Exhibit A of Task Order 2
2005 Statement of Work:
Colorado River flow Relationships to Aquatic Habitat
And State Threatened Species: blue sucker
Vendor: Bio-West, Inc.

Date: April 1, 2005

Colorado River - Aquatic Habitat and Water Quality
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Draft Comments

1. Overview

Page 1, Study Objective, 2nd bullet. This objective does not read in a meaningful manner, was a word such as "determine" omitted - ...blue sucker to "determine" the degree that...

Task 3 – Intensive Site – Physical Data Collection
Subtask 3.10 – Hydrodynamic Model Calibration

Page 8, Task 3, Subtask 3.10 - Hydrodynamic Model Calibration: In the first sentence or two the standard process of calibrating a model followed by its subsequent verification is explained. It appears from further description that the focus of this subtask must only be collecting data for calibration. By absence of any discussions of actual verification of the model in this subtask (or subtask 7.20), SRP wonders whether there is truly a verification planned. Further elaboration on this important aspect of model development should be incorporated in the SOW. It appears that Subtask 7.20 - Hydrodynamic Model actually envisions a calibration process without a verification process. Again, such may be appropriate for the process of model developed envisioned for this project, but present wording is confusing.

3) Within the same Subtask 3.10, collection of velocity data to "validate" the model is mentioned. What does the word "validate" mean in this usage - is it part of calibration or verification?

Subtask 3.30 – Sediment Transport

Page 10, Task 3, Subtask 3.3 - This section of the task order describes sediment transport divided into two categories: bed load and suspended load and how sediment transport will be modeled to evaluate how alternative flow regimes may affect riparian and aquatic habitat. Field data collected to develop bed load rating surveys will include surveyed channel cross sections, water surface slope, and streambed particle size distributions within each of the intensive sites. The task order describes the data collection approaches to bed load sampling as:

"*Bed load Sampling*

Bed load will be sampled at all intensive sites. Bed load will be sampled during low, moderate, and high flows using a modified Helley Smith type bed load sampler. To sample bed load, the sampler will be lowered into the flow by hand or cable/winch and held firmly to the streambed. This will be done at different locations incrementally across the channel. Total sample time will be dependent on the material moved but will be approximately 20 minutes.

Bed load Sieving

Each field-collected bed load sample will be dried and sorted into the following size categories using standardized sieves. After sieving each size category will be individually weighed using a digital scale accurate to 1 gram. When practical, organic matter present in the sample will be removed before weighing. The organic material will also be individually weighed. Additionally, before sorting, digital photographs will be taken of each sample using a penny for scale. These photographs will be sued to compare sample characteristics for the different intensive sites and collection dates."

SRP has included a section from a USGS techniques webpage (http://water.usgs.gov/osw/techniques/sedtech21/ryan.html)

concerning bed load sampling considerations and limitations using a Helley Smith type bed load sampler that need consideration by the project team.

There are several recognized limitations to bed load data collected by portable samplers, such as the Helley-Smith. Their main weakness is that the confidence in measurements can be relatively low, at least in comparison to other sampling methods, such as instream traps. The reason for low confidence in estimates of transport is that the spatial and temporal variability may not be adequately assessed by these samplers and methods. There are several different "philosophies" on how the samplers should be used to obtain the most reliable measurements for mean transport. For instance, there is little consensus on the correct number of verticals needed or the number of times an individual vertical should be measured. Additional weaknesses result from difficulties in designing a suitable device for measuring bed load for a wide range of conditions. This is problematic because introducing any device to the stream alters local flow hydraulics, which, in turn, may affect local transport patterns. There is some indication that slight differences in sampler design can produce significant differences in bed load collection rates (e.g., Ryan, in progress). Also, there is a limit to the size of material that may be sampled with a relatively small nozzle (3 x 3" in our case) so estimates of flow competence based solely on data from portable samplers are suspect. Finally, sampling efforts using portable samplers are highly labor intensive and, therefore, can be quite expensive.

