Removal of Obsolete Dams in South Carolina

A Handbook for Project Managers and Dam Owners

The South Carolina Aquatic Connectivity Team Regulatory Committee

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The South Carolina Aquatic Connectivity Team (SC ACT) was created in 2020 to bring together a wide range of partners representing state and federal agencies, universities, and conservation organizations to establish a peer-to-peer learning network that supports and accelerates removal of obsolete dams across the State. The SC ACT's goals are to increase the understanding of the impacts dams have on streams; train people to identify and prioritize dam removal projects critical for ecosystem restoration; and facilitate dam removal by sharing design techniques, permitting guidelines and funding opportunities. The creation of the SC Dam Removal Handbook would not be possible without the efforts of the following SC ACT Regulatory Committee members who served as authors, contributors, and reviewers, making time in their exceptionally busy professional lives to share their expertise and their organizations' knowledge, processes, and resource information.

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Cover photos: Dam Removal Congaree Creek, Gerrit Jöbsis, American Rivers

Acronyms

CWA	Clean Water Act
DHEC	South Carolina Department of Health and Environmental Control
DNR	South Carolina Department of Natural Resources
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
GNIS	Geographic Names Information System
HUC	Hydrologic Unit Code
IPaC	Information for Planning and Consultation
NHPA	National Historic Preservation Act
NRCS	Natural Resources Conservation Service
NID	National Inventory of Dams
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NWP	Nationwide Permit
PCN	Pre-construction Notification
RGL	Regulatory Guidance Letter
SARP	Southeast Aquatic Resource Partnership
SC ACT	South Carolina Aquatic Connectivity Team
T&E	Threatened & Endangered
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

Glossary of Terms

Bankfull: The elevation on the stream bank where flow begins to spill over onto the floodplain.

Breached Dam: An opening created through a dam that allows drainage of the impounded waters. A breach can be intentional and controlled, such as during removal, or uncontrolled, such as during an extreme weather event.

Diadromous: Fish that spend portions of their life cycles partially in fresh water and partially in salt water which includes anadromous fish (which spend most of their adult lives at sea and return to fresh water to spawn) and catadromous fish (which spend most of their time in fresh water and return to sea to spawn.)

Headcut: Bare soil at the upper end of a gully that is susceptible to erosion which tends to progress further uphill.

Low-head Dam: A structure built from one riverbank to the other, blocking the waterway and sometimes backing-up water behind the structure.

Run-of-River Dam: A dam that has little to no reservoir storage capacity.

Spillway: The structure over or through which flow is discharged from a reservoir.

Tailrace: The body of water immediately downstream of a dam.

Thalweg: The line of deepest water along the channel of a stream.

Purpose of this Handbook

This Handbook is intended to provide dam owners and project managers in South Carolina with the information and resources needed to undertake a dam removal project. All such projects have unique aspects and varying complexities, depending on the primary factors driving project initiation and permitting – from restoration of aquatic life or water quality, to addressing dam safety, removing a recreational hazard, reducing costs for dam owners, or protecting endangered species, historic, or cultural sites. While many excellent sources of information on dam removal are available, this Handbook is specifically intended to address the process for South Carolina, providing links to the most-up-to-date information on state resources and regulatory agencies.

This Handbook provides information and references for a step-by-step approach to dam removal, encompassing conception and planning, information gathering, funding, design, permitting, and removal. However, this is not a linear process. Each of the steps may proceed at different speeds, with many occurring at the same time or in different order.

Why remove obsolete dams in South Carolina?

Thousands of dams in South Carolina no longer serve a purpose but are relics of priorities from the 20th century or earlier. Obsolete dams clog streams, prevent aquatic life from accessing essential habitat, pose public safety hazards, increase flood risk, and block recreational and economic opportunities.

Removal of these obsolete dams is increasing in South Carolina and around the nation. The voluntary removal of unwanted, harmful dams offers many benefits for dam owners, communities, state and local economies, anglers, boaters, wildlife, and the environment. Dam removal is one of the most efficient ways to restore streams and stream functions, and immediately open access to the habitat above the site of the former dam. It removes the risk associated with dam failures and dangerous currents below dams, which have led to many deaths.

Dam removal also builds resiliency and combats the impacts of climate change that are stressing freshwater resources and communities in South Carolina. The state experienced record-breaking droughts in the early 2000s and multi-year droughts are predicted to become more frequent. Conversely, rising global temperatures and climate variability will continue to increase the frequency and severity of extreme storms and flooding. South Carolina has already seen these effects with record setting rainfall and floods associated with hurricanes and tropical storms in 2015, 2016 and 2018. Dam removal mitigates these effects by returning natural flow and water temperatures regimens, restoring floodplains, and allowing aquatic species to migrate to climate refugia where conditions better meet their needs.

PHOTO: USFWS

Clifton 1 Dam at Pacolet River, SC

Benefits of Removing Dams

Maintenance costs: Dam owners may find the one-time cost of removing a dam is significantly lower than the cost of maintaining or repairing an aging structure that has outlasted its usefulness or which may be a safety hazard

Dam safety/Public safety: Most dams in South Carolina were constructed before the establishment of the Dams and Reservoir Safety Act and have long outlived their design lifespan. Decommissioning (i.e., dam removal) improves public safety by eliminating risk of a dam failure and potential impacts to populations downstream. The dam owner will decrease the concerns for public safety — and their potential liability — through a decommissioning process that is properly planned, implemented, and permitted through the state dam safety office.

Fish populations: Dam removal can help restore South Carolina's once thriving migratory fish runs, which were once a significant contributor to the cultural landscape and heritage of Native Americans and early settlers of the state. Shad, sturgeon, striped bass, and many other species have been shown to quickly return to spawning grounds once barriers are removed providing an opportunity to return long lost cultural traditions.

Recreation: When dams come down, safe recreation can be established with water trails, parks, and greenways that support the local economy. According to the Outdoor Industry Association, each year over half of South Carolinians participate in outdoor recreation activities including bicycling, camping, fishing, hunting, trail and water sports and wildlife viewing. A 2016 survey by Clemson University estimates the economic impact for fishing, hunting and wildlife viewing in South Carolina at $2.7 billion.[1]

Water quality: Removing dams can significantly improve water quality, increasing dissolved oxygen, reestablishing natural water temperature patterns, and reducing downstream erosion. Dam removal restores habitat for species endemic to South Carolina, such as those that formerly thrived in shoals (the shallow, fast-moving areas of water on bedrock or cobble) long ago flooded by impounded waters (see Brook Trout insert, pg 7.)

Resilience: Removing dams rapidly restores stream ecosystem processes including sediment transport, flow patterns and floodplain functions. It makes streams and rivers more resilient to the effects of climate change which include increasing temperatures, changing precipitation patterns, and more frequent floods and droughts. Without dams blocking their way, temperature-sensitive and habitat-restricted aquatic species can more freely access environs suiting their needs.

Recreational water hazards: Each year, fatalities result when swimmers, kayakers, canoers, or anglers get trapped in the hydraulics below low-head dams. Removing obsolete dams permanently eliminates this danger and, potentially, any associated liability for the dam owner.

Compensatory mitigation: United States Army Corps of Engineers (USACE, 2018) reviews many projects with impacts to aquatic resources each year. Consistent with the goal of "no net loss," some projects may require compensatory mitigation to replace aquatic resource functions and area. Dam removal and restoration of the area can be considered compensatory mitigation.

[1] The Economic Contribution of Natural Resources to South Carolina's Economy https://www.dnr.sc.gov/economic/EconomicContributionsSC.pdf

DID YOU KNOW?

Brook Trout Can Benefit from Dam Removal!

Brook Trout are the only salmonid species native to South Carolina. Threats to their habitat began with European settlement in the mountains of South Carolina in the early 19th century. By the late 1800s, changes in the landscape from timber harvesting pushed the remaining populations of eastern Brook Trout to retreat to the state's most remote headwaters. The introduction of Rainbow Trout native to the western United States, and Brown Trout, native to Europe, outcompeted Brook Trout resulting in further loss of Brook Trout range. Their available habitat continues to be affected by development, especially ponds and lakes on tributaries that flow into trout streams. Ponds, lakes, and reservoirs can have negative impacts on sediment inputs that cause stream instability downstream. They also cause nutrient issues downstream, especially in ponds associated with livestock operation. Ponds, lakes, and reservoirs always have thermal impacts to cold water streams, even where water control structures or spillways release from deeper waters. Increases in water temperature downstream result in a loss of available habitat for trout.
To address the impacts, the SC Department of Natural Resources (DNR) continues to work towards identifying and supporting stream restoration efforts to restore habitat and initiate re-establishment of healthy, native Brook Trout populations. One such project that has had excellent results for South Carolina Brook Trout is the Matthews Creek dam removal which was supported with the help of Naturaland Trust, Trout Unlimited, USFWS, and the DNR.

To learn more about this project, see Appendix A: Case Study 3 — Matthews Creek Dam Removal.

PHOTO: MAC STONE

Introduction and Overview of Dams in South Carolina

Dams provide many useful functions, by generating hydropower, supplying drinking water and providing recreation across the country. However, many aging dams are obsolete – no longer serving their intended purpose. Removing them has emerged as a viable means of restoring connectivity for aquatic life in rivers and streams, reducing the risk of catastrophic failure, enabling safe passage for river and stream recreation, and providing dam owners with a cost-effective option for addressing unsafe infrastructure.

According to American Rivers' database on dam removals, over 1,797 dams have been removed in the United States. Despite the COVID pandemic in 2020, 69 dams were removed reconnecting 624+ upstream river miles. American Rivers'[2] 2020 list includes a South Carolina success story — the removal the Burson Lake Dam on Reedy Creek (Appendix A: Case Study 1).

Ample opportunities exist to remove obsolete dams. There are two inventories of 'regulated' dams that have some permitting, licensing, or regulatory requirements. The U.S. Army Corps of Engineers' (USACE) National Inventory of Dams (NID) identifies over 91,000 large and hazardous dams (see Figure 1) that would cause serious harm, damage, or hazard if they failed.[3] Under the Dams and Reservoirs Safety Program, the State regulates 2,273 dams including those that are 25 feet in height or greater, impound 50-acre-feet of water, or improper operation or failure may cause loss of human life regardless of size. (For detailed information, see Dam Safety State of Dams[4]). Over 87 percent of the state-regulated dams are privately owned and most were constructed before 1970 (NID, 2019).

However, numerous small and medium sized dams do not appear in NID and are not regulated by the State. These smaller dams do not fall under any regulatory program and are not tracked in any formal tracking system. The total number, including all regulated and unregulated dams in the US, is estimated to range from 2,000,000 to as many as 2,500,000 (Poff and Hart, 2002). As many as 75 to 95% of these smaller dams, such as those built to support the early mill economy, are considered obsolete and may no longer serve a functional purpose. (Graf, 1993; EPA, 2016)

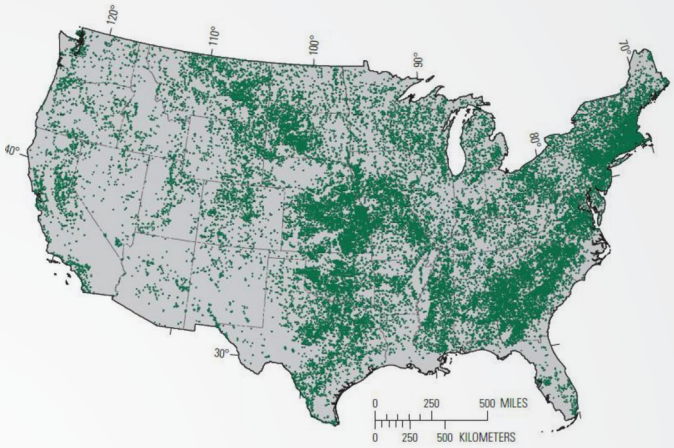


FIGURE 1: According to the Army Corps of Engineers' National Inventory of Dams, there are 91,468 large or hazardous dams in the US (accessed February 2020).

Since 2010, the Southeast Aquatic Resource Partnership (SARP), researchers, and other conservation practitioners have worked to identify dams in the Southeastern U.S. that are not in the NID. While the total number of dams in the Southeast is not known, over 146,000 dams have been identified within SARP's Comprehensive Southeast Aquatic Barrier Inventory. Of those, approximately two percent (or over 3,200) are in South Carolina. About 72 percent of them meet the criteria to be regulated under the state Dams and Reservoirs Safety Program. The remaining dams are unregulated by any state or federal programs.

Dams in South Carolina

- **3,200** Dams currently identified
- **2,300** Regulated under the South Carolina dam safety program
- **87%** of regulated dams are privately owned
- Most regulated dams created prior to the 1970's

Source: SARP and DHEC

[2] 69 Dams Removed in 2020 https://www.americanrivers.org/2021/02/69-dams-removed-in-2020/

[3] The NID includes dams meeting one of the following criteria: 1) High hazard potential classification — loss of human life is likely if the dam fails, 2) Significant hazard potential classification — no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns, 3) Equal or exceed 25 feet in height and exceed 15 acre-feet in storage, 4) Equal or exceed 50 acre-feet storage and exceed 6 feet in height.

[4] State of the Dams Report: Investment in the protection of South Carolina's people, natural resources, and infrastructure through dam safety. https://scdhec.gov/sites/default/files/media/document/State%20of%20the%20Dams%20_FINAL_8-20-2020_0.pdf

PHOTO: GERRIT JÖBSIS

Failure of Lake Elizabeth Dam near Columbia closed Highway 21 for more than one and one-half years.

Most dams in South Carolina were constructed before the establishment of the Dams and Reservoirs Safety Act. Some date back to the 18th century, but many were built from the early 1900s to the 1970s. Their original purpose was to power paper and textile mills, create water supply reservoirs, and provide impoundments for boating, fishing, and hunting recreation. Public Safety concerns arise due to unmaintained dams and the age of this infrastructure. This is a national problem. Even today, with new construction methods, materials, and design criteria, a dam is rarely constructed with a design lifespan that exceeds 50 years.

Poor or inadequate dam maintenance increases the risk of dam failure, which can cause significant ecological and community damage downstream. Extreme weather events increase the volume and force of water pushing against a dam and can cause devastating breaches. Dam breaches cause water surges through a river corridor, washing away riverbeds, damaging roads and bridges, stranding communities, and inundating homes, schools, and businesses. More than 80 dams have breached in South Carolina since 2015, most the result of unprecedented rainfall associated with hurricanes and tropical storms — including Tropical Storm Joaquin in 2015, **Hurricane Matthew**[5] in 2016 and Hurricane Florence in 2018. In Richland County alone, 17 dams failed during a single storm event — many failing in series as a result of others failing upstream. These failures "exacerbated already dangerous flooding conditions and caused mandatory evacuations of communities. The threat of weakened, rain-soaked dams failing continued well after the storm had passed, causing great concern from the threat of continued evacuations in communities already dealing with property damage and safety concerns." (EPA 2016). The potential for dam failures may increase as extreme weather events increase.

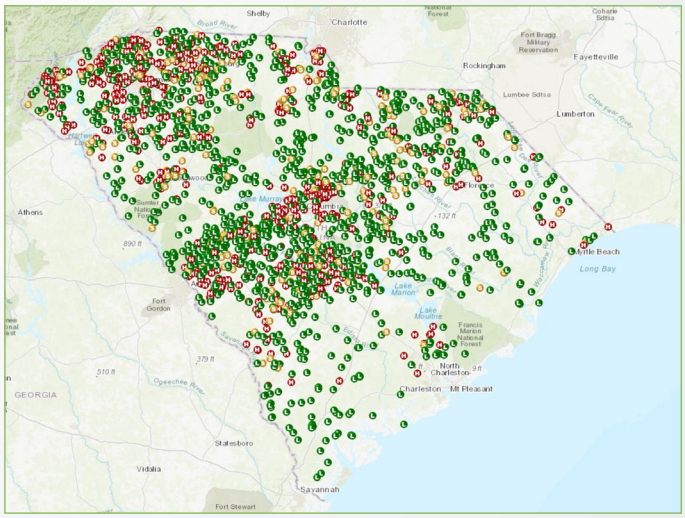


FIGURE 2: State regulated dams are classified as high (red), substantial (yellow) and low (green) hazard. **Source:** DHEC

Regular inspection, maintenance and repair of dams is necessary to maintain safety and avoid breaches, but maintenance activity can be a high financial burden for dam owners. For more information about efforts to improve dam conditions and safety nationwide, access the webpage of the Association of State Dam Safety Officials (ASDSO).

