

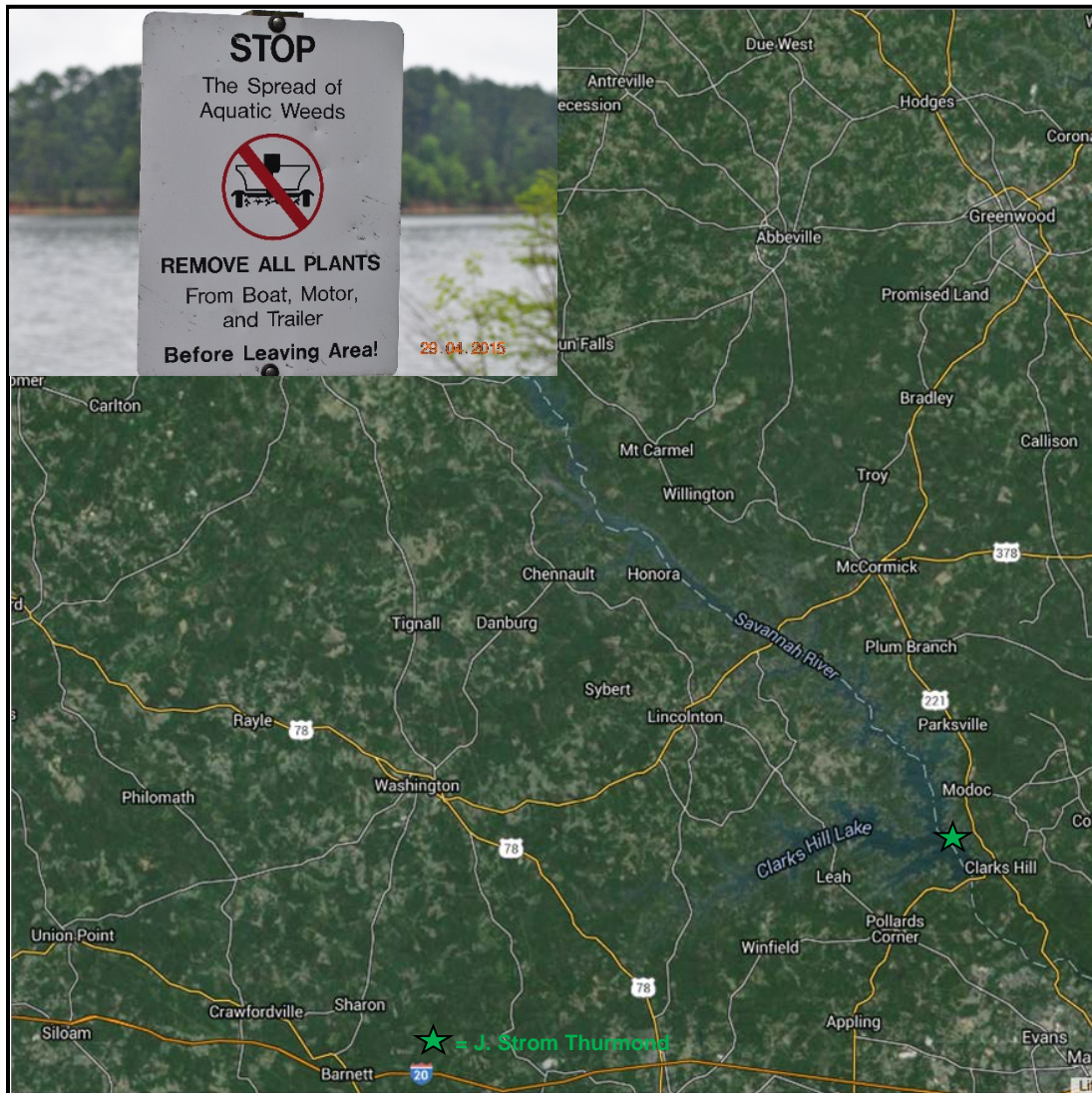


US Army Corps
of Engineers®
Savannah District

ENVIRONMENTAL ASSESSMENT

AVIAN VACUOLAR MYELINOPATHY REDUCTION FOR J. STROM THURMOND LAKE

Columbia, Lincoln, McDuffie, Elbert, and Wilkes Counties, Georgia and
McCormick and Abbeville Counties, South Carolina



