SOUTH CAROLINA ELECTRIC & GAS COMPANY

COLUMBIA, SOUTH CAROLINA

SALUDA HYDROELECTRIC PROJECT

FERC NO. 516

STUDY PLAN

INSTREAM FLOW OF THE LOWER SALUDA RIVER

FINAL

FEBRUARY 2007

Prepared By:

Kleinschmidt

Energy & Water Resource Consultants

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

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1.0 INTRODUCTION

The Saluda Hydro project is a 202.6 megawatt (MW) licensed hydroelectric facility located on the Saluda River in Lexington, Newberry, Richland, and Saluda counties of South Carolina and is owned and operated by South Carolina Electric & Gas (Figure 1). The project consists of Lake Murray, the Saluda Dam, the new back-up Saluda Berm, spillway, powerhouse, intakes, and penstocks. The project is currently licensed by the Federal Energy Regulatory Commission (FERC No. 516) and the present license is due to expire in the year 2010.

To initiate the Project relicensing process, SCE&G prepared and issued the Initial Consultation Document (ICD) on May 20, 2005. The Licensee submitted the document to a number of state and federal resource agencies for their review and comment. As a result, the United States Fish and Wildlife Service (USFWS), South Carolina Department of Natural Resources (SCDNR), National Marine Fisheries Service (NMFS), and several Non-governmental Organizations (NGO's) requested studies to determine the potential impact of Project operation on downstream fishery resources and aquatic habitat, including a Instream Flow Incremental Methodology Study for the lower Saluda River downstream of the Project.

1.1 Existing Operations

Historically, SCE&G has operated the Saluda Hydro Project in a variety of operating modes, including base load, peaking and load-following. Currently, the project occupies a specific, very important niche in SCE&G's generating portfolio in that it provides *reserve capacity*. Reserve capacity means the Project generators can increase output immediately in response to a major generator or transmission *outage* and can

reach full output within 15 minutes to comply with the North American Electric Reliability Council's Control Performance Standard.

1.2 Study Objective

The objective of this study is to provide data quantifying the effects of flows on aquatic habitat suitability in the LSR for target species and lifestages.

2.0 DESCRIPTION OF STUDY AREA

The Saluda River rises on the east slope of the Appalachian Mountains, and flows southwest across the Piedmont geomorphic province to its confluence at the fall line (Hunt 1974) with the Broad River in Columbia, South Carolina, where the combined flows form the Congaree River. Between the Saluda dam and the confluence, LSR flows for approximately ten miles through generally low gradient[1] riverine geomorphology (Figure 2). The lower Saluda River, beginning one mile below Lake Murray Dam to its confluence with the Broad River, was designated a State Scenic River on May 31, 1991. The drainage area at the Saluda dam is 2,420 square miles. Real time stream flow gages exist at USGS 02168504 (*Saluda River below Lake Murray Dam*), and USGS 02169000 (*Saluda River near Columbia, SC*).

2.1 Upstream and Downstream Boundaries

The LSR segment between Lake Murray and the confluence with the Broad River, (Figure 2) was identified by the Instream Flow/Aquatic Habitat Technical Working Committee (TWC) as the study area for purposes of this study. Flow in this reach is primarily influenced by releases from the Saluda Project powerhouse, although there are some additional contributions from small tributaries such as Rawls, Twelvemile, Kinley, and Stoop creeks and Senn Branch, which collectively contribute approximately 100 square miles of additional drainage area.

2.2 Habitat and Geomorphology

The LSR flows southeasterly through a river corridor that gradually shifts from rural to suburban to urban land uses, and in general the river banks and riparian zones are forested. Overall the river is relative straight, with gentle bends and little sinuosity. The upper segment of the LSR is dominated by well-defined banks, relatively low-gradient pools and glides periodically segmented by short shoals and alluvial riffles. The lowermost segment also contains pools, glides and runs, but exhibits higher gradient,

[1] Reach is punctuated by short, higher gradient reaches (3-4%), such as Millrace Rapids, but generally gradient is 1% or less.

more pronounced riffles, and features ledge and boulder substrates which reflect down cutting through the piedmont terrace at the fall line. There is some evidence of localized bank erosion and ephemeral alluvial shoaling. Beginning downstream of Riverbanks Zoo, the LSR becomes highly braided, with the lowermost mile becoming backwatered by the Broad River (Isely, et. al, 1995). There are a few scattered islands with pronounced side channels and/or braids in both the upper and lower reaches of the LSR.

An important macrohabitat consideration on the LSR is that the ambient water temperature and dissolved oxygen (DO) is influenced by releases from below the thermocline of Lake Murray via the project powerhouse. Average water temperatures below the Project dam range from approximately 9.5^{o}C in February to 17.5^{o}C in early-October, and from approximately 10 to 18.5^{o}C in the vicinity of Riverbanks Zoo[2]. A site-specific study aimed at gaining greater understanding of the downstream extent and mixing characteristics of temperature impacts is underway. Average DO levels below the dam range from 6.2 mg/L during September to 11.0 mg/L during February, with periodic excursions below 1.0 mg/L for short periods of time[3].

2.3 Fishery, Fish Management Objectives, and Seasonal Habitat Uses

The LSR supports a diverse community of coldwater and warm water fish species and provides a variety of fishing opportunities (Beard, 1997). This two-story fishery has been established through stocking of rainbow and brown trout by SCDNR to enhance LSR recreational fishing opportunities. In the mid-1980's, the SCDNR experimented with stocking of smallmouth bass in the LSR, due to recent successes with the species in the Broad River (H. Beard, SCDNR, Pers. Comm.). This stocking effort was generally considered unsuccessful and stocking was discontinued. In 1995, the SCDNR again investigated the potential to establish a smallmouth bass fishery in the LSR. SCDNR's findings suggested that while many criteria to support a smallmouth bass fishery were present, it was not feasible to implement this strategy as a fishery management goal in the LSR because suitable habitat was found to be inadequate.

[2] Based on monthly averaged 2000 to 2006 data as measured at USGS Gage # 02168504 (below Murray Dam) and at USGS Gage # 2169000 (Columbia).
[3] Based on monthly averaged 2000 to 2006 data as measured at USGS Gage # 02168504 (below Murray Dam).

Resident Fishery Resources

The LSR resident fishery is typical of many southern tailwater systems, and includes an assortment of resident game and non-game species (Crane, 1987; Jobsis, 1991; Table 1). Studies conducted as early as 1991 found approximately 50 species of fish, 48 of which are considered endemic to the region (Jobsis, 1991). Redbreast sunfish were the most abundant game species found in the 1991 study. Bluegill were also typically found in relatively high abundance but abundance was highly variable based on specific habitat types (Jobsis, 1991). Redbreast sunfish were dominant in the upper sections as compared to the lower and middle sections. LSR redbreast sunfish growth studies indicated that this species grows slowly compared to those of other rivers in the southeast (Jobsis, 1991). However, this is not surprising since coldwater temperatures have been shown to limit growth of warmwater fish in similar watersheds (Ruane et al., 1986).

A fishery management plan for the LSR is currently being revised by the SCDNR. However, a recent SCDNR creel census suggested that the fishery generates approximately 1.8 million dollars annually, with the trout fishery being responsible for the majority of the revenues (Beard, 2000).

Diadromous Fishery Resources

American shad, striped bass, and Atlantic and shortnose sturgeon have historically used Project waters. Mills reported as early as 1826 that American shad and sturgeon ascended rivers above the fall-line, more specifically the Saluda River (USFWS, 2001). SCDNR has reported no presence of diadromous species such as blueback herring or American shad in the LSR (Beard, 2002). Sampling conducted by SCE&G in the spring of 2003 detected the presence of three American shad in the LSR; however, recent gillnet sampling targeting these species resulted in no captures, suggesting that densities may be extremely low in the LSR (Isely and Kleinschmidt, 2005; 2006).

Striped bass, the only known anadromous fish to consistently use the LSR, migrate upstream from the Santee-Cooper Lakes in early spring and use areas of the LSR in late summer as thermal refuge. LSR anglers have reported catching individuals exceeding 50 pounds (personal Communication, Hal Beard, SCDNR, 2002). SCE&G's 1995–2003 spring electrofishing sampling revealed only sporadic catches of striped bass; however, recent SCDNR studies suggest that 50% or more of the Santee-Cooper Lakes striped bass population may utilize the lower Saluda River during the late-summer months (D. Christie, SCDNR, Pers. Comm.).

The American eel is the only known catadromous fish reported to inhabit Project waters (Beard, 2002). Recent sampling during 2005 and 2006 resulted in the capture of only one eel, and electrofishing by SCE&G and SCDNR has yielded only sporadic eel captures (Kleinschmidt, 2005; Kleinschmidt, 2006; personal communication, H. Beard, SCDNR, 2006; S. Summer, SCANA Services, Inc., 2006), suggesting that eel densities in the LSR are likely limited in abundance.

Anadromous fish restoration efforts for the Santee Basin appear to focus on restoring runs of anadromous fish primarily up the Congaree and Broad Rivers. The Santee Cooper Basin Diadromous Fish Passage Restoration Plan reports that the Broad River and its tributaries are the highest priority for diadromous fish restoration (USFWS, 2001). The Saluda along with Catawba and Wateree sub-basins are listed as next in priority. The Plan states that the cold hypolimnetic water significantly reduces the ambient LSR water temperature, and thus migrating fish may choose to use the warmer waters of the Broad rather than the Saluda (USFWS, 2001). Furthermore, alteration of the existing thermal regime of the LSR would be an engineering challenge and likely adversely affect the coldwater trout fishery in the tailwater.