[5] For detailed information, photos, and data on the impact of Hurricane Matthew see the South Carolina Story Map at https://scdnr.maps.arcgis.com/apps/MapJournal/index.html?appid=3f423920fe0d48018ad77a90d3dcb34c.

Removal of obsolete dams is relatively uncommon in South Carolina. Only 15 dams are known to have been intentionally removed in the state. One third of these dam removals occurred in the past 10 years showing the increasing use of this stream restoration technique. (See Table 1)

TABLE 1: South Carolina dams known to have been intentionally removed

Year	Name	Stream	River Basin
Unknown	Old Saluda Reservoir Dam	Red Bank Creek	Congaree
Unknown	Shealy's Pond Dam	Savana Branch	Congaree
Unknown	Robert Thompson Pond Dam	Stoddard Creek tributary	Reedy
1970	Tumbling Shoals Dam	Saluda River	Saluda
1979	Unnamed dam at State Road 11-58	Long Branch of Island Creek	Pacolet
1988	Old City Reservoir Dam	Turkey Quarter Creek	Catawba
1990	Pole Branch Dam	Pole Branch	Catawba
1993	Millers Trust Pond Dam	Tools Fork tributary	Catawba
1999	I-95 Rest Area Lagoon Dam	Black Creek tributary	Pee Dee
2001	Kirkley Pond Dam	Little Sandy Creek	Broad
2011	Woodside 1 Dam	Twelvemile Creek	Savannah
2011	Woodside 2 Dam	Twelvemile Creek	Savannah
2019	Congaree Creek Sheetpile Dam	Congaree Creek	Congaree
2019	Unnamed dam	Matthews Creek tributary	Saluda
2020	Burson Lake Dam	Reedy Creek	Chattooga

To encourage successful dam removal projects, dam owners are encouraged to acquire the services of environmental consultants who can assist in design, acquire the necessary regulatory permits, and oversee construction (demolition), stabilization and monitoring following removal. Communication between the dam owner and their agents with the regulatory and resource agencies is important to ensure that what is "on paper" can be implemented on the ground and in the water and will consider human safety, water quality protection, habitat considerations, cost effectiveness, and timing.

In addition to the information provided in this Handbook, project managers and dam owners may find the following resources of value:

- **American Rivers' Restoration Tools and Resources**[6] page is a digital guide including videos, fact sheets, and reports about removing dams, replacing culverts, and restoring floodplains.
- **American Rivers' Removing Small Dams, A Basic Guide for Project Managers**[7] provides general information on project management and design, potential funding sources, and recommendations on community involvement.
- The Environmental Protection Agency's (EPA) **Frequently Asked Questions on Removal of Obsolete Dams**[8] provides information on water quality, Clean Water Act (CWA) permitting requirements, and EPA-related funding sources.
- American Rivers' **Funding Restoration Projects**[9] provides a list of funding sources that can support dam removal projects.
- A wide variety of other state-specific guides are also available, for instance **Massachusetts**, **New York**, **Texas**, **Georgia**, and **Vermont**.

[6] *Restoration Tools and Resources* https://www.americanrivers.org/conservation-resources/river-restoration/

[7] *Removing Small Dams, A Basic Guide for Project Managers* https://s3.amazonaws.com/american-rivers-website/wp-content/uploads/2016/05/24144210/NatlDamProjectManagerGuide_06112015.pdf

[8] *Frequently Asked Questions on Removal of Obsolete Dams* https://www.epa.gov/sites/default/files/2016-12/documents/2016_december_2_clean_final_dam_removal_faqs_0.pdf

[9] *Funding Restoration Projects* https://www.americanrivers.org/river-restoration-funding-sources/

STEP 1: Research the Dam

Section 1.1 Getting Started

The first step in beginning a dam removal project is to gather information about the dam. The project manager or dam owner can save costs and time by gathering such data and information before beginning the permitting process or selecting an engineer to construct the project.[10] As noted throughout the document, the project manager or dam owner should keep an open line of communication with the regulatory agencies, primarily USACE and the South Carolina Department of Health and Environmental Control (DHEC), following the completion of a pre-application meeting and/or once a permit is submitted. This communication will be critical in determining how much information is needed for the federal CWA permitting process. The information outlined below includes what will be needed for permitting, in addition to what is needed to design the removal and conduct outreach. The amount and types of information needed for permitting will vary based on the specific project's constraints and environmental considerations; not all information outlined below may be needed.

The name and address of the dam will be needed for all subsequent steps. Map and satellite views in **Google Maps** and **Google Earth** are excellent resources to help determine the GIS coordinates (latitude and longitude) of the dam and/or its physical address, or the closest address nearby. SARP's **Southeast Aquatic Barrier Prioritization Tool**[11] is also a great resource to help identify the exact location of a dam. Many dams have names that help to identify them: the dam removed on Crane Creek in South Carolina in 2018, for example, had been known as the Lake Elizabeth Dam and was located on Lake Elizabeth.

Section 1.2 Determining the Current Dam Ownership

Establishing ownership is complex and often not straightforward. As stated in state Dams and Reservoirs Safety Program regulations, the owner(s) is defined by those who own(s), control(s), operate(s), maintain(s), manage(s), or propose(s) to construct a dam or a reservoir. In general, the boundaries lines of the property per the county tax records (land titles, easements, convenances, agreements) along with previous permits are utilized to determine who owns any portion of the dam or appurtenant works of the dam. The definition of ownership can include the operator of a dam that performs functions to preserve or protect a dam or reservoir or holds an easement to perform these functions.

Prior to proceeding with a dam removal project, all local, state, and federal permits must be obtained.

The 2020 South Carolina ***State of the Dams Report***[12] provides a statistical breakdown of ownership for SC's approximately 2300 state regulated dams. Most SC regulated dams (87.7%) are privately owned by individuals, estates, or corporations, etc.; 3.3% are owned by a State Agency, and 3.9% are owned by Local Government (counties, municipalities, special purpose districts, etc.). A small percentage is jointly owned by state and local governments or local government and private industry.

In addition to determining basic ownership of the dam, project managers will also need to determine:

- Who currently owns the property on either side of the dam?
- Who currently owns land below the dam that could be impacted by its removal?
- Could owners of waterfront property be impacted by the removal of impounded waters (e.g., docks and private boat ramps)?

Many resources are available to help determine this information in South Carolina:

- Property appraisal, tax parcel information and the dam owner's name may be found through online property search sites available through each County's tax assessor office. Access to information varies by county.
- Adjacent property owners/neighbors may be sources of information, but deed recorded plats from county courthouses may be the best tool to identify ownership when it is debated.

[10] **Note:** The process of removing a dam is often called "construction," a term used throughout this Handbook to refer to active removal of the dam.

[11] Southeast Aquatic Barrier Prioritization Tool **https://connectivity.sarpdata.com**

[12] *State of the Dams Report: Investment in the protection of South Carolina's people, natural resources, and infrastructure through dam safety* **https://scdhec.gov/sites/default/files/media/document/State%20of%20the%20Dams%20_FINAL_8-20-2020_0.pdf**

Section 1.3 Physical Properties of the Dam

Researching the historical background of a dam may provide important information on the original design and materials used to construct it — critical for estimating costs of removal and design for construction. Once a dam owner has decided to proceed with removal, information on the physical construction of the dam and surrounding structures should be collected to aid in the permitting process. The following information should be compiled to support the design and construction methodology that will be detailed in permitting applications:

- Maps or photographs that show the dam and the surrounding landscape, such as historic aerials, USDA soil maps, topo maps, etc.
- Technical plans on the dam, including 'as-builts' showing construction material.
- Dam dimensions (i.e., height and width).
- Date constructed. If the date of a dam's construction is known, but other construction details are lacking, local newspapers may be able to provide additional information about a dam's history.
- Date modified (any significant additions, upgrades, repairs, operation and maintenance history).
- Construction material (e.g., earthen, rock, concrete, fill material inside dam, mixed, etc.).
- Original purpose (hydropower, amenity pond, water supply, etc.)
- Current dam function. Is water impounded creating a backwater effect, lake, or pond behind the dam? Is water freely flowing over the dam without causing significant modification of the width of the stream or river channel upstream of the dam? Are water flows affected at various stream flows (low-flow, drought periods vs high flow events)?
- Ancillary features.
  - For hydropower facilities:
    - Is there a powerhouse, turbines, sluice run, bypass channel, etc.?
    - Are the control structures currently functioning?
    - Do gates still open? Have they been removed?
    - Are panels missing?
    - Is there water passing through the dam?

Determined by the size of the dam, owners of regulated dams have responsibilities for maintaining their dam to ensure its structural integrity, the safety of those who recreate on or around the dam, and the liability associated with any potential dam failure. Maintaining obsolete dams that no longer serve a purpose over a long period of time can often prove costly compared to the one-time cost of removal.

  - For earthen dams:
    - Is there a roadway on the top of the dam?
    - Are there functioning overflow spillways or discharge pipes?
    - Is there leakage through the dam?
    - Are foliage/trees growing on the top and/or backside of the dam? If so, what is the size?

Section 1.4 Public Infrastructure

A project manager or dam owner should identify public infrastructure upstream and downstream of the dam that could be impacted by the removal. Downstream landowners may be impacted by increased flood flows; upstream landowners may be impacted by the disappearance of the backwater pool caused by the dam. The latter is important if there are surface water intakes or discharge points associated with National Pollution Discharge Elimination System (NPDES) permits. When considering infrastructure that may be impacted upstream of the dam, a project manager or dam owner should include the length of the backwater effect of any impounded waters, which can be determined by measuring from the top of the dam back to the bed of the river.

The DHEC Watershed Atlas[13] is a helpful tool to identify the location of surface water intakes and NPDES permit locations.

- Note approximate distance from dam to bridges, abutments and retaining walls with information on bridges by county.[14]
- Identify roads either on the dam, or those in close proximity, identify road ownership (state, local, private) by contacting the county or the South Carolina Department of Transportation.

[13] DHEC Watershed Atlas www.scdhec.gov/atlas

[14] Bridge Information by County http://bridgereports.com/sc/

- Identify water utility lines (e.g., sewer/stormwater) by contacting local public works departments.
- Identify underground and aerial utility lines such as gas, electric, telecommunications, and cable lines either by visual observation or online resources.[15]
- Consult Google Earth to identify land uses, structures, infrastructure and other important features that might not be obvious or visible during a site visit.

Section 1.5 Historical Significance of the Dam and the River Prior to the Dam's Construction

Some dams and their associated structures are designated historic properties – defined as any prehistoric or historic district, site, building, structure, or object that is generally over 50 years old. Information on when a dam and associated structures were built, and their historical significance, are needed for the permitting process. All federal permits require Section 106 Consultation under the National Historic Preservation Act (NHPA) to assess potential impacts of a federal action on historic structures. In South Carolina, those determinations of effect are coordinated between the USACE and the State Historic Preservation Office (SHPO) in the Department of Archives and History after a permit application has been submitted. Books, photographs, maps, and other historical documents can provide details about historical dam ownership, construction, and use. Local libraries, college and university libraries, historical associations, and museums are excellent sources of information. To begin the process, access the following resources:

- Check to see if the dam is listed on the National Register of Historic Places by checking the National Register of Historic Places Database.[16]
- Check to see if the dam or any structures associated with the dam, such as historic mill sites, have been identified as a cultural resource. Note any other cultural resources nearby such as historic battlegrounds, Native American mounds, and ferry sites and associated roads that could be impacted by the dam removal process. Cultural resources that have been surveyed within a specific area are noted within ArchSite,[17] an online GIS database. Other search options for cultural resources includes the South Carolina Historic Properties Records.[18]

If the dam is not designated as a historic structure and its age is unknown, consult the following resources which may help identify a range of dates within which it was constructed:

- South Carolina's landscape has been captured by aerial photography since the 1930s. Black and white images, which can be searched at the county level, are available online through the South Carolina Aerial Photograph[19] collection and other historic aerials.[20]
- Sandborn Fire Insurance Maps[21] may also prove helpful.

Rivers had long periods of cultural and historic uses before dams were constructed. If possible, compile information on the cultural importance of the river prior to the dam's creation. Names associated with the pre-dam natural features of the river, (e.g., shoals, ferry crossings, wildlife, or aquatic life) may indicate its original use. These references may also indicate Native Americans and early settlers used the river as communal fishing grounds or as a location for fishing weirs, for example, before the dam was built. Restoration of the river after dam removal may also restore some of these historical uses or cultural attributes that we buried under impounded waters.

Section 1.6 Current Regulatory Status of the Dam

Most obsolete dams are not regulated under any state or federal program; however, a subset of dams in South Carolina is regulated for safety or for hydropower generation. Determining whether the dam is covered under any regulatory program is a critical step in the process.

1.6.1 South Carolina Dams and Reservoirs Safety Program

Dams and reservoirs have been constructed long before dam regulation was in place. After the United States saw multiple dams fail and fatalities, the federal government inspected known "high hazard" dams. The findings of the inspection program were responsible for the establishment of dam safety programs in most states, and, ultimately, the creation of the

[15] Utility Line Locator https://sc811.com

[16] National Register of Historic Places Database https://npgallery.nps.gov/nrhp

[17] ArchSite http://www.scarchsite.org/default.aspx

[18] SC Historic Properties Record http://schpr.sc.gov/

[19] SC Historical Aerial Imagery Data Sources https://www.dnr.sc.gov/GIS/deschistaerial.html

[20] Historic Aerials https://www.historicaerials.com/ or https://www.dnr.sc.gov/GIS/deschistaerial.html

[21] Sandborn Fire Insurance Maps https://www.loc.gov/collections/sanborn-maps/about-this-collection/

National Dam Safety Program, which supports dam safety programs in 49 states. The state Dams and Reservoirs Safety Act is the basis of South Carolina's dams and reservoirs safety programs. Its purpose is to protect citizens health, safety, and welfare by creating a regulatory program to reduce the risk of failure of dams. The law confers upon DHEC the regulatory authority to accomplish the purposes of the act, including the power to promulgate regulations, require permits, conduct inspections, guide the removal and decommissioning, and take enforcement actions. These Regulations ultimately set the requirements and best practices to encourage and promote effective dam safety to reducing the risk to human life, property, and the environment from dam-related hazards.

These regulations specify the administrative process for obtaining a permit for a new dam or the alteration, repair, or removal of an existing dam. They cover the specifics of the permit application package and general design criteria a dam must meet. The design and submittal must be carried out by a South Carolina licensed professional engineer. DHEC's Dams and Inundations database[22] shows regulated dams in South Carolina.

1.6.2 Federal Energy Regulatory Commission Licensed Dams

The Federal Energy Regulatory Commission (FERC) regulates non-federal dams that produce hydroelectricity[23] and fall under the FERC's jurisdiction pursuant to Section 23(b)(1) of the Federal Power Act (FPA). All FERC licensed projects regularly submit compliance and other documents that address the physical details and characteristics of a dam. Information about FERC licensed dams is available via FERC's website.[24]

FERC has 20 currently active hydroelectric licenses based in South Carolina, some of which include multiple dams and reservoirs under one license. The table below is a list of FERC licensed hydroelectric projects in South Carolina.[25]

TABLE 2: FERC-licensed hydroelectric projects. Projects can have multiple dams under one license.

Project Number	Project Name	Licensee	Waterway
P-199	Santee-Cooper	South Carolina Pub Serv Auth	Santee and Cooper Rivers
P-516	Saluda	Dominion Energy South Carolina, Inc	Saluda River
P-1267	Buzzards Roost	Greenwood County	Saluda River
P-1894	Parr Shoals	Dominion Energy South Carolina, Inc	Broad River
P-1895	Columbia	City Of Columbia, SC	Broad River
P-2232	Catawba-Wateree	Duke Energy Carolinas, LLC.	Catawba and Wateree Rivers
P-2315	Neal Shoals	Dominion Energy South Carolina, Inc	Broad River
P-2331	Ninety-Nine Islands	Duke Energy Carolinas, LLC.	Broad River
P-2416	Ware Shoals	Aquenergy Systems, LLC.	Saluda River
P-2428	Piedmont	Aquenergy Systems, LLC.	Saluda River
P-2503	Keowee-Toxaway	Duke Energy Carolinas, LLC.	Keowee and Toxaway Rivers
P-2535	Stevens Creek	Dominion Energy South Carolina, Inc.	Stevens Creek and Savannah River
P-2620	Lockhart	Lockhart Power Co	Broad River
P-2621	Pacolet	Lockhart Power Co	Pacolet River
P-2740	Bad Creek Pumped Storage	Duke Energy Carolinas, LLC.	Bad Creek and Lake Jocassee
P-2880	Cherokee Falls	Cherokee Falls Hydro Project, LLC.	Broad River
P-6731	Coneross	Coneross Power Corp	Coneross Creek
P-10253	Pelzer Mills Lower Hydro	Consolidated Hydro Southeast, LLC.	Saluda River
P-10254	Pelzer Mills Upper Hydro	Consolidated Hydro Southeast, LLC.	Saluda River
P-11286	Abbeville	City Of Abbeville	Rocky River

Source: FERC[26]

[22] Dams and Inundations https://gis.dhec.sc.gov/scdams/

[23] FERC does not regulate federal dams, including those operated by the USACE.

