

ALABAMA POWER COMPANY

COOSA RELICENSING PROJECT

ADAPTIVE MANAGEMENT PLAN

for the

COOSA RIVER-WEISS BYPASS

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COOSA RELICENSING PROJECT
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COOSA RIVER- WEISS BYPASS

1.0 INTRODUCTION

The Alabama Power Company (APC) recently completed the pre-filing relicensing process for its seven hydroelectric projects on the Coosa River, and filed an application for a new license with the Federal Energy Regulatory Commission (FERC) on July 28, 2005. . This relicensing process was a multi-year cooperative effort between APC and interested stakeholders to address operational, recreational and ecological concerns associated with hydroelectric project operations. As part of that relicensing process, APC consulted with a wide variety of stakeholders including, state and federal resource agencies, non-governmental organizations and concerned citizens seeking their input on important relicensing issues. As a result of that consultation and subsequent stakeholder meetings, relicensing participants identified several issues that they believed needed to be addressed during the relicensing process including the issue of flow in the approximately 20-mile section of the Coosa River that is bypassed by the Weiss Hydroelectric Project.

The Weiss development is located in northeast Alabama on the Coosa River. Weiss Lake extends approximately 52 miles upstream from the Weiss Dam through Cherokee County, Alabama. The upstream portion of Weiss Lake extends into Floyd County, Georgia (approximately 11 miles of the lake are located in Georgia). Weiss Lake has a surface area of 30,200 acres at a normal summer water surface elevation of 564 ft msl.

The Weiss Bypass is approximately 20 miles in length and is the “original river channel” of the Coosa River. Flows to this section of river were historically diverted by construction of the Weiss Development. Terrapin Creek is a major source of stream flow for the bypass and enters approximately 7 miles downstream of the Weiss Spillway. The significant increase in stream flow at that point divides the bypass into an upper and lower reach with distinctly different habitat types. The entire bypassed reach is comprised of sections of sand, silt, mud and

gravel soil types and can be characterized as having sections of fallen trees, submerged logs, overhanging limbs and downed timber that provide habitat structure. The upper reach of the bypass is more lentic (lake-like) with little to no appreciable flow. Aquatic habitats vary and include fallen trees, aquatic vegetation, over-hanging limbs, and open water. The lower reach (downstream of Terrapin Creek) is more lotic (riverine) due to the increase in stream flow. The lower sections of the river are basically limited to two types of habitat, fallen tree/brush and open water habitats (APC 2000, Irwin 2001, Stewig 2001).

In July 2004, the US Fish and Wildlife Service (USFWS) designated the upstream reach of the bypass as critical habitat for eight mussel species. A critical habitat designation identifies geographic areas that contain elements essential for the conservation of a threatened or endangered species and may require special management considerations. Two of these eight mussel species are currently found within the critical habitat unit, while the others were historically found there, but have been extirpated (Section 2.1).

As part of the relicensing process, APC worked with stakeholders to define the issue regarding flows in the bypass reach, to define resource goals and objectives within that area, and to determine a process for evaluating changes and making decisions based on the best available information. During meetings from January 2004 to November 2005, a consensus based Adaptive Management Plan (AMP) was developed to address flows in the Weiss Bypass reach during the new license term.

The AMP is described in the following sections:

- Section 2 – Background of Weiss Bypass
- Section 3 – Goals and Objectives for the Weiss Bypass
- Section 4 – Formation of Weiss Bypass AMP Steering Committee
- Section 5 – Monitoring Starting Flow and Determining Modifications
- Section 6 – Master Implementation Schedule
- Section 7 – Compliance

2.0 **BACKGROUND OF WEISS BYPASS**

2.1 Existing Literature and Available Studies

Below are summaries of recent and current resource studies performed in the Weiss Bypass.

Fisheries Resources

There are two recent fishery resource studies available which characterize the fishery community of the Weiss Bypass. The first study was the *Survey of Shallow-Water Fish Communities in the Dead River and Terrapin Creek* (May 2001) by Elise R. Irwin, Ph.D. (USGS, AL Co-op); Mary C. Freeman, Ph.D. (USGS, UGA); Ashley Belcher and Kevin Kleiner (AL Co-op). The objective of this study was to quantify, describe and compare the shallow-water fish assemblages of the upper portion of the Weiss Bypass (upstream and downstream of the mouth of Terrapin Creek) and the lower reaches of Terrapin Creek.

During the study, fish were collected from two reaches of the Weiss Bypass upstream (DRU) and downstream (DRD) of Terrapin Creek, and one reach of Terrapin Creek (TC) using pre-positioned area electrofishers (PAE). A total of 15,169 fish were collected, including 46 species and 12 families. Species richness was highest in Terrapin Creek (38), lower in the DRD (34), and lowest in the DRU (25). Diversity was similar for Terrapin Creek and DRD, and lowest in the DRU. The DRU reach had higher densities of centrarchids and lower densities of cyprinids than the other reaches. The study also detected an abundance of the introduced red shiner (*Cyprinella lutrensis*) in the bypass, dominating the cyprinid population. This species appears to be out competing the native blacktail shiner (*Cyprinella venusta*), which is a host species for the southern clubshell mussel. Habitat in the DRU was characterized as lentic, with shallow pools over bedrock, extensive *Justicia*, and multiple beaver dams. Habitat in the DRD was characterized lentic, with gravel bars, riffles, and runs. Habitat in TC was characterized as lentic, with gravel bars, riffles, and pools.

The second fishery study was the *Assessment of Largemouth Bass and Spotted Bass Populations in the Dead River Section of the Coosa River, Alabama* (May 2001) by Joseph D. Stewig (Auburn University graduate student). The objectives of this study were (1) to assess the black bass populations in the Weiss Bypass by examining age, growth, condition, and habitat use

and compare these to other Coosa River populations and (2) to describe the fish community in the Weiss Bypass and the effects of flow modifications on that community.

During the study, three sites in each of four river sections were surveyed by boat and back-pack electrofishing. A total of 9,872 fish representing 46 species and 12 families were collected. Stewig reported that the Weiss Bypass was numerically dominated by threadfin shad (45.6%), gizzard shad (21.5%), bluegill (11.0%), black crappie (2.3%), and largemouth bass (2.1%). The upstream reaches of the Bypass (Sections 3 and 4) exhibited higher species diversity and richness, and were dominated by centrarchids and gizzard shad. Downstream reaches were dominated by threadfin shad and gizzard shad. Stewig reported that generation backflow reversed flow in the lower reach of Weiss Bypass, and increased water depths for a distance of up to 25 km upstream of the tailrace. Stewig also reported that water quality was relatively uniform throughout the bypass.