Other Fishery Resources

Cold water releases from the Saluda Hydro Project have supported a unique put, grow, and take rainbow and brown trout recreational fishery in the LSR since the early 1950's. According to stocking records, SCDNR typically stocks the LSR with

approximately 28,000 to 30,000 trout annually, at a 3:1 ratio of brown trout to rainbow trout. The fish length at time of stocking is typically 7-8" for brown trout and 9-10" for rainbow trout. Trout are typically stocked from November – March throughout the LSR. These trout do not represent a native population, and are presently restocked annually to offset angling exploitation and predation. However, angler reports of trophy fish of 4 to 8 pounds indicate that some rainbow trout may survive up to several years (Kleinschmidt, 2003).

Table 1: Fish Species Typical of the Lower Saluda River

Family/Common Name	Scientific Name
Amiidae	
bowfin	*Amia calva*
Anguillidae	
American eel	*Anguilla rostrata*
Aphredoderidae	
pirate perch	*Aphredoderus sayanus*
Catastomidae	
Northern hog sucker	*Hypentelium nigricans*
creek chubsucker	*Erimyzon oblongus*
spotted sucker	*Minytrema melanops*
striped jumprock	*Moxostoma rupiscartes*
silver redhorse	*Moxostoma anisurum*
smallfin redhorse	*Moxostoma robustum*
shorthead redhorse	*Moxostoma macrolepidotum*
v-lip redhorse	*Moxostoma pappillosum*
Centrarchidae	
black crappie	*Pomoxis nigromaculatus*
white crappie	*Pomoxis annularis*
bluegill	*Lepomis macrochirus*
pumpkinseed	*Lepomis gibbosus*
redbreast sunfish	*Lepomis auritus*
redear sunfish	*Lepomis microlophus*
warmouth	*Lepomis gulosus*
largemouth bass	*Micropterus salmoides*
smallmouth bass	*Micropterus dolomeiu*
Cluepeidae	
gizzard shad	*Dorosoma cepedianum*
threadfin shad	*Dorosoma petenense*
Cyprinidae	
dusky shiner	*Noropis cummingsae*
spottail shiner	*Notropis hudsonius*
rosyface chub	*Notropis rubescens*
sandbar shiner	*Notropis scepticus*

Family/Common Name	Scientific Name
swallowtail shiner	*Notropis procne*
yellowfin shiner	*Notropis lutipinnis*
highfin shiner	*Notropis altipinnis*
ironcolor shiner	*Notropis chalybaeus*
Eastern silvery minnow	*Hybognathus regius*
whitefin shiner	*Cyprinella nivea*
thicklip chub	*Cyprinella labrosa*
golden shiner	*Notemigonus crysoleucas*
bluehead chub	*Nocomis leptocephalus*
carp	*Cyprinus carpio*
Esocidae	
chain pickerel	*Esox niger*
Cyprinodontidae	
lined topminnow	*Fundulus lineolatus*
Ictaluridae	
snail bullhead	*Ameiurus brunneus*
flat bullhead	*Ameiurus platycephalus*
brown bullhead	*Ameiurus nebulosus*
yellow bullhead	*Ameiurus natalis*
white catfish	*Ameiurus catus*
channel catfish	*Ictalurus punctatus*
Lepisosteidae	
longnose gar	*Lepisosteus osseus*
Moronidae	
white bass	*Morone chrysops*
striped bass	*Morone saxatilis*
white perch	*Morone americana*
Percidae	
carolina darter	*Etheostoma collis*
piedmont darter	*Percina crassa*
tessellated darter	*Etheostoma olmstedi*
yellow perch	*Perca flavescens*
Poeciliidae	
eastern mosquitofish	*Gambusia holbrooki*
Salmonidae	
brown trout	*Salmo trutta*
rainbow trout	*Oncorhynchus mykiss*

3.0 PROPOSED METHODS

3.1 Field Reconnaissance and Habitat Mapping

The TWC concluded that the an Incremental Instream Flow Methodology (IFIM) study would be appropriate to develop an understanding of key habitat-flow relationships in the LSR, and elected to use a Physical Habitat Simulation (PHABSIM) model to quantify these relationships. The model will be used to quantify flows that meet habitat requirements to support a balanced aquatic community based on model results representing selected diadromous and resident fish, and aquatic biota (*i.e.* macroinvertebrates). In addition, empirical data and/or a flow demonstration approach may be required to document flows that provide adequate fish passage at falls such as Millrace Rapids.

Consistent with IFIM protocol, a study team comprised of agency and licensee biologists will be formed for the purpose of making technical decisions regarding input parameters and review of study output. Specifically, that team will designate the: 1) boundaries of the study area; 2) locations of specific representative or critical study sites; 3) locations of study site transects; 4) Habitat Suitability Index (HSI) criteria; and 5) calibration flows and range of flows to be assessed. The study team may participate in field and analytical activities as deemed feasible.

Mesohabitat Classification

A field reconnaissance survey will be conducted with the study team to determine:

1) The classification and distribution of mesohabitats in the LSR study area; and
2) The location(s) of potentially limiting zone of passage for migratory fish movement.

Mesohabitat mapping will include a review of Isely, et al. (1995), aerial photographs, fly-over video, followed by ground verification. Mesohabitat will be field-mapped to delineate the relative quantity and spatial distribution of each habitat type in the study area. The team will define each mesohabitat type of interest, and assign specific attributes to each that can be used for field delineation. Delineation will occur during a period of relatively low-to-moderate flow so that breaks in mesohabitat, substrate, object cover and hydraulics representative of approximate base flow conditions can be readily observed. Study team members are encouraged to participate in delineation to the extent feasible. The upstream and downstream boundary of each mesohabitat within the study area will be classified and geo-referenced in the field, and the information transferred to a Geographic Information System (GIS) format. GIS will then be used to provide both a visual map and quantitative tabular information on the abundance of mesohabitat types in the study area. Additional features relevant to differentiation of mesohabitats, such as geomorphic and physiographic characteristics, will also be collected where appropriate.

Selection of Reaches, Study Sites and Transects

The study team will consult to define study reaches and select applicable mesohabitat study sites within each reach, as well as transects within each study reach. Study reach boundaries are typically placed at significant breaks in geomorphic, hydrologic or habitat use in the study area (Bovee, et al., 1998)[4]. Within each study reach, the study team will identify candidate study sites that represent typical and/or unique but critical mesohabitats, and select upstream and downstream cell boundaries within each study site based on localized observable shifts in stream width, cover, substrate, and hydraulics. The field crew will subsequently locate a transect within each longitudinal cell.

[4] As noted above, the upper and lower ends of the study area have distinct differences in slope and substrate, suggesting that at least two geomorphic reaches may be justifiable. Hydrologic reach breaks are conventionally set at points where a tributary adds 10% of more additional drainage area to the study area.

3.2 Field Data Collection

3.2.1 PHABSIM Study Sites

General Approach

The second phase will entail the determination of habitat-flow relationships for selected species, lifestages, and guilds in the LSR. Standard PHABSIM data collection and flow modeling procedures of the Instream Flow Incremental Methodology (IFIM) (Bovee, 1982, Bovee et al. 1998) will be used to evaluate habitat suitability, and empirical flow measurements will be obtained to evaluate zone-of-passage hydraulics at a limiting river channel site.

Modeling will be based on hydraulic data developed from cross-sectional depth, velocity, and substrate measurements following Milhouse, *et al.* (1989), using PHABSIM for Windows (V 1.2), developed by the United States Fish and Wildlife Service and distributed by the USGS Fort Collins (CO) Science Center.

Flow Range to Be Modeled

Based on TWC consultation (See Appendix A), SCE&G anticipates that habitat-flow relations would be developed for flows ranging up to approximately 20,000 cfs, and that the modeling effort would focus on both representative mesohabitat types and the limiting fish passage channel site selected by the study team.

Suitability Index Criteria

The TWC is presently gathering and considering specific habitat Suitability Index (SI) rating curves for use in this study. Based on TWC consultation, SCE&G proposes the use of HSI curves adopted primarily from those previously used in instream flow studies in the Catawba-Wateree and Pee

Dee River studies. These curves, which are contained in Appendix B, were developed in support of recent IFIM studies and PHABSIM models conducted for similar fish assemblages with similar geomorphic and ecoregion characteristics. To the extent possible, species and lifestages of interest will be classified into habitat guild classes (*i.e*. deep slow, shallow slow, shallow fast, deep fast), and representative HSI curves for each guild selected by the team in consultation.

In some cases, stand-alone species and lifestages may be modeled, such as rainbow and brown trout. Additional HSI curves for brown trout, rainbow trout, and a surrogate for fish passage will be obtained from other studies and reviewed for applicability, discussed, modified as necessary and approved by the study team.

Transect Data Collection

The location of each transect will be field blazed with flagging or other appropriate means. Each study site and cell will be mapped sufficiently to quantify the area represented by each transect. The transect headpin and tailpin ends will be located at or above the top-of-bank elevation, and secured by steel rebar or other similar means. A measuring tape accurate to 0.1 ft will be secured at each transect to enable repeat field measurements to occur at specific stream loci[5]. Stream bed and water elevations tied to a local datum will be surveyed to the nearest 0.1 ft using standard optical surveying instrumentation and methods.

Depth, velocity, and substrate data will be gathered at intervals (verticals) along each transect. Each vertical will be located to the nearest 0.1 ft wherever an observed shift in depth or substrate occurs. Between 20 and 99 verticals per transect will be established as necessary to define cross-sectional habitat. Verticals will be arranged so that no more than 10% of the river flow passes between any pair, thus enhancing hydraulic model calibration. At least one staff gage will be located per study site, and will be monitored at the beginning and end

[5] Supplemental transects may be located as needed to record water surface and bed elevation data at hydraulic controls to establish backwatering parameters necessary for hydraulic modeling.

of each set of hydraulic measurements to confirm stable flow during measurements. If flow is found to be insufficiently stable, the related data will be discarded and re-measured once stable flow is established.

