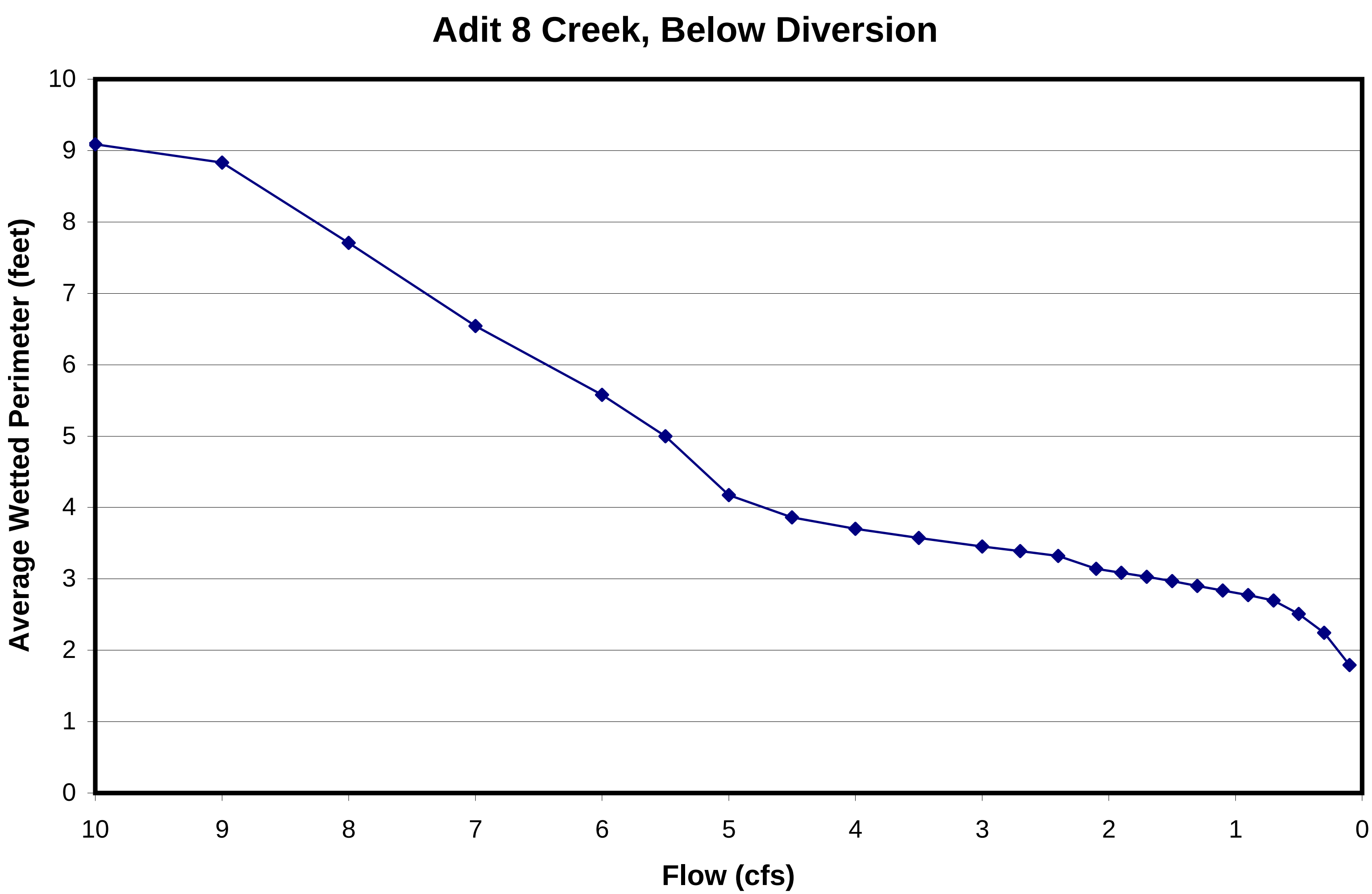


Figure CAWG 3-18. Average Wetted Perimeter versus Flow Functions for Adit 8 Creek.