Relative to the USGS concern that sediment transport determinations are labor intensive, SRP determined from the task order that bed load sampling will occur at 10 sites x 3 flow regimes x 20 locations (note the project team did not specify the number of locations but instead reported a 20 minute total sample time distributed across the channel, the 20 locations SRP used in this calculation is based on USGS recommendations for using a Helley-Smith sampler) across channel/site = 600 sediment samples. From the SOW task order (see above), each sample will be sieved into 6 sediment categories plus an organic and each then dried and weighed. This represents 7 sediment categories x 600 sediment samples = 4200 separate samples and weightings- a lot of work.

Also on the USGS techniques webpage are recommended procedures and guidelines for using the Helley-Smith sampler and those guidelines are copied below.

(http://water.usgs.gov/admin/memo/QW/qw79.17.html)

Until further guidelines are issued the Helley-Smith sampler with a 76.2 mm opening should not be considered for use in

a) streams in which the median diameter of the bed material is smaller than about 1.0 mm. (Exception: If the median diameter is smaller than 1.0 mm but the content of material finer than about 0.25 mm is no greater than 10-15 percent, the sampler may still be used.

b) streams in which the median diameter of the bed material is larger than about 8 mm. (Exception: If the median diameter is larger than 8 mm but the content of material larger than 32 mm is no greater than about 10 percent, the sampler may still be used.)

c) streams in which the quantity of fine material, particularly organic material, is great enough to clog the sampler bag.

d) streams in which large particles or irregular bed configurations are likely to interfere with a good fit of the sampler to the streambed. Dune bed forms having a length: height ratio of less than about 20 may fall in this category.

Sampling technique--Emmett's field-calibration studies indicated that the technique used in the collection of samples with the Helley-Smith sampler may be as significant as the actual efficiency of the sampler. Therefore, upon receipt of this memorandum and until further notice, the following sampling technique should be used. This technique used with the standard 76.2 x 76.2 mm Helley-Smith sampler and for material in the size range specified above, will be considered a provisional method of the Geological Survey for measurement of bed load discharge. Measurements made using this method should be documented and referred to as having been collected by the provisional USGS method (for bed load sampling using the standard Helley-Smith sampler).

Provisional method

1. Samples will be collected at a minimum of 20 equally-spaced sampling stations in the cross section.

Variations--For wide cross sections, sampling stations should not be spaced greater than 15 meters (50 ft) apart. For narrow cross sections, sampling stations need not be closer than about 0.5 meters apart.

2. The sampling duration will be the same at each sampling station (for each sample in the cross section). The sampling duration will depend upon the rate of filling of the bag, and probably will vary from 30 to 60 seconds. If more than 60 seconds is required to collect an appreciable quantity of material, the transport rate generally is insignificant.

The correct procedure would be to collect a sample at a high-velocity location in the cross section to see whether there is bed load moving and to select a sampling duration that will assure that the bag does not fill to more than about 40 percent at any sampling station (Druffel, 1976).

3. One sample will be collected at each sampling station starting from one bank and proceeding across to the other bank. Each sample will be placed in a separate bag and labeled. Return to the beginning sampling station and repeat the sampling, collecting a second sample at each of the same stations sampled during the first pass across the river. Each sample will be placed in a separate bag and labeled.

4. Depending upon the objective of the sampling program, (l) each sample will be analyzed individually, or (2) a composite of the two samples collected at each sampling station will be analyzed. It is recommended that analyses always include a determination of particle-size distribution in each sample or composite.

5. Results will be reported in terms of mass per unit time per unit width, such as pounds per second per foot (of width) or kilograms per second per meter. The unit bed load discharge reported will be a width weighted average for the cross section.

6. If possible, the bed should be sampled to determine the size distribution of the bed material, and suspended-sediment samples should be collected so that total sediment discharge can be calculated (Hubbell, 1964, pp 7-19). Note that this is not a simple calculation.

SRP recommends the Project Team use the provisional method of USGS for sediment transport determinations. The Project Team should also conduct preliminary sediment sampling to determine if the sediment particle size distribution of the Colorado River falls into one of the 4 categories (a-d above) where USGS deems a Helley-Smith sampler inappropriate. The Project Team should consider if instream traps may be more suitable.

