Statement of Work: Colorado River Flow Relationships to Aquatic Habitat and State Threatened Species: Blue Sucker

Vendor: BIO-WEST, Inc.

1. Team Members

The following table presents key BIO-WEST Project team members for this activity:

TABLE 1. BIO-WEST PROJECT TEAM MEMBERS

Name	Position on Project
Edmund Oborny (Bio-West)	Project Manager
Dr. Paul Holden (Bio-West)	Principal
Dr. William Espey (Espey Consultants)	Principal
Dr. David Harkins (Espey Consultants)	Senior Expert - Engineer
Roy Frye (Hicks & Co.)	Senior Expert - Scientist
Joe Trungale (TES)	Engineer
Dr. Chris Bunt (Biotactic)	Telemetry Expert
Darren Olsen (Bio-West)	Fluvial Geomorphologist
Cynthia Gorham-Test (Bio-West)	Biologist III
Michael Robertson (Bio-West)	Biologist II
Melissa Stamp (Bio-West)	Hydrologist / Watershed Scientist
Frank Chapa (Espey Consultants)	CADD / GIS
Sandra Turner (Bio-West)	Editor
Chimene Oborny (Bio-West)	Administrative

5. Statement of Work

Task 1: Project Management / Meetings

Subtask 1.10 – Contract / Project Management
Subtask 1.20 – Task Coordination
Subtask 1.30 – Meetings (CH2M Hill and LCRA/SAWS)

Description of Work: Project management, contracting, task coordination, and internal and external communication are included in this category. Communication of progress with LCRA and the CH2M Hill Project Management Team is extremely important. As depicted in

the schedule, three meetings are proposed for July, October, and December 2004. In addition to these face-to-face meetings, the BIO-WEST project team anticipates frequent communication via phone or email with the CH2M Hill Project Management Team.

Communication with the other study groups will also be a vital component in the success of the LSWP. The BIO-WEST project team anticipates bi-weekly conference calls sponsored by the CH2M Hill project team that involves all study leads. In addition, BIO-WEST will maintain frequent communication via phone/email or meetings with the other project teams to facilitate the proper coordination and integration of studies. The original Detailed Study Plans provide a good description of the interdependencies of the LSWP studies and highlight the critical path communications that the BIO-WEST project team will maintain during the project.

Key Assumptions:

- *Three face-to-face meetings with CH2M Hill/LCRA/SAWS.*
- *Bi-weekly conference calls including all study leads.*

Deliverables: Monthly Progress Letter Reports with invoices
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader: Dr. Paul Holden

TASK 2 – Existing Data Review

Subtask 2.10 – Data Review

Description of Work: As described in the DSPs, the existing database of biological resources in the lower Colorado River is sizable and includes the Mosier and Ray study, 1998 feasibility studies, and existing LCRA routine fisheries monitoring data. In addition to compiling this information, other resource agencies will be contacted to evaluate the potential for additional aquatic resource information for the lower Colorado River. Data reviews for the other key components (sediment transport, riparian vegetation [importance of riparian buffer length and area], and recreation) will also be conducted during this initial task order. This task will also include a review, assessment, and application of relevant scientific literature from the perspective of theory and methods, even though the research may have been conducted on rivers other than the lower Colorado River.

The amount of information specific to life history requirements of the lower Colorado River blue sucker population is limited. A review of the 1998 feasibility study, field notes, and results will be conducted. In addition, a detailed review of the known life history requirements of blue sucker will be conducted and the key researchers working with blue suckers in several other river basins will be contacted to discuss life history information they have collected over the years on this species. An understanding of trends in other river basins may allow the project team the flexibility to adjust methodologies for larval fish collection, spawning evaluations, and migration assessments in the lower Colorado River.