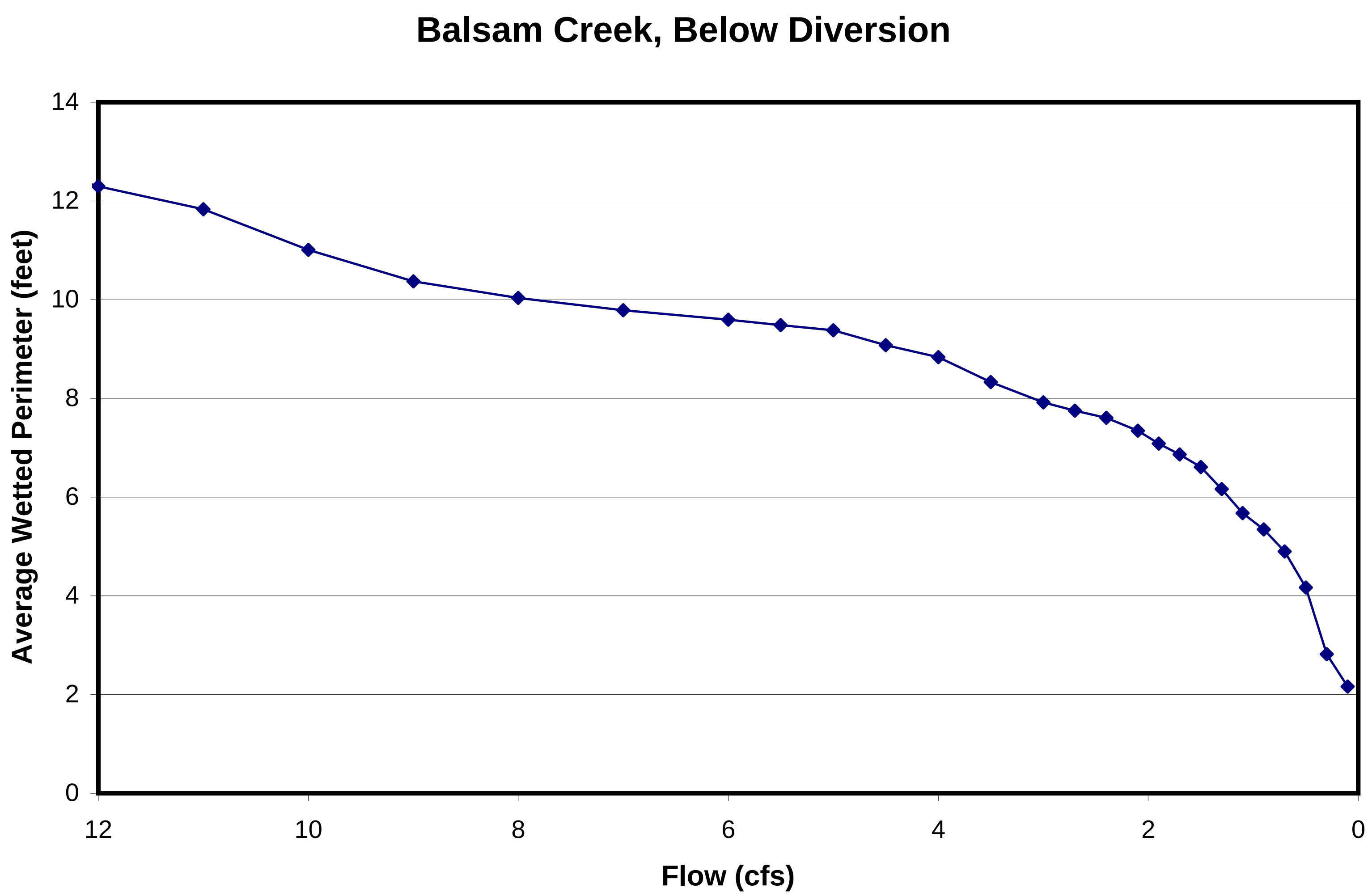


Figure CAWG 3-19. Average Wetted Perimeter versus Flow Functions for Balsam Creek.

