# North Carolina Department of Natural and Cultural Resources

## State Historic Preservation Office

Ramona M. Bartos, Administrator

Governor Pat McCrory
Secretary Susan Kluttz

Office of Archives and History
Deputy Secretary Kevin Cherry

March 1, 2016

John Crutchfield
Duke Energy Carolinas
526 South Church Street, EC12Q
Charlotte, NC 28202

john.crutchfield@duke-energy.com

Re: Cowans Ford Development, Catawba Wateree Hydroelectric, FERC 2232, Multi County, ER 03-0359

Dear Mr. Crutchfield:

Thank you for your letter of January 14, 2016, concerning the above-referenced undertaking. We have reviewed the *National Register of Historic Places Evaluation of the Cowans Ford Hydroelectric Development* and offer the following comments.

Although the Cowans Ford Hydroelectric plant maintains a good degree of integrity, the report argues the property is not eligible for listing in the National Register of Historic Places due to the following:

- The property was constructed between 1959-1963; long after Duke Power planned the facility
- the "landscape of electrical generation had changed both nationally and within the company's own portfolio" during the period of significance, and;
- steam power plants were more common in the 1950s and 1960s

We believe the significance of the Cowans Ford hydroelectric plant should not be solely evaluated by its date of construction, nor is its significance contingent upon past national trends of water-based power plant construction. Rather, the hydroelectric plant, constructed by Duke Power to meet the needs of its North Carolina constituents is eligible for listing in the National Register under Criterion A as an important source of power in the local energy industry. It is also eligible under Criterion C for engineering, as the facility continues to exhibit the characteristics of a hydroelectric plant, including the powerhouse, spillway, dam and saddle dike.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

cc: Christy Churchill, Christy.churchill@duke-energy.com
Mark Oakley, mark.oakley@duke-energy.com

DUKE ENERGY.
CAROLINAS

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RECEIVED
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HISTORIC PRESERVATION OFFICE

January 14, 2016

ER 03-0359

5-See Letter
ACH 2/10/16

Ms. Renee Gledhill-Earley
State Historic Preservation Office
North Carolina Department of Cultural Resources
4617 Mail Service Center
Raleigh, NC 27699-4617

Subject: Duke Energy Carolinas, LLC
Catawba-Wateree Hydroelectric Project No. 2232-522
Historic Properties Management Plan and Programmatic Agreement Implementation
National Register of Historic Places Evaluation of the Cowans Ford Development

Due 2/16/16

Dear Ms. Gledhill-Earley:

As specified in Article 410 of the Federal Energy Regulatory Commission (FERC) operating license issued to Duke Energy Carolinas, LLC (Duke Energy) for the Catawba-Wateree Project No. 2232 on November 25, 2015, Duke Energy is implementing the Final Programmatic Agreement and the associated Historic Properties Management Plan (HPMP). As part of the Final Programmatic Agreement approved by the FERC on April 12, 2013, and the HPMP dated May 2006, Duke Energy committed to conduct a National Register of Historic Places (NRHP) evaluation of the Cowans Ford Development in 2015 and seek concurrence of the eligibility assessment from the North Carolina State Historic Preservation Office (NCSHPO). The evaluation was conducted by Brockington and Associates, Inc. in December of 2015 and is hereby submitted for NCSHPO review.

If you have any questions regarding NRHP evaluation, please contact me at 980-373-2288 or Christy Churchill at 980-373-4183.

Sincerely,
John Crutchfield

John Crutchfield, Director
Public Safety & Recreation Strategy Planning Services

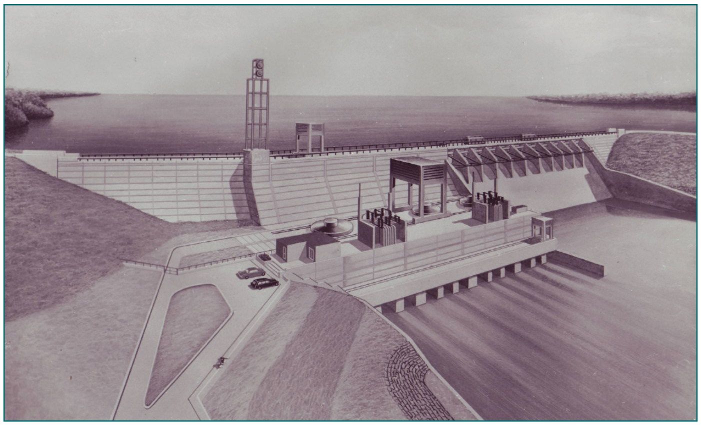
CLC/cc

c: Ms. Christy Churchill
Mr. Kevin Friel
Mr. Peter Huff
Mr. Mark Oakley
Mr. David Scott

# National Register of Historic Places Evaluation of the Cowans Ford Hydroelectric Development

Lincoln and Mecklenberg Counties, North Carolina

FERC #2232



January 2016

Brockington
CULTURAL RESOURCES CONSULTING

# NATIONAL REGISTER OF HISTORIC PLACES (NRHP) EVALUATION OF THE COWANS FORD HYDROELECTRIC DEVELOPMENT

**LINCOLN AND MECKLENBURG COUNTIES, NORTH CAROLINA**
**(FERC #2232)**

JANUARY 2016

**Prepared for:**
Duke Energy Carolinas, LLC
Charlotte, North Carolina

**Prepared by:**

F. Patricia Stallings

F. Patricia Stallings
Senior Historian

**Brockington and Associates, Inc.**

Atlanta • Charleston • Savannah • Elizabethtown

# Executive Summary

The Cowans Ford Hydroelectric Development is located in Mecklenburg and Lincoln Counties, North Carolina, approximately 20 miles north of Charlotte. Completed in 1963, the hydro station has four generating units with a total installed capacity of 350 megawatts (MW). It operates as part of the broader Catawba-Wateree Hydroelectric Project, which is licensed under the Federal Energy Regulatory Commission (FERC) as Project #2232.

Because the Catawba-Wateree Project (and thus the Cowans Ford Development) operates under federal license, the licensee (Duke Energy) is required to comply with a number of federal laws, regulations, executive orders, policies and guidelines. Among these requirements is Section 106 of the National Historic Preservation Act (NHPA) of 1966 and the regulations implementing Section 106 issued by the Secretary of the Interior (36 CFR Part 800). Section 106 of the NHPA requires the FERC to take into account the effect of its undertaking on Historic Properties.

The Cowans Ford Hydroelectric Facility was previously evaluated for the National Register of Historic Places (NRHP) and found to be ineligible due to is relatively recent construction (Cleveland and Holland 2005). However, one of the goals stipulated in Duke Energy's Catawba-Wateree Historic Properties Management Plan (HPMP), its guiding document for Section 106 compliance, is to re-evaluate the facility once it turns fifty years of age. In December 2015, Brockington and Associates, Inc. (Brockington) completed an NRHP evaluation of the hydroelectric structures associated with Cowans Ford. The investigations, documented in this report, were designed to fulfill Duke Energy obligations pursuant to Section 106.

Construction of Cowans Ford began in 1959 and the first three generating units went operational in 1963; a fourth unit went online in 1967. The primary facilities at the Cowans Ford include the 350 MW Cowans Ford Hydroelectric Station (the powerhouse containing turbines and generators), the Cowans Ford Dam and spillway, and the Hicks Crossroads Saddle Dike. The Duke Energy property also contains several auxiliary structures (a boathouse, maintenance shop, several non-historic offices and sheds, and a trailer), but these are not included within the FERC Project Boundary and, therefore, are not subject to Section 106. They are not included as part of this FERC-mandated evaluation.

The scope of this project included an inspection of all hydroelectric structures located within the FERC License boundary and an updated NRHP evaluation based on the facility's relative historic context. After evaluation, including considering Cowans Ford within its proper historic context (e.g. modern hydroelectric development), we recommend that the facility's hydroelectric structures do not meet the criteria for inclusion in the NRHP and, therefore, do not require management as historic properties.

**Acknowledgements**

The author gratefully acknowledges individuals who contributed to the report's completion. At Duke Energy, Ms. Christy Churchill provided coordination for the site visit, archival research, points of contact, and other project information. At Cowans Ford, Mr. Kevin Friel and Mr. Ricky Thompson guided staff through the facility and both supplied helpful information on the facility's history and operation. At the Duke Energy Corporate Archives in Charlotte, Mr. Chris Hamrick and Mr. Akeem Flavors graciously assisted staff with historical research. At Brockington, Ms. Gitisha Goel produced graphics and Ms. Meagan Brady edited the report.

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# 1.0 Introduction

Duke Energy Carolinas, LLC (Duke Energy) owns and operates the 350 megawatt (MW) Cowans Ford Hydroelectric Development, located in Mecklenburg and Lincoln Counties, North Carolina (Figure 1.1). Completed in 1963, the Cowans Ford Development operates as one component of the Catawba-Wateree Hydroelectric Project, which is licensed under the Federal Energy Regulatory Commission (FERC) as Project #2232. The Catawba-Wateree Project received its new 40-year license on November 25, 2015. Because the Project operates under federal license, Duke Energy is required to comply with a number of federal laws, regulations, executive orders, policies and guidelines. Among these requirements is Section 106 of the National Historic Preservation Act (NHPA) of 1966 and the regulations implementing Section 106 issued by the Secretary of the Interior (36 CFR Part 800). Section 106 of the NHPA requires the FERC to take into account the effect of its undertaking on Historic Properties.

During the initial re-licensing effort in 2004 and 2005, the Catawba-Wateree Project was inventoried for historic architectural properties (Cleveland et al. 2004; Cleveland and Holland 2005). Those inventories included an evaluation of 11 hydroelectric developments with 11 reservoirs and 13 powerhouses. At the time, only the Cowans Ford Hydroelectric Development (completed 1963) did not meet the 50-year age guideline for inclusion in the National Register of Historic Places (NRHP). Cleveland and Holland (2005) recommended Cowans Ford as ineligible for the NRHP due to its more recent age and did not find that facility met Criteria Consideration G, for properties of “exceptional importance.” The investigators also recommended that the facility be re-evaluated once it reached 50 years of age (2013) so that it could be more thoroughly assessed within its relative historical context.

Duke Energy’s guiding document for cultural resources management at the Catawba-Wateree Project is its Historic Properties Management Plan ([HPMP] Brockington and Associates, Inc. 2006). Drafted in 2006, the HPMP identified long range goals and objectives for protecting and managing historic properties located within and adjacent to the FERC Licensed Project Boundary. One of the goals of the HPMP is to re-evaluate the Cowans Ford facility.

Hydroelectric facilities such as dams and powerhouses have the potential to be considered historic properties. Because the facilities may be affected by general maintenance and repair activities required for operation, the purpose of this NRHP evaluation study is to determine if the Cowans Ford hydroelectric structures are historic properties and, if so, what features (i.e., “character-defining features”) contribute to their eligibility. The methodology of the current study was tailored to meet these goals.

The Cowans Ford Hydroelectric Development includes the 350 MW Cowans Ford hydroelectric station (including turbines and generators), the Cowans Ford Dam and spillway with 11 taintor gates, and the Hicks Crossroads saddle dike (Figure 1.2). Components that fall outside of the FERC License boundary include a warehouse, a boathouse, and several non-historic ancillary buildings. Commercial development of Cowans Ford began with three generating units going online in 1963; a fourth unit went operational in 1967.

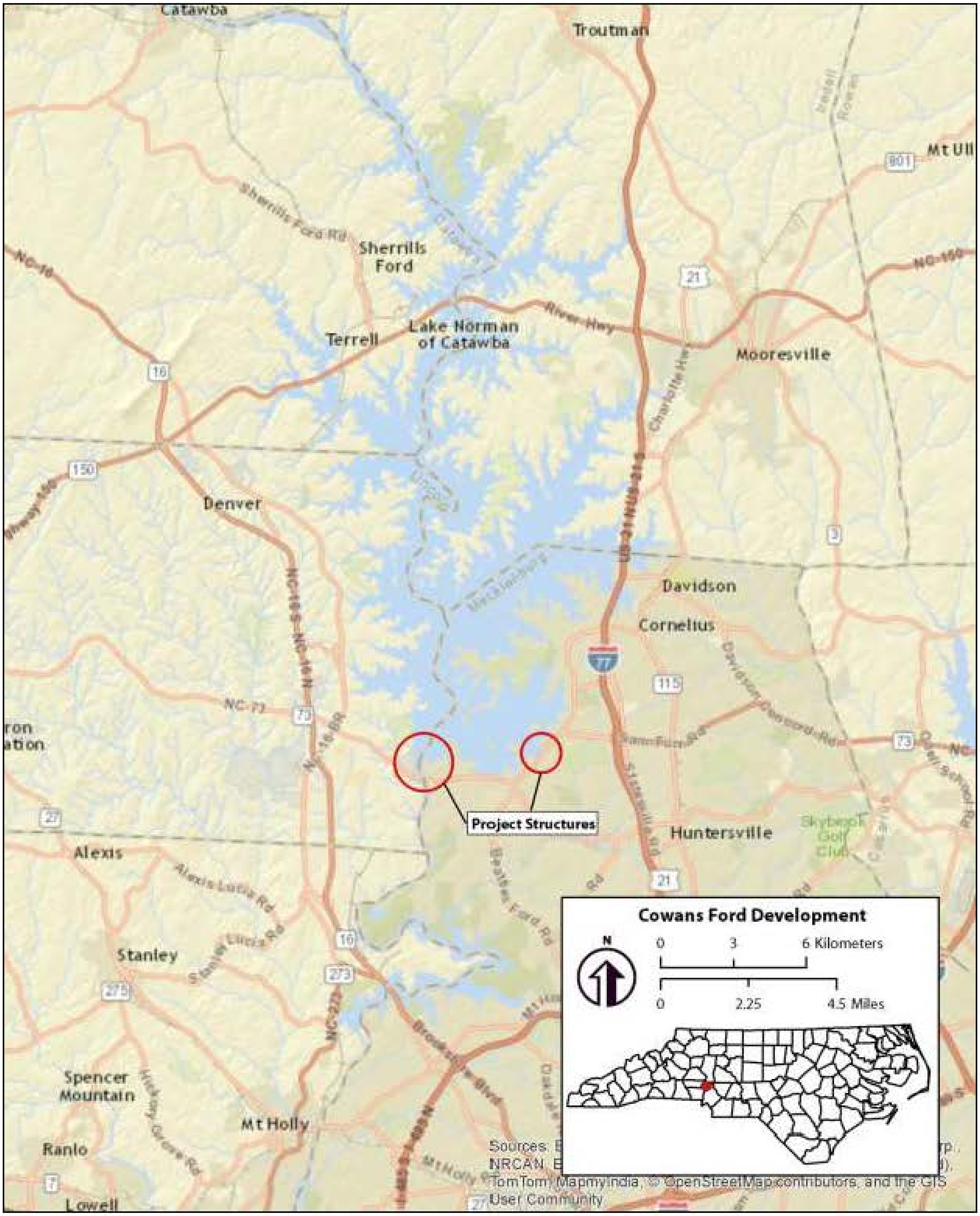

Figure 1.1. Location of the Cowans Ford Development (FERC #2232).