Mean column velocity will be measured to the nearest 0.1 ft/second with either a calibrated electronic velocity meter mounted on a top-setting wading rod, or alternatively an Acoustic-Doppler Current Profiler (ADCP) transducer. In water less than 2.5 ft depth, measurements will be made at 0.6 of total depth (measured from the water surface); at greater depths, paired measurements will be made at 0.2 and 0.8 of total depth and averaged.

Each calibration flow will be provided by scheduled releases from the Project via unit operation. Turbine rating curves, USGS gauging, and study-site field gauging will be collectively used to estimate each calibration flow release. The hydraulic model will be built from measurements gathered at a *minimum* of three calibration flows to facilitate extrapolation of hydraulic data across the range of interest. To accomplish calibration, a full set of depth, velocity and water surface elevation (WSEL) data will be gathered at the intermediate flow, and WSEL will be measured at each transect for the low and high flow calibrate. At transects with complex hydraulics such as braided channels or riffles, and/or sites with unusual backwatering or eddy effects, supplemental velocity data may be gathered at the low and/or high calibration flows. This will be determined in the field on a case-by-case basis.

Each calibration flow should ideally be separated by about an order of magnitude to provide a suitable stage-flow release curve for the hydraulic model. At a minimum, SCE&G anticipates utilizing calibration flows of approximately: 350-500; 1200-1500; and 10,000 cfs. Depending on calibration quality, this should allow the PHABSIM model to theoretically project Weighted Usable Area (WUA) for a flow range from 40 to over 20,000 cfs. The need for additional calibration flow data may vary by transect and will be evaluated on a case-by-case basis.

Hydraulic Modeling

Hydraulic modeling and quality assurance/quality control techniques will be in accordance with standard practice for PHABSIM use. Hydraulic modeling will be accomplished by correlating each surveyed water stage with flow releases to develop a stage-flow release relationship for each transect. Once this relationship is established, the model then adjusts velocities obtained at calibration flows to each flow increment of interest for which a defined water stage has been calculated. The model is then calibrated by comparing simulated hydraulics to empirical measurements taken at the calibration flows.

Detailed steps are summarized below:

Field data collected at the transects (e.g. cross section surveys, water surface elevations, velocities, flow and slope measurements) will be entered into a computer database compatible with PHABSIM software. All field calculations of flow releases and data entry are proofed and cross-checked for accuracy. The field data include measurements at three calibration flows, and are used to simulate depth, velocity, substrate and cover conditions at target flows other than the calibration flows. The three calibration flows will include low, mid-range and high flows. Flow releases and water surface elevations are determined for all calibration flows. Bed profiles, substrate and cover used in the model are derived from surveys made during low flows. Velocity calibration in the PHABSIM model typically relies on velocities measured during mid-range flows, although velocity measurements are sometimes made in the field for low flows at features such as riffles where velocities are very irregular across the cross section.

Transects within a common study site and mesohabitat type will be linked hydraulically (*i.e.* within the same datum) with adjacent transects or with downstream hydraulic controls that create backwater conditions. Most transects, however, will be independently modeled. Simulation of water surface elevations at each transect will be accomplished using one of three methods within

PHABSIM: IFG4, MANSQ or WSP. Often, all three models are run with the best stage-flow release relationship determined for each cross section. The specific model used at a given transect depends on site characteristics, including gradient and backwatering from downstream hydraulic controls. IFG4 uses a log-log fit to determine a stage-flow release curve for the three calibration flows. MANSQ determines the stage-flow release relationship using the Manning's equation for stream flow, while WSP uses hydraulically-linked cross sections in a backwater model to determine the relationship. WSP is similar to backwater models such as the U.S. Army Corps of Engineers' HEC-RAS program.

Velocity calibrations for each transect are performed using routines within the IFG4 model, usually at the mid-range flow. Where a low flow velocity set is also available, two models may be prepared, one to cover low flows and the other to represent mid-range to high flows. The range of simulated flows represented by each calibration set is determined by the hydraulic engineer based on the model's performance at the calibration flows and trends in hydraulic parameters such as water surface elevation and velocity. PHABSIM output such as Velocity Adjustment Factors (VAFs) for each simulated flow are plotted as smooth curves, with aberrations in these curves indicative of ranges boundaries for a given calibration flow. Typically, these fall toward extreme low or high flows in high gradient channels, at which point one of the other of the three calibration sets will be used to continue the model out to the extremes. The hydraulic engineer will review all hydraulic output and determine and document the acceptable range of simulated flows; this range usually extends from slightly below the low calibration flow to slightly higher than the high calibration flow. All hydraulic model output is reviewed by a second hydraulic engineer before being used in habitat modeling.

Habitat Suitability

Once the hydraulic model is calibrated, estimates of habitat suitability at each flow increment of interest will be generated by combining the HSI and

hydraulic model data using the HABTAE and supporting programs within PHABSIM. These ultimately produce output known as Weighted Usable Area (WUA) for each transect at each flow increment. WUA is an index of habitat suitability based on units of square ft of optimal habitat available per 1,000 ft of represented stream length. WUA output for all transects in a given mesohabitat type are then weighted according to actual linear distance each transect represents within the mesohabitat, as mapped in the field, to provide a mesohabitat habitat-flow curve. All mesohabitat WUA within a given study reach is then weighted and summed for each flow increment to provide a net WUA estimate for the entire study reach.

3.2.2 Fish Passage Study Site(s)

The TWC identified fish passage through shoals as a critical habitat concern, specifically at Millrace Rapids, a location where the LSR descends through a demolished mill dam at the Piedmont fall line boundary. This location is characterized by large rubble, boulder, and other object cover that produces complex hydraulics and interstitial flow that is difficult to model. The TWC concluded that an alternate approach will be required at this site. The objective at this site is to establish sufficient water depth to facilitate volitional upstream fish passage through the most limiting portion of the channel. SCE&G proposes to conduct a site visit with the study team during a period of low wadable flow when channel geometry and probable zone of passage routes can be readily be observed. The study team will then select a representative transect location at a critical passage site to allow characterization of hydraulics (wetted depth, width, and velocity) at a range of flows bracketing what the team feels will produce suitable fish passage conditions according to the established HSI criteria. The field crew will then proceed to obtain water elevation and velocity measurements at the transect at each flow of interest, with gauging data obtained from the USGS 02169000 gage, which is located in close proximity to Millrace Rapids. These data will then be displayed graphically and in tabular format to identify flows that promote hydraulics that can provide suitable fish passage.

4.0 REPORTING

A draft report will be prepared for study team review and comment, documenting methods and results as encountered in the field and during modeling. WUA and supporting hydraulic data will be presented in graphic and tabular form, along with an analysis of trends in the data, and documentation of study team consultation. Appendices will also include cross-sectional survey data and reference photographs of study sites. The report will be finalized and provided to the TWC following receipt of input from the study team.

5.0 USE OF STUDY RESULTS

Data developed from this study will be used as an information resource during discussion of relicensing issues with the SCDNR, NMFS, USFWS, NGO's, relicensing issue working groups, and other relicensing stakeholders. Upon receipt of the final report, the TWC may elect to apply these data to further analyses such as (see Appendix A for a detailed summary of discussions):

- A range of flows acceptable for target species and lifestages, as well as the downstream floodplain;
- Evaluate how flow ranges for the target species compare to the natural hydrograph of the LSR;
- Evaluate potential impacts of flow ranges for the target species on the Congaree River and its floodplain; and
- Provide input to the hydrologic, operational and other models for purposes of evaluating the costs and benefits of providing alternative flows to the lower Saluda River, including:
    - Effects of managing Lake Murray water levels on downstream habitat;
    - Impact of providing downstream flows on Lake Murray water levels; and
    - Effects of project operations on downstream habitat.

6.0 SCHEDULE

TASK	COMPLETION DATE
Finalize Target Species/Guilds	February 1, 2007
Finalize HSI Curves to be Used	February 15, 2007
Mesohabitat Characterization; Select Transect Locations	April 15, 2007
Collect Transect Data	May 15, 2007
Complete Modeling	July 15, 2007
Issue Draft Report	August 15, 2007
Issue Final Report	October 1, 2007

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Figure 1: Project Location
(Click Here to go Back to Section 1)

