Cooper Creek Draft PHABSIM Model Review
R2 Resource Consultants

Phase	Item	Features	Relevance	How to Resolve	Affected Sites	Affected Trips	HDR/Chugach Response	Adjustment to Model
Data Collection	1	Velocity and depth data were collected at only 8 to 15 wetted verticals in each transect.	Sufficient verticals are necessary for accurate habitat modeling and flow measurement. Each cell should not have more than 10% of the total flow for accurate flow measurement.	Either accept the measurements as being somewhat inaccurate or collect velocity and depth data at more than 25 wetted verticals	all sites (Site A to Site L)	Trip 1 & Trip5	Many cross-sections had more than 8-15 wetted cell measurements, some as many as 20. Numbers of vertical measurements increased with stream width and flow; placement of verticals depended on channel geometry and flow/velocity conditions.	None.
Data Collection	2	No flows were measured at any of the sites during Field Trips 2, 3, and 4.	Flow measurements are needed to develop stage/discharge rating curves and to develop relationships between Weighted Usable Area (WUA) and flow.	Provide explanation of how flows were developed for each site for each of the five field trips.	all sites (Site A to Site L)	Trips 2, 3, and 4	For Trips 2, 3, and 4, flows were estimated using the Haested Methods FlowMaster Software (v. 6.1). Channel geometry, energy slope, and water surface elevation data were entered into the program to estimate flows at each cross-section. Output was averaged when appropriate across the study site, and compared to known data at the USGS gage for Study Sites I, J, K, and L, and at the project flow gage for Study Sites E and F. Flows were directly measured in Trips 1 and 5.	The decision was made to limit the water surface elevation and velocity calibration to Trips 1 and 5, for which individual cross-section flows were collected.
Data Collection	3	Longitudinal WSE slope was not surveyed	Longitudinal slope is needed to judge the quality of hydraulic simulations based on cross-sectional Manning's "n"	Survey WSE over a distance of at least 20 channel widths, or estimate slope from 1:24,000 scale topographic maps	all sites except Site K	Trip 1 to Trip 5	Longitudinal water surface slope can be determined from the water surface elevations of the upstream and downstream cross-sections. The distances between all cross-sections within a study site are known. Most sites provide sufficient distances between the upstream and downstream cross-sections to accurately estimate longitudinal slope using this method.	Collected longitudinal slope data were used in adjustment of water surface elevations and measured discharges.
Data Collection	4	Level loops were not surveyed for all site visits.	Surveyed WSE and ground surface elevations rely on vertical control established at each site. Inconsistencies in surveyed WSE's can sometimes be traced back to a site benchmark or control pin that have been disturbed. Level loops are needed to ensure some level of redundancy in vertical control at each site.	Survey a level loop at each site to ensure that no pins have been disturbed.	all sites	all trips	Level survey was conducted at each site on each trip. Level loops were conducted and closed within reasonable margins of error for many of these measurements. While loops were not conducted at each site, the benchmarks were considered stable by the survey crew with the exception of TBM K-B, which was not used for survey after the first trip (explained in item #7).	None.
Data Collection	5	Unclear how WSE was measured and what was done to ensure plumb surveying rod	Potential error in WSE data.	Describe procedure used to survey WSE.	all sites	all trips	Level survey protocol included the assurance that the rod was plumb on all vertical shots. The level operator determined if the rod was plumb by using vertical cross-hairs. With the distance from the level at which the water surface elevation measurements were taken, the maximum elevation error that could have occurred if the rod was slightly out of plumb was about 0.01 ft.	None.
Data Collection	6	Velocity meter calibration results were not provided.	To ensure the accuracy of measured velocity.	Perform calibration for each meter used in the data collection. Develop correction curves and apply corrections to the velocity data.	all sites	all trips	The velocity meters used in this study were calibrated in the factory immediately prior to the first data collection trip.	None.
