Attachment C
Dam Removal Feasibility Study – Burton

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BURTON DAM: DAM REMOVAL FEASIBILITY STUDY

January 10, 2025

Prepared for:
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Project Number: 175578493

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Acronyms / Abbreviations

CFR	Code of Federal Regulations
CFS	Cubic feet per second
CLOMAR	Conditional Letter of Map Revision
CWA	Clean Water Act
DEM	Digital elevation model
DNR	Division of Natural Resources
DOA	Department of the Army
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPD	Environmental Protection Division
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRM	Flood Insurance Rate Map
Ft	Feet
GA	Georgia
GIS	Geographic Information System
GPC	Georgia Power Company
HPD	Historic Preservation Division
IPaC	Information for Planning and Consultation
LF	Lakefront
LOMR	Letter of Map Revision
LV	Lakeview
M	Million
Mi^2	Square miles
MLS	Multiple Listing Service
MSL	Mean Sea Level
MW	Megawatts
NAVD	North American Vertical Datum
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NWP	Nationwide Permit
O&M	Operation & Maintenance
OPCC	Opinion of Probable Construction Costs
RM	River Mile
USACE	U.S. Army Corps of Engineers
USFS	United State Forest Service
USFWS	United State Fish and Wildlife Service
USGS	United States Geological Survey
WQC	Water Quality Certification

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1 Introduction

Stantec Consulting Services Inc. (Stantec) was contracted by Troutman Pepper Hamilton Sanders LLP (Troutman Pepper LLP) to conduct a feasibility analysis to assess the potential implications and cost drivers of removing Burton Dam. Burton Dam is one of six developments that make up the North Georgia Hydroelectric Project (North Georgia Project), which is operated by Georgia Power Company (GPC) and licensed for operations under Federal Energy Regulatory Commission (FERC) Project No. 2354.

1.1 Dam Background

Burton Dam, located at river mile (RM) 368 on the Tallulah River, was constructed between 1917 and 1920 with Lake Burton reaching full pool in August 1920 (GPC, 1991). Burton Dam is the farthest upstream dam of the six developments that make up the North Georgia Project. Lake Burton is the 2,775-acre reservoir that is impounded by Burton Dam and serves as the main storage reservoir for the North Georgia Project hydroelectric power system. On October 3, 1996, FERC issued a 40-year license for the North Georgia Project, allowing the licensee to continue operating and maintaining the existing project. The current operating license will expire September 30, 2036 (77 FERC ¶ 62,002 (1996)).

Burton Dam is a 128-foot-high concrete gravity structure with a left non-overflow section, a gated spillway, a sluiceway section, an intake section, and a right non-overflow section with combined sluiceway and intake leading to a powerhouse at the toe of the dam. The powerhouse facility at Burton Dam was built in 1927. The powerhouse has two vertical Francis turbines, and generators that were modified in 1984 and have a total rated capacity of 8.1 megawatts (MW).

Every year from November through May, Lake Burton is drawn down to accommodate the historically high rainfall months and limit discharges through the gated spillway. Typically, the drawdown is approximately 8 feet (ft) maintained after November following a rule curve established by GPC (GPC, 1991). During refill after the rule curve drawdown, an elevation of 1860 must be reached by March 1st of each year. Water from the tailrace of the Burton development returns to the Tallulah River and flows into Lake Seed, a 260-acre reservoir behind Nacoochee Dam. Nacoochee Dam is located 4.8 miles downstream from Burton Dam at approximately RM 363 and is a 73-foot-high concrete gravity dam (FERC, 1996). The four remaining developments that make up the North Georgia Hydroelectric Project include Mathis-Terrora (RM 354), Tallulah Falls Dam (RM 347), Tugalo Dam (RM 343), and Yonah Dam (RM 340).

1.2 Study Scope

Stantec assessed the concept for the removal of Burton Dam by completing a data review and analyses related to full dam removal, focusing on various hydrologic, hydraulic, and community impacts parameters. Key considerations in the analysis include financial and logistical factors associated with sediment quantity and potential effects on recreational resources. Stantec assessed sediment quantity in the reservoir by conducting a bathymetric survey and estimating the amount of sedimentation accumulation since Burton Dam's construction in 1920. Additionally, Stantec assessed the potential property and recreational impacts associated with removal of Burton Dam.

A field reconnaissance to identify and verify notable shoreline development (including residential homes, public access points, parks and marinas) was performed by Stantec. Additionally, field personnel collected measurements of the lakebed at strategically selected locations. Topographic mapping, surveying, and hydraulic modeling were not part of the scope.

The results of these analyses and data reviews informed assessment of construction feasibility, costs, and potential impacts for the removal of the Burton Dam facilities. A planning level, Class 4 Opinion of Probable Construction Cost (OPCC) was developed for the removal of Burton Dam that included construction costs. Permits and agency coordination that could affect implementation of dam removal were reviewed and conceptual figures were created for dam removal.

1.2.1 SHORELINE DEVELOPMENTS AND RECREATIONAL IMPACT

The potential impacts on shoreline developments and recreational opportunities at Lake Burton was a primary consideration when considering the potential removal of Burton Dam.. Lake Burton is used for recreational boating, fishing, and swimming and developments along the shoreline include commercial marinas. restaurants, residential homes, parks, and a trout hatchery. Desktop investigations and field reconnaissance were conducted to inventory existing developments around the lake.

1.2.2 COST AND IMPACTS

In addition to the impact on shoreline developments around the lake as discussed in Section 1.2.1, construction costs were considered as another factor of feasibility. Construction cost was estimated for the removal of Burton Dam, and a relative cost of maintenance was developed. Sedimentation of the dam would likely increase the cost of dam removal over time, including significant construction costs associated with dredging, stabilization, or removal of this additional sediment. Actual requirements related to ongoing monitoring, shoreline stabilization, and other restorative work would be determined through the FERC license surrender process.

The economic impact of foregone electrical generation should be considered and will be evaluated by GPC and therefore was not included in this study. Additionally, losses in recreational value, legal costs, public outreach costs, and additional impacts to third parties, such as potential losses in water supplies, were beyond the scope of this study and were not included in the cost estimates. Natural capitalization was considered but was not included in the cost estimate as it was considered limited in relative benefits compared to the construction costs.

2 Existing Site Conditions

2.1 Project Setting

Burton Dam is located on the Tallulah River near the towns of Tiger and Clayton, in Rabun County, Georgia. Lake Burton is the largest lake in Rabun County with 2,775 acres of surface area and 62 miles of shoreline that is developed with over 1,200 shoreline homes. The normal full pool elevation of Lake Burton is 1866.6 ft (FERC, 1996). Under normal operation, the water level of the lake is controlled by discharges through the powerhouse. If needed, during higher inflow events, the 8 spillway gates, as shown in Figure 1, are used to maintain reservoir pool elevation. The top elevation of the gates is approximately 1866.6 ft (NAVD88) (GPC, 1991).

The total contributing watershed upstream of the dam site is approximately 118 square miles. Small tributaries discharging directly to the lake account for approximately 33 square miles of the basin area, the remainder is associated with the mainstem Tallulah River. From the west side of the lake, Mill Creek contributes 0.44 square miles, Wildcat Creek contributes 6.26 square miles, Moccasin Creek contributes 7.9 square miles, Dicks Creek contributes 6.99 square miles, and Popcorn Creek contributes 0.08 square miles. From the east side of the lake, Acorn Creek contributes 0.69 square miles, and Timpson Creek contributes 10.7 square miles.

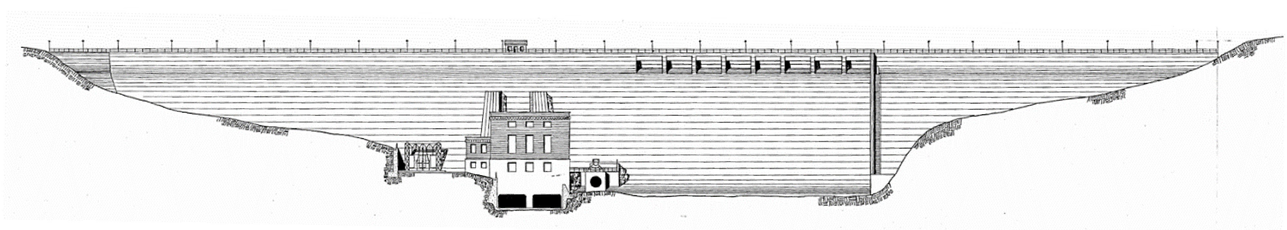

Figure 1. Profile of Burton Dam From Historic Drawings (GPC 1962)

The Burton Development is part of the North Georgia Project, a FERC licensed hydropower project that consists of six hydroelectric developments (Burton, Nacoochee, Mathis-Terrora, Tallulah Falls, Tugalo, and Yonah). The North Georgia Projects spans over a 37-mile stretch of the Tallulah and Tugalo Rivers and facility locations are shown in Figure 2. The Burton Development consists of Burton Dam, an 8.1MW powerhouse and the 2,775-acre Lake Burton.

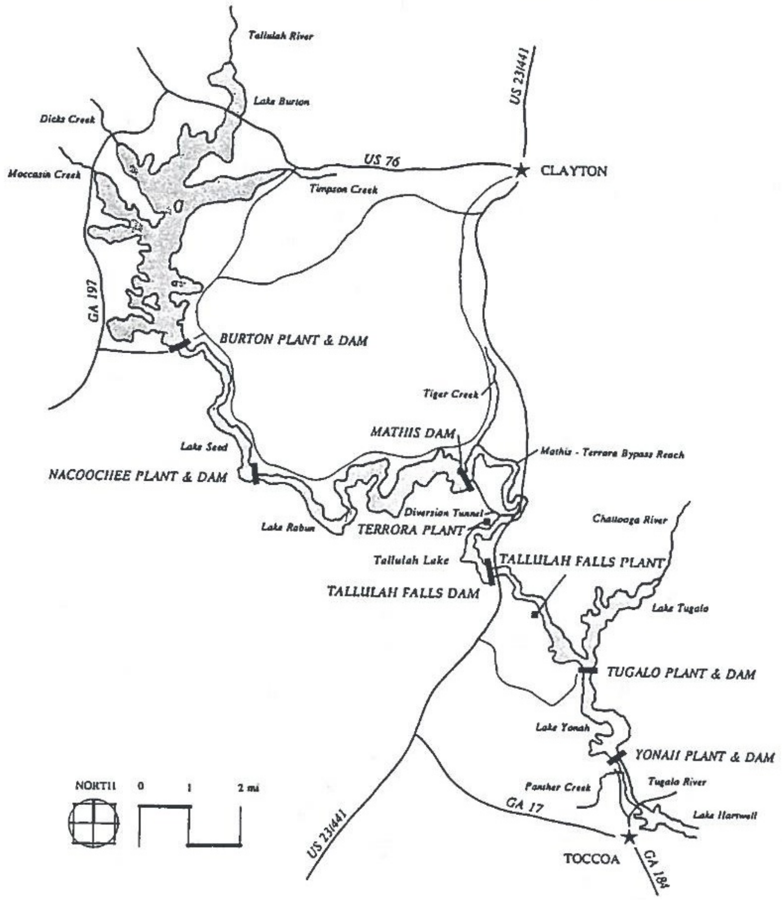

Figure 2. The North Georgia Project Overview Map from GPC Historic Hydro-Engineering Report (1990)

The North Georgia Project is operating under its second license from FERC. The original 50-year license expired December 31, 1993, and the new 40-year operating license was issued October 3, 1996, that will expire September 30, 2036 (77 FERC ¶ 62,002 (1996)).