Key Assumptions:

- *The existing biological data collected by Mosier and Ray (1992) and others will provide a solid biological database and additional biological sampling beyond that proposed for this project will not be necessary.*
- *Where data gaps exist, the project team will consult nationally acceptable databases (or statewide databases) and literature and/or scientific experts to fill in any gaps.*

Deliverables: see Subtask 2.30
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader: Dr. Paul Holden

Subtask 2.20 – Aerial Mapping: Data Collection and Compilation

Description of Work: The purpose of this task is to generate an orthorectified GIS base layer and printed imagery that can be used in the field to map riparian vegetation types and meso-scale hydraulic habitat types. This data would be used primarily to delineate reaches along the lower Colorado River, select representative intensive sites, provide photographic maps for rapid and accurate field delineation of vegetation and provide necessary data to extrapolate results from the intensive sites to the entire river. Many ancillary benefits will be derived from producing an ortorectified base layer (terrestrial studies, other aquatic studies, baseline river/riparian data for future change detection, water quality studies, etc.). A key assumption is that LCRA currently has the digital color imagery for the entire lower Colorado River at a scale appropriate to complete this task. Therefore, new collection of imagery is not proposed. However, data acquisition and compilation activities will be required.

Key Assumption:

- *LCRA has the digital color imagery for the entire lower Colorado River and adjacent riparian corridor at a level of detail sufficient to satisfy the riparian corridor assessment.*

Internal Deliverable: Base maps for use in Task 3.
Task Leader: Dr. David Harkins
Quality Control/Quality Assurance Leader: Edmund Oborny

Subtask 2.30 – Data Review Summary Report

Description of Work: Upon completion of Task 2, the BIO-WEST project team will submit a Data Review Summary Report that highlights the available data, data gaps, and updated assumptions associated with the project.

Major Deliverable: Data Summary Report
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader: Dr. Paul Holden, Dr. William Espey

Subtask 2.40 – Conceptual Flowchart

Description of Work: Upon completion of Task 2, a "conceptual model" flow chart of this project and associated linkages with other models will be developed and submitted to LCRA/SAWS.

Major Deliverable: Conceptual Flowchart
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader: Dr. Paul Holden, Dr. William Espey

Subtask 2.50 – Technical Advisory Group (TAG) / Science Review Panel (SRP) Conference Call

Description of Work: A conference call with the SRP and TAG (or subset of the TAG - instream group) will be conducted following the existing data review task to discuss information collected and proposed methodologies for sampling. It is proposed that the Data Review Summary Report and Conceptual Flow Chart be provided to the TAG and SRP prior to the call. This call will include a verbal presentation of the findings of the existing data collected. The TAG and SRP will be asked to provide input so that the integrated nature of the data collection and modeling approaches will have been properly considered.

Deliverable: Within one week of the call, the BIO-WEST project team will submit to LCRA/SAWS a letter report summarizing the TAG/SRP conference call and comments provided.
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader: Joe Trungale

Task 3 – Reconnaissance / Whole River Habitat Mapping

Subtask 3.10 – Reconnaissance

Description of Work: Prior to the commencement of Tasks 3 and 4, a reconnaissance of the river at a representative base flow will be conducted. The reconnaissance will involve a flight of the entire river and subsequent visits to specific areas via vehicle, boat, and/or kayak. During the flight, a video of the river will be taken to be used in subsequent habitat mapping and evaluations.

Key Assumptions:

- *The 292-mile stretch of the lower Colorado River from Longhorn Dam to the Gulf Coast will be the study area.*
- *An LCRA fisheries biologist will accompany the project team on the reconnaissance effort.*

Internal Deliverable: Reconnaissance knowledge for future tasks.
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader: Joe Trungale

Subtask 3.20 – Field Activities

Description of Work: Following the reconnaissance in subtask 3.1, a field effort will be conducted to define meso-scale habitat types (run, pool, riffle, etc.) and draw them onto field images of the lower Colorado River obtained in Subtask 2.20. The habitat mapping/ground truthing will be conducted by boat, kayak, and/or walking depending on the specific reach of river. It is anticipated that the majority of the mapping will be conducted via boat. A representative base flow condition is that other than during irrigation releases. For this project, river conditions not influenced by irrigation releases will be considered representative base flow unless natural events (high-flow) deviate river conditions from historical non-irrigation release averages.

Aquatic Habitat Types

The categories that are used to map aquatic habitat at the reach scale will be built upon those used by Mosier and Ray (1992) which are shown in the following Table. If necessary, additional habitat categories may be added in order to characterize habitat types not identified.

