FINAL REPORT

Review of Major Dams and an Examination of Watershed Fragmentation

Report prepared by
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A Division of North Wind, Inc.

Submitted to
Saluda-Reedy Watershed Consortium

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www.saludareedy.org

Project Background, Objectives and Methods

Man has traditionally attempted to harness the energy and resources of moving water by damming rivers and streams. Impoundments created by this process provide many benefits including potable water supplies, power generation, flood control, and recreational opportunities. However, construction of dams effectively fragments a watershed by slowing rivers and blocking the natural flow of water and sediments.

Improper land management and poor erosion, sediment, and storm water management practices also cause water bodies to accumulate unnatural amounts of sediment. Proper dam management techniques can help mimic the natural flow of water and mitigate rates of sedimentation.

Aging dams and their proper maintenance are also a concern to dam owners and downstream residents. Numerous dams exist in the Saluda-Reedy Watershed (SRW) that are older than 50 years – the average design life for a dam. It is likely most dams in the SRW, as elsewhere, do not receive proper maintenance attention.

The Pinnacle Consulting Group (Pinnacle) was tasked by the Saluda-Reedy Watershed Consortium (SRWC) with examining dams in the watershed and their role and effects on water resources. This paper presents the results of an ongoing assessment of the effects of dams and impoundments on the water resources of the SRW.

Several thousand impoundments have been constructed within the 1167 square mile SRW over the last 100-plus years. These impoundments range from hundreds of small farm ponds of an acre or less to Lake Greenwood with a surface area of over eleven thousand acres. Significant rates of sedimentation have been observed on several of the larger impoundments in the SRW. Sedimentation rates were analyzed in a Geographic Information System (GIS) and results from this analysis are presented in an associated report.

Fragmentation of the watershed's natural hydrologic function as well as its natural biological systems occurs when dams are erected on streams, slowing the flow of water and sediments downstream. Hydraulic fragmentation of perennial streams in selected sub-watersheds was assessed in a GIS. A statistical-based GIS analysis was also conducted to determine the total number of impoundments in the watershed. Several thousand dams are estimated to exist in the SRW, with fewer than 200 being regulated either by state or federal agencies.

As part of this GIS-based analysis a database was developed of all regulated dams in the SRW. To produce a complete inventory of regulated dams in the SRW, Pinnacle examined several sources of dam and impoundment information. The final database is based on the United States Army Corps of Engineers' (USACOE) National Inventory of Dams (NID) database, with several enhancements. Two databases, one from the South Carolina Department of Health and Environmental Control (SCDHEC) Dams Safety Program and one from the Federal Energy Regulatory Commission (FERC), were used to cross check and augment the USACOE NID database. The finalized database was then spatially referenced in a GIS and checked for inaccuracies. The final GIS-based database contains over 10,000 records documenting regulated impoundments.

Regulated Dams

Regulated dams in the SRW were surveyed in a GIS. A database was developed based on the USACOE's NID and cross checked with databases developed by SCDHEC and FERC. The USACOE NID database included in-depth information on numerous regulated dams and dam qualities/criteria within the SRW including all Class 1 (high hazard), Class 2 (significant hazard) dams along with Class 3 (low hazard) dams that either exceeds 25 feet in height and 15 acre-feet of storage or those that exceed six feet in height and 50 acre-feet of storage. The SCDHEC database included spatial information on all regulated dams regardless of size but did not contain the depth of attribute information of the USACOE's NID.

This study documented 164 state and federally regulated dams within the SRW. These include state regulated Class 1, Class 2, and Class 3 dams, and federally regulated FERC dams. For a dam to be regulated it has to meet at least one of the following three criteria: have a dam height of 25 feet, have the capability to impound at least 50 acre-feet of water, or have properties located downstream that would lead to the conclusion that there would be possible loss of life with dam failure. *(See Figure 1: Saluda-Reedy Watershed Regulated Dams (opposite), and Table 1: Regulated Dams in the SRW Categorized By Major Watersheds (Appendix A)).*

Regulated dams were fairly evenly distributed across the SRW with small clusters in the central watershed and slightly denser distributions in the northern reaches corresponded by less dense distributions in the southern reaches of the SRW. *(See Figure 1: Saluda-Reedy Watershed Regulated Dams (opposite), and Table 2: Dams Categorized by HUC-11 Watersheds*

