MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
SALUDA HYDRO PROJECT RELICENSING
INSTREAM FLOW/AQUATIC HABITAT
TECHNICAL WORKING COMMITTEE

SCE&G Offices at Carolina Research Park
May 3, 2006

Final csb 6-2-06

ATTENDEES:

Bill Argentieri, SCE&G
Shane Boring, Kleinschmidt Associates
Jeni Summerlin, Kleinschmidt Associates
Dick Christie, SCDNR
Amanda Hill, USFWS
Scott Harder, SCDNR
Steve Summer, SCANA Services
Tom Eppink, SCANA Services
Jim Glover, SCDHEC
Ron Ahle, SCDNR
Sam Drake, L. Murray Assoc.

ACTION ITEMS:

- Distribute 1989-90 Lower Saluda IFIM Study Report to TWC

Shane Boring/Jeni Summerlin

- Draft list of target species for IFIM studies on Lower Saluda

Amanda Hill/Ron Ahle

- Compile and distribute Congaree floodplain studies to TWC

Shane Boring

- Contact NPS to determine status of ESWM process on Congaree River

Shane Boring/Bill Argentieri

- Provide clarification regarding GIS coverages needed to satisfy Comprehensive Habitat Assessment

Dick Christie/Amanda Hill

- Coordinate with Tommy Boozer regarding available GIS-based habitat maps for L. Murray

Bill Argentieri

- Draft framework for white paper assessing potential for self-sustaining trout fishery in LSR

Shane Boring/Jeni Summerlin

- Contact Gerrit Jobsis and Jeff Isely to make presentation on existing IFIM Study

Shane Boring

DATE OF NEXT MEETING: **June 14, 2006 at 9:30 am**

Location: SCE&G Offices at Carolina Research Park
111 Research Drive
Columbia, SC 29203

MEETING NOTES

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MEETING NOTES:

These notes serve to be a summary of the major points presented during the meeting and are not intended to be a transcript or analysis of the meeting.

Shane Boring opened the meeting at approximately 10:20 AM. Shane reminded the group that, at the February 22nd Fish and Wildlife RCG meeting, the Technical Working Committees (TWCs) were formed and study requests were assigned to the TWCs[1]. It was noted that the purpose of today's meeting would be to review the study requests assigned to the Flow/Aquatic Habitat TWC (See Meeting Handout - Attachment A) and to begin assigning tasks toward addressing each request. Discussions regarding each of the study requests are summarized below.

Request for Instream Flow Studies[2]

Shane noted that Ron Ahle from SCDNR had provided the field datasheets, study plan, and final report for the 1989-90 Lower Saluda River (LSR) Instream Flow Study. A copy of the study plan was distributed to attendees (Attachment B) and the original data was returned to Ron. Shane noted that he would scan the final report and distribute it to the TWC via e-mail. He added that photocopies had been made of the field data should the TWC decide to use the existing data in the evaluating instream flow as part of the current relicensing. Ron Ahle proposed, and the group agreed, that having the authors of the 1989-90 IFIM study provide a presentation detailing the project methods and findings would be a reasonable first step in evaluating it's relevance in the current relicensing. Shane agreed to contact Gerrit Jobsis and Jeff Isely in hopes of scheduling a presentation for the next TWC meeting. Ron Ahle, Dick Christie, and Amanda Hill noted the importance of establishing target species in evaluating the existing IFIM data. Ron and Amanda agreed to collaborate on development of a list of target species.

Bill Argentieri noted that specific flows were recommended by SCDNR in their comments to the Initial Consultation Document [470 cfs for one-way downstream navigation; 590 cfs (July-November), 1170 cfs (January-April), and 880 cfs (May, June, & December) for seasonal aquatic habitat] and enquired as to how these flows were derived. Bill enquired specifically as to whether these flows were based on the 1989-90 LSR IFIM study. Dick Christie noted that the recommended flows were based on the SC Water Plan and were not related to the 1989-90 study. He added that the flow recommendations were offered in lieu of a site-specific IFIM study for LSR, adding that the agency certainly encourages a site-specific study.

[1] See February 22nd, 2006, Fish and Wildlife RCG meeting notes for study request summaries and assignments.
[2] Subheading correspond to Study Requests in attached meeting handout.