[24] NFERC Hydropower Projects https://www.ferc.gov/industries-data/hydropower

[25] There are FERC licensed hydroelectric projects based in Georgia and North Carolina that affect South Carolina waters that are not listed.

[26] FERC Hydropower https://ferc.gov/industries/hydropower.asp

FERC Exempt Licenses: Some hydropower facilities are considered exempt based on size and design. However, these exempted projects must still comply with any conditions identified by the US Fish and Wildlife Service (USFWS) and the South Department of Natural Resources (DNR)

Table 3 below identifies the only FERC Exempt hydropower dam in South Carolina.

TABLE 3: Hydropower projects having exempt licenses.

Project Number	Project Name	Owner	Waterway	Description
P-8185	Clifton No. 3	Converse Energy Corporation	Pacolet River	Exemption — 5 MW

Decommissioned/Surrendered FERC Licenses: Some hydropower dams may no longer meet profitable power generation needs, no longer generate hydropower, or may need expensive maintenance. In these instances, hydroelectric dam owners may choose to surrender their licenses to FERC. The owner must go through the full process of license surrender and meet FERC's requirements for decommissioning (e.g., ensuring the site is not operational and meets safety requirements). Most license surrenders and decommissionings do not require dam removal, but the owner may choose that option. Table 4 below lists some of the dams where FERC licenses were surrendered, and the project decommissioned. None have yet to be removed.

TABLE 4: Hydropower projects for which licenses were surrendered. None of these dams have been removed.

Project Number	Project Name	Former Licensee	Waterway
P-4362	Riverdale	Inman Mills	Enoree River
P- 4632	Clifton Mills No. 1	Spartanburg Water System	Pacolet River
P-10881	Whitney Mills	Daniel Evans	Lawsons Fork Creek

Revoked FERC Licenses: On rare occasions, under the enforcement authority of the FPA, the FERC can revoke a license. Dam owners are not automatically required to remove dams if a license is revoked, but FERC may have additional requirements in revoking the license, such as decommissioning all hydropower equipment.

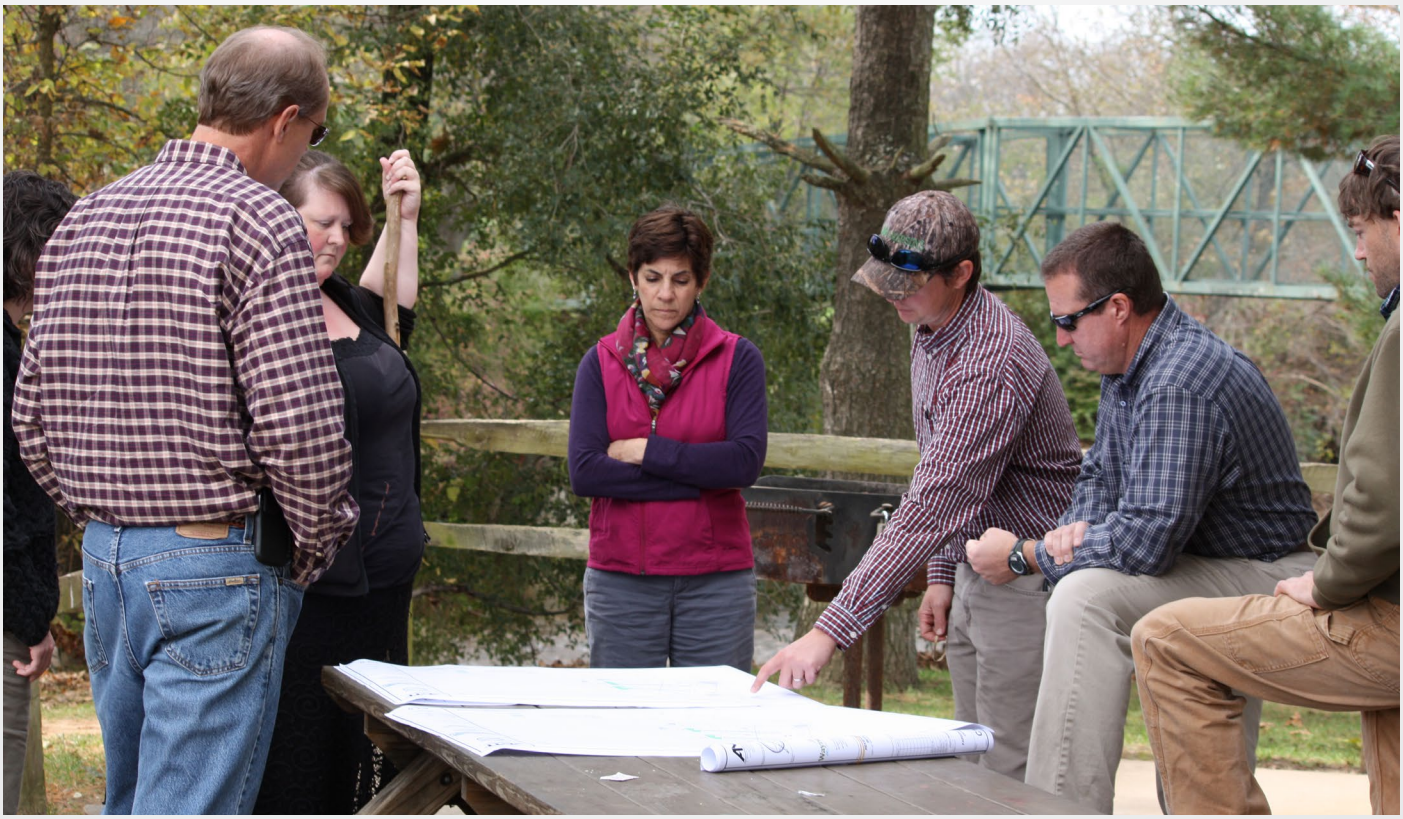


PHOTO: JESSIE THOMAS-BLATE

Site visits are important for understanding dam removal projects.

STEP 2: Research the River and Surrounding Landscape

Researching the river ecosystem and surrounding riparian area is critical to understanding the potential impact of dam removal. This section provides resources for the project manager or dam owner preparing to research the area around the dam.

Section 2.1 Basic Description of the Resource

In addition to the United States Geological Survey's (USGS) hard copies of maps of rivers and surrounding landscape, its National Map Viewer[27] is a good resource for basic information that may be needed for the permitting process:

- Zoom in on the topo map to see the official name of a stream or river from the US Geographic Names Information System (GNIS). Small streams may not have official names.
- Identify tributaries and any confluences with other major rivers up or downstream.
- Identify the stream by segment description, if necessary; e.g. "from Hwy 110 to the confluence with Big Creek."
- If a waterbody is impounded, determine if the impoundment has a name that differs from that of the dam. Many dams can be found in the "Dams" layer, a sublayer within the "Cultural Points" group layer in the "GNIS" layer.
- Turn on the "Watershed Boundary Dataset" layer to obtain a watershed Hydrologic Unit Code (HUC) name and number.
- USGS stream gage locations are visible in the "Point Event" sublayer within the "National Hydrography Dataset" layer.
- Obtain land cover classifications and topographic/elevation data from various layers.

Other good resources for information about rivers and streams include:

- SARP's Southeast Aquatic Barrier Prioritization Tool[28] provides information about various aquatic passage barriers, including dams.
- The USGS Stream Stats[29] can be used to delineate drainage areas for user-selected stream sites and then add in basin characteristics (including land use) and estimates of flow statistics.
- USGS National Water Dashboard[30] is an interactive site providing provisional real-time water data collected in context with weather related events.
- USGS Daily Streamflow Conditions[31] provides real-time daily streamflow conditions and discharge (cubic feet per second).
- USGS National Water Information System Mapper[32] provides access to current and historical observations to surface water and groundwater sites.

Accessing the dam for its removal poses additional considerations. Wetlands are often part of riparian areas that may be associated with the stream above and below the dam. To help avoid impacts and minimize damage to these important resources, the project manager or dam owner can utilize the following resources as a preliminary guide:

- The USFWS National Wetland Inventory Wetlands Mapper[33] predicts the location of wetlands.
- The Natural Resources Conservation Services (NRCS) Web Soil Survey[34] tool allows an area to be selected and evaluated for the presence of hydric soils which are one indicator of the likelihood of wetlands onsite. Look for "Hydric Rating by Map Unit" in the Land Classification section of the Suitabilities and Limitation for Use tab.

American River's Removing Small Dams: A Basic Guide for Project Managers[35] (pg. 16) provides an excellent description of a process to complete geomorphological surveys and base mapping, which will be needed to assess hydraulics and sediment. Overall, this guide states that the survey should include:

1. Cross sections of the river and adjacent land, upstream and downstream of the dam.

[27] United States Geological Survey (USGS) National Map Viewer https://viewer.nationalmap.gov/advanced-viewer/

[28] Southeast Aquatic Barrier Prioritization Tool https://connectivity.sarpdata.com/

[28] USGS Stream Stats https://streamstats.usgs.gov/ss/

[30] USGS National Water Dashboard https://dashboard.waterdata.usgs.gov/app/nwd/

[31] USGS Daily Streamflow Conditions https://waterdata.usgs.gov/nwis/rt

[32] SUSGS National Water Information System Mapper https://maps.waterdata.usgs.gov/mapper/index.html

[33] USFWS National Wetland Inventory Wetlands Mapper https://www.fws.gov/wetlands/data/mapper.html

[34] NRCS Web Soil Survey https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

[35] Removing Small Dams: A Basic Guide for Project Managers https://www.americanrivers.org/2015/06/want-to-remove-a-dam-not-sure-where-to-start-check-this-guide-out/

2. A longitudinal profile of the "thalweg" (i.e., the deepest part of the river channel) through the impoundment following the draining of the impoundment, upstream and downstream of the dam.
3. A survey of the depth of soft sediment throughout the impoundment (often described as the "depth of refusal," or the point where a rod hits a harder surface and cannot easily be pushed further down).
4. A delineation of the resource areas that will be affected, including wetlands, and ordinary high water mark and low water marks.[36] (For additional information on wetlands and sediment, see Sections 2.4 and 2.5, respectively.)
5. A hydrology and hydraulics (H&H) assessment to assess the magnitude and frequency of flows in the river (including depths, velocity, and scour potential).

Section 2.2 Water Quality

Information about any documented impacts the dam has had on water quality may be needed for the permitting process. This information can also be used if applying for grants or funding tied to demonstrating that water quality may be improved by dam removal. According to EPA, "[v]irtually every dam will have an impact on the river or stream where it is located, although the types and extent of the impact will vary based on the size, operation, and purpose of the dam as well as the size and general characteristics of the waterway. In general, increased retention time of water behind dams causes physical, thermal, and chemical changes to take place both in the impounded and downstream waters," (EPA 2016). These changes may impact water quality related to nutrients, temperature, sediments, algal blooms, dissolved oxygen, pH, hydrogen sulfide, iron, manganese, and other metals. The presence of the dam may also cause impacts to aquatic life as measured through biological sampling and metrics, including macroinvertebrates (e.g. crayfish or dragonfly larvae), mussels, or fish. For more information on water quality and dams under the CWA, as well as the potential for grants to address dams that cause water quality impacts, see EPA's Frequently Asked Questions on Removal of Obsolete Dams.[37]

DHEC and volunteers through DHEC's Adopt-A-Stream and other programs collect water quality data and information on many rivers, streams and lakes throughout South Carolina. The following information and resources provide access to readily available water quality data:

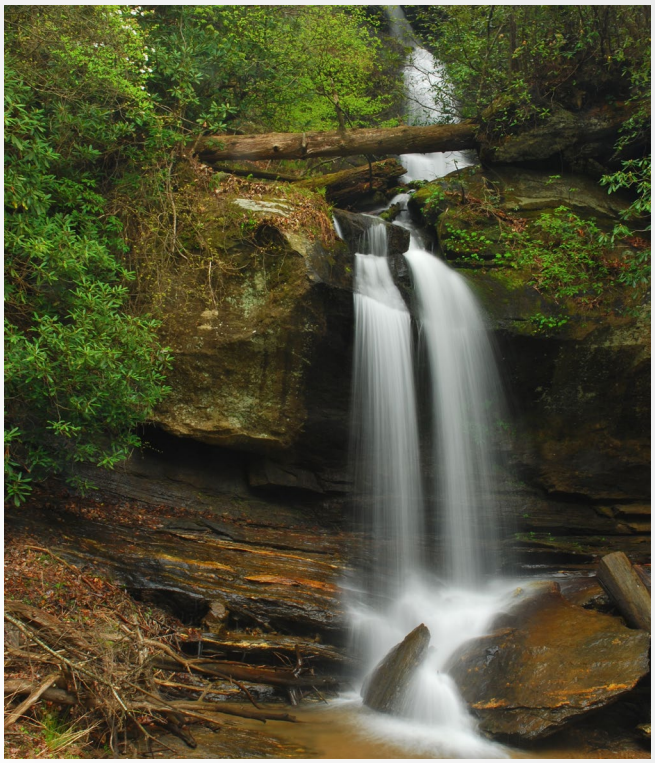


PHOTO: RON AHLE

Wright Creek Falls, SC

- South Carolina's water quality standards are promulgated in S.C. Regulation 61-68, Water Classifications and Standards. This regulation sets forth the classifications of our State's waters and establishes water quality standards that protect and maintain the existing and classified uses of those waters.
- S.C. Regulation 61-69, Classified Waters, is a compilation of many of the waters of the State listed by name, the county(ies) where the waterbody is located, the classification of the waterbody, any designation for that waterbody, and a brief description of the waterbody and any site-specific numeric criteria that apply to the listed waterbody. All waters of the state of South Carolina are classified even if they are not specifically named or listed in R.61-69. For those waters not listed, the classification of the waterbody to which they are tributary to is the assigned class for those waters pursuant to the rules in both R.61-68 and R.61-69.
- All freshwaters in South Carolina, including those classified as Outstanding Resource Waters, Trout waters, and Freshwaters, are designated in S.C. R.61-68 as suitable as a source for drinking water. If the dam is located in one of

[36] Ordinary High Water Mark is defined as, "...that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas." Corps Regulatory Guidance Letter, 2005 (RGL 05-05), and 33 CFR 328.3(e)

[37] Frequently Asked Questions on Removal of Obsolete Dams https://www.epa.gov/cwa-404/frequent-questions-removal-obsolete-dams

these waters, note that raw water intake structures in the river could be impacted by dam removal. For example, an upstream intake could be exposed when the dam is removed and the impounded water is lowered, or a downstream intake could be impacted by sediments released during removal. Surface water withdrawal locations can be viewed in the SC Watershed Atlas.[38]

- The DHEC Watershed Atlas brings 90 layers of the Agency's most current and comprehensive watershed and water quality information into a user-friendly, statewide application. This searchable atlas includes watershed boundaries and descriptions; DHEC Bureau of Water permits and advisories; public water supply information; water quality monitoring stations and assessments; water classifications; floodplains; National Wetland Inventory data; county parcels; National Land Cover Data; and Municipal Separate Storm Sewers Permits (MS4s); TMDLs.
- DHEC monitors waterbodies across the state to assess water quality as required under Section 305(b) of the CWA. Using the State's Assessment Methodology, DHEC compares the results with the State Water Quality Standards to determine if waterbodies are meeting their designated use. That information, submitted to EPA in the State's Integrated 305(b)/303(d) Reports, may include information relating to water chemistry or biological indicators (macroinvertebrate), or information on historical or legacy pollutants (such as PCBs or mercury). South Carolina 303(d) List of Impaired Waters & TMDLs[39] provides current and historical reports. Waters that have been identified as impaired can also be viewed in the SC Watershed Atlas.[40] Use attainment status and water quality trends for DHEC monitoring stations can also be viewed in the SC Watershed Atlas.
- DHEC's water quality monitoring data is available through the Water Quality Portal.[41] The Water Quality Portal (WQP) is a cooperative service sponsored by the USGS, EPA, and the National Water Quality Monitoring Council (NWQMC). DHEC biological assessment data is not yet available through the Water Quality Portal, but can be requested directly from the DHEC Aquatic Sciences Program.
- EPA's How's My Waterway[42] site allows a user to search for a location and get a map and summaries of the watershed, the waterbodies and their designated uses, and whether they are meeting their uses or are identified as impaired, as well as the water quality monitoring stations and permitted dischargers locations.
- DHEC's Adopt-A-Stream program provides water chemistry and biological data.[43]
- Local stakeholders, neighbors and newspapers, among other sources, may have anecdotal accounts of water quality issues.