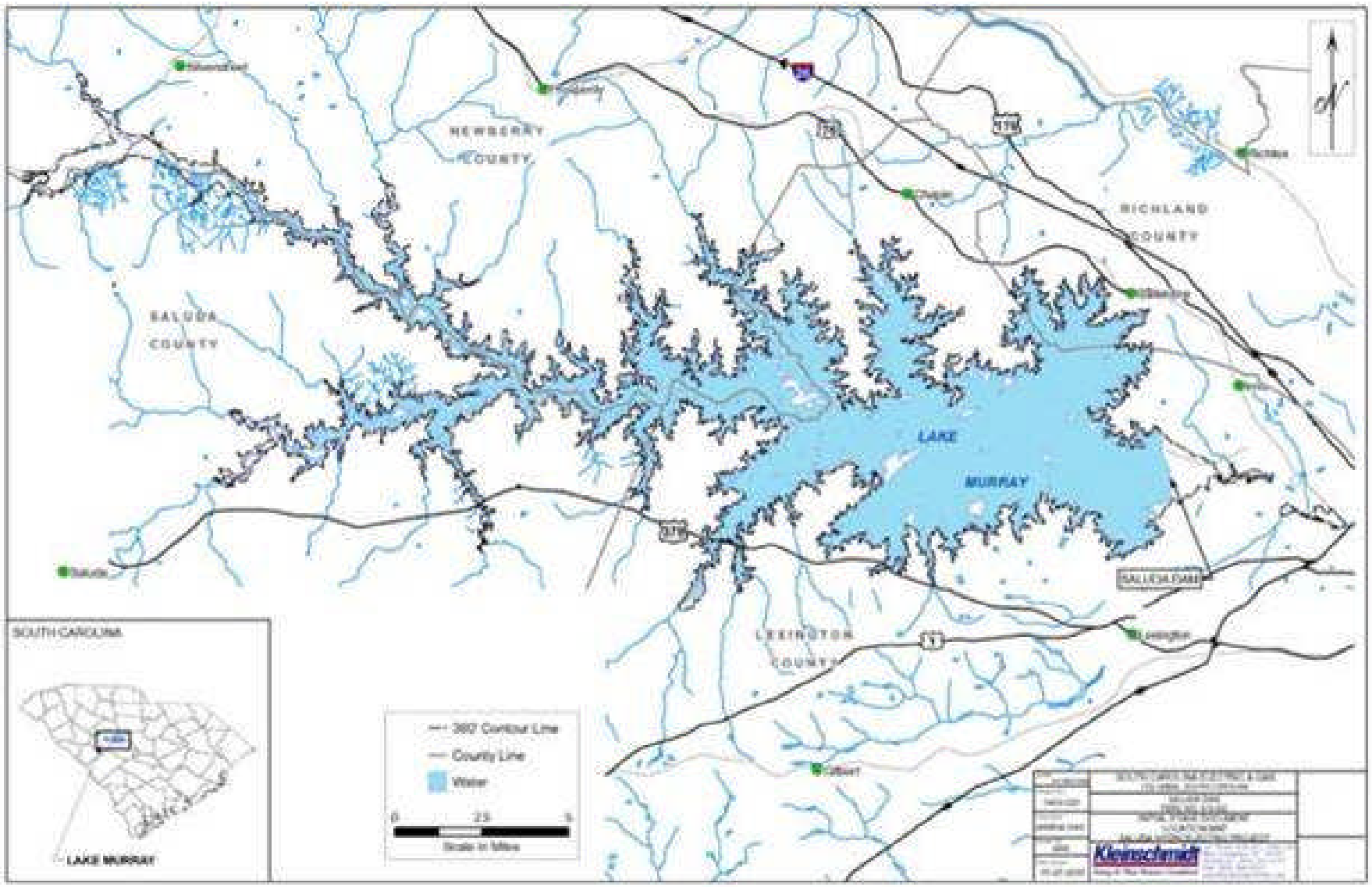
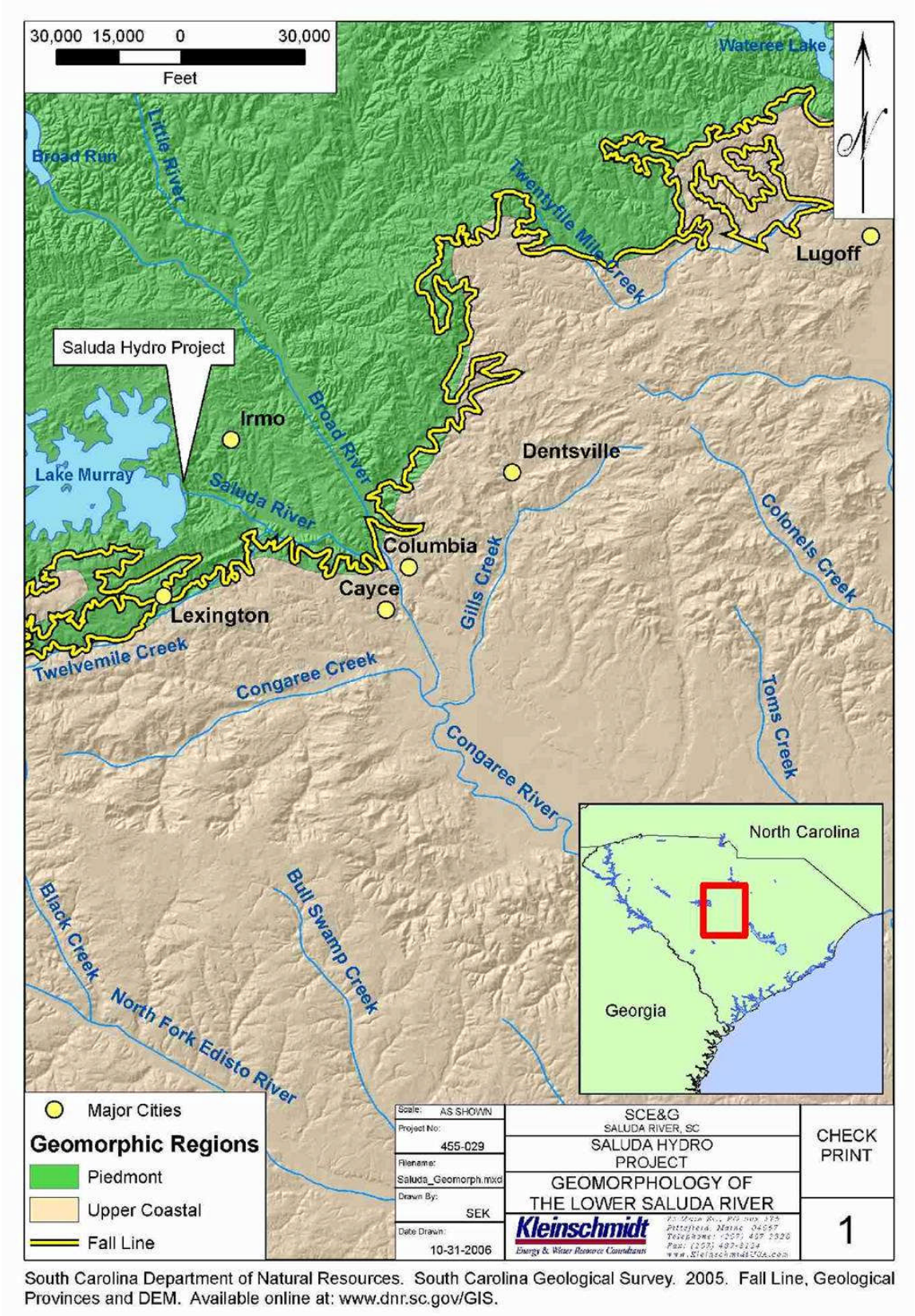


Figure 2: Lower Saluda River

(Click Here to go Back to Section 2)



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APPENDIX A

SALUDA HYDROELECTRIC PROJECT

INSTREAM FLOW/AQUATIC HABITAT

TECHNICAL WORKING COMMITTEE MEETING NOTES

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

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

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

Attachment B

1989-90 Lower Saluda River IFIM Study Plan

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
September 7, 2006

ATTENDEES:

Bill Argentieri, SCE&G
Randy Mahan, SCANA Services
Alan Stuart, Kleinschmidt Associates
Jeni Summerlin, Kleinschmidt Associates
Dick Christie, SCDNR
Amanda Hill, USFWS
Scott Harder, SCDNR
Shane Boring, Kleinschmidt Associates
Malcolm Leaphart, Trout Unlimited
Theresa Thom, National Park Service
Brandon Kulik, Kleinschmidt Associates
Ron Ahle, SCDNR
Gerrit Jobsis, Am. Rivers
Hal Beard, SCDNR

ACTION ITEMS:

- Provide Brandon Kulik with HSI curves used in 1989-90 LSR IFIM Study

Gerrit Jobsis

- Check with USC Geography Dept. for GIS habitat coverages for the LSR

Theresa Thom

- Provide Theresa Thom with bibliography of Congaree floodplain flow studies found thus far

Shane Boring

- Discuss acceptability of SCDNR flow proposal with SCE&G management

Bill Argentieri

- Contact MaryAnn Taylor to discuss potential for using existing LIDAR photography to develop GIS-based habitat layers

Shane Boring

DATE OF NEXT MEETING: **October 16th, 2006, at Lake Murray Training Center, beginning at 9:30 am.**

MEETING NOTES:

These notes serve as 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 9:30 AM with a review of action items from the last meeting (June 14). Specifically, Shane noted that he had completed the literature review for studies with potential to help address the National Park Service (NPS) request for floodplain flow studies to assess the impact of project operations on Congaree National Park. Shane indicated he would compile the studies he found into a bibliography, which he would forward to Theresa Thom. Theresa Thom indicated that she would compare the bibliography to NPS studies/data that she is aware of and report back to the group. Scott Harder noted that he had spoken with Bud Badr and that Bud was not aware of any additional studies.

In reference to the request for a comprehensive habitat assessment of shallow aquatic areas of Lake Murray, Shane noted that he had received contact info for MaryAnn Taylor (GIS Analyst, SCANA) from Bill Argentieri and that he would be contacting her in the coming week to discuss the potential for using the existing LIDAR photography to develop GIS-based habitat layers. Shane noted that he would report back to the group at the next meeting regarding this issue.

Shane then noted that, since Brandon Kulik was in attendance, the remainder of the meeting would focus on utilizing his knowledge of IFIM studies to review the existing Saluda study, assess its applicability to the current relicensing, and to define goals of any future IFIM study, if deemed necessary.

IFIM Goals for the Saluda River

Brandon encouraged the group to make IFIM goals as specific as possible. After some discussion, the group outlined the following as potential goals of an IFIM study:

- Identify a minimum flow for the Lower Saluda River (LSR)
- Determine flows needed for target species and lifestages, as well as the downstream floodplain
    - Determine the range of flows acceptable to meet these criteria
    - Determine how project operations affect these flows
    - Mimic the natural hydrograph of the LSR
    - Consider impact of providing these flows on Lake Murray

Malcolm Leaphart requested that reproduction of trout be included in any new IFIM analysis. Alan Stuart noted that a white paper outlining the habitat requirements for trout spawning is being drafted by Kleinschmidt and will be distributed to the TWC for review within the next couple of weeks. Dick Christie noted that, in additional to summarizing the needed habitat, the paper will summarize the agency management objectives for the LSR as they relate to trout reproduction.