December 2016

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ENVIRONMENTAL ASSESSMENT

Avian Vacuolar Myelinopathy Reduction for J. Strom Thurmond Lake Columbia, Lincoln, McDuffie, Elbert, and Wilkes Counties, Georgia and McCormick and Abbeville Counties, South Carolina

1.0 INTRODUCTION.

The U.S. Army Corps of Engineers (USACE), Savannah District (CESAS), has prepared this Environmental Assessment (EA) to evaluate the potential impacts of managing hydrilla (*Hydrilla verticillata*) (Figure 1) within J. Strom Thurmond Lake (JST) (also known as Clarks Hill Lake) to reduce occurrences of Avian Vacuolar Myelinopathy (AVM) in bald eagles (*Haliaeetus leucocephalus*). This EA was prepared in accordance with the National Environmental Policy Act of 1969, Council on Environmental Quality's Regulations (40 CFR 1500-1508), USACE Engineer Regulation ER 200-2-2. The document was prepared in conjunction with an Avian Vacuolar Myelinopathy Plan for U.S. Army Corps of Engineers, Savannah District, J. Strom Thurmond Project (AVMP) dated September 2016. The AVMP is incorporated by reference into this EA. This EA provides sufficient information on the potential adverse and beneficial environmental effects to allow the District Commander, U.S. Army Corps of Engineers Savannah District (CESAS), to make an informed decision on the appropriateness of an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI).



Figure 1: Hydrilla at JST

1.1 Proposed Action - Integrated Approach with Incremental Grass Carp Stocking and Herbicide Use Targeting 50% Hydrilla reduction.

The proposed action alternative consists of an integrated approach of biological and chemical control. The proposed action is made up of an incremental stocking of certified sterile triploid grass carp¹ (*Ctenopharyngodon idella- triploid*) (CSTGC) at JST plus limited herbicide application to reduce hydrilla by 50%. Full details can be found in the AVMP. Implementation of this plan is funding dependent. The District is developing a budget package to compete in the government funding process, however the competition for funding is severe in these times of constrained budgets with many highly deserving projects.

The AVMP is not intended to replace the Aquatic Plant Management Plan for U.S. Army Corps of Engineers, Savannah District Water Resources Projects, South Carolina and Georgia, Updated December 2002 (APMP). The APMP outlines procedures to minimize impacts to authorized project purposes caused by nuisance aquatic vegetation including hydrilla. The full text is available at <http://www.sas.usace.army.mil/Portals/61/docs/lakes/thurmond/AquaticPlan.pdf>. The APMP covers Hartwell Lake, Richard B. Russell Lake, J. Strom Thurmond Lake, and the New Savannah Bluff Lock and Dam. The AVMP is specific to J. Strom Thurmond Lake.

In 1985, the U.S. Fish and Wildlife Service (USFWS) issued a Biological Opinion (in Appendix A) stating that use of triploid grass carp for aquatic weed control is environmentally safe and that triploid grass carp may be stocked in closed or open waters (USFWS 1987). The USFWS oversees certification of triploid grass carp via the National Triploid Grass Carp Inspection and Certification Program (NTGCICP). CSTGC should not be confused with other types of Asian carp that are considered invasive species including bighead carp, black carp, silver carp (jumping carp), and diploid (non-sterile) grass carp. CESAS would obtain necessary permits for CSTGC stocking.