Surrounding the reservoir and occupying 148,684 acres of Rabun County is the Chattahoochee-Oconee National Forest. The Chattahoochee-Oconee National Forest provides significant recreation resources to the people of Georgia as well as timber and mineral resources and natural resources protection and enhancement benefits to the region. Rabun County is highly reliant upon recreational visits and residential home development surrounding Lake Burton for its tax revenue. The largest industries in the county include retail trade, accommodation and food services, and construction (Deloitte, 2021).

2.2 Basin Characteristics

The drainage area contributing to Lake Burton is approximately 118 square miles with predominantly wooded land cover (Figure 3). The United States Geological Survey (USGS) StreamStats web-based geographic information systems (GIS) application was used to delineate the full contributing watershed above Burton Dam. Basin characteristics are summarized in Table 1.

Table 1. Overview of Basin Characteristics of the Burton Dam Watershed

Basin Characteristic	Characteristic Description	References
Physiographic Province	*The Tallulah River is in the Blue Ridge physiographic province, characterized by steep, mountainous terrain.*	*Mast and Turk, 1999*
Topography	*Elevations within the basin range from 1,867 ft at Lake Burton to 5,498 ft at Standing Indian Mountain, resulting a in a steep stream gradient.*	*Mast and Turk, 1999*
Ecoregion	*The basin lies in the Central Appalachian Broadleaf Forest ecoregion. Vegetation surrounding Lake Burton is dominated by mixed pine-hardwood and white pine communities. Soils are classified as Ultisols, steep, well-drained soils with a red to gray-brown layer of loam. The underlying geology consists of metamorphic rock with some pockets of intrusive igneous rock. Gneiss, schist and quartzite are particularly common.*	*Bailey et al., 1994; Carson and Green, 1981; EPD, 2001*
Land Uses	*Land within the basin is entirely within the boundaries of the Chattahoochee and Nantahala National Forests. The Nantahala National Forest is over a half million (M) acres of mountains and valleys in southwestern North Carolina and has 27,000 acres of designated wilderness lands. The Chattahoochee National Forest is over 750,000 acres and has 117,000 acres of designated wilderness lands. These national forests are managed by the U.S. Forest Service (USFS) and have comprehensive land and resource management plans that balance sustainable uses, protect resources, and maintain healthy ecosystems by defining desired conditions/objectives and setting standards for different forest components (water quality, soils, terrestrial ecosystems, management areas, etc.). Lake Burton supports a mixture of residential and recreational land uses, including over 1,200 residential homes, campgrounds, marinas, a golf course, and a state park.*	*USFS, 2022; USFS, 2004*
Climate	*Climate in the basin is characterized by mild temperatures and large participation quantities; average annual precipitation at Coweeta's weather station is 72 inches. Precipitation is highest in late winter and spring with March having the most precipitation.*	*Mast and Turk, 1999*

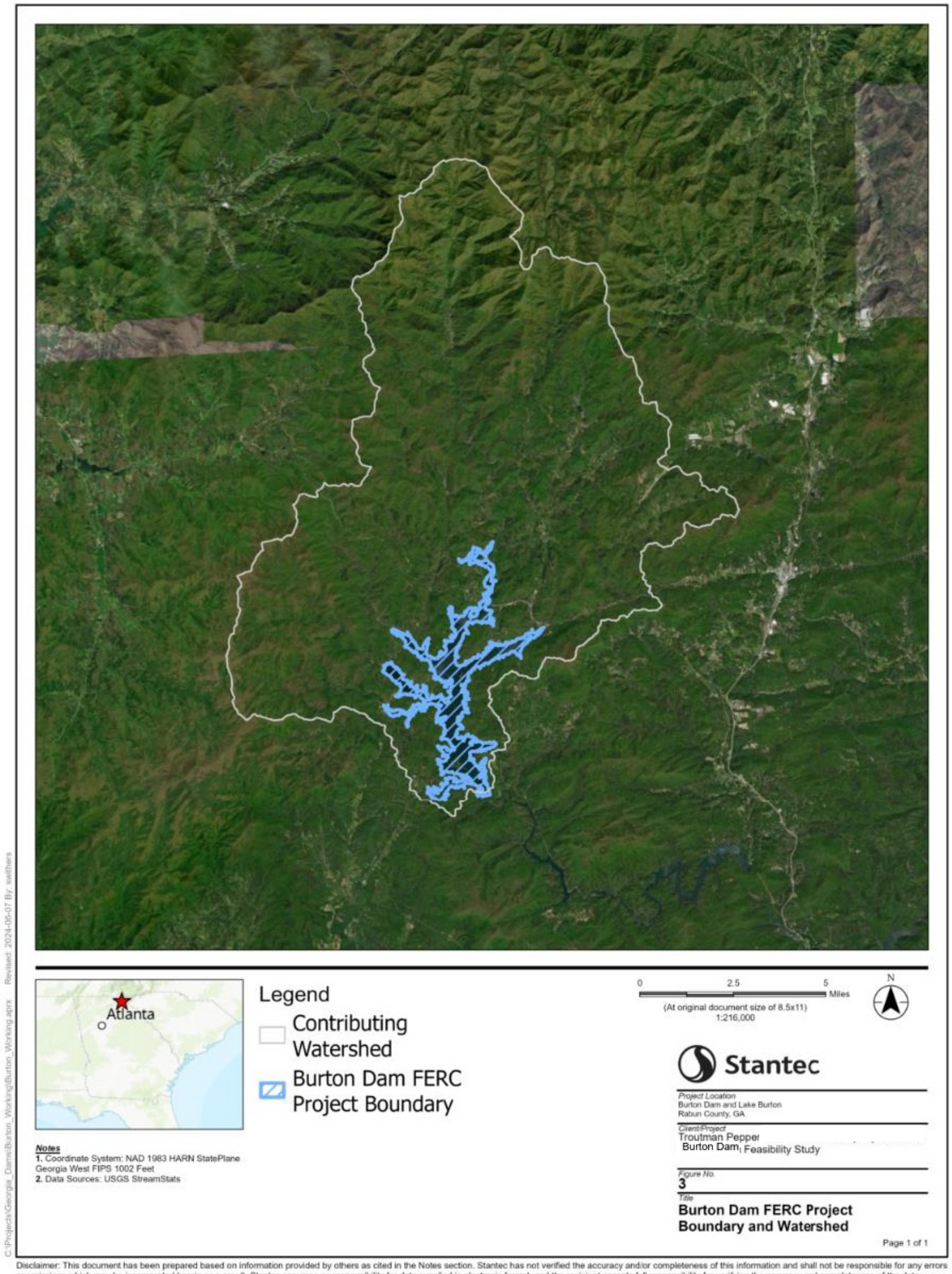

Figure 3. Burton Dam Catchment and Project Area

2.3 Shoreline Development, Recreation Resources, and Water Withdrawals

Lake Burton supports extensive residential, commercial, and public recreational shoreline developments including recreational areas, a state park, marinas, campgrounds, and a golf course. There are several lake access points with boat launches including Murray Cove Boat Launch (managed by GPC), Anchorage Marina, LaPrades Marina, and a public boat launch at the Burton Trout Hatchery (Table 2; Figures 4-6). Representative photographs of some recreation amenities are provided below. It is estimated there are over 1,200 residential homes along the extensive shorelines of Lake Burton. There are no known water utility withdrawals from Lake Burton. However, the Lake is used as a water supply for local fire protection..

Stantec personnel conducted a field reconnaissance of major shoreline developments on January 1, 2024. Facilities included in the field reconnaissance included marinas, recreation areas managed by GPC and Georgia DNR, hotels, and residential areas around Lake Burton. Major shoreline developments are summarized in Table 2 and shown on Figure 7.

Table 2. Major Recreational Shoreline Developments at Lake Burton

Recreation Facility	Management	Facility Type	Reservoir Access
Jones Bridge Recreational Area	GPC	Day Use	No Boat Launch
Timpson Cove Beach	GPC	Day Use	No Boat Launch (Public Beach)
Murray Cove Boat Launch	GPC	Day Use	Public Boat Launch
Moccasin Creek State Park	Georgia DNR	Camping	Public Boat Launch
LaPrades Marina	Private	Day use/restaurant	Public Boat Launch
Anchorage Marina	Private	Day use	Public Boat Launch
Burton Trout Hatchery [1]	Georgia DNR	Day Use	Public Boat Launch
Waterfall Club	Private	Private	No Public Access

[1] Burton Trout Hatchery is located next to Moccasin Creek State Park and not presented on Figure 7.

Figure 4. Murray Cove Boat Launch managed by GPC. Photo from field reconnaissance performed by Stantec (January 2024).

Figure 5. Recreational boating amenities available at LaPrades Marina. Photo from field reconnaissance performed by Stantec (January 2024).

Figure 6. Public Boat Ramp at the Burton Trout Hatchery, across from Moccasin Creek State Park. Photo from field reconnaissance performed by Stantec (January 2024).