Scott Harder recommended that Acoustic Doppler (AD) technology be considered for any site-specific studies, adding that it could provide fine-scale data and is considerably less labor-intensive. Steve Summer agreed, noting that AD technology is being considered for evaluating impacts of operating unit 5 on stripped bass habitat during the DO "crunch" period in late summer.

Request for Floodplain Flow Evaluations

Shane noted that there are a number of recent and ongoing studies that have potential to assist in addressing this issue. Specifically, Shane noted that there is a USC graduate student currently researching the impacts of hydro dam operations in the Santee Basin on Congaree River flows and subsequently the vegetative communities of Congaree National Park (NP). Bill Argentieri noted an existing study that examined the influence of the Saluda on overall flows in the Congaree, adding that he believed the study concluded that the Saluda contributes approximately 1/3 of the Congaree's flow. Shane agreed to gather as many of these studies as possible and distribute to the TWC. The group agreed that the best course of action is to coordinate with the National Park Service to determine what data/studies exist. Following review of existing data and studies, the TWC will convene to determine a course of action for this issue.

Ecologically Sustainable Water Management (ESWM) Request

Dick Christie noted that SCDNR was involved with the development of an ESWM framework for the Savannah River, adding that the process involved numerous experts working together through a series of workshops to develop recommendations for the basin. Ron Ahle noted that result of any instream and/or floodplain flow studies conducted as part of this relicensing (see above, as well as items 1&2 of attached handout) would undoubtedly provide important information for development of an ESWM framework and suggested that it may be beneficial to complete these studies prior to beginning ESWM discussions. Amanda Hill noted that the ESWM process provides a framework to develop a flow regime that balances the various water uses in the basin. Dick noted that The Nature Conservancy (TNC) has managed development of ESWM in other basin and suggested contacting them to provide additional information regarding the process. After further discussion, the group agreed that the NPS should be contacted to determine exactly how they would like SCE&G to contribute to the ESWM process and how far along they are in the development process.

Request for Sediment Regime and Transport Studies

Shane enquired as to whether the group was aware of any existing sedimentation data for the LSR. Steve Summer noted that he was not aware of any specific studies, but noted that substrate was one of the factors considered in the 1989-90 LSR IFIM study. Ron Ahle suggested a good starting point

for addressing this issue might be to revisit the transect locations from the previous study to determine whether there have been changes in substrate at these sites. Several group members noted that, while this is undoubtedly a good first step, the scope of the study request appears to go beyond just substrate. It was noted by some attendees that this is a very broad study request and it is unclear exactly what is being requested (i.e. the proposed study objectives(s)).

Request for Comprehensive Habitat Assessment

Shane noted that SCE&G's aerial photography for Lake Murray and video flyover for the LSR have potential for providing a fairly thorough assessment of the aquatic habitat in the project area. Amanda Hill acknowledged this, but added that they are looking for a GIS-based approach. Bill Argentieri noted that the shoreline GIS maps developed by Tommy Boozer's group includes Environmentally Sensitive Areas and thus may include the level of detail being requested. Dick Christie and Amanda Hill both noted that they needed to give further consideration to what is needed and would report back to the group at the next meeting. Bill agreed to coordinate with Tommy Boozer to determine the suitability of the shoreline maps in helping to address this issue.

Request for Study to Determine Feasibility of Self-Sustaining LSR Trout Population

Dick Christie noted that, while SCDNR certainly encourages improvement in water quality and/or habitat that might result in improvements to the existing put, grow and take trout fishery (i.e., improved growth and/or survival), establishment of a reproducing trout population is not one of the agency's management goals for the LSR. Amanda Hill noted that USFWS would certainly support any enhancements to the existing fishery, but added that USFWS is "not in the business of promoting reproducing populations of non-native species." After some additional discussion, it was determined that, despite the fact that a reproducing population is not within agency management objectives, stakeholders requesting this study (Trout Unlimited) are due a fair evaluation of the proposal. As such, the group agreed to author a white paper summarizing the biotic and abiotic factors necessary for establishment of a self-sustaining population; summarizing potential benefits of existing and proposed water quality and/or habitat enhancements on the existing put, grow, and take fishery (including incidental reproduction); and outlining agency management objectives relative to trout for the LSR. Kleinschmidt staff will compile an initial framework for the white paper and distribute to the TWC for input.