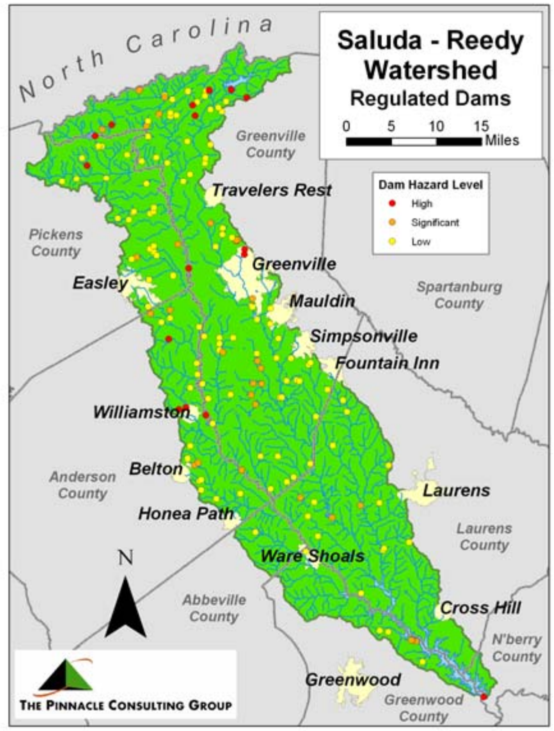

Figure 1: Regulated Dams in the Saluda-Reedy Watershed

(Appendix A)). (Note: HUC stands for Hydrologic Unit Code and is a watershed classification scheme used by the United States Geological Survey).

The majority of regulated dams had a surface area of less than 20 acres. *(See Table 3: Dam Impoundments Categorized by Surface Area (Appendix A)).* This information combined with the volume of water held behind dams can prove useful in identifying dams that could be of potential concern for future study.

Most regulated dams (58%) had less than 100 acre-feet of water impounded. Ten percent of regulated dams, however, had over 1,000 acre feet of water impounded with four regulated dams impounding more than 10,000 acre-feet. *(See Table 4: Dam Impoundments Categorized by Volume (Appendix A)).*

Construction of regulated dams went through a peak of activity from the 1950's to the 1970's. Since most dams have a design life of about 50 years, many of these older structures may be suspected of developing structural, mechanical, or settlement problems and should be routinely examined for potential safety concerns. Several dams in the SRW were built in the early 20th century or even the late 19th century. These older dams will progressively experience more frequent and more serious safety hazards over time. *(See Table 5: Dams Categorized by Decade of Construction (Appendix A)).*

Unregulated Dams and Watershed Fragmentation

Information on unregulated dams is much more limited as compared to available data on regulated dams. Since the vast majority of dams in the SRW are unregulated, and data on unregulated dams is not kept in one central location, a large data gap exists on these structures. This project has attempted to partially fill this data gap by estimating the total number and density of unregulated dams in the SRW.

Unregulated Dams - Estimates

Two different GIS analysis methods were used to estimate the total number of impoundments in the SRW. Watershed-wide GIS data were not readily available on a scale that would allow for the capture of location data on all impoundments so statistical based analyses were employed.

The first method used 1999 National Aerial Photography Program (NAPP) aerial imagery to sample impoundments in random portions of the SRW. This count was then extrapolated out to represent the entire SRW. By this method it is estimated that 2,700 total impoundments exist, of which over 2,500 are unregulated.

The second GIS based method that was used to estimate the total number of impoundments in the SRW used a water body shapefile from the Greenville County GIS department. Data for the total number of impoundments in the Greenville County portion of the SRW were generated and then extrapolated out into the SRW. This method estimated that there were roughly of 3,400 total impoundments in the SRW, of which over 3,200 are unregulated.

These numbers produce a density of approximately three impoundments per square mile in the SRW. This equates to one dam for every 2.22 miles of perennial streams or one regulated dam for every 7.2 miles of perennial streams. Impoundments range from .02 to 11,400 acres in size. *(Note: This observation does not account for the thousands of sediment and stormwater detention ponds ever more ubiquitous on the landscape, especially at the heads of, or along the course of ephemeral drainages).* For an example of one of the denser areas of impoundments see Figure 2: Stream Fragmentation *(next page).*

The regulation of dams into classes or hazard levels is based upon potential environmental damage and loss of human life if a dam were to fail and release its impounded waters downstream. Unregulated dams, even though smaller in both dam height, storage volume, and level of predicted danger from a possible dam failure, can present substantial concerns to downstream waters and properties. The high numbers of these unregulated dams multiplies these concerns.

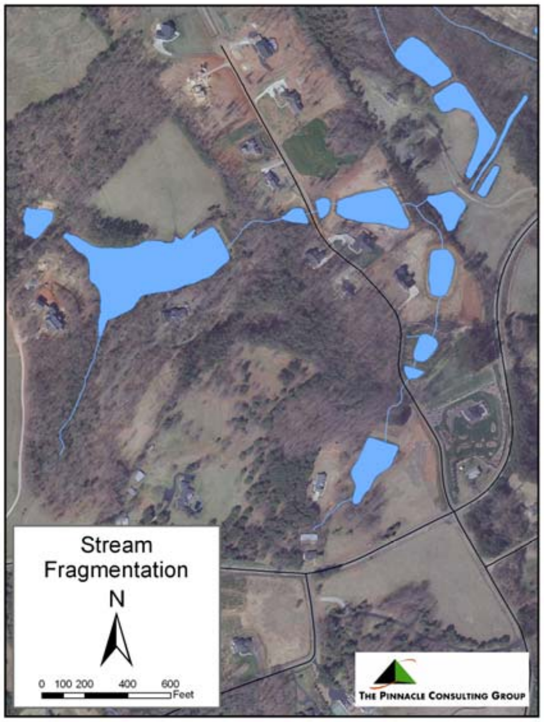

Figure 2: Stream Fragmentation – Ponds in Upper Reedy River Basin of Greenville County – 2003 Imagery

