MEETING NOTES

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

SCE&G Training Center
November 27, 2006

Final jms/bhk/csb 01-03-07

ATTENDEES:

Alan Stuart, Kleinschmidt Associates
Bill Argentieri, SCE&G
Brandon Kulik, Kleinschmidt Associates
Dick Christie, SCDNR
Gerrit Jobsis, American Rivers/CCL
Hal Beard, SCDNR
Jeni Summerlin, Kleinschmidt Associates
Milton Quattlebaum, SCANA Services
Randy Mahan, SCANA Services
Ron Ahle, SCDNR
Scott Harder, SCDNR
Shane Boring, Kleinschmidt Associates
Theresa Thom, National Park Service

ACTION ITEMS:

- Find out if Prescott has HSI curves for Atlantic/shortnose sturgeon

Amanda Hill

- Ask Steve Summer if he has any flow data for the LSR

Milton Quattlebaum

- Provide HSI curves for brown/rainbow trout from Savannah River/Catawba Wateree IFIM studies

Dick Christie

- Contact Jim Ruane about obtaining HSI curves for trout in the Chattahoochee River basin and research other potentially applicable trout curves

Brandon Kulik

- Research applicable smallmouth bass HSI curves

Brandon Kulik

- Edit the guild matrix and send out to committee members

Brandon Kulik

- Plan a meeting to discuss the guild matrix and *HSI* curves in more detail

Shane Boring

- Edit the draft IFIM study plan and send out to committee members

Brandon Kulik / Shane Boring

- Edit mesohabitat descriptions and send out to committee members

Brandon Kulik

DATE OF NEXT MEETING[1]: **December 19, 2006 at 9:30 a.m.**
Located at the Lake Murray Training Center

[1] this meeting will be to discuss issues pertaining to the Congaree River

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.

Review of Action 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 Brandon Kulik sent the draft IFIM study plan to committee members for review; Gerrit Jobsis provided a link to the Pee Dee HSI curves; and Dick Christie sent the Catawba Wateree HSI curves to Brandon. Shane noted that the purpose of today's meeting is to: (1) review the draft IFIM study plan, (2) review the lower Saluda River (LSR) aerial video, (3) discuss the guild matrix and HSI curves, (4) discuss the classification, types, and definition of mesohabitats, and (5) discuss field site locations that study participants wish to visit on November 28th.

Review of Draft IFIM Study Plan:

Comments on the draft IFIM study plan can be viewed in track changes in Attachment A. A copy of the draft IFIM study plan was distributed and Shane asked committee members if they had any comments. There were several editorial and organizational recommendations made by SCDNR and American Rivers to better describe the context of river fishery resources, and clarify the scope and role of this study. Dick and Hal noted that recent DNR studies reveal that striped bass use the LSR as a thermal refuge (as much as 50% of the population), and that there may be potential for the river to be managed for smallmouth bass in the future, as smallmouth bass are colonizing the Broad River near the confluence with the Saluda and DNR anticipates that they will begin to inhabit the Saluda in the near future. Gerrit recommended that the project description include a reference to other historic operating regimes that the Saluda project has employed during the life of its current license besides the current operating mode (reserve).

Regarding the technical approach, Scott Harder asked about the number of velocity sets that will be taken at each transect. Brandon noted that velocity measurements will be taken on a transect basis. Brandon went on to explain that at least one velocity set will be taken at each transect. There will be three calibration flows (low, medium and high), and velocity data are collected at the middle calibration flow. In the case of transects with complex hydraulics (usually riffles and shoals) additional velocity sets will likely be collected at the low flow since hydraulic parameters such as friction coefficients and turbulence will likely be different due to the substrates and supercritical flows inherent in such sites. This is decided on a case-specific basis with input from a hydraulic engineer, In order to provide a suitable stage-discharge curve for the hydraulic model to project

Weighted Usable Area (WUA) for a flow range from 40 to over 20,000 cfs, the three calibration flows to be used are expected to be approximately:(350-500 cfs, 1200-1500 cfs, and 10,000 cfs. Scott inquired how error will be treated in the model. Brandon indicated that for each flow increment at each transect, the Velocity Adjustment Factor (VAF) obtained during each transect's calibration is used as an indicator of accuracy. If VAF's for some flow range is out of range, additional modeling or supplemental .flow data may be required. Brandon agreed to supplement the modeling discussion in the draft plan methodology with additional details.

