EXHIBIT 3-A

NORMANDEAU environmental consultants

Memorandum

Wednesday, March 11, 2015

TO: Larry Hampson, MPWMD
FROM: Mark Allen, Normandeau Associates
SUBJECT: Proposed Study Plan for Testing Transferability of Habitat Suitability Criteria in the Carmel River

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INTRODUCTION

Instream flow studies will be conducted in the Carmel River for assessing the potential effects of flow management alternatives on aquatic habitat for steelhead, *Oncorhynchus mykiss*, which are currently listed as Threatened in the Carmel River Basin (NOAA 2006). One important component of instream flow modeling is the Habitat Suitability Criteria (HSC), which are a description of the relative quality of aquatic habitat components, such as water depth, water velocity, substrate type, and instream or overhead cover, on a scale of 0 (not-suitable) to 1 (optimal), to the species of interest. HSC can be developed on-site or HSC can be 'borrowed" from studies conducted on other, preferably similar, watersheds. Although steelhead are widely studied along the west coast, very little HSC-specific data have been collected on streams draining the central or southern coast of California. HSC work conducted on the Big Sur River, approximately 20 miles south of the Carmel River, represents the only known source of recent HSC developed in this ESU (CDFW, in prep).

An early step in preparing for the upcoming instream flow assessment includes a determination of what HSC are most appropriate for use in the Carmel River. Will an existing source of HSC, such as those derived from the Big Sur River, be representative of steelhead habitat selectivity in the Carmel River, or will HSC developed from other locations, or from the Carmel River itself, be most appropriate? One way of answering this question is to conduct an HSC transferability test, which compares the performance of candidate HSC (such as the Big Sur HSC) in predicting the relative utilization of specific habitat locations in the Carmel River by steelhead. This is accomplished by collecting a limited dataset of habitat characteristics in the Carmel River where steelhead are either present (e.g., occupied positions) or are absent (e.g., unoccupied positions). Transferable HSC are those that will consistently predict a higher suitability value for positions that are occupied by steelhead versus those positions that are not occupied by steelhead.

Although HSC transferability protocols are not universally standardized, the most widely accepted methodology is based on techniques described by Thomas and Bovee (1993), including adaptations proposed by Groshens and Orth (1994). Both publications utilize essentially identical analytical procedures, and differ mostly in field application and the method of defining habitat quality from the candidate HSC curves. Following is a description of the field methodologies and candidate HSC selection and definition process proposed for use in this transferability study.

CANDIDATE HSC CURVES

Once the field data is collected, there is little additional time or expense in assessing the performance of a multitude of candidate HSC curves. Although measurement of depth and velocity data is a standardized procedure, methods of assessing substrate and/or cover characteristics is highly variable among HSC studies, and consequently some candidate HSC curves may require collecting alternative substrate or cover codes in order to specifically assess those HSC datasets.

This study plan proposes to test the transferability of the following steelhead HSC datasets:

1. Big Sur River (in prep)
    a. steelhead fry <6cm , juvenile 6-9cm, 10-15cm
    b. depth, mean column velocity, distance to cover
2. Bovee (Bovee 1978)
    a. steelhead fry, juvenile (no sizes defined)
    b. depth, mean column velocity, "Bovee" substrate code
3. Trinity River (Hampton 1997)
    a. steelhead fry <5cm , juvenile $\geq$5cm

    b. depth, mean column velocity
4. Clear Creek (USFWS 2011)
    a. steelhead fry <8cm , juvenile ≥8cm
    b. depth, mean column velocity, cover

As stated above, the Big Sur HSC is the only dataset available from small to medium coastal streams in California. The Bovee HSC is the "standard" HSC dataset that has been used or assessed over the past 30 years, and is thus included as a general reference dataset. The Trinity River and Clear Creek HSC are both from larger streams than the Carmel River, but most other California datasets are from yet larger rivers (e.g., the Klamath and mainstem Central Valley rivers). Depth and velocity HSC curves for each of the fry and juvenile steelhead datasets are shown in Figures 1 and 2, respectively. It is anticipated that review of this study plan will lead to the addition or subtraction of one or more candidate HSC datasets.