Dick Christie noted the need to clearly define the "impact area" for any IFIM studies, noting that it likely extends beyond the Project Boundary. Gerrit Jobsis agreed and emphasized the need to consider the downstream floodplain when developing the IFIM goals.

Discussions of Target Species

Shane noted that, at the June 14th meeting, Ron Ahle had distributed a draft list of IFIM targets, which included both species and guilds (Attachment A). He added, and Brandon agreed, that typically either a species-specific or guild approach is used for such studies. Ron clarified, noting that the list was intended to be a starting point and that his preference was to take a guild approach, but also include certain priority species (i.e. smallmouth bass and threadfin shad). Amanda Hill noted the importance of keeping diadromous species on the list USFWS, adding that it may be acceptable to remove American eel. Gerrit recommended going back and looking at the HSI curves for compatibility with the guild approach. Gerrit agreed to provide Brandon with the HSI curves used in the previous study.

In reference to the species list category "other", Shane enquired as to whether generalized (multi-species) HSI curves exist for categories such as benthic macroinvertebrates and mussels. Dick noted that there are HIS curves for EPT's. Gerrit added that there were generalized curves for freshwater mussels that were used for the Duke Power relicensing.

After considerable discussion, it was determined that defining the specific target species/guild may not be possible at today's meeting. It was determined that the existing IFIM study should be reviewed more thoroughly and a determination made as to whether an additional study is needed. The group agreed to revisit the issue of target species/guild after such a determination is made.

Discussion of Existing IFIM Study and Need for Additional Study

The group then discussed the memo prepared by Brandon Kulik providing a critical review of the existing IFIM study (Attachment B). Brandon pointed out several aspects of the study that he feels need further clarification, including:

- Choice of HIS curves and how they were weighted;
- Number of curves (too many curves resulted in difficult interpretation of result); and

- Applicability of transects to current conditions (i.e. potential changes in stream geomorphology).

The group then briefly discussed the accuracy of the existing transect information relative to current conditions. Gerrit noted potential changes in the areas of the transects due to sedimentation, and added that he felt instream aquatic vegetation has also increased. Ron Ahle noted that there has been considerable channel widening in the upper LSR due to streambank erosion. Several group members enquired as to whether there are GIS layers and/or aerial photography that could be used to determine the degree of change in the transect areas. Shane indicated that he had recently conducted a search and was unable to find any GIS data. Theresa Thom noted that she would check with the Geography Department at USC for potentially applicable GIS layers. Gerrit and Ron A. subsequently suggested a possible field visit to determine the degree to which transects have changed.

Brandon Kulik noted that the model in the previous study was calibrated at low flows, thus the accuracy of the model likely starts to decrease at flows greater than 1000 cfs. Gerrit noted that, during execution of the study, Jeff Isely did have problems with calibrations and thus limited the flow range to lower flows. Scott Harder added that SCDNR has concerns about model accuracy in riffle and pool areas at higher flows.

Dick Christie reiterated the flow proposal provided by SCDNR in their comments on the ICD. Specifically, he noted that SCE&G could forego an additional IFIM study if they implement the proposed flow of 1170 cfs during the month of January through April, 879 cfs during May and June, 586 during July through November, and 879 cfs during December. Dick added that these flows are based on the SC State Water Plan and were developed using the 20%, 30%, 40% method (of mean annual flow). Several group members noted that, despite the many shortcoming that have been pointed out, the flows recommended in the existing IFIM study report (1326 cfs January – April; 950 cfs May – June; 575 cfs July – November; 950 cfs in December) are very similar those being proposed by SCDNR.

Gerrit Jobsis noted that he would have to give some consideration as to whether his group would be satisfied with the flows being proposed by SCDNR, adding that he would prefer the flows recommended through study of the Saluda River by the Water Resources Commission/Wildlife and Marine Resource Department (Bulak, J.S. and G.J. Jöbsis. 1989[1]) as this study provides site-specific information (i.e. on channel morphology, fish passage, hydrography). Bill Argentieri noted that the project is being operated much differently than when these site-specific recommendations were

[1] Bulak, J.S. and G.J. Jöbsis. 1989. *South Carolina instream flow studies: a status report*. South Carolina Wildlife and Marine Resources Department. 51 pages.

developed. Alan Stuart pointed out that the primary difference between the two proposals is the magnitude of the high flow period (1170 vs. 1326 cfs). Gerrit added that the higher flow in the report was based on providing passage for adult striped bass at Millrace Rapid, the most limiting area. He clarified that the recommendation was based on development of a stage – discharge relationship, which took into consideration a number of site-specific factors (i.e., wetted perimeter, depth needed for adult passage, natural hydrography). The existing IFIM study took measurements at Corley's Island and Millrace Rapids and verified that Millrace was the most limiting.

Gerrit added that the existing study does not take into the account potential negative impacts associated with infrequent higher flow (> 10,000 cfs), adding that this should be taken into account in any future studies. Attendees added that the frequency, duration, and magnitude of such flow should also be taken into consideration. Amanda Hill and Gerrit cited the potential for using a dual flow analysis to address this issue. Gerrit and others also raised interests in how project operations affect the Congaree River, e.g. striped bass and diadromous fish spawning, flows for floodplains and the Congaree National Park, that would not be addressed under the DNR proposal.

After some discussion, it was determined that there are too many uncertainties with the existing study. The group then began to discuss what the next steps should be considering this decision. It was determined that it is up to SCE&G to determine whether proposed flow regime is acceptable. Agency staff noted that if the proposed flows are deemed not acceptable, SCE&G will need to conduct an additional IFIM study. Bill Argentieri agreed to discuss the proposed flows with SCE&G management and report their decision back to the group. Bill requested, and the group agreed, to give SCE&C until mid to late-October to evaluate the proposal.

Date/Location of Next Meeting

The group agreed that the next Instream Flow TWC meeting will occur on October 16th, 2006 at the Lake Murray Training Center, starting at 9:30 AM. Shane B. will send out an electronic meeting announcement confirming date, time and location. The meeting adjourned at approximately 3:00pm.

Attachment A

Proposed List of IFIM Target Species/Guilds
(Source: SCDNR)

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
Division of Wildlife and Freshwater Fisheries
Environmental Programs Office

Guild Approach

1) Shallow Slow Guild (<2 ft, <1 ft/sec); redbreast sunfish spawning
2) Shallow Fast Guild (<2 ft, >1 ft/sec); margined madtom, Saluda darter
3) Deep Slow Guild (>2 ft, <1 ft/sec); redbreast sunfish adult
4) Deep Fast Guild (>2 ft, >1 ft/sec); shorthead redhorse

Potential Stand Alone Species

1) Diadromous Fish
    a. American shad
    b. Blueback herring
    c. Striped bass
    d. Shortnose sturgeon
    e. American eel
2) Resident Fish
    a. Robust redhorse
    b. Highfin carpsucker
    c. Northern hogsucker
    d. Spotted sucker
    e. Brown trout
    f. Rainbow trout

3) Others
    a. Native mussels
    b. Benthic macro-invertebrates
    c. Spider lily

REMBERT C. DENNIS BUILDING * P.O. BOX 167 * COLUMBIA, SC 29202
TELEPHONE: (803) 734-2728 * FACSIMILE: (803) 734-6020

Attachment B

Memo: Technical Review of Existing Lower Saluda River Instream Flow Study
(Source: Brandon Kulik, Kleinschmidt Associates)

Kleinschmidt
Energy & Water Resource Consultants
40 YEARS 1966 - 2006

MEMORANDUM

TO: Instream Flow/Aquatic Habitat Technical Working Committee (TWC)

FROM: Brandon Kulik, Kleinschmidt Associates

DATE: July 31, 2006

RE: Review of Lower Saluda River Instream Flow Study

It is my understanding that TWC is interested in evaluating how much of the study entitled "*Instream Flow Requirements for the fishes of the lower Saluda River*" dated March 28, 1995 can be applied to contemporary relicensing decisions about the Saluda Hydroelectric Project. The stated purpose of this study was "*to evaluate the effects of rate from the Lake Murray Dam on the amount of suitable habitat for fishery resources of the LSR*".

At your request I have reviewed the report, and am providing some observations.

General Comments

The field study and methods of computer modeling as described appear to generally adhere to methods described by Bovee (1982), and thus the raw Weighted Usable Area (WUA) vs. flow relationships are probably reasonable at least for the lower flow range. A few aspects of this report, that at face value may not be entirely consistent with study design elements recommended by Bovee, *et al.* (1998), may or may not affect how the extrapolated and weighted WUA data in the existing report can be used, but to start the discussion, I have flagged a few of these items as they may be worth group discussion.

Specific Comments

The following comments are arranged by report topic heading.

1. *Study Area:* The overall study area boundaries appear logical, as it extends from the point of flow control (Lake Murray Dam) to the influence from another large and independent source of flow (Broad River).

    a. The report does not clearly articulate a rationale for establishing the boundaries for the three reaches. It appears that the reaches were divided into thirds. Reach boundaries are typically placed where there is a shift in conditions that may influence hydraulics (*e.g.* river channel morphology, slope), habitat (geomorphology, dominant cover, substrate, or mesohabitat composition), or hydrology (contribution of tributary inflow, such as a 10% increase in flow or drainage area) (Bovee, *et al*., 1998).

b. It is not clear from the description (pp 6-7) if model output was weighted according to the relative linear abundance of each habitat type (see Table 2) within each reach or globally for the entire study area (*i.e.* all three reaches combined). Reach weighting can influence the shape of the wetted area and WUA curves.

c. Model results obtained in rapids and riffles usually will show a different sensitivity to flow changes from pools and runs. However, frequently, certain species and lifestages may only use a subset of the overall habitat types. The report as written leads to a conclusion that all habitats were blended together for each lifestage to develop a WUA curve. Thus it may be worth some group discussion to clarify how this was handled.