In regards to the fish passage evaluation, Gerrit explained that the 1990 IFIM study that he participated in came up with a 1300 cfs fish passage flow based on SCDNR criteria for Millrace Rapids. This was based on data obtained at a location in Millrace Rapids chosen by Steve De Kozlowski. Gerrit questioned the need to redo this part of the study, because the criteria will not change much, and he believes that the river channel characteristics have not changed much. Brandon noted that the study plan was written so as not to foreclose on the need to conduct a new analysis, but that the full study team would make the final decision. Another option might be to obtain and review the original data sets and Steve De Kozlowski input if practical. Dick Christie felt that the study should take advantage of new fish passage hydraulic criteria that may be specifically applicable to anadromous fish species. Brandon added that he had obtained these criteria from Alex Haro of the Conte Anadromous Fish Laboratory in Turners Falls, MA, and that they rate, temperature, fish swimming strength, slope and water velocity in ascending rapids.

Hal Beard asked how braided sections in the LSR will be evaluated. Brandon indicated to the extent the team desires that these be modeled, that each channel braid selected will be treated as a separate stream channel, with separate transects. Manual flow gauging will be required during calibration to provide an estimate of how water flows through each braid. Scott inquired as to how the Acoustic-Doppler Current Profiler (ADCP) will be used with the large amounts of vegetation in the LSR. Brandon explained that if these mats of vegetation are extensive, they may effect the model simulation, in that they act as ephemeral objective cover and may change the velocity relative to unvegetated periods. Brandon specifically noted that vegetation will certainly be considered when evaluating the mesohabitats. Hal noted that vegetation in the LSR has increased over the years; about 70% of the river has vegetation, specifically from Twelvemile Creek to the I-20 Bridge. Vegetation is most pronounced in areas of lower velocity and comparatively less pronounced in rapids and riffles. Hal mentioned that the group may want to consider talking to Cindy Aulbach. She conducts fly-over's for SCE&G to evaluate vegetation in the LSR.

Review of Lower Saluda River Aerial Video:

To gain a better understanding of the different types of habitats, the group viewed flows of the LSR at 540 and 840 cfs video graphed from a helicopter flying from downstream to upstream during spring 2005. Gerrit noted that transects at Corley Island, Oh Brother Rapids and Shandon Rapids should be evaluated. Through discussion, the group separated the LSR into four segments: (1) Lake Murray Dam to Rawls Creek; (2) Rawls Creek to I-26 Bridge; (3) I-26 Bridge to Millrace Rapids; and (4) Millrace Rapids to the confluence of the lower Saluda and Broad river's. The group noted that segment (2) was extremely uniform in width, depth, and channel shape.

Classification, Types and Definition of Mesohabitats:

Comments on the guild matrix can be viewed in track changes in Attachment B. Brandon explained that in order to simplify the WUA analysis, the TWC had agreed to sort species and life stages into habitat-use guilds. Brandon noted that for purposes of this straw man, the guild groups (shallow-slow, shallow-fast, *etc*) categories were the commonly-used categories developed by Mark Bain. Brandon explained that life stages of each species were assigned to habitat use guilds based on life history and habitat preference using Dilts et al. (2003) *Application of New Approaches to Instream Flow: Use of Two Dimensional Modeling and Habitat-Use Guilds in a Southeastern Stream* as a generalized model. He asked that the TWC review this approach for reasonableness and welcomed any river- or species-specific refinements that the group cared to recommend.