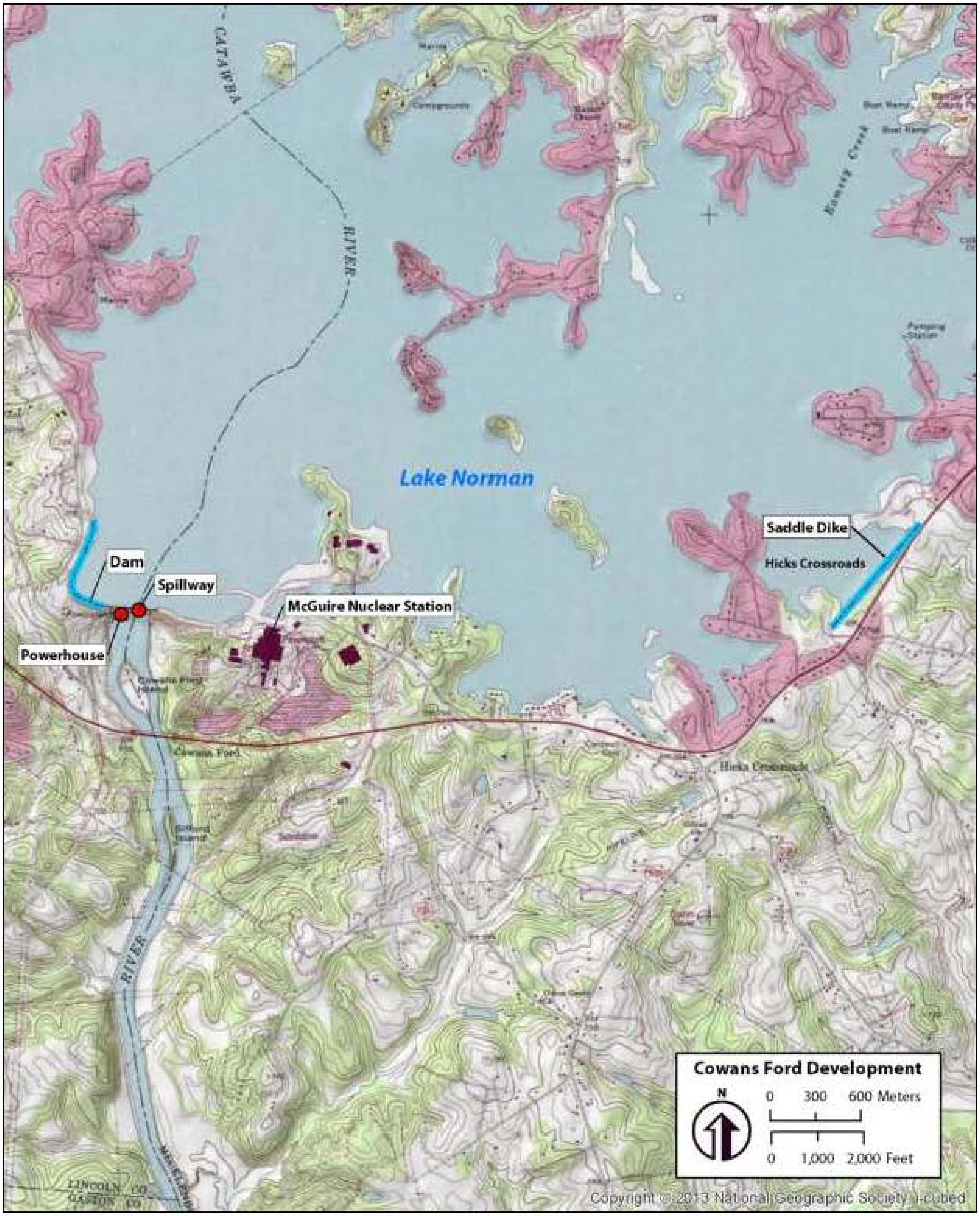

**Figure 1.2. Structures associated with the Cowans Ford Hydroelectric Development. Note: McGuire Nuclear Station is shown for locational purposes only.**

## 1.1 Methodology

Prior to visiting the Cowans Ford Hydroelectric Development, Brockington reviewed the previous cultural resources inventory reports completed by Duke Energy consultants during the re-licensing process. This included evaluation documents for the hydroelectric developments in both North and South Carolina (Cleveland et al. 2004; Cleveland and Holland 2005). To further assist in the development of the historic context and facilities assessment, we reviewed contemporary newspaper articles on the planning, construction, and operation of the facilities. The Senior Historian also reviewed historical documents (including photographs, monographs, and engineering drawings) obtained at the Duke Energy Corporate Archives in Charlotte, North Carolina.

On Monday November 30, the Senior Historian conducted an intensive architectural survey of the hydroelectric structures at Cowans Ford. This survey included inspections of the interiors and exteriors of the powerhouse and dam, and visual survey of the dams, saddle dike, and ancillary power generating equipment. Photographs of the hydroelectric structures were taken in consideration of security concerns and have been vetted through Duke Energy security personnel. This NRHP Evaluation Report provides a detailed summary of the archival research, descriptions of the hydroelectric structures, a detailed historic context for hydroelectric development at both the national and state levels, and provides an NRHP evaluation of the facilities.

## 1.2 Historic Properties Analysis: Eligibility to the National Register of Historic Places

Eligibility to the NRHP is based upon whether or not a property possesses significance under specific criteria (Savage and Pope 1998). The NRHP criteria for evaluation are set forth at 36 CFR 60.4, as follows:

> The quality of significance in American history, architecture, archeology, engineering, and culture 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
>
> 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 in prehistory or history.

A property may be eligible for the NRHP under one or more of these criteria. Criteria A, B, and C are most frequently applied to historic buildings, structures, objects, non-archaeological sites (e.g., battlefields, natural features, designed landscapes, or cemeteries), or districts. The eligibility of archaeological sites is most frequently considered with respect to Criterion D. A general guide of 50 years of age is employed to define "historic" in the NRHP evaluation process. That is, all properties greater than 50 years of age may be considered for evaluation. However, more recent properties may be considered for evaluation. According to Sherfy and Luce (1998:1), the passage of time is necessary in order to apply the adjective *historic* and to ensure the adequate perspective, but properties less than 50 years of age may be considered eligible for listing in the NRHP if they rise to a level of "exceptional importance," defined as Criteria Consideration G. To determine whether properties qualify as exceptionally significant, Sherfy and Luce (1998) emphasize the importance of a historic context.

## 1.3 Project Chronology

This section presents a summary of the milestone events associated with the construction and operation of the Cowans Ford Hydroelectric Development.

| | |
|---|---|
| 1907 | Southern Power Company begins purchasing property for an eventual development at Cowans Ford as part of a broader goal to develop much of the Catawba River system. Additional property is purchased in the 1920s, but a combination of the Great Depression (1930s) and the company's transition to steam power generation (1920s-1950s) puts Cowans Ford on indefinite hold. |
| 1956 | Duke Power prepares a preliminary report determining that developing Cowans Ford is economically feasible. |
| 1957 | Duke Power files an application with the Federal Power Commission ([FPC] now FERC) for a license to develop Cowans Ford. |
| 1958 | Duke Power receives FPC license to develop Cowans Ford. |
| 1959 | Groundbreaking ceremonies are held on September 28. |
| 1962 | Gates closed to begin filling reservoir. |
| 1963 | Units #1-3 go into commercial operation. |
| 1964 | Cowans Ford dedicated on September 29. |
| 1967 | Unit #4 goes online. |
| 2004 | Cowans Ford evaluated for the NRHP during the re-licensing process for the Catawba-Wateree Project (FERC #2232) and determined ineligible due to not meeting 50-year age guideline. |
| 2006 | Catawba-Wateree Project HPMP goes into effect. |
| 2015 | Re-evaluation of Cowans Ford initiated. Catawba-Wateree Project receives its new 40-year license on November 25. |

# 2.0 Hydroelectric Overview and Historic Context

## 2.1 Introduction

Hydroelectric dams and powerhouses in the United States are enduring, tangible products of the historical development and technological refinement of water-generated electricity. Along with facilities that used steam to produce electricity, early hydroelectric projects played an instrumental role in the process by which homes, businesses, and industries were modernized with the now-ubiquitous commodity of electric energy. The history of hydroelectricity documents an ingenious merging of traditional hydromechanical technology with the evolving nineteenth-century technology of electric lighting and power. This process was followed by development of transmission systems capable of safely and efficiently distributing this new energy source to distant markets. The post-World War I history of hydroelectricity fits into the larger context of the emergence of electric utilities as powerful business institutions, overseeing complex, interconnected systems of electricity from diverse power sources. The post-World War II history of hydroelectricity represents a time of increasing federal hydropower production and the emergence of hydroelectricity as primarily a peaking source for investor-owned utilities.

The historical study of hydroelectric facilities is unusual compared to many other fields within engineering history, where ongoing technological evolution often brought about widespread destruction or major alteration of original facilities. As historian Duncan Hay (1991:134) noted, “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.” Many surviving examples have changed little in appearance or design (aside from the effects of routine maintenance), because industry advancements generally have not been dramatic enough to warrant the retirement of still operational equipment, powerhouses, and dams.

## 2.2 Hydroelectric Development in the United States

In his two-volume *Hydroelectric Development in the United States, 1880-1940,* Hay (1991) identifies and describes three broad periods in the evolution of hydroelectricity in the United States prior to World War II: a pioneering period (1880 to 1895); a period of innovation and experimentation (1895 to 1915); and a period of standardization (1920 to 1930). Hay (1991) provides no explanation for the five-year gap between the end of the second period and the beginning of the third; however, with the United States’ participation in World War I, changes in hydroelectricity were related to production scale (an increase of two million horsepower in generating capacity between 1917 and 1919) and to increased interconnectedness of systems. During the mid-twentieth century, the majority of hydroelectric facilities constructed across the United States were initiated by the federal government as part of broader flood control and navigation systems within river basins. Private utilities continued to invest in hydropower, but at a much smaller rate. Instead, for electrical generation, private utilities began looking to high-capacity steam plants, nuclear power, and, more recently, natural gas facilities. A summary of Hay’s developmental history, updated to reflect trends of the mid- to late-twentieth century, is presented here.

The ***pioneering*** phase of hydroelectric development in America technically began in 1880, when Michigan’s Grand Rapids Electric Light and Power Company first connected a dynamo to a water turbine for the purpose of powering arc lights. Hydroelectricity had its antecedents, however, in a long-established tradition of hydromechanical power production.

Throughout the nineteenth century, falling water supplied a significant part of America's industrial power, and after 1850, water turbines designed by innovators such as James B. Francis began to overshadow traditional open waterwheels. Though electrical engineering was a much newer science by comparison, by the late 1870s, rudimentary arc lighting systems were joined by incandescent systems developed by Thomas Edison and others.

Accordingly, the necessary components for hydroelectric development were in place by the onset of the 1880s. The number of hydroelectric plants generating direct current for local electric light systems grew rapidly during the decade. According to an August 21, 1886 article in *Electrical World*, one such plant had even been established in Columbus, Georgia (Hay 1991).

Long distance transmission remained the biggest obstacle to industry expansion, because both arc and incandescent lighting operations were limited by the typically high line losses associated with low voltage direct current. The Westinghouse Electric Company, formed in 1886 by George Westinghouse, overcame this limitation with the refinement of high voltage alternating current systems and transformers. Westinghouse's new system proved itself when matched with the challenge of developing Niagara Falls, whose 180-foot drop would produce far more energy than could be used locally. Detractors maintained that alternating current was inherently unsafe and thus there was no effective way to market and distribute the vast power of sites such as Niagara. Despite opposition, Westinghouse successfully devised a "universal" distribution system of transmission lines and transformers that could match Niagara's output with the individual voltage needs of distant consumers. In August 1895, generators were started up at Niagara Falls, the largest hydroelectric plant in the world at the time. Niagara Falls and its contemporaries marked a turning point in hydroelectric development by (1) demonstrating the economic viability of hydroelectric development coupled with long distance power transmission; (2) establishing standards for the industry; and (3) illustrating that hydroelectricity demanded significant changes in hardware and attitudes toward the use of water power in conjunction with electrical distribution. Powerhouses of the pioneering phase ranged from small shacks to imposing and elaborate structures (Figure 2.1) designed to emphasize the power of the corporation and the growing industry (Hay 1991).

A quarter century of ***innovation and experimentation*** followed developments at Niagara Falls in 1895, as the trends that began there were elaborated and modified at hundreds of waterpower sites throughout the United States. Engineers borrowed freely from new as well as existing technologies, tailoring their creations to individual site conditions by combining electrical, hydraulic, mechanical, and civil features in innovative ways. Electrical transmission systems improved, allowing the power of remote or inaccessible sites to be harnessed. Innovations in dam construction, both for hydroelectric and other purposes, focused on designs that were stronger or used smaller quantities of materials, such as Nils Ambursen's hollow-core dams of reinforced concrete slabs and buttresses.

Design improvements also flourished for the wide range of devices used to retain, direct, and control water, including flashboards, intake apparatuses, canals and flumes, diversion tunnels, pressure conduits, penstocks, surge tanks, and penstock valves. Horizontal impulse waterwheels were increasingly supplanted by an assortment of reaction turbines tailored to maximize the energy that could be extracted from the available head, or the distance that the water falls before hitting the turbines. In 1912, Professor Albert Kingsbury introduced large capacity thrust bearings from which reaction turbines could be suspended vertically, eliminating the need to use less efficient, horizontal mountings of turbines and generators. Few horizontal high head reaction turbines were installed after World War I, and by 1920, vertical single-runner

Francis turbines were being installed even at high head facilities. Oil hydraulic governors introduced by the Lombard and Woodward companies began to supplant mechanical governors, and scroll cases and flared draft tubes improved the efficiency of water flow into and out of the turbines.

Contemporary textbook authors of waterpower development advocated new powerhouses to be more utilitarian in design than their predecessors. With the exception of some of the larger hydroelectric projects, powerhouses of this period began to lack architectural embellishments (Figure 2.2). Most designs used a brick exterior over a steel frame or reinforced concrete walls; roofs were pitched lower and even flattened for a more parapetted effect. Powerhouses of this period were smaller as well, as the growing use of outdoor transformers and switchyards after 1913 reduced the amount of interior space needed. In addition, designs routinely accommodated space in the foundation for future generating units. By the end of this period, some designs truncated the traditional powerhouse structure. The new abbreviated or semi-outdoor powerhouse (Figure 2.3) housed only the control panel, exciters, and repair shops in a smaller, traditional building. Metal casings protected generators, which were serviced by a free-standing gantry crane anchored to a mass concrete substructure; the cranes accessed the generating units via hatches in the powerhouse roof (Hay 1991).

While innovation in hydroelectric development continued into the 1920s, ***standardization*** increasingly characterized the design of many plants built after World War I. According to Hay (1991:95), “a larger number of hydroelectric plants came on line or were significantly upgraded between 1920 and 1930 than during any decade before or since.” Equipment and designs tended to vary only in response to topographical and regional conditions. Most new lower and medium head plants were driven by vertical single-runner Francis turbines supported by a Kingsbury-type thrust bearing, a combination that increasingly came to be used for high head applications as well. Speed was generally controlled by hydraulic governors (usually Woodward designs) that activated wicket gates to control water flow, and most turbines received water through some type of scroll case. In a continuation of the architectural trends of the previous period powerhouses tended to be brick and steel structures with steel-framed windows (either rectangular or arch-topped) and primarily had flat roofs, which allowed maximum clearance for overhead cranes while minimizing materials for walls and roofs. In general, development in the 1920s focused more on the integration of hydroelectric plants into larger systems than on their appearance or equipment (Figures 2.4-2.5).

A key aspect of hydroelectricity’s third phase was the way in which standardized plant designs and technology reflected the evolution of both the industry of hydroelectricity and the institution of utilities. Technological advances do not flourish independently; they must be supported, applied, and distributed by systems that develop around them. The standardization of hydroelectricity by the 1920s can be traced to a number of factors, including the cumulative experience of preceding developments, the attention of national and regional technical periodicals, the growing influence of consulting management and engineering firms, the availability of capital through holding companies, and the consolidation of local utilities into regional concerns. Of these trends, the emergence of regional utilities dramatically affected development in general, as interconnected power systems brought growth and modernization to rural as well as urban areas.

Though hydroelectric operations continued to function after the standardization period of the 1920s, the industry changed considerably around 1930 in response to several conditions. The efficiency and economy of thermal (steam) power improved steadily during the 1910s and 1920s, causing power company managers to re-evaluate the role of hydro within their total systems. Hydroelectric facilities, which could be brought "online" almost instantaneously, gradually emerged as producers of peak load power, while new, large steam plants took over most base load production. The limited remaining stock of developable hydropower sites spurred the trend towards larger-scale projects, as engineers of the 1930s developed enormous dams and powerhouses to conquer the highly challenging sites that remained, particularly in the western United States. The stock market panic of 1929 and the ensuing Great Depression brought cataclysmic changes to the electric utility industry and the nation that it served. Reduced demands for power in a Depression-era economy diminished incentives to acquire and develop new hydropower sites, and hydroelectric development by investor-owned utilities came to a virtual standstill during the 1930s. The 1930s began, for utility companies, a period of heightened federal regulation and intervention that brought more changes in organization and operation than in technology and development.

**Figure 2.1. Adams Powerhouse (completed 1905), Niagara Falls, New York.**

**Figure 2.2. Catawba Powerhouse (completed 1904), India Hook, South Carolina.**

**Figure 2.3. Semi-outdoor powerhouse design at the Tillery Development (completed 1928), Yadkin River, North Carolina.**

**Figure 2.4. Duke Energy's Great Falls-Dearborn Development, showing two phases of powerhouse architecture. The Great Falls powerhouse (left) was completed in 1904; Dearborn (right) was completed in 1923.**

**Figure 2.5. Lake Blackshear (Warwick) Powerhouse (constructed 1930), Crisp County, Georgia.**

### 2.2.1 The Big Dam Era: Federal Hydroelectric Development and New Technologies (1930-present)

While the 1930s had a stagnating effect on the evolution of non-governmental hydroelectric development, the agendas and resources of Roosevelt's New Deal fostered a vastly different era of hydroelectric development carried out by the federal government. In the west and the Tennessee Valley, federal agencies including the U.S. Army Corps of Engineers (USACE), the Tennessee Valley Authority ([TVA] formed by the Tennessee Valley Authority Act of 1933), and the Bonneville Power Administration launched into massive dam construction programs designed to provide flood control, irrigation, public works, and regional economic development in addition to hydroelectric power. The federal projects, "which were consciously different from their power-company predecessors in terms of appearance, scale, and operation," represent the majority of the hydroelectric construction that occurred from the 1930s through the energy crisis of the 1970s (Hay 1991). Powerhouse designs trended toward streamlined architecture, and were largely monolithic concrete structures (Figures 2.6-2.7), many of which featured minimized Art Deco features. According to Hay, "Federal architects and designers sheathed hydroelectricity in entirely modern clothes, as if to separate it from its past" (Hay 1991:132). Another key design trend for powerhouses from the mid- to late-twentieth century included a decrease in window size. Earlier buildings typically included large windows extending from the entire height of the generator floor for light and ventilation. Modern heating and air systems allowed for much smaller windows. Some designs, in a continuation of the semi-outdoor powerhouse type, eliminated the powerhouse altogether, and placed the generating units in weatherproof cubicles recessed entirely within the powerhouse foundation (USACE 1985:2.31).