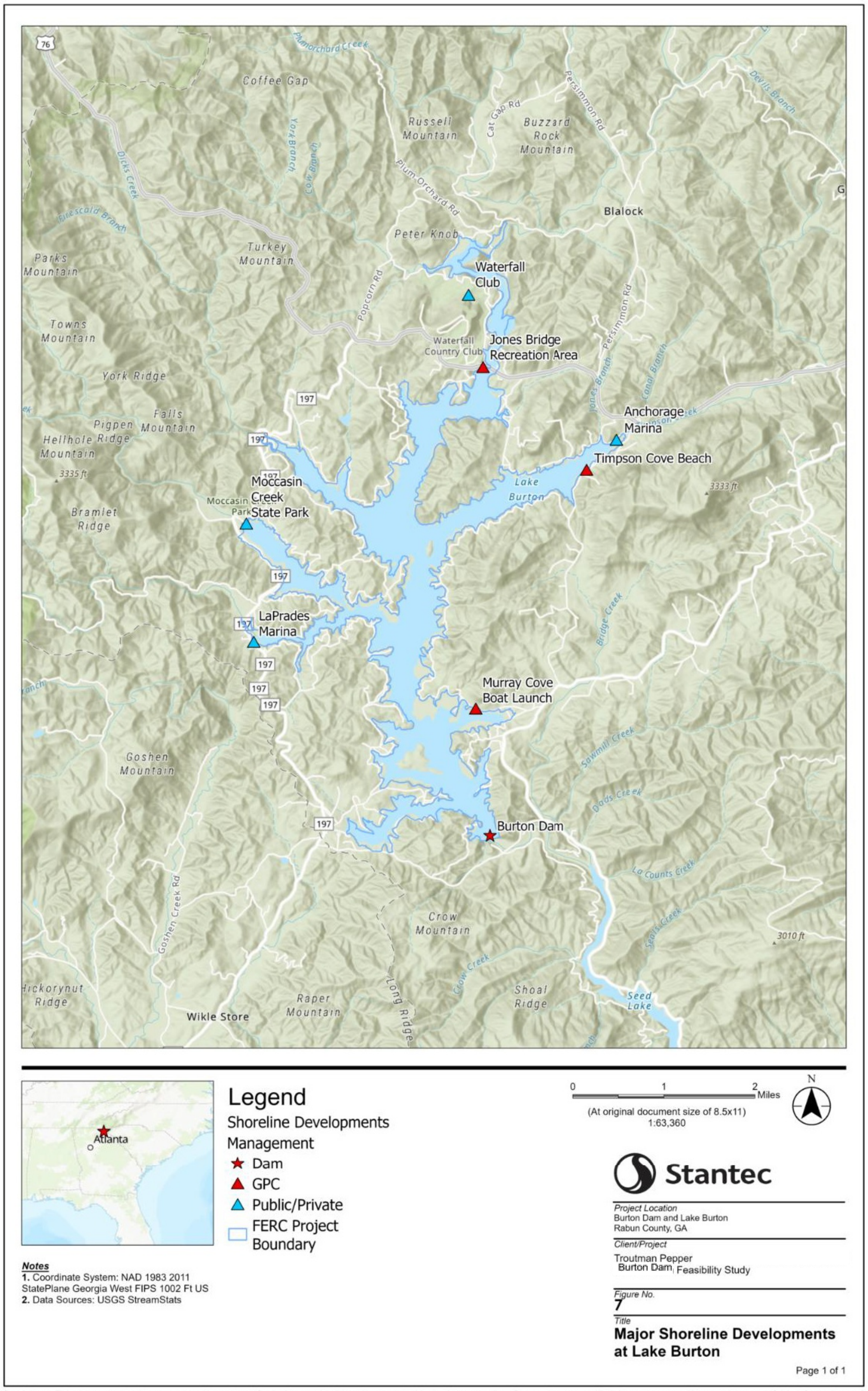

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Figure 7. Major Shoreline Developments at Lake Burton

2.4 Existing Conditions of Dam

Burton Dam is a 128 ft high cyclopean concrete gravity dam with a crest length of 983 ft. The other accompanying features (and their lengths) to Burton Dam are the left non-overflow section (292 ft), right non-overflow (360.5 ft), a gated spillway (197 ft), and an intake (64 ft)/sluiceway (69.5 ft). The left and right non-overflow sections have crest elevations of 1873 ft above Mean Sea Level (MSL). The concrete spillway has a crest elevation of 1860 ft MSL and contains eight motor-operated bottom-hinged gates (7.5 ft high by 22 ft wide). The powerhouse is located at the toe of the intake section. Construction of the dam took place between 1917 and 1920 with the powerhouse and penstocks being added in 1927. According to the 2020 Part 12D Inspection Report various improvements and repair were made including adding concrete and gunite facing to the non-overflow sections in the 1940 and 1960s. Post-tensioned rock anchors were installed in the early 1990s (Schnabel Engineering, 2021).

2.5 Hydrology and Hydraulics

To inform the development of conceptual designs for scenarios, a desktop evaluation of stream flow patterns for the project area was performed using data from the United States Geological Survey (USGS) Gage 02178400 (Tallulah River Near Clayton, GA). The gage is located approximately 2 km upstream of where the Tallulah River discharges into the Lake Burton reservoir. Drainage area above the gage is 58.4 square miles. In comparison, the drainage area at Burton Dam is 118 square miles due to the tributaries flowing into Lake Burton.

Mean monthly discharge was highest in March (273 cfs) and lowest in September (116 cfs) (Figure 8). While mean streamflow was higher in the winter and early spring, high flow events occurred throughout the year (Figure 8).

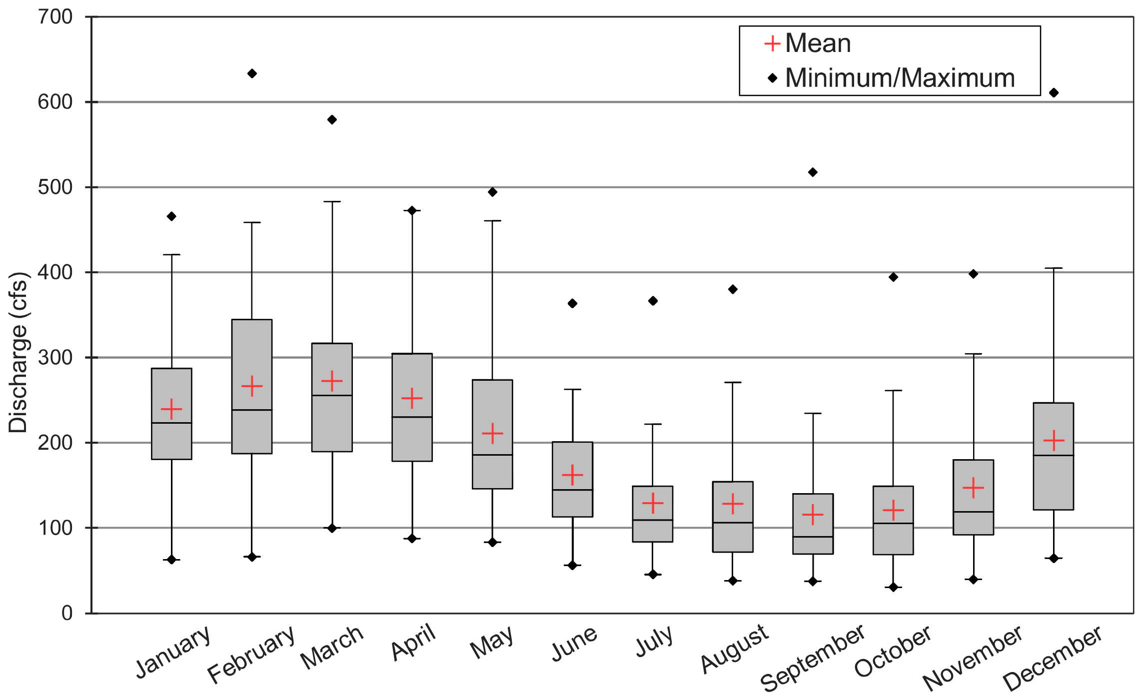

Figure 8. Mean monthly discharge summarized by month at USGS Gage Station 02178400. Boxes represent the 25th, 50th, and 75th percentile flows. The gage period of record extends from April 1964 to present.

A peak flow analysis was conducted using the USGS gage station data. The resulting peak discharges for eight return intervals are presented in Table 3.The peak inflow associated with the flood of record for Lake Burton was estimated to be 19,000 cfs on May 28, 1973 (Schnabel Engineering, 2021).

Table 3. Peak Flow Statistics 1989-2024, USGS Gage 02178400

Return Interval (years)	Peak flow (cfs)
1.25	1,710
1.5	2,160
2	2,890
5	4,720
10	6,240
25	7,720
50	8,333
100	8,500

Daily flow data were used to construct a flow duration curve to examine how the basin provides flows of various magnitudes (Figure 9). The flatter curve demonstrates high flows are maintained for large portions of the year due to large precipitation events.

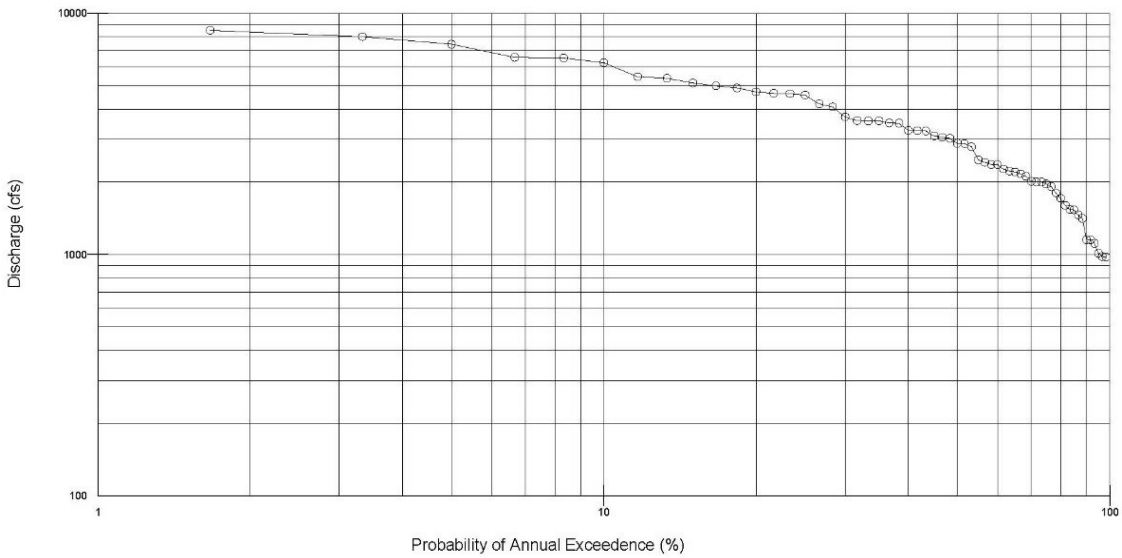

Figure 9. Flow Duration Curve for the Tallulah River at USGS Gage 02178400

2.6 Sediment Assessment

To estimate the extent of sediment storage in Lake Burton, bathymetric data was collected by Stantec in 2023 and compared to data collected by Lowe Engineers in 2012. The 2023 survey consisted of two cross-sections, near the upstream and downstream extents of the reservoir, and a longitudinal profile (Figure 10). The 2023 cross-section locations were intended to replicate the location of cross-sectional data collected in the 2012 survey. The purpose of the 2023 data collection was to confirm the 2012 data and assess the need for more granular data collection efforts in the future. To compare datasets the 2012 data were compiled into a digital elevation model (DEM) with a cell size of 25 ft by interpolating among survey points.