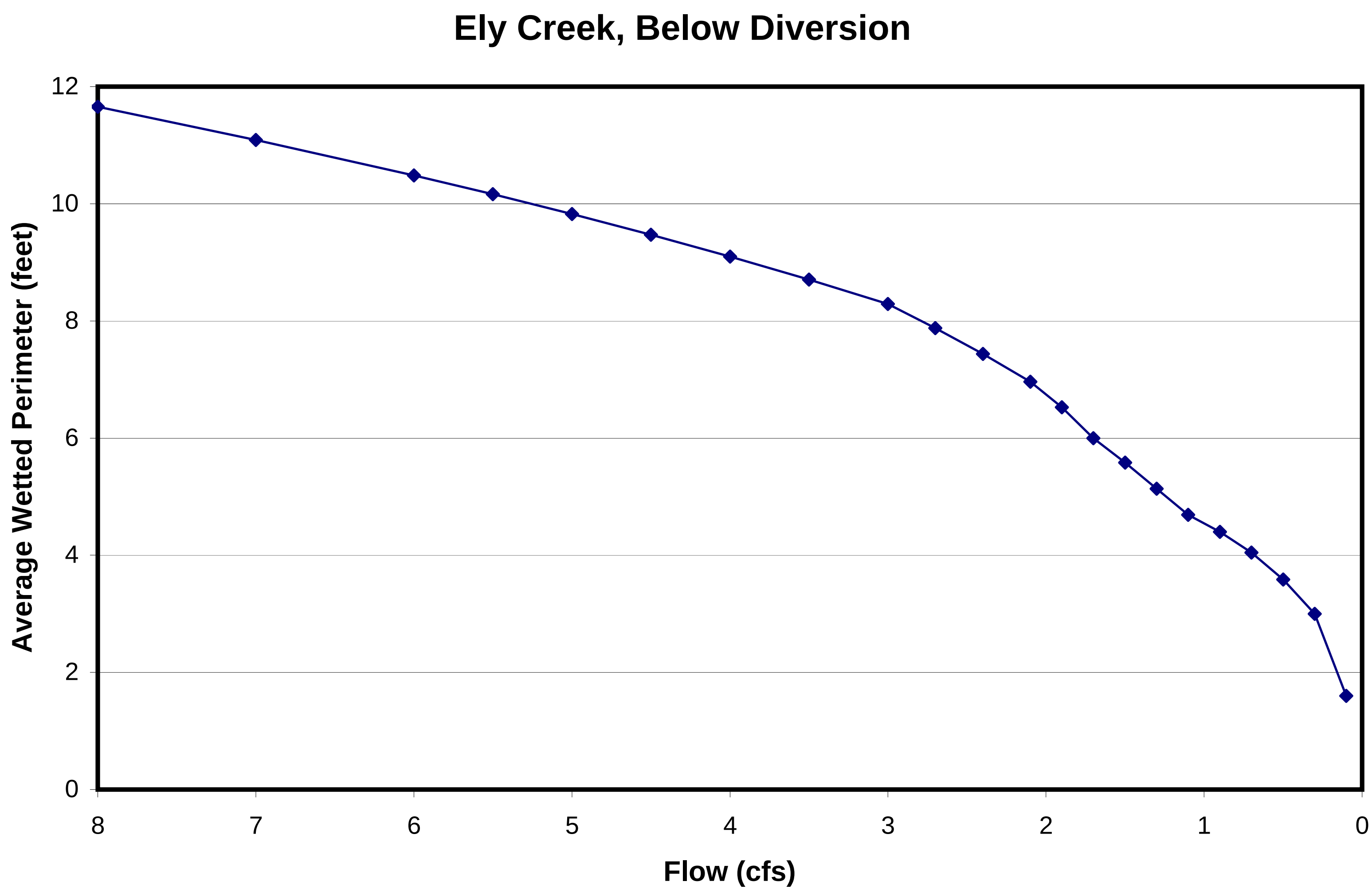


Figure CAWG 3-20. Average Wetted Perimeter versus Flow Functions for Ely Creek.