PHOTO: RON AHLE

Good water quality benefits aquatic resources, drinking water and recreation.

[38] DHEC Watershed Atlas https://gis.dhec.sc.gov/watersheds/

[39] South Carolina 303(d) List of Impaired Waters & TMDLs https://scdhec.gov/bow/south-carolina-303d-list-impaired-waters-tmdls

[40] DHEC Watershed Atlas www.scdhec.gov/atlas

[41] Water Quality Portal https://www.waterqualitydata.us/

[42] EPA's How's My Waterway https://mywaterway.epa.gov/

[43] DHEC Adopt-A-Stream Program https://scdhec.gov/environment/your-water-coast/adopt-stream-program

Aquatic Biodiversity by the Numbers

Alteration of water flows and sediment movement from the construction of dams has caused a negative impact on a large portion of freshwater fish species, especially the migratory species like shad, sturgeon and striped bass, and freshwater mussels.

According to South Carolina's 2015 State Wildlife Action Plan (SWAP),[44] South Carolina has an abundant and diverse aquatic community including:

- **146 fish species** that are known to inhabit the freshwaters of South Carolina or are seasonally dependent on freshwater habitats to complete their life cycle, such as shad and sturgeons. **57 freshwater fish species** and **6 diadromous fish** are listed a Species of Greatest Conservation Need by the SWAP. 32 of these species, including the Carolina Darter and the Sandhills Chub, are endemic to the State, meaning they are only found here or within drainages shared with neighboring states.
- **38 crayfish and freshwater shrimp species**, 9 of which appear to be endemic to the State. Many others are found only in South Carolina and an adjacent state. SWAP conservation priority species include: **25 of the State's known crayfish species**; one freshwater shrimp species, the Ohio River Shrimp; **3 freshwater snail species** and **28 of the 30 freshwater mussel species**.
- **60 SC freshwater aquatic species** are also on the Southeastern Association of Fish & Wildlife Agency's Regional Species of Greatest Conservation Need list (SEAFWA-WDC 2019)

Section 2.3 Aquatic Resources

The Southeastern United States is a global hotspot for aquatic biodiversity. Without future conservation and restoration efforts, many species will become imperiled (Duncan, et.al 2019).

The DNR's Natural Heritage Program gathers data on the abundance and distribution of rare, threatened, and endangered species across the state from the agency's own biologists as well as from universities and other state and federal agencies. The Natural Heritage Program database[45] can provide a dam owner or project manager a list of species that could be within the vicinity of the dam structure and access roads and may be affected by the dam removal project.

Consideration should be given to the amount of accumulated sediment behind a dam. A rapid release of such material can have numerous impacts on water quality factors, such as dissolved oxygen that can lead to suffocation and burial of freshwater mussels and oxygen depletion for fish eggs, larvae and even adults. While dams obstruct flows and change sediment processes in stream systems, altering behavior of fishes and the makeup of fish communities, they sometimes serve a beneficial purpose in keeping invasive species from impacting fish communities upstream of the dam. For large dam removal projects, the DNR's Office of Environmental Programs (environmental@dnr.sc.gov) should be contacted to ensure that greater environmental harm is not caused by the removal of a dam.

Also, consideration of the species that may benefit from the dam removal project could provide opportunities for collaboration with state and federal agencies and potential grant funding. Identifying key species and habitats, both aquatic and terrestrial, in the area affected by the dam removal is a requirement of the state and federal permitting process. The following questions should be addressed:

- Are rare (State Wildlife Action Plan conservation priorities), threatened, or endangered species present in the project area? Submit a request for a list of potential species in the project area through the DNR's Natural Heritage Program by emailing speciesreview@dnr.sc.gov.
- Are economically or recreationally important aquatic or riparian species in the project area?
- Consider how removal of the dam may positively or negatively impact species. For instance, will dam removal allow fish movement above and below the dam? Will released sediment affect species or their habitats downstream?
- Will migratory fishes (e.g., American Eel, shad, or sturgeon) benefit from the removal?
- Will non-migratory species (e.g., Robust Redhorse) benefit from the removal?
- Would dam removal create, restore, or enhance habitat for species (e.g., support mussels; increase aquatic diversity; enable spawning by species of concern)?

[44] 2015 State Wildlife Action Plan (SWAP) https://www.dnr.sc.gov/swap/index.html

[45] To access the Natural Heritage Database, visit: https://schtportal.dnr.sc.gov/portal/apps/sites/#/natural-heritage-program or email speciesreview@dnr.sc.gov

- Are invasive plant or animal species present above and/or below the dam? Would dam removal allow invasive species to expand their distribution? Review the complete list of invasive aquatic plant species in the SC Aquatic Plant Management Plan.[46]

- The USFWS and the National Marine Fisheries Service (NMFS) are charged with protecting threatened or endangered (T&E) species and designated critical habitat under the Endangered Species Act (ESA), the Fish and Wildlife Coordination Act and Magnuson Stevens Act. To determine if T&E species are present, explore the USFWS's Information for Planning and Consultation (IPAC) tool for species under the jurisdiction of the USFWS. A list of T&E species by county is available online from the **USFWS**[47] and **DNR**.[48]

More information about these **species**[49] and associated **critical habitat**[50] is available from the agency. If T&E species are present, be sure to note the requirements to consult with the USFWS by following the steps in the IPAC tool or directly with NMFS, more fully discussed in Step 3. Note that impounding water through dams has caused or contributed to the endangerment of some imperiled species, particularly those adapted to free-flowing water throughout the southeastern US. Removing dams may provide opportunities for the restoration of local populations of some species.

Section 2.4 Connectivity

Dams act as barriers to aquatic organism passage, significantly altering the migration of native diadromous fishes — those that require access between freshwaters and saltwater habitats to complete their lifecycles.[51] Removing dams can provide significant benefits for increasing the range of these fishes and access to critical habitats.

SARP's **Comprehensive Southeast Aquatic Barrier Inventory** includes over 137,000 dams and approximately 25,000 assessed road stream crossings. Together with the Conservation Biology Institute, SARP has created an online tool called the **Southeast Aquatic Barrier Prioritization Tool** to prioritize these barriers

Benefits of Connectivity: American Eel

PHOTO: SCDNR

The American eel is an intriguing species and ubiquitous across South Carolina. A catadromous fish, this species spends its adult life in freshwater and returns to the ocean to spawn in the Sargasso Sea. The offspring float in the ocean for a year changing from larva into glass eels. During late winter and early spring, glass eels will be present in coastal rivers. They metamorphose again into the elver stage and appear by the thousands at the mouth of creeks and rivers as they transcend upriver to grow. Historically, American eel were common throughout the Piedmont, but dams across many of the state's large rivers have impeded them. The Edisto River system and its tributaries are the only major river system in SC where eel can migrate upstream without encountering a large dam. Most of the large hydroelectric facilities regulated by FERC require improvements for eel passage, which should help increase their abundance upstream of those large barriers.

Dam removal improves eel habitat, water quality, and natural flow patterns supporting population growth and survival. Since eels are thought to reach sexual maturity at a slow rate, barriers and dams affecting eel passage negatively impact population recruitment and over time this contributes to a continuous decline in the population.

[46] SC Aquatic Plant Management Plan **https://www.dnr.sc.gov/invasiveweeds/plan.html**

[47] USFWS South Carolina List of At-Risk, Candidate, Endangered, and Threatened Species by County **https://www.fws.gov/southeast/pdf/fact-sheet/south-carolina-species-list-by-county.pdf**

[48] SC Heritage Trust Tracked Species by County **https://experience.arcgis.com/experience/af61ba156d054cc7b3e27d09a0c35c0f**

[49] NOAA Fisheries South Carolina Threatened and Endangered Species and Critical Habitats Under NOAA Fisheries Jurisdiction **https://www.fisheries.noaa.gov/southeast/consultations/south-carolina**

[50] NOAA Fisheries Endangered Species Conservation: Critical Habitat **https://www.fisheries.noaa.gov/national/endangered-species-conservation/critical-habitat**

[51] Anadromous species live part of their life cycle in salt water but return to freshwater to spawn. In South Carolina, these species include American Shad, Hickory Shad, Blueback Herring, Atlantic Sturgeon, Shortnose Sturgeon and Striped Bass. Catadromous species, such as American Eels, live in freshwater and return to salt water to spawn. Potamodromous species live entirely within freshwater; however, they spend much of their lifecycle downstream and migrate upstream to spawn. In South Carolina, Robust Redhorse is an example of a potamodromous species.

for removal or bypass based on ecological metrics. This tool allows users to visualize the inventory of barriers, understand information about each barrier's river network, and identify top priority structures for removal based on the geographic area of interest. The results can be used to work with the SC ACT members and landowners to implement passage projects. The tool can also be used to understand the potential impact of dam removal, including, for example, the number of miles accessible by species with the removal of the dam. To explore how many river miles may be gained, click on "Start Prioritizing", then "Prioritize dams." Once the map opens, select "State" then begin typing, "South Carolina." Zoom to the area of interest and click, "Select dams in this area." Once a particular dam is selected, the tool will provide information on Feasibility & Conservation Benefit, Miles Gained, Dam Height, Threatened & Endangered Species, and more.

Section 2.5 Wetlands

The presence of wetlands and other waters of the United States regulated under Federal law is an important consideration in the regulatory permitting process. Wetlands are defined by EPA and USACE[52] as "...areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." More information on how wetlands are defined is provided by USEPA.[53]

Wetlands may have been present prior to dam construction, or dam construction may have created wetlands adjacent to the impounded area of the river or stream over time. Dam removal could have direct and immediate effects on any existing wetlands within the project area. Natural wetlands may have existed on the lowest terraces of the floodplain before impoundment, and removal of the dam could prompt reestablishment of the original wetland community. Alternatively, wetlands created by a dam could be cut off from their water source post-removal or may no longer continue as wetlands. These areas would then have relict hydric soils, (soils that are no longer either permanently or seasonally saturated by water), and the vegetative community may eventually become dominated by upland species.

Topography is vital to determining if wetlands are present. Incised channels in narrow valleys may not typically have wetlands adjacent to them. Conversely, if the valley is relatively wide and flat, and the floodplain is not cut off from the river,

Removing Dams Keeps Rivers and Streams Clean by Supporting Mussel Populations

South Carolina is home to over 30 species of freshwater mussels, including two state and one federally listed endangered species. These animals have complex and fascinating life histories and help filter the stream and lake water that we all use for drinking water and recreation. Because freshwater mussel use fish to turn their larvae into young mussels, structures that block fish movement have the potential to negatively impact the dispersal and survival of these species. In addition, most species of mussels in South Carolina prefer living in free-flowing, un-impounded streams and rivers. Dams degrade mussel habitat by blocking flow and food sources, changing water temperatures, and turning stream bottoms into zones containing heavy siltation, low oxygen, and relatively high pollutant concentrations.

PHOTOS: MORGAN WOLF, USFWS

The yellow lampmussel (*Lampsilis cariosa*) is a SC mussel species that could benefit greatly from dam removal projects; L: yellow lampmussel found in the Stevens Creek sub-basin of the Savannah River; R: the fish "lure" used by the closely related plain pocketbook (*Lampsilis cardium*) to attract the attention of potential host fish; Potomac River, WV.

[52, 53] How Wetlands are Defined and Identified under CWA Section 404 https://www.epa.gov/cwa-404/how-wetlands-are-defined-and-identified-under-cwa-section-404

impoundments could alter the hydrology of the middle terraces enough to saturate the soil and create new wetlands. Another scenario is that a moderately incised channel, once impounded, could overflow onto a relict floodplain, re-hydrating soils and reestablishing wetlands. Other circumstances may result in creation of wetlands.

A qualified wetland delineator should be engaged to identify and map all wetlands that would or could be affected by the project. Regulatory agencies may consider the relative environmental condition and functionality of the wetlands, which means that a functional assessment may also be required. There are various functional assessment methods available, one or more of which may be applicable when used by a qualified wetland assessor.

Section 2.6 Sediment

Addressing sediment will likely be a key component of working with the regulatory agencies during the permitting process. All rivers contain sediment, which consists of sand, silt, clay, gravel, rocks, minerals, and organic matter. The movement of sediment through waterbodies is an important geophysical process that distributes nutrients and other materials across the landscape. Dams slow the flow of water and impede the natural movement of sediment downstream. Sediment may build up behind a dam over time, making it an important issue to consider in dam removal projects. Waters downstream of a dam may have been sediment-starved while the dam was present, and dam removal will play an important role in restoring natural sediment transport dynamics. However, release of sediment can cause abrasion or bury aquatic plants, animals, or habitat (EPA 2016). Sediment can also be contaminated with pollutants, putting downstream drinking water and aquatic life at risk if released without remediation. Properly collecting and analyzing data on the quantity and quality of sediment upstream of a dam is critical to safely managing it in a removal project. The process is iterative, starting with readily available information that is reanalyzed as more data becomes available (Subcommittee on Sedimentation, 2017).

Sediment quantity can vary depending on the dam design, location, and historic land use surrounding and upstream of the body of water. For example, some low-head dams may have comparatively little sediment trapped within their impoundments due to the constant flow of water over the dam. Measuring relative sediment volume is done by finding the ratio of the existing reservoir sediment mass to the average annual sediment mass entering the reservoir (Subcommittee on Sedimentation, 2017). If the volume is determined to be negligible, the USACE may determine that no extensive sediment investigations are needed. Volumes that are greater than negligible will likely require further investigation. Work with USACE to determine how sediment will be addressed during removal. USACE Regulatory Guidance Letter (RGL) 05-04 provides guidance regarding which releases of sediments from or through dams require a USACE permit.

Sediment can be contaminated with pollutants, putting downstream drinking water and aquatic life at risk if released without remediation. Properly collecting and analyzing data on the quantity and quality of sediment upstream of a dam is critical to safely managing it in a removal project.

A due diligence review will be needed to determine if the sediment behind the dam may be contaminated by pollutants. Contamination occurs when pollutants enter an upstream waterbody through stormwater runoff, effluent discharge, or illegal dumping; the slow water behind the dam causes contaminants to settle and accumulate in the sediments (Subcommittee on Sedimentation, 2017). The potential for contamination can often be informed by investigating the historical land use and human activities of the upstream watershed. For example, sediment contamination could be the result of industrial manufacturing upstream of the dam. Extensive land clearing activities for agriculture or development and high proportions of impervious surface are other indicators of potential sediment contamination. Work with USACE to determine if sediment chemistry sampling and analysis is needed. For references that may be helpful, see the EPA's **Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual**,[54] the Bureau of Reclamation's **Dam Removal Analysis Guidelines for Sediment**[55] or EPA's **Inland Testing Manual**.[56]

[54] EPA-823-B-01-002 https://www.epa.gov/sites/default/files/2015-09/documents/collectionmanual.pdf

[55] Bureau of Reclamation https://acwi.gov/sos/pubs/dam_removal_analysis_guidelines_for_sos_final_vote_2017_12_22_508.pdf

[56] EPA-823-B-98-004 https://www.epa.gov/sites/default/files/2015-08/documents/inland_testing_manual_0.pdf

Section 2.7 Federal Emergency Management Agency (FEMA) Flood Hazard

FEMA creates flood hazard maps that outline the flood risk areas in communities around the country. Dam removal projects located in Special Flood Hazard Areas may have special requirements. For more information, review FEMA's Flood Maps[57] and handbook Living with Dams: Know Your Risks[58] or the National Dam Safety Program publications library.[59] To understand your permitting steps required per the local communities Flood Damage Prevention Ordinance, contact the Local Floodplain Manager[60] for the community in which the project is located.

Section 2.8 Recreation, Economic Benefits and Public Safety

Information on the river's recreational uses may not be needed for the permitting process but could be of value as the dam owner or project manager conducts community outreach on the project. Understanding the current recreational uses of the affected waterbodies is an important step in understanding how the project may affect different groups.