Grass carp is a member of the largest group of fishes, Family Cyprinidae, which also includes such well-known examples as the goldfish and the golden shiner. It is an exotic species, not native to the United States. Grass carp that are legally stocked by permit are certified sterile triploid grass carp. They have been genetically manipulated under closely-controlled hatchery conditions to have three sets of chromosomes instead of the normal two. This renders these fish incapable of reproducing. This is an important precaution in case stocked fish accidentally gain access to an unintended area. For this same reason, CSTGC are not considered an established exotic species (having a permanent population). Without restocking, every population will eventually die out. Grass carp have a life span of approximately ten years in Florida (Sutton, 2012), whereas other studies indicate that grass carp can live for 21 years where food is plentiful (Gorbach, 1961) where they are native. The ranges of mortality estimated

¹ The U.S. Fish and Wildlife Service (USFWS) offers a triploid grass carp inspection service for natural resource agencies in the United States and in other countries, to help States and others protect their aquatic habitats. <http://www.fws.gov/warmsprings/FishHealth/frgrscrp.html>

(Kirk, 2003) in the Santee Cooper reservoirs in South Carolina demonstrate that significant numbers of CSTGC will persist for a least 5 years and perhaps as long as 9 years.

Grass carp are primarily vegetarian. Their popularity for vegetation control stems from their preference for certain plants often considered troublesome from a lake management perspective. The aquatic plants that grass carp most prefer are hydrilla, Southern naiad, pondweeds, and chara (musk-grass). The most prevalent aquatic plant at JST is hydrilla, a non-native invasive species. Grass carp in general possess a high affinity for hydrilla.

Because the peak effectiveness of stocked CSTGC is often delayed until Year 4 after stocking (Stich et al. 2013), an initial stocking of CSTGC in JST will occur in Year 1 and 2 with a Year 3 maintenance stocking to account for initial mortality. CSTGC stocking will target 7.5 fish per vegetated acre in Year 1 and 9.75 fish per vegetated acre in Year 2 resulting in a total of 15 fish per vegetated acre (including 2.25 fish per acre to offset 30% mortality rate). Vegetated acres are calculated by applying a density estimate to the total acres containing hydrilla (e.g. 10,000 acres of hydrilla at a density of 50% results in 5,000 vegetated acres). The density value is determined by an acoustic survey to determine the actual bottom coverage (density). A survey for hydrilla coverage and density was completed 19 November 2015 (Figure 2, the Appendix B). The acreage of hydrilla will be determined using the best available information on coverage and density. Stocking will occur in fall or spring from various locations around Thurmond. Fish would be ordered from an approved certified supplier to ensure sterility. CSTGC would be at least 10-12 inches total length (TL) to reduce predation. Using a 30% mortality rate in Year 1 and 20% in Year 2, 3.75 fish per vegetated acre will be stocked in Year 3 to compensate for the initial mortality. The CSTGC will be stocked based on the average of our 2010 and 2015 hydrilla estimates. The acreage used for the calculation of the stocking is 3,661 (4,959 acres in 2010 and 2,363 in 2015).

Based on recent information regarding grass carp site fidelity (S. Wilde pers. comm), stocking would be more concentrated in areas with the highest bald eagle mortality (e.g., Bussey Point, Shriver Creek). JST has 1,200 miles of shoreline and at full pool level encompasses 71,000 acres. Hydrilla growth and abundance in a given area varies considerably from year to year. Carp stocking locations will be determined on historical eagle/coot interactions and known hydrilla abundance (Figure 2).

At this level of stocking, a minimum 4-year time lag is expected from the initial stocking until significant effects are observed. Therefore, no activity other than possible herbicide treatments will occur during years 4 and 5. During Year 5 and 6, exclosures established in various locations will be examined to compare hydrilla and native plants within the exclosure to vegetation outside the exclosure.