Greenville County Watershed Fragmentation

Due to the availability of higher quality GIS data in Greenville County a more detailed study of the total number of impoundments is possible. A count was performed of the total number of impoundments in all HUC-14 digit watersheds that are completely within Greenville County. These statistics are provided in Table Six: Total Impoundments in Greenville County HUC-14 Watersheds *(Appendix A).* Total number of water bodies for each HUC-14 unit varied from 9 to 155 with a density from 0.1 to 2.8 water bodies per square mile.

New Dam Construction Rates

The documentation of new dam construction rates is difficult due to the lack of information on unregulated dams. Due to the lack of information, new dam construction rates were estimated with two methods: using data obtained from the Natural Resources Conservation Service (NRCS-USDA) and a calculation based on the construction rates of regulated impoundments. The NRCS provides design, technical and construction oversight support to farmers and other cooperators in its USDA-sponsored programs.

Based on construction rates provided by the NRCS for impoundments in Greenville County it is estimated that the NRCS provides assistance for the construction of 37 dams per year in the SRW.

Based on Table 5: Dams Categorized by Decade of Construction *(Appendix A)*, since 1960 an average of just over 13 regulated dams have been built per decade. If unregulated dams are constructed at a similar rate, this equates to approximately 232 new dams constructed per decade, or 23 dams per year.

Aging Structures

Aging structures pose an additional hazard to the people and resources of the SRW. Generally speaking, 50 years is the typical lifespan for a dam. At this age most dams require additional maintenance beyond routine servicing. Older dams with more complex designs require proportionately more maintenance attention after 50 years.

Age statistics are not readily available for unregulated dams but it is assumed that the age distribution of unregulated dams is similar to that of regulated dams where construction dates are known. With regards to regulated dams 18 of 164 structures are older than 50 years with 12 dams of an unknown age. This equates to 11 percent of dams being older than 50 years with seven percent of unknown ages.

Photo 1: Lake Conestee Dam, ca. 1892, on the Reedy River, Greenville County. View of dam from upstream with partially open gate, August 2000. Note dilapidated gate assembly and accumulated trash and debris.

Under the assumption of ages being equivalent between regulated and unregulated dams there would be approximately 300 to 370 dams over 50 years of age with 190 to 240 with unknown ages. These dams require additional inspections, monitoring, and possibly repairs to keep them in a safe operating condition. In many cases these dams should probably be considered for decommissioning and removal.

"Conestee Canyon"

The Lake Conestee dam presents a unique situation which underscores a variety of management issues that can befall old dams. This dam is a stone masonry structure believed to have been constructed about 1892 on the Reedy River about six miles south of Greenville. Other dams had existed at this location as early as the 1830's or even earlier. This dam originally had a movable gate, which was typical of most dams of this design. *(See Photo 1).*

During Lake Conestee's lifespan the volumetric capacity of the lake has been reduced approximately 95 percent by sediment deposited from upstream sources. This equates to roughly 2.3 million cubic yards of accumulated sediment.

On about June 01, 2000 the gate assembly of the dam unexpectedly opened. It was determined that the gate had gradually decayed and had lost its ability to function as a gate probably decades ago. Examination of conditions following the breach event, indicated that what had been thought to be an intact gate was evidently simply a log-jam. Due to the lack of maintenance of this primary water level control feature of the dam, the gate gradually decayed and was replaced with a dense log jam. During a severe drought which began in 1998, streamflows were dramatically reduced, and with that the predictable delivery of large woody debris to replenish the log-jam essentially ceased. The debris in the eight-foot diameter gate orifice, which was sufficient to hold back the river and keep the lake full to the top of the dam under ordinary streamflow conditions, decayed to a point where it abruptly broke through. This allowed the lake to de-water over a matter of hours. The gate remained open from June 01, 2000 to June 21, 2001. This occurred shortly after the purchase of the lake and dam by the Conestee Foundation, a non-profit group formed to rehabilitate the lake and surrounding parcels into a public park.

During this twelve month period, the Reedy River, flowing through Lake Conestee, steadily cut down through the lake's accumulated sediments. This was a natural and predictable process of erosion wherein an impounded river, upon accessing its original base level, will dissipate energy by eroding the channel down to that base elevation. *(See Photo 2).*

Two NRCS surveys of the eroded "Conestee Canyon" channel were conducted during the one year of open-dam conditions. These surveys determined that roughly 95,000 cubic yards of sediments were flushed from the lake downstream during this period.