STUDY SITE SELECTION

Discussions with MPWMD biologists and inspection of habitat mapping data suggested that channel gradient, substrate composition, habitat type proportions, and riparian characteristics showed significant changes in the anadromous reaches below Los Padres Dam. Such differences in habitat availability could influence the transferability of candidate HSC; consequently, HSC transferability effort is proposed to be partitioned among three study reaches: the 8.4 mi Below Narrows (BN) reach (lagoon to Scarlett Well), the 10.3 mi Above Narrows (AN) reach (Scarlett Well to San Clemente Dam), and the 6.3 mi Inter-Dam (ID) reach (San Clemente to Los Padres dams).

In order to focus sampling effort within discrete areas feasible for random unit selection and reasonable access to sampling units, each of the three reaches were divided into approximately one mile sub-reaches. Two of the sub-reaches in the AN reach were subsequently excluded from selection due to the predominance of man-made features (e.g., numerous swim dams and bankside homes), one sub-reach was also excluded from the ID reach due to its remote location (a 1-1.5 hour hike). Finally, the uppermost one mile below San Clemente Dam and the uppermost one-half mile below Los Padres Dam were excluded from selection due to reservoir-induced reductions in water visibility, which would significantly limit effectiveness of direct observation (snorkel) surveys, particularly in deeper pools. Also, the sub-reaches below each dam displayed much increased gradient with narrow, confined channels that were significantly different than the remaining 20+ miles of Carmel River habitat.

One of the one-mile sub-reaches was then selected at random from among the eight available sub-reaches in the BN reach, one was selected from the seven available AN sub-reaches, and one was selected from the five available ID sub-reaches, for a total of three one-mile study sites.

Sampling within each study reach will then be conducted within randomly selected habitat units according to a habitat-stratified design. The CDFW Level-III habitat typing data was used to partition each habitat type into one of four habitat categories based on general depth and velocity characteristics, as follows:

Deep/Slow (D/S): pools with maximum depths ≥4 ft
Shallow/Slow (S/S): pools <4 ft deep or glides
Deep/Fast (D/F): runs or pocketwaters
Shallow/Fast (S/F): low-gradient riffles, high-gradient riffles, or step-runs

Sampling units will be selected randomly from within each of these four habitat categories according to an equal-area sampling design. The equal-area sampling design helps to account for the influence of habitat availability on the resulting HSC curves (or HSC transferability results) by ensuring that all possible habitat types are represented, and that variations in densities of steelhead fry and juveniles will be reflected in the resulting data. For example, if riffles (S/F) are sampled with the same effort (measured as surface area) as deep pools (D/S), and if densities of steelhead fry are greater in riffles than in pools, most of the HSC data will be representative of shallow and fast microhabitat, which reflects the fishes selectivity. In contrast, if a larger juvenile steelhead "prefers" deep/fast habitat, more HSC observations will occur in runs than in riffles or pools, thereby reflecting that life-stage's selectivity for areas that combine deeper and faster microhabitats.

A power analysis of HSC transferability data indicated that reliable test results required a minimum sample size of at least 55 observations of locations were the target species/life-stage were present (e.g., an "occupied" position), and at least

200 observations of locations where the species was not present (e.g., "unoccupied" positions). Consequently, available information on densities of steelhead in the Carmel River (provided by MPWMD biologists) was used to estimate how much habitat was required to achieve these minimum sample sizes for transferability testing. Mean densities of steelhead (fry and juvenile sizes combined) were calculated for each of the three reaches using data from 2006 and 2012, which were recommended as representing years with "average" densities. Mean channel widths were combined with the mean fish densities to estimate that approximately 4,000 to 5,000 ft^2 of sampled habitat may be necessary to achieve a minimum of 55 observations of steelhead fry and 55 steelhead juveniles in each reach. This area divided among the four habitat categories gives an estimate of 1,250 ft^2 per habitat per reach.