Mussel Resources

Mussel resources of the Weiss Bypass were documented in the study “Examination of the freshwater mussel (Bivalvia: Unionidae) community, including the federally endangered southern clubshell, *Pleurobema decisum*, within the Old Channel of the Coosa River, between Weiss Spillway Dam and Weiss Hydropower Dam, Cherokee County, Alabama” (June 2001), by Jeffrey J. Herod, Holly N. Blalock-Herod, D. Shane Ruessler, and James D. Williams (USGS); Timothy S. Gross and Nicole J. Kernaghan. The objective of the study was to survey the Weiss Bypass for mussel species presence, distribution, and baseline population biology.

Mussel surveys were conducted at 16 sites in the Weiss Bypass. Using quantitative and qualitative techniques, the surveys found 19 species, including the federally endangered southern clubshell (*Pleurobema decisum*) and federally threatened fine-lined pocketbook (*Lampsilis altilis*). The mid-reach of the Weiss Bypass, downstream of Terrapin Creek, had the highest species richness, overall density, and juvenile density compared to the other reaches surveyed. The southern clubshell was found in its highest densities in the mid-reach. Also, a single fine-lined pocketbook was found in the mid-reach, the only individual of this species found during the survey. The survey also noted the presence of *Corbicula*, a non-indigenous bivalve.

Water Resources

Water resources of the Weiss Bypass were characterized through a study that APC performed in 1999 – 2002. The study was performed to collect baseline water quality data in the Weiss Bypass upstream and downstream of the mouth of Terrapin Creek.

Water quality in the Weiss Bypass exhibits diurnal fluctuations of dissolved oxygen (DO) and temperature levels during the summer and early fall months. Data from the downstream Bypass monitor at the Catfish Farm indicate higher DO levels and lower water temperature than the upstream monitor at the Sod Farm. This is likely due to the more lentic conditions in the bypass upstream of Terrapin Creek. Terrapin Creek provides cooler, more oxygenated water, enhancing water quality in the bypass downstream of its mouth. On several occasions, DO levels in the upstream reach of the bypass at the Sod Farm dropped below 4.0 mg/L, usually only for a few hours, but in several instances, greater than 24 hours. The DO levels in the downstream reach of the bypass at the Catfish Farm rarely dipped below 4.0 mg/L, and then only for a few hours. Water temperature generally ranged from a high of approximately 35 °C (usually July or August) to a low of approximately 4 °C in the winter months.

2.2 Work Group Meeting Notes

The Weiss Bypass Working Group and Technical Teams were formed from the Project Released Issue Action Group (IAG) and met for the specific purpose of developing an instream flow strategy for the Weiss Bypass. The meeting minutes record of their efforts are presented in Appendix A on Compact Disk # 1. Participants on each group are also listed in the meeting notes.

2.3 On-going Baseline Monitoring

Baseline monitoring as described in Section 3.0 was begun in the spring of 2004. The Technical Teams “fine-tuned” monitoring collection methods and locations during the 2004 and 2005 collections. Baseline monitoring (incorporating these modifications) will be continued in 2006 and will complete the collection of baseline data. These same collections methods will be used during the initial flow releases to measure changes in the Weiss Bypass aquatic resources. A full description of monitoring techniques presented in Section 5 of this document.

3.0 GOALS AND OBJECTIVES FOR THE WEISS BYPASS

3.1 Goals

The Weiss Bypass Working Group developed goals focused on three primary resource areas: water quality, fisheries, and macroinvertebrates (mollusks, crayfish, and insects). Their purpose was to develop consensus based goals and objectives for the Weiss Bypass and to determine field collection methods to gather data to measure the success of these goals. The general resource goals for each area are described below.

Water Quality & Quantity

The general goal for the water resources of the Weiss Bypass is:

- to release water from the Weiss Project that complies with applicable State Water Quality Standards and that will support the life cycle of aquatic organisms and not adversely affect critical habitats.
- provide flows in the Weiss Bypass that will mimic a natural riverine flow regime which will reflect flow patterns of the upper Coosa River drainage based on climatic conditions in the basin;

Fisheries

The general goals for the fishery resources of the Weiss Bypass are:

- restore and enhance the abundance and diversity of riverine fishery populations that are comparable to a riverine biotic community of an unregulated drainage of similar characteristics and/or fish species expected to be present in the reach; and
- restore and improve riverine habitat in the Weiss Bypass to a level that allows future recruitment, augmentation, and or reintroduction of historic fauna.

Mollusks & Macroinvertebrates

The general goals for the mollusk and macroinvertebrate resources of the Weiss Bypass are:

- restore and enhance the abundance and diversity of riverine aquatic invertebrate biota including, mussels, snails, crayfish, and macroinvertebrate populations that are comparable to a riverine biotic community of an unregulated drainage of similar characteristics and/or the aquatic biota expected to be present in the reach

- restore and improve riverine habitat to a level that will allow future recruitment, augmentation, and reintroduction of historic fauna
- protect and enhance federally protected aquatic species currently present in the Weiss Bypass

3.2 Objectives

There are several qualitative and quantitative objectives for measuring the success in meeting the goals stated in Section 3.1.

Water Quality

1. Measure existing water quality and water chemistry in the Weiss Bypass.
2. Measure changes in the water quality in the Weiss Bypass as new flow releases are introduced.
3. Measure changes in the water chemistry of the Weiss Bypass as new flow releases – or modifications thereto – are introduced.

Fisheries

1. Measure changes in the fishery community by summarizing data in standard community-level metrics, such as species diversity, richness, relative abundance, trophic levels, presence and distribution of key species, and other summarizations that the Fish Team deems appropriate. The Technical Team notes that increases in riverine species in the Weiss Bypass would be a positive response.
2. Document the use of the Weiss Bypass for migratory species (spring spawning), and
3. Document recruitment of young-of-year within the Weiss Bypass
4. Describe the habitat associated with each sampling area. The Technical Team will determine the level of data to be collected.

Mollusks and Macroinvertebrates

1. Measure changes in the macroinvertebrate community by summarizing data in standard community-level metrics such as species diversity, richness, relative abundance, trophic levels, presence and distribution of key species, and other summarizations that the Mussel and Macroinvertebrate Team deems appropriate. The Technical Team notes that increases in riverine species in the Weiss Bypass would be a positive response.