This history of the development of "Conestee Canyon" is of interest to the SRWC not just because of the dynamic related to the dam, but also because of the unique character of Lake Conestee. Because of its location downstream from historic industrial Greenville, this impoundment has been uniquely positioned to be a repository for Greenville's industrial contaminants. Two phases of Environmental Protection Agency (EPA) funded Targeted Brownfield Assessment have characterized contaminants in the lake's sediments. Based on the average concentration of contaminants in the lake sediments, the mass of industrial contaminants released and flushed downstream along with the 95,000 cubic yards of sediment was estimated. *(See Table Seven in Appendix A).*

Photo 2: "Conestee Canyon" as seen looking downstream during a cross-sectional survey of the river channel on 10 November 2000.

The Conestee Foundation was able to work with the NRCS and the Foothills Resource Conservation & Development Council in 2001 to obtain an Emergency Watershed Protection grant from USDA to install a temporary plate over the gate orifice to the Lake Conestee Dam. This temporary measure was installed on 21 June 2001 and was instantly effective in controlling water level and preventing excessive release of contaminated sediments.

Candidates for Dam Removal in the SRW

Dams become candidates for removal when they no longer serve any significant beneficial function, they start to pose a serious threat either to humans or the environment, or their presence is determined to impair otherwise desirable environmental conditions, such as re-establishment of a riverine fishery. The selection and removal of dams must be thoroughly assessed in a careful and systematic manner in order to not cause any additional damage to humans or the environment.

One source of concern with the removal of dams is the reintroduction of sediment (contaminated or not) into a river or stream that has historically been impounded behind the dam. Trapped sediment can contain legacy contaminants from upstream uses and discharges, as in the case of Lake Conestee. These contaminated sediments, if introduced back into a river system, can cause serious damage to aquatic life and drinking water supplies.

One example of a dam that does not serve its original purpose but absolutely cannot be removed due to contaminated sediment is the Lake Conestee dam. This dam needs to be maintained in order to keep polluted sediments from historic upstream uses effectively trapped in place and minimizing releases of contaminants to waters and potable drinking water supplies downstream in Greenwood County. This is a prime example of the importance of maintenance of old dams for reasons other than their original purpose.

Cedar Falls Dam

One potential candidate for removal is Cedar Falls Dam located on the Reedy River approximately 18 miles below the City of Greenville. Currently this century-old stone-masonry and timber-crib dam does not actively impound water or serve any beneficial function. The orifice in the dam is breached except for accumulated woody debris. This dam does have a spillway but only experiences top-of-dam overflows during high water events.

This dam still impounds a small amount of water and a small volume of sediment. Since Cedar Falls Dam does not provide any advantageous uses and only serves to fragment the SRW hydraulic network it may be a prime candidate for removal, once appropriate feasibility and impact issues are addressed. Cedar Falls Dam does currently pose a threat to canoers and kayakers who have to portage the dam and run the risk of being swept through the orifice. Removal of this dam, if justified through further investigation, will serve to improve water quality, enhance recreational opportunities, and improve recreational safety. *(See Photo 3: Cedar Falls Dam).*

Photo 3: Cedar Falls Dam – note canoe in bottom right for scale. Lower Greenville County.

Other Candidates For Removal

Additional dams that may be candidates for removal include Culbertson's Dam (Ekom Beach) and an unnamed dam at Union Bleachery on Langston Creek. Both dams are currently breached and their removal would provide additional benefits to the river ecosystem.

A dam located at the Peace Center on the Reedy River in downtown Greenville could also be a candidate for removal due to a sediment accumulation and maintenance problems, and the question of significant beneficial uses attributable to the dam.

Research by other agencies (Army Corps of Engineers) has alluded to other potential structures in the watershed that may be candidates for removal, to include at least one structure in the Huff Creek portion of the Reedy watershed.

Other dams where removal could be proposed can be identified through further study of the database produced by this project along with field visits, surveys, and additional research.

Historic Dam Removal in the SRW

Dam removal is not a new process. During the course of this project it has been discovered that several dams have been removed in the SRW historically.

