HOLDING BACK TIME: HOW ARE GEORGIA'S HISTORIC DAMS UNIQUE RESOURCES?

by

MARK MOONEY

(Under the Direction of Wayde Brown)

ABSTRACT

Much of what we recognize as modern, urban, industrialized Georgia can be credited to the availability and development of water power. Historic dams, originally through direct mechanical drives and later through electrical generation and transmission, provided significant impetus for the growth of the state. Additionally, the scale, scope, effort, and ingenuity involved in the construction of large dams makes them awe inspiring structures. Despite their contribution to our culture, and the complex context surrounding their construction, dams are often overlooked as historic resources. This thesis studies historic dams from around the country to establish a context for examining Georgia's own dams. How are they unique resources, deserving of a discrete set of tools for preservation? Four Georgia dams are evaluated and suggestions are made based on the conclusions found.

INDEX WORDS: Dams, Historic Preservation, Industrial Archaeology, Hydropower, Hydroelectricity, Historic Survey, National Register, National Inventory, GNAHRGIS, Whitehall Dam, Eagle & Phenix Dam, Morgan Falls Dam, Tallulah Dam.

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TABLE OF CONTENTS

LIST OF FIGURES

Page

Chapter 1: Introduction

Traditionally, the historic preservation movement has focused on residential structures, designed gardens, and examples of high architectural style. Industrial structures tend to receive less attention than they may deserve despite the significant role they played in the formation of the present American landscape. Many large cities exist today because they were the site of early industrial development. Frequently, dams played a key role in the industrialization of American towns, especially prior to World War II. Dams provided consistent, reliable power for factories; first through direct, on-site generation, then later through alternating current lines stretching for miles from dam sites. The scope and effort required to fund, design, construct, and maintain a large dam necessarily involved more community members, landowners, businessmen, and engineers than a small residential or commercial project. Dams are also uniquely dynamic structures. Unlike a house, factory, or monument, which only sits *on* the land, dams are built *in* the land, and in direct opposition to a usually inexorable force; a river.

More than ten thousand dams in the United States, built between 1800 and 1940, still exist. Less than two hundred of them are listed on the National Register of Historic Places. Georgia alone has over two hundred dams built prior to 1940, but only one listed on the Register. In other states, where hydropower has played a significant role in development, State Historic Preservation Officers have created guidelines for determining the significance of historic dams to supplement the criteria of the National Register. Considering the diverse roles and impacts that dams played in the agricultural, industrial, economic, and social development of Georgia, how are they a unique challenge for preservationists, worthy of a discrete set of tools and guidelines?

This thesis examines dams built between 1800 and 1940 to determine how they are distinct resources and require a unique approach to preservation. Chapter One establishes a national context, through literature review, for the process of building a dam, including design, funding, construction, and maintenance or preservation. The contextual research includes dams built around the country during the specified time period, the impetus for their creation, and the visionaries responsible for their completion. Chapter Two is an inventory of Georgia's historic dams conducted through the National Inventory of Dams (NID), the National Register of Historic Places, the Historic American Engineering Record (HAER), and the Natural, Archaeological, and Historic Resource GIS (GNAHRGIS) databases. These databases represent a wide range of perspectives on the nation's historic dams, from federal emergency response to state historic resource preservation. Chapter Three examines four Georgia dams through the context provided in Chapter One to determine if local dams represent similar historic values. These case studies included site visits, historic research, and inventory research. Chapter Four looks at implications and challenges for the preservation of Georgia's historic dams and includes recommendations based on common criteria in other states with a strong historic hydropower component.

Chapter 2: National Context

Designing, financing, building, and maintaining dams is difficult under the best of circumstances. There is no generic answer for a dam, as the available resources and requirements at any given site are different, even for two sites on the same river. Geological and geographical factors play a strong role in the design of a dam, as they affect the shape of the structure, the materials necessary, and the eventual size of the finished project. The financial strength of the site owner or corporation allows for better design, materials, and construction procedures. Usage also plays a large part in the design of a dam, as the requirements of a small mill town are drastically different from the hydroelectric needs of a city such as Atlanta. Even once the construction is complete, climactic conditions and changing usage patterns impact a dam and must be considered during the continued operation of the structure. When a dam is no longer in use, other considerations develop. Often, historic dams represent significant commitments by their owners, operators, and the inhabitants of the area. The (frequently negative) environmental impact of historic dams has become alarmingly clear in the last decade, but this must be weighed against the value historic dams represent as massive and complicated structures with integral ties to many aspects of modern and historic culture[1].

[1] Environmental impetus for dam removal is increasingly common. See MSNBC, "*Largest dam removal aims to bring salmon back.*" Accessed February 3, 2012. http://www.msnbc.msn.com/id/44554709/ns/us_news-environment/t/largest-dam-removal-aims-bring-salmon-back/#.Tyw0zeTfWSo and, Kevin Colburn, "*Goodbye*

Recorded evidence of large dam building projects is evident in Egypt as early as 2900 BC. The oldest structure is a forty-nine foot tall masonry monster built to protect the city of Memphis from flooding. Archaeological remains of a thirty-seven foot tall earthen dam dating around 2700 BC are still present near modern-day Cairo[2]. While these structures are not typical, they do show that dam building and design has been carried out on a large scale for at least the last five thousand years. More common than massive river-spanning projects were "simple, often short-lived earth-and-wood diversion dams to direct irrigation water during flood season."[3] These structures were easier and cheaper to construct, often lasted several seasons, and were not difficult to repair or replace. At the same time, their small scale and the relatively small amount of water they controlled meant that design was not a critical element of construction.

Dating as far back as the late eighteenth century, many of the earliest dams in the United States were no more than ten to fifteen feet high, made of wood, earth, or some combination thereof, and used primarily for small-scale industry.[4] Little recorded evidence exists regarding any unique design of these dams, as they were likely haphazard structures built

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Dams, Hello South Carolina Whitewater." Accessed February 3, 2012. http://www.americanwhitewater.org/content/Article/view/articleid/30914/, and Steve Chawkins, "*On a divisive barrier, a snippy bit of graffiti."* Accessed February 3, 2012. http://articles.latimes.com/2011/sep/19/local/la-me-dam-scissors-20110919.

[2] Steven Solomon , *Water: The Epic Struggle for Wealth, Power, and Civilization*, (New York: HarperCollins, 2010), 31.

[3] Ibid, 31.

[4] Army Corps of Engineers, "National Inventory of Dams." Accessed January 16, 2012. http://geo.usace.army.mil/pgis/f?p=397:1:2169044086488407::NO.

using available materials with little thought given to long-term use and potential risk. Like the ancient Egyptian irrigation and diversion dams, eighteenth and early nineteenth century American dams probably showed little consistent design. Peter Molloy, an author and researcher on historic industrial sites, writes "...dams were small affairs of wooden cribs, frames, or even branches and tree trunks, seldom exceeding five feet in height. If a freshet breached or carried away such a dam, as often occurred, repair or replacement was fairly simple."[5] By the middle of the nineteenth century, however, this began to change. Large cities such as Boston, New York, and Atlanta, had much greater commercial and industrial needs than small, self-sufficient, geographically remote mill-towns.

The industrial revolution in the United States and in Europe saw a drastic increase in urbanization as small farmers moved to factory work to support their families. During the early 1800s, most factories served only local needs, relying on coal and steam or a small waterwheel for power. By 1860, the US boasted roughly 140,000 industrial businesses. Many of these were small neighborhood affairs.[6] By the turn of the century, there were over 200,000 industrial businesses, excluding those same neighborhood sellers.[7] A call for regular and available horsepower reflected an increasing demand for industrial goods such as textiles, lumber, and

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[5] Peter Molloy, "Nineteenth-Century Hydropower: Design and Construction of Lawrence Dam, 1845-1848," *Winterthur Portfolio*, 15, no. 4 (1980): 315.

[6] Some large scale dams were constructed in the United States during the first half of the Nineteenth Century. For e.g., Lowell Dam on the Merrimack River in Massachusetts (c. 1828). Also, Henry Latrobe was associated with several dam projects with complex canal systems in Philadelphia and Washington, DC.

[7] David Billington, Donald Jackson, and Martin Melosi, *The History of Large Federal Dams: Planning, Design, and Construction* , (Denver: US Bureau of Reclamation, 2005), 2.

leather. Small-scale waterwheels and steam engines were unable to meet this new level of demand. Increasingly, mill and dam owners looked for more efficient and powerful ways to run their engines. While industrial demand certainly helped fuel the growth in size and design complexity of dams, several other factors also contributed. A series of inventions and improvements on existing designs led to the large-scale hydroelectric dams now common around the United States. Prior to 1845, almost all dams used some variation of a vertical or horizontal drive-shaft type system to power the attached machinery. These drive-shafts relied on a large waterwheel or series of buckets (Figure 1). They were fairly inefficient, only utilizing a fraction of the wheel's rotation to provide power. Additionally, the use of a waterwheel mandated head heights of no more than twenty-five to thirty feet in most cases. Larger heads would necessitate massive and unwieldy water wheels, and were fragile and subject to frequent damage and costly repairs.[8] 1845 marked a turning point in dam design with the advent and rapid popularization of the reaction turbine. Turbines could utilize all the available head in a single drop and were much more efficient than waterwheels. The turbines themselves were also much smaller than waterwheels, so no massive structure was needed to house them. The development of the turbine made feasible the placement of dams on rivers and sites previously thought untenable because of topography or geology.[9]

[8] Molloy, 319.

[9] Duncan Hay, *Hydroelectric Development in the United States: 1880-1940*, (D.C.: Edison Electric Institute, 1991), 3.

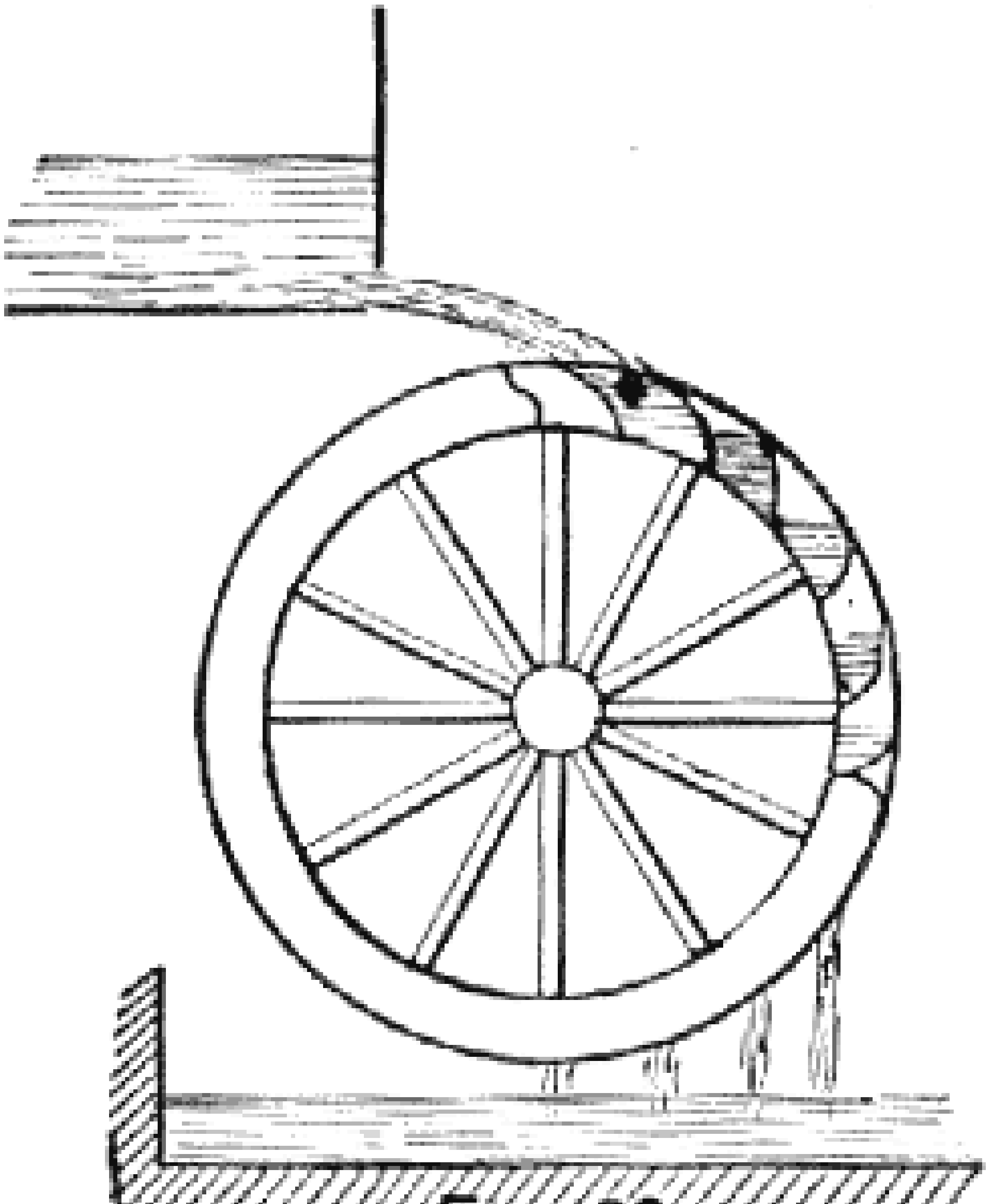

Fig. 82

Figure 1. Overshot water wheel diagram.

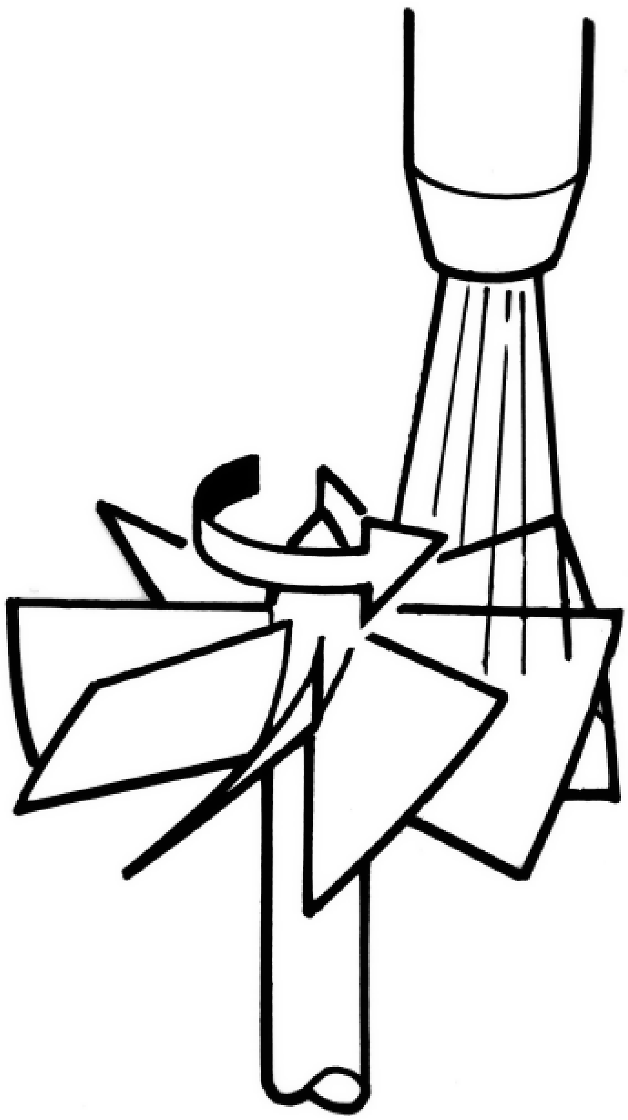

Figure 2. Reaction turbine diagram.