Gerrit pointed out that spawning and adult life stages of shortnose sturgeon should be added to the guild matrix. He mentioned that the Catawba Wateree, Pee Dee, and Santee Cooper may have developed HSI curves for shortnose/Atlantic sturgeon. Amanda Hill noted that Prescott Brownell may have developed these curves. Amanda recommended adding spawning life stage for striped bass. Dick indicated that there has been no indication of spawning striped bass in the LSR. He clarified that striped bass use the LSR as a thermal refuge area rather than for spawning. Dick noted that if striped bass spawning is included, we may be able to use HSI curves from the Savannah River or Catawba Wateree. There was a brief discussion about the type of HSI curves that could be used for brown trout and Shane noted Dick had observed that it may not be feasible to use Catawba Wateree curves because it would not be reflective of the LSR. In response to a question, Brandon noted that USFWS "bluebook" adult and juvenile HSI trout curves have been criticized as non-transferable curves, at least in most eastern rivers. He was aware of some recent trout curve development in Pennsylvania and New England that may have potential transferability. Hal noted that SCDNR is more concerned with adult trout from a resource perspective; they would like to include some southeastern trout HSI curves. Alan Stuart noted that TVA may have developed HIS curves for trout in the Chattahoochee basin. Gerrit mentioned that the USFWS HSI curves for trout are from 1984/1985. He mentioned that Jim Ruane may be able to provide some information on these curves. It was generally agreed that if Brandon could find and circulate these HSI curves for committee members to review that satisfactory adult curves could be identified by the group. Brandon will also research and summarize smallmouth bass HSI criteria.

Shane inquired if committee members were satisfied with the guild approach. The group noted that they were comfortable with this guild approach, but certain species should be stand alone. Specifically, Dick noted that smallmouth bass, spottail shiner, gizzard and threadfin shad species are not easily categorized into specific guilds. Gerrit noted that the group should reexamine each species and how they are categorized into each guild, specifically the northern hogsucker. Brandon noted that he would update the guild matrix and send out to committee members for review. Shane noted, and the group agreed, that a meeting devoted entirely to finalizing the guilds is needed.

Classification, Types and Definition of Mesohabitats:

Brandon displayed various mesohabitats definitions for the group and noted that it is important to reach a common understanding of these definitions. These definitions are in part a way to link life stages to habitat-use guilds, but is primarily a tool to facilitate habitat mapping. The distribution and abundance of mesohabitats in each reach will in turn be used as a mechanism to select study sites and transects at a later stage. He pointed out that the definition of each mesohabitat was adopted from the Catawba Wateree, and Santee Cooper studies and Dunn and Leopold, 1998. Brandon read through each habitat type and a few comments were made.

The group agreed to meet at the guard shack located at the Saluda Hydro Dam at 9:30AM to visit specific sites of interest, gain a common understanding of the river from a habitat perspective, and test and refine the definitions of mesohabitats on the LSR.

ATTACHMENT A

COMMENTS ON THE DRAFT IFIM STUDY PLAN

SOUTH CAROLINA ELECTRIC & GAS COMPANY
COLUMBIA, SOUTH CAROLINA

SALUDA HYDROELECTRIC PROJECT
(FERC NO. 516)

INSTREAM FLOW STUDY OF THE LOWER SALUDA RIVER

DRAFT – November 8, 2006

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. A separate study will be conducted to evaluate effects of project operation on the Congaree River.

1.1 Existing Operations

Saluda Hydro occupies a specific, very important niche in SCE&G's generating portfolio in that it is a facility in the SCE&G system that 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.

Comment: This section should focus on the hydrologic affects of operations not VACAR or reserves. Delete below and insert summary of project op effects on downstream hydrology. Document that project operations have varied under the existing license term from Peaking to Load-Following to Reserve Capacity - document years under each operation mode.-Gerrit Jobsis

SCE&G is a member of the Virginia-Carolinas Southeastern Electric Reliability Council sub-region (VACAR), whose members are bound in a reserve-sharing agreement by which each has agreed to assist any other member in generation emergencies. SCE&G must employ its reserves (Saluda Hydro) to meet its own generation emergencies before calling on assistance from other VACAR members, but it also must be constantly ready to provide reserve generation to other VACAR members to meet SCE&G's contractual reserve obligations.

Under SCE&G's obligations as a member of VACAR, it must be able to supply approximately 200 MW within 15 minutes in the event of an out-of-system emergency. The Saluda Project's greatest single value in support of SCE&G's system obligations is its ability to provide up to 202 MW of generation almost instantly. In the case of any system emergency, Saluda may be dispatched for up to full capacity generation for minutes or even hours.
Add intro section on Saluda River - state's first scenic river, trophy striped bass fishery, significant refuge habitat for Santee-Cooper striped bass spawning stock, unique trout fishery; this river segment is of high statewide priority

1.2 Use of Study Results

In general, the TWC is interested in exploring the protection of instream habitat in the lower Saluda River (LSR) below the Saluda Project (see Appendix A for a detailed summary of discussions).