Hydrilla Distribution - October 2015

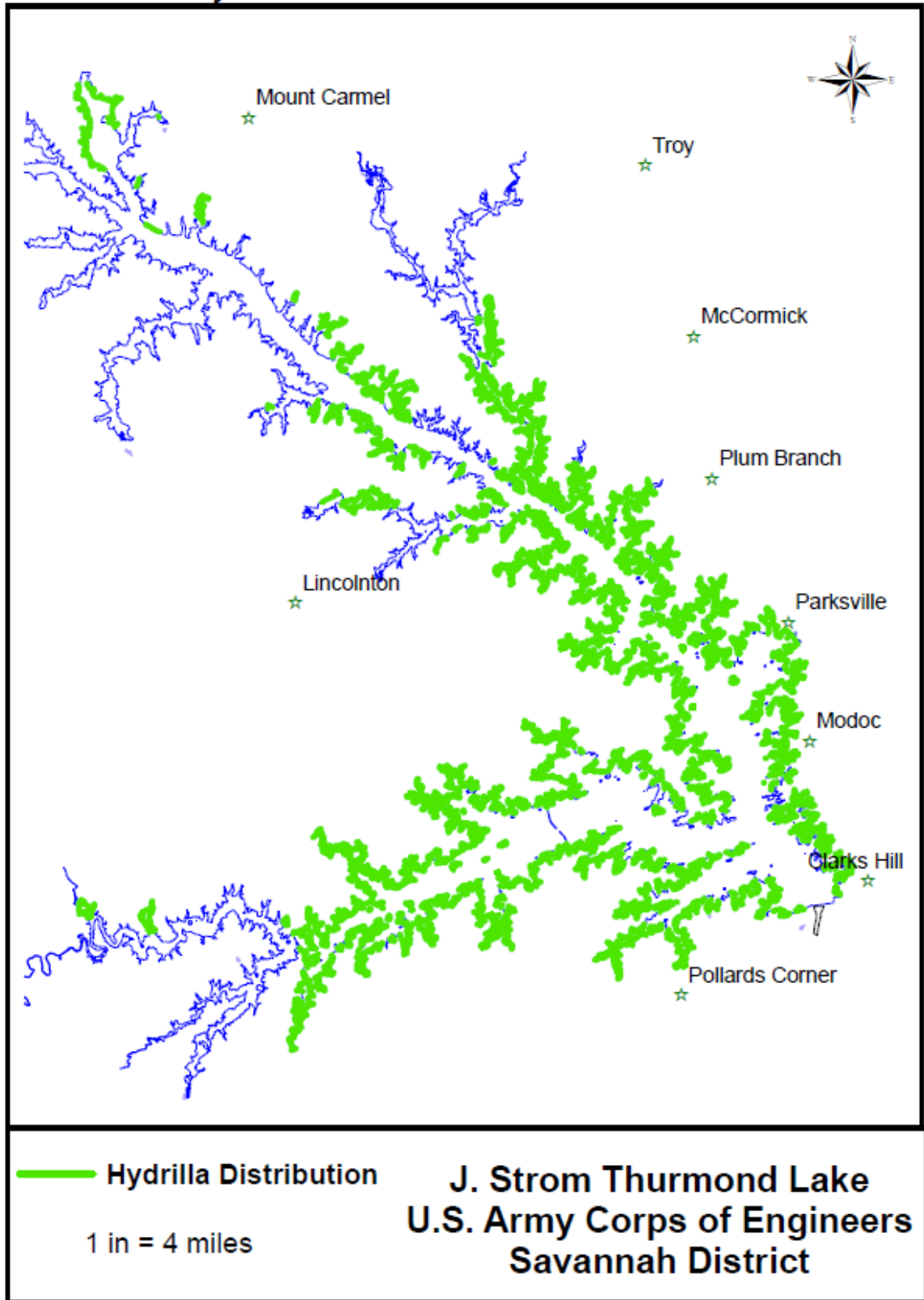


Figure 2: Hydrilla Distribution 2015

In addition at Year 6, standard vegetation sampling will occur at 0.5-mile intervals along the shoreline, along with hydrilla density estimates to evaluate the effectiveness of the treatments. Based on results from Year 6 surveys, USACE will determine if incremental stocking or further maintenance stocking is needed to meet the hydrilla reduction objectives.

In addition to stocking of grass carp, as part of this integrated approach, spot treatments of herbicide (at a minimum 200 acres) will occur in areas where hydrilla is at or near the surface with priority given to those areas known to have high concentrations of American coots and past eagle mortalities. Only those herbicides labeled as “aquatic use” by the Environmental Protection Agency (EPA) will be used. Product labels with instructions and warnings can be found at <http://www.cdms.net/manuf/default.asp>. The type, application rate, and method of herbicide application would be selected based on site conditions and vegetation density. The timing of this could include when water levels are low hence exposing additional hydrilla beds.