South Carolina's rivers and streams are highly popular for recreation. All major rivers and many streams are used for boating. The DNR, Upstate Forever, SC Heritage Corridor and the Rainey Foundation collaborated to promote non-motorized boating and water trails. Branded as PaddleSC, they identified over 2,500 miles of paddle trails in the state. Canoe Kayak South Carolina (Ferguson 2014) is a guide to paddle trails across the state and provides information for paddling 1,700 miles of water trails on 30 rivers. These can be useful resources to understand existing or potential recreation uses associated with your project.

Dam removal can create new economic opportunities for communities through the development of ecotourism. Removal of dams may improve paddle sports and provide sport fishing opportunities for species adapted to free-flowing water. Dam removal can also provide opportunities to develop water trails, which can be economically important especially to rural communities. River-focused tourism can also stimulate the economy in indirect ways through an increase in tax revenue, real estate value, and employment opportunities (Warren, 2015). Investing in infrastructure for outdoor recreation attracts new businesses and an active workforce, strengthening the local economy and the social wellbeing of the community (The Outdoor Industry Association, 2017). Environmental restoration, which includes dam removal, is an important economic engine contributing 220,000 jobs and $25 billion to the nation's economy (American Rivers, 2020)

PHOTO: RON AHLE

Paddlers on Congaree River, SC

Dams can be a physical barrier to recreation as well as a safety concern due to dangerous hydraulic conditions below dams (Wright & Tschantz, 2011). Lowhead or run-of-river dams are especially dangerous dams for recreational users (Kern, Hotchkiss, & Ames, 2015). They are characterized by low height and little storage capacity, allowing water to consistently flow over the top of the spillway. Often referred to as "drowning machines"[61] by dam safety experts, the water flowing over lowhead dams create dangerous currents[62] downstream of the spillway. The circular flow patterns known as hydraulic rollers entrap boaters, anglers and swimmers. Dams as little as three feet high can create hydraulic rollers strong enough to cause drownings. The hydraulics are practically inescapable for anyone or anything passing over the dam or even those who approach the dam from below and become entrapped. A regional example of this hazard is the Milburnie Dam[63] near Raleigh, North Carolina where 11 drownings are known to have occurred below the dam prior to its removal in 2017. There is no national database to track the deaths associated with dams; however, researchers at Brigham Young University compiled a database[64] listing at least 555 deaths at 276 low-head dams since the 1950s.

[57] FEMA's Flood Maps https://www.fema.gov/flood-maps?web=1&wdLOR=c783C141B-C5F3-4956-BF19-5B614E3C43C1

[58] Living with Dams: Know Your Risks https://www.fema.gov/sites/default/files/2020-08/fema_living-with-dams_p-956.pdf

[59] National Dam Safety Program https://www.fema.gov/emergency-managers/risk-management/dam-safety/publications

[60] National Flood Insurance Program directory https://www.dnr.sc.gov/water/flood/documents/nfipadmindirectory.pdf

[61] Introducing a Low-Head Dam Fatality Database and Internet Information Portal https://www.researchgate.net/publication/273641278_Introducing_a_Low-Head_Dam_Fatality_Database_and_Internet_Information_Portal

[62] Dangerous Currents at Low-head Dams https://krcproject.groups.et.byu.net/

[63] Info Kit Milburnie Dam Removal Restoration https://milburniedam.com/wp-content/uploads/2017/10/MilburnieDam-MediaKit-Final-2.pdf

[64] Locations of Fatalities at Submerged Hydraulic Jumps https://krcproject.groups.et.byu.net/browse.php

STEP 3: Understanding the Regulatory Process for Obtaining a Permit for Removal of Dams in South Carolina

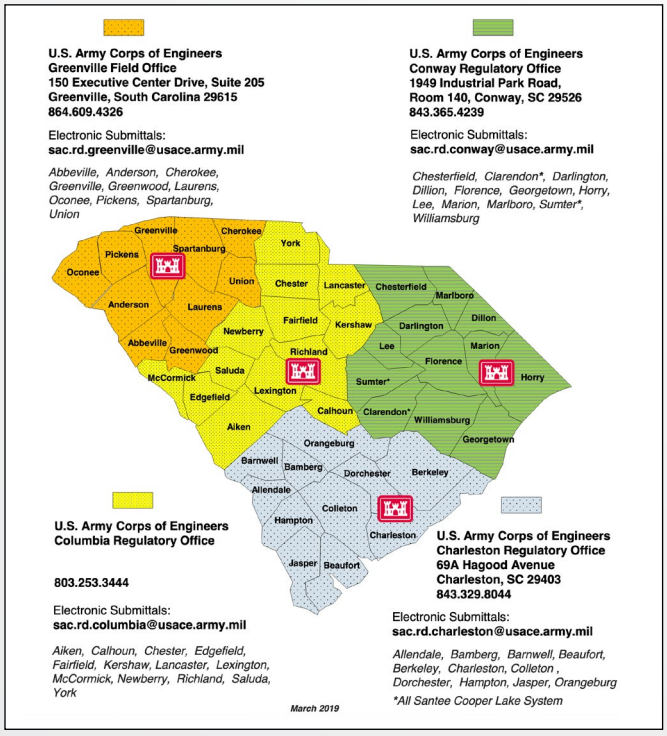
Section 3.1 Federal Regulatory Authorities Overview

Section 404 of the CWA requires that a permit be obtained before dredged or fill material can be discharged into jurisdictional waters of the United States, with some limited exemptions for forestry, ranching, and farming activities. The USACE is the primary agency for issuing Department of the Army permits, conducting or verifying jurisdictional determinations, as well as enforcing permit conditions (for more information see EPA 404 Permit Program[65]). The EPA works closely with the USACE to interpret policy, guidance, and environmental criteria used in permitting, as outlined in the Section 404(b)(1) guidelines (40 CFR Part 230).

Section 10 of the Rivers and Harbors Act (1899) governs the construction and modification of structures created in navigable waters of the United States. A list of these waters is maintained by the USACE.[66] On a case-by-case basis, dam breaching, dam modification, or dam removal activities may require a permit under Section 404 and/or Section 10. USACE has guidance stating that ". . . if a dam operator modifies or deviates from normal operation of the dam in such a manner that bottom sediment accumulated behind a dam could be removed and transported downstream through the dam, either deliberately or accidentally, that activity may require a permit pursuant to Section 404." (RGL 05-04).

Additionally, Section 408 (33 USC 408) requires USACE to process requests by private, public, tribal, or other federal entities to make alterations to, or temporarily or permanently occupy or use, any federally authorized Civil Works project. In addition to structures, alteration of flowage easements and other associated areas are subject to Section 408 review. The USACE Project Manager will determine whether or not a proposed project has potential to adversely affect a federally-authorized project.

FIGURE 3: Corps of Engineers Charleston District Regulatory Office Coverage



Section 3.2 USACE Permitting Overview, Charleston Corps District

The USACE South Atlantic Division of the Corps includes five districts in the Southeastern U.S.: Charleston, Jacksonville, Mobile, Savannah, and Wilmington. Applications for federal permits to remove a dam located within the geographic boundaries of the State of South Carolina would be processed by the Regulatory Division of the Charleston District. If a dam removal project is proposed on waters forming State boundaries, applicable Corps Districts with adjoining regulatory boundaries will determine the "lead" District for permit application and processing. Persons or parties planning dam removal projects on rivers or streams forming South Carolina state boundaries should begin that process by contacting the District office for a determination.

The Charleston District has four Regulatory office locations that cover the State of South Carolina. Permit applications and project submittals should be submitted to the office that covers that County.

[65] EPA Permit Program under CWA Section 404 https://www.epa.gov/cwa-404/permit-program-under-cwa-section-404

[66] Federal Navigable Waters https://www.sac.usace.army.mil/missions/navigation.aspx

The email for the four USACE Branch offices are:

Charleston Office SAC.RD.Charleston@usace.army.mil
Conway Office SAC.RD.Conway@usace.army.mil
Columbia Office SAC.RD.Columbia@usace.army.mil
Greenville Office SAC.RD.Greenville@usace.army.mil

Section 3.3 Individual v. General Permits

Two types of USACE permits may be used to authorize a dam removal project — an Individual Permit or one or more general permits. There are also two types of general permits — Regional General Permits and Nationwide Permits (NWP). The USACE District office decides on a case-by-case basis which type of permit is needed. Large, complex projects with potential for significant impacts may require review and authorization under the individual permit process. Small projects expected to have minimal adverse effects may be handled under the general permit process.

Applicants should begin to collect the information on their project as outlined in Steps 1 & 2 for initial scoping of the project. Once that is done, but prior to completing and submitting any permitting forms, applicants should begin the informal process by discussing the proposed project with the appropriate USACE office.

Maintaining clear and open lines of communication with USACE Project Manager (PM) is the best way to facilitate timely and accurate Section 404 regulatory review.

The length of the regulatory process will depend in large part upon the type of permit required, the complexity of the proposed project, quality and thoroughness of information submitted by the applicant, and the applicant's responsiveness to requests for information from the USACE.

The applicant can begin the process of applying for a permit at any time and can find additional information on the USACE webpage.[67]

After the permit application is received, USACE will determine whether the proposed work will require an individual permit or whether the project may proceed under one of the NWPs described above.

- **Individual Permit:** If USACE determines that the project will require an individual permit, the applicant must complete the Joint Federal and State Application Form and submit it to USACE.
- **Nationwide Permits:** If USACE determines the project can proceed under one or more NWPs, they will determine which NWP(s) is/are most appropriate. NWP 3 for Maintenance, NWP 27 for Aquatic Habitat Restoration, Enhancement, and Establishment Activities, NWP 33 for Temporary Construction, Access, and Dewatering, or NWP 53 Removal of Low Head Dams (see sidebar below) are examples of what may be applicable.
- Relevant forms and information for the permit application: **Joint Federal and State Application Form:** This is the application form to fill out for all permit application submittals.
- **Regional Conditions:** All NWPs have associated Regional Conditions. These will be updated every time the NWPs are re-issued (typically every 5 years). Visit Charleston District's website for the current version of the Regional Conditions and associated NWP information.

Nationwide Permits

NWPs that have been, or potentially could be, used for dam removal in South Carolina:

NWP No. 3 Maintenance

- The repair, rehabilitation, or replacement of any previously authorized fill.
- The removal of previously authorized structures.

NWP No. 27 Aquatic Habitat Restoration, Enhancement, and Establishment Activities

- Activity must result in net increase in aquatic resource functions.
- Activity must result in aquatic habitat that resembles reference conditions.

NWP No. 33 Temporary Construction, Access, and Dewatering

- Temporary structures, work, and discharges necessary for construction activities.

NWP No. 53 Removal of Low-Head Dams

- Low-head dams are defined as dams built to pass flow over all or nearly all of width of dam
- Structure must be deposited in an area with no waters of the U.S.

[67] USACE Charleston District https://www.sac.usace.army.mil/Missions/Regulatory/Permitting-Process/

3.3.1 Compensatory Mitigation

Methods of providing compensatory mitigation include aquatic resource restoration, establishment, enhancement, and preservation. Dam removal can be part of a compensatory mitigation plan. The criteria for a compensatory mitigation plan can be found at 33 CFR 332 and the current version of the Charleston District's guidelines for preparing a compensatory mitigation plan found on the Charleston District's website.[68] This regulation and the guidelines include information for mitigation banks and permittee responsible mitigation plans. Most sites used for compensatory mitigation require some kind of legal protective instrument, which can include a conservation easement or restrictive covenant. USACE RGL 18-01[69] provides guidance on factors to consider when generating credit for the removal of obsolete dams or other structures, recommends mitigation credit, and has recommendations for the treatment of losses of wetlands that may result from the removal of the dam or structure. Dam removal projects, including those proposed for compensatory mitigation credit, can involve monitoring and may require more detail in the submittal.

Section 3.4 State Regulatory Overview

The State of South Carolina has permitting/certification procedures in multiple program areas that applicants must follow when considering dam removal.

3.4.1 Section 401 Water Quality Certification

DHEC administers the Water Quality Certification program pursuant to Section 401 of the Federal CWA and S.C. Regulation 61-101, *Water Quality Certification*. Section 401 requires that the State issue certification for any activity that requires a Federal permit and may result in a discharge to State waters. The certification must state that applicable effluent limits and water quality standards will not be violated.

All activities requiring a Federal 404 permit (a U.S. Army Corps of Engineers permit for the discharge of dredged or fill material) result in a discharge to waters or wetlands, so DHEC must take certification action on all 404 permit applications. During review of applications for Water Quality Certification, the Department looks at whether there are feasible alternatives exist, if the activity is water dependent, and the intended purpose of the activity. Certification is denied, for example, if a feasible alternative to the activity, would reduce adverse consequences on water quality and classified uses. The Federal permit cannot be issued if certification is denied.

S.C. Regulation 61-101 gives DHEC authority to condition the certification upon compliance with all measures necessary to minimize adverse effects. Standard conditions generally include stormwater best management practices. The regulation also gives DHEC authority to include monitoring requirements necessary to assure maintenance of classified or existing water uses and standards, compliance with other requirements of S.C. Regulation 61-101, or other appropriate requirements of State law.

In addition to reviewing individual applications for certification, DHEC has authority to issue, deny, or revoke general certifications for categories of activities or for activities specified in Federal nationwide or general dredge and fill permits pursuant to Federal law or regulations. Such general certifications are subject to the same process as individual certifications.

On March 7, 2017 DHEC certified without special conditions the following 2017 USACE Nationwide Permits that may be applicable to dam removal: NWP 3 Maintenance; NWP 27 Aquatic Habitat Restoration, Establishment, and Enhancement Activities; and NWP 33 Temporary Construction Access, and Dewatering. DHEC denied certification for NWP 53 Removal of Low-Head Dams. Projects processed by the USACE under NWP 53 will require public notice and individual certification by DHEC. In addition, the 2017 DHEC certification included the following general condition applicable to all NWPs, including NWPs 3, 27, and 33: "Activities in the Critical Areas (as defined in 48-39-10, R 30.1(D) and R 30.10) require a direct permit from DHEC [Office of Ocean and Coastal Resource Management] or OCRM. DHEC OCRM's action on direct critical area permits will serve as the consistency determination for the critical area activity." For more information on DHEC certifications applicable to NWPs, consult DHEC's **Nationwide Permits for Minor Projects webpage**.[70]

3.4.2 Permits for Construction in Navigable Waters

Any activity, such as construction, dredging, filling, or other alteration below the mean high-water line (in tidal waters) or the ordinary high-water mark (in nontidal waters) in a navigable waterway of South Carolina is subject to the permitting jurisdiction of S.C. Regulation 19-450, *Permits for Construction in Navigable Waters*, which is administered by DHEC. The only exception are those navigable waters within the Critical Area of the State's Coastal Zone, which are subject to the Critical Area permitting jurisdiction of DHEC's Office of Ocean and Coastal Resources Management.

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[68] USACE Charleston District Website **www.sac.usace.army.mil**

[69] FUSACE Regulatory Guidance Letter **https://www.nap.usace.army.mil/Portals/39/docs/regulatory/regs/RGL-18-01-Determination-of-Compensatory-Mitigation-Credits-for-Dams-Structures-Removal.pdf?ver=2019-02-22-140711-787**

[70] DHEC Nationwide Permits for Minor Projects **https://scdhec.gov/bow/nationwide-permits-minor-projects**

A DHEC Permit for Construction in Navigable Waters may be required even when a U.S. Army Corps of Engineers permit is not required. The regulation exempts certain activities and provides that a separate Permit for Construction in Navigable Waters is not required for activities that require another DHEC permit or certification, including but not limited to 401 Water Quality Certifications, water supply permits, National Pollutant Discharge Elimination System permits, wastewater construction permits, and mining permits. These DHEC permitting/certification areas will coordinate with the DHEC Construction in Navigable Waters Permitting staff to insure adherence to the provisions of this regulation.

The DHEC Bureau of Water, using procedures established under S.C. Regulation 19-450, has issued general permits (or GPs) to agencies, political subdivisions, public service corporations, and the general public for certain clearly described categories of activities or substantially similar activities in particular Navigable Waters across the State. GPs have expiration dates and may be reissued, modified, suspended or revoked, in whole or in part.