Page 10, Suspended Load: The SOW appropriately distinguishes between single-point sampling and cross-sectionally flow-weighted sampling for TSS and the potential bias of using the former data without correction. Since no data collection effort appears to be associated with this project aspect, it would be helpful to add a sentence or change wording in an existing sentence to bring assurance that there are indeed sufficient existing cross-sectional, flow-weighted TSS data to determine the bias in any sing-point sampling data.

Task 4 – Intensive Site – Biological Data Collection

Page 11, Subtask 4.10 – Fish Collection to supplement fish habitat guild development; The addition of a backwater/tributary/side channel functional habitat for fish guild development is a good idea and will provide a more complete understanding between fish community and flow conditions.

Page 12, Subtask 4.20, Description of Work and Key Assumptions: The description of work indicates that all ten intensive sites will be sampled for biological aspects during low-flow conditions. That seems appropriate given the logistical complications of biological sampling at high flows. But if such be the case, why is a key assumption made regarding being able to collect moderate- and high-flow biological data?

Task 5 – Blue sucker Life History Assessment

Page 12 and subsequent pages under Task 5 - Blue Sucker Life History Assessment: Under subtask 5.10, the mention is made of spawning surveys to occur in the spring of three years (2005-2007). It is not clear in subsequent studies whether there is a mistake in study duration or whether the spawning surveys are the only monitoring efforts that go into 2007. As examples, a) Subtask 5.10, last paragraph mentions habitat characterization over the course of the study (2005 and 2006) - so not through 2007?; b) subtask 5.20 also mentions larval/juvenile sampling only in 2005 and 2006; and c) subtask 5.30 has as the 2nd key assumption a 2 1/2 year time period of study which is the same as that for subtask 5.10, which again goes through 2007.

Page 13, Subtask 5.10, paragraph at top of page. For the spawning surveys it is mentioned that as many as 10 visits will occur per site. Is this up to 10 visits per year or total over project duration? Under key assumptions mention is made that additional tagging may be necessary if survival rates (from tagging are low?). Yet, under key assumptions (page 15, subtask 5.3) if mortality or tag shedding of blue suckers is greater than 50%, then re-tagging is not proposed. The 2 contrasting statements need reconciled.

Page 14, Subtask 5.20 – Larval/Juvenile Sampling and Habitat Assessment: The Project Team will conduct larval and juvenile sampling in areas downstream of the five likely spawning areas as well as up to five additional sites that might be determined to be located below spawning areas during previous biological sampling efforts and these sites will be sampled from April to June (one time per month) in both 2005 and 2006 and subsequently in August and November of each year to track year class development and recruitment success. They will use a combination of seining, light traps, and dip netting associated with lights for larval sampling. Backpack electrofishing with block nets and hoop nets will likely be employed as an additional collection method for juveniles.
The SOW notes the primary focus of this evaluation is to document the existence of larval/juvenile blue suckers in the lower Colorado River and define the associated habitat requirements. SRP understanding is that in a number of studies of blue suckers in streams of several states that collection of larval/juvenile blue suckers is infrequent. What contingencies are planned by the project team if during initial sampling efforts larval/juvenile blue suckers are not encountered? The ability to capture ecologically meaningful numbers of larval/juvenile blue suckers should be listed as a key assumption.

Page 15, Subtask 5.30 – Migration Assessment: Under key assumptions for this SOW the Project Team writes, "*It is likely that some of the fish will die and others will shed their tags, but the majority of the fish should remain for subsequent tracking. If mortality or tag shedding of greater than 50% of the individuals occur, then this method will be deemed unsuitable for collection of this type of data. Therefore, re-tagging is not proposed under these circumstances. However, in the event that telemetry is deemed unsuitable, the contingency plan will be to document the situation and use the remaining funding associated with subsequent telemetry tasks for physical observations of fish movement and spawning via conventional sampling techniques*." This is a confusing key assumption in that decision statements and alternatives appear arbitrary. For example, what is critical about the 50% loss of tagged fish relative to study objectives? A 50% loss means there are still 15-tagged fish. How many tagged fish are required to meet the study objectives and what are the criteria by which this number is reached?