In the southeastern United States, in addition to the TVA, the Flood Control Acts of 1938 and 1944 authorized numerous multi-purpose projects across the region, although construction on most projects was delayed until after World War II. Constructed by the USACE, the projects were located in the basins of the Cumberland, Roanoke, Savannah, Alabama, and Chattahoochee Rivers. The projects were authorized for a variety of purposes including navigation, flood control, water quality, recreation, and water supply (Figure 2.8). Many of the projects also included a hydropower component, with the electricity marketed by the Southeastern Power Administration (SEPA), then part of the U.S. Department of the Interior and now part of the U.S. Department of Energy, to area municipalities and rural electric cooperatives, known as "preference customers" (Brockington 2012; Norwood 1990).

When the advent of World War II and the subsequent postwar boom brought increased demands for electric energy, investor-owned utility companies responded to market needs by diversifying their energy portfolio. They did so by constructing large-scale steam (coal-fired) stations, nuclear plants, and later, natural gas facilities. In addition, because of the limited number of suitable sites combined with the large environmental footprint required for hydropower, construction of hydroelectric facilities by investor-owned utilities declined in the late twentieth century. Hydropower continued to play a critical role in the electric power supply, however, in that it provided peaking power, was more cost-efficient to put online (or take offline) as required by electrical demands, and proved a viable method of balancing thermal base loads.

Another important component of the mid- to late-twentieth century includes the technological advancements that led to a greater emphasis on pumped-storage hydroelectric development. Pumped-storage hydro, or the concept of using a lower reservoir to pump water into an upper reservoir for energy storage, was not a new industry design. In 1908, the world's first pumped-storage facility was completed in Germany, and other small-scale examples were present throughout Europe. The Connecticut Light and Power Company completed the first commercially operable pumped-storage hydroelectric facility in the United States in 1929 near New Milford, Connecticut. Called the Rocky River Plant, it was constructed to stabilize firm energy capacity among a series of hydroelectric plants on the Housatonic River, which had variable season inflows. The station used two 54-inch centrifugal pumps to transfer water into the Lake Candlewood reservoir, which fed the conventional hydro units (American Society of Mechanical Engineers [AMSE] 1997:69-71).

Having separate pumps for pumped-storage developments remained standard practice until international engineers demonstrated the viability of a reversible pump/turbine during the 1940s. Reversible turbines were not integrated into hydroelectric designs in the United States until the mid-1950s. The first was a small 8.5 MW reversible unit installed in 1954 at the Flatiron Project, an integrated component of the larger Colorado-Big Thompson water diversion project operated by the U.S. Bureau of Reclamation. Just two years later, the TVA installed a 60 MW Allis Chalmers reversible pump/turbine unit at Hiawassee Dam in North Carolina, which was the first use of the design for significant power generation (ASME 1997:74-75). Another major milestone for pumped-storage development was reached in 1963 at the Taum Sauk project in Missouri. Operating under 764 feet of head and 408 MW of reversible capacity, it dramatically improved upon previous turbine designs. Because the amount of power generated at hydroelectric is directly proportional to the head, and with penstocks typically representing a small percentage of total project costs, these improved turbine designs were critical in proving the economic efficiency of high-head pumped-storage projects (Dames and Moore 1981:2.9).

In addition to the proven viability of reversible turbines, the post-World War II economic growth “reshaped the electric demand pattern by increasing the peak-to-base-load ratio and creating more distinct seasonal peaks for electricity” (Dames and Moore 1981:2.6-2.8). During the early twentieth century, utilities relied heavily on electricity generated by conventional hydroelectric power plants as well as conventional steam units. By the mid-twentieth century, as average electric loads doubled each decade, utilities began developing a more diverse energy portfolio to account for base and peak load variability. Technological advancements in steam-power generation and the introduction of nuclear power helped stabilize the increasing demands for base load capacity. However, using those types of generation for peak power production could potentially lead to mechanical stresses in the units. Utilities, therefore, began looking to pumped-storage facilities for addressing peak demands and typically designed the projects to operate in conjunction with other generation facilities. The 1960s and 1970s witnessed a sharp increase in the number of proposed pumped storage developments across the country (Dames and Moore 1981:2.7-2.9). Duke Energy’s Jocassee Development in the South Carolina Upstate is a prime example of using pumped-storage hydropower to balance base load. In fact, Jocassee was part of the comprehensive Keowee-Toxaway Energy Project, which combined conventional hydro, pumped-storage hydro, and nuclear generation (Stallings 2012)

By the 1970s, the United States had entered into an energy crisis. Overall consumption had begun to decrease and inflation hit the marketplace. New environmental legislation took its toll on large-scale energy projects, including hydropower, and new regulations impacted utilities’ generation costs. During this time, the federal government entered the final stages of completing its multi-purpose dam projects and investor-owned utilities constructed a minimal number of hydroelectric facilities. Nationwide, hydropower represented an increasingly smaller percentage of total power generation, dropping to below ten percent by the 1990s. In the modern period, however, concerns over climate change have placed a new emphasis on renewable energy development, including solar, wind, and geothermal, as well as hydropower. With new renewable energy demands, hydropower continues to play an important role as a source of peaking power as investors look to new innovative methods of capitalizing on existing dam infrastructure for low-head hydro developments.

**Figure 2.6. TVA's Guntersville Powerhouse (completed 1939), Marshall County, Alabama.**

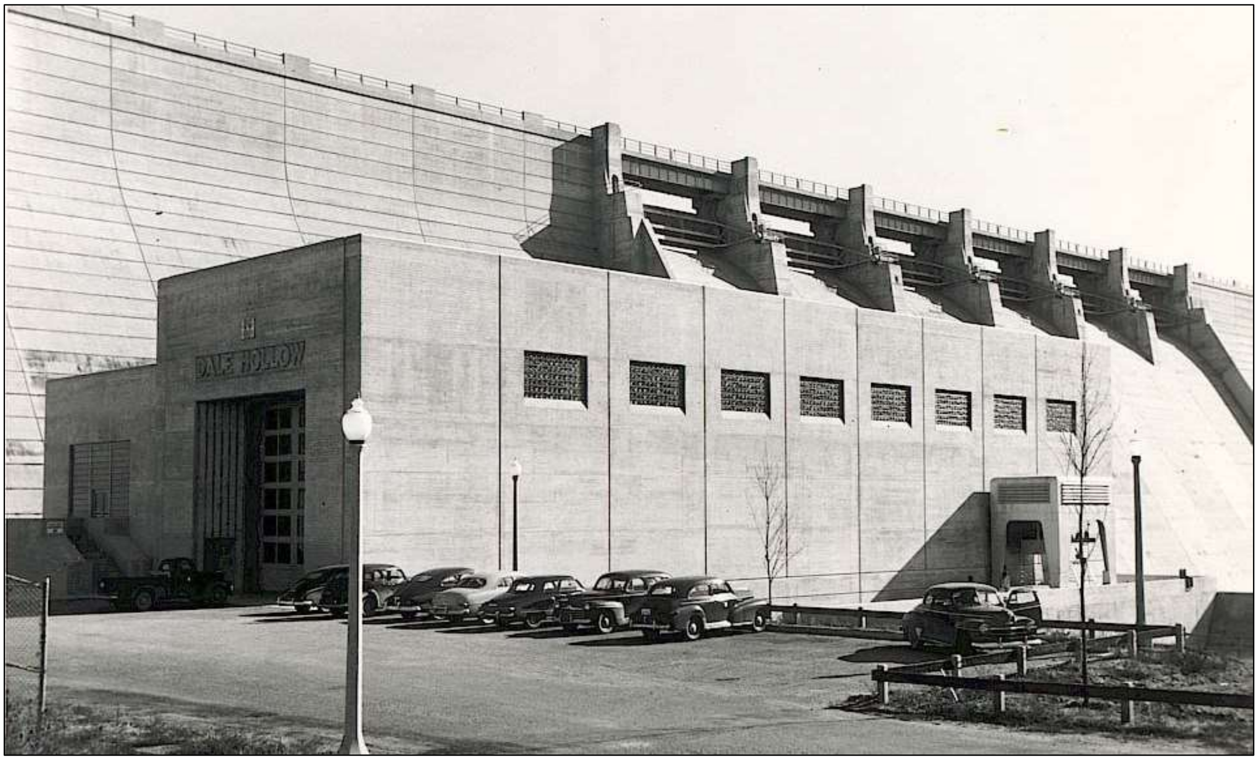

Figure 2.7. USACE Dale Hollow Powerhouse (completed 1948), Kentucky-Tennessee border.

Figure 2.8. USACE Cordell Hull Powerhouse, Lock, and Spillway (completed 1973), Smith County, Tennessee.

## 2.3 Regional Variations

As with most aspects of history, regional variations of national trends in hydroelectric development are the product of factors such as topography, settlement patterns, natural resources, transportation systems, and market forces. In outlining three basic phases in pre-World War II American hydroelectric development, Hay (1991) highlights fundamental distinctions between the East and the West based on differences in terrain and market needs. Regional differences appear to be less distinct in subsequent decades, as the development of utilities nationwide began to follow more standardized patterns of consolidated operations and ownership, interconnected supply systems, and diversified power sources.

Distinctions between the East and the West fostered significant regional differences in the early decades of hydroelectric development; the following examples are summarized from Hay's observations. During hydroelectricity's pioneering phase, industrial waterpower sites in the eastern U.S. and western U.S. had relatively low heads but ample stream flows and immediate markets for electric power among urbanized areas. By comparison, waterpower sites with heads of several hundred to more than a thousand feet were available in the West but were generally located far from population centers. Accordingly, innovation and experimentation in the West focused on developing long distance, high-voltage transmission systems, while the East turned its attention to hydraulic systems that would maximize the typically lower heads and higher flows of eastern rivers. Tunnels to carry water through ridges or between drainage basins became more common in the West, particularly for projects in the mountain ranges of the Sierras, Cascades, and Rockies. While western engineers proceeded with modifications to traditional high-velocity impulse wheels, eastern designers were forced to develop and refine the technology of the more versatile reaction turbine. By the time hydroelectric development entered a period of standardization after World War I, eastern-style configurations of vertical, single runner Francis-type reaction turbines were common in most new low and medium head plants and were introduced in high head applications as well. The trend toward consolidation and interconnection among utilities and the subsequent rise of federal involvement affected the hydroelectric industry in both the East and the West. Table 2.1 summarizes information regarding the hydroelectric plants operating in North Carolina today.

**Table 2.1. North Carolina Hydroelectric Plants (adapted from Hay 1991).**

| Name | Last Owner of Record | River | Start-up Date | Kw Capacity |
|---|---|---|---|---|
| Idols (Fries) | Duke Energy | Yadkin | 1898 | 1,411 |
| Weaver[1] | Progress Energy | French Broad | 1904 | 2,500 |
| Spencer Mountain | Duke Energy | South Fork Catawba | 1905 | 640 |
| Buckhorn[1] | Progress Energy | Cape Fear | 1908 | 2,900 |
| Marshall [2] | Duke Energy | French Broad | 1911 | 3,000 |
| Blewett Falls[2] | Duke Energy | Pee Dee | 1912 | 24,600 |
| Dillsboro[3] | Duke Energy | Tuckaseegee | 1913 | 225 |
| Eury[1] | Progress Energy | Little | 1914 | 400 |
| Lookout Shoals | Duke Energy | Catawba | 1915 | 18,720 |
| Narrows | Alcoa Inc. | Yadkin | 1917 | 96,500 |
| Cheoah | Tapoco Inc. | Little Tennessee | 1919 | 110,000 |
| Falls | Alcoa Inc. | Yadkin | 1919 | 21,485 |
| Bridgewater | Duke Energy | Catawba | 1920 | 20,000 |

| | | | | |
|---|---|---|---|---|
| Tuxedo | Duke Energy | Green | 1920 | 5,000 |
| Carbonton[1] | Progress Energy | Deep | 1921 | 1,000 |
| Mountain Island | Duke Energy | Catawba | 1923 | 60,000 |
| Brevard | Cascade Power | Little | 1924 | 1,000 |
| Mission[3] | Duke Energy | Hiawassee | 1924 | 1,800 |
| Rhodhiss | Duke Energy | Catawba | 1925 | 25,500 |
| Bryson City[3] | Duke Energy | Oconaluftee | 1925 | 1,980 |
| Franklin[3] | Duke Energy | Little Tennessee | 1925 | 1,040 |
| Turner Shoals | Duke Energy | Green | 1925 | 5,500 |
| High Rock | Alcoa Inc. | Yadkin | 1927 | 33,000 |
| Oxford | Duke Energy | Catawba | 1928 | 36,000 |
| Tillery (Norwood)[2] | Duke Energy | Yadkin | 1928 | 65,850 |
| Walters[2] | Duke Energy | Pigeon | 1930 | 11,200 |
| Hiwassee | TVA | Hiwassee | 1940 | 185,000 |
| Fontana | TVA | Little Tennessee | 1944 | 238,500 |
| Chatuge | TVA | Hiwassee | 1954 | 13,000 |
| Tuckertown | Alcoa Inc. | Yadkin | 1962 | 38,040 |
| Cowans Ford | Duke Energy | Catawba | 1963 | 350,000 |

[1] No longer in operation. Hay (1991, Volume II) notes as many as 53 hydroelectric facilities constructed in North Carolina by 1940. Only a select few are noted here.

[2] Acquired through merger with Progress Energy (formerly C&PL), 2012.

[3] Acquired through acquisition of Nantahala Power & Light, 1988.

### 2.4 Hydroelectricity in North Carolina and the Emergence of Duke Power

National developments in hydroelectric power arrived at the same time as the "New South" movement came to prominence. Urban and commercial leaders throughout the South touted the region's promise in the new world of industrial development and international commerce, citing, among other benefits, the region's natural resources. Perhaps the most visible result of the New South boosterism was the cotton mill boom. The number, size, and sophistication of southern cotton mills grew rapidly in the 1880s and 1890s. North Carolina, South Carolina, and Georgia led the South's cotton mill expansion, along with the more general industrial development in the region, and it was not mere chance that these states also led the South in hydroelectric developments.

Like other areas of the eastern United States, commercial and industrial development in North Carolina benefitted from a good network of rivers with ample stream flows, particularly near the fall line. The entire state was drained by a vast number of tributaries feeding into a number of river systems, including the Yadkin-Pee Dee, Cape Fear, Catawba, Broad, French Broad and the Little Tennessee. Rivers at or above the fall line, however, where the rushing mountain streams and rivers settled down and drained toward eastern tidal plain, provided the most ready and easily accessible source of power for textile mills. More than topographical and technological conditions influenced the development of hydroelectric power, however. Political and legal issues also shaped the pattern of growth in the state, as did questions of urban development and economic consolidation. The history of hydroelectric power is closely intertwined with the attempts by economic and political leaders and entrepreneurs to bring the state into national commercial and manufacturing currents. Importantly, the history of hydroelectric power in North Carolina is also very much interrelated to that of its neighbor to the south.

Hydroelectric power was new in the 1880s and 1890s, but the use of water power for industrial purposes was common in the North Carolina Piedmont throughout the nineteenth century. The state's first textile plant was the Schenck-Warlick Textile Mill, constructed in 1813 at Lincolnton near the fall line. The rich supply of available water power, combined with the burgeoning cotton market, led to a number of other mills being established during the antebellum period, including factories at Rocky Mount, Cedar Falls, and Alamance. By 1860, North Carolina led the south with 39 cotton mills (Ready 2005:184-185).

Beginning in the 1820s and 1830s, turbines came into use. Rather than dropping water into a bucket, as in a water wheel, turbines forced the water into an enclosed space under pressure. Water forced through a race began to rotate before entering the water wheel within the turbine; this allowed the water wheel to capture the water's energy more efficiently in situations of low head. Many of North Carolina's eastern rivers presented situations of low head. This in essence remains the technology used in modern hydroelectric turbines. By the later nineteenth century, stock pattern turbines were available (Hay 1991:60-67). These various water power technologies were in widespread use throughout the North Carolina Piedmont during the nineteenth century, where the rivers could sustain industrial sites.

National hydroelectric developments emerged in a pioneering phase during the early 1880s. The Piedmont Carolinas entered the field in 1894 with the creation of the Columbia Mills in South Carolina. This was the first time in the nation that hydroelectric power operated an entire textile mill. A contemporary observer noted the time lag between the appearance of hydroelectric power and its introduction into textile mills, claiming mill owners were conservative, but always on the look-out for labor-saving machinery: "They are slow to act when new ideas are broached, but, having once made up their minds, carry out the work with the greatest sagacity and skill" (Bell 1895:275). Innovations in hydropower technology, including the ability to transmit power over greater distances, ultimately facilitated the growth of a burgeoning textile industry in the Piedmont Carolinas. As the North Carolina State Board of Agriculture predicted:

> This distance of most of the North Carolina [water]powers from railroad transportation is the factor that has prevented their development; but the transmission of power by electricity promises to do away with this disadvantage by making it practicable to locate the factories on the railroad lines and still operate them by water power, whether one or twenty miles away. This new factor is giving a new and greater importance to our water powers than they have had before (North Carolina State Board of Agriculture 1896:136-137).