Aquatic Habitat Types to be Used in Channel Reach Mapping

Code	Habitat Type*	Description
IS	Island	Any parcel of land within the flood plain that is surround by either wetted channel or dry channel that is periodically inundated during higher flows.
RI	Riffle*	Shallow reaches with fast water causing some surface disturbance. These are normally section controls and are most apparent at low flows. Substrate is generally larger in riffles due to the evacuation of larger materials from pools and subsequent deposition during high flow periods
RA	Rapid*	Fast water (shallow or deep) with substantial whitewater present. Rapids develop at rock outcrops or other areas where the bed material is highly resistant to transport and a substantial drop in bed elevation occurs.
CH	Chute*	Deep, fast water with little or no surface disturbance. Chutes are usually caused by constrictions in the channel or occur between objects such as large boulders.
RN	Run*	Shallow reaches with moderate to fast water and little surface disturbance. Runs are frequently section controls but may be wide, shallow areas in a spool. Substrate is usually sand to gravel or rubble.
PO	Pool*	Deep reaches along the main channel with relatively slow current. Substrate is normally sand or silt. Pools frequently have a steeply sloped bank and a shallow side.
BW	Back Water*	Quiescent, normally shallow areas contiguous to the main channel with little or no current. Typical backwaters are sloughs and the mouths of smaller streams. Substrate is typically silt and detritus.
DC	Dry Channel	Any side channel which had no flow during mapping but possessed evidence of use during higher flows.

Aquatic Habitat Types to be Used in Channel Reach Mapping

Code	Habitat Type*	Description
CB	Cobble Bar	Depositional area of the channel dominated by cobble-sized substrate that had no flow during mapping.
GB	Gravel Bar	Depositional area of the channel dominated by gravel-sized substrate that had no flow during mapping.

* description used by Mosier and Ray (1992)

Riparian Habitat Types

The categories used to map riparian vegetation types at the channel reach scale are listed below. In addition to these broad categories, dominant species types within each category will be noted on the field maps, and areas with important young tree species (i.e., areas exhibiting recent recruitment) will be specifically noted.

Riparian Vegetation Types

Vegetation Type	Description
Wooded	Areas dominated by trees. Common species to be determined. Stand age (young vs. mature) will be noted on field maps
Scrub-shrub	Scrub-shrub riparian area. Dominant species to be determined.
Herbaceous	Riparian areas consisting mostly of grasses, sedges, and/or rushes.
Disturbed	Disturbed areas consisting of bare ground, rip rap, etc.

Key Assumptions:

- *The 292-mile stretch of the lower Colorado River from Longhorn Dam to the Gulf Coast will be the study area.*
- *LCRA has the digital color imagery for the entire lower Colorado River and adjacent riparian corridor at a level of detail sufficient to satisfy the riparian corridor assessment.*

Internal Deliverable: Data collection for whole river habitat map generation.
Task Leader: Melissa Stamp
Quality Control/Quality Assurance Leader: Edmund Oborny

Subtask 3.30 – Map Generation

Description of Work: Field notes and drawings will be digitized and incorporated into a GIS layer that can be used to query the amount and location of various habitat types. Riparian vegetation categories will also be delineated on the photos, digitized and incorporated into a GIS layer. This information will be used initially to locate appropriate intensive sites that adequately represent habitat found in entire reaches. The channel reach maps will also used to extrapolate modeled habitat at the "Intensive site" scale to total habitat available within the "Reach."

Internal Deliverable: Arcview shapefile with whole river habitat map for internal use in intensive site selection and modeling interpretation.

Task Leader: Dr. David Harkins
Quality Control/Quality Assurance Leader: Melissa Stamp, Edmund Oborny

Task 4 – Fish Sampling and Tagging

Subtask 4.10 – Blue Sucker Collection and Tagging

Description of Work: The telemetry study will involve the collection and tagging of approximately 30 blue suckers (various ages will be collected and tagged) from along the lower Colorado River. Of the 30 total individuals, an effort will be made to collect individuals from each of the five sites established for spawning surveys. Additional sites near Bastrop, LaGrange, and Garwood will be sampled if necessary. The collection effort will take place in late October/early November 2004 during low-flow base conditions when water temperatures are declining to improve catch success and reduce potential infections. The collection effort will involve backpack electrofishing with block nets in wadeable areas and boat electrofishing in deeper areas. Upon collection, the individual fish will be anesthetized with MS-222, and surgery will be conducted to implant a radio tag within the body cavity. Upon suturing, an antiseptic will be generously applied to reduce the potential for infection. After tagging, the fish will be held in river water for a minimum of one-hour for observation and then released back into the river at a slow velocity section near the area of collection. The selected radio tags will have an operational life of at least three years to cover potential seasonal changes of blue sucker movement from fall 2004 through the spring 2007.