- Identify a minimum flow for the 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

The TWC has identified the following issues that this study will provide data for:

Comment: New Section - Information provided by this study-Gerrit Jobsis

- evaluate alternative flow regimens for the LSR;
- identifying flow regimens that are protective of aquatic habitat;
- provide data that can be used to weigh the effects of managing Lake Murray water levels on downstream habitat; and
- provide data that can be used to weigh the effects of project operations on downstream habitat.

1.3 Purpose of This Study

The scope of this study is to provide data quantifying the effects of flows on aquatic habitat suitability in the LSR for the aquatic community and its managed fish resources, including diadromous and resident fish species, and aquatic invertebrates and to assist the TWC in identifying flow regimens that support habitat requirements for a balanced aquatic community. These data will then be used in conjunction the Congaree River flow study, and hydrologic, operational and other models to evaluate the costs and benefits of providing alternate flows to the lower Saluda River.

Comment: Move this sentence to top paragraph

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 Lake Murray dam and the confluence, LSR flows for approximately ten miles through generally low gradient[2] riverine geomorphology (Figure 2). The drainage area at Lake Murray 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 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, 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 cold water releases from below the thermocline of Lake Murray via the project powerhouse. Average water temperatures below the Project dam range from approximately 9.5°C in February to 17.5°C in early-October, and from approximately 10 to 18.5°C in the vicinity of Riverbanks Zoo[3]. 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

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

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

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[4].

Comment: May want to mention trout fishery is enabled by project operations

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 SCDNR stocking to enhance LSR recreational fishing opportunities. In 1995, the SCDNR 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.

Comment: Add that water quality (DO and temperature) of Saluda is recognized as affecting fish community.-Gerrit Jobsis

Comment: Add paragraph on LSR being a state scenic rive and a valuable fishery

Comment: Add that DNR stocked smallmouth bass in mid-1980s but this was generally recognized as unsuccessful.-Hal Beard

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 (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). Cite Crane 1987 study

Comment: Include table of resident fish species.-Theresa Thom

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).

SCE&G data show that gizzard shad comprised approximately 25% of the catch prior to 1997. After 1997, a marked decline was observed in LSR gizzard shad abundance, while sport fish species abundance increased. Recent SCDNR sampling indicates similar trends. SCDNR theorized a significant increase in chain pickerel populations is due to recent increases in the aquatic macrophyte community (personal communication, H. Beard, SCDNR, 2003).

Comment: Turbine venting??

Comment: Suggest clarification or delete. Has not necessarily increased.-Hal Beard

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).

Comment: Add recent striped bass information

[4] Based on monthly averaged 2000 to 2006 data as measured at USGS Gage # 02168504 (below Murray Dam).

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). 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. The SCDNR has reported no presence of diadromous species such as blueback herring or American shad in the LSR (Beard, 2002); however, sampling conducted by SCE&G in the spring of 2003 detected the presence of three American shad in the LSR. The American eel is the only know 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.

Comment: Make sure this statement is correct

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.

Comment: May want to mention fish use LSR during active seasons

Comment: Sentence may need to be revised-based on engineering enhancement

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 a 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)[5]. 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.

3.2 Field Data Collection

3.2.1 PHABSIM Study Sites

General Approach

The second phase will entail the determination of habitat-discharge 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-discharge 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

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[5] 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.

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[6]. 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 discharge 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 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 gaging, and study-site

[6] 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.

field gaging 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-discharge 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 will be accomplished by correlating each surveyed water stage with discharge to develop a stage-discharge relationship for each transect. PHABSIM uses a family of hydraulic models such as IFG4, MANSQ and WSP. Once this relationship is established, the model then adjusts velocities obtained at calibration flows to other flow increments of interest for which defined water stages have been calculated. The model is then calibrated by comparing simulated hydraulics to empirical measurements taken at the calibration flows. Coefficients such as relative stream channel roughness are then iteratively adjusted as needed to optimize model accuracy across the full flow range.

Comment: Add details on calibration measurements and accuracy

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 gaging 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.

Comment: Is another study needed? Little channel morphometry changes are anticipated since 1980's study.-Gerrit Jobsis

Comment: Include reference to passage releases (1500 cfs?) by SCE&G requested by Bulak in 1991(?) that resulted in fish passing Millrace Shoals. –Gerrit Jobsis

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 CONSULTATION

Upon receipt of the final report, the TWC may elect to apply these data to further analyses such as assessing project operation issues, lake level management, and overall flow regime evaluation (see section 1.3).