Measurements of fish focal positions (e.g., "occupied" positions) and measurements of habitat availability (e.g., "unoccupied" positions if not proximal to occupied positions) will be made along a series of three cross-sectional transects within each sampling unit (fewer for short units). Four habitat units of each habitat category with three transects per unit should result in the above sampling area goals, assuming fish densities and channel widths similar to 2006/2012 and a habitat availability measurement taken at approximately three ft intervals along each transect. Transects will occur within the lower, middle, and upper thirds of each sampling unit using systematic sampling with a random start, while maintaining a minimum of 15 ft between transects to ensure that fish observations made at one transect will not influence fish distributions in the next transect upstream.

Deep pools may be sampled using a different approach by first defining the extent of pool "head" (where velocities are present), pool "body" (typically including the deepest locations), and pool "tail" (area with decreasing depth and increasing velocity). Pool "body" transects may be intentionally placed across the deepest portion in order to better define steelhead's selectivity for deeper habitats, which are rare in smaller coastal streams. A maximum of three transects will be surveyed in each selected habitat unit to ensure that sampling effort is distributed among many individual habitat units, rather than all being placed in a few larger units.

The "effective search area" surveyed by a diver will be estimated as the length of a selected dive transect (left to right bank) times the search width, or distance upstream and downstream of the transect that the diver can effectively see a steelhead (estimated at each habitat unit). These sampling areas will be cumulatively totaled until the equal-area objective is achieved, at which point the cumulative number of occupied (55+) and unoccupied (200+) locations will be tallied to determine if the sample size goals are met.

The actual number sampling units per habitat category, or the number of transects per sampling unit, may be adjusted upward or downward from the above proposal depending on the fish densities and channel widths actually present during sampling in 2015, with the objective of producing a minimum of 55 occupied and 200 unoccupied measurements in each reach for both fry and juvenile steelhead.

FIELD DATA COLLECTION

When the transect interval is determined for a particular sampling unit, one diver carefully enter the transect and progress across the channel while scanning the water column for undisturbed steelhead. The focal position of each observed fish will be marked with a numbered lead weight and the following data will be transmitted to a downstream data recorder (or in some cases an underwater slate):

- fish species (assumed steelhead unless otherwise noted)
- fish size (cm FL, with reference to a wrist-mounted ruler)
- fish behavior (feeding, holding, roaming, disturbed [not sampled])
- focal height (distance above bottom or percentage of total water depth)

Microhabitat data will not be measured for fish that appear to have been disturbed or displaced prior to identification of its focal position. After each of the habitat unit's transects have been surveyed, the crew will relocate each marker and record the following information:

- water depth
- mean column velocity
- substrate type (using a code consistent with candidate HSC)

- cover type (using a code consistent with candidate HSC)
    - cover may be recorded during the dive if appropriate

Mean column velocity will be measured using standard USGS procedures. The substrate and cover coding systems used in this study will be designed to be comparable to the codes used for the candidate HSC curves being validated. Dive times and photographs will be taken at each sampling unit. Water temperature and water visibility will be measured periodically; streamflow will be taken from the nearest gage.

Measurement of habitat availability data and determination of "unoccupied" positions will be conducted after collection of fish focal (or, "occupied" position) data. Measurements will be collected using the same variables and methodologies as described above at approximately three foot intervals across each transect, using a random start point of 1, 2, or 3 ft from the nearest bank of the initial transect, then continuing at three foot intervals along each of the sampling unit's three transects. In addition to the above data, if any fish focal positions, as indicated by the deployed markers representing occupied positions, occur within two feet of the habitat availability point, that location will not be classified as "unoccupied" since the presence of the proximal fish may have restricted use of that position by other fish. If an availability point is more than two feet from any fish focal position, it will be classified as an unoccupied position for the purposes of the transferability analysis. It should be noted that all of the habitat availability data points can be used in a subsequent effort to develop new HSC, if that alternative is adopted.