A popular view during the middle of the nineteenth century was that, "All waters of every free flowing river should be commandeered from its natural bed in economic service to the nation."[10] While there were less than fifty large dams in active service in the United States and Canada in 1880, over two hundred were recorded by 1889.[11] The reason for this dramatic increase in large dams was the advent and standardization of electrical generators. With the subsequent invention of alternating current lines in 1886 by Nicola Tesla, it was possible to generate electricity at a dam site and then transmit excess energy to distant markets. In 1895, the Niagara Falls plant began transmitting electrical current via Westinghouse's AC lines. This, more than any other development, spurred the exponential growth of hydropower and dam building. Developers and investors saw hydropower as an untapped, infinitely renewable and cheap resource, especially given the cost to acquire and transport the alternative: coal. Frequently referred to as "White Coal,"[12] hydropower received more attention in the United States than in Europe, where many viewed the developing industry, and the American interest, as backwards.

Dam sites which once powered a single mill or loom were increasingly used for several engines. Additional dams were constructed up and down the length of those rivers with

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[10] Solomon, 327.

[11] Thomason and Associates Preservation Planners, *National Register of Historic Places Eligibility Study of Seven Hydroelectric Projects in the Nantahala Area, North Carolina*, (Nashville: Thomason and Associates Preservation Planners, 2003), 1.

[12] Christopher Manganiello,. *Dam Crazy with Wild Consequences: Artificial Lakes and Natural Rivers in the American South, 1845-1990,* (Athens, University of Georgia), 68.

adequate flow in order to satisfy industrial demand. Frequently, the retention pool from one dam reached all the way upstream to the foot of the dam above it. More than simply increasing in number, dams also began to grow in scale, often spanning the width of large rivers in an effort to glean more horsepower. Increases in scale, more than anything, marked the need for a conscious design effort. The wooden crib dams of the past were relatively small and cheap to construct (Figure 3).[13] The amount of water they were capable of impounding, if released all at once, would not cause catastrophic damage downstream. Large dams were necessarily more expensive, complex, and risky in the event of failure.

Engineers in the mid-nineteenth century had multiple resources for inspiration and precedent when designing large dams. As early as 1850, there were multiple texts on the theory of dam building, though they were of dubious value for large dams of the sort necessary for hydropower projects.[14] Most of the dams American engineers had to draw inspiration from were relatively small compared to those they were asked to build for large hydroelectric projects. According to Hay, "Dam building enjoyed a long tradition in North American before the advent of hydroelectricity in the 1880s. Masonry, earth, and timber dams were common

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[13] Crib dams are dressed lumber structures filled with earth or rubble. They were cheap and relatively easy to construct, but limited in size by the nature of the materials used. Wikipedia. "Dams." Accessed April 8, 2012. http://en.wikipedia.org/wiki/Dam#Arch_dams.

[14] Early texts on dam building included John Smeaton's "Design for a Dam upon the River Coquet," (1776), Henry Moseley's *The Mechanical Principles of Engineering and Architecture*, (1840), and Ira. A Baker's *A Treatise on Masonry Construction* (1889). Molloy, 25. Garvin, 7.

and the principals of their design and construction were widely understood."[15] No precedent could totally apply to a new dam site because conditions and requirements always differed.

Figure 3. Timber crib dam.

[15] Hay, 45.

New projects used unique and novel combinations of extant and developing technology and applied a variety of engineering knowledge in order to satisfy the demands of site developers. Innovation was always subject to cost restrictions, so engineers were forced to design more with less whenever possible. Arch dams were common as they transferred much of the weight of the water evenly across the structure without requiring large amounts of raw materials (Figure 4). Buttressed dams used a series of massive buttresses to support a relatively thin main face (Figure 5). Gravity dams relied on the sheer weight of materials used in construction to resist horizontal and vertical motion(Figure 6).[16] Dam designers used a combination of these established styles to make cheaper, stronger, larger structures at lower cost. New designs also emerged. In 1903, Nils Frederick Ambursen patented a unique hollow dam with a sloped upstream face and a buttressed downstream face. Because the core of the Ambursen dam was hollow, very large structures could be built with a minimum of raw materials. John Eastwood furthered Ambursen's designs by incorporating multiple arches, requiring even fewer building materials.[17]

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[16] Arch Dams rely on a combination of gravity and one or more arches for strength. Typically, they are located at a site with strong canyon walls or buttresses for support. Buttressed Dams are very similar to Arch Dams, though they may not use an arched structure for strength. Gravity Dams are characteristically massive structures. For Gravity Dams, the weight of the structure itself holds back the water behind the dam. Megann Polaha. SimScience, "Cracking Dams: An Interactive Website for K-12." Accessed January 19, 2012. http://simscience.org/cracks/advanced/mintro.html, and Wikipedia. "Dams."

[17] Thomason and Associates Preservation Planners, 4.

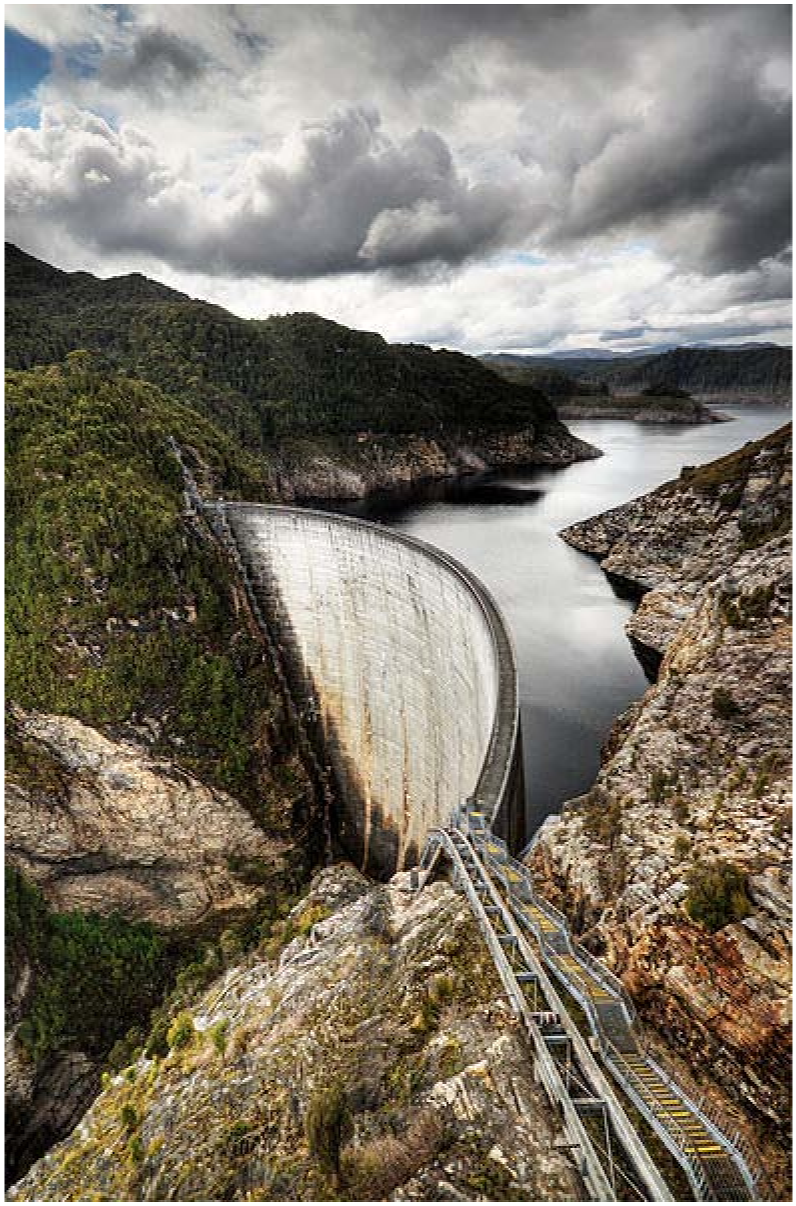

Figure 4. Arch dam

Figure 5. Buttressed dam.

Figure 6. Gravity dam.

Despite the long tradition of dam building in the United States, large dams were a new type of structure requiring extensive funding, new designs, and an international level of involvement from engineers and financiers. Many large dams were, at least at first, owned by small corporations on the leading edge of industrial development. Initially, these corporations were local affairs, funded by doctors, lawyers, small business owners, and other influential community members. From those small beginnings grew many large state-wide organizations still in operation today, including Alabama Power, Duke Power, and notably, Georgia Power. As an urban center, Atlanta owes much to the growth of the Georgia Power company and the development of the Morgan Falls Dam on the Chattahoochee River.[18] A.J. Warner, a founding member of the N. Georgia Electric Company and eventual member of the Georgia Power Company, said "With the exception of Buffalo, New York, there was no city in the country more advantageously situated with respect to the development of hydroelectric power than Atlanta."[19] Beginning in the 1850's, local developers in Atlanta formed partnerships with northern investors to examine the possibility of hydropower on the Chattahoochee. As Wade Wright, former Georgia Power Company historian, wrote

> These were men who had enough faith to embark upon the development of hydroelectric projects at a time when most people still looked upon the use of electricity for light and power as of doubtful safety and dependability, even when produced in plants located at the point of use.[20]

The early investors and founders of the Georgia Power company, like the men behind many hydrodevelopment projects around the country, were visionaries willing to take a risk on an emerging technology. S. Morgan Smith, for whom the Morgan Falls Dam is named, was one of the founding members of the company. Smith, originally a clergyman in Pennsylvania, left the practice for various health reasons. As a businessman, he worked with the York Manufacturing Company developing farm equipment and washing machines. Using that experience, Smith invented and perfected a turbine system for use in small mills. With the

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[18] Patricia Stallings, *Morgan Falls Project; 100 Years of Energy: Historic Hydro-engineering Report*, (Atlanta: Brockington and Associates, 2005), 16-17.

[19] Wade Wright, *History of the Georgia Power Company 1855-1956*, (Atlanta: Georgia Power Company, 1957), 110.

[20] Wright, 106-110.

successful turbine to his credit, Smith needed an opportunity to develop a hydropower site to employ the technology. A business associate informed him of the Bull Sluice site on the Chattahoochee river northwest of Atlanta. Smith almost immediately began the process of purchasing the site. An eventual partnership with a law firm and a real estate development firm led to the formation of the Atlanta Water and Electric Power Company.[21]

Similar stories were common nationally during the early development of hydropower. In California, large increases in population drove the demand for both dependable electric power and controlled water for irrigation. With some level of water management infrastructure already in place from the gold rush, California was primed for large dam projects. Wealthy Californians were an excellent source of funding for emerging sites. The Pacific Gas and Electric company relied on bankers, mine-owners, and politicians to bankroll their developments. Like the Georgia Power Company, the early investors in Pacific Gas and Electric had to take a chance on the potential of hydropower. According to Steve Hubbard, "Investors prospered because the rapid growth of California's population fueled a continuously increasing demand for electrical power. Like the construction of a modern day freeway, each powerhouse's capacity was oversubscribed the day it went on line."[22]

The support of burgeoning corporations provided legitimacy to the young hydroelectric industry. With funding secured, the construction process could begin. Site surveys evaluated

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[21] Stallings, 21-24.

[22] Steve Hubbard, "Hydropower in California," *Sacramento History: Journal of the Sacramento County Historical Society* , 6, no. 1-4 (2006): 226-227.

topography, surface and subsurface geology, and potential for future development. When a proper site was selected, engineers began the design process. Like the company owners, the engineers who designed and built large dams were unique men possessed of remarkable talent, experience, and drive. Often, the engineers and designers of large dams were educated at the finest schools around the world. After completing their formal education, a long apprenticeship followed, allowing the growing engineer to hone his skills while under direct supervision from an accomplished teacher. The result of this long process was a group of men capable of designing extraordinary structures under unique and challenging circumstances. More often than not the men selected were capable of designing successful large dams, many of which still stand.

The chief engineer of the Lawrence Dam (built 1845-1848, in Lawrence, Massachusetts), Charles Storrow, was the son of an English officer and a New Englander. Soon after his birth, Storrow and his family moved to Paris. He was educated there during his formative years before returning to New England as a teen. Storrow attended Harvard, graduating at the head of his class. He then returned to Paris, enrolling at the *Ecole nationale des ponts et chaussées*, Europe's top civil engineering school. He also attended lectures at the *Ecole polytechnique*. While in Europe, Storrow also spent time traveling to various engineering projects, observing and learning, sometimes as an apprentice. Returning again to the United States, Storrow became an assistant engineer on the Boston and Lowell Railway. He later worked as a consulting engineer for the Proprietors of Locks and Canals at the Lowell mill site. Summarizing his experience and readings from Europe, Storrow published *A Treatise on Water-Works*.[23] While the book did not directly address dams, it did represent a great degree of familiarity with civil engineering projects on an international level. The assistant engineer on the Lawrence Dam, Charles Bigelow, was a graduate of the United States Military Academy at West Point. The Military Academy was originally started to educate the Army Corps of Engineers and prepare them for any military or civil engineering project they might encounter.[24] Graduates of the academy were highly respected for their abilities; they frequently served as managers, designers, and chief engineers on major projects around the country.

John L. Savage was either the chief designing engineer or the consulting engineer on at least ninety-three dam projects during the early to mid-twentieth century. He was responsible for the design of the Hoover Dam, the Grand Coulee Dam, and early work on the abandoned Yangtze River Gorge Project. Savage's high school education was conducted at a private school taught by the aunts of Frank Lloyd Wright, who stressed classical studies. Upon graduation Savage went to the University of Wisconsin. He spent summers working as a surveyor for the United States Geological Survey. His senior thesis discussed methods for calculating stresses in hinged arches[25]. After his undergraduate work, Savage took work as an engineering aide for the United States Reclamation Service (USRS). It was during his time with the USRS that Savage first

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[23] Storrow, Charles. *A Treatise on Water-works for Conveying and Distributing Supplies of Water; with Tables and Examples*. Boston: Hilliard, Gray, and Co., 1835.

[24] Molloy, 320-323.