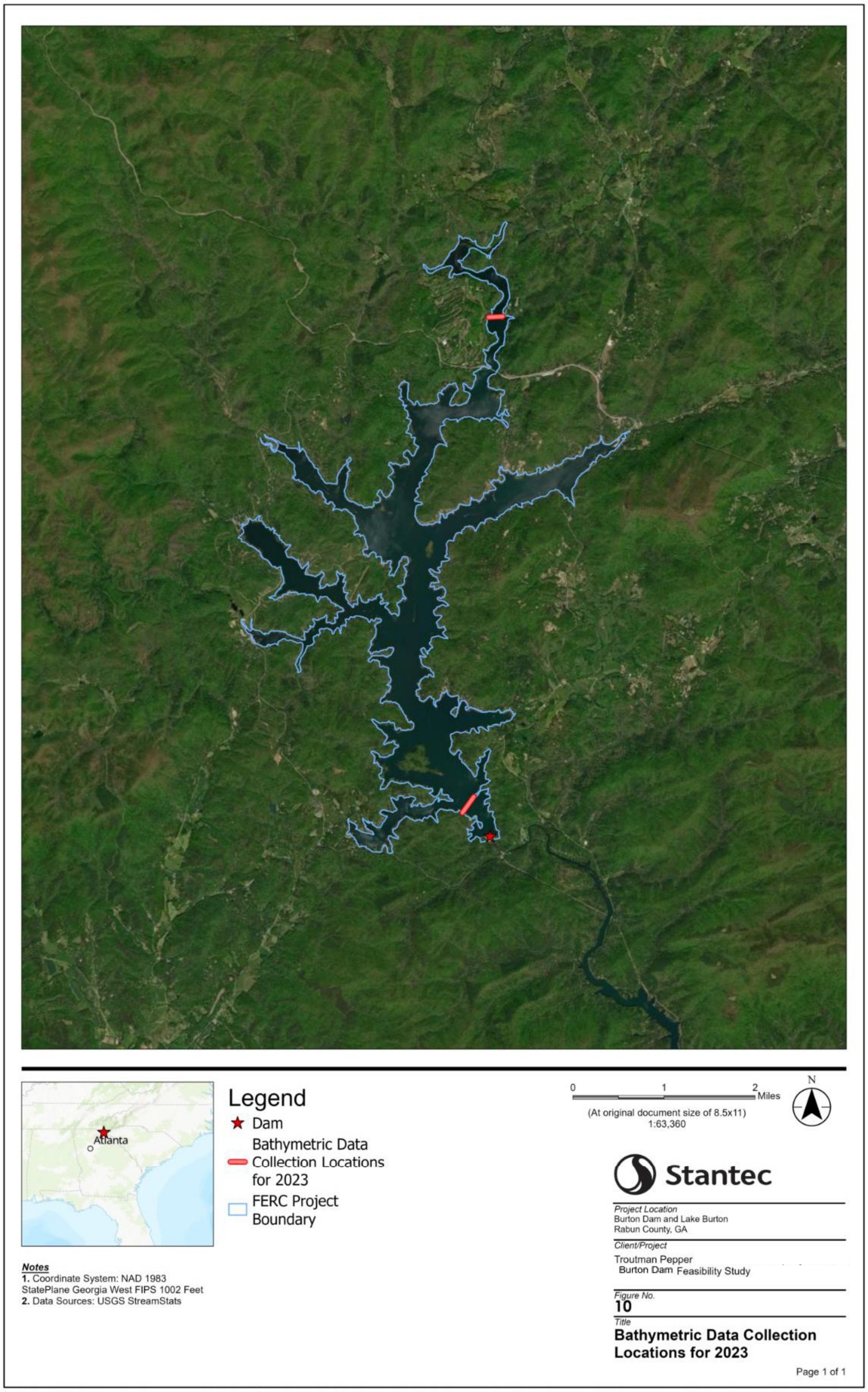

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Figure 10. Bathymetric Data Collection Locations for 2023

A comparison of the 2012 and 2023 longitudinal profiles shows negligible changes in lakebed elevations. A representative section of the longitudinal profiles from approximately 20,000 to 25,000 ft upstream of the dam is presented in Figure 11, which suggests additional sedimentation in the reservoir was not substantive over the past 11 years. Differences between the 2012 and 2023 longitudinal profiles may in part be due to 1) discrepancies in data collection methods, 2) triangulation errors that are artifacts of the 2012 DEM generation process, or 3) topographical features along the lakebed, rather than large quantities of sediment deposition during this time.

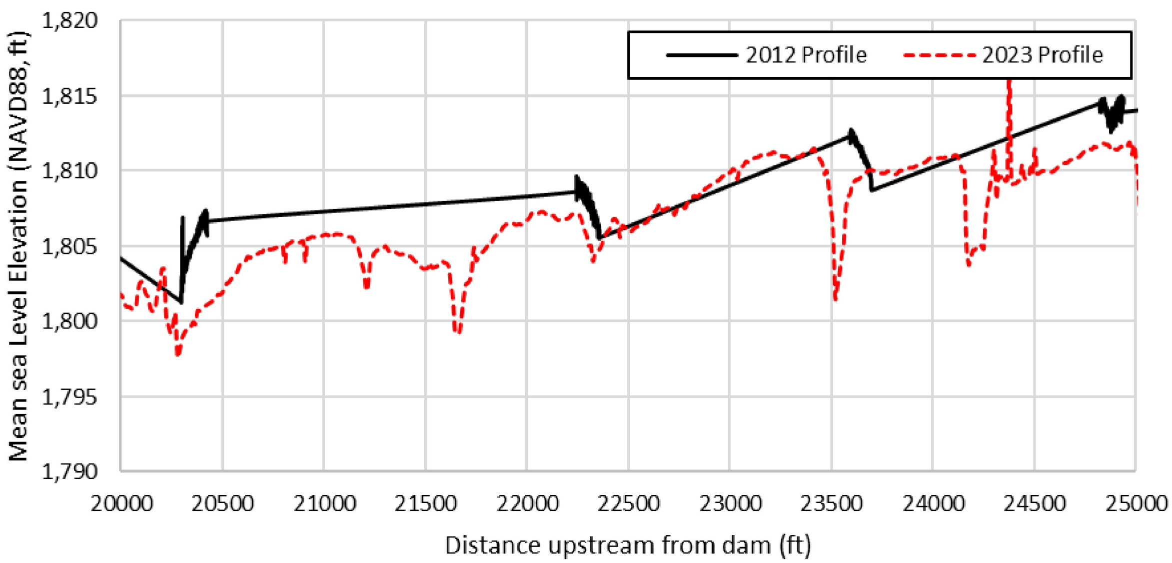

Figure 11. Comparison of 2012 and 2023 Longitudinal Profiles from 20,000 to 25,000 ft Upstream of Burton Dam

Figure 12 and Figure 13 show a comparison of the two cross-sections from the 2012 and 2023 datasets. Cross-section locations in 2023 were collected in the same general vicinity as 2012, but alignments did not match up exactly. At the downstream cross-section, a decrease in lakebed elevation was observed between 2012 and 2023 (Figure 12). The decrease in bed elevation was less than 5 ft across most of the cross-section. It is reasonable to assume that this change may be a result of the normal ebb and flow of sediments on the bottom of the lake, or this may be due to inconsistencies in data collection and processing methods between the two datasets. If it is a sediment transport or erosion process, then it is most likely small silts and clays falling out of suspension and settling on the bottom, then being resuspended by temperature fluxes, wind, wave, and flood flows acting on the lakebed. The upstream cross-section showed a small increase in elevation, likely due to sediment accumulation between 2012 and 2023. A maximum accumulation of approximately 3 ft was observed across the 600 ft cross-section (Figure 13). This suggests that sedimentation was not substantive along the upstream extents of the impoundment between 2012 and 2023. Just as likely as the sedimentation processes, the differences may be due to the differences in means and methods between the surveys. A justifiable sedimentation characterization would require a more extensive sediment survey, that would capture more of the surface and subsurface information of the lakebed.