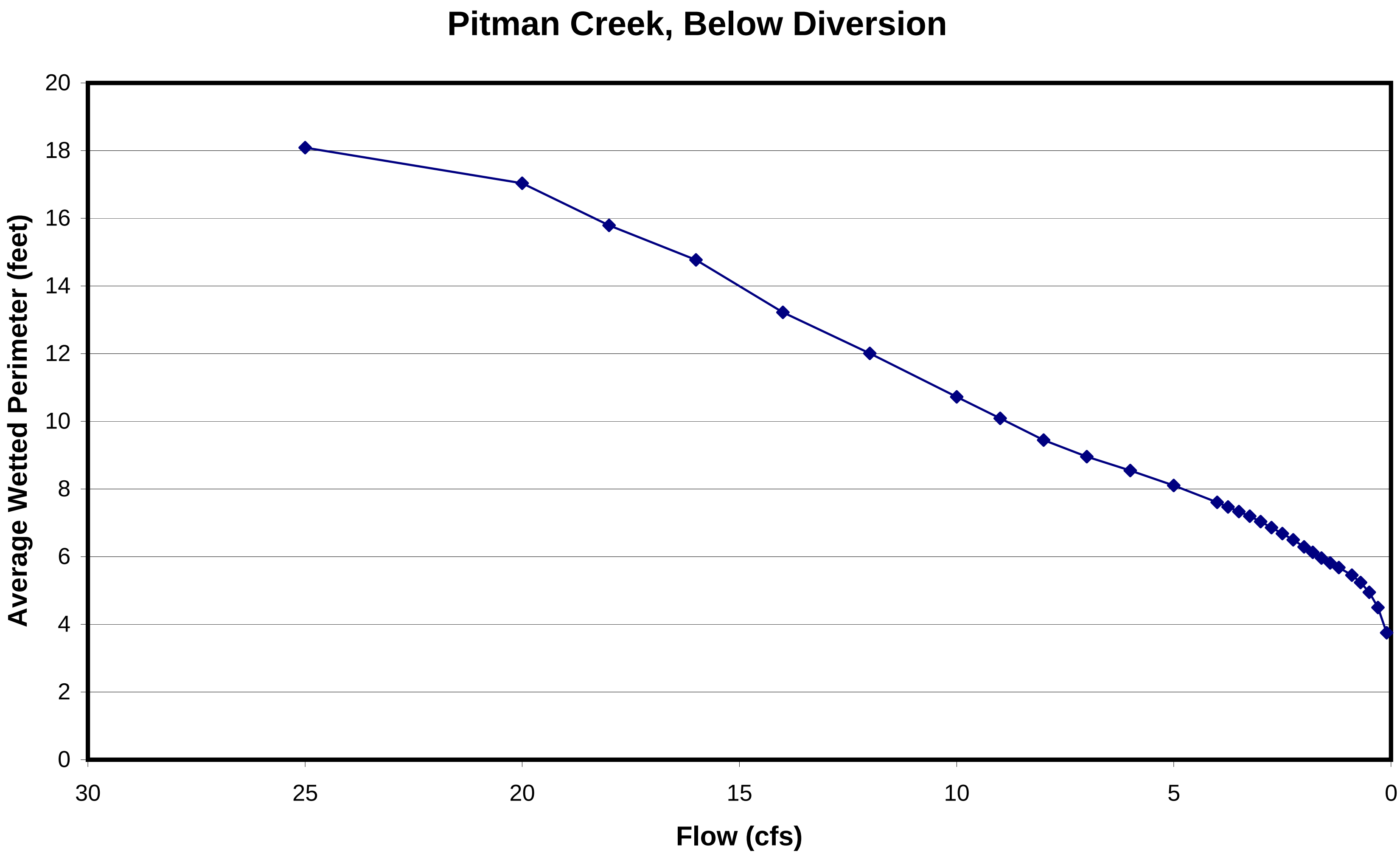


Figure CAWG 3-21. Average Wetted Perimeter versus Flow Functions for Pitman Creek.