Date/Location of Next Meeting

The group agreed to have the next Instream Flow/Aquatic Habitat TWC meeting on June 14, 2006 at the Research Park at 9:30 am. Shane noted that he would issue an electronic meeting invitation to confirm the date with individual members and provide directions to the meeting site. The meeting adjourned at approximately 1:00 PM.

Attachment A

May 3, 2006, Instream Flow/Aquatic Habitat TWC Meeting Handout

Saluda Hydro Relicensing
Instream Flow/Aquatic Habitat Technical Working Committee Meeting
May 3, 2006 – Carolina Research Park

Members:

Shane Boring	Alan Stuart	Brandon Kulik
Ron Ahle	Amanda Hill	Dick Christie
Steve Summer	Gerrit Jobsis	Prescott Brownell
Hal Beard	Wade Bales	

Study Requests to be Addressed:

1) **Instream Flow Studies**: Requested for the Saluda River and the Confluence area. An assessment on how Project operations affect stream flows, and which flow regimens would best meet the needs of the biota.

   Requested by: CCL/American Rivers, City of Columbia Parks and Recreation, SCDNR*,* LSSRAC, National Marine Fisheries Service, SC Council Trout Unlimited, USFWS

   **[IFIM requested by SCDNR in lieu of implementing an instantaneous flow of at least 470 cfs needed to support one-way downstream navigation, and flows of 590 cfs (July – November), 1170 cfs (Jan-April), and 880 cfs (May, June and December) to provide seasonal aquatic habitat]*

2) **Floodplain Flow Evaluations**:[1] A study was requested in order to evaluate the flows necessary for incremental levels of floodplain inundation for the Lower Saluda, Congaree River, and Congaree National Park. It is requested that it include an inventory of floodplain vegetation as well, in order to classify and characterize the vegetative species composition and structure of the floodplain areas within the zone of operational influence of the river reaches.

   Requested by: CCL/American Rivers *(requested floodplain inundation study as well as floodplain vegetation component)*, LSSRAC *(requested floodplain vegetation component only)* National Park Service

   **In relation to this study, SCDNR requests that the hydrologic record associated with the operation of the project be compared to the unregulated hydrology that would have occurred under a natural flow regime over the life of the project. Including an estimate of the timing, duration and magnitude of flood events that occurred and that would have occurred in absence of the project*.

   Requested by: SCDNR

Saluda Hydro Relicensing
Instream Flow/Aquatic Habitat Technical Working Committee Meeting
May 3, 2006 – Carolina Research Park

3) **Ecologically Sustainable Water Management (ESWM)**: Described by the National Park Service as a "inclusive, collaborative, and consensus-based process to determine a scientifically based set of river flow prescriptions in order to protect downstream resources while balancing upstream benefits." The NPS notes that they believe this process can be readily adapted to the Saluda Project and have already began gathering information and developing an interactive GIS tool to provide information regarding the effect of various Saluda operational scenarios on the degree of inundation at the Congaree National Park. NPS seeks "partnership" with SCE&G as well as stakeholders in implementing this ESWM process.

   Requested by: National Park Service

4) **Sediment Regime and Sediment Transport Studies:** A request has been made that a study be performed on the sediment regimen in the Project area as well as the Project effects on the sediment regimen of the lower Saluda River. Should include such things as sediment composition, bedload movement, gravel deposition, sediment storage behind dams, and bedload changes below the dam; and project effects on downstream geomorphometry, sediment availability and streambank erosion, and the possible addition of gravel to mitigate for project impacts. Also, the effects of the Project operations on habitat requirements for spawning fishes.

   Requested by: CCL/American Rivers, USFWS

5) **Comprehensive Habitat Assessment**: To provide quantitative and qualitative data in GIS format of available and potential spawning, rearing, and foraging habitats (i.e., riffles, shoals, open water, shallow coves, littoral zones) for diadromous and resident fishes in Lake Murray, the Saluda River and its major tributaries, and the Lower Saluda River below the Project.

   Requested by: National Marine Fisheries Service, USFWS

6) **A Study to Determine the Factors Needed for a Self Sustaining Trout Fishery**: The purpose of this study should be to determine the factors needed for a self sustaining trout fishery that can reproduce and thrive year round, and how the operation can be modified to meet the habitat needs. Dissolved oxygen, flows, spawning and rearing habitat, the aquatic food base, especially in the shallow, rocky foraging areas, and actual water chemistry should be key items in such an assessment.