SC GP 2009-001[71] is one such General Permit available to the public for authorization, subject to the general and special conditions of the GP, of activities that are subject to permitting by the US Army Corps of Engineers (Corps) and quality for nationwide permits (NWP) issued by the Corps where such activities have been certified by the Department in accordance with Section 401 of the CWA and are in accordance with all conditions pursuant to the certification. Some NWPs included in the GP are subject to the Corps' Section 10 authority only and the 401 Certification is not applicable. NWP 3 and NWP 27 (referenced above under 401 Water Quality Certification)) are included in the GP, while NWP 33 and NWP 53 (also referenced above) are not and would require individual permits.

3.4.3 NPDES Permitting for Construction Stormwater Permits

DHEC is the permitting authority in South Carolina for the NPDES Stormwater Program as approved by the EPA, which itself is tasked with running this program nationwide as mandated in the CWA. As the permitting authority, DHEC must regulate stormwater runoff from construction sites to improve water quality. Each project owner must develop and implement a site-specific stormwater management plan to control stormwater runoff and sediment from construction sites. These plans must be reviewed and approved by DHEC.

If you are planning any construction/land-disturbing activity (including clearing, grading, and excavating) within the State of South Carolina, you must first apply for an NPDES permit or meet notification requirements. All requirements are based on the amount of disturbance, the project location, and other related factors such as whether the project is part of a Larger Common Plan, whether the project is located within the State's Coastal Zone and/or within an MS4 jurisdiction or Urbanized Area. For additional information on these requirements, including application procedures and forms, technical documents, and information on additional Coastal Zone requirements, consult DHEC's Stormwater–Construction Activities Overview.[72]

3.4.4 South Carolina Dam Safety Programs

As outlined under the Dams and Reservoirs Safety Act, to be considered a dam, a structure must be at least 25 feet tall (vertical height, measured from highest point on crest of dam to lowest point on downstream side of dam), or have the ability to store at least 50 acre-feet (volume) at maximum capacity, or have the potential to cause loss of life in the event of dam failure regardless of dam height or storage capacity. If a structure meets ***any*** of these criteria it is considered a dam subject to state regulation under the Act. The DHEC is responsible for evaluating and assigning each dam that is subject to regulation under the Act a Hazard Potential Classification either High Hazard, Significant Hazard, or Low Hazard. These classifications are not based on the condition of the dam but rather on the potential consequences should the dam fail. Dams are also assigned a size classification, either Large, Intermediate, Small, or Very Small.

The regulations under the Act provide size classification criteria as follows:

TABLE 5: Dam sizes are classified by water storage capacity and height.

Size Classification			
Category	**Implementation Storage (acre feet)**		**Height (feet)**
Very Small	<50	and	<25
Small	≥50 and <1000	or	≥25 and <40
Intermediate	≥1000 and <50,000	or	≥40 and <100
Large	≥50,000	or	≥100

[71] DHEC Permit for Construction in Navigable Waters https://scdhec.gov/sites/default/files/media/document/SC%20GP%202009-001.pdf

[72] DHEC Stormwater–Construction Activities Overview https://scdhec.gov/stormwater-construction-activities/stormwater-construction-activities-overview

The Regulations provide Hazard Potential Classification criteria as follows:

TABLE 6: Regulated dams are classified as High, Significant or Low hazard.

Hazard Potential Classification	
Hazard Classification	**Hazard Potential**
High Hazard (Class 1)	Dams located where failure will likely cause loss of life or serious damage to home(s), industrial and commercial facilities, important public utilities, main highway(s) or railroads.
Significant Hazard (Class 2)	Dams located where failure will not likely cause loss of life but may damage home(s), industrial and commercial facilities, secondary highway(s) or railroad(s), or cause interruption of use or service of relatively important public utilities.
Low Hazard (Class 3)	Dams located where failure may cause minimal property damage to others. Loss of life is not expected.

The Act contains 5 circumstances where a dam may be exempt from regulation by DHEC. These include:

1. Dams <25 feet in height and <50 acre-feet in storage, unless improper operation or failure of the dam may cause loss of life;
2. Any dam owned or operated by any department or agency of the federal government;
3. Any dam owned or licensed by the FERC, the South Carolina Public Service Authority, the Nuclear Regulatory Commission, the United States Army Corps of Engineers, or other responsible federal licensing agencies considered appropriate by the Department;
4. Any dam upon which the South Carolina Department of Transportation or county or municipal governments has accepted maintenance responsibility for a road or highway where that road or highway is the only danger to life or property if the dam failed; and,
5. Any dam, which in the judgement of DHEC, because of its size or location could pose no significant threat of danger to life or property with respect to failure of the dam.

Dam owners who choose to remove a state-regulated dam are required to obtain a dam removal permit from DHEC. The dam owner must utilize a licensed Professional Engineer registered in South Carolina to prepare a permit application that includes, but is not limited to, construction plans, specifications, and calculations that demonstrate how the removal is to be conducted in accordance with the Dams and Reservoirs Safety Act regulations. Once the permit application is approved and the dam has been removed (also known as decommissioned), the dam owner will have no further responsibilities under the Act.

The DHEC Dams and Reservoirs Safety Program notes the importance of recognizing that in some cases, removing a dam may increase the frequency of floods in downstream areas. Most dams, especially regulated dams, provide some storage for inflows and discharge at a near constant rate. This is especially true of higher return interval floods such as 1-, 5-, 10-year, and possibly the 25- and 50-year, floods. Larger floods, such as the 100-year flood and above, are generally passed through a dam's emergency spillway, and thus are not attenuated by the dam. Removal of a dam, and the flood attenuation it provides, may cause the downstream area to experience flooding from the smaller magnitude but more frequent events. For this reason, DHEC will require the Professional Engineer to address the hydrologic impacts of removing the dam. Local flood ordinances and dams in FEMA-regulated floodways may impose additional requirements where the flood response in downstream areas will be affected.

When removing a state-regulated dam, the Professional Engineer should consider design issues including:

- Removal of the entire structure versus an engineered breach: Where the entire structure is not being removed, the engineer must provide calculations to justify the width of the section of dam to be removed and the extent of the dam that is to remain.
- The dam removal should seek to restore the natural stream bed geometry. Where the entire dam is not being removed, the center of the engineered breach of the dam should be located in the original stream bed. The width of the engineered breach should be at least as wide as the original stream bed.
- The 100-year flood should be used as the design flood for hydrologic and hydraulic analyses.
- The engineered breach should be constructed to be stable and erosion-resistant
- The final condition should be resistant to obstruction from debris buildup. The goal is to leave the site in a "walk away and forget" condition. DHEC will not approve a design for removal that requires ongoing maintenance or other human intervention to sustain a dam's removed or decommissioned condition.

DHEC requires submission of this **Application**[73] for removing a dam. Additionally, DHEC maintains a list of engineers that have experience with dams and have submitted previous projects to DHEC.

[73] DHEC Application to Construct or Alter a Dam https://scdhec.gov/sites/default/files/Library/D-2602.pdf

3.4.5 State Historic Preservation Office (SHPO) Coordination

Under Step 1, the applicant should have collected relevant historical background information on the dam. That information will be used when the Corps Project Manager is assigned to coordinate review of the project with the State Historic Preservation Office (SHPO). Section 106 of the NHPA requires that federal agencies consider the impacts of their "undertakings"[74] on historic properties. As such, SHPO, the federal agency, and other consulting parties (tribes, the public, etc.) should be involved early and often throughout the project's timeline. Those parties can provide feedback on alternatives, technical assistance, and similar comments. The Section 106 process often cannot be completed until a preferred alternative has been selected as final, the scope of work is known, and project plans are near completion. Without this information, impacts to historic properties cannot be completely assessed. Additionally, considering the proximity to water and the nature of dam removal causing ground disturbance, keep in mind that an archaeological survey may need to be completed by a Secretary of the Interior's Qualified Professional. All surveys needed are the responsibility of the applicant. More information can be found on the **Advisory Council on Historic Preservation's webpage**.[75]

Although some federal agencies delegate the responsibility for this review to applicants, USACE is one of the federal agencies that does not delegate its Section 106 responsibilities. Applicants should be in constant contact with their USACE Project Manager, who understands the process and will consult with an internal USACE cultural resource specialist and, if necessary, the SHPO office. Formal consultation with SHPO may or may not be needed and will be determined by the USACE Project Manager. Be responsive to the USACE Project Manager's requests for any additional information to keep the process moving forward.

Applicants should note that one outcome of a review may be an adverse effect determination. If this happens, applicants should remember that a Section 106 assessment of effects is based solely on the impacts on historic properties, with no consideration given to potential benefits to the environment, the surrounding community, costs, or similar factors. If a project is determined to have an adverse effect, it may just indicate that a few more steps are necessary to proceed. The first two steps are to look at all alternatives that would avoid or minimize the impact to historic properties, such as maintaining the dam as-is, partial versus full breach, etc. If, after all alternatives have been explored that avoid or minimize the adverse impact of partial or full demolition and data-driven explanations for ruling out these alternatives have been provided, with SHPO's and other consulting parties' acceptance, then the third step is mitigation. Mitigation must benefit preservation/history and have some linkage with the impacted area. Once mitigation is agreed to by all parties and a legally-binding Memorandum of Agreement or Permit Special Condition is executed, then the project can continue concurrently with the mitigation.

The **Advisory Council on Historic Preservation (ACHP)**[76] is charged with ensuring federal agency regulatory compliance with the NHPA. Although ACHP is usually not involved with the Section 106 process it will occasionally become involved if the project is precedent-setting, highly complicated, engenders numerous conflicting viewpoints, or if the applicant is asked to involve one of the required consulting parties. If the project is determined to have an adverse effect, the federal agency or their delegate is required to ask the ACHP if it wants to be involved in the resolution, regardless of its past involvement. Most of the time, the agency does not get involved unless one of the above circumstances occurs. More information specific to South Carolina is available from the **South Carolina Department of Archives and History**[77] or the **State Historic Preservation Office**.[78]

PHOTO: GERRIT JÖBSIS

Lower Saluda River, SC

[74] "Undertakings" are anything a federal agency does, funds, or regulates in some way (such as, permits, licenses, etc.).

[75] Protecting Historic Properties **https://www.achp.gov/protecting-historic-properties**

[76] ACHP **https://www.achp.gov/**

[77] Department of Archives and History **https://scdah.sc.gov/**

[78] Historic Preservation Office **https://scdah.sc.gov/historic-preservation**

STEP 4: Planning and Design of the Project

Once the information outlined in steps 1, 2, and 3 of this Handbook has been gathered, and the regulatory process has begun, it is time to begin the planning and design phase. Project planning and design are case-specific and can be relatively simple or, in the case of larger projects, involve multiple intermediate steps including a feasibility study, a conceptual design, and a preliminary design, before the final design is completed. Dam removal planning and design is not a linear process. It is the job of the dam owner's project manager to coordinate multiple work streams in synchrony through the planning, design, and implementation phases.

Section 4.1 Identifying Consultants

Dam removal, as a practice, is relatively new in South Carolina. One of the most critical tasks in the dam removal process is the selection of qualified consultant to lead the project. Environmental, economic, ecological, engineering, social, and legal complexities require a multidisciplinary approach. An effective lead consultant can assist project partners in building a successful team. Dam removal projects depend on effective communication between project partners, regulators, and consultants. For this reason, taking the time to carefully research the dam, the river and surrounding landscape, and the basic regulatory process prior to selecting consultants is essential.

Section 4.2 Identifying Relevant Stakeholders

As a project plan is being developed, it will be important to consider those outside the core project partners that will be affected by the dam removal. Careful consideration of values and opinions of relevant stakeholders can help to minimize conflict as information about the project becomes public. From the onset of the planning process, the project team should develop a clear outreach plan to share with stakeholders on the purpose and intent of the removal. The facts related to benefits of dam removal included in this Handbook may provide helpful information during the outreach portion of the project.

Section 4.3 Evaluation of Project Alternatives

As information from all relevant stakeholders is assimilated by the project team, it is important to remember that the final plan will be evaluated by multiple regulatory agencies. The final design may include a comprehensive evaluation of designs utilizing the information gathered to assess impacts to resources and costs and benefits that may result in modification of the original planned design.

This process should begin with careful consideration of all potential effects of removing the dam. Much of the information required has already been described in previous sections of this Handbook. Beyond information gathered for the permitting process, this step should consider all stakeholders involved. Examples of the types of effects to consider are:

- **Ecological Effects** (Please refer to Step 2.0 Basic Description of the Resource, Mapping & Surveys of this document for details.)
- **Economic Considerations**
  - Dam owner costs and benefits
  - Societal costs and benefits
  - Recreational costs and benefits
  - Environmental costs and benefits
  - Property value considerations
  - Costs/risks associated with the dam
  - Availability of funding for dam repair or removal
- **Societal Issues**
  - Community relationship to the river
  - Services provided by the dam
  - Community sentiment towards the river and the dam and dam removal process
  - Historical significance of the dam
  - Recreational safety
- **Technical/Engineering Issues**
  - Feasibility of repairing and maintaining the existing structure
  - Feasibility and design of dam removal

The evaluation of project alternatives should describe a process acceptable to all relevant stakeholders.

Section 4.4 Stages of Project Design

For very simple, straightforward projects, the information gathered in steps 1, 2, and 3 of this Handbook, plus the results of project alternatives analysis, may be sufficient to develop a final project design for the purposes of permit application. This determination should be made by the lead consultant for the project. For more complex projects, and to ensure successful implementation subsequent to permitting, additional stages will likely be required. These intermediate stages may include the following.

4.4.1 Feasibility Studies

If problems or unanswered questions arise during the early stages of information gathering and project planning, a more detailed feasibility study may be warranted. This study may be conducted by project partners with appropriate skills, by consultants, or a combination of the two. Feasibility studies often involve additional data collection including economic, technical, legal, and logistical considerations. The goal of this process is to provide the best available solution in order to achieve all identified project goals.

4.4.2 Conceptual Design

Once the project team feels an optimal approach to meeting their goals has been identified, it is time to prepare a concept-level description of planned work. This concept-level description may be referred to as a "10% design" and will include preliminary drawings or other materials that can be used to articulate the overall design to key stakeholders, including regulators, so they can provide feedback before details are finalized.

4.4.3 Preliminary Design

After any questions or concerns raised by key stakeholders and regulatory agencies have been addressed, a more detailed plan, sometimes referred to as a "30% design" can be prepared.