Data Collection	7	Significant BM elevation change; BM-B of site K changed 0.05ft in two trips.	BM elevation accuracy is the basis of modeling. Inaccurate BM will not warrant successful hydraulic modeling.	Surveyed WSEs may be inaccurate and should be used with caution.	K		During field trip #3 on 9/17/2003, a change in TBM elevation was noticed at study site K. Only two TBMs were set at each study site, so it can be difficult to tell where the error occurred. However, in this case, the cause of the problem was fairly obvious. TBM K-A was a 6-inch spike set in a 16-inch diameter spruce on the northwest bank (downstream left) of the creek. The bank was showing signs of erosion and possible slump. The level loop showed a 0.05' change from the previous trip on June 24 earlier that year (an assumed decrease in elevation of TBM K-A). TBM K-B showed no signs of change from the previous trip. It was assumed that the bank erosion contributed to the decrease in elevation of TBM K-A, and since there was no reason to assume bank erosion would stop, TBM K-A was not used for level surveys in field trips 3 and 5.	None.
Data Collection	8	Flow (velocity-depth) and WSE were determined from data collected on different days.	WSE's and flows measured on different days should not be used together in the calibration. This might result in serious errors.	Use measured water depths and surveyed bed profile elevations to estimate the WSE for the day that the flow was measured.	G,H	Trip 1	During Trip 1, the velocity meter stopped working on May 14 and the field crew did not have a backup. As a result, velocities could not be measured on May 14 at Study Sites G and H. The field crew returned to the sites the following day to collect velocity data. Water surface elevations were collected on both days. Calibration for study sites G and H should use the measured flow water surface elevations on May 15.	Water surface elevations collected on May 15 were used in water surface elevation and velocity calibrations.

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Data Collection	9	Substrate grain size was measured from a single sediment particle selected from each vertical.	Substrate size is important for quantifying spawning habitat. It is normally determined from a visual assessment of dominant (and sometimes subdominant) substrate from an area of the channel bed representative of the vertical.	Provide a description of the procedure used to select the sediment particle from each vertical. If necessary, reassess substrate size using the visual technique.			At each vertical, a visual technique was utilized in which field personnel selects the substrate size that most closely represents the substrate size in the immediate vicinity (relative to neighboring verticals and about a foot upstream and downstream of the cross-section). This was deemed more accurate than using a visual technique for incongrous "regions" of the cross-section. The size of the particle was measured using a Wolman Pebble Meter, sometimes called a "gravelometer," that returned the upper and lower bounds of the intermediate axis. This range of intermediate axis corresponded with the substrate codes used in the model. A table (separate to this document) was developed to show this relationship.	None.
Data Collection	10	The sediment size ranges on the gravelometer do not match the size ranges used for PHABSIM studies on Falls Creek and on Ward Creek in Alaska.	Substrate size is important for quantifying spawning habitat.	Provide a list of the size ranges used for the PHABSIM model and how they can be determined from the size ranges of the gravelometer.			See comment for item #9.	None.
Data Entry	11	Differences in WSE across transect not treated consistently when determining what values to enter into data decks. Some transects used average WSE, while the others used specific WSE.	Error in stage-discharge regressions	Need clarification/development of a consistent process to determine which WSEs are used at each site, and why specific WSEs were used; re-check data entry	F, E	Trip 1	Average water surface elevations were consistently used for all field trips. All data points were used except when professional judgment was used to eliminate an outlier at an improperly located measurement point (e.g. top of a wave, on a high water terrace with little flow).	Professional judgment of water surface elevations was used in a subsequent review of the final model data entry
Data Entry	12	The WSE's adopted for the model do not match the surveyed WSE's.	Accurate WSE's are needed to develop stage/discharge relationship and to quantify habitat.	Correct the error or provide explanation for the difference.	A, B,C, E, G, I, K,L	Trip 1	See comment for item #11.	See comment for item #11.
Data Entry	13	Velocities were not entered correctly in the data decks.	Predicted velocity distributions will not match the measured velocities and the habitat quantification will be inaccurate.	Check data entry and make correction.	A, B, C, D, E, H	Trip 1	This correction will be made in the final model.	The correct velocities were entered for all cross-sections in the final model.