2. Document recruitment of mussels and snails (with special concern for federal T&E species) over time.
3. Document changes to the diversity and relative abundance of the crayfish community over time.
4. Describe the habitat associated with each sampling area. The Technical Team will determine the level of data to be collected.

3.3 Species Restoration Efforts

As discussed above, one of the goals of the Weiss Bypass Group is to restore and improve riverine habitat to a level that will allow future recruitment, augmentation, and/or reintroduction of historic fauna. Historic fauna may include species and/or their habitats that are protected (or candidates for protection) under federal and/or state law, such as the federal Endangered Species Act. Two examples are the federally endangered southern clubshell (*Pleurobema decisum*) and the federally threatened fine-lined pocketbook (*Lampsilis altilis*). Also, in July 2004, the USFWS has designated the Weiss Bypass from the power line crossing at Maple Grove upstream to the Weiss Spillway as critical habitat for eight mussel species (including the two currently found there). As such, an Incidental Take Permit for the Weiss Bypass may be needed as incidental or unexpected take of protected species may occur with the introduction of a minimum flow and will be coordinated with the USFWS as part of the Section 7 Consultation process. The additional need for Safe Harbor Agreements, Candidate Conservation Agreements, and/or Habitat Conservation Plans between USFWS, Alabama Department of Conservation and Natural Resources (ADCNR), and APC is addressed as part of the funding agreement for the Alabama Aquatic Biodiversity Center.

4.0 FORMATION OF WEISS BYPASS AMP STEERING COMMITTEE

The AMP provides for the formation of the Weiss Bypass Steering Committee (Steering Committee) which will oversee the implementation of the AMP. APC is ultimately responsible for collection and analysis of data, but requests that Committee members/organizations actively participate in all facets of the AMP.

4.1 Committee Members

The Steering Committee will be comprised of representatives from the APC, Alabama Department of Conservation and Natural Resources (ADCNR), the USFWS, Alabama Rivers Alliance (ARA), and the Weiss Lake Improvement Association (WLIA). APC will serve as chairperson of the Steering Committee, and be responsible for organizing meetings and distributing documents to committee members. Responsibilities of committee members are detailed below. Each entity shall have the opportunity to select its own representation to the Steering Committee. The Steering Committee is regulated by FERC such that any disputes within the Steering Committee will follow the dispute resolution process described in Section 4.2.

The Weiss Bypass Working Group and Technical Teams have developed this Adaptive Management Plan during the relicensing process for inclusion in the FERC license application and eventual incorporation into the new Coosa License. The Technical Teams consist of individuals from APC, ADCNR, and USFWS that are technical experts in field biology. This Technical Team will remain intact during post licensing to assist the Steering Committee in the review and adjustment of the field collection portion of the AMP. The Steering Committee will ultimately be responsible for guiding the decision making processes specified in the Weiss Bypass AMP. The Steering Committee's responsibilities may include, but are not limited to:

- Collection and evaluation of baseline information and evaluation of study plans (with assistance from the Technical Teams);
- Providing overall guidance and decision making for the AMP process;

- Evaluating other study (*i.e.*, existing) information or information which becomes available during the time period of evaluations;
- Establishing and documenting the goals and objectives of each modification and determine the appropriate metrics for evaluative purposes; (Section 5.4 of the AMP details the IBI criteria to be used)
- Keeping other stakeholders aware of information relative to potential decisions and providing opportunities to comment prior to decisions on modifications (e.g., test flows, etc.) and provide a notification system of Steering Committee meetings;
- Determining and considering long term impacts of operational modifications on downstream projects and project economics when evaluating the feasibility of implementing flow modifications;
- Reviewing the annual report that provides information on the prior year's activities which APC will be required to file with FERC;
- Consider how changes in flow releases from upstream Corps of Engineer dams may impact the proposed starting flow scenario; and
- Determining modifications to the bypass starting flow scenario that will be presented to FERC and determining if any amendment action is necessary during the license.

The Steering Committee acknowledges the importance of allowing interested stakeholders to review and comment on major documents such as study results that may impact the evaluation and potential modification to the project. The Steering Committee chairman (an APC representative) will distribute these study results and make annual reports available to interested stakeholders. Interested stakeholders can request documents in writing to the Steering Committee chairman. The Steering Committee chairman will ensure that interested stakeholders have adequate notice and review time prior to final decisions of the committee relative to modifications to test flows, etc. For all other documents on which stakeholders wish to comment, the Steering Committee will review all timely comments and include these comments in the official record.

All information from the Steering Committee relative to this Adaptive Management Plan, including notification of meetings, meeting summaries, study results and final study plans will be coordinated by APC and shared with each committee member.

4.2 Dispute Resolution Process

The Steering Committee will use the following three tier dispute resolution process for all major decisions relative to determining flows, evaluation mechanisms, and final recommendations. The Steering Committee anticipates “day to day” decision making, such report formats, meeting locations and time, etc., will be addressed within the committee and will not need the dispute resolution process. However, major decisions that may arise as a result of multiple years of study that would involve determining whether to adjust flows (*i.e.*, modifying project operations), may not result in consensus among the committee members. The Steering Committee is confident it can and will attempt to reach consensus; however, the following three tier process would be employed in the unlikely scenario of disagreement.

Tier 1 Dispute Resolution involves attempting to reach consensus at the Steering Committee Level. The Steering Committee can employ many methods to reach consensus among its members including, but not limited to, facilitation, expert testimony, small group decision making, etc. The Steering Committee anticipates that 99% of all disputes can and will be resolved using Tier 1 techniques to reach consensus.

Tier 2 Dispute Resolution occurs if the Steering Committee believes it has exhausted all reasonable means to achieve consensus on an issue using Tier 1 methods. Tier 2 involves the Steering Committee chairperson contacting FERC’s Alternative Dispute Resolution (ADR) Division to seek assistance. The ADR offers trained facilitators and mediators to assist groups in resolving issues. The ADR’s assistance to the committee is non-binding and is meant to serve as a resource for achieving consensus not achieved in Tier 1.

Tier 3 Dispute Resolution involves each party presenting its position and related administrative record to support its position to FERC for a final, binding decision (subject to rehearing through FERC’s administrative process and further judicial review). Tier 3 dispute resolution would occur as a last resort for the Steering Committee and is not the preferred method to resolve disputes. However, the Steering Committee recognizes that issues may arise during the implementation of the AMP that potentially may not be resolved through Tier 1 and 2 dispute resolution.