Tumblin' Shoals Hydroelectric Project

Tumblin' Shoals hydroelectric project was built in 1907 by the Reedy River Power Company near the community of Hickory Tavern, in upper Laurens County. This hydro project was in service for the Reedy River Power Company until it was acquired in 1912 by the Sullivan Power Company. It was next acquired by Duke Power in 1935. This dam was decommissioned and removed by Duke Power in December 1970. *(See Figure 3: Tumblin' Shoals Hydroelectric Project, for an approximated shoreline location as built as in 1954).*

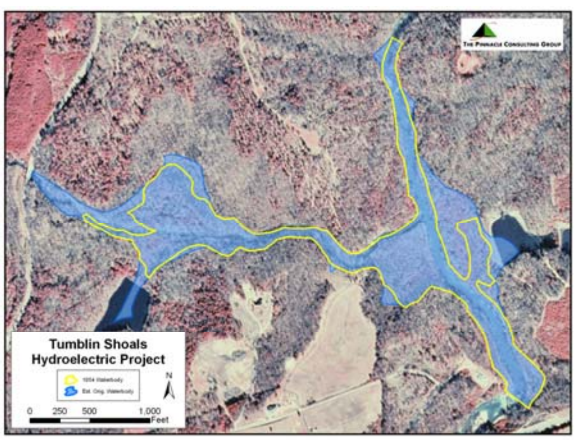

Figure 3: Tumblin' Shoals Hydroelectric Project, The impounded area is portrayed here as reflected in a 1954 aerial photo. The aerial photo displayed is from 1999.

The following photographs *(Photos 4-7)* depict the removal of the dam at Tumblin' Shoals, and current site conditions.

Photo 4: Tumblin' Shoals Dam on the Reedy River in Upper Laurens County, pre-1970.

Photo 5: Tumblin' Shoals Dam Demolition, drilling for placement of explosives, Dec 1970.

Photo 6: Tumblin' Shoals Dam Demolition, Dec 1970.

Photo 7: Tumblin' Shoals in 2002

"Sirrine Pond"

"Sirrine Pond," as it has been named for this project, is located just south of the Reedy River near downtown Greenville. *(See Figure 4: Sirrine Pond).* This pond was identified on an 1884 map of the City of Greenville. This map was rectified and the pond area transferred into a GIS. Sirrine Pond was calculated to be 2.2 acres. Based on current conditions, the historic footprint area of the pond has been filled, and the area is presently occupied by several multi-family dwellings. The dam's location is very close to the present location of McDaniel Avenue.

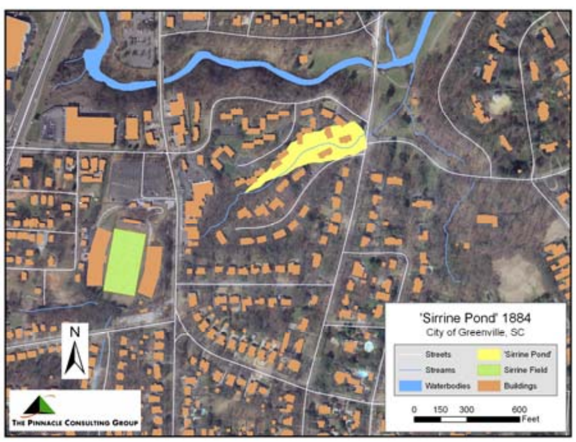

Figure 4: Sirrine Pond

Candidates for Modification

Dams become candidates for modification when their current condition or operational regime causes impacts to the environment or man that are no longer acceptable. In some cases modifications to a dam structure, or to its operational regime, may help to mediate the dam's impacts. In many cases this may be achieved without significantly affecting the dam's ability to meet its core functions. Modifications can include changes to the dam's frequency and magnitude of releases, type of release (top release versus bottom release), retrofitting of water control structures to change baseflow conditions, and flood control modifications, among others.

Trout Fisheries

Trout fisheries in South Carolina produce both a great recreation and economic resource. The trout waters of the SRW are among the most healthy and pristine waters of the SRW and hence are most deserving of protection.

Impacts on natural trout waters from land development and impoundments have depleted and degraded many of these waters. Modifications to current land use practices and dam management techniques can help to restore these natural trout fisheries closer to their original conditions. Modification of dams from a top to a bottom water release will lower the temperature of water flowing from the impoundment thereby improving trout habitat.

Several organizations allied with the SRWC have been working to enhance mountain trout streams in the upper SRW over the past several years through a program called "Partners For Trout" (South Carolina Department of Natural Resources, SCDNR). Led by the Foothills Resource Conservation and Development Council, this program identifies cooperating landowners and dams that may be candidates for trout habitat improvement programs.

Within the SRW, additional dams for consideration of modification include Poinsett (North Saluda) and Table Rock (South Saluda) Reservoirs along with several smaller impoundments. *(See Figure 5: Saluda-Reedy Watershed Trout Waters (next page)).* Both of these impoundments are fed by streams that support wild, reproducing populations of trout (Wild Trout). The streams that flow from these reservoirs are not Wild Trout waters, but rather "Put, Grow, & Take" waters. Put, Grow, & Take waters can support trout year-round but due to habitat deficiencies these trout can not successfully reproduce and require a yearly stocking of fish, generally due to elevated temperature regimes. Other habitat deficiencies can include high sediment loads and competitive species. The third category of trout waters are "Put & Take." These waters are only capable of supporting trout populations during cooler months of the year. The most commonly cited causes for this condition are warm water.