[25] Benjamin Rhodes, "From Cooksville to Chungking: The Dam-Designing Career of John L. Savage," *The Wisconsin Magazine of History*, 72, no. 4 (1989): 246.

worked on water management projects. There he found that civil engineering and its immediate and direct impact on humanity were a source of great personal pleasure. Savage was subsequently promoted to assistant engineer at the USRS, where he worked to design irrigation structures. He was soon promoted to engineer, where he was supervised by an already well-known engineer, Andrew Wiley. With Wiley, Savage began to design large dams throughout Idaho and Wyoming, developing a reputation for excellent and consistent work. In addition to designing large dam structures, Savage also developed a formula for accurately determining the stresses on the upstream surface of a dam. After proving himself on a number of large design projects, many of which were later constructed, Savage was selected to design the Boulder Dam, later renamed the Hoover Dam. Although Savage might not have had quite the international education that Storrow and some of his contemporaries did, he was well known among the dam design community. After presenting Savage with an award for distinguished engineering service, Bureau of Reclamation chief engineer Raymond Walter said, "I believe he is the most outstanding and widely known authority on high dams in the United States if not the world."[26] His long experience as a surveyor and designer allowed him to account for the unique features and requirements at each new dam site, creating simple, affordable, and above all effective dams.[27]

Construction of large dams was dangerous, expensive, and time consuming. As the scale of a project increased, calculating the physical requirements of the dam became more involved.

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[26] Rhodes, 265.

[27] Rhodes, 246-252, 265.

While the weight of water affecting a dam under normal conditions was well understood, large dams were subject to external factors like flooding, ice floes, and debris that had no effect on small dams. Impacts and higher than predicted volume could wreak havoc on large dams, subsequently releasing the water impounded behind them. Additional factors also applied to large dams. Uplift, caused by the force of water working underneath the dam, could physically lift the entire structure and overturn it. Masonry and concrete dams were also subject to water forcing its way inside the structure and weakening joints, essentially causing the structure to float. For large hydropower dams, initial cost often precluded any repairs or alterations. Early designers had one chance to create a successful dam.[28]

Completed in 1848, the Lawrence Dam took three years to construct. During that time, engineers and laborers created an arched masonry dam measuring 943 feet from one side of the river to the other. The height of the Lawrence Dam was set at thirty-two feet, so as not to flood the tailraces of the dam immediately upstream. The bed of the river was composed of extremely hard stone, allowing Storrow and his engineers to anchor the structure solidly on the bottom and along the river banks. Plenty of local materials were available for construction, which significantly reduced cost. In order to reduce the chance of uplift, Storrow included an embankment on the upstream face of the dam. He also required that all the masonry be set in hydraulic concrete to prevent infiltration of water into the structure. The construction of the entire project proceeded in stages. Because of the width of the river, it was impossible to divert the entire flow at once. By diverting a third of the river at one time, engineers could complete

[28] Molloy, 330.

one section, then allow water to flow over the newly finished piece while completing the next stage. Completed on November 19, 1848, Lawrence Dam has stood the test of time and water, needing only minimal repairs even after significant floods.

Figure 7. Postcard view, Lawrence Dam.

Essex Company civil engineer John Freeman wrote in 1888 that Storrow's dam "was built in a day when there were few precedents to guide the engineer in designing such a structure, and it stands today, so far as I know or can learn, the most magnificent mill dam in the world."[29] A large timber dam completed at the same time was destroyed the day it opened.

Construction of the Hoover Dam was one of the most massive undertakings of the early twentieth century. John Savage designed an engineering marvel that stood 726 feet tall and reached 1244 feet across the Colorado River. Capable of withstanding forty tons per square foot of pressure, the Hoover Dam is a gravity arch, overbuilt in case of a catastrophic flood.[30] Extensive survey work identified the ideal location in the Black Canyon of the Colorado. By using the existing walls of the Black Canyon as buttresses, Savage was able to significantly cut cost. Subsequent preparation established strong foundations to prevent any uplift of the completed structure. Unlike the Lawrence Dam's masonry faces, the concrete of the Hoover Dam is less susceptible to any water infiltration. The dam used more concrete than any structure previously built. Innovation on the construction site was especially crucial because of the amount of concrete used. If the entire structure had been poured at once, the changes in temperature would have prevented the concrete from setting properly. Instead, engineers poured independent rectangular blocks which were cooled by refrigerated water. After each block had set, the entire structure was grouted together (with more concrete) to form a monolithic whole. Despite the extensive amount of design, quality control, engineering, and

[29] Molloy, 333-343.

[30] Rhodes, 260-264.

labor involved in constructing the Hoover Dam, it was completed before schedule[31]. Because of the timing of the construction project during the Great Depression, the Hoover Dam was viewed as an excellent economic booster. Workers from around the country came to Arizona to work on the dam. While at the construction site, 112 lost their lives. The Hoover Dam, like many other hydropower projects, represents a combination of science and culture not seen in other types of construction. In the 1981 nomination to the National Register of Historic Places, Joan Middleton writes "By providing power, flood control, and irrigation waters, the dam... [had] far-reaching consequences...in the agricultural, industrial, and urban development of the Southwestern United States."[32]

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[31] United States Bureau of Reclamation, "The Story of Hoover Dam." Last modified 08/19/2005. Accessed January 24, 2012. http://www.usbr.gov/lc/hooverdam/History/storymain.html.

[32] Middleton, Joan. Bureau of Reclamation, "National Register of Historic Places Inventory-Nomination Form: Hoover Dam." Last modified 5/31/1985. Accessed January 24, 2012. http://pdfhost.focus.nps.gov/docs/NHLS/Text/81000382.pdf.

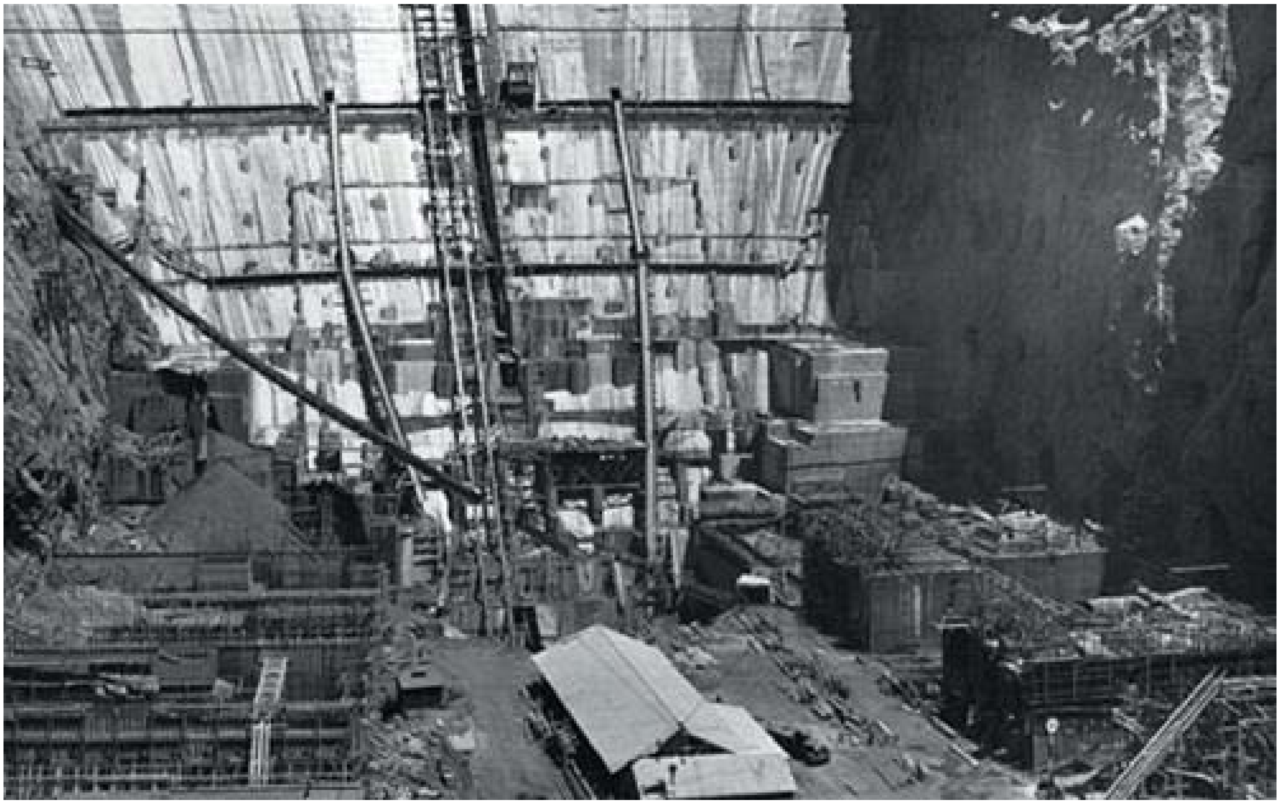

Figure 8. Hoover Dam construction.

If a residential structure, built of wood, brick, or stone is damaged, it is typically easy to repair. Access is not an issue, no water must be diverted, no generators must be taken off-line. Dams are difficult to repair. They are massive structures, half-submerged, tall and lengthy. Unlike residential structures, well-made dams rarely need major repair. Because dams must be built to withstand constant water pressure and erosion, possible floods, ice, and debris impacts, many operate for more than one hundred years. Duncan Hay, an employee at the National Park Service Boston Support Office and a former researcher and author for the Edison Institute, writes, "Hydroelectric plants are remarkably durable; few other classes of industrial facilities have such a large portion of their number in production after more than half a century."[33] Most historic dams have experienced little change since they day they went on-line; other than routine maintenance, little upkeep is required. The National Inventory of Dams (NID), maintained by the Corps of Engineers, tracks dams with heads higher than six feet. Their database lists more than ten thousand dams in the United States built between 1650-1940 that are still standing.[34] Though the use of many of these dams has changed, the fact remains: historic dams are integral features of the American landscape and require unique measures for preservation. In an article for Preservation Magazine, author Wayne Curtis argues, "Dams should be preserved not just as elements in pleasing landscapes. Those that mark the ingenuity of our earliest engineers should be preserved for future generations to study and admire."[35]

To determine whether a property is of significant historic value, the National Register of Historic Places examines four main criteria, which state:

> The quality of significance in American history, architecture, archaeology, engineering and culture that is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and
>
> (a) That are associated with events that have made a significant contribution to the broad patterns of our history; or

[33] Hay, 134

[34] National Inventory of Dams, interactive database.

[35] Curtis, Wayne. "Going with the Flow." *Preservation Magazine*, July-August 2003.

(b) That are associated with the lives of persons significant in our past; or

(c) That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) That have yielded or may be likely to yield, information important to prehistory or history.[36]

These criteria fail to adequately address the cultural, economic, and scientific benefits of dam building.

In addition to the national criteria, some states, particularly those with a long history of waterpower, have elected to create supplemental guidelines for determining the significance of their historic dams. These guidelines typically seek to establish a hierarchy among extant historic dams in order to determine relative value.[37] An increasing call for removal of defunct dams has led to a need for prioritization.

[36] Andrus, Patrick. National Park Service, "How to Apply the National Register Criteria for Evaluation." Last modified 2002. Accessed January 24, 2012. http://www.cr.nps.gov/nr/publications/bulletins/nrb15/.

[37] Serena McClain, Stephanie Lindloff, and Katherine Baer, *Dam Removal and Historic Preservation: Reconciling Dual Objectives*, (Washington, DC: American Rivers, 2008), 13. This document is one of the few up-to-date and widely available reports specifically on preservation issues and dams.

The NID monitors 367 dams in the state of Vermont. Of these, 197 were completed prior to 1940.[38] For a small state where water power has a distinct and prominent role in the development of industrial and urban centers, the National Register criteria have not been adequate to determine value. In addition to the four Register categories, Vermont also addresses how long a dam has been in its location, the extant historic environment around the dam, the features and structures associated with the dam, the physical characteristics of the dam, the age of the dam relative to others from the same period, and the integrity of the dam. The State Historic Preservation Office (SHPO) has also developed a series of mitigation options beyond those recommended by the National Register. These include extensive documentation, feasibility studies, assistance for site owners, moving decommissioned buildings to other locations, preservation easements, off-site mitigation, and a range of other public benefits.[39]

Pennsylvania practices a more reserved approach to evaluating historic dams. In general, the Commonwealth of Pennsylvania has been very active about removing historic dams in order to improve fish access and sediment transport via natural river channels. Most of the dams that are considered eligible for the National Register in Pennsylvania are mill sites. If most of the historic context of the dam, including mills and raceways, are intact, the SHPO recommends minimizing adverse effects. While the SHPO also considers dams with less intact context, they are not given as much weight.[40]

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[38] NID, interactive report. Accessed January 25, 2012.

[39] McClain, Lindloff, Baer, 48-49.

[40] Ibid, 49-50.

California hydropower projects tend to be larger in scale and more remote than many on the East Coast. As a result, removal of these dams tends to be more expensive, leading to strict evaluation of the removal process. While much of the additional consideration given dam removal is related to the California Environmental Quality Act and the California Public Resources Code, there is a growing amount of attention given to the historic nature of dams. Unlike many states, California has no minimum age for a historic resource. Additionally, California legislature addresses "modern landscapes reflecting the aesthetic values, technological developments, and rapidly changing and diversifying cultures of the mid-twentieth century." This wording allows for a significant increase in the protection of historic dams beyond that provided by the National Register.[41]

Where Vermont, Pennsylvania, and California focus directly on the value of historic dams, Wisconsin approaches their preservation in a more roundabout manner. The aim of the Wisconsin Historic Society/SHPO is to protect submerged cultural resources in the event of a dam removal. Though this language does not address the historic dam adjacent to the potential submerged resource, the wording of the SHPO criteria does indirectly protect the dam site.[42]

Dams reflect the American industrial movement from the early 1800s through the start of World War II. Like residential and commercial structures, there are unique styles and examples of dam design and construction. Unlike small residential structures though, dams represent the risks and innovations on a large scale. The collaboration of owners and financiers,

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[41] Ibid, 51.

[42] Ibid, 52.

the vision of engineers and designers, the determination of the construction crews; all are evident in the massive masonry, concrete, and steel structures still standing (and operating) after more than one hundred years. While historic dams do fall under the jurisdiction of the National Register and its criteria, there are more stringent measures in place in some locations. According to the American Society of Civil Engineers, by 2020, eighty-five percent of American dams will be older than fifty years[43]. This fact warrants consideration on a national level and at home in Georgia. The following chapter examines some of the inventories of historic dams on national, regional, and state levels. Georgia dams are listed along with context for each inventory.

[43] Ibid, 6.