The Steering Committee members acknowledge that each Tier of dispute resolution is proportionately related to the amount of time spent to reach a final decision, whether by consensus (Tier 1 and hopefully in Tier 2) or by decision by FERC in Tier 3.

4.3 Budget/Resources

The implementation of this AMP will rest primarily with APC, as licensee for the Weiss hydroelectric development. Annual budgets will be developed by APC relative to the monitoring and study costs as well as administrative costs and expenses. APC will also rely on other resources outside of its establishment including, but not limited to, the following:

- federal, state and local grants
- donated services (federal and state agency involvement)
- equipment (purchases and loaners)
- expertise (governmental, non-governmental, private)

4.4 Meeting Schedule

The Steering Committee will establish a meeting schedule based on the activities and deliverables in any given year. The Steering Committee will establish an annual calendar and distribute it, along with any notes from previous meetings, to committee members. The tentative schedule is provided in Section 6 of this plan. It should be noted that this schedule is based upon the issuance of a new license in 2007. A delayed issuance of the license will require that the schedule be revised accordingly.

5.0 **MONITORING STARTING FLOW AND DETERMINING MODIFICATIONS**

5.1 Starting Weiss Bypass Spillway Flows

The Weiss Bypass AMP identifies a starting flow range for the Weiss Bypass spillway release based on a monthly percentage of the Coosa River flow as measured at the USGS Mayo's Bar gage (Coosa River near Rome, GA – USGS STAID 02397000) (Table 1). The gage is located in the last “free-flowing” section of the Coosa River before it enters the upper project boundaries of Weiss Reservoir, and serves as a “best case” indicator of “natural flows”. Since the Coosa Basin is impounded further upstream (eg. Carter's and Allatoona Reservoirs), the current flows are somewhat modified (high flows are reduced and the low flows are elevated) from historic flow records.

The proposed average monthly spillway releases vary from 4 to 9% and yield an average annual release flow of 7% of the Coosa River flow (Table 1). This range was selected based on habitat analysis, best professional opinion of the Working Group, and estimated impact to project generation. The starting spillway release flow will be scientifically evaluated and adjusted during the license as described in the AMP.

The monthly percentage will be used in combination with the 3 or 4-day average Coosa River flows (at the USGS Mayo's Bar gage) to determine the flow that will be passed into the Weiss Bypass at the Spillway structure. This will provide seasonality of flows (both monthly and annually). Flows will be adjusted on Tuesday and Friday of each week. The Tuesday adjustment will be based on the average flow from the previous 4 days (Friday, Saturday, Sunday, and Monday). The Friday adjustment will be based on the average flow from the previous 3 days (Tuesday, Wednesday, and Thursday). For example - during January:

$(\text{Tu}+\text{We}+\text{Th flow at Mayo})/3 = \text{Ave 3-day flow} * 6\% (\text{Jan}) = \text{Weiss spillway flow for Friday through Monday.}$

$(\text{Fri}+\text{Sat}+\text{Sun}+\text{Mon at Mayo})/4 = \text{Ave 4-day flow} * 6\% (\text{Jan}) = \text{Weiss spillway flow for Tuesday through Thursday.}$

These starting flows were selected to produce flows in the bypass that mimic “natural flow patterns”. These flows may be modified (up or down) as part of the AMP process. During

the life of the license, APC will periodically explore the option of using a “minimum flow” turbine to make passing a flow more economical and potentially pass a higher flow. Progress on this issue will be reported to the Steering Committee at annual meetings.

Month	Percent of Flow at Mayo’s Bar Gage
January	6 %
February	9 %
March	9 %
April	9 %
May	9 %
June	5 %
July	4 %
August	4 %
September	6 %
October	9 %
November	8 %
December	7 %

Flushing flows (spillway flood events) in the bypass have been identified as a positive flow event for the bypass and typically occur on a natural basis at least once per year. APC will continue to provide flushing flows to the Weiss Bypass as part of their flood control operations. APC cannot limit the frequency or magnitude of spillway releases due to the federally mandated flood control obligations of the project. Due to the volume of water needed, APC will not artificially create a flushing flow in the bypass.

5.2 Length of time for Starting Flow evaluation

The Starting Flow evaluations will continue until 2020, at which time the Weiss Bypass Steering Committee will evaluate the biological data and make a recommendation for any changes in the Weiss Bypass flow. Specifics for this period are detailed in Section 6.0 Master Implementation Schedule of this document.

5.3 Establishing Monitoring Criteria and Schedule

Monitoring methodology was developed by the Weiss Bypass Technical Teams during 2004 and 2005. This final version of the AMP includes Technical Team input up through November 2005.

5.3.1 Collection Sites

To better standardize collection sites and methods, the Technical Team has selected the location of “Community Sampling” stations within the Weiss Bypass. These sites include all habitat types available in the bypass (run, riffle, pool) and all monitoring will be performed within each sampling station. The Team established four (4) community sampling stations and a “control” reference site on the lower end of Terrapin Creek (Figure 1):

Station 1 Extends from just below the spillway gates (Lat: 34.1707° - Long: -85.7526°) downstream to old “section 2” transect (Lat: 34.1582° - Long: -85.7408°)

Station 2 Extends from old “section 3-A” transect (Lat: 34.1417° - Long: -85.7025°) downstream to old “section 5-C” transect (both upstream and downstream of the Highway 20 bridge) (Lat: 34.1345° - Long: -85.6862°)

Station 3 Extends from old “section 6-A” transect (Lat: 34.1310° - Long: -85.6883°) downstream to old “section 7-B” transect (immediately downstream of Terrapin Creek) (Lat: 34.1261° - Long: -85.7098°)

Station 4 Extends from old “section 8” transect (Lat: 34.1238° - Long: -85.7313°) downstream to old “section 8-C” transect (near the Catfish farm) (Lat: 34.1217° - Long: -85.7583°)

Terrapin Creek Extends from the Co Hwy 71 bridge downstream to the confluence with the Weiss Bypass

Boat electrofishing, backpack electrofishing/seining, and macroinvertebrate sampling will be conducted at each of these “community” sample stations and the Terrapin Creek reference site annually, in the September/October time frame. Water chemistry and water quality will also be collected in most of these stations. The GPS location of each Station will be established, recorded, and used during the study to ensure consistency of sampling over time.