   Requested by: SC Council Trout Unlimited

Attachment B

1989-90 Lower Saluda River IFIM Study Plan

Lower Saluda River Study Plan

July 9, 1990

I. Introduction

The lower Saluda River (LSR) is an important recreational resource offering approximately 10 river miles of fishing, picnicking, sunbathing, and whitewater canoeing within the Columbia, South Carolina metropolitan area. The fishery resources of the river include an assortment of resident and migratory populations of game and non-game species. The river supports put-grow-and-take brown trout (Salmo trutta) and rainbow trout (Oncorhynchus mykiss) fisheries. Adult striped bass (Morone saxatilis) migrate upstream from the Congaree River after spawning and use the LSR as a cool-water refuge during the spring and summer months. The flow of the LSR is almost entirely controlled by releases from generation of electricity at the Lake Murray Dam (also known as Saluda Dam), owned and operated as a peaking hydroelectric facility by South Carolina Electric and Gas Company (SCE&G). This dam is licensed (Number 516) by the Federal Energy Regulatory Commission (FERC).

The following study has been initiated as a cooperative effort among the Charleston, South Carolina Field Office of the U.S. Fish and Wildlife Service (USFWS-SC); the USFWS Aquatic Systems Branch, Fort Collins, Colorado (USFWS-CO); and the South Carolina Wildlife and Marine Resources Department (SCWMRD). SCE&G has been informed of the study plans and has agreed to provide reasonably available information and has conditionally agreed to water releases necessary for its completion. SCE&G

will have the opportunity to review and comment on the study plan prior to field work and is welcome to participate in all study phases.

This study will have two phases. Phase I will be an evaluation of the magnitude, duration, and water quality of releases from the Lake Murray Dam and their effects on the fishery resources of the LSR. To establish how these variables affect fishery habitat, fish passage through shoals, and water quality, we will use the Instream Flow Incremental Methodology (IFIM) developed by the USFWS-CO.

Phase II will evaluate alternatives that can reduce the impacts, if Phase I indicates current conditions are negatively affecting LSR fishery habitat, fish passage through shoals, or water quality. Should reasonable alternatives that reduce these impacts be identified during Phase II, then agencies participating in the study will petition the FERC to append these alternatives to the project's operating license.

II. Fishery Resource Issues

Based on past studies (Younginer 1986; Borders 1987; Crane 1987; McKellar and Stecker 1988), the SCWMRD and the USFWS are concerned that the magnitude, duration, and water quality of releases from the dam may be negatively affecting the fishery resources of the river.

III. Phase I

Objective: Assess if current conditions limit the fishery habitat of the LSR.

Phase I will assess the effects of current conditions on the LSR fishery resources. Dissolved oxygen, water temperature, base-flow, and generation-flow effects on habitat will be evaluated. Instream flows required to allow passage of migratory fishes through shoals will also be assessed.

Resident fish species need flows for adult fish populations, spawning and rearing of fry and juveniles. Selected non-game and game species of pool/stream-margin and riffle habitat guilds will be used to represent resident fish community habitat requirements. Passage requirements of fish populations migrating through shoals will also be evaluated.

IV. Phase II

Objective: Identify reasonable alternatives to reduce impact if Phase I results indicate current conditions are significantly limiting fishery habitat.

Trade-off analysis is required to determine how various modifications affect fishery habitat. If study results indicate alternative flow regimens are needed for fishery resources, then the effects of those regimens on hydroelectric power generation and other water uses will be evaluated. The SC Water Resources

Commission's Saluda River Water Budget and Reservoir Operation Model, which relates water release requirements to lake-level maintenance and power production, will be used as part of this evaluation.

V. Study Boundaries

The study area comprises of the entire LSR, from the Lake Murray Dam to the confluence with the Broad River. This area encompasses approximately 10 river miles (RM). Major tributaries of the LSR are Rawls Creek (RM2.1), Twelvemile Creek (RM3.7), and Kinley Creek (RM4.5). Under natural flow conditions these creeks do not contribute significantly ($\geq$ 10%) to the Saluda's stream flow. However, because the dam can reduce or eliminate all but leakage flow from the river, these tributaries can contribute significantly to the LSR flows especially during periods of non-generation and high runoff.