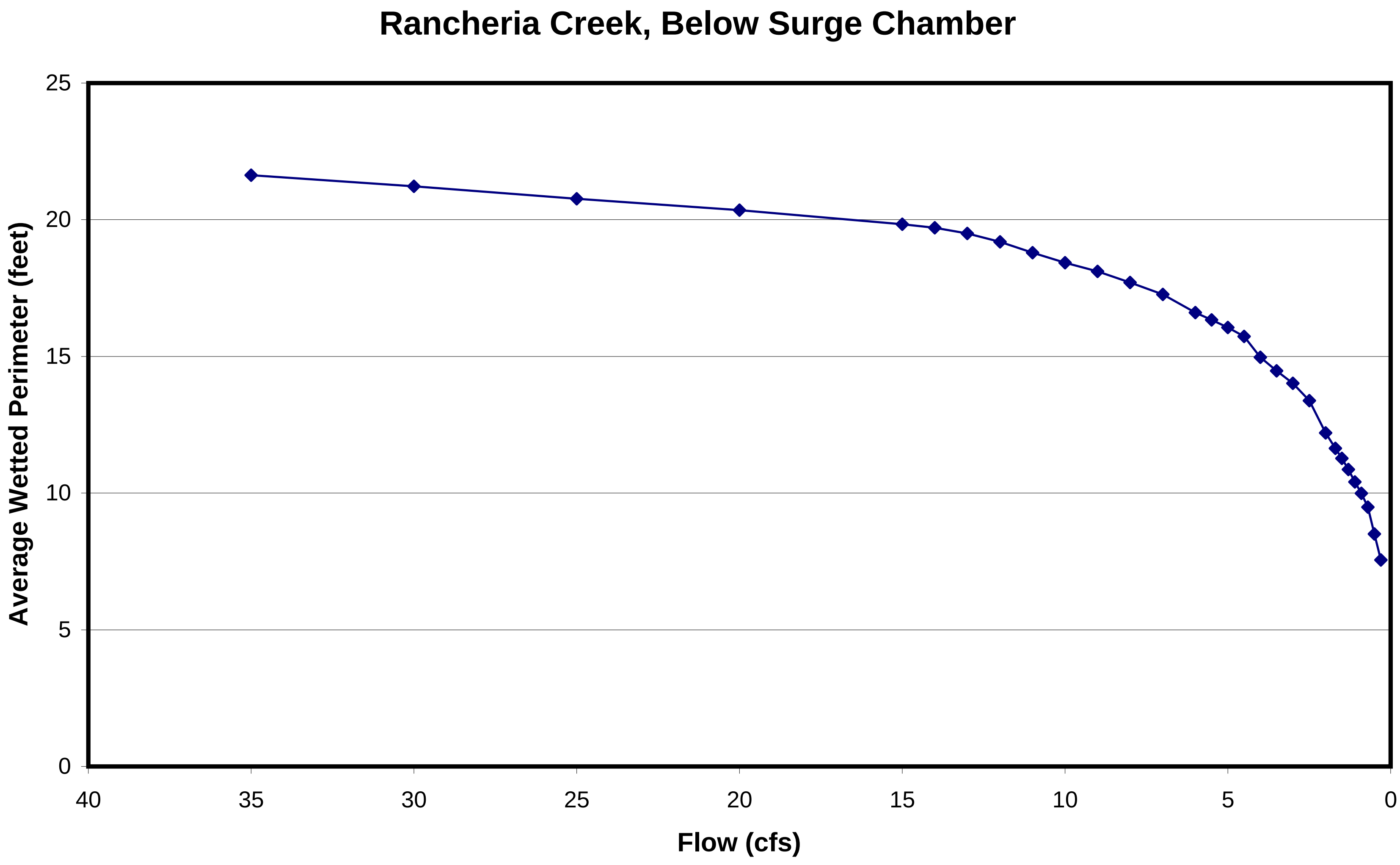
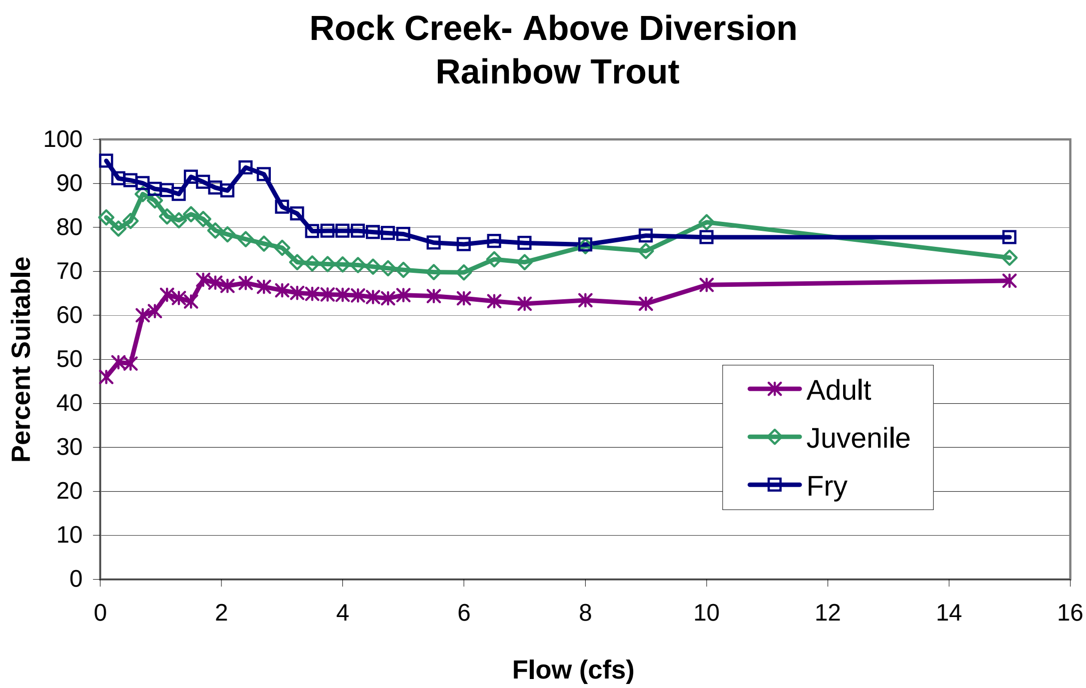


Figure CAWG 3-22. Average Wetted Perimeter versus Flow Functions for Rancheria Creek.