5.3.2 Water Quality Monitoring

Water Quality monitoring in the Weiss Bypass is necessary to establish an accurate baseline and to evaluate changes in water quality resulting from the Weiss Bypass initial flow release regime. Monitoring will be performed on a qualitative and quantitative basis. The monitor in the Weiss Dam Bypass (Station 1) shall record dissolved oxygen and temperature continuously at 60-minute intervals from May 1 through September 30 as required in the Water Quality Certification for FERC Project Nos. 2146, 618, and 82 issued by the Alabama Department of Environmental Management on July 1, 2005. During flood events, the monitoring may be temporarily discontinued until tailrace elevations return to normal. Following issuance of the new license for the Coosa Project, water quality data will also be collected in the Weiss Dam tailrace. The monitor in the Weiss Dam tailrace shall record dissolved oxygen and temperature at 60-minute intervals during periods of generation following one continuous hour of generation beginning May and extending through September 30 as required in the Water Quality Certification for FERC Project Nos. 2146, 618, and 82 issued by the Alabama Department of Environmental Management on July 1, 2005.

Collection Sites and Sampling Techniques

Continuous water quality data (temperature and DO) will be sampled during May through October at the sod farm (Station 2) and the catfish farm (Station 4). When the flow release has begun, an additional continuous sampling site will be added just downstream of the spillway (Station 1). The data will be evaluated and the need to move or eliminate the sod farm water quality sampling location will be determined. Data will be collected with a continuous water quality monitoring device (or equivalent). The continuous water quality monitoring device (or equivalent) will be changed out periodically and calibrated prior to and upon retrieval to ensure quality of the data.

Water chemistry data will be collected in the Weiss Lake spillway forebay at elevation 548 msl (the approximate depth of water that will pass from the lake through the spillway gates into the Weiss Bypass); at the sod farm (Station 2 - at mid-depth of the water column), and the catfish farm (Station 4 - at mid-depth of the water column). Water chemistry data was collected

monthly during February through October in 2004 and was collected monthly starting in March 2005 and will continue through March 2006 to provide one continuous year of chemistry data. The water chemistry data is being collected to better understand the current conditions in the bypass and to anticipate potential changes in future conditions with the release of flow from the lake environment. A sample from the photic and aphotic zone will be collected and will be composited as one sample. If depths are less than 10 ft (no photic zone), one water chemistry sample from mid-depth will be collected. Samples will be collected, labeled, preserved as specified by protocols, and returned to APC's Central Test Laboratory for testing of the following parameters:

Alkalinity, Total (mg/l as CaCO ₃)	Manganese, Total (mg/l)
Aluminum, Total	Magnesium, Total (mg/l)
Antimony, Total (mg/l)	Molybdenum, Total (mg/l)
Arsenic, Total (mg/l)	Nickel, Total (mg/l)
Barium, Total (mg/l)	Nitrogen, Ammonia(mg/l)
Beryllium, Total (mg/l)	Nitrogen, Nitrate (mg/l)
Bicarbonate Alkalinity (mg/l as CaCO ₃)	Nitrogen, Nitrite (mg/l)
Bromide (mg/l)	Nitrogen, Total Kjeldahl (mg/l)
Cadmium, Total (mg/l)	Phosphate, Ortho (mg/l as P)
Calcium, Total (mg/l)	Phosphorus, Total (mg/l)
Carbon Dioxide, Free (mg/l)	Pigment Ratio (SU)
Carbon Dioxide, Total (mg/l)	Potassium Total (mg/l)
Carbonate Alkalinity (mg/l as CaCO ₃)	Secchi Disk Photic Zone Depth (feet)
Chloride (mg/l)	Selenium, Total (mg/l)
Chlorophyll A, Spectro, Corrected (ug/l)	Silicon, Total (mg/l)
Chromium, Total (mg/l)	Silver, Total (mg/l)
Cobalt, Total (mg/l)	Sodium, Total (mg/l)
Conductivity (umho/cm)	Solids - Suspended (mg/l)
Copper, Total (mg/l)	Solids, Total (mg/l)
Fluoride(mg/l)	Strontium, Total (mg/l)
Hardness, Total (mg/l)	Sulfate (mg/l)
Hydroxide Alkalinity (mg/l as CaCO ₃)	Thallium, Total (mg/l)
Iron, Total (mg/l)	Tin, Total (mg/l)
Lead, Total (mg/l)	Titanium, Total (mg/l)
	Total Organic Carbon (mg/l)
	Turbidity (NTU)

Temperature, DO, conductivity, and pH will be collected along with these chemistry samples at the time of sampling each site. APC's Central Test Laboratory is an accredited laboratory and will provide calibration data or Standard Operating Procedures upon request.

A special collection of initial temperature data at Station 3 and in Terrapin Creek will be collected from June through October during 2005. This data will help to provide a better understanding of the water quality of the Weiss Bypass

ADCNR - We need continuous DO and temperature data collected at the pull zone in the reservoir above the spillway during the summer months. -

The real time DO monitor located just downstream of the spillway should sufficiently characterize the DO of the minimum flow entering the upper portion of the bypass.

FWS - We also need continuous DO data collected at the sub-substrate zone of bars being used by mussels currently and on bars where restoration is proposed.

The feasibility of collection of DO within the substrates is questionable. Technical Team members have agreed to try to collect this during the fall of 2006 to determine if it can be done. Based on their success, the Technical Team may recommend collection of this data again during subsequent sampling years.

Monitoring Timeline

Fishery sampling was begun in 2004 and will continue as indicated in Section 6 and depicted in Figure 2. Water quality sampling may be suspended in later years of the timeline if all state water quality standards are maintained during 2008-2010 sample period. If water quality parameters are not met, the sampling will continue. As stated previously, if the license is not issued in 2007, the timeline will be adjusted appropriately.

5.3.2 Fish Monitoring

Fishery Community monitoring in the Weiss Bypass is necessary to establish an accurate baseline and to evaluate changes in the fishery community resulting from the Weiss Bypass initial flow release regime. Monitoring will be performed on a qualitative and quantitative basis.

Collection Sites and Sampling Technique

Fisheries data will be collected at the four Community Sampling sites in the Weiss Bypass and the Terrapin Creek reference site. Two types of fishery samples will be collected – Fish Community Samples and Fish Spawning Samples. Fish Spawning Samples will not be collected at the Terrapin Creek reference site. The following sections outline the techniques that will be used to collect these samples. Collection sites are depicted in Figure 1.