Data Entry	14	Velocity profile of TR B-4 (Trip 1) was one station off.	Predicted velocity distributions will not match the measured velocities and the habitat quantification will be inaccurate.	Check data entry and make correction.	B	Trip 5	This correction will be made in the final model.	The correct velocities were entered for all cross-sections in the final model.
Data Entry	15	Bed elevations were not calculated correctly, or stations were nor entered correctly. Differences in transect profiles were detected between the 7/20/04 version of the model and the 8/9/04 version of the model. For example, Sta=26.6 in TR L-4 is missing in the 8/9/04 model.	Predicted depths and velocities will not match the measurements and the habitat quantification will be inaccurate.	Check data entry and make correction.	A,B,C,D,E,F,G,H,J,K	Trip 1	Station 26.6 does not exist in cross-section L-4 in either model. The two models should be the same with the exception of the Mannings n data. The model sent to R2 and ADFG on 8/9/2004 should be utilized for review and to build the final model. Differences betweeen the 8/9/2004 model and the previous model should be documented and investigated to produce the most accurate product.	Final model input was compared to field measurements and any discrepancies were corrected .
Data Entry	16	Not all measured WSE data were used in the modeling	More survey data can increase the reliability of hydraulic and habitat modeling results.	Include all valid measured data in the modeling.	E, I,J,K,L	-	See comment for item #11.	See comment for item #11.
Data Entry	17	WSE's of Trip 1 are inconsistent with the WSE's of other trips in several of the 12 sites.	Accurate WSE's provide the foundation for a good hydraulic calibration. Unrealistic WSE's will result in questionable hydraulic and habitat simulations.	Calculate WSE's using water depths and bed surface elevations at all measured stations.	A,C,D,E		At several stations in trip #1, water surface elevations were measured near the stream margins when appropriate (i.e. not when there was an elevated terrace).	Measured depths and stream bed elevations were used at some cross-sections to estimate water surface elevations when the validity of the surveyed water surface elevation was questionable.
Data Entry	18	Transect profiles were not developed from data collected from different site visits. The stability of channel morphology could not be determined.	A stable channel morphology is critical for the PHABSIM model in order to utilize data collected from multiple site visits. The PHABSIM model developed for Cooper Creek is based on the assumption that all transects were stable during the entire survey period from May, 2003 to May, 2004. This assumption requires verification.	Calculate a transect profile from the WSE's surveyed and the flow depths measured during Field Trip 5. Compare with the transect profile surveyed during Field Trip 1.	all sites	all trips	Cross-section bed profiles were measured using level survey on the first trip in May 2003. Subsequent trips did not include the verification of bed profiles. The cross-sections were set in relatively stable areas with little or no evidence of frequent bed transport or deposits, including colluvial material. No "channel building flows" occurred in the stream between the time the cross-sections were set and the final field trip. A geomorphic investigation was undertaken as a component of the instream flow study; this study concluded the channel is "roughly in equilibrium with the current hydrologic and sediment delivery regimes."	The final model transect profile was developed from the measured flow depths in Trip 5.
Data Entry	19	Surveyed WSE's indicate water flowing uphill within a site.	Incorrect WSE will reduce the habitat model credibility.	Check data collection procedures and check instrument accuracy.	F,G,H		In some cases, water surface measurements showed a higher elevation downstream than upstream. This is not indicative of "water flowing uphill," rather it is likely a result of local turbulence and highlights the difficulty of water surface measurements that are located in close proximity. For example, only 8 feet separate the three cross-sections in Study Site F. Modeling is made more difficult with measured data like this.	For situations where water was measured as flowing "uphill," each water surface profile at each study site was inspected. When feasible, the water surface elevation was recalculated using the geometry station elevation and the measured depth. If this did not correct the problem, no further action was taken, and the flow was avoided during calibration, if possible.

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Data Entry	20	Calculation of measured WSEs was inconsistent; some were calculated using measured water depths, while others were calculated without using measured water depths.	WSE accuracy is low. Calibrated hydraulics not credible.	Include all measured water depths in the WSE calculation.	A	1	See comment for item #11.	See comment for item #11.