Hydroelectricity was coming online in a New South increasingly focused on industry and manufactures. Electrical demand was on the rise and stressing the region's existing fuel source, coal. During this period, the coal industry was also beset with labor strikes and bad management which created volatility in the market, much to the consternation of mill owners. Hydroelectricity, sometimes referred to as "white coal," was cheap, renewable, and "more easily manipulated than human labor" and "hastened the textile boom" in the South (Manganiello 2015:49-51).

In 1896, the Columbia Water Power Company built a powerhouse and dam that replaced the original powerhouse for the Columbia Mill in South Carolina. This plant not only provided power for the mill, but also for city's street railway and lighting systems (Kovacik and Winberry

1989:118). Anderson, South Carolina was another city to receive street lighting by way of hydroelectric power. After William Whitner designed the small hydroelectric facility for the town, the Anderson Water, Light, and Power Company had him build a dam and hydroelectric facility at Portman Shoals on the Seneca River, which was completed in 1897.

William States Lee, an Anderson native, served as the resident engineer and Whitner's assistant, and oversaw the installation of the nation's first 10,000-volt generator (Durden 2001:7; *Electrical World* 1910:738). This power was sent along some of the nation's first high-tension electrical transmission lines and powered electric lights for the city of Anderson along with eight mills built between 1899 and 1903 (Carlton 1982:134; Kovacik and Winberry 1989:118). The Portman Shoals site was also owned by Dr. Walker Gill Wylie, who was one of the stockholders and leaders in the Anderson Water, Light, and Power Company (Durden 2001:8). Both Lee and Wylie later played a significant role in the development of hydroelectric power in the Piedmont Carolinas.

The first significant use of hydroelectricity in North Carolina was the Idols Hydroelectric Plant on the Yadkin River. Constructed in 1898 by the Fries Power and Manufacturing Company, the Idols facility powered textile mills, street cars, and small manufacturing plants in nearby Winston and Salem. Other small hydroelectric plants began emerging in the state. Duncan Hay's study (1991) identifies some 53 facilities in North Carolina constructed before 1940. While some of these were small and operated for only a short time before becoming uneconomical, others were absorbed by emerging larger utilities such as Duke Power and Carolina Power & Light (Cleveland and Holland 2005).

These hydroelectric facilities at the mills and the municipal plants, for all of their technological innovations, were relatively small affairs and local in scope. This was not to be the pattern of hydroelectric activity in the state or the nation in the twentieth century. This was the era when immensely powerful and wealthy men with imperial visions consolidated smaller firms within various industries. It was the period when John D. Rockefeller organized the Standard Oil Company, when Andrew Carnegie was amassing what was to become the United States Steel Company, and when the Vanderbilts and others formed the great national railroad companies. In this era of consolidation, any large-scale industry with national implications that required immense capitalization and had the potential for immense profits was ripe for combination. The generation of electricity, particularly hydroelectric power, was among these industries, and North Carolina was one of the principal areas where the effect of consolidation was felt.

During the early twentieth century, three large utilities emerged: Carolina Power & Light (CP&L), the Aluminum Company of America (Alcoa), and Duke Power. In 1908, CP&L was formed with the merger of the Raleigh Electric Company, Cape Fear Power Company, and Consumers Light and Power Company. The merger was timely, in that the individual companies had just completed or were in the process of completing their own hydroelectric facilities. CP&L began improvements to transmission lines immediately and by the early 1910s had begun acquiring smaller electric companies in western North Carolina. By 1926, CP&L had 19,800 customers and was nearing completion of its Tillery hydroelectric plant on the Yadkin River (Cleveland and Holland 2005; Riley 1958).

Alcoa emerged as a regional utility, not as a municipal electric supplier, but as one for a specific industry. In 1895, the Pittsburgh Reduction Company became the first customer of the newly constructed Niagara Falls facility and soon the company (re-named Aluminum Corporation of America) began constructing their own hydropower facilities in other locations. In 1917, Alcoa constructed the Badin hydroelectric plant on the Yadkin River, to be followed by three others: Yadkin Falls (1919), High Rock (1927), and later at Tuckertown (1962). Alcoa also formed a subsidiary in western North Carolina, the Nantahala Power & Light Company (NP&L), for residential and commercial electrical service in western North Carolina. The Glenville and Nantahala dams benefitted from the fall (head) readily available in the mountainous terrain (Cleveland and Holland 2005; Thomason and Associates 2003).

Similarly, the South's first regional power company, the Catawba Power Company (predecessor of today's Duke Energy), had its origins in early hydroelectric plants of the 1890s. Instead of consolidating previously-built plants and transmission lines, this company created its own network of plants. William Whitner, the engineer who designed the plants for Anderson, sought to build another dam and hydroelectric plant at India Hook Shoals on the Catawba River near Rock Hill, South Carolina. Whitner approached Dr. Walker Gill Wylie of the Anderson Water, Light, and Power Company about funding. Wylie, a native of Chester, South Carolina and by 1900 a successful physician in New York City, was deeply interested in the development of hydroelectric power and had been a backer of the projects in Anderson. In 1900, Wylie, along with his brother Robert and Whitner, created the Catawba Power Company with the plan of building the plant at India Hook Shoals (see Figure 2.2). During construction, Whitner resigned as engineer. In his place, the Wylies hired William States Lee, Whitner's former assistant who at the time was overseeing the construction of a hydroelectric plant in Columbus, Georgia (Durden 2001).

Together, Lee and the Wylies completed the dam and hydroelectric plant in 1904 (Durden 2001; *Electrical World* 1910:739). Wylie introduced Lee into his vision for the complete development of the Catawba-Wateree River system in North and South Carolina. Hydroelectric plants would capture the entire fall of the river system and, according to this vision, would provide electricity to the Piedmont's growing cities and would power the region's textile mills which were rapidly increasing in number. James B. "Buck" Duke, a North Carolinian who moved to New York and consolidated the nation's leading tobacco companies into the American Tobacco Company in 1890, heard of this vision from Dr. Wylie. After a meeting with Lee and Wylie, Duke offered to support the project from his enormous coffers.

Buck Duke, along with his older brother Benjamin N. Duke, was no stranger to hydroelectric power. In the late 1890s, he and his brother Ben, who had invested in textile plants in North Carolina in the early 1890s, began buying water power sites in North and South Carolina under the American Development Company, which they created in 1899 (Durden 2001:16; Maynor 1979:14; Savage 1973:298). In particular, Duke was willing to risk his money on the still relatively untested transmission of high-voltage electrical power over long distances for use in manufacturing operations. Lee was able to interest Duke in his plan to link the various proposed hydroelectric plants along the Catawba River in order to provide the continuous system that textile plants would need (Durden 2001). In 1905, with Duke's support, the Catawba Power Company became part of the new Southern Power Company, the predecessor to Duke Power Company. By 1920, the Southern Power Company had created a network of hydroelectric power houses along the Catawba-Wateree river system (Figure 2.9), including Great Falls (1907), Rocky Creek (1909), Lookout Shoals (1915), Fishing Creek (1916), Wateree (1920), Mountain Island (1924), Rhodiss (1925), Cedar Creek (1926), and Oxford (1927) (Maynor 1979; Durden 2001). By the 1940s, as one historian noted, Duke Power Company's dams were placed and used so efficiently on the Catawba River that "they capture[d] for electric energy all but 304 of the 1,056 feet of the river's fall" (Simkins 1953: 478).

The original plan of Lee, Wylie, and Duke with the Southern Power Company was to provide electricity to the region's textile mills. Duke independently built several hydroelectric powered textile plants, and also provided financial support for others to create plants. Residential customers soon became an important component of Southern Power Company's market as well. Beginning with textile mill villages that mill owners insisted be supplied with electric power, Southern Power Company began serving residences and businesses in the region's towns and cities (Durden 2001; Maynor 1979). By 1924, 80 percent of the company's electricity was destined for textile mills, with 10 percent going to other manufactures, and the remainder consumed by various municipal systems (Manganiello 2015:51).

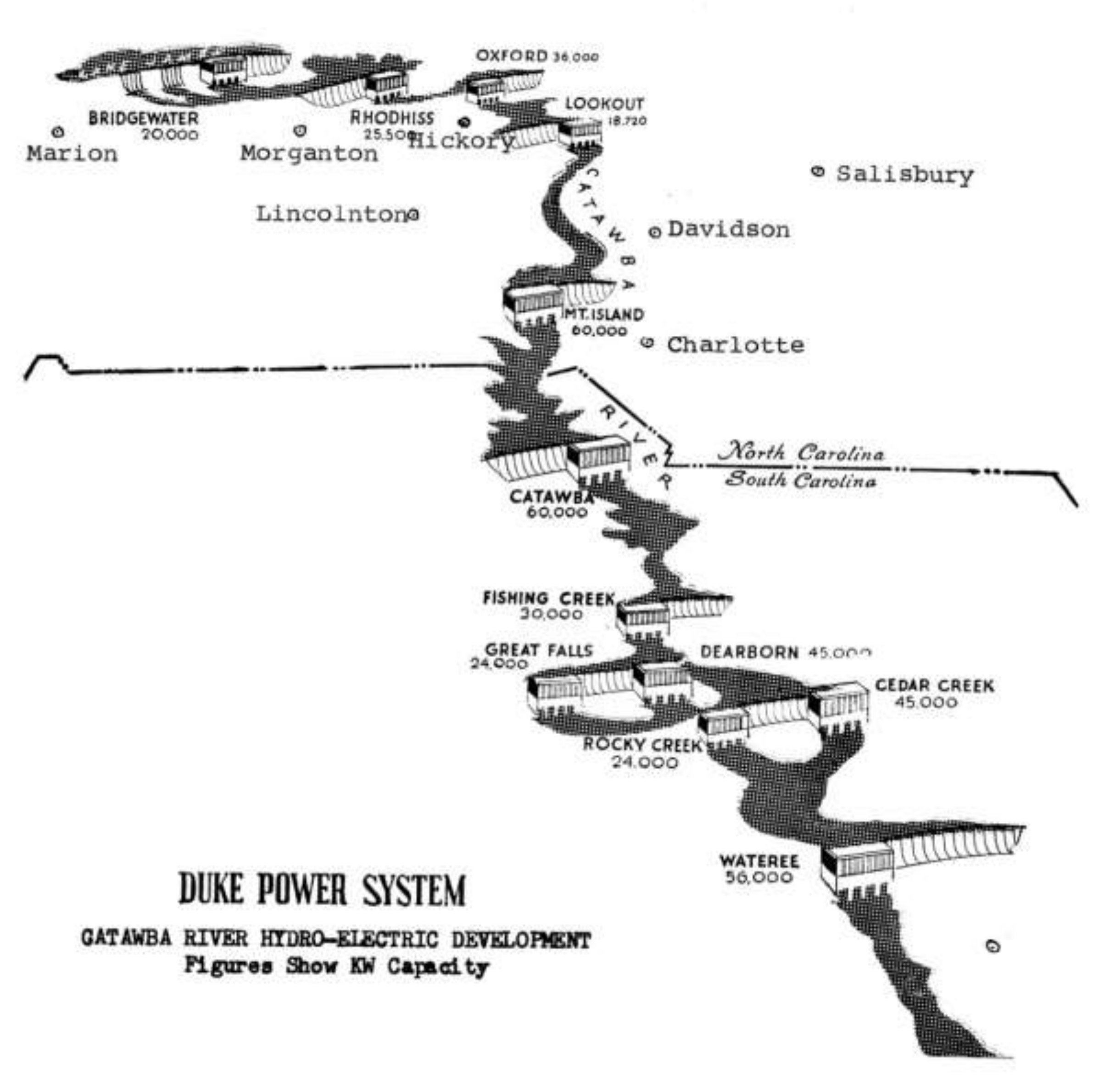

**Figure 2.9. Hydroelectric Plants Along the Catawba-Wateree River System (Duke Energy Archives).**

One of the chief problems of generating hydroelectric power was dealing with fluctuations in the river levels. Floods could wash out dams and power houses, while droughts could put a stop generation altogether. In the mid-1920s, for example, just as the newly christened Duke Power's network was gaining strength, a record drought lowered lake levels nearly to the ground. This situation forced a more widespread acceptance of having adjoining steam plants to the hydroelectric facility. As one historian has noted, although Duke Power already had two steam generating plants, "the unified system of mutually supplementing steam and hydro plants of today's system was born of the 1925 drought. By 1930, a fourth of the power sold was produced in steam plants" (Savage 1973:300).

Hydroelectric power had been one of the industries that experienced a great degree of consolidation during the period of economic and industrial consolidation in the 1910s and 1920s. Because the amount of capital necessary to erect dams, power houses, substations, and cross-country transmission lines, concentration of resources was necessary. Few individual companies could compete in what was coming to be a natural monopoly. The number of power companies in America declined from 4,224 in 1912 to 1,627 in 1932. By the early 1930s, most of these plants were in the hands of six giant corporations; Duke Power Company was alone in remaining independent of outside holding companies. Moreover, most hydroelectric power was sent to various states from individual power plants; hydroelectric power was therefore an aspect of interstate commerce, and not subject to regulation by state governments (Morrison and Commager 1937:537-539; Tindall 1967:74).

The Federal government alone had the ability to regulate the generation, transmission, and sale of hydroelectric power. In the 1920s and 1930s, however, the Federal government was not inclined to involve itself in regulating hydroelectric power. Under a reforming Progressive impulse that was led by Senators Robert LaFollette of Wisconsin and George Norris of Nebraska, Congress made several moves to encourage public ownership of hydropower plants. The first attempt was the Water Powers Act of 1920, which authorized the Federal Water Power Commission to regulate power plants on the navigable streams of public lands. It proved to be of little value, however, and citizens, industries, and municipalities alike continued to complain of extortionary electric rates by the private utility companies. The central fight of the decade was for control of the Muscle Shoals plant on the Tennessee River in Alabama. The Muscle Shoals plant was constructed by the government shortly before America's entrance into World War I under a bill introduced by South Carolina Senator Ellison D. Smith. In 1928, Congress passed a highly contentious bill to permit continued government operation. President Coolidge vetoed the measure in 1928, and his successor, President Hoover, vetoed a similar bill in 1931. While there was some divisiveness, most southern congressional representatives supported public ownership of the power plant as a way to stimulate business in the South (Grantham 1994:93-94; Morrison and Commager 1937:538; Schlesinger 1959:322; Tindall 1967:241).

The move toward public control of hydroelectric power plants gained momentum in the 1930s under President Franklin Roosevelt's New Deal programs. As one historian of the New Deal observed, Roosevelt "shared the popular outrage at the electric power octopuses that had fleeced the consumer, corrupted legislatures, and, by their elusive operations, evaded state regulation" (Leuchtenberg 1963:154). The South in the New Deal continued to support federal policies such as the Agricultural Adjustment Act and the Federal Emergency Relief Administration. These agencies pumped significant amounts of federal aid into the South, which had been in a state of economic crisis since the 1920s, long before the onset of the Great Depression. By late 1933, one historian notes, "more than four million southerners (more than one in every eight) were receiving public relief dispensed by the federal government" (Grantham 1994:120). Of particular interest was the Tennessee Valley Authority (TVA), which was established May 18, 1933 and provided a "coordinated regional program of flood control, navigation, agricultural regeneration, and cheap hydroelectric power" to the South (Grantham 1994:119). In addition, the TVA solved the Muscle Shoals controversy by incorporating the plant into its regional network. Eventually, TVA would construct four hydroelectric plants in western North Carolina, one of which included the famed Fontana Dam, the highest dam east of the Rocky Mountains.

Regionally, South Carolina in the 1930s was a vanguard in providing public control of hydroelectric power and to provide electricity to its rural citizens. The state legislature created a Public Service Authority in 1934. The principal purpose of this agency was to develop the Cooper, Santee, and Congaree Rivers for navigation, hydroelectric power, and to reclaim swampy lands. It was a controversial move and private power companies resented the prospect of competition from the state government, and factions within the legislature were unconvinced that it was a proper function of the state. The different factions within the legislature eventually came to a compromise, however, and enabling legislation was passed in April 1934 (Ball 1934).

The precedent for federal funds for an intrastate hydroelectric power facility had to wait until January 1938, when the Supreme Court handed down a decision regarding the Buzzard Roost facility in South Carolina and several facilities in Alabama. The plan called for dams to impound two enormous reservoirs. These reservoirs, now Lakes Moultrie and Marion, would be used to facilitate navigation and to provide hydroelectric power. Despite continuing opposition from private power companies through the late 1930s, the plant (located at Monck's Corner) went online in 1942 (Ball 1934; Kovacik and Winberry 1989:119; Larsen 1947:14).