Task 6 – Aquatic Resource Characterization

Page 15, Subtask 6.10 – Species of Concern Evaluation: This subtask describes a second component of the aquatic resource evaluation to look at potential impacts to not only the state-listed blue sucker, but also those species of concern that may be listed before the permit process is complete. It is unclear what is meant by species of concern, especially in the context where the product will be an evaluation of a wide group of species (guild) as opposed to individual species and/or life stages? This needs clarification as well as a better description or reference on what is involved and the ecological basis of a *spatial niche* approach in the evaluation of aquatic habitat. What are alternatives to the spatial niche approach and why were they not considered and the spatial niche is more appropriate?

Page 16, Subtask 6.20 – Connectivity Assessment: It is not clear how a qualitative assessment can be used to determine whether significant "fragmentation" and loss of connectivity of riparian and aquatic habitat occurs nor how this determination can be made using existing information. The nature of the existing information to be used in the qualitative decision needs to be stated as well as the criteria by which a subjective decision is to be made.

Page 16, Subtask 6.30 - Entrainment Assessment: Do existing pumps used by irrigation districts afford any opportunity to assess actual entrainment. [Perhaps existing pumps, intake structures, etc. are so different from what will be needed for the off-channel reservoir fillings that such studies would not be relevant.] The Project Team poses a scenario where if the intake site has the potential for entrainment of larval/juvenile fish in the intake structure to fill the off-channel reservoirs and is found to be unacceptable, a new site may need to be selected. It is not clear by what criteria or analysis an intake site will be determined to be unacceptable - all sites in the river have potential to entrain fish. Decision-making criteria for acceptable/unacceptable site determination should be explained.

Task 7 – Intensive Site – Model Development

Page 17 & 18, Subtask 7.20 - Hydrodynamic Model, Perform Sensitivity Analysis: It is excellent that a sensitivity analysis is being performed. The breadth of this sensitivity analysis bears closer attention as the project progresses to the point when these analyses will be performed. Part of the uncertainty analysis (which would be interpretation of the sensitivity analysis) may also need to deal with the imprecise nature of the model predictions. For example, one would anticipate that the model predicted velocity fields throughout any site would not exactly represent those of the measured calibration data. While some of this discrepancy will be associated with the inherent inaccuracies of field measurement, some will also be due to the fact that the system cannot be exactly represented through a numerical model. Depending on how the spatial distributions of velocities are used to determine aquatic habitat, etc. model inaccuracies may (will?) result in uncertainties in the decisions determined from the model regarding availability of habitats. Also, it is envisioned that given the range of flows under which the model will be applied (10 to 3, 000 cfs), that the model will be applied in an extrapolation mode, i.e., it will be difficult to capture the low end flow regimes under the present operation of the lower Colorado River system and wastewater effluents received by the system. Extrapolation of model application to conditions outside those for which there are calibration data is intuitively more problematic than when a model is applied within the range of measured conditions used to calibrate the model, though admittedly such is often a necessity in model application and often one of the reasons to apply models. Nonetheless, uncertainty in results and findings from application of the model in an extrapolation mode may need to be considered and to the degree possible quantified. The project team is encouraged to interact with the SRP on the sensitivity and uncertainty analysis development so that what is performed meets the approval of the SRP and indeed reflects some quantitative measure of the uncertainties associated with results and findings from the model.

Overall comment: SRP was not sure how the hydrodynamic model is to be used with the fish guild information. The Conceptual Flowchart for this portion of the project readily indicates where the blue sucker data informs the hydrodynamic model, etc.; however, it is not readily apparent from the SOW or flowchart how the guild information will be used. Further explanation of this matter will be appreciated. Is the hydrodynamic model to be used to estimate LSWP impacts to the overall fish community or just the blue sucker?