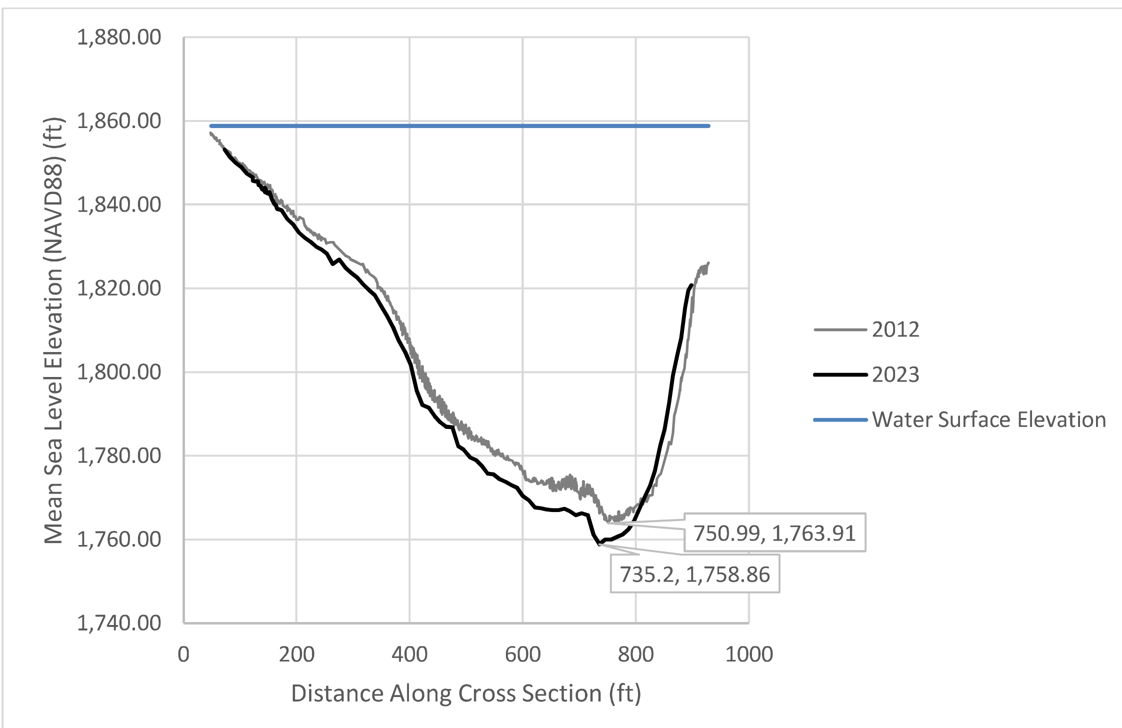

Figure 12. Downstream Cross-Section Comparison of Bathymetric Data

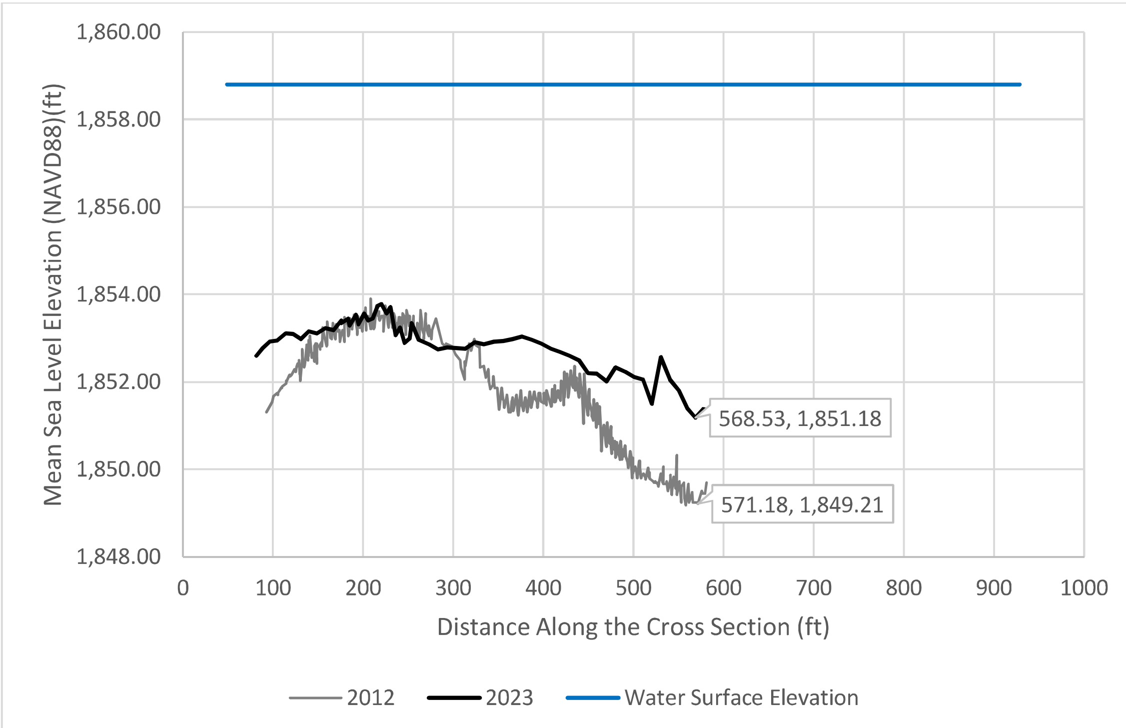

Figure 13. Upstream Cross Section Comparison of Bathymetric Data

The total volume of sediment storage in Lake Burton was estimated by comparing the bottom elevation of the dam shown in historical drawings and measurements of the lakebed elevation at the dam in 2023. In the 1963 FERC license application, the Typical Sections of the Dam noted the lakebed elevation behind the dam as 1751.72 ft. In the North American Vertical Datum 1988 (NAVD 1988), this elevation is 1750.42 ft. The 2023 bathymetric fieldwork recorded the lakebed elevation at the dam as 1761.90 ft, approximately 11.48 ft higher than the historical elevation. To estimate a total sediment storage volume within the reservoir, it was conservatively assumed that average sediment accumulation thickness was 11.48 ft across the lakebed. The total lakebed area was estimated to be 1,108 acres by delineating the historical floodplain of the Tallulah River and its tributaries Figure 14. The assumed sediment thickness (11.48 ft) was multiplied by the lakebed area (1,108 acres) to estimate the total sediment volume stored in Lake Burton as approximately 20.5 million cubic yards. Compared to the total storage volume of the reservoir (108,000 ac-ft), sediment storage accounts for approximately 12 percent of total reservoir storage capacity. For a more detailed estimate of sediment storage volume, a current bathymetric survey of entire reservoir by using ground penetrating technology would be needed to understand the accumulated sediments.

Changes in lakebed elevations observed were small when comparing available bathymetric datasets. A lack of recent large-scale disturbances to the watershed suggest that sediment storage is relatively stable for Lake Burton. Most of the drainage area contributing to Lake Burton falls within either the Nantahala or Chattahoochee-Oconee National Forests, where current land management practices (refer to Section 2.2 for further discussion on land management practices within the national forests) likely prevent large quantities of sediment loading. The metamorphic geology of the region may also contribute to lower sedimentation rates in the basin since metamorphic rocks are more resistant to weathering and erosion than other types (i.e., sedimentary). Prior to the establishment of the Chattahoochee and Nantahala

Forests in the mid-1930's and designation of the Southern Nantahala Wilderness in 1984, most of the basin was logged with clearcutting being the most popular method of cutting prior to the 1990s (Dougless and Hoover, 1988). Sediment storage in Lake Burton is likely due to these historical impacts resulting in erosion and sedimentation in the reservoir as well as normal sediment transport processes within the Tallulah River basin. Roads within the basin may also have a minor contribution to sediment loading to streams during storm events.

Generally, the sediment wedge behind dams increases in thickness closer to the dam. More coarse sediments (e.g., cobble and gravel) are generally deposited at the upstream limits of the impoundment, whereas finer substrates (e.g., silt and sand) are deposited further downstream behind the dam and along channel margins. In large impoundments, such as Lake Burton, there is often a secondary wedge of sediment that forms at the upstream end of the impoundment where higher velocity flow with a steeper energy slope enters the low-velocity backwater of the pool (Randle et al., 2015). While sediment management can be a costly part of dam removals, management of sediment in Lake Burton may be limited to control of reservoir drawdown rates during dam removal and seeding of exposed reservoir sediments. If more significant removal of sediment is deemed necessary by FERC, U.S. Army Corps of Engineers (USACE),, or other regulatory agencies following more extensive surveys of the reservoir, costs associated with dredging and hauling of lake sediment would be so great that removal would be unfeasible. Beyond the construction work required on-site, developing a receiving site and the potential environmental and regulatory impacts of such work would make it unfeasible.

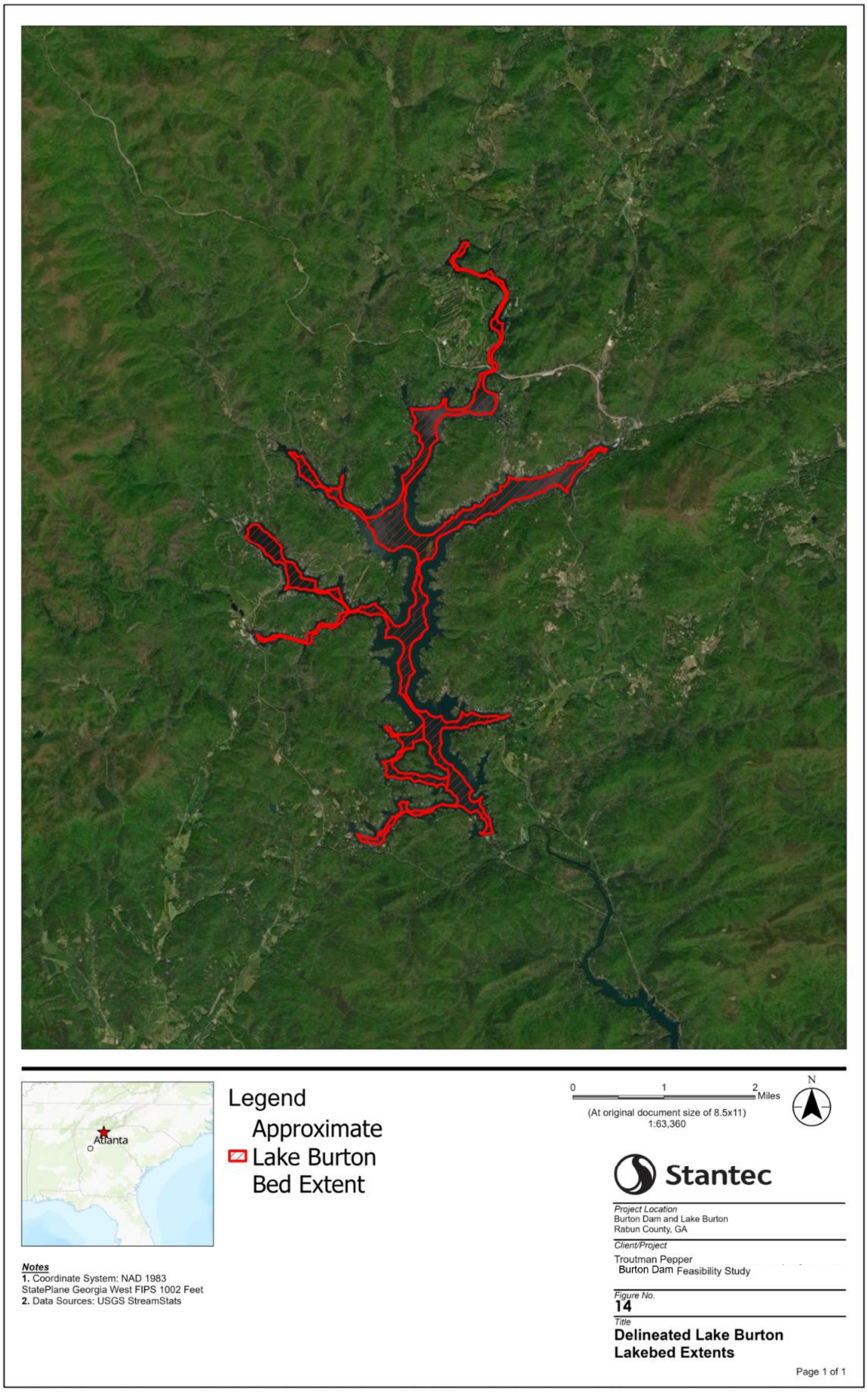

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Figure 14. Delineated Lake Burton Lakebed Extents

2.7 Cultural Resources

Based on cultural resources surveys associated with the licensing studies in the early 1990s, there are at least seven archaeological sites eligible for listing in the National Historic Register are within the area of potential effect of the North Georgia Project, with most associated with the downstream impoundments. However, it is possible two or more are associated with the Lake Burton development. Additionally, the hydroelectric facilities including dams are eligible for inclusion in the National Register of Historic Places as a Historic District. Under the current FERC License, the Burton Project has a Programmatic Agreement in place since 1996 that guides management of cultural resources and specifies how to plan and conduct ground-disturbing activities or other actions that may affect any historic properties within the project's area of potential effect.

2.8 FERC Licensing and Compliance

Burton Dam is one of six developments that make up the North Georgia Hydroelectric Project (North Georgia Project), which is operated by GPC and licensed for operation under FERC No. 2354. The current 40-year license for the North Georgia Project, will expire September 30, 2036, and the relicensing process will need to commence in 2031.