SAMPLING PERIODICITY

This study plan proposes collection of HSC transferability data during two time periods: spring (April or May) and summer (June or later, depending on flow). The spring surveys will be conducted to yield data on small steelhead fry shortly following emergence, at which time they are highly limited in the depths and (especially) velocities they can tolerate. All juvenile steelhead observed during the spring survey will also be assessed. The summer survey will be conducted to assess habitat selectivity and HSC transferability when flows are somewhat more restricted and water temperatures are higher, two variables that are expected to influence habitat choice.

TRANSFERABILITY TESTING PROCEDURES

One of the first tasks in conducting a transferability test is to define the ranges of depth, velocity, or substrate/cover that will be used to represent "optimal", "usable", "suitable", and "unsuitable" habitat. These range definitions can vary among transferability studies, and the method for determining them also differs depending on the candidate HSC. The Thomas and Bovee (1993) protocol calculates these definitions using a ranked listing of the raw microhabitat data from the candidate HSC, by setting the central 50% of observations to represent "optimal" habitat, the central 95% to represent "suitable" habitat, and the intermediate range (between 50% and 95%) is considered "usable". All observations outside of the central 95% are thus considered as "unsuitable". This protocol is only feasible when the original or raw HSC data is available for the candidate HSC, which is possible for the Big Sur HSC, but not for the other candidate HSC datasets listed above.

Consequently, the alternative method of defining suitability ranges proposed by Groshens and Orth (1994) may be preferred, where the optimal, usable, suitable, and unsuitable ranges are based on the final HSC curves, not on the raw data. If multiple candidate HSC datasets are considered for testing, as proposed above, this study plan proposes to define the suitability ranges using the final HSC curves, as described in Groshens and Orth. If, following review of this plan, only the Big Sur HSC is considered for testing, the transferability study can utilize the ranked, raw data to define ranges as per Thomas and Bovee.

Groshens and Orth (1994) used final HSC curves from candidate datasets to define the suitability ranges as:

- "Suitable" = the range in habitat having HSC suitability >0
- "Unsuitable" = the range in habitat having HSC suitability = 0
- "Optimal" = the range in habitat having HSC suitability ≥0.7
- "Usable" = the range in habitat having HSC suitability between 0 and 0.7 (labeled as "marginal" in their paper)

The Groshens and Orth definitions are similar in nature to the ranked range definitions suggested by Thomas and Bovee, except that the latter considered observations at the extreme ends of the distributions (e.g., the 2½% on each end) as being fish in "unsuitable" habitat, whereas Groshens and Orth considered anywhere that fish were observed as being "suitable" (as defined by the HSC curves). The Groshens and Orth definitions listed above are proposed for use in the Carmel River transferability study, however subsequent review of this study plan may lead to different definitions.

Both transferability methodologies used paired 2x2 contingency tables to assess the relative frequency of occupied and unoccupied locations that were calculated (by the tested HSC) to be suitable, unsuitable, optimal, or usable. These tests determine whether a particular HSC curve would show a significantly higher proportion of occupied locations in optimal vs usable locations, and likewise a higher proportion of occupied locations in suitable vs unsuitable locations. Tests were made using all measured habitat attributes, or just using depth and velocity attributes. In general, it is expected that the more variables used in a test the less likely an HSC dataset will successfully transfer. This study plan proposed to conduct transferability tests using all habitat attributes as well as depth and velocity only.

COST ESTIMATE

The estimated costs include $6,000 for study planning, $30,000 for field work, and $9,000 for Data Analysis and interpretation for a total cost of $45,000. These costs assume similar fish densities and channel widths as encountered during 2006 and 2012, which were considered "average" years (it should be noted that fish densities may be significantly less in 2015, due to the small number of adult returns in 2014 and 2015). The cost estimate also assumes that Normandeau will provide a biologist and that MPWMD will provide a technician to form one field crew, and a second crew will be supported by CDFW (with no cost to MPWMD). Given the above assumptions, it is expected that six days of sampling in the spring and six days of sampling in the summer will meet sample size goals for testing transferability within each of the three reaches.