Fish Community Samples

Fish community data will be collected at Sites 1, 2, 3, and 4 and Terrapin Creek in the September – October time period during each year of data collection. Collections will only be attempted when the Weiss Bypass flows are within 20% of the scheduled flow release cfs. Collections during the baseline data years (2004 – 2006) will be performed at a spillway flow of 300 to 500 cfs provided during boat electrofishing sampling and 50 cfs provided during backpack electrofishing/seining sampling.

Boat daytime electrofishing will be used at each community sampling reach and Terrapin Creek to sample the fish community in generally deeper areas (greater than 2 feet deep).

Community Sampling Stations will be sampled as follows:

Sampling will include 4-ten minute samples in each reach. Boat electrofishing sampling will commence at the beginning of each reach with a shoreline (10 min.) and a mid-channel (10 min.) sample, if feasible. If two electrofishing boats are present, these samples can be conducted simultaneously. Each 10 minute sample will be processed as a separate sample. After processing the samples, another shoreline (10 min) and mid-channel (10 min) sample will be collected until the reach has been sampled for a total of 40 minutes. If habitat and channel width does not permit both a shoreline and mid-channel sample, mid-channel efforts will be shifted to shoreline sampling to obtain the required 40 minutes in the sample reach. Within each sampling station, all microhabitats (pools, riffles, runs, brush piles, stumps, boulders, etc.) will be sampled in an attempt to clearly describe the fishery community present.

Terrapin Creek will be sampled for 20 minutes with one smaller stream boat due to limited accessibility.

All stunned fish will be collected during sampling, placed in a live well or collection container, identified to species, total length measured, weighed to nearest gram and released as described below.

Collect Length and Weight on all:

- 1) spotted bass, largemouth bass, redeye bass, freshwater drum, black and white crappie, striped and hybrid-striped bass, white bass, and all Catostomidae species.
- 2) Bluegill larger than 150 mm (Collect length only on all individuals smaller than 150 mm).
- 3) Centrarchids (sunfish other than bluegill).
- 4) Catfish larger than 300 mm (Collect length only on all individuals smaller than 300 mm).
- 5) any species not specifically mentioned in the sections below will be weighed and measured.

Collect Length only:

- 1) yellow bass
- 2) minnows/shiners, darters, sculpins, bullhead catfish, & mosquito fish

Sub-sampling shad species:

- 1) Process threadfin and gizzard shad separately.
- 2) Measure and record up to 10 individuals (for each species collected) and then determine and record the aggregate weight of the 10 individuals.
- 3) On the remaining individuals (of each species), count the total number – measure and record the largest and smallest – and determine and record the aggregate weight.

Collection of Carp, Gar and smallmouth buffalo– note the total number observed in the sample area, but do not net them.

Backpack daytime electrofishing and seining will be used to sample the fish community at each collection site (including Terrapin Creek) where shallower areas (less than 2 feet deep) are present. A sampling unit of effort is defined as a seine haul through a pool, a seine set in a riffle or run where fishes are shocked into the seine, or a set length of shoreline shocked for fishes. At each sampling reach two 150 ft. shoreline transects (150 feet in length x 2 feet wide) will be electrofished. Each of these transects are processed as separate samples. In addition, 10 pool, 10 run, and 10 riffle “sampling efforts” will also be collected. A sampling effort is defined as a 15 ft. X 15-20 ft. area that is either shocked or seined as a unique sample. Shocking into a seine in riffle or run areas is acceptable and is counted as one effort. Each “sampling effort” is processed and recorded separately. If sufficient pool, run, or riffle habitat is not present to collect 10 sampling efforts of each, then efforts should be shifted to an alternative habitat type so that a total of 30 sampling efforts are collected. Within each sampling station, all microhabitats (pools, riffles, runs, brush piles, stumps, boulders, etc.) will be sampled in an attempt to clearly describe the fishery community present. Each “sampling effort” is processed as a separate

sample. For each sample, the number of each species collected is recorded and fish are returned downstream of the collection area.

Any problematic species identifications will be collected and preserved in 10% formalin or on ice and returned to APCO lab for identification and enumeration and addition to the data sheet. Other information pertinent to collections will also be recorded (date, time, weather conditions, sample location, collection technique, sampling effort, water temperature, DO, and secchi disc, etc.) as directed on each data sheet.

Fish Spawning Samples

Based on Spring Spawning collections during 2004, the Technical Team adjusted the location of the collections. The same “upper” and “lower” stations were sampled in 2005 and the “middle” station was relocated further downstream to more riverine type habitat.

Spring spawning samples will be collected at in community stations 1, 4, and approximately 1 mile downstream of Station 4 during the March – April time period during each year of data collection (Figure 1). Collections will only be attempted when the Weiss Bypass flows are within 20% of the scheduled flow release cfs. Some of the key species of interest are: striped bass, white bass, yellow bass, spotted sucker, redhorse (black, blacktail, golden, and river), freshwater drum, smallmouth buffalo, mooneye, and blue sucker.

Gill nets (100’ nets with 20’ panels of 1”, 1 ½ “, 2”, 2 ½ “ and 3” bar mesh) will be used for fish collections. Gill nets will be set in the morning and tended every 1 hour to prevent excessive mortality of adult spawning fish. Four sets /site/day is the target for collection effort. Fish collected will be placed in a live well, total length measured to the nearest mm, weighed to the nearest gram, and released downstream of the sampling area. Other information pertinent to collections will also be recorded (date, time, weather conditions, sample location, collection technique, net time, water temperature, DO) as indicated on each data sheet.

Monitoring Timeline

Fishery sampling was begun in 2004 and will continue as indicated in Section 6 and depicted in Figure 2.

5.3.3 Mollusk and Macroinvertebrate Monitoring

Mussel and macroinvertebrate community monitoring in the Weiss Bypass is necessary to establish an accurate baseline and to evaluate changes in the community resulting from the Weiss Bypass flow release regime. Monitoring will be performed on a qualitative and quantitative basis.

Sampling Techniques and Collection Sites

The GPS location of each collection site will be established, recorded, and used during the study to ensure consistency of sampling over time.