### 2.4.1 Mid-Century and Beyond: Meeting Peak Demands

Duke Power's predecessor, Southern Power Company, had begun integrating steam stations into its generation portfolio as early as 1913, but these served only to support peak loads with hydro providing base load (Durden 2001:33). Heavy floods during the 1910s, which damaged several of the Catawba River plants, and then droughts of the 1920s, encouraged company officials to look at large steam plants for greater reliability. In 1926, Duke Power's first large steam plant, Buck Steam Station on the Yadkin River near Salisbury, marked the company's transition toward fossil fuel generation for base load power (Cleveland and Holland 2005). The Riverbend Plant near Gastonia went online in 1929 and, following a lull during the Great Depression, the Cliffside Station near Mooresboro was completed in 1940.

To meet the new increased electrical demand in the Carolina Piedmont after World War II, Duke Power again focused on higher-capacity generating facilities, including additional steam plants at Dan River (1949), Lee (1951), and Allen (1957). Power stations increased exponentially in size (Figure 2.10) due to improved technologies, particularly in steam turbines, during the 1945-1965 period (Table 2.2). By the end of the 1950s alone, new steam plants could generate over one million kilowatts of power. In 1958, Duke Power reported that of its total 12.5 billion kilowatt hours (kwh), 85.3 percent came from steam plants, 13.3 percent by hydro, and 1.4 percent was purchased from other companies (Durden 2001). By 1965, its hydro capacity had dipped to 8.4 percent (Duke Power 1965). During this time, Duke Power's net electric generation grew from 2.65 billion kwh in 1940 to 22.65 billion kwh in 1965. Figure 2.11 illustrates the Duke Power service area and its generating portfolio during this period.

**Figure 2.10. Duke Energy's Marshall Steam Station (completed 1965).**

**Table 2.2. Anticipated Additions to Duke Power's Generating Capacity, 1945-1965 (Duke Power 1965).**

| Existing Generation and Expected Additions* to Steam Plants | Began Operation | Net Peak Capacity (KW) |
|---|---|---|
| Lee #1-2 (Anderson, SC) | 1951 | 209,220 |
| Riverbend #4-5 (Charlotte, NC) | 1952 | 217,800 |
| Buck #5-6 (Salisbury, NC) | 1953 | 275,200 |
| Riverbend #6-7 (Charlotte, NC) | 1954 | 285,600 |
| Dan River #3 (Reidsville, NC) | 1955 | 156,580 |
| Allen #1-2 (Belmont, NC) | 1957 | 339,720 |
| Lee #3 (Anderson, SC) | 1958 | 169,860 |
| Allen #3 (Belmont, NC) | 1960 | 274,920 |
| Allen #4 (Belmont, NC) | 1961 | 274,920 |
| Allen #5 (Belmont, NC) | 1961 | 293,720 |
| Marshall #1 (Catawba, NC) | 1965 | 373,550 |
| Marshall #2 (Catawba, NC) | 1966 | 373,550 |
| Marshall #3* (Catawba, NC) | 1969 | 650,000 |
| | | |
| **Hydro Additions, 1951-1966** | | |
| Cowans Ford #1-3 | 1962 | 650,000 |
| Cowans Ford #4* | 1967 | 93,000 |
| | | |
| | **Total KW** | *4,266,640* |

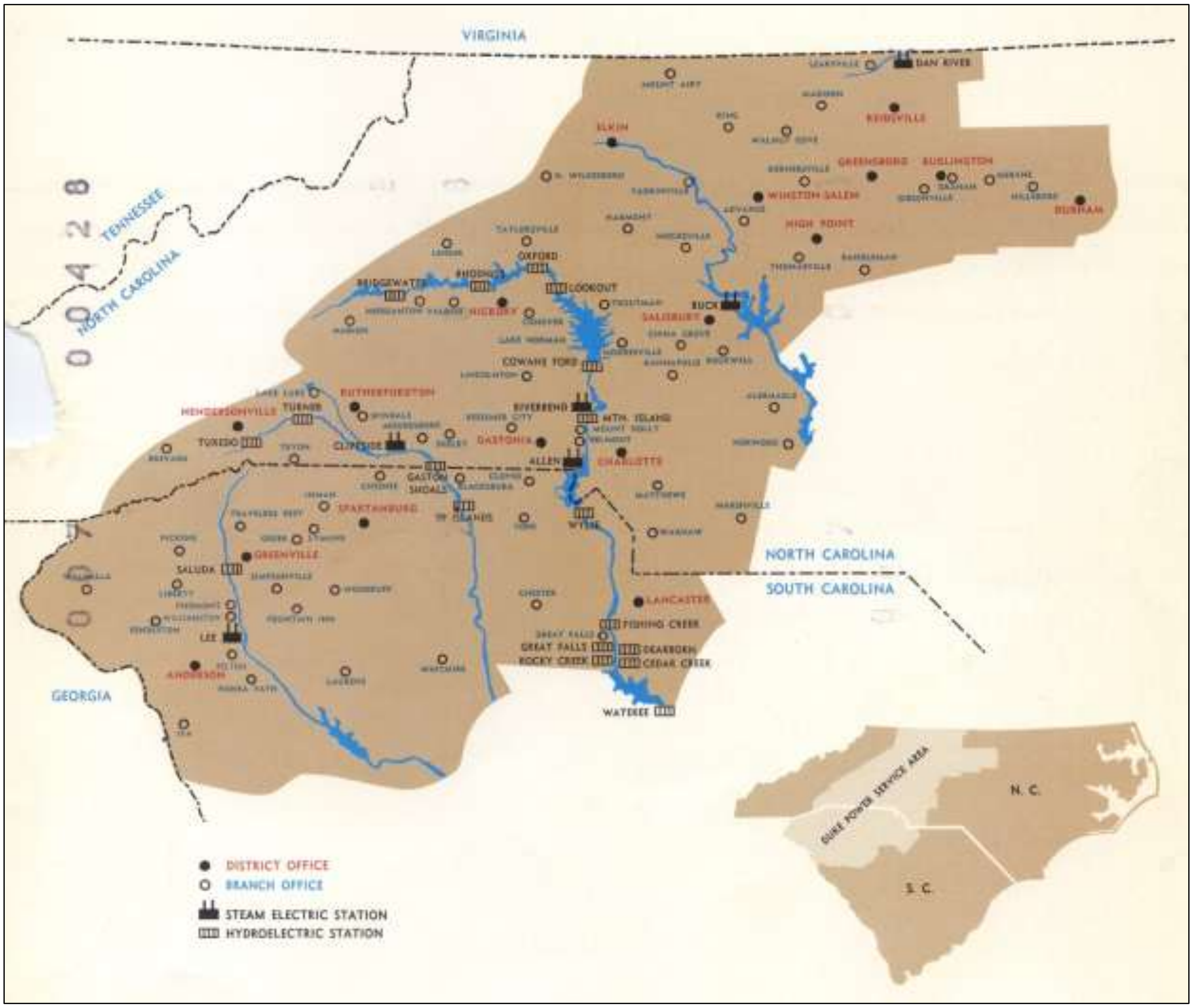

**Figure 2.11. Duke Power service area with generating plants, 1960s.**

Although the company relied heavily on its steam generating plants, it was also interested in other new sources of power. By 1960, the atomic age had arrived and while Duke Power was not prepared to begin construction of a wholly-owned nuclear generating station, it partnered with three neighboring utilities (Carolina Power & Light, Virginia Electric & Power Company, and South Carolina Electric & Gas Company) to form Carolinas-Virginia Nuclear Power Associates, Inc. In 1963, this conglomerate completed the first nuclear reactor in the U.S. South, on the Broad River at Parr, South Carolina (Durden 2001:121).

As discussed earlier, most of the hydropower development underway during the mid-twentieth century was initiated by the federal government for its multi-purpose river system projects. But, Duke Power had yet to fully abandon hydropower as a source of electricity. In 1963, the company completed the last project of the Catawba-Wateree system, Cowans Ford in North Carolina. Discussed in greater detail in Section 2.4.2, Cowans Ford represented a new era for Duke Power in that the company also saw the impoundment, Lake Norman, as an investment opportunity. In addition to leasing popular lakeside lots, the company formed a subsidiary to develop the real estate around the lake (Durden 2001).

During the early 1960s, Duke Power also began planning a larger, more comprehensive power generation project in the Upstate of South Carolina near Seneca (Figure 2.12). The lynchpin of the Keowee-Toxaway Energy Project was the company's first wholly-owned nuclear generating station to supply base load capacity. A pumped-storage hydropower component at Jocassee would supply medium-capacity peaking hydroelectricity, while the Keowee hydro station would supply additional peaking capacity and serve as a backup power supply for the nuclear station.

When Duke Power filed for its Federal Power Commission (FPC) license in 1965, the company met with immediate resistance from downstream federal power interests. The USACE had a system-wide flood control effort underway along the Savannah River, including three projects with a hydropower component: Hartwell, Clarks Hill, and Trotter Shoals. A group of federal power customers, primarily rural electric cooperatives in the Carolinas and Georgia, began a vocal opposition to the Keowee-Toxaway Energy Project. Because political support in South Carolina strongly supported Duke Power's efforts, ultimately the federal power customers in South Carolina dropped their protests. In 1965, Secretary of the Interior Stewart L. Udall expressed his own opposition to Keowee-Toxaway. Udall suggested that Duke Power could always purchase its peak power needs from the federal government and that Keowee-Toxaway was an unnecessary excess into the electrical market (Durden 2001).

Concurrently, Duke Power was also opposing the federal government's multi-purpose project at Trotter Shoals (now R. B. Russell Lake and Dam), which had been authorized by Congress in 1966. The regional investor-owned utilities, including Duke Power, Georgia Power, Carolina Power and Light, and South Carolina Electric and Gas, had all been vocal against regional federal hydropower development. During the 1930s and 1940s, when the USACE, Bureau of Reclamation, and the TVA were constructing multi-purpose projects, the federal agencies also built associated transmission facilities. In the southeast, however, the private power interests opposed federal transmission lines, arguing that because the region already had a sufficient grid, customers would be forced to pay for an excess service. By the 1950s, the private power interests had won the argument, and Congress defunded all planned federal transmission lines in the South. This left the regional federal power marketing agency, SEPA, to contract or 'wheel' with investor-owned utilities in order to serve the federal power customers (Durden 2001; Norwood 1990).

Ultimately, the parties negotiated a compromise in 1966. Duke Power agreed to drop its opposition to the Trotter Shoals project and the federal government and cooperatives agreed to no longer oppose the Keowee-Toxaway Energy Project. That same year, the FPC granted Duke a license to operate the Keowee-Toxaway Hydroelectric Project (Durden 2001; *Augusta Chronicle* July 21, 1966). Construction of the comprehensive energy project proved an enormous undertaking and took seven years to fully complete. The Keowee Development went online in 1971, followed by the pump-storage facility at Jocassee in 1973. The Oconee Nuclear Station also went online in 1973. Further, Duke Power planned for the $700 million Keowee-Toxaway Energy Project to meet long-range needs and anticipated other potential pumped-storage facilities in the higher elevations above Jocassee. The company filed with the FPC in 1974 for the Bad Creek Pumped Storage Project, which was ultimately completed in 1991 (Duke Power 1975).

While Duke Power had identified its last hydroelectric facility for construction, it would soon acquire more. In 1988, the company purchased Nantahala Power & Light from Alcoa, which included six hydroelectric facilities and extended its service area further into western

North Carolina. More recently, in 2012, the newly named Duke Energy merged with Progress Energy (a consortium of CP&L and Florida Power & Light). This brought four additional hydroelectric facilities into their fleet: Tillery and Blewett on the Yadkin River in the East and Walters and Marshall in the Smoky Mountains. As of 2015, Duke Energy's hydroelectric plants provide 3,525 megawatts of renewable energy and with 44 facilities, Duke Energy is the second largest investor-owned hydroelectric operator in the United States.

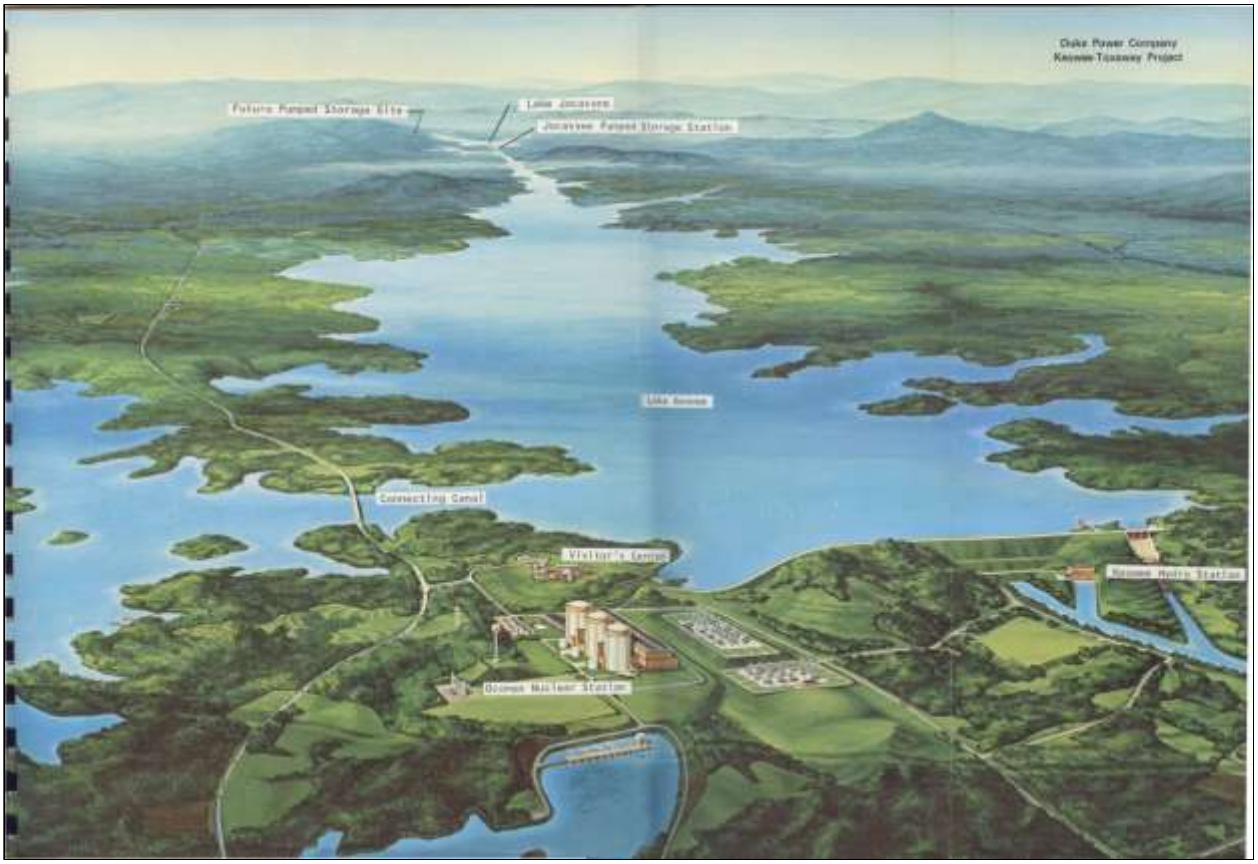

**Figure 2.12. Vision of Duke Power's comprehensive Keowee-Toxaway Energy Project, combining conventional hydro, pump-storage hydro, and nuclear generation (Duke Energy Archives).**

### 2.4.2 Hydroelectric Development at Cowans Ford

Development of the Catawba River began in 1900 when construction began at the "Old Catawba" Plant. Four years later, the plant began producing electricity which was delivered to the Victoria Cotton Mill at Rock Hill, South Carolina over an 11,500 volt transmission line. As noted in Section 2.4, Southern Power Company (and subsequently Duke Power) continued developing hydropower facilities along the Catawba during the early 1920s, with the last (at least temporarily) completed at Oxford in 1927 (Wray 1960). While the fall available at Cowans Ford certainly intrigued the company, indeed land had already been purchased, by the time Oxford came online, Duke Power was beginning a steady transition towards steam generation. "Earlier development of this low energy project would have been of little value in meeting the large demand for energy in this transition period," wrote one employee. "It was not until 1955 that sufficient steam plant capacity had been added to permit the full use of the existing hydro capacity during a low water year for peaking purposes." Planners estimated by 1965, Duke Power's steam and hydro capacity would be 80 percent and 20 percent, respectively, and generation at Cowans Ford, an estimated 350MW, could "operate very satisfactorily on the company's load curve" as a peaking facility (Wray 1960:2-3).

Completion of Cowans Ford would also represent the last link for Buck Duke's vision for electrifying the Catawba River (Figure 2.13). In his early surveys of the river, Duke had identified a total of 1,052 feet of available fall between the headwaters near the future Bridgewater Plant and the tailwaters of the Wateree Plant. The site at Cowans Ford, some twenty miles northwest of Charlotte, would increase the developed head to 891 total feet, or 85 percent of the available fall. Because of Duke's early vision, much of the acreage for Cowans Ford was purchased during the early twentieth century. Initial tracts were acquired as early as 1907 with more added during the 1920s at a total cost of $1,470,000. The company had also purchased the East Monbo and Long Island textile plants which would be submerged by the new reservoir (Duke Power 1956:4-5).