Data Entry	21	Difference between predicted WSE and average measured WSE greater than 0.3ft.	Low calibration credibility.	Provide reason to justify the significant WSE difference between measured and modeling WSEs.	A,C,D,H,J,K,L		Final model calibration will strive to match measured water surface elevations.	New calibration resulted in study sites with calibration error less than 0.10', with the exception of Site J (0.14' for Transect 1, Trip 1), Site K (0.33' at Transect 2 and 0.14' at Transect 3 for Trip 5) and Site E (0.19' to 0.22' for Trip 1).
Data Entry	22	Difference between measured right WSE and measured left WSE greater than 0.2ft.	Large differences indicate rough water in a steep channel, high velocity flow through a bend, or survey errors.	Check photos to validate the significant difference.	A, C, E, I, L	1	In the case where a cross-section possessed a very turbulent character, many water surface elevation measurements were taken to average the elevation across the section. Some measurements were taken at the crests of waves and others were taken in the troughs; the difference between these elevations could easily be 0.2 feet.	See comment for item #21.
Data Entry	23	Transect not perpendicular to stream direction ("~25 degree angle upstream")	Over-estimated discharge.	Use calibration and modeling results with extreme caution.	K		Flows were not calculated at this cross-section using measured data.	Flows were calculated using other cross-sections in the Study Site.
Data Entry	24	Measured flows were not used in the modeling; source of modeling flows were not available.	Generally site-specific measured flows are used for calibration, because it reflects the actual flow condition.	Document the source of flows for each site, and compare to the measured flows for validation.	all sites	.	See comment for item #2.	See comment for item #2.
Calibration	25	Not all VAF's and/or Fr (Froude number) increase monotonically with Q	Can be indicative of real phenomenon (e.g., a low terrace with vegetation becomes inundated at intermediate flows) or prediction error in the WSE calibration.	Need documentation of each case where VAF/Fr does not increase with Q, and reasons why. If due to prediction error, need to revise Stage-Q relations for affected transects	A,F,G,H,I,J,K		VAFs are not expected to behave monotonically with discharge; normally VAFs increase with discharge to account for the decrease in roughness factor as depth increases. This does not always occur; however, as normal stream geometry might invert this relationship. A description of each transect is not necessary, but some analysis would be helpful in the calibration process to identify problematic flow-water surface elevation relationships.	In the final calibrated velocity model, VAFs and Froude numbers increased with flow at most cross-sections; the few cross-sections (A-2, E-3) for which this relationship was not seen had odd physical situations (low terrace at E-3, consistent water surface elevation eccentricities at A-2).
Calibration	26	Predicted stage/discharge curves from different transects within the same site cross each other.	Raise doubt of modeling accuracy. May not be a problem if the flow at which the two curves cross differs greatly from the flow claim.	Change method of WSE calibration; review WUA-Q curves and address as/if needed	H		The "cross-over" occurs at the lowest modeled discharges and is a result of measured data where a slightly lower water surface elevation was measured at a higher flow.	The final model calibration solved this problem.
Calibration	27	WSE calibration error > 0.1ft	Undermines the credibility of hydraulic modeling.	Change WSE calibration method. Check WSE calculation. Check WSE survey procedures.	A,B,C,D,E,F,G,H,J,K,L	-	Final model calibration will strive to match measured water surface elevations.	See comment for item 21.
Calibration	28	WSE calibration error > 0.3ft	Results of hydraulic modeling become even more questionable.	Change WSE calibration method. Check WSE calculation. Check WSE survey procedures.	E,L		Final model calibration will strive to match measured water surface elevations.	See comment for item 21.
Calibration	29	Manning's n not specified in input data decks	No adjustments made to velocity predictions to reflect location specific features that may affect accuracy of prediction at other flows; can result in smoother than actual velocity distributions when extrapolating downwards, rougher than actual when extrapolating upwards	Review all velocity predictions and treat accordingly	all sites/transect except transect A-1		Manning's n roughness values are calculated in the hydraulic models and were used in the calibration process to identify "problem areas." Beta values and RMODS manipulated roughness values in the MANSQ and WSP models, respectively. Minimum and maximum roughness values were set in calibration when necessary.	Mannings n values were entered for all "edge cells" and some overbank cells at all cross-sections.