Habitat analysis is needed from the dam downstream to include Millrace Rapids, approximately 9 miles downstream of the dam. Downstream of Millrace Rapids to its confluence with the Broad River, the lower Saluda becomes highly braided. This 1-mile section will not be included in the IFIM analysis because of backwater effects from the Broad River.

VI. Target Species

Several target species and lifestages will be used to represent the habitat requirements of the LSR fish community and

important game species. Riffle and pool/stream-margin habitat guilds will be used to represent the resident populations as prescribed by Leonard and Orth (1988). The adult northern hogsucker (Hypentelium nigricans) and margined madtom (Noturus insignis), both obligate riffle dwellers, will represent the riffle guild. The pool/stream-margin guild will be represented by redbreast sunfish (Lepomis auritus) spawning and young-of-the-year northern hogsucker lifestages. Requirements of important game species to be modeled include striped bass - adult habitat; redbreast sunfish - adult habitat; brown trout - adult, spawning, and incubation habitat; and rainbow trout - adult, spawning, and incubation habitat.

Shoal passage requirements of migrating fish populations, which include American shad (Alosa sapidissima), gizzard shad (Dorosoma cepedianum), threadfin shad (Dorosoma petenense), blueback herring (Alosa aestivalis), and striped bass, will be represented by adult striped bass (> 24").

The flow requirements of each target species and lifestage will be evaluated only during their respective periods of occurrence (Table 1).

VII. Habitat Suitability Criteria

A. IFIM Target Species

Habitat suitability criteria available from published literature and recently completed, unpublished studies will be evaluated for all target species. Specific curves will then be

developed for this study. The habitat suitability criteria to be evaluated are given in Appendix I.

B. Fish Passage

Criteria for passage at shoals will be based on requirements that allow unimpeded passage of adult striped bass (> 24") and will be developed from published literature. The passage flow will be the discharge that meets striped bass passage criteria for 10% of the stream width during the period of occurrence.

VIII. Hydrologic Baseline and Time-Step Analyses

Hydrologic conditions of the LSR are controlled by releases from the Lake Murray Dam, completed in 1930. Lake Greenwood, located approximately 50 river miles upstream of Lake Murray Dam, has limited control over water availability of the LSR. Filling of Lake Greenwood was completed during 1941. Therefore, the appropriate period of hydrologic record for this study should be from 1942 to present. During this period, flows of the LSR have been monitored by US Geological Survey (USGS) gage number 02169000, the Saluda River at Columbia. This gage is located 8.4 river miles downstream of the Lake Murray Dam. A second USGS gage, Saluda River below Lake Murray Dam (number 02168504), is located 1/2 mile downstream of the Lake Murray Dam and has been in operation for 2 years.

The LSR hydrology will be analyzed incorporating historical streamflow (with project) and natural streamflow (without

project) information. The time-step to be used for this study will be determined after the hydrologic analysis has been completed.

IX. Data Collection and Required Measurements

A. Habitat Mapping

Transect location selection will be based on habitat-type rather than representative-reach methods. To determine the proportions of different habitats occurring, the LSR was canoed by SCWMRD personnel in August 1988 at Q = 600 cfs (USGS gage 02169000). The frequency of major habitat types was determined by classifying habitats at 48, equally spaced transects. Six major habitat types were found. All riffle habitats were associated with transverse ridges of rock outcroppings. Run and pool habitats were separated into those with and without rock outcroppings. The last habitat type was split channel. Two major split channel habitats occur; Corley's Island at RM2.7 and Saluda Hills at RM7.5. Rapids are known to occur in the river, but no habitat transects were located at this habitat type.

The proportion of habitat types determined in August 1988 (Table 2) will be used for weighting transects selected to represent each habitat type.

The proportion of the habitats was a function of the discharge at the time of evaluation (600 cfs). The classification of habitat type is expected to change as

discharges vary. For example, pools may become runs at higher flows and visa-versa at lower flows.

B. Stream Segments

The 9-mile study section will be divided into 3 segments of 3 miles each to enable evaluation of hydroelectric peaking effects. The upper section begins at the dam and terminates at the lower end of Corley's Island (RM1-RM3). The middle segment (RM4-RM6) will span from Corley's Island to the I-20 bridge. The lower segment extends from the I-20 bridge to Millrace Rapids (RM7-RM9).