Based on Year 6 surveys, potential adaptive management techniques may consist of increasing triploid carp numbers, stocking in new locations, additional vegetative surveys, changes to the frequency, type, or application rate of herbicides, or other actions. Adaptive management techniques would be coordinated with appropriate federal and state agencies USACE plans to continue with these efforts to reduce AVM at JST into the future if necessary based on monitoring of AVM related deaths and the density of the hydrilla.

1.2 Purpose and Need for the Proposed Action.

The purpose of the proposed action is to reduce hydrilla abundance within JST to remove the pathway for AVM uptake in bald eagles and other birds. Research has shown an epiphytic blue-green algae (cyanobacteria) that lives on aquatic vegetation produces a toxin which causes the neurological disease AVM in birds. AVM mortality is the result of a toxin from the cyanobacterium (*Aetokthonos hydrillicola*) (Wilde et al, 2014). Although many types of submerged aquatic vegetation (SAV) provide a substrate for the blue-green algae, hydrilla is the predominant SAV at JST. Lakes with submerged vegetation that do not have this particular blue-green algae do not have AVM problems. *A. hydrillicola* attaches to aquatic plants and is ingested by waterfowl and other herbivorous organisms. Once ingested, certain bird species may develop AVM and suffer neurological impairments. The typical food chain link for eagle mortality occurs when American coots (*Fulica americana*) eat hydrilla which has the blue-green algae. Coots develop neurological symptoms and become easy prey for bald eagles and other birds of prey. The disease spreads up the food chain, resulting in bald eagle AVM-linked mortality.

Eighty-one dead bald eagles have been recovered at JST. AVM has been confirmed in 33 of the dead eagles. Aspergillosis was the cause of one mortality. The cause of the remaining 51 mortalities could not be determined due to decomposition. In addition to JST, AVM occurs at 20 lakes and reservoirs throughout the south. USACE would

perform aquatic vegetation management at JST to support the goals of the Bald and Golden Eagle Protection Act [(16 USC 668-668d) BGEPA] to minimize or eliminate eagle deaths linked to hydrilla and its associated toxic cyanobacteria. The goal of BGEPA is to maintain a stable or increasing population of bald eagles. The list of affected species includes; bald eagle, American coot, great horned owl, killdeer, Canada goose, mallard, ring-necked duck, and bufflehead. The effects of the AVM agent on mammals, including human beings, are unknown. However, ten beavers, four raccoons, and a fox at Thurmond Lake showed no AVM lesions when coots were indicating a 17-94% prevalence of the disease.

An aquatic vegetation survey conducted at JST in 2010 found hydrilla present in 11,271 acres. Based on an acoustic survey to determine the actual bottom coverage (density), hydrilla covered about 44% of the area where it has been located. Therefore the actual bottom coverage (areal coverage) would be approximately 4,959 acres. An updated survey was performed in September/October 2015 and found hydrilla present in 10,644 acres. Based on an acoustic survey to determine actual bottom coverage (density), hydrilla covers about 22% of the area where it has been located, therefore actual bottom coverage (areal coverage) would be approximately 2,363 acres. For estimating purposes, USACE used the average between those two years. Therefore, USACE estimates 3,661 acres of hydrilla exists at JST.

1.3 Authority.

The initial construction of JST was authorized as part of the Rivers and Harbors Act of 1927. This act authorized the Corps of Engineers to investigate existing and prospective development on various streams throughout the nation for purposes of navigation, power development, flood control, and irrigation. This authorization was embodied in House Document 308, 69th Congress, first session. Savannah District completed a report on the entire Savannah River Basin in May 1933. This document recommended against any U.S. Government flood control project for the river. Two locations, however, were proposed as likely sites for future power dams in the upper Savannah River Basin: Clark Hill (JST) and Hartwell. JST was authorized as a multipurpose dam and reservoir as part of Public Law 534, 78th Congress, passed on 22 December 1944.