2. *Target Species and Criteria*

a. Fish Passage: An adult striped bass habitat Suitability Index (SI) was used as a criterion for shoal zone-of-passage passage requirements. This SI curve is driven by the resting and foraging requirements of a large pelagic predator. For the purpose of fish migration passage, it may be worthwhile to consider other criteria such as zone-of-passage criteria in natural channels set forth by Bovee (1982), and/or principals of ichthyomechanics and hydraulics (Clay 1995, Bell 1991).

b. Brown trout and rainbow trout: I note that the spawning lifestage for trout is employed, which I take to mean that there is a management objective to establish or maintain a wild population of these species. If so, both fry and juvenile lifestages for these species should also be included but were not. Because spawning/incubation, and fry lifestages of these species occur only for a limited portion of the year; these WUA curve should probably not be employed as part of a blended year-round flow recommendation, but assigned to a time series that targets applicable weeks or months when the lifestage is specifically expected to be present (see suggested matrix below). Because salmonids are not habitat generalists, this analysis would also benefit by documenting the following:

i. Does fishery management rely on natural reproduction?
ii. Does suitable macrohabitat and mesohabitat exist to support each lifestage?
iii. Is suitable fry and YOY habitat available in contiguous reaches?
iv. Can fry and YOY lifestage flows be evaluated and applied during appropriate months?

c. Suitability Index Criteria (*general comment*). SI criteria appear to generally be taken from the literature with no transferability evaluation. For example, Raleigh (1984 and 1986) criteria for brown and rainbow trout were primarily developed from general literature and habitat studies on large western rivers. Use of these criteria on dissimilar ecosystems and

regions without some documented transferability assessment, while expedient, has been criticized in many recent IFIM studies (Bovee, *et al.* 1998, K. Bovee, personal communication). The TWC may wish to discuss overall comfort using such curves.

3. *Discharge Measurements:* Three calibration flows were employed to construct this model, with a single set of calibration velocities taken at the lowest of the three flows. For purposes of a low-flow IFIM model this is probably adequate; however. The accuracy of model hydraulics as flow approaches the middle-to-higher flow range is potentially questionable without further documentation that Velocity Adjustment Factors fell within an acceptable range. The report should explicitly state the range of modeled flows that meet hydraulic accuracy standards. If greater accuracy is deemed important at higher flows, there may be cost effective ways to obtain such data.

4. *Presentation of WUA Data*

These are just some observations about how the WUA results are presented and how that could be enhanced to support decision-making.

a. Although the general statement is made that "*WUA increased rapidly to maximum levels for flows between 300-1000 cfs for most species and life stages…*", this is still a wide range, perhaps due mostly to the blending of species/lifestages, habitat types, and timeframes together. Optimizing habitat for one species at 300 cfs may impair habitat suitability for others that are optimized at higher flows, and visa versa. Also, not all species/lifestages coexist at the same time and in all habitats. Thus the analysis should provide a biological rational for:

   i. Prioritizing species/life stages or at least balancing trade-offs when conflicting WUA curves occur (Bovee 1982, Bovee et al. 1998).
   ii. Correlating species/lifestages to applicable seasonal or monthly periods so seasonally varying flows can be assessed (see example matrix attached below).

b. WUA data are only presented in a "normalized" (*i.e*. percent-of-optimal format) in the main body of the report. (I realize that they are presented in Appendix I as individual graphs, but in that format the relative WUA comparisons among lifestages are difficult to make). Easily viewing the relative magnitude of WUA potentially available at a given flow among species and lifestages would facilitate prioritization of species and lifestages so that inter-lifestage trade-offs can be better evaluated. Along those same lines, WUA data are presented only in graphs; tabular WUA data would enhance the assessment of trade-offs at the finer increments of flow ranging in the zone of interest, and enhance flow recommendations and negotiation.

c. A flow recommendation using a percentage of "optimal" WUA as the sole metric, can potentially be difficult to defend, because optimal WUA is merely an artifact of stream geometry hydraulics and SI information that doesn't factor in site-specific, seasonally varying flow availability. For example, if a flow supporting "optimal" WUA is an infrequent event, then an alternate habitat metric might be the amount of WUA that results from the naturally occurring median for the time increment of interest (*i.e.* seasonal, annual, monthly).

5. *Suggestions*

Model Accuracy

Two primary areas that PHABSIM models are most sensitive to error or bias are in SI criteria, (especially depth and velocity curves), and in how results obtained from study reaches and mesohabitat types are weighted (J. Henrikson, USGS/MESC, personal communication). Related to this is study site stability. If, (as noted by Ron Ahle on June 14, 2006), the river channel geometry has changed, then it would be worth re-surveying at least a subset of the transects to confirm if that has happened, and if it has, the extent to which the potential for past data to be transferable may be lost. If the channel profile details have shifted, but the overall geometry, slopes and widths remain similar, the differences may not be significant.

Assuming the transects remain representative of current and anticipated future conditions, secondary area for potential error in this instance could be in extrapolation of hydraulic data from calibration data.

SI Criteria

The TWC may wish to evaluate if the SI criteria applied to the original model is sufficiently accurate for this application, and update and/or refine criteria if needed. In some cases, new SI criteria may need to be developed to account for new species or lifestages identified at the June 14, 2006 TWC meeting.

Reach Weighting

The TWC may wish to seek clarification as to how individual reach WUA/flow curves were weighted together, and make revisions if deemed necessary. Also consider looking at transect data representing individual mesohabitats that best correlate to use by guild groups and/or lifestages identified at the June 14, 2006 TWC meeting. To the extent supporting data exists, the TWC may wish to re-analyze and re-calculate WUA's. For some species objectives, such as the wild trout fishery some additional habitat mapping and transect data collection may be required, at least to account for early lifestages.

Hydraulic Model Calibration

Of the three calibration data sets, only the low flow contains velocity as well as stage data. The other flows have stage data only. Assuming that the historic transects are found to still be representative of existing channel conditions, the TWC may wish to assess if additional velocity data at a higher flow are necessary to satisfactorily calibrate the model throughout the entire flow range of interest. If the historic transects are adequately geo-referenced, then additional velocity data may be readily collected.

Flow Analysis

Contemporary instream flow recommendations typically recommend flows or flow targets that vary seasonally, rather than provide a single flat minimum flow (Annear et al., 2000). The conventional problem-solving steps would be to:

1. Time series: prioritize species /lifestages according to management objectives, season of occurrence within and throughout the study reaches so that trade-offs among species, lifestages and other water uses can be assessed.
2. Establish a benchmark flow for each month (or season) that represents "typical" inflow for that period, such as a median (50^{th} percentile) flow.
3. Develop a matrix, by month or season (if applicable), of flow and species and lifestages present (see attached example).
4. Based on that flow matrix, select the discharge corresponding to the lowest-flow period during which each species and lifestage is present.
5. Calculate the ambient WUA occurring during that flow period. The month featuring the lowest WUA value is the naturally-occurring maximum WUA and should be used in comparisons. For some species and lifestages, this may require breaking out WUA results from separate habitat types contained in the model.

These next two steps are iterative:

6. Compare WUA produced under alternative flow releases to determine which alternatives provide an acceptable amount of WUA relative to what would exist compared to the naturally-limiting monthly or seasonal WUA.
7. Based on the prioritizations established under steps 1 and 2, determine what species/lifestage(s) drive the flow recommendation for each month, and what the trade-offs if any are to other lifestages and human water uses. If further balancing is required, return to step 6 and assess a different scenario.

Hypothetical Times Series Prioritization Matrices
(N*ote: For illustrative purposes only; seasonality and flow information will be refined in coordination with the TWC.)*

Species- Based Prioritization Matrix

Month	LSR median flow (cfs)	American shad	blueback herring	striped bass	shortnose sturgeon	American eel	robust redhorse	highfin carpsucker	northern hogsucker	spotted sucker	brown trout	rainbow trout
January	1,930			x		x	x	x	x	x	x	x
February	2,090	x	x	x	x	x	x	x	x	x	x	x
March	2,250	x	x	x	x	x	x	x	x	x	x	x
April	1,100	x	x	x	x	x	x	x	x	x	x	x
May	745	x	x	x		x	x	x	x	x	x	x
June	843			x		x	x	x	x	x	x	x
July	1,250			x		x	x	x	x	x	x	x
August	1,330			x		x	x	x	x	x	x	x
September	1,380			x	x	x	x	x	x	x	x	x
October	1,570			x	x	x	x	x	x	x	x	x
November	1,526			x	x	x	x	x	x	x	x	x
December	1,760			x		x	x	x	x	x	x	x

Early Lifestage (ELS)- Based Prioritization Matrix									
Month	**LSR median flow (cfs)**	**Robust Redhorse ELS**	**highfin carpsucker ELS**	**northern hogsucker ELS**	**spotted sucker ELS**	**brown trout spwn & incub.**	**brown trout ELS**	**rainbow trout spwn & incub.**	**rainbow trout ELS**
January	1,930						x		
February	2,090						x	x	
March	2,250						x	x	
April	1,100							x	
May	745	x	x	x	x				x
June	843	x	x	x	x				x
July	1,250	x	x	x	x				x
August	1,330								
September	1,380								
October	1,570					x			
November	1,526					x			
December	1,760					x			