C. Microhabitat Study Sites

Each habitat type will be represented by at least 2 transects in each the upper and lower study segments. No microhabitat measurements will be made in the middle segment because 1) tributaries entering this segment cause discharge to vary longitudinally within this segment, 2) hydroelectric peaking effects on habitat availability will be transitional with respect to the upstream and downstream segments (Gore et al. 1989), and 3) base-flow requirements will be adequately addressed by the upper and lower segments.

Representative areas of the upper and lower segments with good access in which transects can be located are given in Table 3. The exact location of each transect will be determined in the field.

D. Microhabitat Study Site Measurements

Modelling the base-flow requirements for the LSR's fishery resources and the effects of the current hydroelectric operation on fishery habitat will be approached using different methods. To address base-flow requirements, habitat data from the upper and lower segments will be combined and used to represent the base-flow needs of the entire LSR. To evaluate the hydroelectric operation effects on fishery habitat, the upper and lower segments will be evaluated separately because the stage, discharge, and rate at which they change differ longitudinally.

A complete set of microhabitat measurements will be made at the lowest flow used for modelling. This set will include depth, velocity, substrate, and cover. The stage of zero flow will also be determined at this time. Candidate substrate and cover codes (Table 4) will be modified to match habitat suitability curves of target species after the selection of those curves has been finalized.

Water surface elevation measurements will be made at least one mid-range and one high discharge. An additional set of velocity measurements will also be made at a mid-range flow.

E. Discharge Measurements

River flow can range from < 100 cfs at leakage flow to 18,000 cfs when all five hydroelectric units are generating at full capacity. The full range of flows need to be modeled to

evaluate base flow requirements and peaking flow impacts. Microhabitat measurements will be made at a low flow of approximately 200 cfs. Water surface elevation measurements will be made at approximately 200 cfs, 1200 cfs, and 7200 cfs.

Discharges will be determined from depth and velocity data collected during the microhabitat measurements.

Measurements are scheduled for summer 1990. Work requiring low flows will be scheduled for weekends, if necessary. This should enable SCE&G to provide low flows needed for microhabitat measurements with minimal effect on generation requirements. Adequate water for higher, model-calibration flows should be available at this time. Tributary input can be relatively high at this time of year and will have to be accounted for.

F. Macrohabitat Parameters

1. Dissolved Oxygen

Dissolved oxygen, an important water quality variable of the LSR, is controlled to a large extent by releases from the dam. Water quality at temperatures >15 C becomes unsuitable for brown trout at DO concentrations of 6 mg/L (Raleigh et al. 1986) and for rainbow trout at 5 mg/L (Raleigh et al. 1984).

Water discharged from the dam for December through June generally has DO concentrations adequate for fishery resources. Flows of 100 cfs or greater maintain DO concentrations above 5 mg/L throughout the entire river (Borders 1987).

From late July through November DO concentrations from water released through the dam can be below those required for fishery resources. At moderate flows (approximately 225 cfs) the water is reaerated at the first rapids, Hope Ferry Rapids, approximately 1 mile downstream of the dam (McKellar and Stecker 1988). At high discharges the water is not reaerated to 5 mg/L within the study area. Dissolved oxygen concentrations at a flow of 7,350 cfs were approximately 1 mg/L at the dam, 2 mg/L at RM2, 3 mg/L at RM4, 4 mg/L at RM7, and < 5 mg/L at RM9 during this period (Borders 1987). Flows >7350 cfs can be expected to result in lower DO concentrations downstream of the dam.

Because of these temporal differences, DO will be modeled in a monthly time step for July through November. SCDHEC has modelled the LSR's oxygen dynamics using the QUAL2E model (Borders 1987). McKellar and Stecker (1988) collected empirical DO data at different flows. This information will be used to define the relationship between discharge and DO dynamics for the purpose of this study.

2. Water Temperature

Water temperature dynamics need to be evaluated. Trout habitat quality may be limited by high water temperatures in the lower end of the study segment during summer months. Temperature data from the upstream gage (USGS 02168504), downstream gage (USGS 02169000), and McKellar and Stecker (1988) will be analyzed to determine how temperature differs longitudinally at different flows and at different times of the year. The analysis will

determine the discharge versus maximum temperature relationship by river mile using mean daily ambient temperatures for each month from May through October.

G. Channel Morphometry

The channel is considered to be an equilibrium for the purposes of this study. Substrates are mainly stable as a result of years of high discharges from hydroelectric peaking and the dam preventing gravel and sediment from entering the study area.