Once Cowans Ford was determined feasible, it applied for an FPC (now FERC) license in 1957, which was granted the following year. Clearing for the massive development, which would include the largest man-made lake in North Carolina, started on August 3, 1959 with official groundbreaking ceremonies occurring a month later. Its projected cost was approximately $54 million and an estimated 350,000 cubic yards of concrete would be used in its construction along with 6.2 new miles of railroad to transport materials. Figures 2.14-2.28 illustrate the construction progress of the facility.

Construction of the Cowans Ford Dam first required a coffer dam to divert the Catawba River east of its natural channel and then, re-directing the flow back through the new gates once they were in place during early 1962. Such a large project also required rebuilding roads (Figure 2.29), bridges, trestles, and the demolition of old textile mills and dams (Figure 2.30). Seventeen miles of gas pipeline had to be rebuilt or relocated along with more than 40 miles of electric and telephone distribution lines. Many of the local communities relied on the river for water supply and several intake systems had to be reconstructed (Figure 2.31). The impoundment affected approximately 70 roads, half of which became "deadened" and the other half rerouted or raised above the new lake (*Florida Steel Triangle* 1963; *Greensboro Record* 1964). One casualty was the old Beattie's Ford Bridge, a steel truss structure originally constructed in 1916 that carried North Carolina Highway 73 over the Catawba River. On July 3, 1962, the bridge quite literally went out with a bang when demolition teams from the U.S. Army and U.S. Army Reserves detonated charges rigged to the piers and spans (Figures 2.32-2.33; *Charlotte Observer* 1962).

Once completed, the earthen Cowans Ford Dam measured nearly 7,000 feet long and included a 1,279 concrete center with a gravity spillway and 11 taintor gates. Its four vertical-shaft Kaplan turbines were capable of 87,500kW each (Figure 2.34), which was more than the combined output of any single station within the existing Catawba-Wateree system. This also made Cowans Ford the fourth largest installed capacity hydroelectric station in the United States (Cleveland and Holland 2005). The first three units went online in 1963 with the fourth following in 1967. Residences were constructed for on-site operators who were to be available twenty-four hours a day.

Lake Norman, named for retired Duke Power President Norman A. Cocke, at 32,500 acres, represented the largest impoundment in the Catawba-Wateree system. It took sixteen months to fill and is almost as large as the combined area of the ten other lakes (Wray 1961; Blackley 2013). The lake was envisioned not only as a source of energy for the hydroelectric plant, but also as a source of cooling water for new steam plants or potentially even a nuclear plant. Of four envisioned steam sites, only Plant Marshall, which went online in 1965, was ever completed (*Greensboro Daily News* 1964a and 1964b). However, by this time, Duke Power was also considering the possibility of adding more atomic power to its portfolio and the lake eventually served to supply cooling water for the nearby McGuire Nuclear Station, which went online in 1981.

While Lake Norman inundated a significant swath of the landscape, Duke Power took care to acknowledge the local history. In March 1964, a marker dedicated to the early Trans-Catawba history of the area, was erected near the Highway 73 bridge (Figure 2.35). A few months later, the company, in collaboration with the local Daughters of the American Revolution, unveiled a tricorner monument near the powerhouse (Figure 2.36). The marker commemorated the death of General William Lee Davidson, who fell in the nearby Battle of Cowans Ford on February 1, 1781. Later that year, plaques were added specific to the Cowans Ford hydro facility, which was "dedicated to the people of the Piedmont Carolinas."

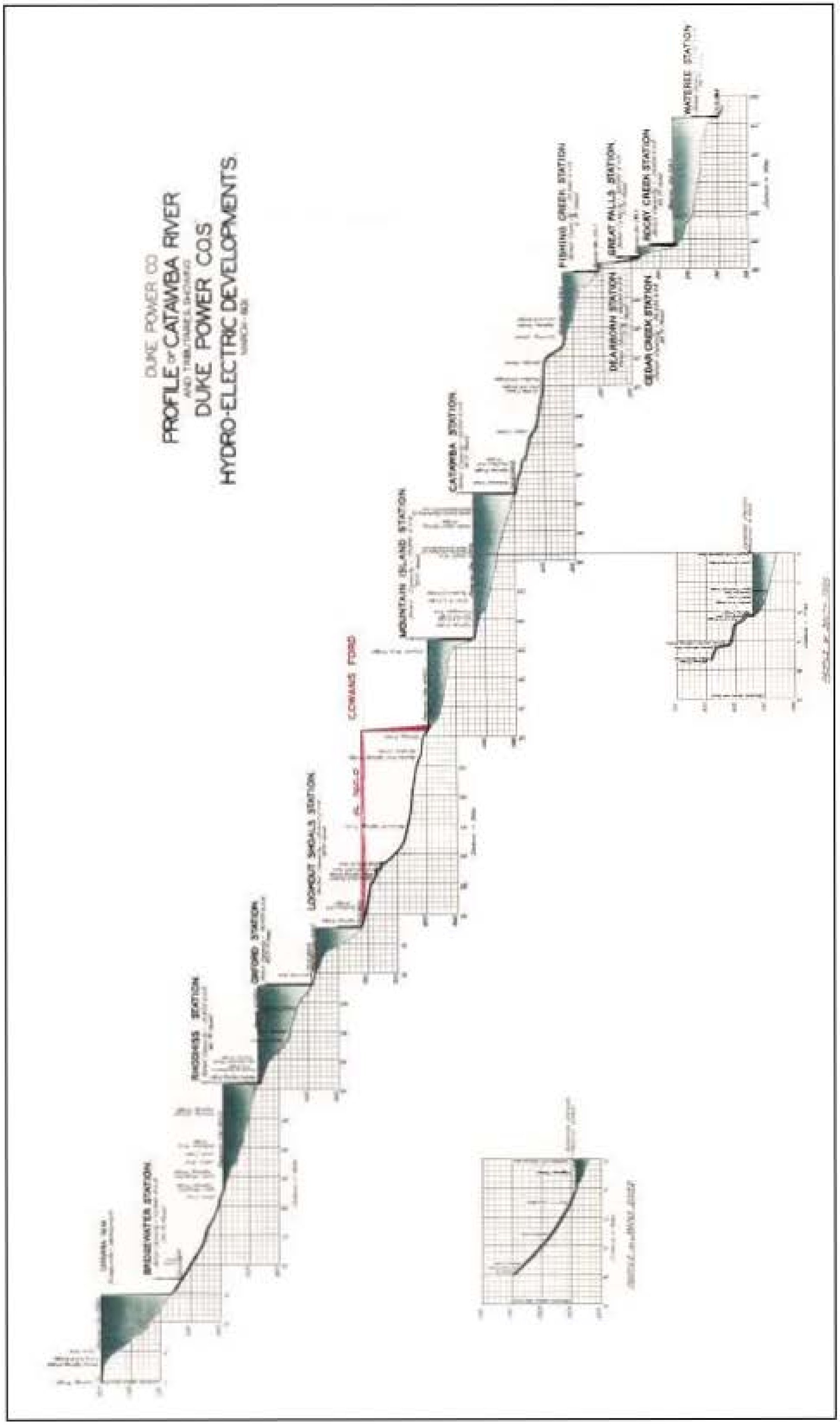

**Figure 2.13. Duke Power's profile of the Catawba-Wateree, showing available fall along the river and how Cowans Ford would fit into the overall system (profile drawn 1931, updated mid-1950s).**

**Figure 2.14. Artist's rendering of the Cowans Ford Facility.**

**Figure 2.15. Cowans Ford underway, October 1959.**

**Figure 2.16. Cowans Ford, April 1960, showing early construction of coffer dam.**

Figure 2.17. Cowans Ford, September 1960, showing manipulated river bed for construction.

**Figure 2.18. Cowans Ford, June 1961, showing water re-diverted back through gates.**

**Figure 2.19. Cowans Ford Powerhouse, November 1961, showing construction.**

**Figure 2.20. Cowans Ford Powerhouse, December 1961, view from dry tailrace.**

**Figure 2.21. Cowans Ford, June 1962, showing progress. The earthen dam (serpentine structure) can be seen just above photo center.**

**Figure 2.22. Cowans Ford Powerhouse, September 1962.**

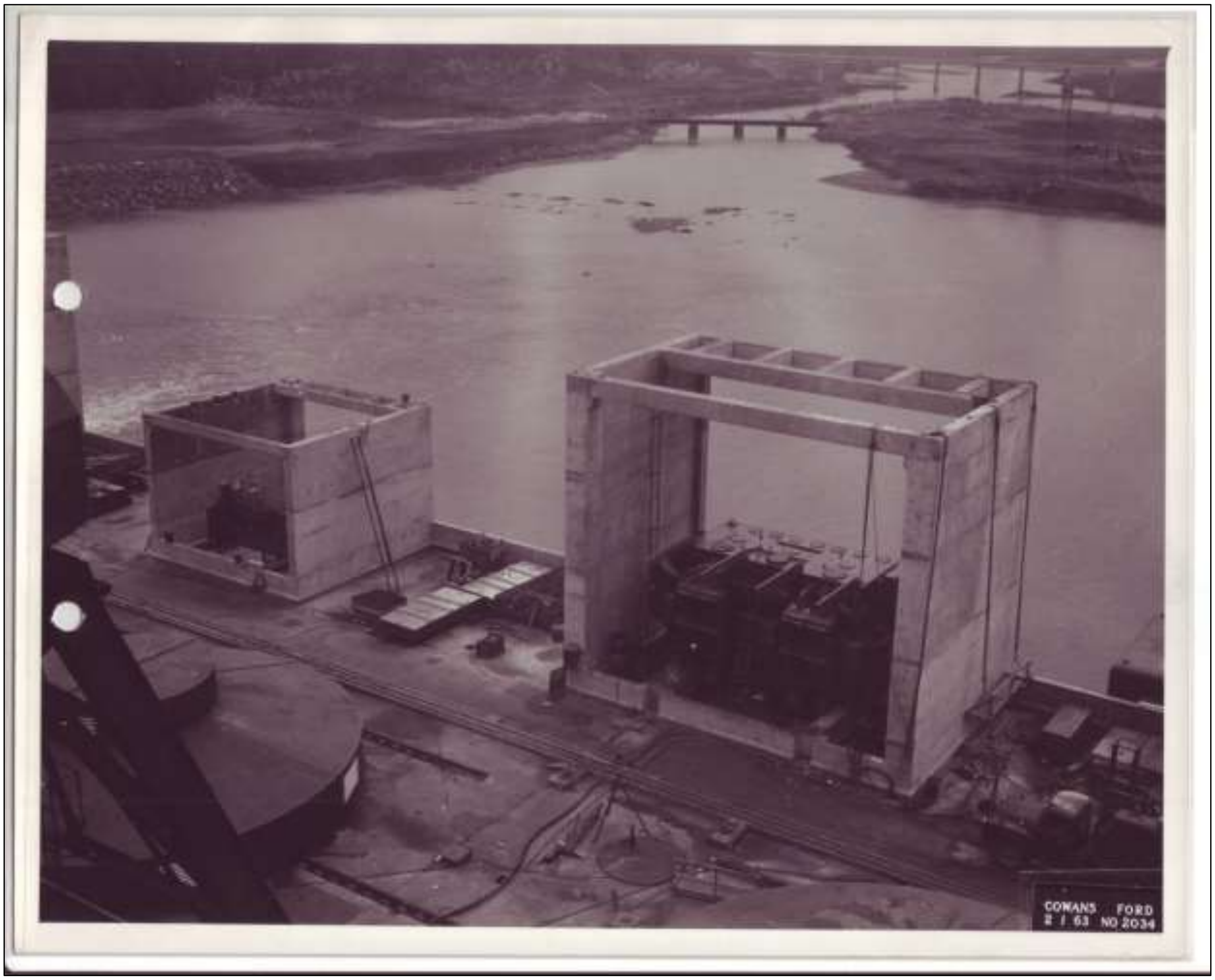

**Figure 2.23. Cowans Ford Powerhouse, February 1963, showing transformer casings.**

**Figure 2.24. Cowans Ford Powerhouse entry, September 1963.**

**Figure 2.25. Cowans Ford, September 1962, showing the adjustable blades on the soon-to-be-installed Kaplan turbines. Photo was taken in the service gallery.**

**Figure 2.26. Cowans Ford control room ready for operations, April 1964.**

**Figure 2.27. Cowans Ford, May 1964. By this time, the facility was essentially completed, including operator residences (far left of photo) and the switchyard (removed 1980s) to the south (bottom left).**

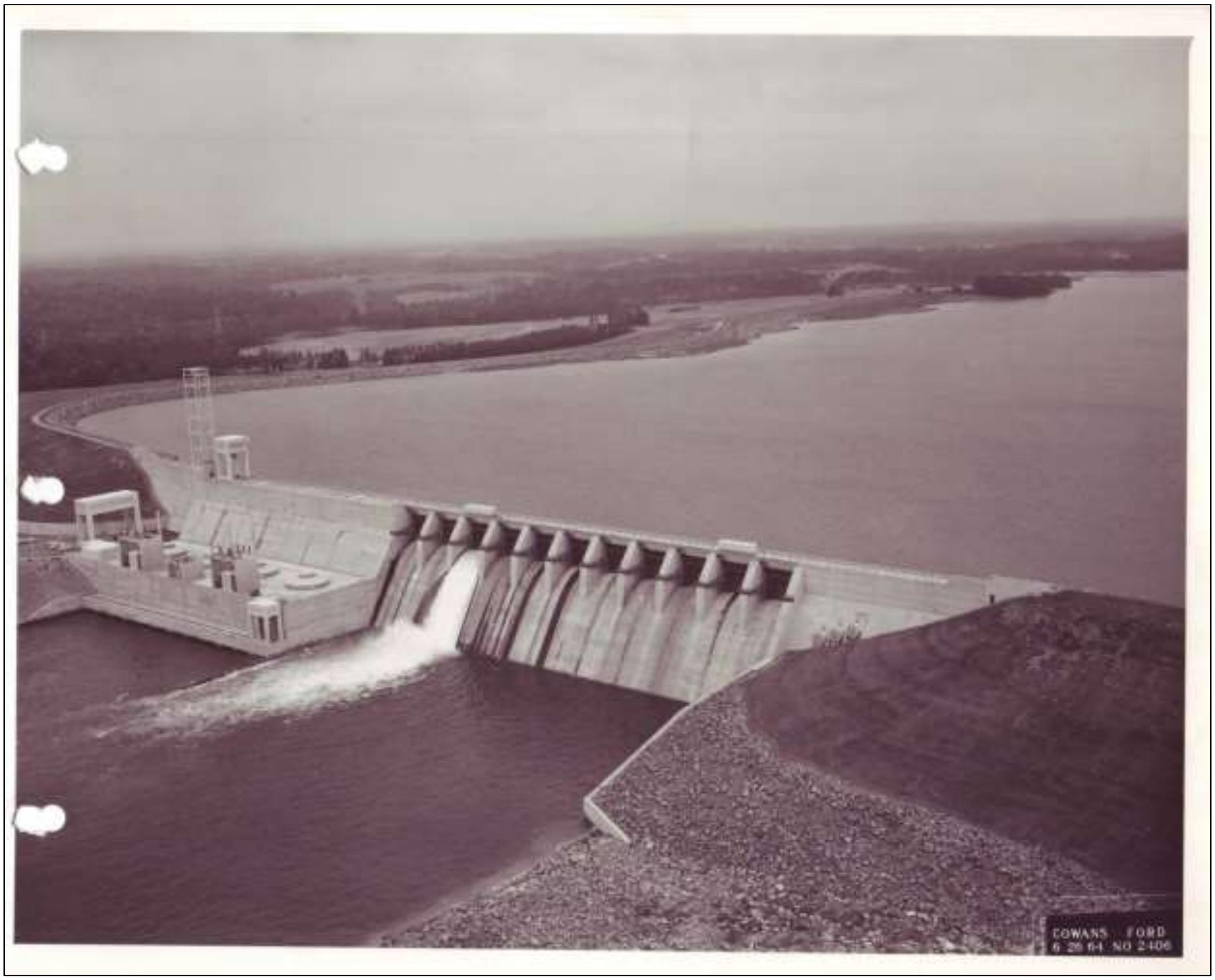

**Figure 2.28. Cowans Ford, June 1964, showing full pool of Lake Norman.**

**Figure 2.29. Rebuilding North Carolina Highway 150 for its new elevation over Lake Norman, showing old road and bridge (left) and new (right). Photo dated March 1962.**

**Figure 2.30. Impoundment of the lake required demolition and removal of several existing textile mill dams, including Monbo Mill. Photo dated January 1962.**

**Figure 2.31. Some of the more necessary logistics for impounding Lake Norman included rebuilding intake systems for local municipal water supply. The one shown here is for the City of Davidson. Photo dated March 1963.**

**Figure 2.32. In this photo, dated June 3, 1962, Lake Norman is creeping up to the girders of the 1916 Beattie's Ford steel truss bridge, which carried North Carolina Highway 73 over the Catawba River. It was one of the last remaining obstacles in the Lake Norman impoundment.**

**Figure 2.33. The Beattie's Ford Bridge was used as a training exercise for U.S. Army and U.S. Army Reserve demolition units and went out with a bang.**