Guild - Based Prioritization Matrix

		shallow slow guild	*shallow fast guild*		*deep slow guild*	*deep fast guild*
Month	**LSR median flow (cfs)**	**redbreast sunfish spawning**	**margined madtom**	**Saluda darter**	**redbreast sunfish adults**	**shorthead redhorse**
January	1,930		x	x	x	x
February	2,090		x	x	x	x
March	2,250		x	x	x	x
April	1,100		x	x	x	x
May	745	x	x	x	x	x
June	843	x	x	x	x	x
July	1,250		x	x	x	x
August	1,330		x	x	x	x
September	1,380		x	x	x	x
October	1,570		x	x	x	x
November	1,526		x	x	x	x
December	1,760		x	x	x	x

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
SALUDA HYDRO PROJECT RELICENSING
IFIM/Aquatic Habitat TWC

SCE&G Training Center
October 16, 2006

Final acg 11-22-06

ATTENDEES:

Alison Guth, Kleinschmidt Associates	Bill Argentieri, SCE&G
Alan Stuart, Kleinschmidt Associates	Randy Mahan, SCANA Services, Inc.
Ron Ahle, SCDNR	Scott Harder, SCDNR
Dick Christie, SCDNR	Hal Beard, SCDNR
Shane Boring, Kleinschmidt Associates	Brandon Kulik, Kleinschmidt Associates
Malcolm Leaphart, TU	Gerrit Jobsis, American Rivers

HOMEWORK:

- Perform literature review for existing studies on widths and depths necessary for fish passage – *Brandon Kulik*
- Distribute draft IFIM study plan to group by email prior to 27th meeting – *Brandon Kulik*
- Send Catawba Wateree HSI curves to Brandon K - *SCDNR*
- Forward Brandon K. an example list of species to be considered under each guild - *SCDNR*
- Send Pee Dee HSI curves to Brandon K. – *Gerrit Jobsis*

UPCOMING AGENDA ITEMS:

- *Addressing the influences of Saluda Operations on the Congaree*

DATE OF NEXT MEETING: **November 27, 2006 at 9:30 a.m.**
Lake Murray Training Center

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.

Review of Homework Items from Previous Meeting:

Shane Boring opened the meeting and noted that the first discussion topic was to review action items from the previous meeting. Shane noted that Gerrit Jobsis was charged with finding the HSI curves used in 1989-90 LSR IFIM Study. Gerrit replied that they could be found in the study

report. Shane also noted that he had talked to Theresa Thom regarding her homework assignment to check with USC Geography Dept. for GIS habitat coverages for the LSR. Shane explained that she was not able to find any GIS habitat layers. Shane also noted that he has contacted MaryAnn Taylor to discuss potential for using existing LIDAR photography to develop GIS-based habitat layers, as was his homework assignment. He noted that Clarence at Orbis was investigating this issue.

Discussion About the Meeting Topic:

The group then discussed the recommendations for instream flows that DNR presented in their ICD comments (1170 cfs during the month of January through April, 879 cfs during May and June, 586 during July through November, and 879 cfs during December). Bill Argentieri noted that SCE&G has reviewed the flow options presented. Bill noted that the flows that were proposed were apparently reflective of the USGS gage at the lower end of the confluence, adding about a hundred sq. miles to the drainage area. Bill explained that based on the 20/30/40 proposal, SCE&G came up with 493 740 and 986 cfs based on the gage directly below the dam. Bill also reiterated that at the last meeting Gerrit provided numbers from the study of the Saluda River by the Water Resources Commission/Wildlife and Marine Resource Department (Bulak, J.S. and G.J. Jöbsis. 1989) which are 575 950 and 1326 cfs. Gerrit noted that the numbers provided in the report are based on physical measurements from the Saluda river to meet the criteria for passage.

As the group began to discuss the existing DNR IFIM report in a little more detail, Dick Christie gave the group a little more background to the report. Dick noted that when the study was done in the 80's, there was only one gage on the lower Saluda River, the gage down by the zoo. He noted that mean daily flow was calculated from that gage. Dick noted that when DNR made the flow recommendations they were actually recommendations for that site in particular, so by default there is a little bit of inflow between the dam and that gage. Dick continued to explain that there may be room for calculating and that they would support the updating of the numbers if the group can come to terms of doing that. Dick asked Bill if SCE&G had developed their flow estimates by subtracting what was calculated to be the drainage area. Bill replied that they had. Gerrit noted that they have dealt with this in the past by using the monthly calculated inflow rather than annual averages, because the drainage areas would have less contribution in the summer.

The group then began to discuss what would be involved in performing a new site specific test. Gerrit suggested a real time analysis to look at the habitat available, looking at flows not based on annual average but on daily or hourly flows. Bill pointed out that the new study would probably not be performed before next year due to the low lake levels. Dick noted that the transects could probably be laid out and the low flow data could be obtained, while the high flow data could be reserved for times when the lake level is higher. Gerrit noted that he believed that the fish passage transects provided in the Bulak, J.S. and G.J. Jöbsis 1989 study were important to consider. He explained that a panel of experts was assembled to weigh in on what they felt was necessary for

unimpeded fish passage. At that time the panel felt that a 10 ft wide, by 18 inch deep slot was necessary for this, or 10% of the channel width. Alan Stuart asked the group if there have been any studies preformed that further address passage. Brandon Kulik noted that he does know of a few studies that they could look into. Brandon also noted that a mesh model could be developed at the rapids that would allow the rapids to be modeled probably better than transects.

Dick noted that he was curious as to whether consideration was given to the time or timing on the flows for fish passage in the existing IFIM report. Hal Beard was asked to give an account of his experience fish sampling on the lower Saluda. Hal noted that based on the years that he has worked, both drought and normal, he has not seen an absence of striped bass in the river. However he noted that he could not comment as to the relative abundance of striped bass. He mentioned that he could compare the data he collected to flows.

Malcolm Leaphart asked for an reiteration as to why the flows had been requested for those particular times during the year. Dick noted that the 20/30/40 recommendation is based on a typical hydrograph and is also something that the utilities are able to implement.. Dick continued to explain that if you look at a typical hydrograph you will see the highest flows are in the spring, and that it is commonly understood that the fish have probably adapted to the hydrograph. Thus, the policy should be adapted to the hydrograph, to which the fish have adapted to.

Presentation and Review of Scoping Elements:

After a short break, Brandon gave a brief presentation on PHABSIM. (Can be viewed on the website). Alan suggested reviewing the video flyovers to help decide what areas to use in the study and what reach breaks to use. Brandon explained that during a study they would have to come up with commonly understood definitions of runs and riffles along the lower Saluda.

After lunch the group discussed the 7 basic instream flow study scoping elements, listed below.

BASIC INSTREAM FLOW STUDY SCOPING ELEMENTS

1. Specify habitat and resource management objectives
2. Define geographic boundary of study area
3. Define type of problem (*i.e*. diversion, maintenance of minimum flow, alteration of existing flow regime, *etc*)
4. Define macrohabitat influences (*e.g*. water quality, temperature, etc.)
5. Select and justify evaluation criteria
6. Define temporal periods and units
7. Define flow ranges and increments of interest

During discussions on item number 2, defining geographic boundary of study area, Gerrit noted that he believed the Congaree river was important to consider as well. Gerrit further asked that the group have an agenda item at an upcoming meeting to specifically address Saluda's potential influence on the Congaree.

Brandon moved to item number three, Define the type of problem. Dick explained that it could be defined as the alteration of an existing regulated flow. He also asked if there would be an evaluation of peaking included in the study. It was explained that peaking over a 12 hour period would have quite a different impact than peaking over a 1 hour period (Reserve usage). The group noted that the duration of high flows would be taken into account in a dual flow analysis.

The group progressed through the scoping elements, pausing for brief discussion on number 6. Ron noted that he preferred the idea of initially taking smaller temporal units and lumping them together if need be. Gerrit suggested using the same temporal periods for setting up life stages as used in the Pee Dee. Brandon noted that there were advantages to using monthly units, and asked the group if they would like the units to be smaller than that.

The group discussed how to look at the reserve component during this study. Brandon noted that if reserve is used for only a few hours there is probably some sort of measurable effect just below the powerhouse, however these effects will probably attenuate throughout the stretch of river. The group agreed that in order to best look at the reserve use is to have a few transects close to the dam.

On item 7, Alan noted that the flow range would be up to 20,000 cfs, or what the top-end of the potential upgrade is going to be.

Discussion of Proposed Target Species List:

The group then began to discuss the Proposed Target Species list and the group interactively changed a few items (attached below). Brandon noted that it would be helpful to begin mapping out the different life stages for diadromous fish at different months of the year, as well as what type of meso-habitat is necessary.

As the group discussed the proposed target species, the guild approach as well as potential stand alone species, it was noted that an HSI curve did not exist for the Saluda Darter, so a surrogate curve would have to be used for that species. The group noted that general HSI curves would be used, unless specific curves were needed for a species. A list of the individual species contained in each HSI curve will be made as well. The group emphasized keeping the amount of species considered at a manageable level that the group could comfortably handle. Alan asked the group if there were any species that are not on the target species list that should be. The group indicated that the list was satisfactory. Kleinschmidt Associates will look at combining some of the species, where applicable. Concurrently, the agencies will also look at obtaining HSI curves from Catawba

Wateree data. SCDNR will also send an example to Brandon of a list of species considered under each guild. Gerrit will forward the Pee Dee HSI curves to Brandon.

Brandon noted that he felt comfortable drafting a study plan with the information gleaned from the meeting and the group closed. Brandon noted that he would send out the study plan for review prior to the next meeting. The group scheduled the next meeting date for November 27th at the Training Center.