Chapter 3: Inventory of Georgia Dams

Over the next ten years the United States will see a massive increase in the number of historic dams, from around twenty-five percent of total dams to roughly eighty-five percent. To properly manage these new resources, it is important to establish guidelines for identifying and evaluating dams and their relative value. A number of databases on national, regional, and state levels document both modern and historic dams for various reasons. Valuable conclusions regarding usage, building materials and methods, and current condition can be extracted from these databases. There are more than two hundred historic dams in Georgia according to the National Inventory of Dams. Few of these are listed by any other database, despite their significant contributions to the growth of Georgia's economy and the development of many of the state's urban centers. In order to determine how Georgia's historic dams are valuable resources, and how many still exist, this chapter will examine the National Inventory of Dams (NID), the National Register of Historic Places (NRHP), the Historic American Building Survey and Historic American Engineering Record (HABS/HAER), and the Natural, Archaeological, and Historic Resources GIS of Georgia (GNAHRGIS).

More than 84,000 large dams around the country are catalogued in the National Inventory of Dams. Authorized by Congress in 1972, the first publication of the NID arrived in 1975. Since that time, the NID has seen regular updates and consistent funding under the

Water Resources Development Act of 1996. The Army Corps of Engineers, the managing organization of the NID, uses the database to track and detail dams considered to be 'high-hazard'. This classification is based on a number of factors, including potential loss of life in the event of failure, possible property or environmental destruction, head height, and storage capacity. The NID pulls information from a variety of sources including state and federal construction and regulation offices. As part of a national effort to standardize safety efforts, even privately owned dams are frequently licensed or monitored under government programs. These programs use a standard set of NID codes to document each dam then submit the information for periodic updates to the inventory.[44] Data submitted to the NID includes; Dam name, year completed, owner type, primary purpose, dam type, river, county, year modified, height, and designer name, among many other points. The inventory includes graphical depictions of national, state, and local dam locations, as well as a database with user-defined parameters.

The NID lists 4606 dams in Georgia; of these, 264 were built prior to 1940.[45] These 264 historic dams represent a wide range of construction materials, sizes, primary usage, and owners/operators types. Nearly seventy-five percent (188) of Georgia's historic dams are now used for recreation. Despite their current usage, many of these recreational dams bear names like Thompson Millpond Dam or Watson Millpond Dam, implying more traditional original uses. According to the Federal Emergency Management Agency's website, a recreational dam

[44] NID, Introduction.

[45] Many of the dams in Georgia listed on the NID are privately owned earthen structures. Construction dates for these dams range from 1811 to present.

provides "prime recreational facilities throughout the United States. Boating, skiing, camping, picnic areas, and boat launch facilities are all supported by dams."[46] These recreational dams are the most common, both in the state and nationally. However, many newer recreational dams may be also used for multiple purposes, including irrigation, water supply, and flood control. Hydroelectric dams account for only thirty-one of the total in Georgia. Most of these are owned by public utilities, often the Georgia Power Company. Thirteen dams are categorized as "Fire Protection, Stock, or Small Fish Pond."[47] Four are used to create fish and wildlife ponds. Two dams are designated for flood control. Five are for irrigation, one for navigation, and eleven are listed as "other." Because the NID is concerned primarily with the possible hazards of dam failure, the information provided by their database is relatively unhelpful, at least from a preservation standpoint. However, the NID is a more comprehensive research tool for dams than any other database, and does serve as an excellent starting point for further historic survey.

The Historic American Engineering Record (HAER) was initiated in 1969 under the direction of the National Park Service. Early versions of HAER, along with sister project the Historic American Building Survey (HABS, initiated 1933), were created to provide work during the Great Depression as well as to document the increasingly historic American material

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[46] Federal Emergency Management Agency, "FEMA: Benefits of Dams." Last modified 09/11/2010. Accessed January 30, 2012. http://www.fema.gov/hazard/damfailure/benefits.shtm.

[47] NID, Interactive Database.

landscape.[48] Combined, HABS, HAER, and the Historic American Landscape Survey (HALS, 2000) have documented nearly forty thousand resources since the start of the program. Searching the HABS/HAER database for "dams" produces 9730 results, though these include multiple entries per resource as well as resources indirectly associated with dams.[49] 750 are complete surveys. Results include measured drawings, large format black and white photographs, and written survey documents. Narrowing the search further to "Georgia Dams" produces 115 results. Only twenty of these results are considered complete surveys by the website.[50] There is no differentiation between types of dams, usage, or any other characteristic as listed on the NID. The focus of HABS/HAER is simply documentation of historic resources in their present condition. While some dam surveys listed on the HABS/HAER database include extensive photographs, drawings, and written history, other sites are represented by only a few pictures with no written background. This inconsistency from one resource to the next makes HABS/HAER beneficial but haphazard.

[48] National Park Service, "Heritage Documentation Programs: About Us." Last modified 06/17/2011. Accessed February 5, 2012. http://www.nps.gov/history/hdp/about.htm.

[49] Library of Congress, "Historic American Buildings Survey/Historic American Engineering Record/Historic American Landscapes Survey." Accessed February 7, 2012. http://www.loc.gov/pictures/search/?q=dam&co=hh.

[50] Library of Congress. HABS/HAER. Accessed February 9, 2012.

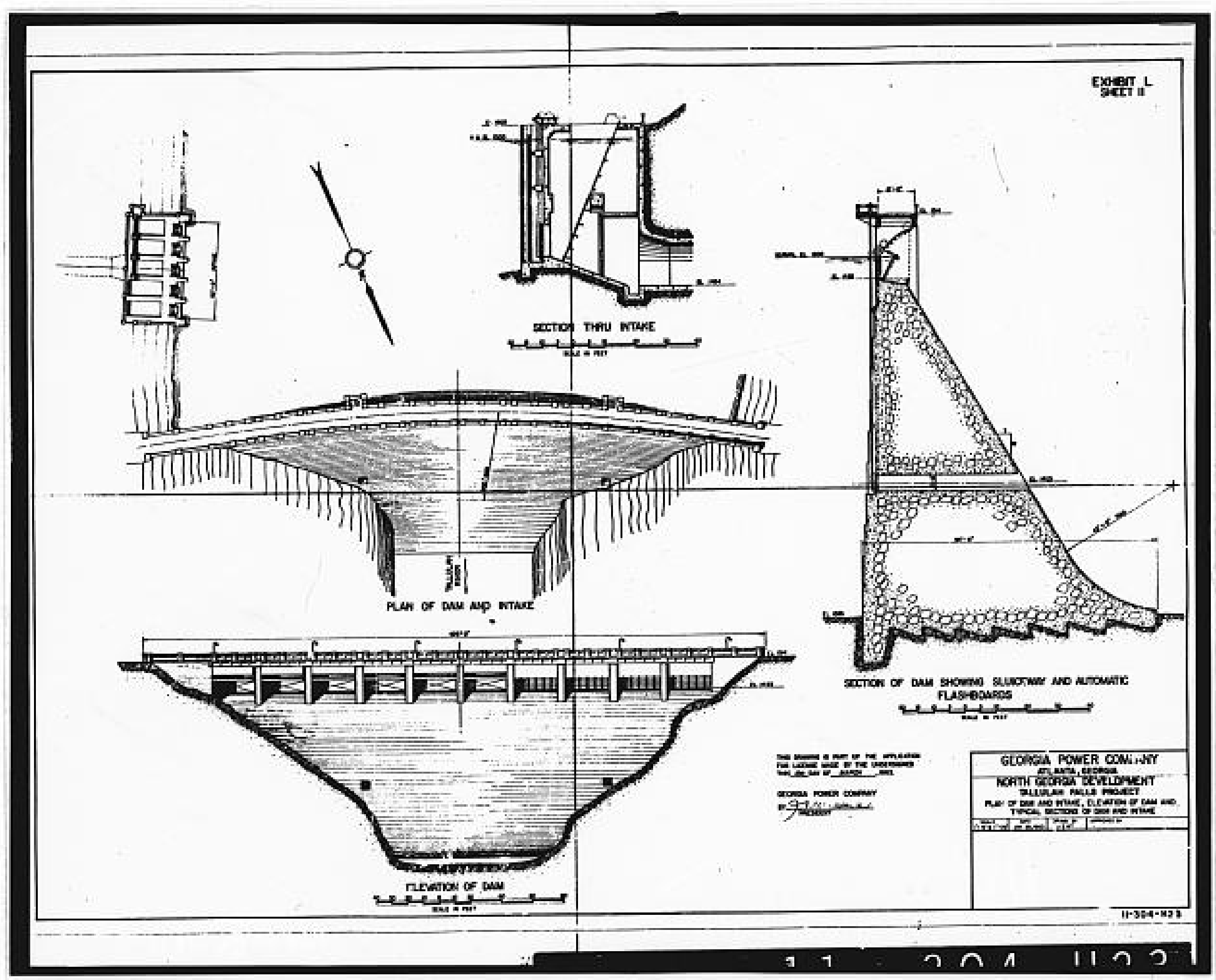

Figure 9. HABS/HAER measured drawings, Tallulah Dam.

Like HABS/HAER, the National Register of Historic Places (NRHP) is administered by the National Park Service. Created in 1966 as part of the National Historic Preservation Act, the NRHP includes resources nominated by local, state, and national organizations.[51] These

[51] National Park Service, "National Register of Historic Places Program: About Us." Last modified 06/13/2011. Accessed February 7, 2012. http://www.nps.gov/nr/about.htm.

resources include residential, commercial, and industrial structures and sites, cultural landscapes, and archaeological sites. The same broad criteria are applied to any resource on the register, regardless of type. More than eighty thousand resources and 1.4 million structures are currently listed on the NRHP. Only 186 of these resources are dams and associated structures. Vermont, known for its efforts preserving dams, has two listed on the Register. California has five, Pennsylvania lists eighteen, and Wisconsin has seven dams.[52] Georgia has only one listed; the Mayo's Bar Lock and Dam near Rome.[53] Unfortunately, the National Register has only recently begun converting its database to a digital format. Many of the resources listed on the Register are only available in hard copy on site.

The NID, HABS/HAER, and the NRHP are all national databases for documenting and tracking structures for various reasons. Because of the scope of a national-level database, inclusion of resources is often limited by budget, staff, or participation from smaller organizations. State level databases do not exhibit the same scope and are therefore able to include a broader representation of resources particular to the region. Created via a partnership between the Georgia State Historic Preservation Office and the Georgia Archaeological Site File at the University of Georgia, Georgia's Natural, Archaeological, and Historic Resources Geographical Information System (GNAHRGIS), is a continuously updated

[52] Vermont's NRHP dams are the Ascutney Mill Dam and the Green River Crib Dam. California's dams include Barker Dam, Boca Dam, Lake Tahoe Dam, and the Old Mission Dam. Pennsylvania's Registered dams include the Allegheny River Lock and Dam, the Austin Dam, Davis Island Lock and Dam, Greenwood Lake Dam, Halfway Lake Dam, and the Parker Dam. Wisconsin dams include Cedars Lock and Dam, De Pere Lock and Dam, Little Kaukauna Lock and Dam, Menasha Dam, Mondeaux Dam, Rapide Croche Lock and Dam, and Round Lake Logging Dam. NRHP.

[53] National Park Service. NRHP. Accessed February 9, 2012.

database of historic and archaeological resources. GNAHRGIS is available to archaeological and historic resource professionals and, with limited access, to the general public.[54] GNAHRGIS contains nearly eighty thousand resources, many with multiple contributing structures. There are eighty-seven listings under the "Industrial/engineering: Waterworks/reservoir/dam/water tower/canal" category on GNAHRGIS but only nineteen of these are dams and associated structures.[55] The GNAHRGIS database is built on information from field surveys; each resource is detailed in a series of short responses or blanks. These descriptions include location information, some historical context when available, and physical descriptions of the resource and its condition. Surveyors for GNAHRGIS typically include both professionals and students, so there is a great amount of inconsistency between different resources. David Cullison, a former surveyor at the Georgia State Historic Preservation Office, surveyed many of the nineteen dams present on GNAHRGIS. Because of the attention to physical detail in Mr. Cullison's reports, it is likely he had some experience evaluating dams. There are several dams on GNAHRGIS, submitted by other surveyors, that are not presented in the same amount of detail.

Very few of the dams in any one database are also present on any other database. There are likely several reasons for this.

- The diverse uses for each database limit the resources represented by that database. The NID is used solely to track dams and their potential hazards with

[54] Georgia's Natural, Archaeological, and Historic Resource GIS (GNAHRGIS), "Welcome to GNAHRGIS." Accessed February 9, 2012. https://www.itos.uga.edu/GNAHRGIS/.

[55] GNAHRGIS database. Accessed February 9, 2012.

no focus on preservation. The National Register and NARHGIS are preservation-oriented but both databases track a wide range of resource types without emphasis on any one type; each database also addresses a different scope. Like the National Register, HABS/HAER document resources nationally, but include a variety of resource types.

- Because of the varied uses of each database, the surveyors for each system have a range of expertise. Historic resource survey tends to focus on residential and, to an extent, commercial structures. Industrial structures are frequently ignored or inaccessible. Many historic preservation education programs do not address industrial resources in great detail; graduates are not often prepared to survey dams, mills, factories, and other such resources.
- 215 of the 264 historic dams in Georgia are earthen structures, composed of stone, gravel, dirt, and sometimes covered in sod.[56] The result of this, especially for smaller dams, is that the structures might be mistaken for natural features of the landscape. On private property, in rural areas, or if there are no auxiliary structures present, a surveyor might overlook an earthen dam without realizing it.

Georgia has 264 dams built prior to 1940 listed on the most comprehensive database, the NID. Since the NID is not focused on historic value, this number is of limited benefit.

[56] NID interactive database. Accessed February 9, 2012.

Between the HABS/HAER, the NRHP, and GNAHRGIS, only forty dams are documented with attention to historic significance. Many of them are now used for purposes other than originally intended. Some of these resources have changed significantly, no longer retaining their historic integrity. Those that remain represent a cross section of types, styles, sizes, and usages. While no consistent style is evident across historic dams, many of them exhibit certain characteristics common to large dams. More importantly, they represent a period of industrialization and innovation that drastically changed the shape of the American landscape. The designers, financiers, and builders of Georgia's large historic dams were powerful and influential men. The following chapter examines four dams around the state that mark the confluence and evolution of technology, business, and industrial drive in Georgia.

Chapter 4: Case Studies

Despite a rich agricultural and industrial heritage and a rapidly expanding urban environment, little attention is given to Georgia's historic dams and the role they played in the development of the state as it is now. Many of the dams built from 1800-1880 are gone or no longer used for their original purpose. Bearing names suggestive of their primary use, these old mill dams more often create small recreational lakes or fish ponds or maintain water supplies. These mill dams represent a transitional period in Georgia's, and the entire South's, growth from agricultural backwater to industrialized power. Some, like the Whitehall Dam in Athens, are still standing, though no longer in active use. Later dams, built between 1880-1940, still generate electricity with only minimal changes to their original form. Of these, the Morgan Falls dam in Atlanta is a prime example of the role dams played in creating large urban centers as we recognize them today. Tallulah Dam, near Clayton, represents a unique engineering challenge because of its head height, the topography of the site, and the distance from urban centers necessitating transmission of electricity off-site. Finally, the Eagle-Phenix Dam is a large dam built during the middle of the 19th century amidst the extraordinary development of the textile industry in Georgia. Later alterations and upgrades at Eagle-Phenix, along with Morgan Falls and many other dams from the period, represent increasing demand for regularly available electricity, the incredible growth of the public utility industry, and the omnipresent Georgia Power Company.