3 Dam Removal Study

This study evaluated full removal of dam structure, including the gate spillways, embankments, and the left and right non-overflow sections. This scenario relies on a passive approach to sediment management, using a multiple year construction window to allow the Tallulah River to mobilize and transport sediment in the impoundment at a rate that is appropriate for the stream system. The result of this approach would be a free-flowing Tallulah River through the current reservoir footprint, which over time will evolve to occupy its historic valley.

Construction would begin with the slow removal of the dam and a slow drawdown of the lake elevation over time. This method reduces sediment loading to the downstream reservoirs and helps the tributaries within the current lake footprint to stabilize passively. Dredging any material beyond the immediate dam footprint was avoided in this study to reduce construction cost.

Minimal large-scale stabilization and small-scale channel stabilization measures in the remaining normal pool footprint will most likely be required. Seeding and plantings of trees and shrubs was accounted for across the entire dam footprint. As designed, planting in the normal pool footprint will be a large part of the long-term stability. In the short term, management of the sediment during the dam removal, and allowing natural attenuation of instability points will help avoid large-scale restoration. The result may not be streams with high ecological function, but stability can be achieved over time without significant intervention. An adaptive management plan was included to address invasive species control and localized instability, usually a 10-year period post construction. The associated requirements would be determined by the FERC surrender order,404 permit special conditions, and if any civil infrastructure is threatened. Minimal intervention into stability outside the immediate dam footprint is expected. For improved ecological function in the new stream channels, stream mitigation could be considered.

The channel design through the dam footprint relies on defining the bankfull discharge. The bankfull discharge is the channel forming flow that maintains channel dimensions. A regional curve was used to obtain typical bankfull cross section geometry for the restored stream following dam removal. Regional curves relate bankfull stream channel dimensions (i.e., width, depth, and area) and discharge to the stream's drainage area. These relationships are empirically derived from longitudinal and cross-section data and are developed for streams in the same physiographic region with similar rainfall/runoff relationships. The North Carolina Rural Piedmont and Mountain regional curves were used to calculate the bankfull dimensions of the restored channel for full dam removal and is shown in Figure 15 (Harman et al., 2000).

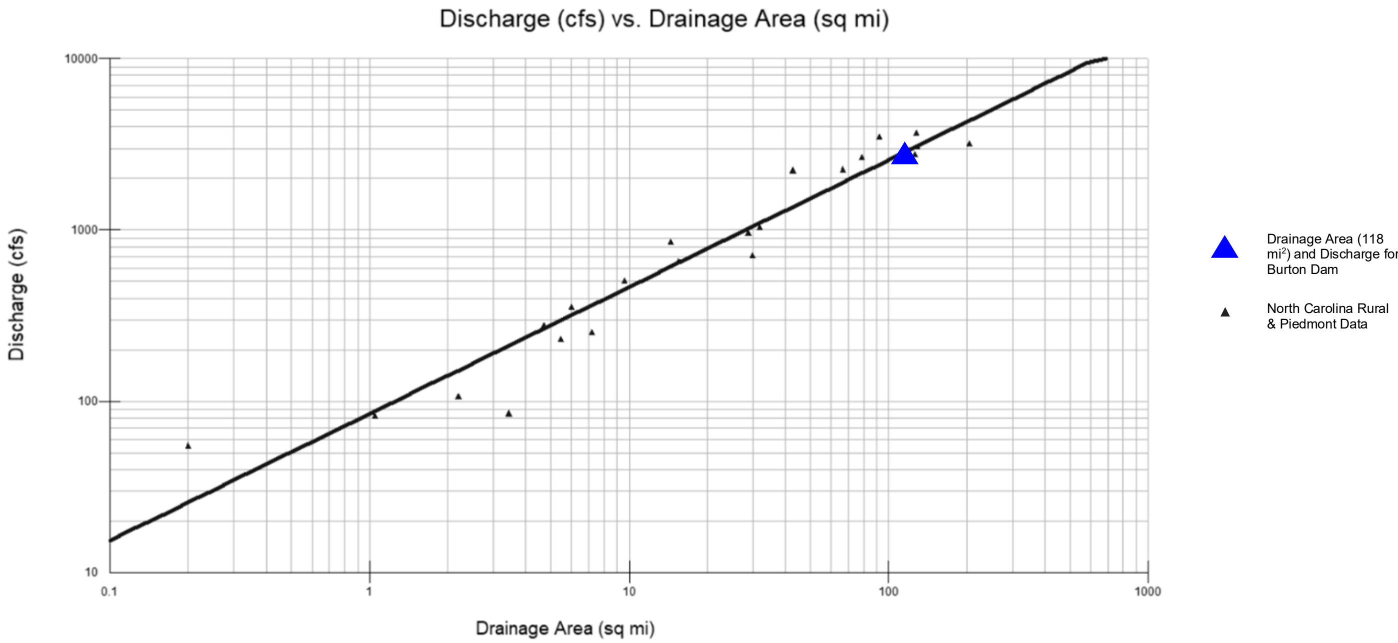

Figure 15. North Carolina Rural and Piedmont Regional Curve and Burton Dam Drainage Area to Bankfull Discharge

Based on the historic valley width estimated from the bathymetry, a total “valley” width of approximately 200-250 ft will be graded through the current dam footprint. This valley width will allow overbank flooding above the bankfull discharge to reduce the potential for scour or sediment deposition caused by flow constriction but is sized to reduce required grading. Riffles and pools, designed with the goal of stability and aquatic habitat, will be constructed within this valley. Some of the material removed during the dam removal will be recovered to perform the channel restoration, to be used as bed or bank material based on gradation and cohesiveness. Grade Control structures are proposed to increase the immediate stability of the proposed channel and control the global profile during post-construction channel adjustment. The profile of the proposed channel slope is 0.7% compared to the Tallulah River outside the dam footprint with average river slope of 0.17%. The higher slope of the proposed reach minimizes the construction cost while still proposing a functional natural channel (Figure 16).

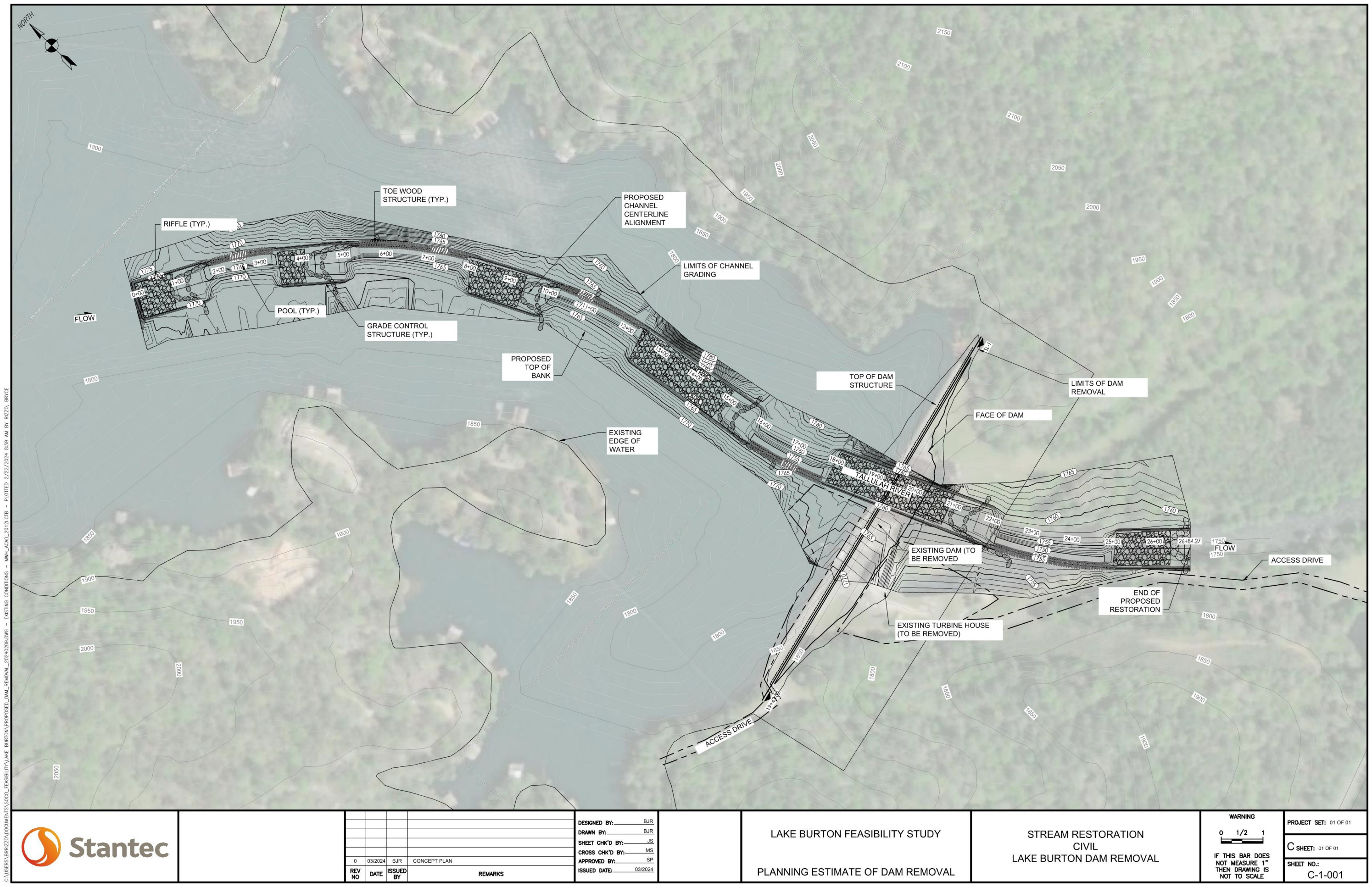

Figure 16. Full Dam Removal Concept Map

4 Evaluation of Dam Removal for Burton Dam

4.1 Recreation, Residential, Commercial, and Lost Power Generation Impacts

Dam removal and decommissioning of the Burton power generation station would have very significant adverse effects on the economic, recreational, and aesthetic resources of Rabun County and surrounding communities.

Burton Lake is a significant resource for many outdoor recreationists in Georgia and adjoining states. Removal of the dam and draining of the lake would transform a large flatwater recreation and residential resource to a much smaller free-flowing riverine recreation resource that would take several years to be able to be used safely by the public. Residential docks and shoreline development would no longer have access to the water's edge. The current recreational commercial infrastructure like marinas, rental properties, and campgrounds would no longer have water access as originally intended. Redevelopment and repurposing of existing infrastructure could be a part of the burden on local stakeholders after dam removal and could potentially be a burden on GPC.