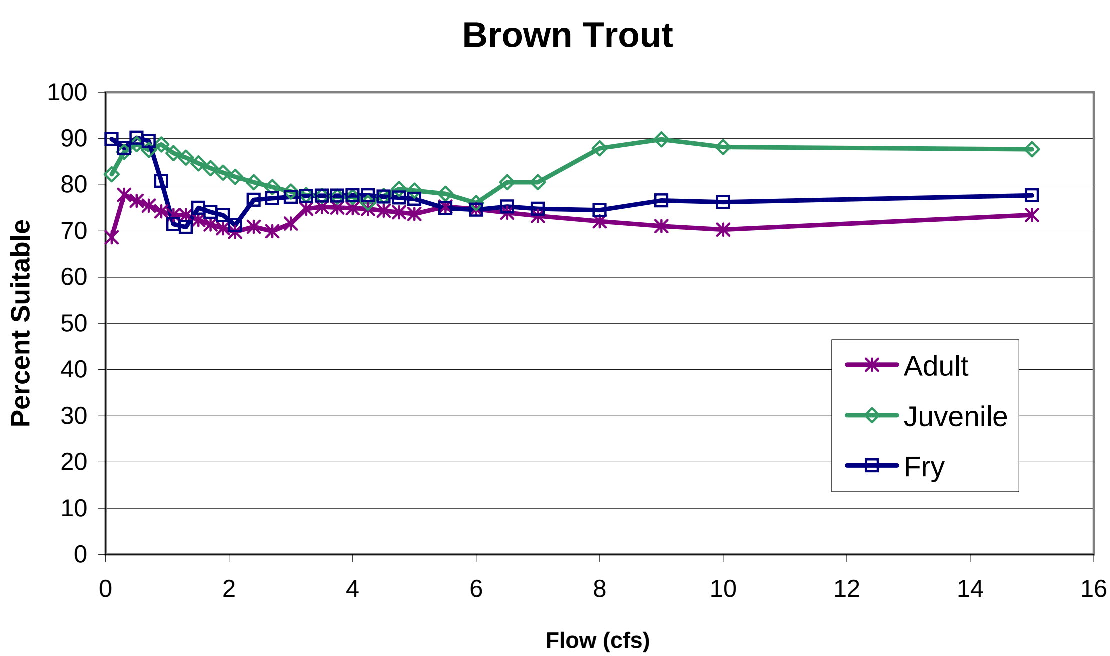
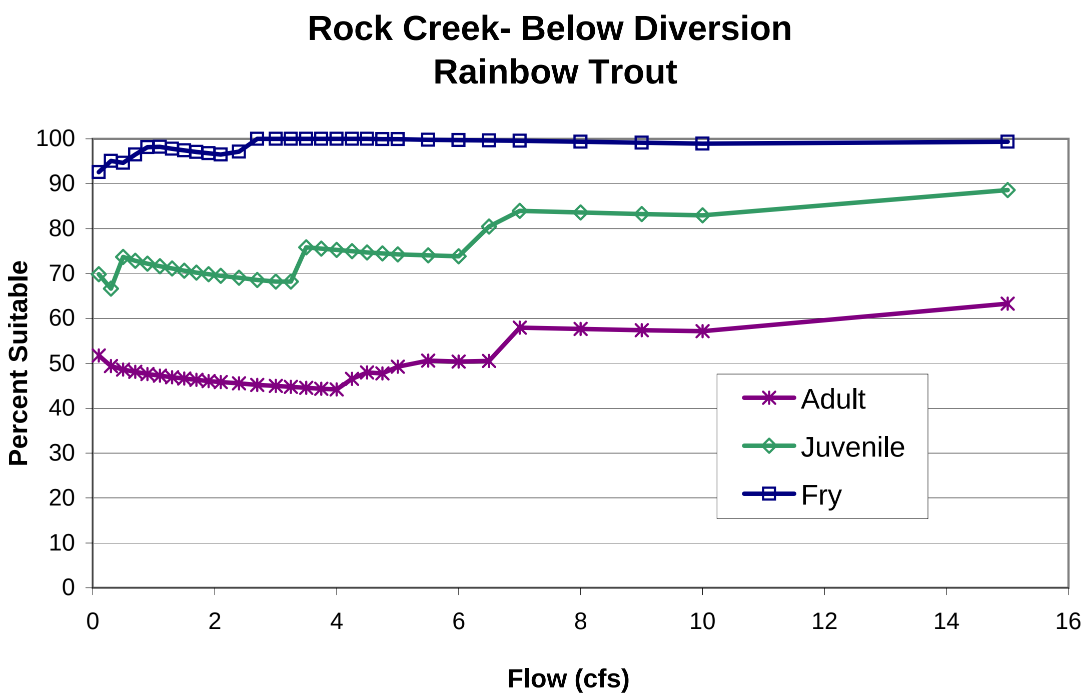