Whitehall Dam was selected as a case study because of its proximity to Athens and the University of Georgia, the role it played in the early development of the textile industry and subsequent electrical generation, and the complete lack of preservation effort at the site despite ownership by a large public entity. The Eagle-Phenix Dam was selected because of its early construction date, the large river it spanned and the size of the dam itself, the importance of the dam in the growth of Columbus and the textile industry, and the extensive documentation process it received prior to demolition. Morgan Falls was selected because of the method of construction, its proximity and importance to Atlanta, the historic value of its namesake, S. Morgan Smith, its continued use by the Georgia Power Company, and the preservation efforts at the site by Georgia Power. The Tallulah Dam was selected as a case study because of the unique solutions for utilizing all of the available drop at the site without compromising the natural beauty of the gorge, the early application of electrical generating and transmission technology, the continued operation and generation of power at the site, and the preservation and interpretation at the Jane Hurt Yarn Museum in the adjacent state park.

Figure 10. Georgia map with major rivers, case studies marked in bold.

Whitehall Dam. Clarke County.

Early dam construction (1800-1880) in Georgia was primarily in response to a burgeoning textile industry. Mills and factories needed constant power and the streams and rivers around the state, especially along the fall line, met this requirement. The forks of the Oconee River, in Athens, were the site of at least three large dams.[57] Charles Strahan, author of *Clarke County, GA and the City of Athens*, describes Barnett's Shoals, Athens Shoals, and the shoals at the Georgia Factory (later called the Athens Manufacturing Company), now the site of the Whitehall Mill and Lofts. The Georgia Factory site, Strahan describes, was

> Located in the centre of the town of Whitehall, and owned by J.R. White and others; five and one-half miles from Athens and 3/4 mile from [the] depot of Whitehall. Now utilized by a cotton factory, with turbines yielding 300 H.P. Fine dam and race 1/2 mile long; also a grist mill run by [the] same race."[58]

Whitehall Dam has not been used for over twenty years. Records on the structure are scarce; access to the dam is controlled, and restricted, by the University of Georgia's Warnell School of Forestry. Literary references typically focus on the factory powered by the dam and the effect textile production had on Athens and Georgia as a whole. The dam is listed on GNAHRGIS. Additionally, the Athens Manufacturing Company is on the National Register of Historic Places. Despite a dearth of direct information, some inferences and conclusions can be made about Whitehall Dam and its significance. While a case study with little available information seems counterproductive to this thesis, the site is an excellent example of how

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[57] Charles Morton Strahan, *Clarke County, GA. and the City of Athens*, (Atlanta: Chas. P. Byrd, 1893), 35-39.

[58] Ibid, 35.

Georgia's historic dams are unique and significant resources. Additionally, the lack of preservation efforts at the site illustrate how little attention is paid to historic dams.

John White was brought to Athens in 1837 to manage the Athens Manufacturing Company Factory at Whitehall. By the early 1850s, White had acquired the factory and the land surrounding it. The growing town of Whitehall had a post office, a store, and housing for the factory workers. The original mill at the site was replaced with a brick structure in 1854 which housed 1704 spindles and twenty looms.[59]

[59] Whitehall Mill, "History of Whitehall Mill." Accessed March 1, 2012. http://www.whitehallmill.com/History_of_WHM.html.

Figure 11. Seal of Whitehall Mill depicting dam and mill structures.

This expanded production capacity was necessitated by the massive amount of cotton grown on plantations around Athens. The new mill was powered by a masonry dam. GNAHRGIS describes the dam as one of the first privately owned generators of electricity; this power generation likely did not happen until the very late 1800s or even the early 1900s. The designer of the dam is not listed on GNAHRGIS.

The construction date listed on the GNAHRGIS survey form is circa 1910. Mr. Cullison conducted the survey; he describes the dam thus:

> Concrete gravity dam, with ogee section. Spillway at north end, open overflow gate near south end. Top two feet of the dam is constructed of stone, perhaps as an early addition. Stone foundations at either end of the structure, though most of the foundation is concrete. South wall of the spillway is a concrete curtain wall with buttresses. Spillway is mostly dry. Stone and concrete platform at the south end, possibly a foundation.[60]

Because the original dam was constructed of masonry during the 1850s, it was likely either completely rebuilt or significantly updated for power generation. The stone foundations Cullison noted might be remnants of the original masonry structure.

Although the architectural details regarding Whitehall dam are scarce, its importance as a historic dam is clear. The establishment of Georgia's position as a textile power was largely a result of the availability of hydropower along the fall line. As early as the 1840s, Whitehall Dam was powering looms and spindles. The dam and factory, under a succession of owners, continued to run until 1988. Direct mechanical power, later substituted by electrical generation and transmission, allowed factory owners to convert large amounts of raw cotton to finished cloth ready for distribution.

[60] David Cullison. Georgia Historic Resources, "GNAHRGIS: Whitehall Dam." Last modified 1992. Accessed March 1, 2012. https://www.itos.uga.edu/GNAHRGISjsp/historic/queryResource.jsp?resource_id=2952.

Figure 12. Upstream face of Whitehall Dam.

Since it closed down in 1988, Whitehall Mill and Dam has undergone a series of changes. The mill structures have been converted to high-end residential loft spaces. The dam itself has fallen into disrepair. Visiting the site is difficult. The dam is located on 840 acres at Whitehall Forest, which is owned by the Warnell School of Forestry and Natural Resources at the University of Georgia.

Figure 13. Current usage of Whitehall Mill.

Figure 14. Current condition of Whitehall Dam.

The lack of information about Whitehall Dam, limited access to the site, and the demolition by neglect occurring at the site are telling: despite its importance in Athens' history, there is no current effort at preservation. Potential uses and treatments for the site are manifold. The expansive forested area demands public access; a park, hiking and biking trails, even a small museum would be beneficial. Interpretive panels like those present at Morgan Falls and

Tallulah Dam would provide context for the remains of the dam, tailraces, and mill building still present on the site.

Eagle-Phenix Dam. Muscogee County.

The Chattahoochee River, from its headwaters in the Blue Ridge Mountains to its confluence with the Apalachicola River near the southwestern corner of Georgia at the Florida border, is shaped and managed by a series of large dams (Figure 10). Many of them have been in place for a hundred or more years. In the city of Columbus, the Eagle-Phenix Dam was one of the earliest of these large structures. Eagle-Phenix Dam was built to support a flourishing textile industry and commerce-based economy in Columbus. Built at the fall line, the dam at Eagle-Phenix harnesses a significant and consistent source of power. Its designers and financiers created a structure that, with some modifications, is still capable of generating power today. Now in the early stages of demolition, the Eagle-Phenix Dam is nonetheless representative of the transition Georgia experienced from agricultural power to industrial and commercial activities.

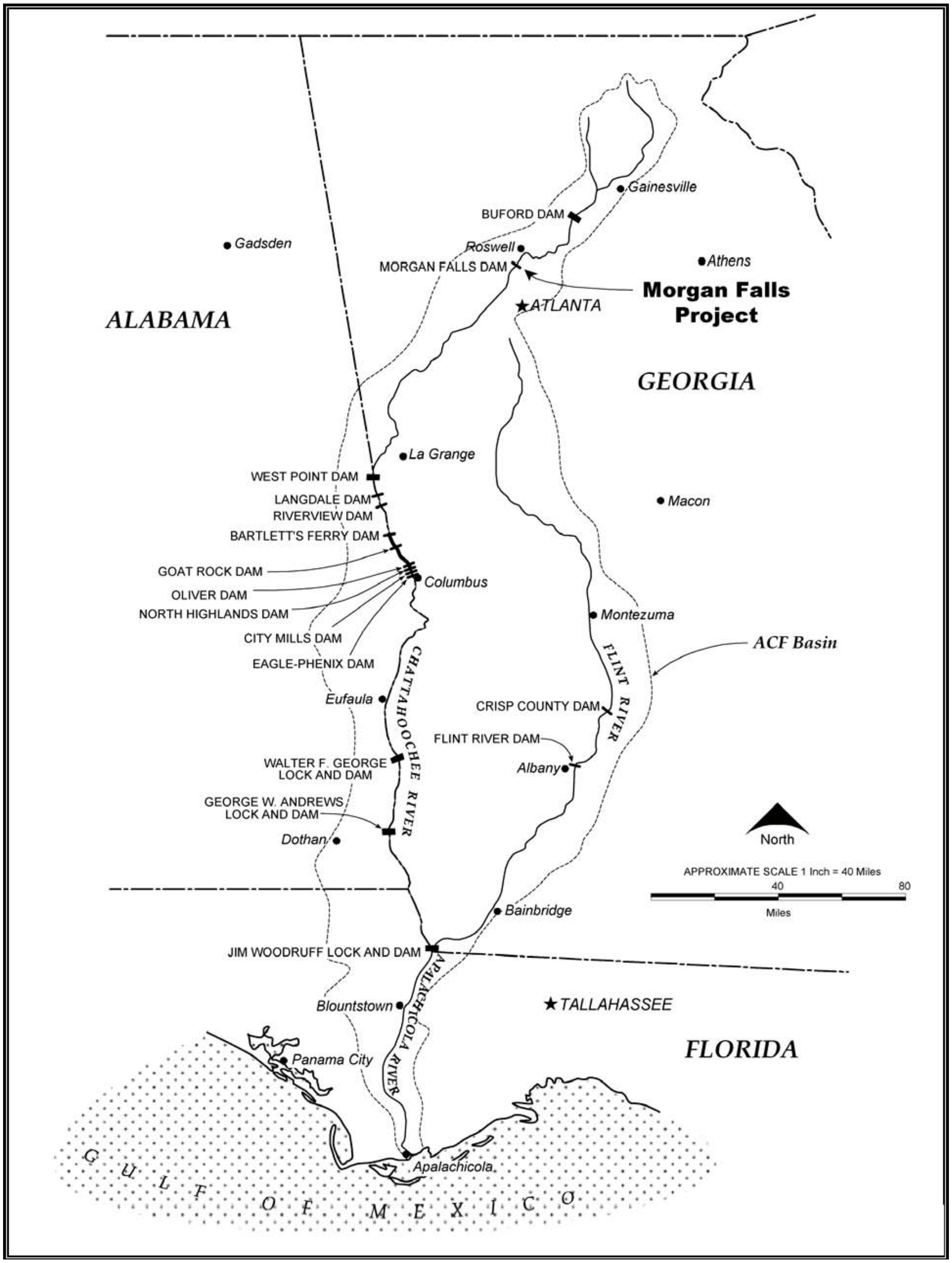

Figure 15. Map of dams on Chattahoochee River.

The Chattahoochee River, which runs through the center of Columbus, supplied power to the growing business as well and provided a consistent means of transporting raw and finished goods up and down stream. By 1840, textile mills along the river's edge were using diverted water to power their engines. These early efforts to harness the power of the Chattahoochee were usually crude affairs constructed of wood and earth, intended for relatively short term use.[61] Recognizing the potential value of hydropower to the textile industry, city managers began a concerted effort to dam the river. A series of land sales, based on provisions for a future dam on site, followed within two years. 1844 saw the first dam constructed, though the structure only reached partway across the river. Developing waterpower resources attracted more factory owners, culminating in the construction of the Howard and Eagle Factory near the site of the present day Eagle-Phenix Dam. The first iteration of the Eagle Dam, a wooden structure, was completed in 1850.[62] Further improvements at the dam were likely minor and sporadic until the end of the Civil War. During Sherman's March to the Sea, the Eagle Factory, along with many others in Columbus, was burned.

The destruction of many of the factories did little to deter the industrial movement in Columbus. Because the Chattahoochee was still a constant source of power, factories were soon rebuilt. To meet the renewed demand, the renamed Eagle-Phenix Dam was strengthened

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[61] Ibid, 3

[62] Ibid, 6.

and repaired in 1869.[63] Large timbers were bolted to the granite bedrock of the river to serve as a foundation for a new wooden dam. A large rock wall was also built to separate the main river channel from the tail race of the dam.[64] Despite the repairs and improvements to the dam following the Civil War, the Eagle-Phenix Dam could not keep up with demand from new factories. It was therefore upgraded from wood to masonry in 1882. The Chief Engineer for the Eagle Company, John Hill, designed the new stone dam. The project supervisor was Major D.W. Champayne, who was also responsible for the construction of the Georgia State Capitol Building.[65] Unlike many other large dams along the fall line, Eagle-Phenix was not designed with any measures to control or maintain a constant flow. The dam was only intended to amass the total divided drop of the rapids in the area into one large falls. No flashboards were ever installed at Eagle-Phenix, nor is the water above the dam significantly deep like many other artificial ponds above dams (Figure 16).[66] Upon completion of the project, company officials at the Eagle Factory reported "Our water power is now permanent subject to little or no repair in the future."[67]

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[63] The Eagle Factory and Eagle Dam were renamed following the Civil War. Eagle-Phenix was meant to be inspiring, representing a return to power by the company. Eagle & Phenix Historic Riverfront Living, "A Brief History of EAGLE & PHENIX 1851 through 2005." Accessed February 27, 2012. eagleandphenix.com/about/.

[64] John Lupold, J.B. Karfunkle, and Barbara Kimmelman, *Eagle and Phenix Mills, 1868*, (Washington, D.C.: Historic American Engineering Record, 1977)http://lcweb2.loc.gov/pnp/habshaer/ga/ga0200/ga0292/data/ga0292data.pdf (accessed February 27, 2012), 18.

[65] Lupold, Karfunkle, Kimmelman, *Water Power Development at the Falls of the Chattahoochee, 1828*, 10.

[66] Flashboards are vertically adjustable wooden panels installed at the top of some dams allowing adjustment of the head height and amount of water retained by the dam.

[67] Ibid, 8.

Figure 16. Flashboards atop a masonry dam.

At this point, the textile mills relying on the Eagle-Phenix Dam for power still used direct-drive mechanical systems to power their looms. The advent of electricity in 1880 saw the Eagle-Phenix Factory converted to interior electric lighting, though the mills and looms continued to use mechanical drives. Advancements in turbine technology and electrical generation eventually led to the factory converting from mechanical drive systems to electrically driven motors.[68]

[68] Ibid, 9.

Figure 17. Postcard view of Eagle & Phenix Dam, tailraces, and Mill.