Permit Compliance and Hydraulic Impact Issues

Now that all regulated dams have been identified within the SRW, particular dams of interest can be examined as to permit compliance and various impact issues. To identify potential non-permit compliance concerns FERC regulated dams will require an in depth study of their permits. Other non-FERC regulated dams and impoundments can be examined as to their impact on the environment via the Clean Water Act.

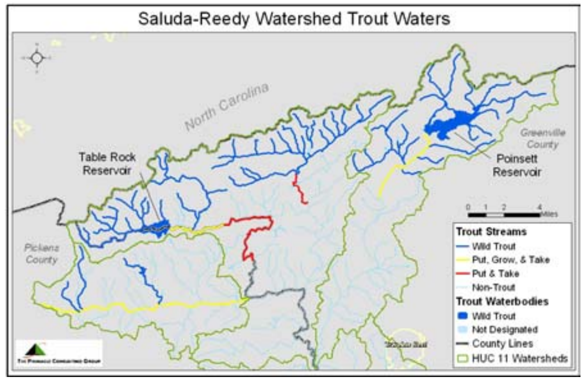

Figure 5: Saluda-Reedy Watershed Trout Waters

One dam of possible concern is Boyd Mill Pond Dam located on the Reedy River. This facility does generate hydroelectric power but not at a scale sufficient to trigger FERC regulation. Dams such as this, because of their small size and old technology typically operate as "peaking facilities," and can only operate profitably by producing hydroelectric power at peak power demand times. This production schedule can cause severe fluctuations downstream, much more so than naturally occurring fluctuations in water levels, or "run of the river" conditions. This manipulation of flows often occurs during the hottest, driest, and lowest flow regime conditions of the year, resulting in the most extreme ecological impacts to the downstream aquatic environment. These abrupt changes in flow can also cause stream bank instability, erosion, scour and degraded water quality. *(See Photograph 8: Effects from Sporadic Hydroelectric Releases from Boyd Mill Pond Dam).* Modifications to this facility's operational regime should be adopted so that releases more closely mimic natural "run of the river" conditions.

Photo 8: Effects from Erratic Hydroelectric Releases from Boyd Mill Pond Dam. On the Reedy River in Laurens County.

Funding and Technical Support of Dams Programs

In the course of our review of the role of dams in the SRW we assessed funding and technical expertise available from various agencies to address dams management issues. With regard to the relevant federal agencies involved in dam building in this region, specifically the Corps of Engineers and NRCS, there are active programs.

The Corps provides limited assistance through its continuing programs authority. These services are generally available only to units of government and on a cost-sharing basis. To our knowledge no actual dam repair programs have been completed through these Corps programs within the SRW.

NRCS has various programs delivering technical assistance and cost-sharing to farmers and other cooperators primarily through federal Farm Bill funding. NRCS has been active in providing technical design and construction assistance on dams to farmers throughout the SRW. It has also been the primary agency involved in the trout habitat improvement assistance and funding via the Partners for Trout program. NRCS has also recognized that its nationwide PL-566 program has created numerous moderately large watershed dams that have a limited life. Most of these structures were built in the 1950's and 1960's, including several within the SRW. NRCS has acknowledged the hazards associated with the accumulation of pesticides and other toxins in the sediments captured behind its dams in agricultural watersheds. NRCS was the only agency that had the resources to assist the Conestee Foundation in 2000 with the temporary repair of the Lake Conestee dam. The agency was able to respond to this unique situation using its USDA Emergency Watershed Protection Program.

FERC's role is exclusively regulatory. Its jurisdiction is restricted to the limited few large dams already subject to FERC regulations. None of these facilities are subject to permit renewal within the short term, but the SRWC should continue to monitor the status of these permits, and the performance of the permittees.

SCDHEC is the state agency with responsibility for administration of the state's dam safety program. From observation and feedback it is apparent that the SCDHEC program is extremely thinly funded. Very limited resources are available for inspections and no routine funding is available for dam repairs.

The Greenville Water System (GWS) has historically performed maintenance on its own dams. In effect, GWS, as the major water purveyor in the SRW is self-regulated and its dam management and maintenance programs are self-funded. These structures represent an exceptional level of scrutiny, maintenance and management attention and in many ways model the level of attention that older structures should receive.

Future Analyses

Future project efforts will involve continued analysis of the effects of dams and impoundments on water quality, sustainable flows, and watershed health. We will also identify dam structures that may warrant consideration for corrective actions, or decommissioning and removal. Assistance and cooperation will be recruited from property owners and interested organizations to facilitate improved maintenance and to protect water resources.