Figure CAWG 3-23. Depth Suitability for Rainbow and Brown Trout in Rock Creek Above Diversion.



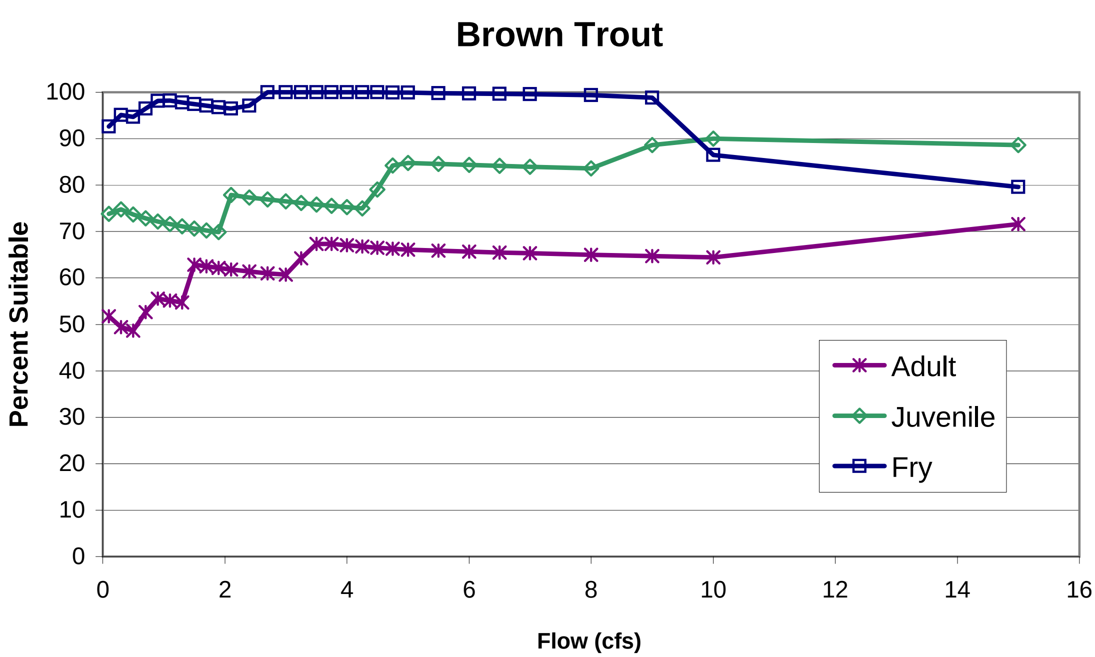


Figure CAWG 3-24. Depth Suitability for Rainbow and Brown Trout in Rock Creek Below Diversion.