The transition to electrically driven motors took place over a period of years, ending in 1920. Despite this change, energy generated at the Eagle-Phenix site was only used to power local mills. Unlike Morgan Falls and Tallulah Dam, which were built specifically to generate and transmit electrical power, Eagle-Phenix would have to be completely reconstructed to generate power for long-distance transmission.[69]

Although there were a number of mergers and bankruptcies by companies running the Eagle-Phenix Dam and Factory between the time the dam was built in 1882 and the present

[69] Ibid, 9.

day, the dam continued to generate power for the mills the entire time. Only in the early 2000s did the demand for energy finally cease when the last operating textile company closed its doors. The Eagle-Phenix Factories have since been adapted for use as upscale river-side housing. A river-walk was constructed by the city. All of these amenities pay homage to the importance of the Eagle-Phenix Dam and the growth of the textile and industrial economies in Georgia. Despite the advanced age of the Eagle-Phenix Dam, and the fact that it continued to deliver power for more than 130 years, it is now being demolished. The environmental impact of a defunct dam rarely outweighs its historic value. Additionally, city planners intend to redistribute the 120 feet of fall covered by the dam over 2.5 miles of man-made whitewater park (figure 18).

Since the Fall of 2011, the Eagle-Phenix Dam has been undergoing demolition in various stages. Prior to removing the dam, archival quality photographs and measured drawings were taken. Extensive narrative documentation was also developed. During the demolition process the water level above the dam was lowered. At this time, construction crews discovered remnants of the original wooden crib and coffer dams from the mid-1800s.

Figure 18. Artist's rendering of proposed urban whitewater course.

Figure 19. Remnants of wooden crib dams upstream from Eagle-Phenix dam.

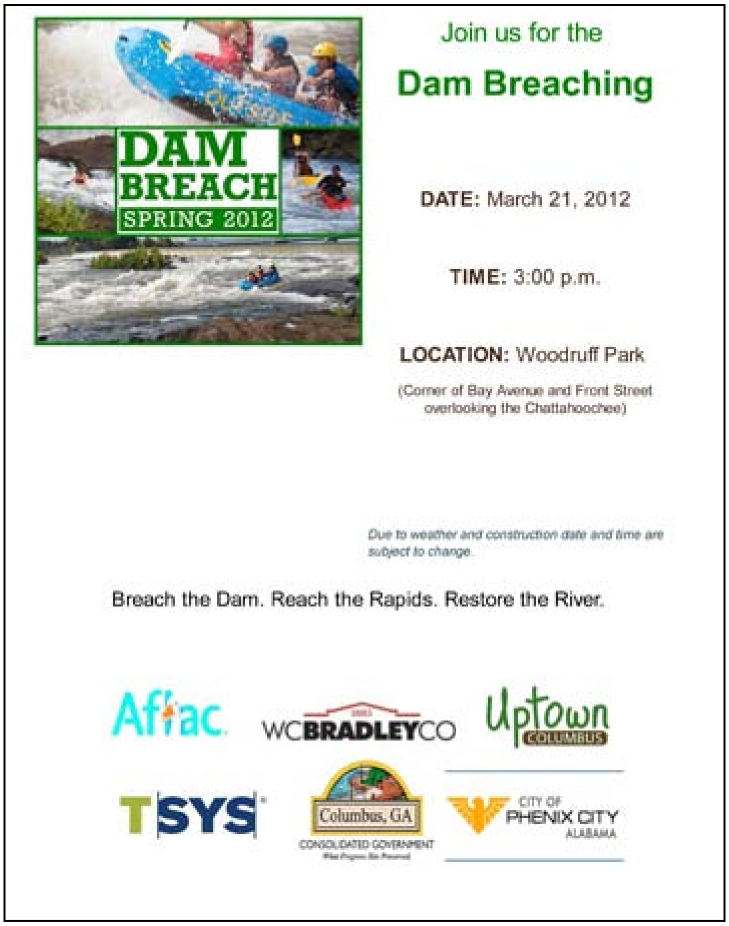

Figure 20. Invitation to Eagle-Phenix Dam breaching event.

As another early example of large dam construction in Georgia, the Eagle-Phenix Dam represents a significant part of the state's history. Because the dam is now defunct, it poses a potential safety hazard and substantial overhead costs. Despite its historic value, the opportunity for urban growth is too great. To mitigate the destruction of the Eagle-Phenix Dam and the City Mills Dam further upstream, extensive documentation occurred at the site. Additionally, the completed riverwalk will display interpretive signs and plaques describing the history of the dam and mill structures. Adaptive reuse of the mill buildings, along with signage, ensure an adequate level of preservation.

Morgan Falls. Cobb/Fulton Counties.

Beginning in the 1890s, the link between dams and hydropower was significantly strengthened by the refinement of turbine technology and the advent of alternating current transmission. When the Niagara Falls dam began transmission of electrical power via alternating current lines in 1895, investors began a scramble for other suitable sites to apply the technology. The Chattahoochee River, already used for transportation and smaller mill-dams and canal systems, was an excellent opportunity. As a growing urban, commercial, and industrial center, Atlanta displayed early signs of demand for hydroelectricity. Additionally, several shoals near the city would provide adequate head for a dam site.

Early hydropower feasibility surveys on the Chattahoochee were conducted beginning in 1897 by the firm Lederle and Bellinger.[70] The survey was funded by private interests in hydroelectric development. In addition to locating ideal sites for dam construction, the surveyors determined what heights would be most economical. Because the construction of a dam creates a lake upstream, land previously above the water line would be flooded. Backers for the project would need to weigh the purchase of flooded ground against the potential sale of energy from the completed dam. For the Morgan Falls project, a height of forty-eight feet was deemed most practical. The site selected from the survey results was Bull Sluice, described as the "most remote portion of Fulton county, being almost at the point where Cobb, Milton,

[70] Stallings, 22. Much of the information in this section comes from Stallings' work, which represents a collection and summary of information regarding Morgan Falls. The report was compiled as a part of the relicensing process by Georgia Power Company.

and Fulton Counties meet."[71] The site was seventeen miles north of the city of Atlanta, well within the capabilities of electrical transmission technology at the time.

A predecessor to the Georgia Power Company, the Atlanta Water and Electric Power Company purchased the title to the Bull Sluice site in 1902. The Atlanta Water and Electric Power Company was a partnership between S. Morgan Smith, law firm King and Spalding, and real estate firm Forrest and George Adair.[72] Smith created the company to capitalize on early interest and opportunity in hydroelectric development. Using his experience in the water turbine industry and connections with contractors, politicians, and local businessmen around Atlanta, Smith was able to move forward with the plans for development at Bull Sluice.

Planning and construction of the Morgan Falls dam was conducted in a somewhat nepotistic manner. Smith's S. Morgan Smith Company was contracted to supply the hydraulic equipment and serve as general contractor. The engineering firm Westinghouse, Church, Kerr and Company was hired to manage the project. Westinghouse also subcontracted to supply electrical equipment. The son of S. Morgan Smith, C. Elmer Smith, was contracted as bookkeeper and agreed to furnish funds for hiring workers, purchasing construction materials, and setting up housing and equipment. Elmer Smith's partner B.H. Hardaway supplied equipment and workers and agreed to supervise part of the construction. Finally, Smith &

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[71] Ibid, 23.

[72] Ibid, 24.

Hardaway were subcontracted by the S. Morgan Smith Company to execute the actual construction of the dam and supporting structures.[73]

The chief engineer for the Morgan Falls project was W.H. Cushman. Cushman was a naval officer during the Civil War, serving as chief engineer aboard the U.S.S. Kearsarge.[74] Cushman's assistants were Frank Lederle, who had previously conducted survey on the site, and B.H. Hardeman. Consulting engineers were also used during the construction.[75] Westinghouse, Church, Kerr and Company had a background in industrial engineering projects including numerous railroads, dams, and early electric power generation.

In order to construct the main dam at Morgan Falls, the engineers first installed a series of wooden crib cells. These cells were large pens filled with excavated earth and stone from the project. Like crib and coffer dams used on other projects, the cells, when in place, diverted water from the area immediately downstream, allowing construction to begin (Figure 14). With the flow of the Chattahoochee diverted, workers were able to excavate into the now-dry bedrock on the river bottom. Cushman and the engineering staff mandated a five foot deep

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[73] Ibid, 25-26.

[74] W.H. Cushman. The New York Times Archive, "THE KEARSARGE AND ALABAMA.; Additional Official Reports. THE CHIEF ENGINEER'S REPORT. THE BOATSWAIN'S REPORT. THE GUNNER'S REPORT. EXTRACT FROM LOG BOOK.." Accessed February 15, 2012. http://www.nytimes.com/1864/07/16/news/kearsarge-alabama-additional-official-reports-chief-engineer-s-report-boatswain.html?pagewanted=all.

[75] Stallings, 28.

Figure 21. Construction at Morgan Falls.

trench at the base of the dam to serve as a foundation and support for the structure to rest against.[76] A massive gravity dam, Morgan Falls was constructed during a period where engineers transitioned from using stone to using concrete. The resulting process was called concrete cyclopean masonry; engineers planted large (up to six feet in diameter) stones in wet concrete, leaving room between each stone. The spaces were then filled in with more concrete,

[76] Ibid, 29.

allowing expansion and contraction within the structure as environmental conditions dictated.[77] Like in the construction of the Lawrence Dam more than fifty years prior, great care was paid to the quality of the raw materials used at Morgan Falls. Regular samples were taken from incoming cement barrels; these samples were subjected to a series of tests to ensure performance under stress and environmental factors.[78]

The dam at Bull Sluice was completed and began to generate power in October of 1904. S. Morgan Smith died before the construction was finished; in his honor the board of the Atlanta Water and Electric Power Company renamed the site Morgan Falls.[79] Despite the ownership of the site by a predecessor to the Georgia Power Company, all power generated at Morgan Falls was sold to the Georgia Railway and Electric Company and the site was therefore not regulated as a public utility.

Like many large hydroelectric dams constructed at the turn of the twentieth century, Morgan Falls, to some extent, preceded regular public demand for electrical power. The result of this was, as demand increased, a need to adjust and upgrade generating capacity at the dam. Additional generators and new turbines were installed within twenty years of the dam going on-line. Like at Lawrence Dam, flashboards were added to the crest of the dam to increase the head height at Morgan Falls, thereby also increasing power. From 1920-1950, Morgan Falls saw a series of sporadic upgrades. Despite these upgrades, much of the integrity of the site remains;

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[77] *Encyclopædia Britannica Online*, s. v. "cyclopean masonry," accessed February 17, 2012, http://www.britannica.com/EBchecked/topic/148097/cyclopean-masonry.

[78] Stallings, 29-30.

[79] Ibid, 34-35.

it is clearly recognizable as the same structure finished more than one hundred years ago. Because the planning and construction of the dam and generating station were so well thought out, it remains an active source of power. As one of the first hydroelectric dams in Georgia and because of its role in powering the streetcars of Atlanta and subsequently delivering power for the Georgia Power Company, Morgan Falls represents crucial aspects of the growth of Atlanta as a metropolitan center and of Georgia as an industrial power.

As a large, publicly visible corporation, the Georgia Power Company must maintain a positive image. As a part of this effort, and also to satisfy Federal Energy Regulatory Commission guidelines, Georgia Power has installed a series of interpretive displays at Morgan Falls. These displays explain a brief history of the dam, its construction, and some biographical material about S. Morgan Smith. Two separate displays, one immediately adjacent to the river at the foot of the dam, and another in a park, provide information. Because the dam is still actively used to generate power, Georgia Power has performed necessary maintenance on the structures. There is visible evidence of erosion on the downstream face of the dam, but the bulk of the dam is unchanged. Signage at the dam and the park indicate that Georgia Power has committed to the preservation of the dam and supporting structures.

Figure 22. Interpretive signage at the base of Morgan Falls Dam.

Tallulah Dam. Rabun County.

The 1880 United States Census included a section on the water powers available in the country. Among these was the Tugaloo River and its tributaries, the Chattooga and Tallulah Rivers. Charles Swain, a professor of civil engineering at MIT, conducted the survey. Swain wrote of the Tallulah:

> The stream flows through a narrow gorge, with very high banks, and descends in a series of pitches (four of which have perpendicular heights of from 50 to 80 feet), falling, it is said, 500 or 600 feet in a mile....I would estimate the flow in the low season of ordinary years at about 44 cubic feet per second, corresponding to 5 horsepower per foot fall. The theoretically available power is therefore large, but practically the power is of no value. [80]

This was one of many surveys conducted during the late 1880s that saw enormous, though inaccessible, potential in Tallulah Gorge. Each survey also recognized the obstacle that one thousand foot granite gorge walls represented to any hydroelectric project. By the early 1900s though, hydroelectric generating technology and demand for consistent electrical power was growing to a point that the North Georgia Electric Company purchased all the land at Tallulah Falls with plans to build a dam.[81]

Despite owning the rights to the land and water at Tallulah Gorge, the North Georgia Electric Company had little capital with which to construct a dam. A series of utility mergers and acquisitions eventually led to the newly formed Georgia Power Company assuming ownership of the Tallulah lands and water rights around 1910.[82] At this time, the Georgia Power Company began construction at Tallulah Falls, utilizing plans developed by Chief Engineer Charles O. Lenz. Lenz suggested that the entire six hundred foot head between the topmost falls and the end of

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[80] Swain, George, ed. *Reports on the Water-Power of the United States*. Washington, D.C.: Department of the Interior Census Office, 1880. "Report on the Water-Power of the Southern Atlantic Water-Shed." http://www.census.gov/prod/www/abs/decennial/1880.html (accessed February 28, 2012), 797.

[81] Georgia Power Company, "Tallulah Falls History." Last modified 2012. Accessed February 28, 2012. http://www.georgiapower.com/lakes/tallulah_history.asp.

[82] Ibid.

the river could be utilized by constructing a tunnel to channel water to a remote power plant.[83] The construction of the dam would allow the power plant to maintain constant flow rates and consistent power generation.

Because the walls of Tallulah Gorge are composed of granite, Lenz was able to use them as buttresses for the dam. Conversely, the granite bedrock posed a problem for the excavation of the tunnel between the dam and power plant. The dam was constructed of steel reinforced concrete, which had become very common by this time. At the time it was completed, Tallulah Dam was the third largest producer of hydroelectricity in the country, behind Niagara Falls and the Keokuk Plant on the Missouri River. Tallulah dam had the highest head of any dam east of the Rocky Mountains. It was a marvel of modern engineering.[84]

Perhaps more impressive than the construction of the dam at Tallulah Falls were the extraordinary lengths necessary to make it functional. In order to deliver water, the tunnel connecting the top of the dam to the power plant needed to be nearly seven thousand feet long. It was excavated through bedrock over the course of fifteen months, then lined with

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[83] Gardner, Jeffrey, *Documentation: North Georgia Hydroelectric Generating Project* , (Atlanta: Brockington and Associates, 1990), 128-129.

[84] Ibid, 131.