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

7.0 LITERATURE CITED

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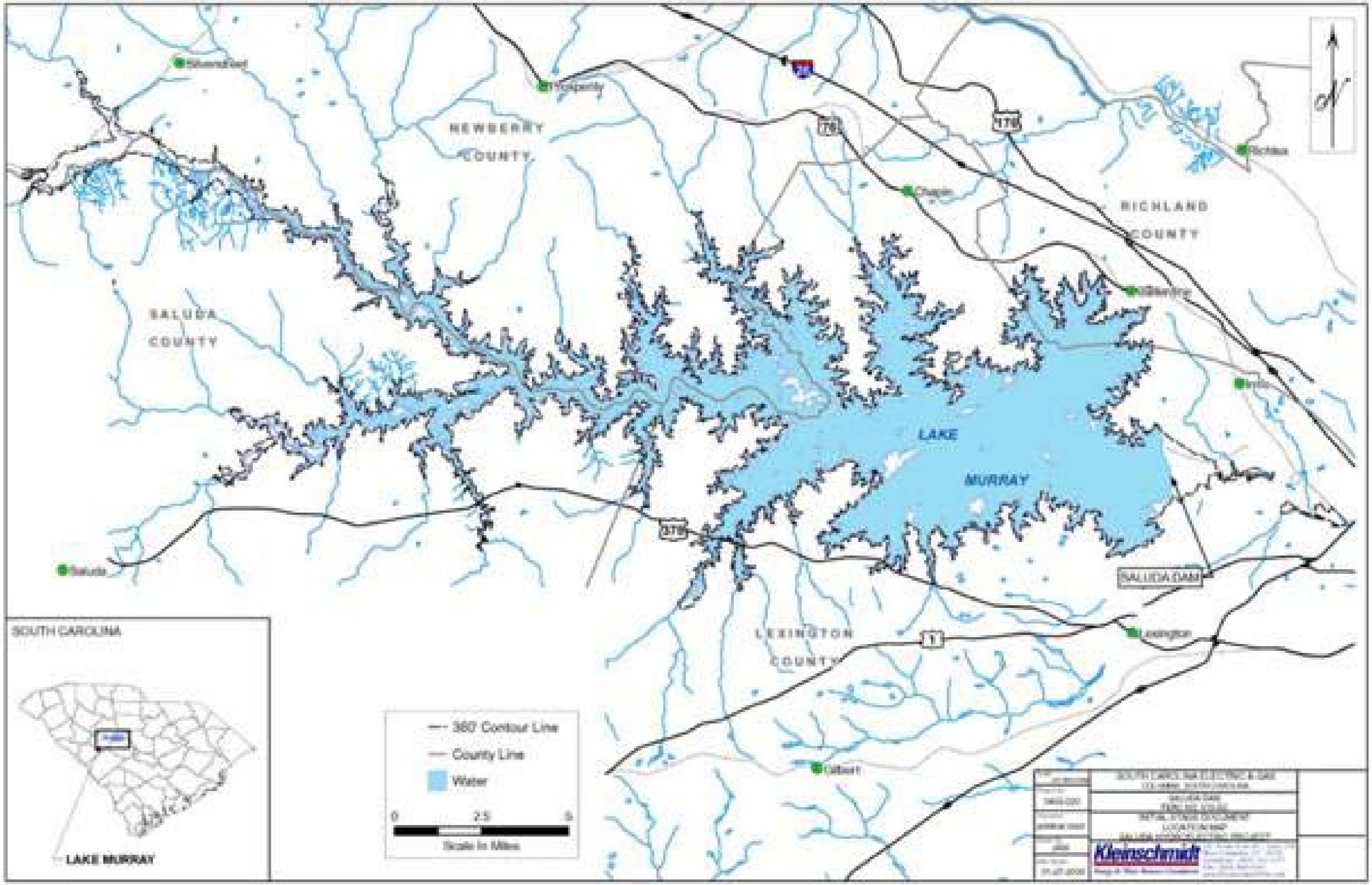
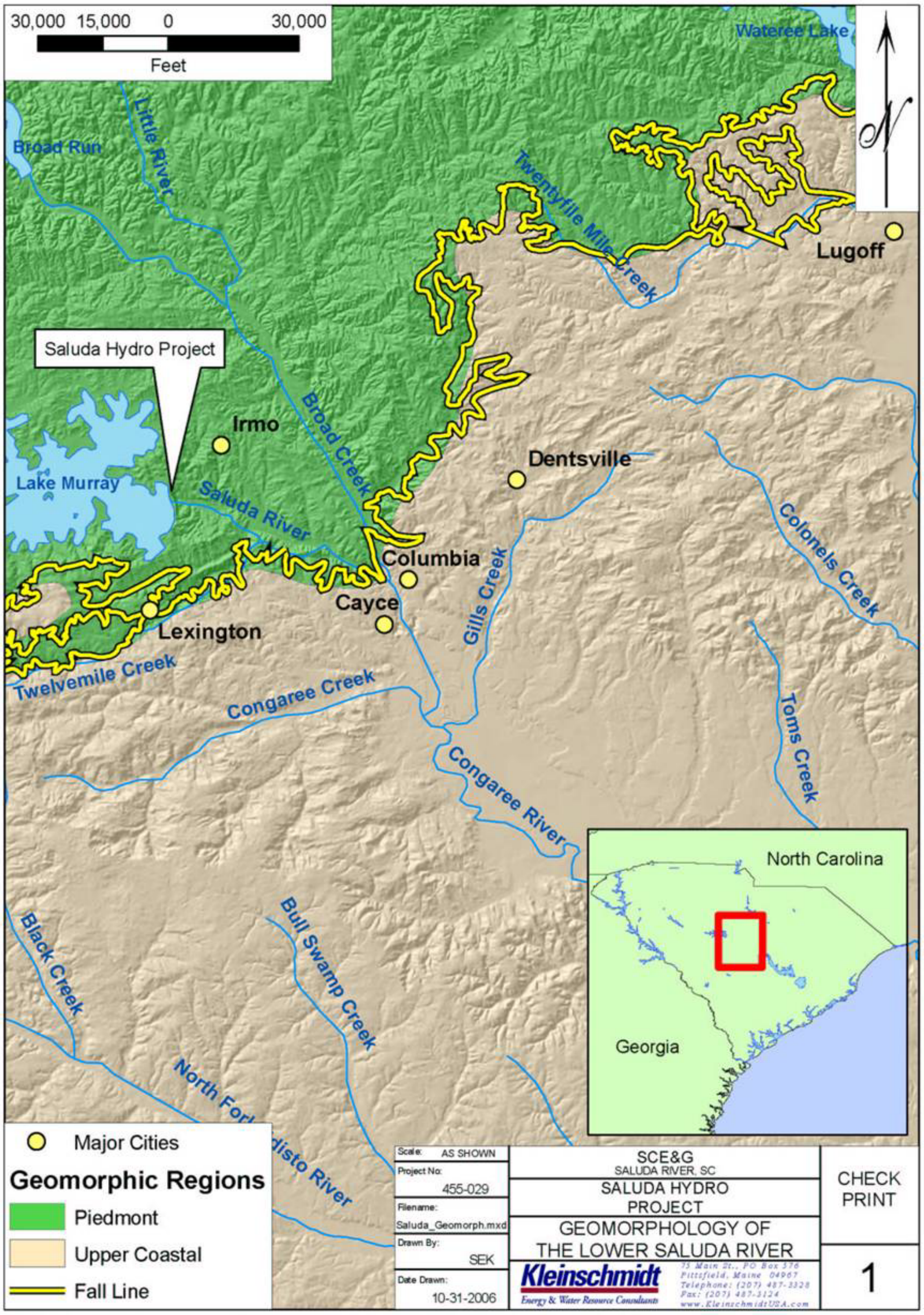