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
SALUDA HYDRO PROJECT RELICENSING
IFIM/Aquatic Habitat TWC

SCE&G Training Center
October 16, 2006

Final acg 11-22-06

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
Division of Wildlife and Freshwater Fisheries
Environmental Programs Office

MEMORANDUM

To: L & LM TWC (Saluda Hydro Project)
From: Ron Ahle
Date: 5-05-06
Subject: Proposed Species List for IFIM Study

Guild Approach - use Catawba-Wateree and possibly Pee Dee curves

1) Shallow Slow Guild (<2 ft, <1 ft/sec); redbreast sunfish spawning
2) Shallow Fast Guild (<2 ft, >1 ft/sec); spottail shiner, ~~margined madtom~~,
3) Deep Slow Guild (>2 ft, <1 ft/sec); redbreast sunfish adult
4) Deep Fast Guild (>2 ft, >1 ft/sec); shorthead redhorse

Potential Stand Alone Species

1) Diadromous Fish
    a. American shad
    b. Blueback herring
    c. Striped bass
    d. Shortnose sturgeon
2) Resident Fish
    a. Robust redhorse (golden redhorse)
    ~~b. Highfin carpsucker~~
    c. Northern hogsucker
    d. Spotted sucker
    e. Brown trout
    f. Rainbow trout
    g. Threadfin/Gizzard shad
    h. Smallmouth bass
    i. Saluda darter (fantail darter)
3) Others
    a. Native mussels (wetted perimeter study)
    b. Benthic macro-invertebrates (EPT)

Deleted: Saluda darter

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Deleted: <#>Spider lily¶

REMBERT C. DENNIS BUILDING * P.O. BOX 167 * COLUMBIA, SC 29202
TELEPHONE: (803) 734-2728 * FACSIMILE: (803) 734-6020

MEETING NOTES

SOUTH CAROLINA ELECTRIC & GAS COMPANY
SALUDA HYDRO PROJECT RELICENSING
Instream Flow/Aquatic Habitat Technical Working Committee
SCE&G's Lake Murray Training Center
January 22, 2007

Final CSB 04-02-07

ATTENDEES:

Bill Argentieri, SCE&G
Alan Stuart, Kleinschmidt Associates
Milton Quattlebaum, SCANA Services
Jeni Summerlin, Kleinschmidt Associates
Amanda Hill, USFWS
Ron Ahle, SCDNR
Gerrit Jobsis, AR/CCL
Shane Boring, Kleinschmidt Associates
Brandon Kulik, Kleinschmidt Associates
Hal Beard, SCDNR
Scott Harder, SCDNR

ACTION ITEMS

- Incorporate comments into the Instream Flow Study Plan and send out to all committee members for review

Shane Boring

- Determine whether HSI curves are available for gizzard shad in riverine systems, and if so, distribute to TWC

Shane Boring/Brandon Kulik

- Email Prescott Brownell about whether it would be applicable to use the Catawba-Wateree shortnose sturgeon HSI curves for the Saluda IFIM study

Amanda Hill

- Compile potential source HSI substrate curves and distribute to TWC prior to Feb. 21 meeting

Shane Boring/Brandon Kulik

- Construct plots of finalized HSI curves (Depth/Velocity for smallmouth bass, rainbow trout, brown trout)

Shane Boring/Brandon Kulik

NEXT MEETING

February 21, 2007 at 9:30am
Location: Lake Murray Training Center[1]

[1] This meeting date was later cancelled.

MEETING NOTES:

These notes serve as 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 10:00 AM and noted that the purpose of today's meeting will be to discuss: (1) HSI criteria for guilds, (2) HSI criteria for stand-alone species, and (3) the next steps that need to be taken for the IFIM study. He briefly reviewed the action items from the previous meeting. Shane noted that he was currently incorporating comments made on the IFIM study plan and would send it back out to committee members within the next week for comments.

Review of HSI Criteria for Guilds

Shane noted that the species guild matrix had been revised based on comments from the previous IFIM meeting and distributed a revised matrix. The group then reviewed the updated matrix, and after several additional revisions, agreed that the following guild approach was acceptable:

Deep Slow Guild

species	life stage	SI curve source
American shad	YOY	Catawba-Wateree
blueback herring	spawning	
blueback herring	YOY	
Norrthern hogsucker	adult	
redbreast sunfish	adult	
robust redhorse	juvenile	
robust redhorse	adult	
spotted sucker	juvenile	
spotted sucker	adult	

Deep Fast Guild

species	life stage	SI curve source
American shad	YOY	Catawba-Wateree
American shad	spawning	
Norrthern hogsucker	spawning	
Norrthern hogsucker	fry/YOY	

Norrthern hogsucker	juvenile
shorthead redhorse	adult
spottail shiner	adult

Deep Fast Guild

species	**life stage**	**SI curve source**
benthic macroinver.	juvenile	Catawba-Wateree
robust redhorse	spawning	
saluda darter	adult	
spottail shiner	spawning	
spotted sucker	spawning	

Deep Fast Guild

species	**life stage**	**SI curve source**
redbreast sunfish	spawning	Catawba-Wateree
robust redhorse	fry/YOY	
spotted sucker	juvenile	
spotted sucker	fry/YOY	

There was a brief discussion about whether to add threadfin shad to the list of target species. It was noted that HSI curves were not available for threadfin shad, but that gizzard shad could potentially serve as a surrogate. Alan Stuart and others noted that the existing gizzard shad HSI curves were developed for reservoir habitats, not riverine systems. After some discussion, it was determined that availability of appropriate riverine HSI curves for gizzard shad should be evaluated prior to determining whether this species can serve as an appropriate surrogate for threadfin shad. The group agreed to withhold a determination on whether or not threadfin shad should be included until after this information is evaluated.

Review of Habitat Suitability Criteria (HSC) for Stand-Alone Species

Brandon Kulik noted that a memorandum regarding HSC for stand-alone species was sent out on January 16, 2007 to all committee members (Attachment A). He noted that this memorandum summarized HSC curves for smallmouth bass, rainbow trout, and brown trout from a number of potential source studies for purposes of evaluating transferability to the lower Saluda study. He noted that TWC members should consider their field experience/observations regarding the target species and the lower Saluda River in evaluating applicability of the potential source curves. The group examined the HSC curves for each species and lifestage for both depth and velocity. The group agreed to use the following HSC curves for the following species:

Species	Life Stage	Parameter	SI Curve Source
brown trout	adult	Depth	Combination: Housatonic (poor), Deerfield
	adult	Velocity	Lackawaxen, w/modifications
brown trout	fry/YOY	Depth	Deerfield
	fry/YOY	Velocity	Deerfield
brown trout	juvenile	Depth	Combination: Deerfield, Raleigh
	juvenile	Velocity	Combination: Lackawaxen, Deerfield
brown trout	spawning	Depth	Raleigh
	spawning	Velocity	Raleigh w/modifications
rainbow trout	adult	Depth	Deerfield
		Velocity	Deerfield (abundant)
rainbow trout	fry/YOY	Depth	Raleigh
		Velocity	Raleigh
rainbow trout	juvenile	Depth	Lackawaxen
		Velocity	Lackawaxen
rainbow trout	spawning	Depth	Raleigh
		Velocity	Raleigh
smallmouth bass	adult	Depth	Combination: Groshens & Orth, Bain
		Velocity	Combination: Groshens & Orth, Deerfield (abundant)
smallmouth bass	juvenile	Depth	Combination: Bain, Deerfield w/modifications
		Velocity	Deerfield (abundant)
smallmouth bass	spawning	Depth	Lockhart
		Velocity	Lockhart
smallmouth bass	YOY	Depth	Combination: Groshens & Orth, Bain
		Velocity	Combination: Deerfield, Bain

Zone of Passage for Striped Bass

Brandon suggested that the minimal flow limiting passage requirement for a fish would be an adequate amount of water so that the body of the fish is submerged. A maximum flow limiting factor for passage would be a high velocity that exceeds the fish's sustained swimming strength. Gerrit noted that there are striped bass passage standards for South Carolina. He explained that according to the standard, river must be 18 inches in depth for a 20 pound striped bass, with a 10 ft

width, covering 10 % of the channel. Hal Beard noted that he thinks there may only be one year in which striped bass were not able to make it up the lower Saluda River past Millrace Rapids. Hal noted that it may have occurred in the months of May/April of 1991. This was because Saluda Hydro was not releasing. Brandon presented a spreadsheet model from the USGS Conte Lab paper (Attachment B) that described limiting velocities for striped bass passage based on fish size and ambient water temperature.

Next Steps

Brandon noted that the group would need to also agree upon appropriate substrate HSC curves. The group agreed that discussion of potential source curves for substrate would be appropriate for the February 21st TWC meeting. Brandon and Shane agreed to draft and similar memo summarizing potential source curves and distribute to the group prior to the meeting.

Brandon noted that Shane will be going out in the field to characterize mesohabitats on the lower Saluda River. Shane added that they hope to have the mesohabitat characterization completed and available for review by the TWC by late March.

Brandon mentioned that they have not yet obtained the final HSC curves for shortnose sturgeon from Prescott Brownell. After some discussion, the group agreed that the Catawba-Wateree IFIM study would be the most likely source for shortnose sturgeon curves. Amanda Hill noted that she would e-mail Prescott regarding transferability of the Catawba-Wateree curves; she recommended contacting Pace Wilbur at NOAA-Fisheries if we were not able to contact Prescott.

Next Meeting

The group noted that the next TWC meeting had been scheduled for February 21st, 2007 at Lake Murray Training Center. The meeting adjourned at approximately 3:10 PM.

Attachment A

Memo Summarizing Potential Source Habitat Suitability Curves for Depth and Velocity for Smallmouth Bass and Rainbow and Brown Trout Lifestages

Attachment B

Spreadsheet Summarizing Limiting Velocities for Striped Bass Passage (Source: Conte Anadromous Fish Lab)