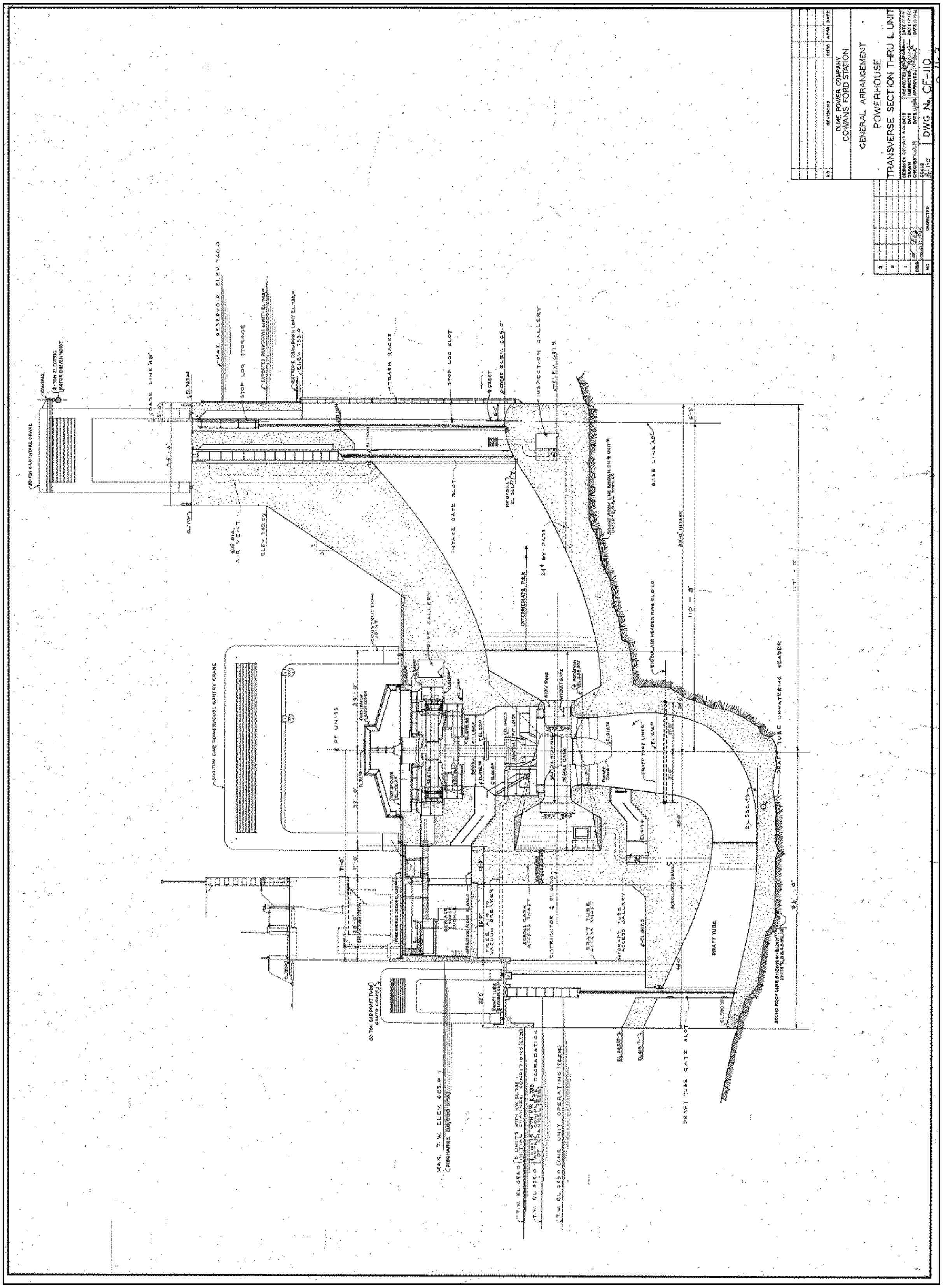

**Figure 2.34. Cross section of the generating units used at Cowans Ford.**

**Figure 2.35. Trans-Catawba marker at North Carolina Highway 73.**

**Figure 2.36. Dedication of the General William Davidson monument near the Cowans Ford Powerhouse, May 20, 1964.**

# 3.0 NRHP Evaluation of the Cowans Ford Hydroelectric Development

## 3.1 Overview

The Cowans Ford Hydroelectric Development was previously evaluated for the NRHP during the FERC re-licensing effort for the Catawba-Wateree Project (Cleveland and Holland 2005). At the time, Cowans Ford did not meet the 50-year age guideline for inclusion in the NRHP. Cleveland and Holland (2005) recommended the facility as ineligible due to its relative recent age. Further, the facility did not meet Criteria Consideration G, as a property of "exceptional importance." The investigators recommended that the facility be re-evaluated once it reached 50 years of age (2013) so that it could be more thoroughly assessed within its appropriate historical context.

The present architectural survey of Cowans Ford consisted of a pedestrian inspection of the hydroelectric development, including the powerhouse, dams, saddle dike, and other associated structures. Particular attention was paid to any changes or modifications to the facilities that might impact the seven aspects of integrity as outlined in Section 1.2. Photographs were taken of elevations, interiors, and equipment where practicable and approved (for security reasons) by Duke Energy staff. Section 3.2 provides an architectural discussion and illustrations of the Cowans Ford Development.

## 3.2 Cowans Ford Hydroelectric Development

At present, Duke Energy operates the Cowans Ford Development for peak power generation and its reservoir, Lake Norman, is used as the cooling pond for the Marshall Steam Station, completed in 1965, and the McGuire Nuclear Station, completed in 1981. The 350 MW Cowans Ford Development is located on the Catawba River in Lincoln and Mecklenburg Counties, North Carolina, approximately 20 miles northwest of Charlotte (see Figures 1.1-1.2). Construction of the development began in 1959 and was officially completed in 1963 when the first three generating units went into commercial operation. A fourth unit went operational in 1967. The facility was formally dedicated in 1964. Cowans Ford includes the following physical components (Figure 3.1):

- The Cowans Ford dam, consisting of a 3,535-foot-long embankment; a 209.5-foot long gravity bulkhead; a 465-foot-long concrete ogee spillway with eleven taintor gates, each 35-feet-wide by 25-feet-high; a 276-foot-long bulkhead; and a 3,924-foot-long earth embankment.
- A 3,134-foot-long saddle dam (Hicks Crossroads).
- A 32,339 acre reservoir with a normal water surface elevation of 760 feet above mean sea level (amsl).
- A powerhouse integral to the dam, situated between the spillway and the bulkhead near the right embankment, containing four vertical Kaplan-type turbines directly connected to four generators rated at 83,125 kW for a total installed capacity of 332.5 MW.
- Other auxiliary buildings (non-historic pre-fabricated office buildings); a circa 1964 maintenance shop; a circa 1964 boathouse; and a trailer of unknown date.
- A monument near the powerhouse, commemorating completion of the hydroelectric facility and the death of Revolutionary War General William Lee Davidson.

**Figure 3.1. Features of the Cowans Ford Development.**

### 3.2.1 Powerhouse

The Cowans Ford powerhouse is a semi-outdoor design, whereby the casings of the generating units and free-standing crane maintenance equipment are not located within a larger powerhouse structure. This type of "semi-outdoor" powerhouse design had been proposed and constructed by the industry as early as the 1910s (see Figure 2.3; Hay 1991) but was more commonly used in the mid- to late-twentieth century. Other regional examples include the USACE Lake Hartwell Powerhouse (1962), Duke Energy's Jocassee Powerhouse (1973), and Georgia Power Company's Wallace Dam Powerhouse (1980). The grounds also include a tri-cornered granite marker (erected 1964) that commemorates Revolutionary War General William Davidson as well as the Cowans Ford Hydroelectric Development.

While the powerhouse structure is primarily below-grade, the entrance to the facility is through a small one-story, concrete structure located west of the generating units (Figures 3.2-3.9). The building (Figures 3.4-3.5) consists of concrete walls and a pebbledash veneer. The entry contains an original metal and glass door topped with a large fixed light and the sides of the building contain large vertical fixed pane windows. The roof is flat with a metal coping around the perimeter. Other features include a raised box planter. This entry building is very similar in design (e.g. utilitarian and unadorned) to that at Jocassee (Stallings 2012). On the other side of the powerhouse is a second, smaller entry portage (for the elevator chamber), with a similar exterior design of pebbledash veneer. The interior of this above-grade section consists of stone floors and finished pebbledash walls (Figure 3.6). An integrated clock is visible above the western door and a table-top visitor display explains the facility's operation. The southern wall contains a mural of the North Carolina Piedmont. According to records at the Duke archives, the mural was painted in 1964 for $4,788 and was the work of Bartlett Associates of Charlotte.

The four generating units are covered with steel casings (see Figures 3.7-3.9) and the 150-ton electrically operated gantry crane is set on steel rails for maneuvering across the length of the powerhouse. The primary below grade service gallery has formed concrete walls and a concrete floor with smooth finishes (Figure 3.10). On the north end of the service gallery is an original "fallout" shelter, a not atypical design of Cold War architecture. There are no unique design features to the room except for exceptionally thick concrete block walls. The breakroom, kitchenette, and restrooms/shower facility each have tiled walls and floor. The control room is also located on this floor and contains much of its original operating equipment and switches, although their functions are now managed by computer with manual override capabilities. Besides the equipment, the room features a dropped ceiling and tiled walls and floor. Figure 2.26 in the previous chapter provides a historical photograph of the original control room.

The four generating units are encased within large concrete cells and the governors and associated machinery are located outside of the respective cell (Figure 3.11). The lower galleries run along the horizontal axis of the powerhouse substructure and also contain formed concrete walls and floors. These galleries provide access to the discharge tunnels, electrical and other auxiliary service equipment. An inspection gallery at the lowest level of the facility runs the length of the dam (Figure 3.12).

There have been few changes to the powerhouse facility. Moderate changes have occurred to electrical equipment and components on the generating floor and the control room. Changes to the interior spaces and electrical components have little effect on the original integrity of the building. These changes are evolutionary modifications to incorporate modern technology (such as computer upgrades) to support the primary purpose of power generation.

### 3.2.2 Turbines and Generating Equipment

The Cowans Ford Development is a conventional hydro operation with vertical-shaft Kaplan-type turbines, originally designed with adjustable blades (see Figures 2.25, 3.13-3.14). Cowans Ford has an authorized installed capacity of 87.5 MW for each unit and a total installed capacity of 350 MW. Water flow is controlled by the wicket gates around the turbines for generating power. The turbines were designed and manufactured by Allis-Chalmers of York, Pennsylvania, and the AC generators were manufactured by Westinghouse Electric Corporation. Both Allis-Chalmers and Westinghouse were well-established manufacturers of hydroelectric equipment by the mid- to late-twentieth century. The four conventional units at Cowans Ford exhibit no extraordinary or innovative technologies compared to their contemporaries. Duke Energy is currently immobilizing the adjustable blades of the Kaplan turbines to create greater efficiency.

The turbines are fed from a power tunnel excavated through the downslope of the dam embankment. The power tunnel extends from an integrated intake structure on upstream side of the dam and feeds the penstocks that lead to the units' scroll casings inside the powerhouse. The scroll casings supply water into the wicket gates, which control the water flowing into the turbine blades. The power generated at the site is conveyed to two step-up transformers located on top of the powerhouse. The 230-kV power is transmitted to the McGuire switching station some 1.67 miles to the east, for distribution and transmission by Duke Energy. Historically, the power was transmitted to an onsite switching station immediately southwest of the powerhouse, but the switchyard removed in the 1980s when McGuire came online. These are typical engineering features of contemporary electrical facilities.

### 3.2.3 Dams and Impoundment

Located immediately behind (north of) the powerhouse, the Cowans Ford Dam (Figure 3.15) is a concrete gravity and rolled earth structure with a concrete ogee spillway (Figure 3.16). The dam measures 130 feet high and 8,738 feet long, and the spillway is about 465 feet long with a crest elevation of 732 feet amsl and 760 feet amsl on top of the closed gates. The spillway has 11 taintor gates (Figure 3.17), 28 feet high by 35 feet wide. The 32,339-acre reservoir (Lake Norman) has a full pond elevation of 760 feet amsl and a usable storage capacity of 298,142 acre-feet. The intake and powerhouse are integral structures, constructed from reinforced and mass concrete. There are four separate intakes, one for each turbine. Each intake has three sets of trash gates measuring 17.7 feet wide by 49 feet high. The only significant changes include new floodwalls atop the east and west abutments and anchors drilled into the spillway and west abutment. These were FERC-mandated modifications made in 2000. In addition to the main Cowans Ford Dam, Lake Norman is also buttressed by the Hicks Crossroads Saddle Dike, located approximately three miles east. The earthen Hicks Crossroads Dike (Figure 3.18), buttressed with riprap, is 3,134 feet long and parallels North Carolina Highway 73.

### 3.2.4 Auxiliary Features

The Cowans Ford property also contains two non-historic office buildings, a circa 1964 maintenance building, an undated maintenance shed, a circa 1965 boat storage building, and a metal trailer. None of these buildings are located within the FERC-licensed boundary and, therefore, were not assessed as part of this project.

**Figure 3.2. Cowans Ford Development, facing northeast.**

**Figure 3.3. Cowans Ford Powerhouse and commemorative monument, facing northeast.**

**Figure 3.4. Cowans Ford Powerhouse and entry, facing northeast.**

**Figure 3.5. Cowans Ford Powerhouse entry, facing southwest.**

**Figure 3.6. Cowans Ford Powerhouse interior. Note mural on wall at left.**

**Figure 3.7. Cowans Ford Powerhouse, illustrating "semi-outdoor" design.**

**Figure 3.8. Cowans Ford Powerhouse from top of spillway, facing west.**

**Figure 3.9. "Roof" of Cowans Ford Powerhouse, showing top casing of generating units. Transformers are in concrete casings at left.**

**Figure 3.10. Powerhouse interior, service gallery, facing north.**

**Figure 3.11. Powerhouse interior, gallery adjacent to casings enclosing the generating units, facing east.**

**Figure 3.12. Inspection gallery in lowest level of powerhouse, facing east.**

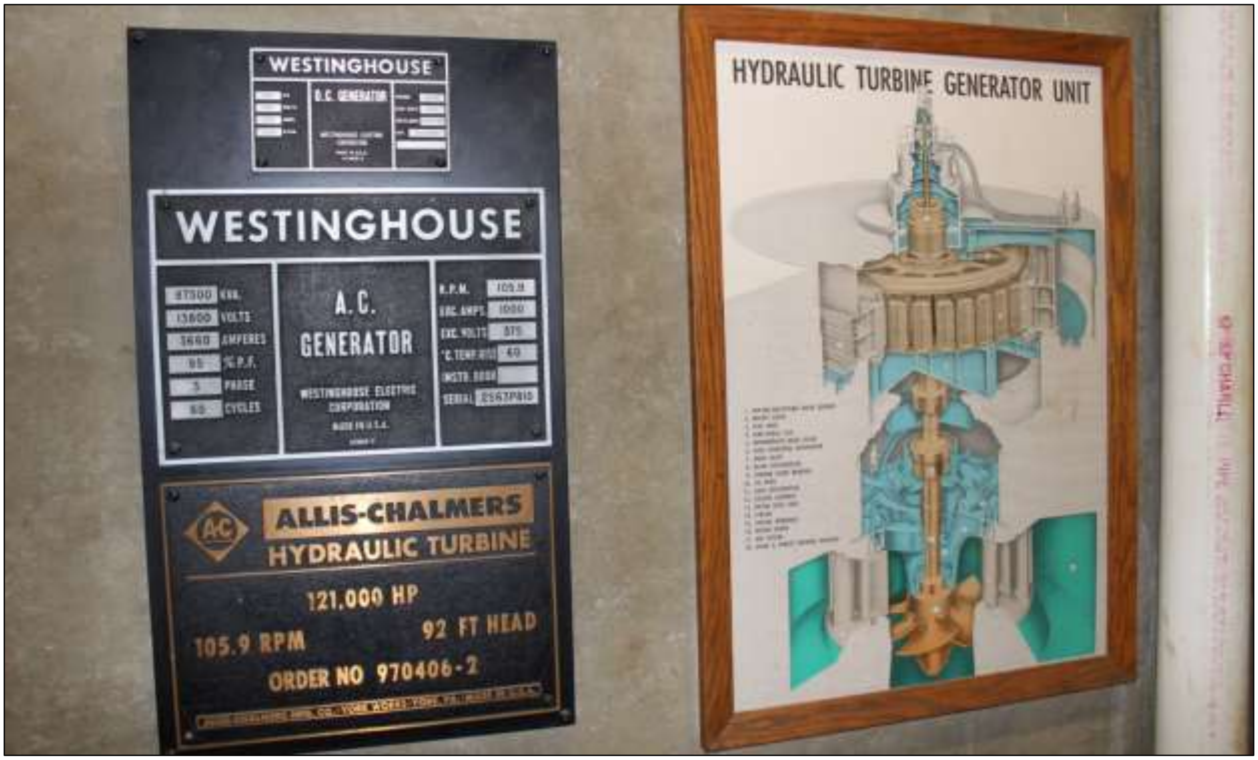

**Figure 3.13. Nameplate for generating unit.**


Figure 3.14. Generating Unit #2.