LITERATURE CITED

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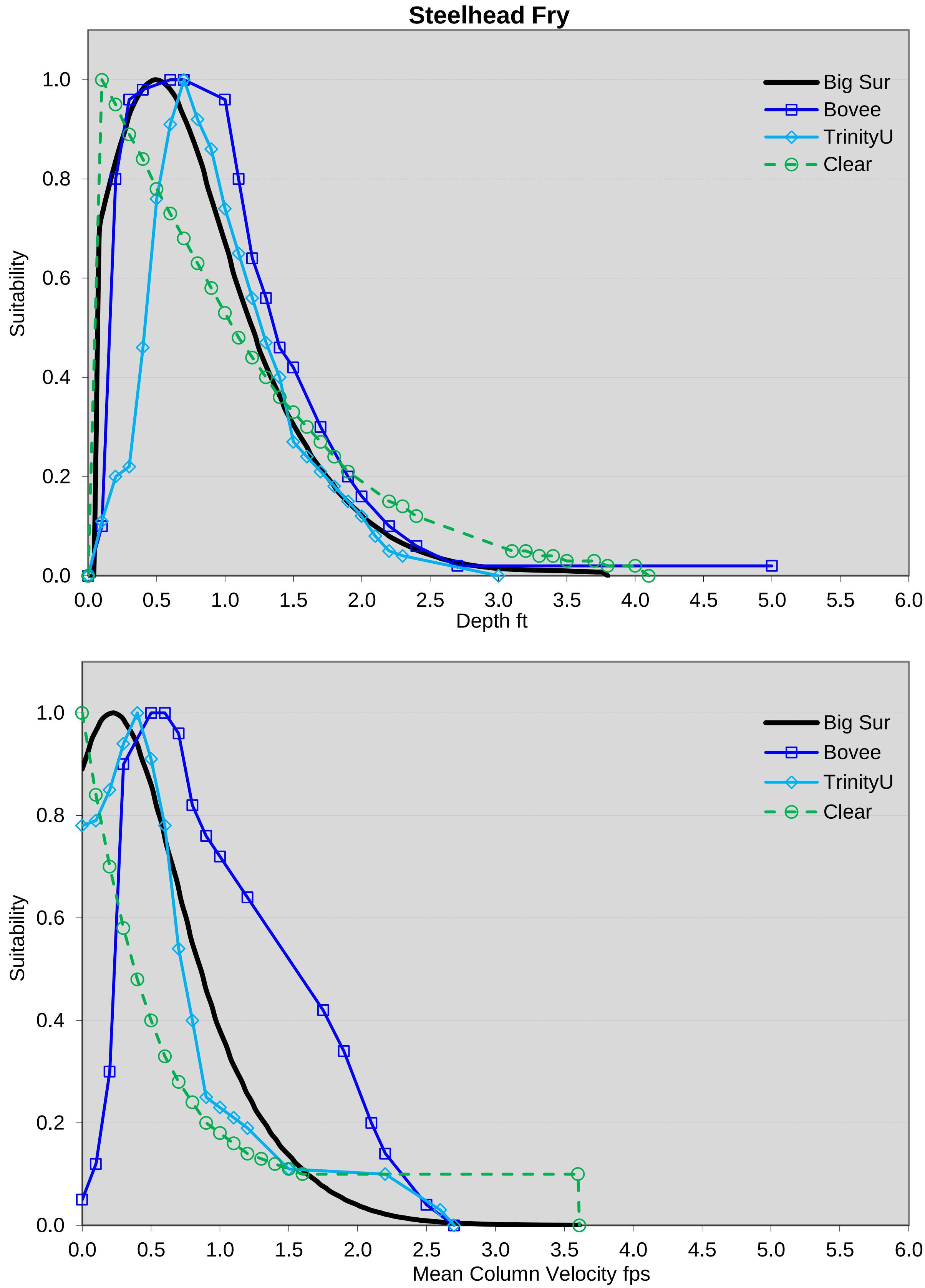

Figure 1. Candidate HSC curves for steelhead fry.