During this initial tagging, a receiver and data logger (anticipating use of LCRA current equipment) will be placed at LCRA Eagle Lake facility along with two above ground antennae. These antennae would allow for the detection of fish and the direction in which the fish are traveling. Upon designation of instream structures associated with this project, this site may be moved to be more reflective of site-specific impacts. The importance of this portion of the telemetry study is to assess the use of the immediate project area by the blue sucker. The amount of use and time frame of use may provide extremely valuable information for the development of the operations plan for the project.

As an addition component with no cost to LCRA/SAWS, the BIO-WEST project team will clip a small piece of fin tissue with no negative impact to the fish and provide to Michael L. Bessert (a Ph.D. student in biology at the University of Nebraska under the direction of Dr. Guillermo Orti). Mr. Bessert is starting a project to study genetic diversity and population genetic structure in the genus *Cycleptus* (blue sucker and southeastern blue sucker) throughout its range in North America. Mr. Bessert's project goal is to ascertain within-drainage population genetic structure using an array of microsatellite genetic markers. Due to their hypervariability, these markers can be used to estimate effective population size (and gene flow between sites) with tissues from as few as 30 fish per target area. Mr. Bessert has assembled user-friendly kits (including instructions, vials, forceps, etc.) and will pay all shipping charges for samples. The genetic data gathered for this project will focus on predicting population size and within river genetic variability (which could assist in answering the question of blue sucker migration within the Colorado River). Overall, Mr. Bessert's genetic findings could strengthen the value of this study and further improve

understanding of the population dynamics of this species all at no additional cost to LCRA/SAWS.

Key Assumptions:

- *The tagging of thirty individual blue suckers and subsequent survival will provide a representative sample of the blue sucker population in the lower Colorado River and will allow interpretation of spawning and migration characteristics. 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. The study team does not anticipate this occurring and has telemetry experts who specialize in these types of collection and tagging efforts. 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.*
- *The biological data collected for the blue sucker over a 2 ½ year time period will be sufficient to describe the habitat suitability requirements of the species for habitat modeling purposes.*
- *The LCRA electrofishing boat will be available for use and 1 LCRA fisheries biologist will assist in this field effort.*
- *The LCRA radio-telemetry receiver and antennae used for the LCRA Altair channel dam project will be available for use in this project.*

Major Deliverables: Placing radio tags in approximately 30 blue suckers in the lower Colorado River for use in subsequent tasks to evaluate life history traits (migration, spawning, habitat use) over a 2.5 year study period.
Task Leader: Dr. Chris Bunt
Quality Control/Quality Assurance Leader: Edmund Oborny

Subtask 4.20 – Fish Collection to supplement fish habitat guild development

Description of Work: Although data from previous studies will be predominantly used to develop habitat suitability curves and habitat niches, a limited data collection effort will be will be conducted on the lower Colorado River to supplement/update and verify existing information. Current data gaps identified include detailed life history information for the blue sucker and a fisheries community update/verification at the sites sampled over 10 years ago by Mosier and Ray 1992.

The level of effort for this update/verification of existing fisheries information during the initial task order will be confined to activities of 4 fisheries biologists in one week. Direct sampling using a pre-determined grid system will be employed to assess habitat usage. Sampling grids will be constructed in key river reaches. These grids will consist of cells (habitat types) arranged into a matrix system and subsequently selected through a stratified random procedure to ensure that all habitats represented in the reach have been adequately sampled. The size of the sampling grid has yet to be determined, however, the methodology will be transferable with Mosier and Ray (1992) to best utilize the existing data. Sampling will typically be performed by seining, backpack electrofishing, boat electrofishing, or some

combination of the three. Direct observations of fish with positive identification but not collected will also be noted. During the biological sampling, several habitat parameters will also be measured per individual sampled cell. At a minimum, these will include velocity, depth, substrate, and cover (instream and canopy).