Macroinvertebrates

- Macroinvertebrate sampling will consist of surber sampling as well as qualitative sampling at each “community structure” sample site. A control site in lower Terrapin Creek will also be sampled.
- Macroinvertebrate community data will be collected during the September – October time frame.
- Replicated surber samplers will be used to quantitatively sample the shallow riffle habitat at each site.
- In addition, qualitative kick net sampling lasting approximately one hour will be conducted at each site in order to more completely characterize the overall macroinvertebrate community.
- Samples will be preserved in the field and returned to the APCO lab for identification and enumeration.

Crayfish

- Crayfish sampling will be conducted concurrently with the macroinvertebrate sampling, at a minimum; additional sampling effort, targeted specifically at crayfish, may be conducted if deemed necessary.
- Crayfish will be sampled qualitatively at each sample station using a combination of techniques including hand collecting, kick-net sampling, and backpack electrofishing. In addition, any crayfishes observed during fish sampling will be collected and saved for analysis.
- Experimental collection of crayfish using baited minnow traps at the sod farm and catfish farm sites was attempted in March 2005 through October 2005. This effort met with minimal success and will be discontinued. However, this collection technique will continue during May & October .
- Specimens will be preserved in the field in 70% ethanol .

- Species identifications will be accomplished using available literature and will be confirmed by taxonomic experts familiar with the group. A voucher collection will be maintained.

Mussels

Qualitative and quantitative sampling of the Weiss Bypass for mussels has been completed and a report submitted by Herod et.al 2001. This data should provide an adequate basis for future comparisons. Data was collected at multiple sites in the Weiss Bypass.

- A. approximately 5.5 river miles downstream of spillway
- B. approximately 5.75 river miles downstream of spillway
- C. approximately 7.0 river miles downstream of spillway
- D. approximately 8 river miles downstream of spillway

At least one or two sites above Terrapin Creek will be sampled after bypass flows have been initiated. Data collections will be consistent with those described in Herod et.al. 2001. Sampling should take place in the September - October period due to low flows and warm water.

Technical Team members performed some preliminary qualitative mussel sampling in Weiss Bypass during the Fall of 2005 to verify the findings of the previous mussel studies.

Snails

Snail sampling should be carried out at each “community structure” sample site. Sampling should take place in the September-October period due to low flows and warm water. A 0.25 m² quadrat or Surber sampler (1 ft²) should be used for monitoring snails. The area sampled may be adjusted based on snail densities. A minimum of fifteen samples should be taken at each site. The surface substrate within the sampling area will be removed to a white enamel pan and will be hand-picked to remove any snails. All snails collected will be preserved in the field in 95% ethanol and will be returned to the laboratory for identification and enumeration.

Monitoring Timeline

Macroinvertebrate sampling was begun in 2004 and will continue as indicated in Section 6 and depicted in Figure 2.

5.4 Analysis of Monitoring Data

All data collected will be assembled by APC into one data report package.

Water Quality

Collected water quality data will be compared to the applicable water quality standard(s) for the designated use classification(s) assigned the reach between the Weiss Dam Spillway and the Weiss Dam Powerhouse Tailrace. The current designated use classification for this reach is “Fish and Wildlife”. The specific water quality criteria of concern are temperature and dissolved oxygen.

Baseline water quality data will be compared to flow release water quality data to determine the potential and observed changes (positive or detrimental) to the aquatic biota associated with the flows. Analysis will include a description of the influence of generation “backflow” on water quality in the Weiss Bypass. Water quality data collected in the Weiss tailrace, as described in Section 5.3.2, will be used in this analysis to analyze "backflow" influence. Other sources of available water quality data may also be incorporated into this analysis.

Fishery Data

Baseline fishery data will be compared to flow release water fishery data to determine the potential and observed changes (positive or detrimental) to the aquatic biota associated with the flows. Analysis of data may include but not be limited to a comparison of the following metrics:

- species richness/diversity
- species distribution
- species density
- trophic shifts
- young-of-year recruitment
- distribution of migratory species
- total number of native species
- proportion of fluvial specialists (intolerant)
- proportion of habitat generalists (tolerant)
- number of darter species
- number of sucker species
- proportion of insectivores
- proportion of omnivores

- proportion of centrarchid species
- proportion of top carnivores
- proportion of exotics (e.g. *Cyprinella lutrensis*)
- total number of individuals
- condition values of sport species
- condition values of commercial species
- percentage of fish as omnivores and stoneroller species.
- percentage of fish as specialized insectivores.
- percentage of fish as piscivores.
- catch rate (average number / 300 FT² or 10 minutes of boat shocking).
- percentage of hybridized individuals in the sample.
- percentage of individuals with disease, tumors, fin damage or other anomalies.

Other sources of available fishery data may also be incorporated into this analysis. Stream Indexes of Biological Integrity (IBI's) for each sampling station will be calculated using the applicable metrics shown above and the TVA and/or the GSA scoring criteria.

Mollusk and Macroinvertebrate

Baseline mussel, snail, macroinvertebrate and crayfish data will be compared to flow release data to determine the potential and observed changes (positive or detrimental) to the aquatic biota associated with the flows. Analysis of data may include but not be limited to comparison of the following metrics:

- species richness/diversity
- species distribution
- trophic shifts
- recruitment
- total richness -- # of non-ambiguous taxa in sample
- percent of total richness composed of EPT taxa (mayflies, stoneflies, & caddisflies)
- percent of total richness composed of chironomids
- total abundance -- # of organisms in sample
- percent of abundance composed of EPT taxa
- percent of abundance composed of chironomids
- average EPA tolerance values for sample based on richness
- percent abundance of most abundant taxon
- percent abundance of 3 most abundant taxa
- percent abundance of 5 most abundant taxa
- Shannon's Diversity Index values
- Margalef's Diversity Index values
- taxa richness (total number of taxa)
- number of EPT taxa (number of mayfly, stonefly, and caddisfly taxa)
- percent EPT taxa (% of individuals composed of EPT taxa)
- abundance –weighted EPA tolerance value for sample (this is essentially the same as the North Carolina Biotic Index-NCBI that is commonly used)

- percent abundance of oligochaetes (% of oligochaetes in sample)
- percent of sample as omnivores and scavengers
- percent of individuals as collectors/filterers
- gastropod richness (# of snail species)
- density of operculate gastropods
- mussel richness (# of species)
- mussel density
- mussel reproduction (open for discussion)
- crayfish richness (open for discussion)

Other sources of available unionid data may also be incorporated into this analysis. Indexes of Biological Integrity (IBI's) for each sampling station will be calculated using the applicable metrics shown above.