4.4.4 Final Design

The last stage of the design phase is the preparation of construction documents and specifications. These documents convey all project design requirements through detailed drawings and specifications. All required machinery, equipment, and material specifications must be clearly indicated. A technical memorandum describing the analysis

FIGURE 4: Preliminary or proposed conceptual design drawing for White Dam, Athens, GA. (courtesy GA ACT)

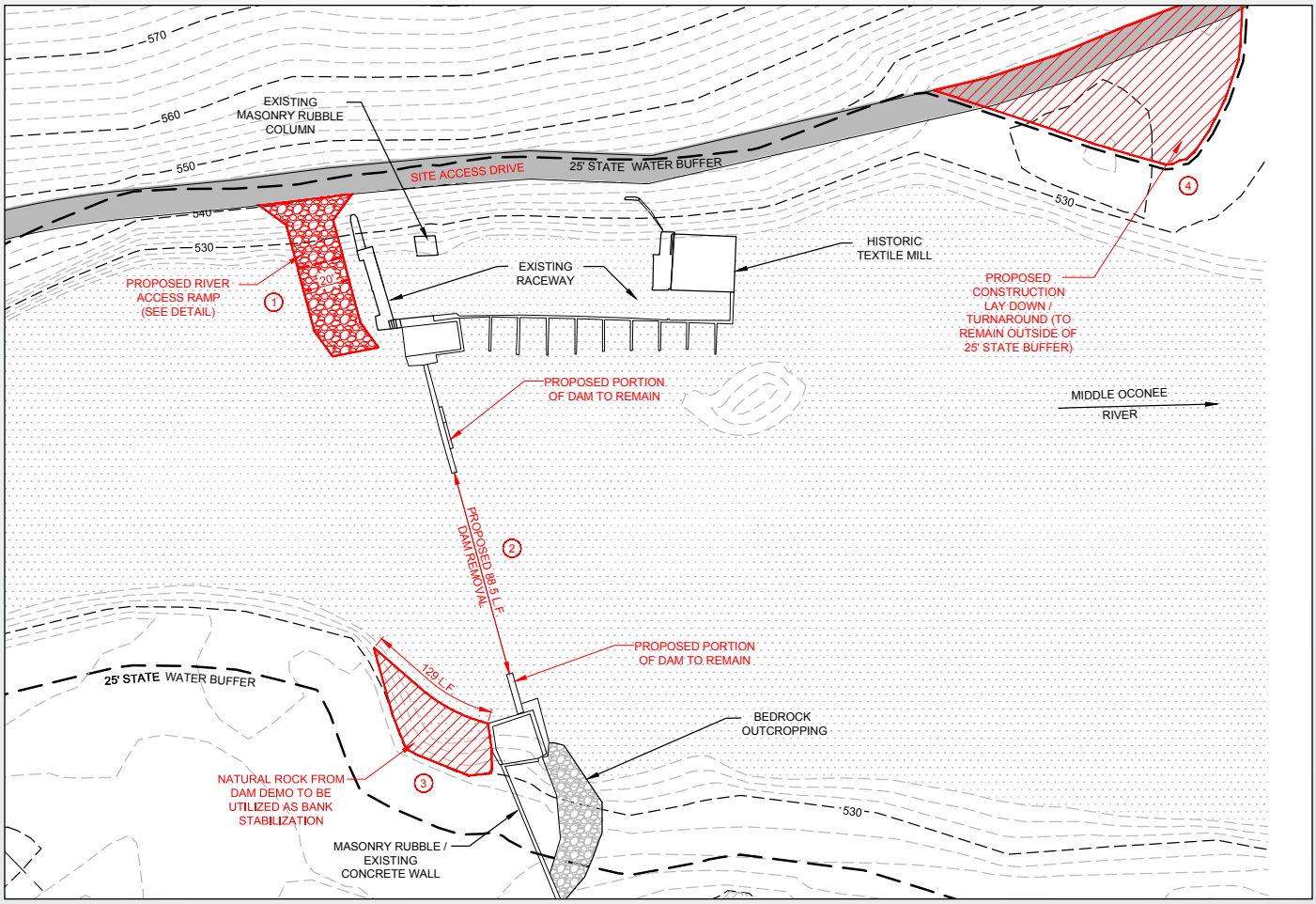
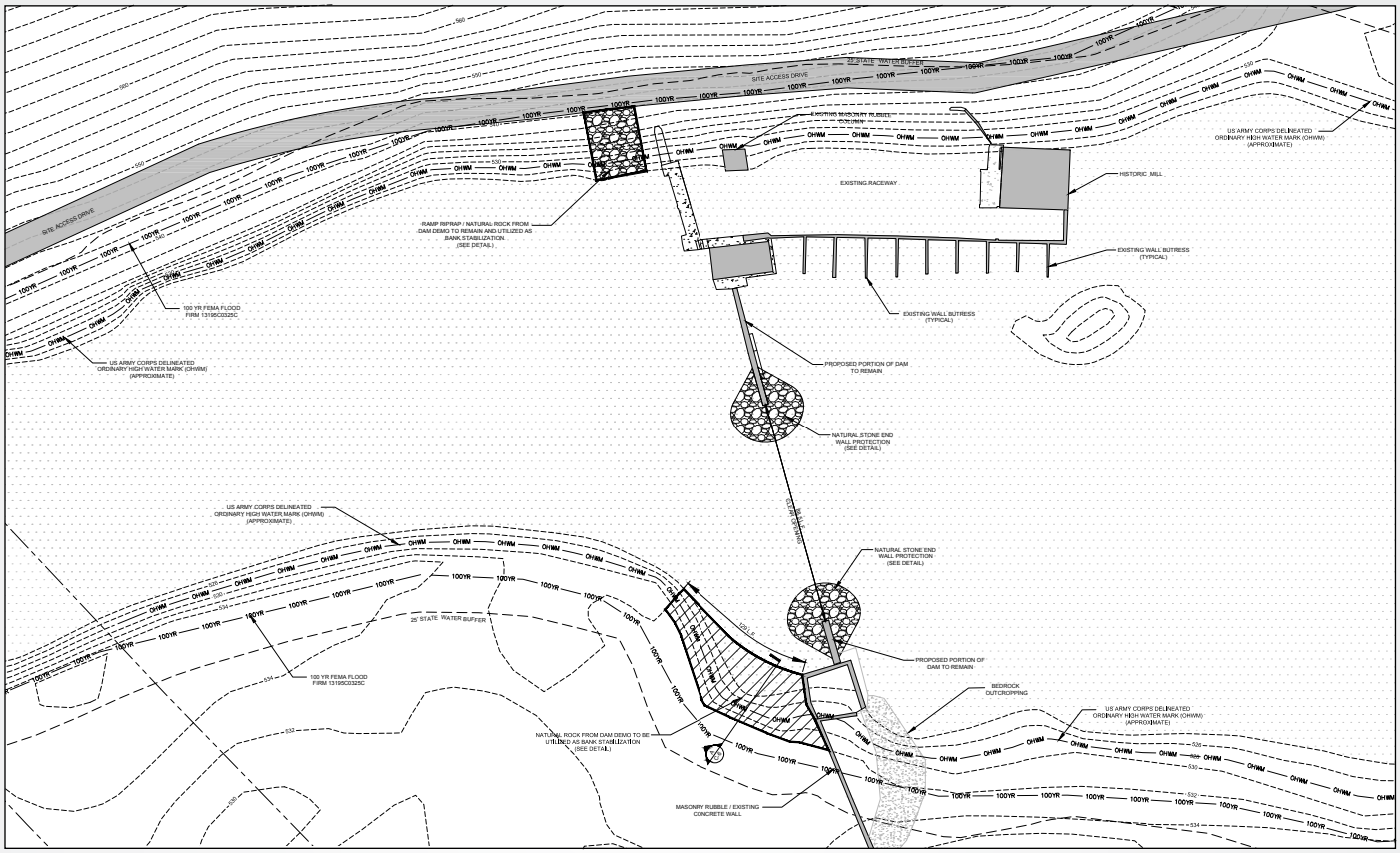


FIGURE 5: Final design drawing submitted with permit application, White Dam, Athens, GA. (courtesy GA ACT)



process and approach will also be included. A final design plan includes a description of the process for removal, mobilization of equipment via temporary access roads, and stabilization in addition to drawings. The following list what may be included in a final design plan:

- Design drawings showing plans for dam removal, sediment management, and channel restoration plans as necessary to reflect the project complexity. Plan sheets typically include base maps and drawings of:
  - Existing site conditions;
  - Staging areas and access;
  - Removal plan;
  - Dewatering plan (sometimes completed by the contractor);
  - Delineation of resource areas;
  - Proposed plan view;
  - Proposed cross sections;
  - Proposed longitudinal profile;
  - Erosion prevention and sediment control practices;
  - Infrastructure replacement/protection; and
  - Habitat feature installation schematics.
- Project specifications providing details on the construction work that will be completed. For very simple projects, specifications may be included directly on the design plans. Typically, specification details include the following:
  - Timeline for construction and restoration;
  - Construction equipment needs;
  - Material specifications and quantities;
  - Project sequencing;
  - Staging area treatment;
  - Site access route treatment;
  - Dewatering; and
  - Other site-specific details, i.e., planting plans, traffic control, infrastructure protection, etc.

Section 4.4.5 Pre-Construction Public Relations

At this stage of the project, it is very important to ensure that the community is aware of the upcoming removal and has a chance to ask questions and get information. Step 7 of American's River's Removing Small Dams: A Basic Guide for Project Managers[79] provides a good overview on this process.

[79] American Rivers Removing Small Dams https://s3.amazonaws.com/american-rivers-website/wp-content/uploads/2016/05/24144210/NatlDamProjectManagerGuide_06112015.pdf

Section 4.4.6 Additional Considerations

- **Data collected** during the preliminary design can provide the baseline for post-project monitoring if future monitoring will be conducted (See 'project monitoring' in Step 6: Post-Removal Actions for more information.).
- **Permit Identification** — The lead consultant will assist the applicant in applying for the appropriate federal, state, and local permits required. All contractors performing the dam removal work should have a copy of all permits, in addition to a copy being on site and available during construction.
- **Technical Memorandum** — A Technical Memorandum, prepared to accompany all design documents submitted for permit consideration, should describe the analysis and provide a recommended approach for each issue.
- **Cost Estimate** — The design team, with the help of the lead consultant, should develop cost estimates to bring the recommended approach to completion, including costs of permitting and construction. The following table provides a list of tasks for a relatively complex project; not all of these tasks may be necessary for any given project, and some additional tasks may be needed depending on the project.

STEP 5: Implementation and Construction

As dam removal is a relatively new form of aquatic restoration in South Carolina, even experienced consultants and engineers may not be familiar with the associated logistical challenges. For this reason, successful implementation of a dam removal project depends on linking the contractor hired to implement the design team's project. Communication between the construction contractor with oversight from the design team is important for ensuring the success of the project and accurate implementation of the plan. This is important in terms of human safety, habitat considerations, cost and timing.

Once an initial conceptual design is available, a pre-application meeting and site visit should be scheduled with the USACE project manager, consulting engineer, and the contractor who will implement the final plan. This will allow all parties to talk through the design and make changes as needed. Additional site visits will likely be required throughout the planning and design process.

PHOTO: GERRIT JÖBSIS

Dam Removal Congaree Creek, SC

While the final approach for removing the structure may have been documented during the project planning and design phase, some issues can have a significant effect on implementation. These include:

- The condition of the dam and associated structures in terms of safety concerns including public access to the site;
- Access to the site by contractors for construction equipment, materials and staging areas; and
- Site limitations, such as utilities or topographic constraints.

Section 5.1 Project Construction

Once the work on planning and design has been completed, and all necessary permits have been obtained, removal can be scheduled. The physical work of removal will likely take a relatively short time in comparison to all other stages of a dam removal project.

The project manager should work closely with the consulting team to select an experienced contractor to do the physical work of removal or deconstruction. Construction may be bid out to qualified contractors; it is important to ensure that all contractors are licensed, bonded, and insured. In some cases, agency programs may provide qualified personnel and the appropriate equipment to complete some or all work (see inset on the USFWS National Fish Passage Program, pg. 34). During construction, the project manager and other members of the design team should always be present onsite to oversee the process. For all dam removal projects, unforeseen circumstances may arise, requiring rapid decision-making and response.

If site monitoring is required by the permit (e.g., water quality, biological, geomorphological monitoring, etc.), it should be done by professionally qualified personnel. Site monitoring may help to demonstrate the ecological impact of the removal. Even if monitoring is not required by the project permit, video and photographic documentation of all critical steps of the removal process are recommended to document and help communicate the outcome of the project to all stakeholders.

Once removal is initiated, it may become necessary to deviate from the original project design. If this occurs, it is pertinent to communicate with all regulatory agencies as soon as possible and note all planned modifications on design drawings.

U.S. Fish and Wildlife Service

National Fish Passage Program and the Southeast Aquatic Restoration Team

The U.S. Fish and Wildlife Service, National Fish Passage Program (NFPP) is a federal program which provides financial and technical assistance to reconnect aquatic habitats through the removal of barriers. The NFPP works in partnership with state and federal agencies, non-government organizations, universities, and tribes. The NFPP focuses solely on issues surrounding aquatic barriers (including obsolete dams) and restoration of waterway connectivity. This nationwide program includes the Southeast Aquatic Restoration Team, who have worked successfully with stakeholder groups in a number of states including South Carolina. The members of this team are highly experienced equipment operators who have successfully removed dams of all sizes.

PHOTO: GAIL LAZARAS

PHOTO: GERRIT JÖBSIS

PHOTO: ERIN MCCOMBS

PHOTO: GAIL LAZARAS

For more information contact:
Tripp Boltin
USFWS — South Atlantic-Gulf and Mississippi Basin Fish Passage Coordinator
walter_boltin@fws.gov

Section 5.2 Public Relations during Construction

A dam removal is an uncommon event and will likely get a lot of attention. It is important to plan to have sufficient personnel prepared to handle visitors to the site and even inquiries from local media. While this is an excellent opportunity to tell your project's story, everyone involved must exercise all appropriate safety precautions. Prior to initiating construction, the project manager should delegate someone with detailed knowledge of the overall plan to interact with visitors. Consult the contractors and equipment operation crew and establish a designated viewing zone a safe distance from the active site.

PHOTO: GERRIT JÖBSIS

Prior to removal, a viewing zone for visitors should be established a safe distance from the active site.

STEP 6: Post Removal Actions

Monitoring project results is an important step in the dam removal process. First, a project evaluation, or as-built drawings, should be completed to determine if the engineering design was constructed properly and to ensure that the project is performing successfully in terms of infrastructure and public safety. If required by the permit, environmental monitoring may be needed to demonstrate that habitat restoration goals were met.

Section 6.1 Project Evaluation

If required by the permit or of interest to the project manager or dam owner, the project team should plan to complete regular inspections of the removal site. They may seek the assistance of the lead consultant in developing a checklist of issues to inspect periodically. The checklist might include visual or quantitative assessments of vegetation growth, erosion and sediment transport, and scour around remaining infrastructure, such as abutments.

Section 6.2 Environmental Monitoring

If required, environmental monitoring of dam removal projects will involve evaluating changes in biological/ecological, physicochemical, geomorphological, hydraulic, and hydrologic parameters to assess project success. Monitoring plans developed during the project development phase should establish pre-project baseline conditions. Trained personnel from universities, environmental consulting firms, or scientific staff from various non-profits can complete post-construction monitoring activities to evaluate changing conditions. In some

cases, state or federal agencies can provide assistance with project monitoring, such as by evaluating fish populations before and after dam removal.

The U.S. National Oceanic and Atmospheric Administration (NOAA), in cooperation with various partners, has prepared useful monitoring-related resources including the Stream Barrier Removal Monitoring Guide by the Gulf of Maine Council on the Marine Environment and NOAA's Guide for Monitoring and Evaluation for Restoration Projects.

A useful approach to post-project monitoring includes the development of fixed photo stations to photograph the site from the same location repeatedly over time. In addition, there are a number of parameters that can be monitored to track the ecological success of a project. Broad categories include:

Ecological Response

- Evaluate changes in fish, benthic macroinvertebrate, and other aquatic species, groups or communities.
- Evaluate vegetation establishment on exposed lands, quantifying both native and non-native or invasive exotic species abundance and distribution.

River Channel Response

- Evaluate sediment transport and deposition, erosion, and habitat structure changes by surveying channel morphology (bedform diversity, bank stability, etc.) and analyzing bed material samples.

Water Quality Response

- Evaluate changes in water quality, including such parameters as water temperature, dissolved oxygen, and turbidity.

Hydraulic Response

- Evaluate changes in flow velocities that may impact aquatic species movement and recreational boating safety in the river.

Finally, once the removal is complete, report it to American Rivers so it can be added to their dam removal database[80] and gets a dot on the national tracking map![81]

PHOTO: WILDLANDS ENGINEERING

Drone imagery can be very useful for monitoring changes in river morphology. (Wards Mill Dam, NC)

Looking Ahead

The SC ACT was created to support and encourage the removal of obsolete dams in South Carolina for all of the benefits it provides to dam owners, recreational users, aquatic organisms, water quality, state and local economies, and public safety. The SC ACT hopes that the links, contacts, and information provided in this Handbook will greatly assist dam owners or project managers to prepare complete applications and navigate the regulatory process.