Figure 3.15. Cowans Ford Dam, east abutment.

**Figure 3.16. Cowans Ford Dam, spillway facing east.**

**Figure 3.17. Cowans Ford Spillway, taintor gate.**

**Figure 3.18. Hicks Crossroads Saddle Dike, facing northwest.**

## 3.3 NRHP Evaluation and Recommendation

The contextual information in Chapter 2 suggests a number of generalizations that apply to hydroelectric plants as a group. In terms of function and use, facilities such as Cowans Ford are inherently industrial in nature, whether they were originally designed for hydroelectric production, were adapted from hydro mechanical applications, or components of a broader generation system. In terms of property type, hydroelectric plants are energy facilities, which combine specialized structures and machinery to produce a particular kind of energy. In terms of areas of significance, hydroelectric plants are potentially significant to both engineering and industry, with secondary significance to commerce and architecture. Hydroelectric plants have the potential for significance at the local, state, or even national level, depending on their level of technical innovation or scope of market served. The facilities also have the potential for a fairly high level of physical integrity, since so many historic hydroelectric plants still serve their original function and industry advancements typically do not warrant drastic overhaul of hydroelectric systems (Hay 1991).

The Cowans Ford Hydroelectric Development was originally conceived during the early twentieth century as part of Buck Duke's vision for "electrifying" the Catawba River. However, construction was postponed for two reasons: the Great Depression and the increased utilization of steam power for base load generation. By the time that Duke Power determined that Cowans Ford was economically feasible, the landscape of electrical generation had changed both nationally and within the company's own portfolio.

The Cowans Ford Hydroelectric Facility *does not possess significance under Criterion A*, "associations with events that have made a significant contribution to the broad patterns of our history." Broadly speaking, as discussed in Chapter 2, the vast majority of hydroelectric projects constructed during the mid-twentieth century were initiated by the federal government as multi-purpose flood control efforts in which hydropower was a beneficial byproduct and not the sole authorized purpose. For investor-owned utilities, between World War II and the energy crisis of the 1970s, hydropower was used to balance base loads and to support an increasing need for peaking power.

Cowans Ford was designed to, according to priority, 1) capitalize on existing and untapped fall within the Catawba River system and 2) provide cooling water for thermal plants. As it pertains to other hydroelectric developments within the broader Catawba-Wateree System, Cowans Ford operates much differently in terms of capacity and possesses a decidedly different architectural design. In regard to the second priority, while Plant Marshall was completed, plans for other anticipated thermal plants would remain unrealized, except for McGuire Nuclear Station, which went online in 1981. By regional comparison, the Keowee-Toxaway Hydroelectric Development, also owned by Duke Energy, was constructed at the same time (1960s) as Cowans Ford. However, Keowee-Toxaway was designed and implemented holistically, as a comprehensive project with three mutually-dependent power generation components: conventional hydro, pumped storage hydro, and nuclear (Stallings 2012).

The Cowans Ford Hydroelectric Facility *does not possess significance under Criterion B*, “associations with persons significant in our past.” The historical research conducted for this evaluation did not identify significant individuals associated with the Project’s planning, construction, or development.

The Cowans Ford Hydroelectric Facility does not exhibit notable “physical design or construction, including such elements as architecture, landscape architecture, engineering, and artwork” and therefore *does not possess significance under Criterion C*. The functional structures at Cowans Ford, including the powerhouse (and powerhouse entry), spillway, dam, and saddle dike are common features and all work in coordination with each other for a primary purpose, generating power. The facilities retain their architectural/engineering integrity; minimal changes have been made to the powerhouses or the associated hydroelectric structures. The modifications at the development, such as upgrading of equipment or small spatial enclosures for modern office space, are typical of industrial facilities and do not detract from the overall purpose or design, which is to generate electricity. The lack of significant changes is not unusual for this resource type; hydroelectric facilities as a broader group tend to retain a high degree of integrity (Hay 1991). Cowans Ford is a conventional four-unit development designed for peak capacity and the structures contain neither innovative nor exceptional technologies or construction methods that deviated from their hydroelectric contemporaries.

The Cowans Ford Hydroelectric Facility *does not appear to meet Criterion D*; the Project has not yielded and is not likely to yield “information important in prehistory or history.”

# 4.0 Summary

The Cowans Ford Hydroelectric Development is located in Mecklenburg and Lincoln Counties, North Carolina, approximately 20 miles north of Charlotte. Completed in 1963, the hydro station has four generating units with a total installed capacity of 350 MW. It operates as part of the Catawba-Wateree Hydroelectric Project, which is licensed under FERC as Project #2232.

The facility was previously evaluated for the NRHP during the FERC re-licensing effort for the Catawba-Wateree Project (Cleveland and Holland 2005). At the time, Cowans Ford did not meet the 50-year age guideline for inclusion in the NRHP. Cleveland and Holland (2005) recommended the facility as ineligible due to its relative recent age. Further, the facility did not meet Criteria Consideration G, as a property of “exceptional importance.” The investigators also recommended that the facility be re-evaluated once it reached 50 years of age so that it could be more thoroughly assessed within its historical context. These recommendations were incorporated into the Catawba-Wateree HPMP, which is Duke Energy’s guiding document for managing cultural resources at the project.

The present architectural survey and evaluation of Cowans Ford was designed to fulfill the previous recommendations to provide an updated evaluation. The survey included an inspection of all hydroelectric structures located within the FERC Project Boundary and, therefore, subject to Section 106 of the NHPA. After evaluation, including considering Cowans Ford within its proper historic context (e.g. modern hydroelectric development), we recommend that the facility’s hydroelectric structures do not meet the criteria for inclusion in the NRHP and, therefore, do not require management as historic properties.

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1964 Cowans Ford Dedication Set For Tuesday. September 24 edition.

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1963 *Franklin D. Roosevelt and the New Deal, 1932-1940*. Harper Torchbooks, New York.

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2015 *Southern Water, Southern Power: How the Politics of Cheap Energy and Water Scarcity Shaped a Region*. Chapel Hill, NC: University of North Carolina Press.

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Stallings, F. Patricia
2012 *NRHP Evaluation of the Keowee-Toxaway Hydroelectric Development, Oconee and Pickens Counties, South Carolina (FERC #2503).* Prepared for Duke Energy Carolinas, LLC.

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2003 *National Register of Historic Places Eligibility Study of Seven Hydroelectric Projects in the Nantahala Area, North Carolina*. Submitted to Duke Power, Charlotte, North Carolina.

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# Appendix A

## Resume of the Principal Investigator

**PATRICIA STALLINGS**
**PROGRAM MANAGER/SENIOR HISTORIAN**

## EDUCATION/WORKSHOPS

B.A. in History (1997), North Georgia College
M.A. in History (2002) and Preservation Studies Certificate (2002), University of Georgia
Advanced Section 106 Seminar, Kansas City, Missouri (2008)
Mid-Twentieth Century Architecture Seminar, Atlanta, Georgia (2009)
Applying the NEPA Process, Norcross, Georgia (2009)
Institute for Georgia Environmental Leadership (2009)
Renewable Energy Development: Impacts to Cultural Resources, Austin, TX (2012)

## AREAS OF SPECIALIZATION

Archival Research and Narrative History Preparation
NRHP Documentation and Evaluation
Hydropower History
Military History
Environmental History
Southern U.S. Agricultural History

## PROFESSIONAL AND COMMITTEE MEMBERSHIPS

Southern Historical Association
Agricultural History Society
Company of Military Historians
Georgia Historical Society
Board of Directors, Barrow Preservation Society (2009-present)
Historic Preservation Commission, City of Winder, Georgia, (2010-present)

## PROFESSIONAL POSITION

Brockington and Associates, Inc.: History Program Manager, Senior Historian, Senior Architectural Historian (2002-present)
Shields-Ethridge Heritage Farm: Volunteer Interpreter/Guide (1998-2002)

## SELECT PROJECTS, PUBLICATIONS, PRESENTATIONS AND EXPERIENCE

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|---|---|
| 2015 | Principal Investigator, *Historic Properties Management Plan for the Yadkin-Pee Dee Hydroelectric Project (FERC #2206), Anson, Montgomery, Richmond and Stanly Counties, North Carolina.* Prepared for Duke Energy Carolinas, LLC (in progress). |
| 2015 | Senior Historian, *Architectural Survey for the Proposed Kentucky Lock and Dam No. 11 Hydroelectric Development, Madison and Estill Counties, Kentucky.* Prepared for Rye Development. |
| 2015 | Principal Investigator, *Architectural Assessment of Effects for the Proposed Nature-Like Fishway at the York Haven Hydroelectric Project (FERC No. 1888), York, Dauphin, and Lancaster Counties, Pennsylvania.* Prepared for the York Haven Power Company, LLC. |
| 2015 | Program Manager, *Integrated Cultural Resources Management Plan Updates for the States of Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee.* Authored report for Mississippi and Co-Authored report for Georgia. Prepared for the 81st Regional Support Command, Ft. Jackson, South Carolina. |

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| 2015 | Project Historian, *Cultural Resources Surveys for Rebuild of the Jack McDonough to Peachtree 230kV "Hairpin" Transmission Line and the Peachtree to Boulevard 230kV Transmission line in Cobb and Fulton Counties, Georgia*. Prepared for the Georgia Power Company, Atlanta. |
| 2014 | Principal Investigator, *Architectural Inventory of Fort Rucker, Alabama*. Prepared for Fort Rucker and the U.S. Army Corps of Engineers, Mobile District. |
| 2014 | Principal Investigator, *Section 110 Cultural Resources Study of Three U.S. Army Reserve Centers in Minnesota* and *Section 110 Cultural Resources Study of the IA008/Creston Memorial USARC in Union County, Iowa*. Prepared for the 88th Regional Support Command and the U.S. Army Corps of Engineers, Mobile District. |
| 2013 | Principal Investigator, Independent Consulting and Review of the *Historic Properties Management Plan for the Keowee-Toxaway Hydroelectric Development, Oconee and Pickens Counties, South Carolina (FERC #2503)*. Prepared for Duke Energy Carolinas, LLC. |
| 2013 | Principal Investigator, *Architectural Survey of Five USARCs in Florida, Louisiana, Mississippi, North Carolina and South Carolina*. Prepared for the 81st Regional Support Command, Fort Jackson, South Carolina, and the U.S. Army Corps of Engineers, Mobile District. |
| 2013 | Senior Historian, *Archaeological Data Recovery at Mitchelville (38BU2301), Hilton Head Island Airport Improvements Study Area, Beaufort County, South Carolina*. Prepared for Talbert, Bright and Ellington, Inc. and Beaufort County, South Carolina. |
| 2013 | Co-Author, *The US Army Engineering and Support Center, Huntsville, Captured Enemy Ammunition and Coalition Munitions Clearance Mission, 2003-2008*. Prepared for the U.S. Army Engineering and Support Center, Huntsville. |
| 2013 | Senior Historian, *Cultural Resources Survey of the New Savannah Bluff Lock and Dam Fish Passage Tract, Aiken County, South Carolina and Richmond County, Georgia*. Prepared for Tetra Tech, Inc. and the U.S. Army Corps of Engineers, Savannah District. |
| 2012 | Author, *History of the Southeastern Power Administration, 1990-2010*. Prepared for the U.S. Department of Energy and the Southeastern Power Administration. |
| 2012 | Principal Investigator, *NRHP Evaluation of the Keowee-Toxaway Hydroelectric Development, Oconee and Pickens Counties, South Carolina (FERC #2503)*. Prepared for Duke Energy Carolinas, LLC. |
| 2012 | Principal Investigator, *Historic Properties Management Plan for the York Haven Hydroelectric Project (FERC No. 1888), York, Dauphin, and Lancaster Counties, Pennsylvania*. Prepared for the York Haven Power Company, LLC. |
| 2012 | Principal Investigator, *Mitigation Efforts for the Closure of Fort McPherson and Fort Gillem*, including HABS Documentation; Existing Conditions and Design Standards for Old Staff Row and McPherson Parade Grounds; NRHP Boundary Expansion for McPherson's Old Staff Row; Narrative Histories of Installations; and Permanent Archival Index of Historic Records. Prepared with Parsons Corporation for the U.S. Department of the Army and the U.S. Army Corps of Engineers, Mobile District. |
| 2012 | Co-Author, *History of the U.S. Army Corps of Engineers, South Atlantic Division, 1945-2012*. Prepared for the U.S. Army Corps of Engineers, South Atlantic Division and Mobile District. |
| 2012 | *Cultural Resources Survey of the Sullivan's Island Elementary School Tract, Charleston County, South Carolina*. Prepared for Cummings and McCrady, Inc. and the Charleston County School District. |
| 2011 | Principal Investigator, *Cultural Resources Assessments of five U.S. Army Reserve Centers in the States of Vermont, Pennsylvania, and West Virginia*. Prepared for Ageiss, Inc., the 99th Regional Support Command, and the U.S. Army Corps of Engineers, Mobile District. |
| 2011 | Principal Investigator, *Architectural Survey of 28 US Army Reserve Centers in the States of Oklahoma, Texas, Arkansas and New Mexico*. Prepared for the US Army Corps of Engineers, Mobile District and the 63rd Regional Support Command. |
| 2011 | Principal Investigator, *Architectural Survey and Inventory of the Newport Chemical Depot, Vermillion County, Indiana*. Prepared for the U.S. Army Corps of Engineers, Mobile District and the Newport Chemical Depot. |
| 2011 | Principal Investigator, *Cultural Resources Study of the York Haven Hydroelectric Project (FERC No. 1888), York, Dauphin, and Lancaster Counties, Pennsylvania*. Prepared for the York Haven Power Company, LLC. |

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| 2010 | Senior Historian, *Archival and Photographic Documentation of the Former Clarksville Base Nuclear Storage Site, Fort Campbell, Kentucky*. Prepared for the US Army Corps of Engineers, Louisville District and the Department of the Army, Fort Campbell, Kentucky. |
| 2009 | Co-Author, *One Door to the Corps: Historical Update of the U.S. Army Engineering and Support Center, Huntsville, 1998-2007*. Prepared for the U.S. Army Engineering and Support Center, Huntsville. |
| 2008 | Project Historian, *Cultural Resources Survey of the Proposed Middletown Armed Forces Reserve Center, Middlesex County, Connecticut*. Prepared for the U.S. Army Corps of Engineers, Mobile District. |
| 2008 | Co-Author with William M. Brockenbrough, *HABS Documentation of the Granite Hill Plantation, Hancock County, Georgia*. Prepared for Erdene Materials Corporation, Palm City, Florida. |
| 2007 | Author, *From Shermans to Strykers: Industrial Maintenance at the Anniston Army Depot, 1940-2007*. Prepared for the U.S. Army Corps of Engineers, Mobile District and the Anniston Army Depot. |
| 2007 | Principal Investigator, *Historic Structures Review of Twenty Facilities for the Missouri Army National Guard* (statewide). Prepared for the Missouri Army National Guard. |
| 2007 | Principal Investigator, *Historic Properties Management Plan for the Lake Blackshear Hydroelectric Project (FERC #659), Crisp, Dooly, Lee, Sumter and Worth Counties Georgia*. Prepared for the Crisp County Power Commission. |
| 2007 | Principal Investigator, *Cultural Resources Investigations of the Proposed Greenville Connector, Washington and Bolivar Counties, Mississippi*. Prepared for ABMB Engineers, Inc. and the Mississippi Department of Transportation. |
| 2007 | *Intensive Architectural Survey and Cold War Assessment of the Anniston Army Depot, Calhoun County, Alabama*. Prepared for the U.S. Army Corps of Engineers, Mobile District and the Anniston Army Depot. |
| 2007 | *Historic Properties Management Plan for the Morgan Falls Hydroelectric Project (FERC #2237), Cobb and Fulton Counties, Georgia*. Prepared for the Georgia Power Company. |
| 2006 | Principal Investigator, *Phase II Cultural Resources Investigations of the Proposed Lawrence Wastewater Treatment Plant, Douglas County, Kansas*. Prepared for Black and Veatch Corporation and the City of Lawrence, Kansas. |
| 2006 | *NRHP Evaluation of the Yadkin-Pee Dee Hydroelectric Project (FERC #2206), Anson, Montgomery, Richmond and Stanly Counties, North Carolina*. Prepared for Progress Energy Carolinas, Inc. |
| 2005 | *Morgan Falls Project: 100 Years of Energy. Historic Hydro-Engineering Report (FERC #2237), Cobb and Fulton Counties, Georgia*. Prepared for the Georgia Power Company. |
| 2005 | *Intensive Architectural Survey of Three Buildings at New Century USARTC, New Century Airfield, Johnson County, Kansas*. Prepared for the U.S. Army Corps of Engineers, Mobile District and the 88th Regional Readiness Command. |
| 2003 | Co-Author with Bobby Southerlin, Dawn Reid and Jeffrey W. Gardner, *Initial Cultural Resources Evaluation of the Lake Blackshear Project (FERC #659), Crisp, Dooly, Lee, Sumter and Worth Counties, Georgia*. Prepared for the Crisp County Power Commission and Framatome ANP, Inc. |