NEWBERRY
COUNTY
SALUDA
COUNTY
RICHLAND
COUNTY
LEXINGTON
COUNTY
LAKE
MURRAY
SALUDA DAM
Chapin
Lexington
Gilbert
Saluda
Prosperity
378
76
1
SOUTH CAROLINA
LAKE MURRAY
360' Contour Line
County Line
Water
0
2.5
5
Scale In Miles
Kleinschmidt



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APPENDIX A

SALUDA HYDROELECTRIC PROJECT

INSTREAM FLOW/AQUATIC HABITAT

TECHNICAL WORKING COMMITTEE MEETING NOTES

Included as a separate file.

APPENDIX B

SALUDA HYDROELECTRIC PROJECT

HABITAT SUITABILITY CURVES FOR TARGET SPECIES/GUILDS

This information is currently being developed by the Instream Flow TWC.

ATTACHMENT B

COMMENTS ON THE GUILD MATRIX

Legend:

- (yellow) guild selection change recommended 11/27/06
- (green) SI curve research and review desired
- (purple) habitat generalist no specific guild or SI curve required at this time

		GUILD CATEGORY							
SPECIES	**LIFE STAGE**	**Shallow Slow**	**Shallow Fast**	**Deep Slow**	**Deep Fast**	**Habitat Generalist**	**Limiting Rapid**	**SI CURVE SOURCE**	**SPECIES**
robust redhorse	spawning		X					Catawba-Wateree	Generic or robust redhorse
robust redhorse	fry/YOY	X						Catawba-Wateree	*guild surrogate*
robust redhorse	juvenile			X				Catawba-Wateree	golden redhorse
robust redhorse	adult			X				Catawba-Wateree	golden redhorse
Norrthern hogsucker	spawning				X			Catawba-Wateree	*guild surrogate*
Norrthern hogsucker	fry/YOY				X			Catawba-Wateree	*guild surrogate*
Norrthern hogsucker	juvenile				X			Catawba-Wateree	*guild surrogate*
Norrthern hogsucker	adult			X				Catawba-Wateree	*guild surrogate* (redbreast sunfish adult?)
spotted sucker	spawning		X					Catawba-Wateree	*guild surrogate*
spotted sucker	fry/YOY	X						*TBD*	*guild surrogate* (redbreast sunfish spawning?)
spotted sucker	juvenile	X		X				*TBD*	*guild surrogate* (redbreast sunfish spawning?)
spotted sucker	adult			X				*TBD*	*guild surrogate* (redbreast sunfish adult?)
brown trout	spawning		X					Catawba-Wateree *(if transferable)*	TVA, other source studies
brown trout	fry/YOY	X						Catawba-Wateree *(if transferable)*	TVA, other source studies
brown trout	juvenile	X						Catawba-Wateree *(if transferable)*	TVA, other source studies
brown trout	adult			X	X			Catawba-Wateree *(if transferable)*	TVA, other source studies
rainbow trout	spawning		X					Catawba-Wateree *(if transferable)*	TVA, other source studies
rainbow trout	fry/YOY	X						Catawba-Wateree *(if transferable)*	TVA, other source studies
rainbow trout	juvenile		X		X			Catawba-Wateree *(if transferable)*	TVA, other source studies
rainbow trout	adult				X			Catawba-Wateree *(if transferable)*	TVA, other source studies
redbreast sunfish	spawning	X						Catawba-Wateree	
saluda darter	adult		X					Catawba-Wateree or Pee Dee	fantail darter surrogate
spottail shiner			X						
redbreast sunfish	adult			X				Catawba-Wateree	
shorthead redhorse	adult				X			Catawba-Wateree	golden redhore
threadfin shad								*get SCDNR staff input*	
American shad	spawning				X			Catawba-Wateree	
American shad	YOY			X	X			Catawba-Wateree	American shad spawning *or deep slow guild*
American shad	passage						X	Conte Lab-American Rivers	
blueback herring	spawning	X						*TBD*	shallow-slow guild surrogate
blueback herring	YOY	X						*TBD*	shallow-slow guild surrogate
blueback herring	passage						X	Conte Lab-American Rivers	
striped bass	passage						X	Conte Lab-American Rivers	
striped bass	adult							Catawba-Wateree & Savannah	*thermal refuge in summer*
shortnose sturgeon	passage						X	Conte Lab-American Rivers	
shortnose sturgeon	spawning							NMFS	
shortnose sturgeon	adult							NMFS	
shortnose sturgeon	juvenile							NMFS	
American eel	juvenile					X		none recommended at this time	
benthic macroinver.	juvenile		X					Catawba-Wateree	
smallmouth bass	spawning								
smallmouth bass	YOY								
smallmouth bass	juvenile								
smallmouth bass	adult								