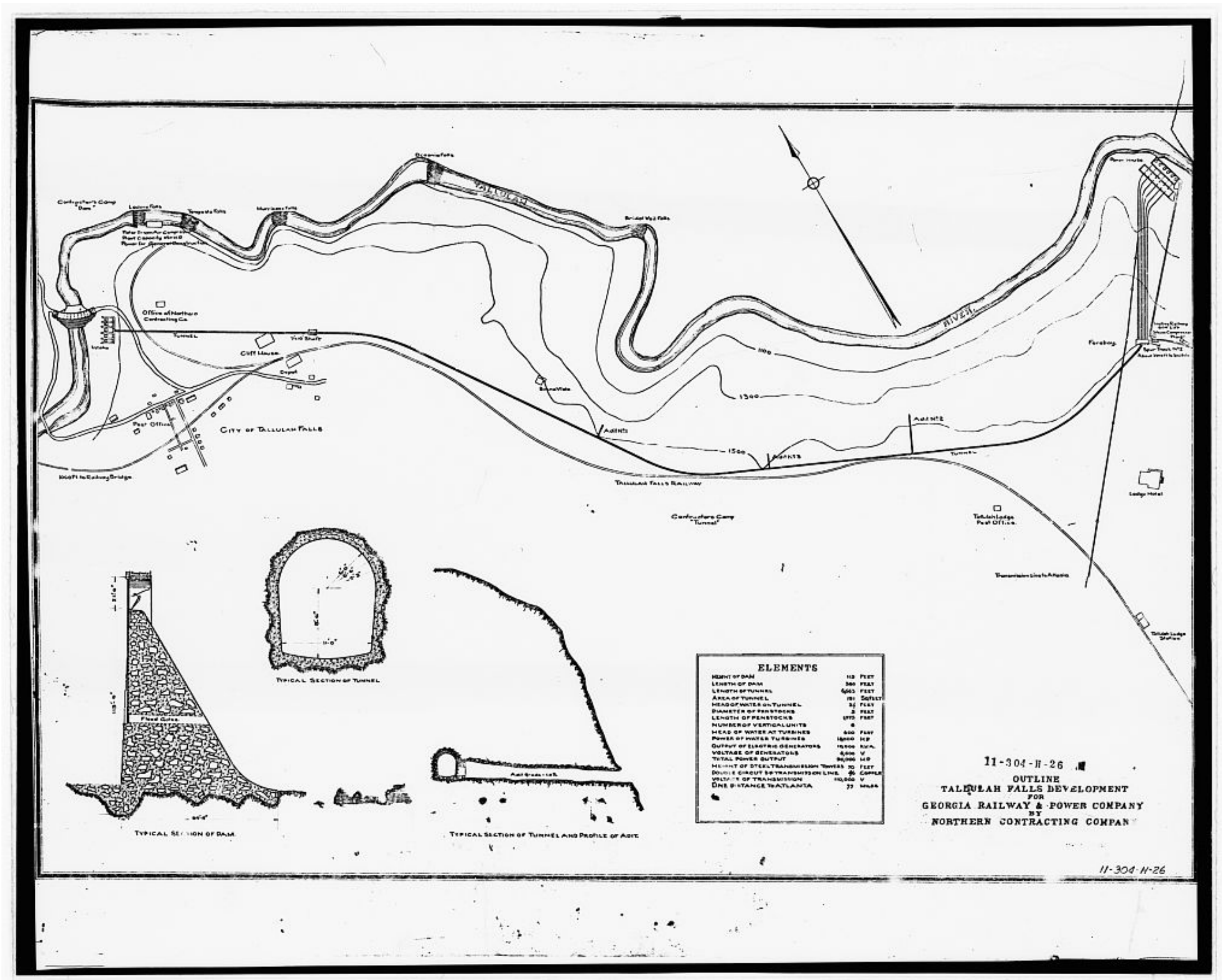

Figure 23. Plan view of Tallulah Dam, tunnel, penstocks, and generating building.

concrete.[85] Because the power plant was constructed at the bottom of an extremely steep canyon, construction workers needed a way to access the site and transport materials. An incline railway was built along the gorge walls to serve this purpose. At the time of its completion, it was the steepest non-vertical railway in the country. It was capable of hauling

[85] Georgia Power Company.

more than one hundred workers from the power plant to the rim of the gorge. The railway is still in operation today.[86]

The design and implementation of the Tallulah Dam, like Whitehall Dam, Eagle-Phenix Dam, and Morgan Falls Dam, required flexibility and the adaptation of existing and developing technology. Economic conditions provided the impetus for these massive projects, but the results at each site can only be attributed to the ingenuity and hard work of the planners, financiers, and construction workers. These projects are still standing, and even functioning, because they are true feats of engineering, demonstrating a rare and unique synergy between aspects of culture, science, and economy.

Because it continues to generate power for the Georgia Power Company, the Tallulah Dam has seen regular maintenance and a degree of preservation. In addition to the upkeep of the structure, a museum at the site, sponsored by Georgia Power, documents the building and usage of the dam (Figure 17). Tallulah Gorge first came to prominence as a natural resource, then lost much of its tourism because the dam blocked the scenic flows of whitewater. The museum at the site recognizes and describes the natural resources of the region as well as the historic social growth and decline. Detailed diagrams, supported by historical photographs, also explain the mechanism by which Tallulah Dam generates electricity (Figure 18).

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[86] Margaret Calhoon, and Lynn Speno, *Images of America: Tallulah Falls*, (Charleston: Arcadia Publishing, 1998), 94-95.

Figure 24. Interpretive display inside Jane Hurt Yarn Museum at Tallulah Gorge.

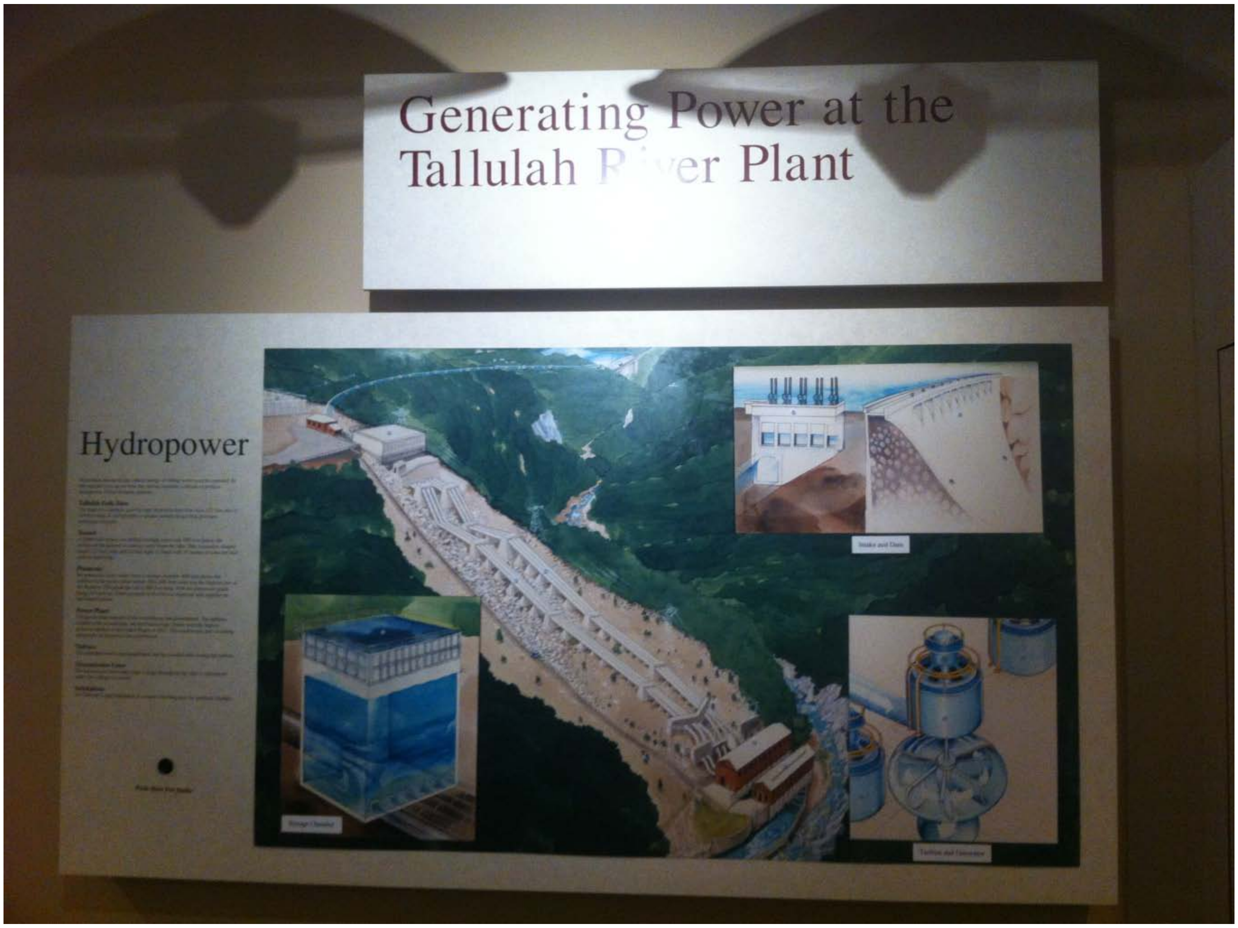

Figure 25. Interpretive diagram of power generation at Tallulah Dam.

Chapter 5: Challenges and Implications for Preservation

The origins of the American preservation movement can be traced to well known, but endangered, residential properties like Mt. Vernon or Woodlawn Plantation in Virginia. The interest of garden clubs and small grassroots organizations led to a groundswell of support for early preservation efforts and, eventually, the National Trust for Historic Preservation. By the mid 1960s, organized and accredited preservation education programs were appearing around the country.[87] Many of these programs were created and influenced through combined efforts by historians, architects, designers, and craftsman. This multidisciplinary approach to preservation ensured the inclusion of a wide range of resource types and allowed significant growth of the preservation movement in America. However, despite the growth and popularity of preservation, there are some resource types that show evidence of neglect. Industrial resources in general and dams in particular, despite their continued benefit, use, and integrity, receive little attention from the preservation-minded public. Georgia, with more than two hundred historic dams, owes much to the development of hydropower. Nearly all of the large urban centers are situated on or near the fall-line; the popularity of hydropower at these sites and the dominance of the textile industry in the state have resulted in a rich heritage that is often overlooked. Most historic hydropower projects in the state, and nationally, have received

[87] Early preservation education programs included Columbia University (1964), Cornell (1975), Boston (1976).

only as much documentation and attention as is required to satisfy federal requirements for periodic relicensing.

The financing, designing, building, and maintaining a large dam, as well as its importance to the urban and industrial landscape, demands a unique approach to preservation. Several issues face historic dams and preservationists advocating on their behalf.

- Dam removal, for a variety of reasons, is becoming more and more common, especially within the last decade.
- Dams represent more than just a large industrial structure; the research necessary to adequately describe their facets and context is time consuming and difficult. Training and education in preservation programs does not often address dams and similar structures.
- Knowledge of dams is not as pervasive or readily available as information on residential resource types; only a small number of experts cover the topic. Much of the literature on historic dams is either extremely old, out of print, or not publicly available.
- Responsible solutions for management and interpretation of historic dams are usually case-by-case. The needs of one site rarely fit those of another; preservationists and site owners are therefore forced to create new management options for each project.

This chapter examines each of the above issues and how dams, as unique and valuable resources, require a novel approach to preservation.

When a dam is constructed, the designers must account for the reservoir that will be created immediately upstream. An artificial lake created by a dam is not a static body of water; as sediment carried by the river flows downstream it is trapped by the dam and thereby forces the lake to shift gradually further upstream. Sedimentation (or a lack thereof) can also drastically affect communities and environments downstream. For rivers that end at large bodies of water, sedimentation provides a renewing source of beach sand as well as providing nutrients for aquatic life nearby. Traditionally, sediment loads carried by rivers also replenished farmlands on the banks. Periodic flooding aided in the process. Dams prevent or minimize flooding and also drastically reduce the sediment load, negatively impacting agricultural communities and economies downstream.[88] Immediately downstream of the dam, exposed bedrock can be subject to above-average erosion because of spillways and other structures associated with hydropower. The environmental impact of a dam, especially one in place for more than one hundred years, is hard to predict.[89]

The impact of dams on wildlife within and around the riverbed can be severe. In particular, historical fish spawns can be dramatically decreased or precluded completely by a dam. Multiple species of fish and other aquatic animals as well as plants have been negatively affected by dams, both because of changed environmental conditions (water temperature,

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[88] National Academy of Sciences, "Understanding Missouri River's sediment dynamics key to protecting endangered species.." Last modified 09/28/2010. Accessed February 21, 2012. http://www.sciencedaily.com/releases/2010/09/100928135049.htm.

[89] See Patrick McCully's Silenced Rivers: The Ecology and Politics of Large Dams, and Elizabeth Grossman's Watershed: The Undamming of America for more information on dam removal and potential and documented environmental effects.

sediment load, oxygen content), and because of the large barrier between their habitats and traditional spawning grounds.[90] This impact extends to tribal communities and modern fishermen who rely on regular fish runs for sustenance and economy; when the runs stop, the communities begin to fail.[91] While some historic designers have acknowledged this issue and installed fish ladders or weirs, the solution is not very common. On the Elwha river in Washington, a fish ladder was included in the original construction plans (per legislative order), but was left out of the actual structure when the builder promised to create a fish hatchery (which failed).[92]

For those historic dams no longer functioning, it can be particularly difficult to weigh the value of the dam against further negative external impacts. The result is a popular call for the demolition of historic dams. Increasingly, government support of dam removal over relicensing and preservation is also becoming evident. This precedent was set in 1999 with the removal of the Edwards Dam on the Kennebec River in Maine. The Federal Energy Regulatory Commission decided that removal of the dam was of more public benefit than its continued operation.[93] In the time since the demolition of Edwards Dam, American Rivers[94] estimates that more than

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[90] Maine State Planning Office, "Edwards Dam Removal Update." Last modified 07/1999. Accessed February 21, 2012. http://www.maine.gov/spo/specialprojects

[91] The Lower Elwha Klallam Tribe, "Dam Removal: Effect on the People." Accessed February 21, 2012. http://www.elwha.org/effectsontheelwhaklallampeople.html.

[92] Oakes, Roger. PBS.org, "Historical Background on the Elwha River Dams." Accessed February 22, 2012. http://www.pbs.org/americanfieldguide/teachers/salmon/history.pdf.

[93] Maine State Planning Office, "Edwards Dam Removal Update."

[94] "American Rivers is the leading organization working to protect and restore the nation's rivers and streams. Rivers connect us to each other, nature, and future generations. Since 1973, American Rivers has fought to

four hundred other dams have been destroyed around the country.[95] This trend continues to grow and, to an extent, snowball. Historic dams are increasingly threatened by development, environmental interests, and economic potential.