While dam removal would open approximately 9.4 miles of riverine habitat upstream of the current Burton Dam it would also leave over 2,000 acres of exposed lands that would either revegetate naturally or by sequenced steps to help establish native vegetation and discourage invasive species from gaining hold. The new riverine habitat represents a change to the current recreational fishing opportunities used locally. The current fish community in Lake Burton is dominated by predatory, sport fish species (e.g., bluegill, crappie, walleye, largemouth, bass, and yellow perch), typical of a warmwater southeastern lake (FERC, 1996).

Developed public recreation facilities that would experience significant loss of use and/or loss of utility would include Jones Bridge Recreation Area, Timpson Cove Beach, Murray Cove Boat Launch, Moccasin Creek State Park, LaPrades Marina, Anchorage Marina and the Waterfall Club shoreline facilities. Based on GPC's FERC Form 80 recreation use data filed with FERC in 2003 and 2015, it is estimated that Lake Burton received 392,628 recreation visitor days in 2014, up from an estimated 281,900 visitor days in 2002 (Licensed Hydropower Development Recreation Report FERC Form 80, 2002 and 2014). Importantly an addition 98,700 overnight visits were recorded in 2014. Dam removal would drastically change the recreation environment and most of future recreation use would be limited to free-flowing river opportunities with some overnight and day use visitation possibly being retained at the State Park if the facility was left in operation. This would lead to the displacement of hundreds of thousands of recreationists, who currently frequent Lake Burton.

This loss in recreation use would result in less direct spending by recreationists for supplies, gas, lodging, restaurants and other retail purchases in the county and other towns and commercial hubs of the region. The current suite of summer recreation events would be greatly affected and likely some events canceled. These include boater safety classes, annual 4th of July fireworks, summer scout camps, and an annual bluegrass music event. The implications to other economic losses that would arise from the potential removal of Burton Dam are impacts to nearby property values[1] from dam removal. Further, the economic impact of foregone electrical generation should be considered and will be evaluated by GPC and therefore are not included in this study..

4.1.1 PROPERTY IMPACTS

Estimating property impacts was accomplished by first establishing a categorized list of property types and defining the broad sets of amenities provided by the lake. For example, lakefront (LF) properties benefit differently from the lake compared to homes with only lake views.

Based on the major types of amenities offered by the lake to nearby properties, four categories of properties were established. These four types are listed as follows (with their shorthand notation in parentheses).

1. Lakefront properties with a secondary structure like a dock or a boat house on the shore (LF-Dock)
2. Lakefront properties without a secondary structure like a dock or a boat house on the shore (LF-NoDock)
3. Non-lakefront properties with high quality views of the lake (LV-High)
4. Non-lakefront properties with poor quality or no view of the lake (LV-Low)

Stantec estimated the number of properties in each of the four categories using a stratified sampling[2] technique across seven geographic regions of Lake Burton. The data sources for the stratified sampling were Google Earth and Zillow. Only those properties within approximately 1,000 ft of the current shoreline were included, though property owners beyond this distance are also likely to be impacted by dam removal. Through satellite imagery sampling and professional judgement, it was estimated that approximately 75% of non-lakefront properties had high quality views of the lake, while approximately 25% of non-lakefront properties had poor quality or no view of the lake.

In this estimate, it was approximated that there were 1,400 properties in the four property categories within approximately 1,000 ft of the lake front (Table 4). The distance of 1,000 ft from the lake front was assumed to be the approximate limit property value may benefit materially from views of the lake.

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[1] For the purpose of this analysis, and generally consistent with the literature in this field, 'home' and 'property' are understood to be synonymous and both refer to a parcel of land upon which a residential and accessory structures reside

[2] This was not true random sampling. However, two independent analyses estimating the number of homes in each category converged within 7% of each other for each property type.

Results from this estimation show that the majority of these 1,400 properties are lakefront, and the majority of lakefront properties have secondary structures geared towards water-based activities.

Table 4. Estimated Number of Properties by Category

Category	Category Description	Number of Properties in Category
LF-Dock	Lakefront properties with a secondary structure like a dock or a boat house on the shore	980
LF-NoDock	Lakefront properties without a secondary structure like a dock or a boat house on the shore	140
LV-High	Non-lakefront properties with high quality views of the lake	210
LV-Low	Non-lakefront properties with poor quality or no view of the lake	70

4.1.2 FOREGONE ELECTRICITY GENERATION

The economic impact of foregone electrical generation should be considered and will be evaluated by GPC; therefore, this impact is not included in this study.

4.2 Construction Costs

A planning level opinion of probable construction cost (OPCC) was prepared for full dam removal. The cost estimate assumes a long enough schedule to allow for natural attenuation of sediment instability behind the dam, and workable access onto the historic floodplain after the draw down. A sediment analysis of the captured fine sediments would be required to understand the stability of these soils. All costs are in 2024 dollars, and escalation is not factored into the costs as no timeline for implementation is suggested by this study. The OPCC includes known major project components, a 15% adaptive management plan, 30% planning level contingency, 15% estimate of survey, design, and permitting professional services,10% construction oversight and owner cost, and a 10% allowance for unknown impact mitigation needs. Detailed cost estimates are presented in Appendix A.

For full dam removal, the total project cost estimated is $169 Million associated with construction cost of the dam removal and site reclamation.

To calculate the construction cost of $169 Million, a post restoration grading surface was created along with an intermediate grading surface that represent the post removal, pre-restoration condition. This allowed the excavation quantity of the dam removal to be separate from the excavation quantity as a part of the stream restoration. Additional sediment outside of the restoration grades was also assumed to require removal and disposal. In total, 250,000 cubic yards (representing approximately 1.2% of the calculated sediment volume within the Lake) was assumed to require dredging and removal.

The first phase of construction would be the multi-stage draw down of the embankment and reservoir. Considerations during this stage was the Control of Water, Mobilization and temporary site development, excavation/demolition of the Dam and Facilities, and disposal of material. Assumptions made in this phase included:

- The entire structure is to be removed;
- Some of the material excavated from the embankment can be reused during the restoration; and
- A reasonably close disposal site can be secured.

After the drawdown of the lake and the excavation of sediment upstream of the dam, the restoration could begin. Potential grade control structures, bank stabilization measures, grading, and planting were priced out during the restoration phase of construction. Planting of the restoration site was included as well as the entire footprint of the normal pool. Planting across the former pool ensures the Tallulah River and tributaries successfully stabilize without active restoration installations. Ancillary benefits include increased species diversity and faster upland recovery. This design will achieve dynamic equilibrium with the rest of the Tallulah River System. This means long-term costs, like site maintenance, are not expected. The Tallulah River will naturally be able to offset the sediment flux out of the project area.

4.3 Regulatory Considerations

If Burton Dam were to be fully removed, a number of regulatory requirements would need to be followed to obtain the necessary permits and approvals associated with decommissioning, dam removal, and subsequent restoration actions. The regulatory processes would involve a combination of federal, state, and local regulations. These processes are described in the sections below. Because the Burton Dam and powerhouse are part of a FERC-licensed project, the current license would have to be surrendered if a removal was pursued. The FERC surrender process would serve as the main process under which compliance with other environmental regulations would fall under. Based on other decommissioning and dam removal planning projects, a surrender process along with gaining other regulatory approvals would take at least 5 to 10 years (and potentially up to 20 years), likely incurring costs of millions of dollars in consulting and legal fees.

4.3.1 LICENSE SURRENDER APPLICATION

In order to relinquish the license for the Burton development of the current hydropower project, a surrender application in accordance with FERC regulations at 18 Code of Federal Regulations (C.F.R.) § 6.1 and 6.2 would be required. If the surrender process was initiated just prior to relicensing (i.e., within 5 to 5.5 years prior to expiration of the existing license) a Notice of Intent to not seek a new license would also need to be filed. FERC projects have different requirements for license surrender based on the project components, state and federal regulations in the project location, and what the licensee intends to do with the project after it is surrendered. Both the surrender application and the surrender process are project-specific, with FERC dictating requirements on a case-by-case basis (American Rivers, 2023).

Development of a surrender application is complex and requires extensive consultation and multiple studies with resource agencies and local stakeholders. The surrender application must identify all project features to be removed including the dam, reservoir, power plant, transmission lines and recreation features and how they will be disposed. Major components of a surrender application include:

1. Removal Plan: For a dam removal, the plan will include details on how the dam and associated structures will be removed and a proposed timeline for removal. A proposed timeline and sequencing of removal activities. The plan will also need to cover current and future safety concerns for the project area.
2. Environmental Impact Description: This description outlines the anticipated effects on dam removal on the baseline environmental conditions of the project area. Effects may include sediment, hydraulic, biological, and recreational impacts.
3. Project Description: Includes description of all components of the project, physical structures, hydraulic impacts of the project on the waterbody, and history of the project.
4. Relevant Consultations with Resource Agencies (see Section 4.3.2)

In general, after extensive consultation with stakeholders and development of a removal plan, once filed with FERC the license surrender process would follow these typical steps:

1. License Surrender Application Submitted to FERC
2. After a public comment period, FERC will review comments and decide if a National Environmental Policy Act (NEPA) document (an environmental assessment (EA) or environmental impact statement (EIS)) will be required or if additional information or studies are needed.
3. NEPA Document Drafted
4. 30-60 Day Comment Period on Draft NEPA Document
5. Within 60 days of close of comments, resource agencies must file conditions.
6. FERC publishes final NEPA document within 90 days of agencies filing conditions.
7. FERC issues a final decision on the surrender application with required mitigation measures for the Burton development.
8. Agencies and others have opportunity to challenge FERC's final decision.

Once the comment periods have closed on the license surrender application and NEPA document, it may take additional time for FERC to render a final decision on the fate of the license, as well as the potential for legal challenges of FERC's decision. If FERC approves the surrender application, the licensee must comply with all terms of the license and surrender application before the license is officially surrendered for the Burton development.

4.3.2 AGENCY CONSULTATIONS ASSOCIATED WITH DAM REMOVAL

As described above in the license surrender application process, consultation with relevant federal, state, and local resource agencies is necessary as part of the surrender process. The following sections overview the regulatory drivers leading to important consultations that would be necessary for planning a dam removal. Each of the individual permits or agency consultations could require approvals and mitigation measures.

Clean Water Act 404 Permit

Section 404 of the Clean Water Act (CWA) authorizes the discharge of dredged or fill material to waters of the United States and is administered by the Department of the Army (DOA) through the U.S. Army Corps of Engineers (USACE). DOA permits can be divided into two basic groups: General Permits and Individual Permits. General Permits are issued for small impacts and Individual Permits are issued for projects with greater impacts or those with classes of actions not authorized under a Nationwide Permit (NWP). The USACE has developed an NWP program that authorizes approximately 54 specific activities. The program has a list of general conditions that must be met by all NWP's. In addition, each NWP has its own list of specific conditions and authorizations. If a proposed activity can be conducted within the constraints of the general and specific NWP conditions, a permit is issued. The selected scenario may qualify for NWP 27 only if it will have a minimal effect on water quality. A minimal effect is defined by as an activity that permanently impacts 0.1 acres or less of Waters of the United States, permanently affects 300 linear ft or less of stream, and does not result in any permanent secondary effects to Water of the United States. It is likely that all scenarios will exceed the impact limits set for a general permit and require preparation of an individual 401 Water Quality Certification (WQC).