Synthesis and Effect

This study has produced several important findings. First, only 164 dams within the SRW are actively regulated by state or federal authorities. The connotation of "regulation" here should not be over-interpreted as regulatory oversight is truly minimal. Approximately 2,500 to 3,200 dams are estimated to exist in the watershed. Even though agency oversight of these 164 regulated dams is important for environmental and human health reasons, the thousands of non-regulated dams and their impoundments are also important due to their overwhelming numbers. The omission of these dams from any comprehensive database basically takes these dams "off radar" for regulatory and other interested agencies. These dams have profound impacts on the condition and function of our streams and contribute to the fragmentation of the watershed.

The compilation of the regulated dams dataset and data on unregulated dams through this project has allowed the SRWC to target specific dams that: 1) identify candidates for removal or modification to enhance natural streamflows; 2) provide focus for further investigation regarding permit compliance; and 3) present possible safety or recreational hazards worthy of further investigation. They have also allowed the SRWC to gain valuable background information on dams for future analysis and projects.

Our review of federal and state agencies responsible for programs related to dams reveals a set of disconnected programs that are demonstrably inadequate given the nature and impacts of dams. Existing programs are severely underfunded and understaffed. The vast majority of dams in the SRW are not subject to routine inspection and no agency is focused or funded to address contaminated sediments associated with dams and their impoundments on a proactive basis. Our conclusion is that dam programs are extremely weak, resulting in a variety of vulnerabilities that put water quality and public safety at risk.

This project underscores the reality that the management of dams and their associated impoundments have probably the most significant impact of any of man's activities on the water resources of the SRW. As the work of the SRWC proceeds, recognition of the role of dams and impoundments will continue to be vital to our understanding of these resources, and that knowledge is essential to achieving the SRWC's goals of providing clean, healthy and abundant water for the entirety of the watershed.

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SCDHEC, Low Hazard Dams GIS shapefile from GIS/Dams Safety Program.

SCDHEC, High and Significant Hazard Dams GIS shapefile from GIS and Dams Safety Program.

Greenville County, South Carolina GIS Department, 2003 GIS shapefiles and imagery.

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National Aerial Photography Program imagery, 1999.

SCDNR, Partners for Trout Program, project plan, 1998.

Photographs

Conestee Foundation – Lake Conestee photographs.

Pinnacle Consulting Group – various photographs.

Duke Power – Tumblin' Shoals photographs.

Other Sources

1884 City of Greenville Map – Source Unknown.

Greenville County National Resource Conservation Service (NRCS) dam construction rates.

NRCS Lake Conestee survey.

Appendix A

Table 1. Regulated Dams in the SRW, Categorized by Major Basin

Table 2. Dams Categorized by HUC-11 Watersheds

Table 3. Dam Impoundments Categorized by Surface Area

Table 4. Dam Impoundments Categorized by Storage Volume

Table 5. Dams Categorized by Decade of Construction

Table 6. Total Impoundments in Selected SRW HUC-14 Watersheds (Greenville County Only)

Table 7. Estimate of Contaminants Released from "Conestee Canyon" (June 2000 – June 2001)

Table 1. Regulated Dams In the SRW Categorized by Major Watersheds

Sub-Watershed	Class 1 Dams	Class 2 Dams	Class 3 Dams	FERC	Total
Upper Saluda	14	16	80	5	110
Reedy	2	15	37	0	54
Total	16	31	117	5	164

Class 1 – High Hazard Dams
Class 2 – Significant Hazard Dams
Class 3 – Low Hazard Dams

Table 2. Dams Categorized by HUC-11 Watersheds

HUC-11 Unit Name	Area in Acres	Class 1 Dams	Class 2 Dams	Class 3 Dams	FERC Dams	Total Dams	% of Total Dams	% of SRWC Area
North Saluda River	48,421	5	0	13	0	18	11	6
South Saluda River	77,994	2	5	14	0	21	13	10
Oolenoy River	31,468	1	0	7	0	8	5	4
Saluda River (1)	91,366	2	2	20	3	24	15	12
Georges Creek	21,101	0	1	7	0	8	5	3
Big Brushy Creek	23,651	1	2	3	0	6	4	3
Big Creek	12,532	2	0	1	0	3	2	2
Saluda River (2)	170,091	1	4	9	2	14	9	23
Broad Mouth Creek	21,782	0	2	6	0	8	5	3
Upper Reedy River	73,746	2	6	17	0	25	15	10
Huff Creek	22,835	0	6	1	0	7	4	3
Lower Reedy River	70,060	0	2	7	0	9	5	9
Rabon Creek	81,499	0	1	12	0	13	8	11
Total	746,546	16	31	117	5	164	100	100

Class 1 – High Hazard Dams
Class 2 – Significant Hazard Dams
Class 3 – Low Hazard Dams

Table 3. Dam Impoundments Categorized by Surface Area

Surface Area in Acres	Count	%
Reported As "0" or Unknown	24	15
<5	44	27
>=5 <20	69	42
>=20 <50	15	9
>=50 <100	5	3
>=100 < 500	3	2
>=500 <2000	3	2
>= 2000	1	1
Total	164	100