[80] American Rivers Dam Removal Database https://figshare.com/articles/dataset/American_Rivers_Dam_Removal_Database/5234068

[81] American Rivers Map of U.S. Dams Removed Since 1912: https://www.americanrivers.org/threats-solutions/restoring-damaged-rivers/dam-removal-map/

References

American Rivers. (2020) *Rivers as Economic Engines.* https://s3.amazonaws.com/american-rivers-website/wp-content/uploads/2020/07/09223525/ECONOMIC-ENGINES-Report-2020.pdf

Duncan, E. et al. (2019). *Illuminating hotspots of imperiled aquatic biodiversity in the Southeastern US. Global Ecology and Conservation*. https://www.sciencedirect.com/science/article/pii/S2351989418304451

Ferguson, P. (2014). *Canoe Kayak South Carolina: A Guide to Paddling the Palmetto State*

Graf WL. (1993). *Landscapes, commodities, and ecosystems: The relationship between policy and science for American rivers.* Pages 11–42 in Water Science and Technology Board, National Research Council. Sustaining Our Water Resources. Washington (DC): National Academy Press

Kern, E., Guymon, J., Walbridge, C., and Tschantz, D. B. *Locations of Fatalities at Submerged Hydraulic Jumps.* Brigham Young University. Retrieved from https://krcproject.groups.et.byu.net/browse.php

Kern, E. W., Hotchkiss, R. H. and Ames, D. P. (2015) *Introducing a Low-Head Dam Fatality Database and Internet Information Portal.* Journal of the American Water Resources Association. https://onlinelibrary.wiley.com/doi/abs/10.1111/jawr.12289

Outdoor Industry Association. (2017). *The Outdoor Recreation Economy.* Retrieved from https://outdoorindustry.org/wp-content/uploads/2017/04/OIA_RecEconomy_FINAL_Single.pdf

Outdoor Industry Association. (2017). *The Outdoor Recreation Economy South Carolina.* Retrieved from https://outdoorindustry.org/wp-content/uploads/2017/07/OIA_RecEcoState_SC.pdf

Poff, N.L., and Hart, D.D. (2002). *How dams vary and why it matters for the emerging science of dam removal.* BioScience, v. 52, no. 8, p. 659–668. http://dx.doi.org/10.1641/0006-3568(2002)052[0659:HDVAWI]2.0.CO;2

Subcommittee on Sedimentation. (2017). *Dam Removal Analysis Guidelines for Sediment.* U.S. Department of Interior. Retrieved from https://acwi.gov/sos/pubs/dam_removal_analysis_guidelines_for_sos_final_vote_2017_12_22_508.pdf

Warren, N. (2015). *An Economic Argument for Water Trails.* River Management Society. https://www.river-management.org/assets/WaterTrails/economic%20argument%20for%20water%20trails.pdf

Wright, K., and Tschantz, B. (2011). *Hidden Dangers and Public Safety at Low-head Dams.* The Journal of Dam Safety 9 (1). Retrieved from https://damsafety.org/sites/default/files/TschantzWright_PublicSftyLowDams_JDS2011_1.pdf

U.S. Environmental Protection Agency. (2016). *Frequently Asked Questions on Removal of Obsolete Dams.* Retrieved from https://www.epa.gov/cwa-404/frequent-questions-removal-obsolete-dams

US Army Corps of Engineers (2018). *Determination of Compensatory Mitigation Credits for the Removal of Obsolete Dams and Other Structures from Rivers and Streams.* https://www.nap.usace.army.mil/Portals/39/docs/regulatory/regs/RGL-18-01-Determination-of-Compensatory-Mitigation-Credits-for-Dams-Structures-Removal.pdf?ver=2019-02-22-140711-787

Appendix A: Case Studies

Burson Lake Dam Removal Project Reedy Creek, Oconee County, SC

Status: Removed June 2020

Owner: US Forest Service

Partners: Keith Whalen – US Forest Service; Tripp Boltin – US Fish and Wildlife Service

Location: Sumter National Forest, Oconee County, SC (34.800392 -83.287598) Tributary of Chattooga River. HUC08 03060102 (Tugaloo River)

Statistics: 240 feet wide; 30 feet high; 8 acre impoundment

Habitat Benefits: Reconnects 0.5 miles upstream to waterfall and 1.2 miles downstream to Chattooga River

Priority Species: Brook Floater Mussel (*Alasmidonta varicose*), Bartram's Bass (*Micropterus sp. cf cataractae*), Chauga Crayfish (*Cambarus chaugaensis*) are species of highest priority for protection by the state of South Carolina. All found in middle portion of the Chattooga watershed where this project is located. Future monitoring will be needed to determine which species recolonize this creek.

Recreation: None expected

Challenges: Spillway damaged by Spring 2020 rain events. USFS decided to fast track removal due to potential of failure during 2020 hurricane season. This was a recreation reservoir (stocked trout). USFS was concerned about public reaction that this a recreation lake was removed. It did not end up being a big issue.

Additional Background: USFS repurposed $200,000 of culvert replacement money for this project. USFWS stream restoration team did the construction. USFS wants to use this as a demonstration site for dam removals so that dam owners considering removal can see what a restored stream looks like. Whalen plans to regularly photo-document the recovery process and conduct stream monitoring.

Appendix A: Case Studies (CONTINUED)

Congaree Creek Dam Removal Project Congaree Creek, Lexington County, SC

Status: Removed May 2019

Owner: City of Cayce, SC

Partners: Rebecca Vance — Cayce City Manager; Lorianne Riggin — SC Department of Natural Resources; Bill Stangler-Congaree Riverkeeper; Erin McCombs and Gerrit Jöbsis — American Rivers; Tripp Boltin — US Fish and Wildlife Service

Location: Below Highway 321 Bridge, City of Cayce, Lexington County, SC (33.937528, -81.077262); Just upstream of Congaree Creek Heritage Preserve and an adjacent property which is under conservation easement.

Statistics: 40 feet wide; 5 feet above waterline; estimated 8 to10 feet below waterline

Habitat Benefits: Opened 10 miles of Congaree Creek and 6 miles of tributaries including Red Bank and Scouter creeks. Connected headwaters to the Congaree River 10 miles downstream and ultimately the Atlantic Ocean.

Priority Species: Blueback Herring (*Alosa aestivualis*), American Eel (*Anguilla rostrata*), Snail Bullhead (*Ameiurus brunneus*), Flat Bullhead (*Ameiurus platycephalus*), Blackbanded Sunfish (Enneacanthus chaetodon), Sawcheek Darter (*Etheostoma serrifer*), Swallowtail Shiner (*Notropis procne*), and Sandbar Shiner (*Notropis scepticus*). American Shad (*Alosa sapidissima*) and Striped Bass (*Morone saxatilis*) are in Congaree River, but less likely to use creek.

Recreation: The dam removal eliminated a hydraulic roller that at certain water levels posed a significant risk to paddlers. A canoe trail begins at the former dam site and continues downstream through Congaree Creek Heritage Preserve to Congaree River. Removal opened upstream mileage to paddlers.

Challenges: Sediment contamination is known to have occurred in 1990s. Tributyl-10 was the contaminant of concern. EPA Record of Decision (ROD) and US Fish and Wildlife Service Tier I sediment analysis agreed that contamination was resolved prior to the dam being cleared for removal.

Permits: USACE Nationwide 53 Permit-Lowhead Dam Removal Permit (CWA Section 404), DHEC Water Quality Certification (CWA Section 401) and DHEC State Navigable Waters Permit

Additional Background: DHEC's Dams and Reservoirs Safety Program informed American Rivers about the potential removal of this dam. An upstream property owner complained the dam caused flooding of his property during October 2015 flood. The dam was constructed as emergency backup water supply for the City of Cayce in 1950s. The City no longer needed the dam and was open to its removal after being briefed on the proposal.

Appendix A: Case Studies (CONTINUED)

Unnamed Dam Removal, Matthews Creek Headwaters, Greenville County, SC

Status: Removed June 2019

Owner: Naturaland Trust

Partners: Mac Stone — Naturaland Trust; Gary Davis — Mountain Bridge Chapter of Trout Unlimited; Tripp Boltin — US Fish and Wildlife Service; Dan Rankin — SC Department of Natural Resources; Gerrit Jöbsis — American Rivers

Location: Headwaters of Matthews Creek adjacent to Watson-Cooper Heritage Preserve, Greenville County, SC (35.12394649628771, -82.68508891549608)

Statistics: 130 feet long; 10 feet high; 0.5 acre impoundment

Habitat Benefits: The Department of Natural Resources considers Matthews Creek as one of the most important Brook Trout streams in the state. Brook Trout is the only trout species native to South Carolina. The dam blocked headwater flows and warmed water temperatures in summer and early autumn months. Cold water is critical to Brook Trout which are known to have spawned below the former dam location.

Priority Species: Brook Trout (*Salvelinus fontinalis*)

Recreation: Limited direct recreation benefits are expected in the immediate project vicinity due to the small size of the stream. Indirect recreation benefits include improved water quality to support recreationally important Brook Trout downstream of the project.

Challenges: Brook Trout is a highly sensitive species. Special care was needed to avoid sediment movement into downstream Brook Trout spawning habitat. Construction was timed to occur outside of the autumn Brook Trout spawning period. The pond was treated with a piscicide prior to dam removal to avoid introduction of non-native to downstream waters. The Greenville County Land Disturbance Permit was difficult to obtain due in part to communication problems.

Permits: USACE Nationwide 18 Permit-Minor Discharges of Dredged or Fill Material (CWA Section 404), and Greenville County Land Disturbance Permit

Additional Background: Naturaland Trust acquired the dam and surrounding property as a potential addition to the Watson-Cooper Heritage Preserve. The design, permitting, and engineering costs were approximately $35,000. Funding was secured from private donations, Trout Unlimited and American Rivers. The U.S. Fish and Wildlife Service removed the dam and paid for construction costs.

Appendix B: Dam Removal Checklist

Information on the Dam

PHYSICAL PROPERTIES

☐ Height_____

☐ Width _____

☐ Date Constructed _____

☐ Date Modified_____

☐ Construction Material _____

☐ Original Purpose_____

☐ Ancillary Features_____

PUBLIC INFRASTRUCTURE

☐ Bridges/Abutments_____

☐ Roads _____

☐ Water Utilities _____

☐ Utility Lines_____

HISTORICAL SIGNIFICANCE

☐ Historical ownership _____

☐ Historical/unique construction _____

☐ Historical use _____

☐ Associated historical people _____

☐ Associated historical buildings _____

☐ Historically significant location _____

REGULATORY STATUS

☐ Is dam regulated under the SC Dams and Reservoirs Safety Program?_____

☐ If so, are there dam inspections and dam safety reports?_____

☐ Is the dam a FERC Licensed, Exempt or Revoked Dam? _____

Appendix B: Dam Removal Checklist (CONTINUED)

Information on the River

WATERBODY DESCRIPTION

- ☐ Waterbody Name(s)_____
- ☐ HUC 10_____
- ☐ USGS Gage Numbers & Locations_____
- ☐ Survey & Base Mapping _____
- ☐ Hydrology & Hydraulics Assessment_____

WATER QUALITY

- ☐ Designated Use _____
- ☐ Drinking Water Intakes _____
- ☐ Existing Water Quality Issues_____
- ☐ Wastewater Discharge _____

WILDLIFE RESOURCES

- ☐ State or Federally Listed Species Present_____
- ☐ Priority Species in State Wildlife Action Plan_____
- ☐ Migratory Species Present or Should be Present_____
- ☐ Amount of Miles Connected Post Removal _____
- ☐ Endemic Non-Migratory Species_____
- ☐ Invasive Sepcies_____

WETLANDS

- ☐ Manmade wetlands that could be impacted_____
- ☐ Natural wetlands that could be impacted _____

SEDIMENT

- ☐ Sediment Analysis _____
- ☐ Due Diligence Testing for Contaminants _____
- ☐ Sediment mapping? _____

Appendix B: Dam Removal Checklist (CONTINUED)

Example: Project Tasks for a Work Plan

- [ ] Hire Project Engineer.
- [ ] Create Scope of Work (SOW) and timeline for all project staff and/or contractors.
- [ ] Create Education and Outreach strategy.
- [ ] Conduct outreach to affected stakeholders.
- [ ] On-going communication with your group (watershed council, federal/state partners, other).
- [ ] Participate in public meetings with affected stakeholders.
- [ ] Build Technical Team and facilitate Technical Team meetings.
- [ ] Collect background site data.
- [ ] Conduct archaeology survey (per SHPO standards).
- [ ] Conduct necessary endangered and threatened species assessments.
- [ ] On-going communication with agency staff.
- [ ] Participate in Technical Team meetings (incorporate feedback into project design & timeline).
- [ ] Create a hydrological and sediment transport model of the system when needed.
- [ ] Collect current discharge data.
- [ ] Conduct pebble counts.
- [ ] Conduct sediment sampling.
- [ ] Conduct geomorphic (including longitudinal profile or bathymetric) surveys.
- [ ] Collect and analyze discharge data from historic records.
- [ ] Create reports, maps, and alternatives analysis of site options for maintaining or removing dam.
- [ ] Develop conceptual design for preferred alternative.
- [ ] Develop preferred alternative to the 60% design level to submit for permits.
- [ ] Prepare permit applications and all necessary accompanying data and documentation.
- [ ] Prepare 60% design for final permit agency review.
- [ ] Prepare 100% design.
- [ ] Prepare bid and specification documents and distribute to potential contractors.
- [ ] Manage bid process to select project contractors(s) for project implementation.
- [ ] Provide construction oversight.
- [ ] Provide any required site monitoring during construction (typically water quality sampling).
- [ ] Prepare as-builts upon project completion.
- [ ] Prepare final reports for funding agencies.

Modified based on Hoffert-Hay, D. 2008. Small Dam Removal in Oregon: A Guide for Project Managers. Oregon Watershed Enhancement Board.

Appendix C: Online Resources

American Rivers maintains a database on intentional dam removal since 1918 (does not American Rivers. 2021. Raw Dataset— ARDamRemovalList_figshare_Feb2021. Figshare. Available: https://doi.org/10.6084/m9.figshare.5234068 Retrieved: May 20, 2021

American Rivers summary of dam removals in 2020 (accessed May 20, 2021.) https://www.americanrivers.org/2021/02/69-dams-removed-in-2020/

American Rivers' Project Manager's Handbook https://s3.amazonaws.com/american-rivers-website/wp-content/uploads/2016/05/24144210/NatlDamProjectManagerGuide_06112015.pdf

ArchSite http://www.scarchsite.org/default.aspx

Association of State Dam Safety Officials https://damsafety.org/

Bridge Information by County http://bridgereports.com/sc/

DHEC State of the Dams Report https://scdhec.gov/sites/default/files/media/document/State%20of%20the%20Dams%20_FINAL_8-20-2020_0.pdf

DHEC Watershed Atlas www.scdhec.gov/atlas

Environmental Consultant List from the USACE Charleston District at the following link: https://www.sac.usace.army.mil/Portals/43/docs/regulatory/Courtesy_List_Environmental_Consultants_October2014.pdf

EPA How's My Waterway https://mywaterway.epa.gov/

Federal Navigable Waters https://www.sac.usace.army.mil/missions/navigation.aspx

FEMA National Floodplain Insurance Program Manager https://www.dnr.sc.gov/water/flood/documents/nfipadmindirectory.pdf

FERC Hydropower Projects https://www.ferc.gov/industries-data/hydropower

GA Dam Removal Handbook https://ga-act.org/georgia-dam-handbook/

Historic Aerials https://www.historicaerials.com/ or https://www.dnr.sc.gov/GIS/deschistaerial.html

Massachusetts Dam Removal Guide https://www.mass.gov/guides/deciding-to-remove-your-dam

The National Inventory of Dams (NID). Note: a partial NID update was conducted from with new updates from several state safe dam programs submitting data from November 2019 through January 2020 (accessed May 20, 2021). https://nid.sec.usace.army.mil/#/

National Register of Historic Places Database https://npgallery.nps.gov/nrhp

New York State Dam Removal and Barrier Mitigation https://www.dec.ny.gov/docs/remediation_hudson_pdf/damremoval.pdf

NRCS Web Soil Survey https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Sandborn Fire Insurance Maps https://www.loc.gov/collections/sanborn-maps/about-this-collection/

SC Historical Aerial Imagery Data Sources https://www.dnr.sc.gov/GIS/deschistaerial.html

SC Historic Properties Record http://schpr.sc.gov/

Southeast Aquatic Barrier Prioritization Tool https://connectivity.sarpdata.com/

SC Aquatic Plant Management Plan https://www.dnr.sc.gov/invasiveweeds/plan.html

Texas Dam Removal Guidelines https://www.tceq.texas.gov/assets/public/comm_exec/pubs/gi/gi-358.pdf

To access the Natural Heritage Database, visit: https://schtportal.dnr.sc.gov/portal/apps/sites/#/natural-heritage-program or email speciesreview@dnr.sc.gov

United States Geological Survey (USGS) National Map Viewer https://viewer.nationalmap.gov/advanced-viewer/

USGS Stream Stats https://streamstats.usgs.gov/ss/

USFWS National Wetland Inventory Wetlands Mapper https://www.fws.gov/wetlands/data/mapper.html

USGS Daily Streamflow Conditions https://waterdata.usgs.gov/nwis/rt

USGS National Water Information System Mapper https://maps.waterdata.usgs.gov/mapper/index.html

Utility Line Locator https://sc811.com

US EPA's Frequently Asked Questions on Removal of Obsolete Dams has information on water quality — water quality, grants and permitting information. https://www.epa.gov/sites/production/files/2016-12/documents/2016_december_2_clean_final_dam_removal_faqs_0.pdf

Vermont Dam Removal Guide https://dec.vermont.gov/sites/dec/files/wsm/rivers/docs/drw_usersguide.pdf

The Economic Contribution of Natural Resources to South Carolina's Economy https://www.dnr.sc.gov/economic/EconomicContributionsSC.pdf