At the Eagle-Phenix Dam in Columbus, Georgia, hydrologists and environmental groups advocated for the removal of the historic structure as a means to restore sediment transport and to promote the return of native aquatic species. City planners and board members saw the proposed project as a source of potential economic gain as well. Located at the fall line, the impoundment behind the Eagle-Phenix Dam, as well as another dam immediately upstream, cover significant rapids more than two miles long. In removing the dams, developers plan to restore and enhance those rapids, thus creating the world's longest whitewater park. Dean Barber, president of an economic development firm in Texas, describes the project:

> Industry professionals refer to this altering process as "river enhancement" and suggest that any environmental concerns are typically negated by the fact that whitewater advocates and designers are seeking free-flowing rivers, absent of dams as much as possible. Hence, recreation meets environment in a way that improves a river and the public's outlook about a river.[96]

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preserve these connections, helping protect and restore more than 150,000 miles of rivers through advocacy efforts, on-the-ground projects, and the annual release of America's Most Endangered Rivers." American Rivers, "About American Rivers." Accessed February 21, 2012. http://www.americanrivers.org/about-us/.

[95] NBC, MSNBC.com. "Largest dam removal aims to bring salmon back ." Last modified 09/18/2011. Accessed February 21, 2012. http://www.msnbc.msn.com/id/44554709/ns/us_news-environment/t/largest-dam-removal-aims-bring-salmon-back/

[96] Barber, Dean. Site Selection, "Churn Stokes Upturn." Last modified 09/2011. Accessed February 22, 2012. http://www.siteselection.com/onlineInsider/Churn-Stokes-Upturn.cfm.

While the scale of the Columbus Whitewater Park is not common, the precedent set by the success of urban man-made river parks is growing. Ripboard.com, a website for whitewater enthusiasts, lists nearly twenty whitewater parks currently in operation, with another eleven under construction.[97] Though dam removal has not led to the creation of all of these parks, it is a feasible option with environmental and economic benefits. Preservationists looking to combat these reasons for dam removal need to be adequately prepared and educated on the value of historic dams and their unique attributes.

In many cases, historic dams may be difficult to fully recognize or appreciate. Because so much goes into their creation, the context for a historic dam is significant and not always evident to an untrained surveyor. Even small details relevant to construction, such as a unique technique or material usage, can give historic significance to a structure. Adding contextual value like the builders and their techniques, financiers, and changing usage make dams even more complex for preservationists.

Preservation education programs are increasingly focused, with societal support, on residential buildings and districts.[98] James Garvin, State Architectural Historian at the New Hampshire State Historic Preservation Office, makes an insightful comparison between historic bridges, which have recently received more attention as valuable resources, and historic dams,

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[97] Ripboard.com, "Whitewater Parks." Accessed February 22, 2012. http://www.ripboard.com/community/whitewaterpark.shtml.

[98] James Garvin authored one of the few modern works advocating an increased awareness and education on the topics of historic engineering in general, and bridges and dams in particular. Garvin, James. "Education to Preserve Bridges and Dams as Capstones of Our Engineering Legacy." *Preservation Education and Research*. 1. (2008): 1.

which lack popular public support and acknowledgement. Garvin writes, "Recent initiatives at 'river restoration,' aimed at returning streams to conditions of natural flow for the benefit of fluvial wildlife and recreational users of waterways, ensures that historic dams will be encountered frequently in future preservation reviews."[99] The increasing attention on rivers demands an increased awareness of the value of historic engineering projects on the part of preservationists. In turn, preservation education must meet the demand. For students, internships and summer studies with HABS/HAER and similar programs can be extremely beneficial. National conferences concerning historic engineering are becoming more common; published essays from these are also a valuable educational resource. For schools with an established preservation program, integrating an introduction to engineering is a positive, direct step towards educating future professionals. In addition to proactive measures from preservation education, the body of literature available to students and professionals is substantial but sometimes obscure.

Outdated engineering textbooks are one valuable resource for preservationists researching dams and other industrial structures. Unfortunately, most engineering programs and publishers view old engineering techniques as obsolete and irrelevant; textbooks are often discarded when a new version is published. From a preservation standpoint, historic textbooks are invaluable sources of information on basic engineering techniques and methods. In the case of textbooks that have become public domain, internet sites like Google Books are digitizing the

[99] Ibid, 2.

old titles and making them available for public use.[100] Additional sources of information include power company archives, where years of research are compiled by company historians for use in relicensing projects. Literature on historic dams, though sometimes difficult to come by, can provide preservationists with necessary resources when defending threatened structures.

With the current popular climate of dam demolition, preservationists face a difficult task. Working within the framework of the National Register guidelines, there are several options for dam preservation. Like the construction of a dam, each preservation effort must be unique in order to fit the needs of the client and the environment. Dam Removal and Historic Preservation: *Reconciling Dual Objectives*, a publication by American Rivers, presents several options for preservation in response to the unique needs of any situation.[101]

Whenever possible, the least invasive action is likely the most desirable from a preservation standpoint. While this is usually relatively easy in the case of endangered residential structures, the most common outcome in projects involving endangered historic dams is the removal of all or most of the structure. If demolition is being sought because the dam is deteriorating and in danger of failure, stabilization, repair, and restoration are probably the best courses of action. Removal can also be the goal when historic dams no longer fill their original use. When this is the case, it can be difficult to convince the public of any benefits to keeping the dam intact. In these situations, contextual research can show how significant a role

[100] Google.com maintains and constantly updates a database of public domain publications on a wide range of topics. Many engineering textbooks that are either very rare or entirely unavailable in hard copy can be found online with free unlimited access.

[101] McClain, Lindloff, Baer, 27-39.

the dam played in the development of the community. Involving members of the public in the preservation process can help build community interest in the success of the project, as well as establishing a personal connection between the dam and the individuals. Public outreach is always desirable during preservation projects.

Even when the outcome of a project is removal of the dam, mitigation in the form of an off-site museum or on-site interpretive displays can be effective preservation measures. Extensive documentation before, during, and after demolition is also valuable, as written and photographic evidence can support future projects. One of the most unique treatments is to modify the dam to satisfy environmental needs while maintaining all or most of the original structure. The Kent Dam on the Cuyahoga River in Ohio is an example of such a project (figure 26).[102] While much of the structure was left intact, the project also involved HAER Level II documentation and a report on the history of the dam and its significance to city.[103]

Like the Kent Dam, the Eagle-Phenix Dam removal project also calls for a partial removal of historic structures. For the Eagle-Phenix dam though, the remnants of the dam will most likely be the buttresses on each river bank and not the larger part of the original dam structure. Kent Dam seems to be a unique and novel method of preserving a defunct historic dam. This approach could be emulated to the satisfaction of both preservation and environmental interest groups on a national basis.

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[102] City of Kent, Ohio, "Cuyahoga River Restoration Project Final Summary." Accessed February 24, 2012. http://www.kentohio.org/reports/dam.asp.

[103] McClain, Lindloff, Baer, 30-31.

Figure 26. Kent Dam after partial removal.

More often than not, demolition is the final outcome for an endangered dam. Public demand, economic and environmental benefit, and eroding structures with regular maintenance costs are tough competition when weighed against historic preservation. Despite this trend, there are tools and significant precedent available to the preservationist. Resources on the history of dams are becoming more accessible and preservation education programs, in some cases, are adding introductory engineering material to their coursework.

The four dams in the previous chapter serve as excellent examples of different levels of dam preservation in Georgia. These case studies illustrate how historic dams played unique and important roles in the growth of the state as an industrial power.

- Whitehall Dam, now defunct and abandoned, has been left to suffer demolition by neglect. Access to the site is severely curtailed. Very little information is available on the structure; it is only (briefly) mentioned in one historic structure survey. There is no interpretive material at the site, even for paddlers on the river. Despite these shortcomings, there is enormous potential for preservation at the site. The University of Georgia owns the property and could allow public access and educational activities. Whitehall Dam, as well as the mill and village that depended on it, represent a significant period of Georgia's history which should be preserved. The dam itself is one of the oldest extant dams used for generating power. It is also an example of early efforts at large dam construction in the state. Despite later modifications, the integrity of the dam is largely intact.
- The Eagle-Phenix Dam in Columbus is being actively demolished because it presents safety hazards and its removal will allow significant economic development. In preparation for the removal of the structure, Columbus officials had the dam thoroughly documented by HABS/HAER. Archaeological and historic materials have been recovered from the site during the demolition process.

Interpretive materials, already in place on the riverwalk, will be supplemented after the completion of the whitewater project. Like Whitehall Dam, the Eagle-Phenix Dam is a very early example of hydropower in Georgia, especially on such a large river. The available power at the Eagle-Phenix site is rare in the state. Much of the growth in Columbus can be attributed to the success of the textile industry, which relied on hydropower, to varying degrees, for nearly 150 years.

- Morgan Falls Dam, owned and operated by the Georgia Power Company, is still actively generating electricity. Because of its advanced age and continued use, Georgia Power has committed to maintaining the dam as well as documenting and providing interpretive materials on the significance of the dam. Morgan Falls is an excellent example of the potential for public awareness and involvement at a historic dam, given proper access and funding. The cyclopean masonry used to construct the Morgan Falls Dam was a technique that was being replaced by steel-reinforced concrete; as such, Morgan Falls is one of the last large dams to employ that method.
- Tallulah Falls Dam, also owned by Georgia Power, has a more substantial interpretive component than Morgan Falls. Much of this is because of the large state-owned museum located adjacent to the dam. The cooperative efforts of Georgia Power and the Tallulah Gorge State Park represent an optimal outcome for the preservation of Georgia's historic dams. At the time of its construction, Tallulah Falls Dam was one of the largest hydropower dams in the country and generated one of highest amounts of power. The 6,666 foot long tunnel

constructed to convey water to the turbines was a unique method for adapting to difficult terrain.

Preservationists face numerous, though not insurmountable, challenges when dealing with historic dams. A popular drive for dam demolition, a lack of education programs and high quality literature, and inconsistent methods of preservation are all obstacles to be overcome. Increasingly, dams and other industrial and engineering resources are recognized for their value and contribution to modern society. The result of the increased awareness is a growth in available resources, education, training, and discourse between professionals.

To an extent, preservationists dealing with historic dams can draw precedent and inspiration from the successful preservation of other industrial resource types. Many defunct factories and warehouses have been adapted for residential or mixed used.[104] These large structures are easily modified and pose no great danger if left to decay. Such remodeled residential living spaces are popular with both the public and within the preservation community. Historic bridges and railways can be integrated into developing or extant greenways.[105] As linear modes of transportation, they lend themselves easily to reuse as greenways and trail systems. Additionally, the infrastructure to support such reuse is frequently already in place. These types of resources are distinctly different from dams; they are relatively easy to adapt for new use, are easily accessed, and sit *on* the landscape, rather than *in* it, as dams do. To what other purpose could a large dam be adapted? Perhaps the most valuable

[104] For e.g., Eagle-Phenix Mill buildings, Whitehall Mill Lofts, et. al.

[105] For e.g., Silver Comet Trail in Georgia and New York City's Highline Walkway.

lesson to be drawn from the preservation of other industrial resources is the value of concerted efforts. National and local organizations for the preservation of historic railways, factories, and warehouses espouse the value of these structures and advocate for their protection. Amidst an increasing demand for their destruction, historic dams have little or no national or local champion. Further complicating the issue is how best to preserve a historic dam and what part(s) of its story should be interpreted. Whether directly or indirectly, many people were affected by the arrival and standardization of hydro-generated electrical power. The impact of historic dams is so widespread, yet very little is done to acknowledge or protect the value of the structures themselves.[106]

The International Council on Monuments and Sites (ICOMOS), in cooperation with The International Committee for the Conservation of Industrial Heritage (TICCIH), adopted The Dublin Principles on 28 November, 2011. This document established protocols for the treatment of industrial resources around the world. The preamble to The Dublin Principles states, "Industrial heritage is highly vulnerable and often at risk, often for lack of awareness, documentation, recognition or protection but also because of changing economic trends, negative perceptions, environmental issues or its sheer size and complexity."[107] The Dublin Principles acknowledge the extraordinary value of industrial heritage and provides guidelines for its protection. While dams are not specifically addressed, preservationists can reference The

[106] See Edward K. Muller's "Food for Thought: Industrial Preservation's Legacy" for discussion on what and how to preserve at industrial sites. Muller, Edward. Historical Society of Pennsylvania, "Food for Thought: Industrial Preservation's Legacy." Accessed April 17, 2012. http://173.203.96.155/node/2943.

[107] International Council on Monuments and Sites, *The Dublin Principles*, (Paris, France: ICOMOS, 2011), 2.

Principles when deciding the appropriate treatment for a historic dam. The Dublin Principles also demonstrate a growing international awareness of the role of industrial sites and the danger they are facing.

Chapter 6: Conclusions

In the Journal for the Society for Historical Archaeology, Theodore Sande, an architectural historian with the National Trust for Historic Preservation, discusses the value of industrial resources: "These structures are the tangible remains of the most profound aspect of American culture. They represent the very heart and soul of this fundamentally technological civilization."[108] Georgia's historic dams exemplify this statement. Because of the importance of historic dams in the growth of the textile industry and the subsequent development of hydroelectric power, dams are especially important in a state with such prolific available waterpower and a prominent cotton industry. The people responsible for designing, financing, building, and managing Georgia's dams can be credited, in part, with creating the urban and industrial state we live in today. Dams directly oppose one of the most powerful of nature's forces. They must be dynamic and durable. Because of these factors, Georgia's historic dams represent a unique challenge for preservationists. The scope of the contributing context for historic dams demands a unique approach and a discrete set of tools for preservation. Fortunately, the professional preservation culture is accepting the importance of historic industrial resources. Increasingly, new and historic literature is available. Educational programs are adding new curriculum to train students on industrial resources.

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[108] Sande, Theodore. "Industrial Archaeology and the Cause for Historic Preservation in the United States." *Historical Archaeology*. 11. (1977): 39-44.

Increasing demand for sustainable environmental policy can override the value of historic industrial resources. More often than not, the first solution in a historic dam project is demolition, and not without reason. However, historic dams, and industrial heritage in general, represent a significant evolution in social structure. A blanket policy for dam removal will only lessen our understanding of that evolution. Given the variety of available alternatives to the complete removal of historic dams, other avenues should be pursued whenever possible.

Many of Georgia's 264 historic dams are small, privately owned structures. These dams are often not recognizable for what they are. Other dams around the state are massive structures; these are truly representative of the significance hydropower has played in Georgia's history. Historic dams served as a nucleus for cultural, economic, and scientific growth. The visionaries responsible for their creation were unlike other men of their time; driven to build large dams before the demand for electrical power had even emerged. Meeting and overcoming the challenges posed by the great water-powers of the state requires structures built to last. Georgia's historic dams are not only still standing, but still operating; often after more than one hundred years. The historic dams of the state are unique because they represent a confluence of society, culture, and technology not seen in other resource types.

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