Table 4. Dam Impoundments Categorized by Storage Volume

Storage in Acre-Feet	Count	%
<30	11	7
>=30 <100	84	51
>=100 <200	27	16
>=200 <500	15	9
>=500 <1000	10	6
>=1,000 <10,000	13	8
>=10,000	4	2
Total	164	100

Table 5. Dams Categorized by Decade of Construction

Construction Decade	Count	%
Unknown	12	7
Before 1900	1	1
1900 - 1909	3	2
1910 - 1919	0	0
1920 - 1929	1	1
1930 - 1939	3	2
1940 - 1949	10	6
1950 - 1959	35	21
1960 - 1969	45	27
1970 - 1979	28	17
1980 - 1989	8	5
1990 - 1999	16	10
2000 Only	2	1
Total	164	100

Table 6. Total Impoundments in Selected SRW HUC-14 Watersheds (Greenville County Only)

HUC-14 Code	HUC-11 Unit Name	Acres	Square Miles	Total Water Bodies	Water Bodies Per Square Mile	Square Miles Per Water Body
03050109010010	Upper North Saluda	16271	25.42	9	0.4	2.8
03050109020020	Lower North Saluda	31446	49.13	149	3.0	0.3
03050109010020	Middle Saluda	32150	50.23	79	1.6	0.6
03050109100010	Upper Reedy River	11547	18.04	97	5.4	0.2
03050109100020	Langston Creek	3748	5.86	60	10.2	0.1
03050109100040	Richland Creek	5552	8.68	105	12.1	0.1
03050109100030	Urban Reedy River	12722	19.88	44	2.2	0.5
03050109100060	Laurel Creek	7435	11.62	56	4.8	0.2
03050109100050	Brushy Creek	8035	12.56	21	1.7	0.6
03050109040040	Grove Creek	22280	34.81	16	0.5	2.2
03050109100070	Middle Reedy River	18879	29.50	49	1.7	0.6
03050109100080	Rock Creek	5828	9.11	132	14.5	0.1
03050109110010	Huff Creek	22835	35.68	35	1.0	1.0
03050109080020	Mountain Creek	13015	20.34	155	7.6	0.1

Table 7. Estimate of Contaminants Released from "Conestee Canyon" (June 2000 – June 2001)

Contaminant	Pounds
Arsenic	1,400
Cadmium	640
Chromium (no hexavalent)	36,500
Copper	10,000
Lead	22,220
Mercury	80
Zinc	39,880
Polynuclear Aromatic Hydrocarbons (PAHs)	1,460
Volatile Organics	3,160
PCBs	75
Pesticides	50

Appendix B

Saluda-Reedy Watershed

Overview of the

Dams Inventory and Database

Saluda –Reedy Dams Inventory and Database - Overview

The SRW Dams Inventory and Database was compiled principally from the Corps of Engineers National Inventory of Dams, Federal Energy Regulatory Commission data, and data available from the South Carolina Department of Health and Environmental Control. Note that the population of dams is extremely varied in character, and all information fields are not complete for all dams. The following listing of data fields represents the primary fields included in the database. This database resides on the SRW server maintained by Pinnacle Consulting Group in Greenville. This database is linked to a GIS which allows spatial and categorical queries.

Field
----
1) Primary dam name
2) Secondary dam name
3) State (SCDHEC) identification code for state regulated dams
4) National (ACoE) identification code for all regulated dams
5) FERC identification code for FERC regulated structures
6) Longitude and latitude
7) County
8) River dam is located on
9) HUC 11
10) Owner name
11) Owner type (private, commercial/industrial)
12) Dam designer
13) Private dam on Federal property (Y/N)
14) Dam type (concrete, earthen, etc)
15) Core type
16) Foundation type
17) Purpose (water storage, recreation, etc)
18) Year completed
19) Year modified
20) Dam length
21) Dam height
22) Structural height
23) Hydraulic Height
24) Height as defined by the NID (National Inventory of Dams - ACoE)
25) Maximum discharge
26) Maximum storage
27) Normal storage
28) NID storage
29) FERC capacity

Field
----
30) Surface area
31) Drainage area
32) Downstream hazard potential (high, medium, low)
33) Emergency action plan (Y/N)
34) Inspection date
35) Inspection frequency
36) FERC permit issue date
37) FERC permit reissue date
38) State regulated dam (Y/N)
39) State regulatory agency
40) Spillway type
41) Spillway width
42) Outlet gates type
43) Volume of dam
44) Number of locks
45) Length of locks
46) Lock width
47) Federal agency involvement in funding
48) Federal agency involvement in design
49) Federal agency involvement in construction
50) Federal agency involvement in regulatory
51) Federal agency involvement in inspection
52) Federal agency involvement in operation
53) Federal agency owner
54) Federal agency other
55) Source agency
56) State
57) URL address
58) Congressional person
59) Political party
60) Congressional district
61) Date information compiled