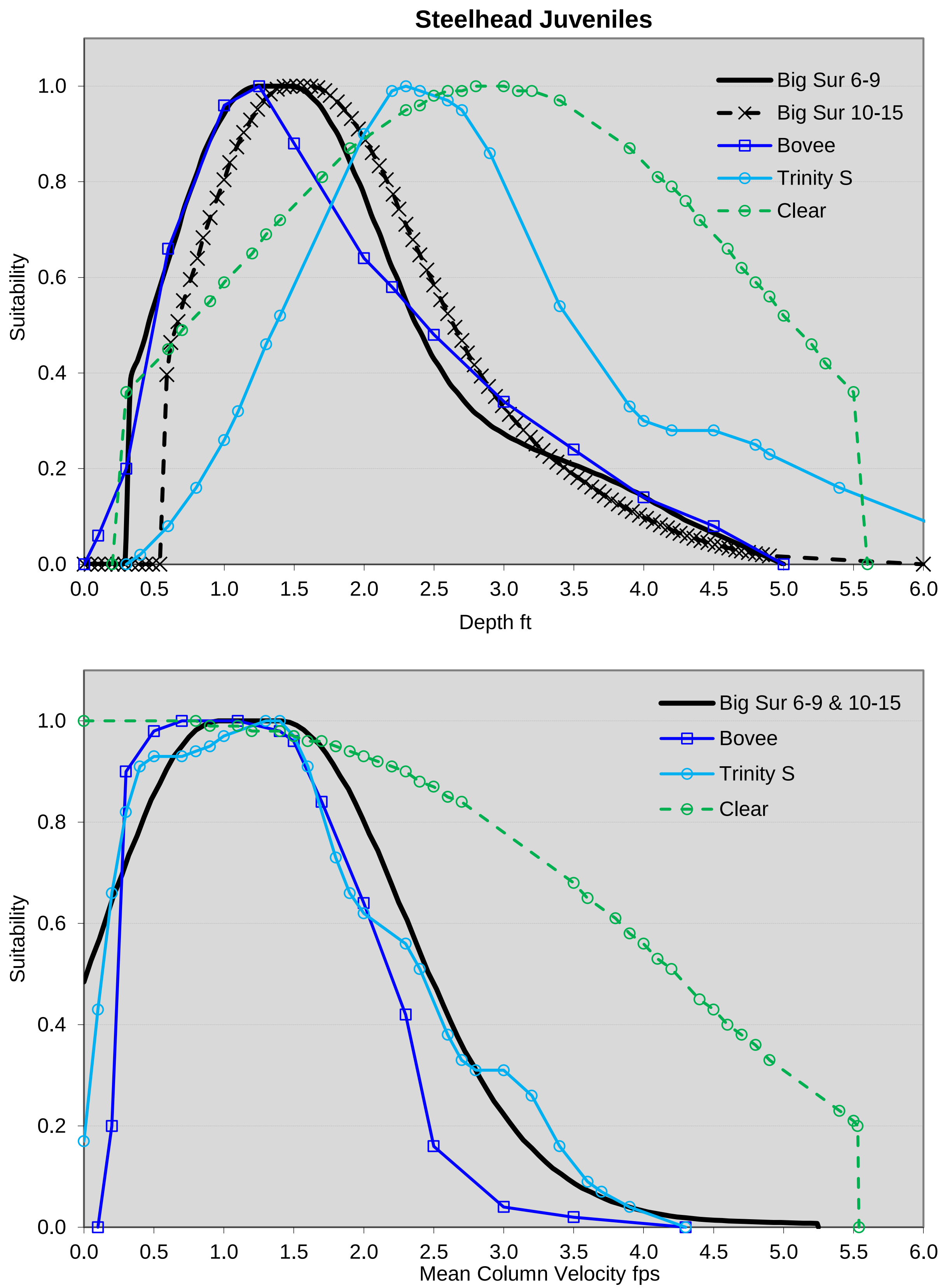

Figure 2. Candidate HSC curves for steelhead juveniles.