Due to the hydropeaking operation, a more scoured channel is expected in the upper segment of the river than in the lower segment. Segmenting the river as discussed above will allow evaluation of potential differences in channel morphometry and substrate types between the upper and lower segments.

H. Fish Passage Transects

Flows to allow passage of immigrating striped bass stocks will be evaluated at Millrace Rapids, the shoal most limiting to passage. A bed profile and water surface elevation data at 3 discharges will be collected. Velocity measurements will not be made because water velocities will not exceed adult striped bass burst-swimming speeds (6 to 14 feet per second).

X. Schedule

A schedule for completion of the lower Saluda River study is given in Table 5.

Hydraulic measurements have been scheduled to begin in the summer of 1990. All reports are to be completed by February 1991. If this study determines current conditions are negatively affecting the fishery habitat of the LSR and reasonable alternatives can reduce this impact, then the agencies participating in this study will petition the FERC for an amendment to the project operating license during spring 1991.

XI. Personnel, Equipment, and Expenses

Field measurements will require 2 crews and a minimum of 6 workers. Three of the personnel will be provided by each SCWMRD and USFWS. All costs associated with personnel will be met by their respective agency.

Most equipment has already been purchased. SCWMRD will provide 1 set of surveying equipment, flow meter, and miscellaneous items such as cable, flagging, etc. USFWS-CO will supply 1 set of surveying equipment, a flow meter, plus equipment necessary for high discharge measurements.

XII. Required Documents

A. Reports

1. Plan of study - SCWMRD

2. Phase I: Effects of current conditions on fishery habitat - SCWMRD and USFWS (December 15, 1990)

3. Phase II: Reasonable alternatives for reducing negative impacts -SCWMRD and USFWS (February 28, 1991) *

4. Recommendation to FERC for amending Saluda Hydro license - SCWMRD and USFWS (May 1, 1991) *

B. Memoranda

Agencies to SCE&G: Summary of status, transmittal of plan of study, request for meeting.

C. Agreement to Cooperate

A written agreement to cooperate throughout the study, provide required flows as available, and supply reasonably available information will be signed by all participants (SCWMRD, USFWS-SC, USFWS-CO, SCE&G). Copy attached.

* Required only if current conditions determined to be negatively affecting the fishery habitat of the lower Saluda River and reasonable alternatives exist.

XIII. References

Borders, T.L. 1987. Water quality of the lower Saluda River, Lexington County. Technical Report 010-87, South Carolina Department of Health and Environmental Control, Columbia.

Crane, J.S. 1987. Lower Saluda River fishery study, preliminary report. South Carolina Wildlife and Marine Resources Department, Columbia.

Gore, J.A., J.M. Nestler, and J.B. Layzer. 1989. Instream flow predictions and management options for biota affected by peaking-power hydroelectric operations. Regulated Rivers: Research & Management 3:35-48.

Leonard, P.M. and D.J. Orth. 1988. Use of habitat guilds of fishes to determine instream flow requirements. North American Journal of Fisheries Management 8:399-409.

McKellar, H.N., Jr. and M.K. Stecker. 1988. Oxygen dynamics in the lower Saluda River. University of South Carolina.

Raleigh, R.F., T. Hickman, R.C. Solomon, and P.C. Nelson. 1984. Habitat suitability information: rainbow trout. US Fish and Wildlife Service. FWS/OBS-82/10.60.

Raleigh, R.F., L.D. Zuckerman, and P.C. Nelson. 1986. Habitat suitability models and instream flow suitability curves: brown trout, revised. US Fish and Wildlife Service. Biological Report 82(10.124).

Younginer, E.M. 1986. A water quality survey of the lower Saluda River, Lexington County, South Carolina. Technical Report 010-87, South Carolina Department of Health and Environmental Control, Columbia.

Table 1. Periods of occurrence for target species and lifestages.