Calibration	30	Two calibration methods used in the WSE modeling for different range of flows without proper smoothing.	There is a discontinuity in hydraulic calibration results. The discontinuity represents significant errors in hydraulics. The habitat modeling using the affected hydraulics would not reflect the realistic habitat condition.	Use smoothing method with proper weighting to remove the discontinuity and to obtain a reasonable stage vs. Q relationship.	C,G,H		Smoothing can be done in the final model calibration.	The final model included smooth transitions of water surface elevations predicted by the MANSQ model at the downstream transect and WSP for the upstream transects.
Calibration	31	Cannot fully judge adequacy of stage-discharge predictions and whether a measurement error may have occurred without computing predicted transect Manning's n value for all simulated flows.	Cannot judge adequacy of hydraulic calibrations or use Manning's n vs. Q plots to determine potential errors in calibrations that might need fixing	Calculate transect hydraulic roughness "n" with Manning's equation for all simulated flows using hydraulic parameters, including WSE, wetted perimeter, average velocity, longitudinal WSE slope, and flow conveyance area.	all sites		Comment noted. Using Manning Equation to develop independent "check" on discharges at the downstream cross-section (as MANSQ uses the Manning Equation as numerical model) is useful but not crucial to model calibration.	Mannings n values were compiled, graphed, and inspected for all final model cross-sections using independent Manning Equation calculations.
Calibration	32	Calibrated velocity profile does not resemble measured velocity profile.	Calibrated velocity profiles are used to simulated velocities for all flows, and it needs to resemble the measured profile for reasonable simulation and habitat quantification	Adjust cell Manning's n values to allow measured and calibrated profiles to be similar.	A,B,C,E,I,J,K		Procedures were taken in final velocity model calibration to correct this problem at the few cross-sections in which this occurred.	Mannings n adjustments resulted in reasonable velocity calibrations at all study sites.
Calibration	33	Depth was used to estimate/calibrate velocity at the measuring stations.	The calibrated velocity profile will be similar to the water depth distribution of the transect. Low credibility of velocity calibration.	Use measured velocity as the template for calibration.	C	5	In Trip 5, velocity data were inexplicably lost at cross-sections C-2 and C-3. Measured velocity data were not entered as input for these cross-sections.	The Trip 1 measured velocities were used for calibration of Transects 2 and 3 in Study Site C.
Calibration	34	Virtually no Manning's n was calibrated for stations at or near water edges.	Unrealistic simulated velocities at edge of water for flows greater than the calibration flow.	Use suitable Manning's n value at edge of water for calibration flows.	all sites		In some cases,minimum and maximum Mannings n values were specified in velocity calibration in leiu of specifying values at individual cells when predicted values were unreasonable.	In the final model, Mannings n values were entered for all "edge cells" at all cross-sections. No n values were entered for the main channel, allowing the model to compute these values.

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Calibration	35	Only one set of velocity profile was used in velocity calibration; some transects had more than one set of measured velocity.	More sets of velocity profile will increase the credibility of habitat modeling.	Use all measured velocity profile in velocity calibration and habitat modeling.	all sites		Velocity data were collected at 10 of the 12 study sites at high flows (all but sites G and H). At sites F and L, professional judgment was used in the decision to not use these data in the model. Several cross-sections and study sites had highly turbulent flow with significant vertical and diagonal velocity components that could not be measured with the velocity meter and could not be modeled in PHABSIM. The decision was made in these cases to not use the velocity data for the high flow trip because it would likely produce unreliable output.	One-flow velocity calibration was performed for Study Sites F, G, H, and L; two-flow velocity calibration was performed for the remaining sites.
Habitat Modeling	36	The option to set the Channel Index in all cells to 1.0 was selected.	A wet cell that is non-suitable (SI=0.0) becomes fully suitable (SI=1.0), and spawning habitat area will be over-estimated. No effect on the habitat area of other life stages.	Do not select the option to set the Channel Index in all cells to 1.0 and re-run the habitat model.	All sites		This comment has ramifications for spawning WUA. The change will be made in the final model.	Habitat modeling was done with this option not selected.