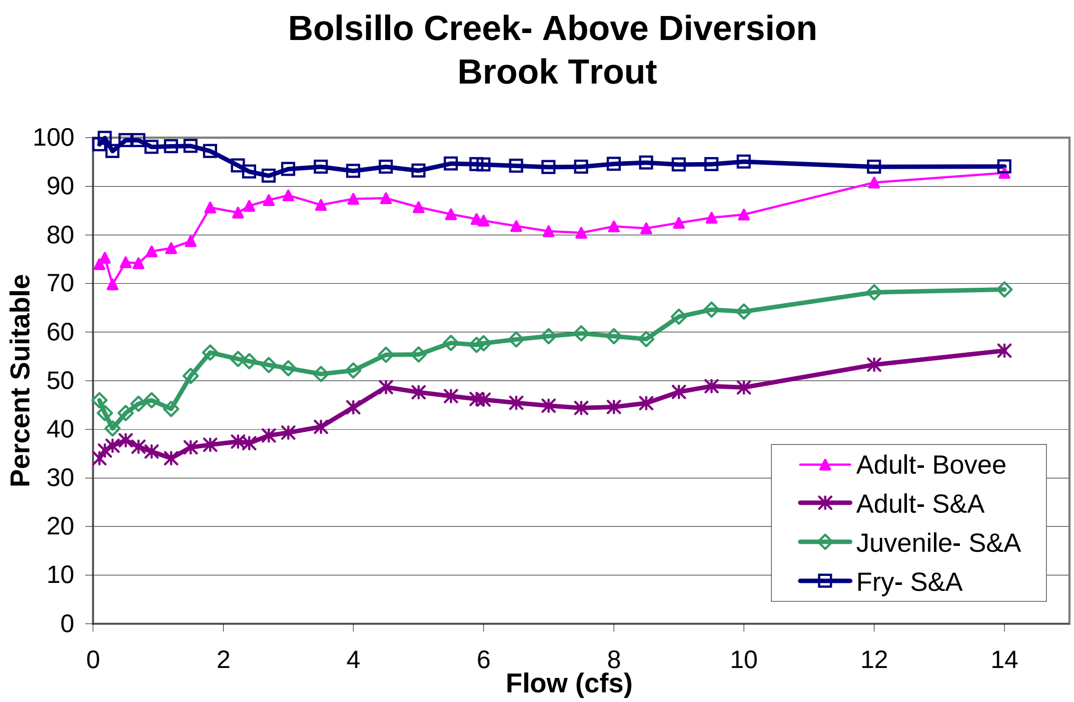


Figure CAWG 3-25. Depth Suitability for Brook Trout in Bolsillo Creek Above Diversion.

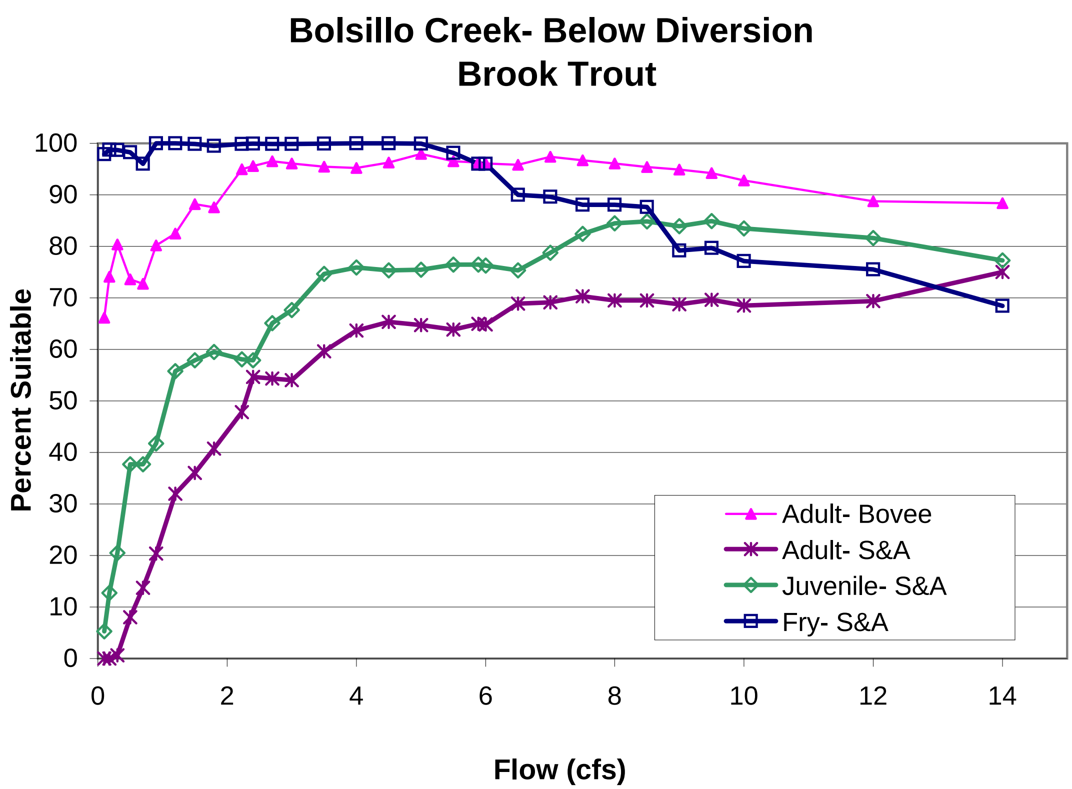


Figure CAWG 3-26. Depth Suitability for Brook Trout in Bolsillo Creek Below Diversion.