Clean Water Act 401 Water Quality Certification

Section 401 of the CWA requires state agencies to certify that a federally issued Section 404 CWA permit will not result in a violation of state water quality standards. Each individual state has the option of placing restrictions on usage of the NWP's under its 401 CWA authority. This authority is administered by the Georgia Environmental Protection Division (EPD).

A 401 WQC application requires additional information not involved in a 404 Pre-Construction Notification (PCN). The application includes discussion of avoidance and minimization measures. The applicant is responsible for issuing a public notice of the application after determination by the Georgia EPD that the application is complete. The Individual 401 WQC application review process may require up to 120 days to complete.

Section 7 of the Endangered Species Act

The Federal Endangered Species Act (ESA) [16 U.S.C.1531 et seq.] became law in 1973 and provides for the listing, conservation, and recovery of endangered and threatened species. The USFWS is the agency responsible for protecting and monitoring populations of listed endangered species. Section 7(a)(2) of the ESA states that each Federal agency shall insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species, or result in destruction or adverse modification of designated critical habitat. A federal action includes approval of a permit or license, including Section 404 permits under the CWA.

National Historic Preservation Act

Section 106 National Historic Preservation Act (NHPA) requires Federal agencies to identify historic properties potentially affected by undertakings, and to seek ways to avoid, minimize, or mitigate any adverse effect on these properties. In cases where the project may have the potential to cause effects to properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized until the requirements of Section 106 of the NHPA have been satisfied. The Georgia Department of Community Affairs' Historic Preservation Division (HPD) is the official historic preservation agency of the state of Georgia.

As described in Section 2.7, there are at least seven archaeological sites eligible for listing in the National Historic Register are within the area of potential effect of the North Georgia Project, with the potential for two of these being associated with the Lake Burton development. A complete inventory of the National Register of Historic Places database will need to be conducted for the Project area to identify historic and archaeological resources potentially impacted by the Project. Additionally, a Phase I Cultural Resources Survey may be required since the Project involves public land. A Phase I investigation generally involves a literature review of site records, aerial photographs, maps, and other relevant cultural resources records. If potential impacts to historic features are identified, coordination with HDP will determine what mitigation measures would be required for dam decommissioning and removal.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) process would be undertaken by FERC as the lead agency and other Federal and State Agencies being invited to cooperate. The environmental review under NEPA can involve three different levels of analysis: 1) Categorical Exclusion Determination, 2) Environmental Assessment (EA)/Finding of No Significant Impact, and 3) Environmental Impact Statement (EIS). The purpose of the EA is to determine if the action will cause significant environmental impacts, in which case a more detailed analyses of project environmental effects are conducted through the EIS process. In this case, it is very likely an EIS would be required given the severity of the likely environmental impacts. The EIS is a more rigorous document than the EA and is published for public review and comment for a minimum of 45 days.

Federal Emergency Management Agency (FEMA) Map Revisions

The FEMA process to modify existing floodplain maps would need to be completed to account for the effects of the dam removal. To update a FEMA Flood Insurance Rate Map (FIRM) for a dam removal, existing condition and proposed conditions models would be completed based on detailed hydraulic and hydrologic analyses. The FEMA process would include development of maps based on proposed condition as part of the Conditional Letter of Map Revision (CLOMR) process which would need to be approved by FEMA. During this process, notifications to impacted property owners would be coordinated with local jurisdictions where property owners would have the opportunity to provide comments. Due to the complexity of the removal of Burton Dam and associated floodplain impacts and coordination with multiple parties, the CLOMR process could take years. After the CLOMR is approved, the project could commence. After completion of the project, a Letter of Map Revision (LOMR) would be completed which is utilized to formally update the maps. The LOMR would be updated map based on constructed conditions (compared to the CLOMR which utilizes proposed conditions).

4.4 Other Considerations

In the process of fulfilling the needs of the individual regulatory authorities including FERC, it is likely that resource protection plans will need to be developed for protection of sediment and soil resources, vegetation and wildlife and fishery resources as well as cultural resources and public safety. In addition, a construction plan that addresses transportation, staging areas, and/or spoil area is needed, and restoration will be likely required. Moccasin Creek State Park and Burton Trout Hatchery facility are situated on the shoreline of Lake Burton and are managed by the Georgia DNR. Specific plans that would outline potential impact to Georgia DNR facilities would likely require coordination for public safety and other arrangements that can be implemented to retain or re-purpose those facilities. There may also be additional, unforeseeable mitigation necessary following dam removal. Determining the type and scale of these mitigations is beyond the scope of this work; however, the owner should be aware of this uncertainty and potential additional risk. Unforeseeable mitigation may be requests from regulators that go beyond the normal burden for a construction project because of the size and scale of the project. Also, dam removal may expose bridge piers for highways and interstates that may require additional stabilization. A 10% rate of the construction cost was estimated to account for this unforeseeable burden.

Public outreach would need to be a major program for any removal option. Change in residential shoreline use of the reservoir and overall recreational use of the impoundment will significantly impact current and future residents and visitors.

5 Summary and Conclusions

Stantec used available data and studies on existing site conditions, data from a field reconnaissance, and bathymetric survey to consider full dam removal for Burton Dam. Full dam removal was evaluated on impacts to recreational and residential developments, ecological effects, and regulatory considerations. Impacts of full removal of Burton Dam are summarized in Table 5.

Table 5. Summary of Project Outcome

Item	Full Dam Removal
Recreational Value	Wadable River, hiking, river fishing
Water Supply	No water utility withdrawal, loss of water supply source for local fire protection entity
Hydrogeneration	Loss of hydrogeneration
Sediment Stability	Sediment stability will be reached over time and will not require any long-term maintenance
Project Impact Cost	$169 Million for construction and removal. Costs associated with losses in hydrogeneration, recreational value, and additional impacts were not included in the estimate.
Maintenance	Restoration of natural channel properties eliminates maintenance requirements
Regulatory Process	License Surrender Application Process

The concept design presented in Section 3 served as a planning level design and was used to develop the construction cost estimate for full dam removal. Cost estimates construction represent best available data for 2024 prices. Cost estimates associated with loss of hydrogeneration have not been included in this study but will be evaluated by GPC as part of the 2025 IRP. Full dam removal was estimated to cost approximately $169 Million associated with construction cost of the dam removal and site reclamation. Additionally, the current reservoir offers opportunities for outdoor recreationalist with marinas and public boat ramps, supports a state park and trout hatchery and has over 1,200 homes developed along the shoreline. Full removal of Burton Dam would have a significant economic impact, a decrease in recreational value for flatwater recreationalists, and a considerable construction cost. The removal of a dam with such significant property impacts would be unprecedented in the United States based on: (i) a review of the 13 large dam removals with construction costs greater than $20,000,000 construction cost (Duda, et al. 2021); and (ii) national knowledge and experience in dam removals.

Stantec's review of available data and studies, existing site conditions and shoreline developments, economic impact, regulatory considerations, and engineering considerations suggests full dam removal is not feasible due to the immense impacts associated. The removal of the dam would drastically reduce the operation and maintenance costs, but the impact to property, recreation, and hydrogeneration outweigh the benefits enumerated. The existing dam operates as originally designed and the lake behind it is not creating sedimentation or other negative impacts that would change the feasibility of the dam removal.

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Appendix A - Cost Estimate

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Opinion of Probable Construction Cost

Client	Troutman Pepper LLP
Project Name	Feasibility Study - Dam Removal
Location	Burton Dam, Clarkesville, GA
Facility	Burton Hydroelectric Plant
Date	January 10, 2024
Project No.	175578493

Dam Removal				
Activity	**Units**	**Quantity**	**Unit Cost**	**Total**
Phase 1 Dam Removal				
Mobilization	LS	1	6,000,000	$ 6,000,000
General and Temporary Works	LS	1	1,070,000	$ 1,070,000
Control of Water	WK	100	105,000	$ 10,500,000
Dam Removal	CY	117,147	60	$ 7,030,000
Demolition (Parking, Drive, Etc.)	CY	6,200	45	$ 300,000
Turbine Removal & Disposal	LBS	156,064	3	$ 534,861
Generator Removal and Disposal	LBS	308,410	3	$ 1,056,980
Electrical Equipment & Disposal	LS	1	4,590,150	$ 4,590,150
Mechanical System Removal & Disposal	LS	1	1,798,782	$ 1,798,782
C&D Hauling & Disposal	CY	64,111	14	$ 900,000
Phase 2 Stream Restoration, Lakebed Stabilization, and Sediment Removal				
Riffle	CY	11,300	173	$ 1,950,000
Grade Control Structure	EA	6	90,000	$ 540,000
Toe Wood Structure	LF	1,095	600	$ 660,000
Live Branch Layering	LF	16,104	120	$ 1,930,000
Dredge, Dewater, Haul Sediment	CY	250,000	75	$ 18,750,000
Onsite Fill Material Processing	CY	53,036	60	$ 3,180,000
Channel Restoration Fine Grading	SY	59,644	45	$ 2,680,000
Lakebed Stabilization & Revegetation	AC	3,100	10,000	$ 31,000,000
Base Construction				$ 94,000,000
Adaptive Management: Invasive Species, Site stabilization (15%)				$ 14,100,000
Construction Contingency (30%)				$ 28,200,000
Design, Studies, and Permitting (Lump Sum) (15%)				$ 14,100,000
Construction Oversight and Owners Cost (10%)				$ 9,400,000
Unknown Impact Mitigation Needs (10%)				$ 9,400,000
Total Project Construction Estimate				$ 169,000,000
Non-Construction Costs				
Loss in Power Generation	Developed separately by GPC			-
Public Outreach and Coordination; Legal Services	Not quantified in this study			-
Total Cost				$ 169,000,000

General Notes:

1. The estimate is a Class 4 Opinion of Probable Construction Costs based on conceptual design from August 2024. If a dam removal occurs, additional studies, design, permitting, and third-party coordination would be required to refine the estimate.

2. Costs associated with sediment management are preliminary and could be substantially modified based on items such as material quantity, selection of on-site vs. off-site disposal, selection of dredging equipment, and sediment characteristics (geotechnical and environmental). Sediment volumes were based on removal for just a portion of the overall Lakebed sediments along the main section of the River closer to Burton Dam.

3. Potential third party costs such as potential loss of water supply or shoreline development impacts were not calculated as part of this Study.

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