5.5 Decision Process for AMP Modifications

This section will be developed by the Weiss Bypass Steering Committee after adequate data collection and analysis has been complete.

5.6 Annual Report Format and Schedule

Each year, APC will prepare reports of the following information for review by the Weiss Bypass Steering Committee:

- summary of Weiss Bypass flow data for the year (including compliance violations)
- summary of fish, water quality, mollusk and macroinvertebrate sampling data
- summary of species reintroductions in the Weiss Bypass

APC will consolidate each of the annual reports into a Summary Report that will be used by the Steering Committee to track trends in the Weiss Bypass.

6.0 **IMPLEMENTATION SCHEDULE**

This section contains a synopsis of the AMP Timeline. This information is also depicted in Figure 2.

2004 – Collect data on Fish, Macroinvertebrates (crayfish and insects), and Water Quality

2005 – Technical Team Meeting – Report Review
Collect data on Fish, Macroinvertebrates (crayfish and insects), Snails, and Water Quality, qualitative mussel survey.

2006 – Technical Team Meeting – Report Review
Collect data on Fish, Macroinvertebrates (crayfish and insects), Snails, and Water Quality

The following schedule may change based on issuance date of the license

2007 – Technical Team Meeting – Report Review
APC should receive the new license in July 2007 and will begin the Weiss Spillway Starting Flows.
First Meeting of the Steering Committee
Collect Water Quality Data as soon as flow releases begin to detect possible immediate impacts to bypass.

2008 – Steering Committee Meeting
Collect Water Quality data

2009 – Technical Team Meeting - adjust collections as needed.
(One full year after start of minimum flow) Collect data on Fish, Macroinvertebrates (crayfish and insects), Snails, and Water Quality, qualitative mussel survey

2010 – Steering Committee Meeting – Report Review
Collect data on Fish, Macroinvertebrates (crayfish and insects), Snails, and Water Quality

2011 – Steering Committee Meeting – Report Review Begin discussion/development of “decision process” (Section 5.5)

2013 – Technical Team Meeting - adjust collections as needed
Collect data on Fish, Macroinvertebrates (crayfish and insects), Snails, and Water Quality (if additional WQ data is warranted), qualitative mussel survey

2014 – Steering Committee Meeting – Report Review
Collect data on Fish, Macroinvertebrates (crayfish and insects), and Water Quality (if additional WQ data is warranted)

2015 – Steering Committee Meeting – Report Review

2018 – Technical Team Meeting - adjust collections as needed

Collect data on Fish, Macroinvertebrates (crayfish and insects), Mussels & Snails, and Water Quality (if additional WQ data is warranted)

2019 – Steering Committee Meeting – Report Review

Collect data on Fish, Macroinvertebrates (crayfish and insects), Mussels & Snails, and Water Quality (if additional WQ data is warranted)

2020 – Analyze Data – Steering Committee Meeting – Report Review

2021 – Decision Point – Steering Committee – to make a change or maintain existing flow regime, and develop a report with next steps for submittal to FERC.

7.0 COMPLIANCE

7.1 Objective

The objective of the AMP is to determine the environmental changes that occur in the Weiss Bypass from the single change of “increased flows” in this stretch of river. The Licensee will strive to comply with the target flow requirements for the study period. For the AMP to produce reasonable results, these flows should be released in the required quantity and at the required time within the tolerances of the equipment. It is also important to incorporate practical deviations from target flows that have no significant impact on the study results and reduce the burden associated with managing the paper track required by reporting a non-compliance.

7.2 Methods and Measurements

The Weiss Bypass Working Group has determined that the release into the bypass reach needs to provide seasonality of flows based on a long-term monthly percentage of the Coosa River flow as measured at the Mayo’s Bar gage (USGS Coosa River near Rome, GA – 02397000). The monthly percentage target flows are presented in Table 5.

Month	Percent of Flow at Mayo’s Bar Gage
January	6%
February	9%
March	9%
April	9%
May	9%
June	5%
July	4%
August	4%
September	6%
October	9%
November	8%
December	7%

In order to mimic a natural riverine flow regime which will reflect an unregulated flow pattern of the upper Coosa River drainage based on climatic conditions in the basin, changes to the flow in the Bypass need to be performed two times per week: Tuesday and Friday. The Tuesday adjustment will be based on the average daily flow from the previous 4 days (Friday, Saturday, Sunday, and Monday). The Friday adjustment will be based on the average flow from the previous 3 days (Tuesday, Wednesday, and Thursday). The daily flows will be determined using data obtained from the USGS Mayo's Bar gage as received by the Licensee's automatic gage information system. The flow in the Bypass will be changed biweekly between the hours of 7AM and 9AM local time. Releases into the Bypass for reasons outside the AMP can be made at anytime and in any amount as necessary for project operation.

The change in biweekly releases will be accomplished by adjusting the opening at the Spillway Structure. The Licensee will use a flow vs. opening relationship. For Trash Gate releases, the Licensee will use the current discharge table that is presently utilized for recording FERC-required project operating data.

7.3 Compliance Guidelines

Average monthly releases into the Bypass will meet a target variation of $\pm 5\%$ volume for compliance purposes. Daily releases into the Bypass will meet a target variation of $\pm 10\%$ volume for compliance purposes. These variations should provide the practicality of meeting the intended flow release while minimizing the burden of paper tracking small deviations in release amounts. Dissolved Oxygen compliance will be measured against the water quality compliance requirements contained in the 401 water quality certification for the Coosa River Project issued by the Alabama Department of Environmental Management on July 1, 2005.

7.4 Reporting Deviations from Guidelines

The Licensee will report suspected deviations in the Compliance Guidelines to the Steering Committee within 14 days. The Steering Committee will periodically meet and determine the ruling of a suspected deviation. Results of the Steering Committee will be reported to the FERC within 14 days.

8.0 REFERENCES

APC 2000 Water Quality Data for the Weiss Bypass.

Herod, J.J., H.N. Blalock-Herod, D.S. Ruessler and J.D. Williams. 2001. Examination of the freshwater mussel (Bivalvia: Unionidae) community, including the federally endangered southern clubshell, *Pleurobema decisum*, within the Old Channel of the Coosa River, between Weiss Spillway Dam and Weiss Hydropower Dam, Cherokee County, Alabama.

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Stewig J. May 2001. Assessment of Largemouth Bass and Spotted Bass Populations in the Dead River Section of the Coosa River, Alabama. Master's Thesis, Auburn University