Species	Lifestage	J	F	M	A	M	J	J	A	S	O	N	D
striped bass	adult				———	———	———						
striped bass	passage				———	———							
no. hogsucker	adult	———	———	———	———	———	———	———	———	———	———	———	———
mar. madtom	adult	———	———	———	———	———	———	———	———	———	———	———	———
rainbow trout	adult	———	———	———	———	———	———	———	———	———	———	———	———
rainbow trout	spawning	———	———										—
rainbow trout	incubation	———	———	———									—
brown trout	adult	———	———	———	———	———	———	———	———	———	———	———	———
brown trout	spawning										———	———	
brown trout	incubation	———	———	———							———	———	
red. sunfish	adult	———	———	———	———	———	———	———	———	———	———	———	———
red. sunfish	spawning				———	———							
		J	F	M	A	M	J	J	A	S	O	N	D

NHS YOY

Table 2. Occurrence of habitat types of the lower Saluda River, August 1988, at a discharge of approximately 600 cfs at the USGS gage 02169000 (river mile 8.4). RO = rock outcropping

Habitat	Percent	Miles of river
Riffle/RO	8 1/2	0.8
Run/RO	13	1.2
Run	7	0.6
Pool/RO	23	2.1
Pool	36	3.2
Split Channel	12 1/2	1.1

Table 3. Representative areas with good access in which transects can be located.

Habitat	River Mile	Description
		Upper segment
Riffle/RO	1.3	Shoal upstream of Hope Ferry
Run/RO	1.4	Shoal upstream of Hope Ferry
Pool/RO	1.4	Shoal upstream of Hope Ferry
Pool	1.5	Hope Ferry ramp
Split Channel	2.7	Corley's Island
		Lower segment
Riffle/RO	8.4	Shoal at USGS gage
Run/RO	7.0	Quail Hollow
Pool/RO	8.1	Police Club
Pool	7.2	Below I-26 Bridge
Split Channel	7.8	Saluda Hills Island

Table 4. Description, classification, and coding of habitat.

Code	Classification	Description
Substrate		
0	Organic	Organic debris/detritus
1	Fines	<0.08 inches
2	Small Gravel	0.1-0.6 inches
3	Large Gravel	0.6-2.5 inches
4	Small Cobble	2.5-5.0 inches
5	Large Cobble	5.0-10.0 inches
6	Small Boulder	10.1-39.4 inches
7	Large Boulder	>39.4 inches
8	Plain Bedrock	surface irregularities <6 inches
9	Irregular Bedrock	surface irregularities >6 inches
Cover		
0	No Cover	Open Water
1	Boulders	Rocks >10 inches
2	Ledges	Bedrock irregularities >10 inches
3	Undercut	Streambank undercut >10 inches
4	Overhang	Objects suspended within 3 feet
5	Log	Log (on bottom) >6 inches
6	Log Complex/ Root wad	Aggregates of logs/ Root system
7	Attached vegetation	Aquatic veg. attached to rocks
8	Rooted vegetation	Aquatic veg. rooted in substrate
Embeddedness		
1	≤25% embedded	Gravel, cobble, and boulder particles have less than 25% of their surface embedded by fines.
2	50% embedded	Gravel, cobble, and boulder particles have between 25 and 50% of their surface embedded by fines.
3	75% embedded	Gravel, cobble, and boulder particles have between 50 and 90% of their surface embedded by fines.
4	90-100% embedded	Gravel, cobble, and boulder particles have more than 90% of their surface embedded by fines.

Table 4. Continued.

Code	Classification	Description
Vegetation type		
0	No vegetation	
7	Attached vegetation	
8	Rooted vegetation	
Vegetation Density		
0	No vegetation	No vegetation present
1	Sparse	≤25% coverage
2	Moderate	25-75% coverage
3	Heavy	75-100% coverage

Table 5. Schedule for completion of lower Saluda River study.

	1989 A M J J A S O N D	1990 J F M A M J J A S O N D	1991 J F M A M
Phase I			
Scoping	———		
Habitat Mapping	complete		
Plan of Study	———		
Meeting		–	
Habitat Suit. Criteria		———	
Hydraulic/Habitat Measurements		—	
Water Quality/ Hydrologic Analyses		—	
PHABSIM Modelling		———	
Output Evaluation		—	
Meeting (Agencies & SCE&G)		–	
Phase I Final Report		—	
Phase II *			
PHABSIM Modeling			———
Output Evaluation			—
Meeting (Agencies & SCE&G)			–
Phase II Final Report			—
Develop and Submit Recommendations to FERC			———
		J F M A M J J A S O N D 1990	J F M A M 1991

* Required only if Phase I determines current conditions negatively affecting the fishery habitat of the lower Saluda River.

Appendix I. Habitat suitability criteria to be used for this study.

Currently being compiled.