Key Assumptions:

- *The existing biological data collected by Mosier and Ray (1992) and others will provide a solid biological database and additional biological sampling beyond that proposed for this project will not be necessary.*
- *Where data gaps exist, the project team will consult nationally acceptable databases (or statewide databases) and literature and/or scientific experts to fill in any gaps.*
- *The LCRA electrofishing boat will be available for use and 1 LCRA fisheries biologist will assist in this field effort.*

Internal Deliverable: Internal Use for refinement of Habitat Suitability information.
Task Leader: Michael Robertson
Quality Control/Quality Assurance Leader: Edmund Oborny

Subtask 4.30 – Initial Migration Assessment

Description of Work: Manual tracking via airplane using a second receiver (that will need to be purchased) will be conducted approximately two weeks following the tagging and release effort to determine the location of individuals. Additionally, after the initial aerial tracking, an effort via boat/kayak will be conducted to pinpoint the specific location of the 30 individual fish and to assess fish health.

Key Assumptions:

- *Thirty individual blue suckers proposed for tagging will provide a representative sample of the blue sucker population in the lower Colorado River and will allow interpretation of spawning and migration characteristics.*
- *The biological data collected in this and subsequent tasks for tagged blue suckers over a 2 ½ year time period will be sufficient to describe the habitat suitability criteria (life stage habitat use [adult, juvenile, spawning]) of the species for habitat modeling purposes.*
- *The LCRA radio-telemetry receiver and antennae used for the LCRA Altair channel dam project will be available for use in this project.*

Internal Deliverable: Continued collection of blue sucker life history data.
Task Leader: Michael Robertson
Quality Control/Quality Assurance Leader: Edmund Oborny

Task 5 – Intensive Site Selection

Subtask 5.10 – Data Reduction and Analysis

Description of Work: Intensive sites will be selected by the project team based on the existing data review, field reconnaissance, and channel reach mapping and will include the full range of habitat types present in the reach it is intended to represent. Therefore, the specific lengths of the sites will be determined during this process and be dependant upon availability and abundance of habitat types, and availability of project resources. The number of sites and approximate lengths of sites were discussed in detail by the project team and TAG in the development of the original detailed study plans and cost estimates. The output from those discussions was that a total of ten intensive sites would be evaluated. Nine sites will be selected from within the segments (Webberville, Bastrop, Smithville, Eagle Lake, and Egypt) surveyed by Mosier and Ray (1992) with one additional intensive site located below the Bay City inflatable dam. All scheduling and cost estimates are based on the project team and TAG discussions relative to the inclusion often intensive sites.

Key Assumptions:

- *The 292-mile stretch of the lower Colorado River from Longhorn Dam to the Gulf Coast will be the study area. Ten representative sites (intensive sites) will be selected from the study area to best represent all habitat types available. It is anticipated that nine of the intensive sites will be taken from within the five previous large-scale segments designated and studied by Mosier and Ray (1992) while the additional intensive site will be located below the Bay City impoundment.*

Internal Deliverable: Selection of Ten intensive study sites for modeling activities.
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader: Joe Trungale

Subtask 5.10 – TAG / SRP Meeting

Description of Work: A meeting with the SRP and TAG (or subset of the TAG - instream group) will be conducted following Tasks 2, 3, and 4 to discuss information collected and proposed sites for intensive data collection. A description of the sites and habitat distribution will be presented to the group prior to the meeting to stimulate meeting discussion. The TAG and SRP will be asked to provide input so that the intensive sites selected are amenable to all parties. Each party would also need to acknowledge that minor adjustments to the intensive site boundaries may be necessary in the field to ensure that the sites meet all modeling requirements.

Deliverable: Within one week of the meeting, the BIO-WEST project team will submit to LCRA/SAWS a letter report summarizing the TAG/SRP meeting and comments provided.
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader: Joe Trungale

Task 6 – Data Analyses / Letter Report Preparation

Subtask 6.10 – Data Reduction and Analysis

Description of Work: The BIO-WEST project team will reduce and analyze data collected and review activities conducted during the initial task order.

Internal Deliverable: Analysis necessary for development of letter report.
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader: Joe Trungale

Subtask 6.20 – Letter Report – Deliverable

Description of Work: The BIO-WEST project team will submit a final progress letter report in mid-December summarizing activities conducted during the Initial Task Order and highlighting any potential fatal flaws identified during those activities.

Major Deliverable: Initial Task Order Activities Letter Report
Task Leader: Edmund Oborny
Quality Control/Quality Assurance Leader: Dr. Paul Holden, Dr. William Espey