Section 864 of the Water Resources Development Act of 1986 (P.L. 99-662) modified JST to include recreation and fish and wildlife management as project purposes. Project lands which are managed or reserved as of the date of the enactment of that law for the conservation, enhancement, or preservation of fish and wildlife and for recreation shall be considered as lands necessary for such purposes. The proposed AVMP would be implemented as part of JST's management of its fish and wildlife resources.

The BGEPA provides the authority for USACE to protect bald and golden eagles as part of natural resource management initiatives.

1.4 Prior Reports.

1.4.1 An Updated Fact Sheet on AVM

CESAS developed a Fact Sheet on AVM at JST was produced in April 2015. The fact sheet (Appendix C) is incorporated herein by reference and is summarized below.

Background: The first known bald eagle death from AVM occurred at DeGray Lake, Arkansas in 1994. The first eagle death attributed to AVM at J. Strom Thurmond (JST) Lake occurred in 1998. AVM has been linked to mortality not only in bald eagles, but also in other raptors (Red-tailed hawks and Great horned owls) and waterfowl (American coots). Hydrilla was first observed in JST in 1995. Aquatic plant management activities including use of herbicides were conducted from 1995-1998 at JST in attempt to control hydrilla; however, hydrilla coverage increased from several hundred acres to over 2,000 acres by 1999. AVM occurs seasonally when the blue-green algae begins to produce toxins. The peak period for toxin production is November through February. During this time, water chemistry changes as the lake cools and begins to mix. Hydrilla also goes dormant in the winter. However, the environmental factors that trigger toxin production have not been completely identified. AVM meetings to discuss ongoing research have been hosted at J. Strom Thurmond Project in 2004, 2005, 2007, 2009, 2011, 2012, and 2014. Researchers from the University of Georgia (UGA) continue to evaluate AVM, hydrilla, and the possible environmental factors affecting toxin production.

As a result of the 2007 interagency AVM meeting, the Corps received letters from GADNR and SCDNR regarding the AVM issue. The two state wildlife management agencies provided four recommendations: 1) document hydrilla coverage and expansion using the best available techniques; 2) initiate a public involvement and stakeholder process examining hydrilla and resource issues relating to hydrilla; 3) conduct public involvement with input from the USFWS and state agencies; and 4) use the Corps' Engineering and Research and Development Center (ERDC) to prepare a management plan to address AVM using input from the public involvement process.

With input from UGA, USFWS, and state natural resource agencies, Savannah District developed a survey to evaluate public opinion regarding hydrilla and impacts to the resource at JST. The stakeholder survey was completed in May 2013 and UGA issued a final report in September 2013. The survey included questions about sterile grass carp which are usually the most controversial treatment method if hydrilla eradication is the preferred alternative. Results indicate that 84.5% of respondents prefer less hydrilla or only native plants and 74.3% are either indifferent or in support of stocking grass carp. Survey results are available at http://www.sas.usace.army.mil/Portals/61/docs/lakes/thurmond/UGA%20Perception%20Survey_Final%20Report.pdf

During the May 2014 interagency AVM meeting, the USFWS suggested that continued eagle mortalities at Thurmond could be considered a "take" pursuant to the BGEPA.

When we raised the issue that “take” typically involves some action or activity that results in the “take”, the USFWS responded that “in-action” to prevent eagle mortality could be considered a “take”. USFWS reiterated that position in a letter dated December 02, 2014 (in section 11.4).

In December 2014, USACE sent a letter to both state natural resource agencies and the USFWS, proposing an integrated plan using grass carp and herbicide to control hydrilla. USFWS and SCDNR concurred and offered technical assistance. GADNR wanted more explanation of the proposed extent of control, expected impacts to native species, and other details to be clarified through the EA process.

Research is ongoing to better determine the effects on bald eagles from AVM. In April 2015, transmitters were attached to three bald eagle nestlings. One transmitter was lost and one eagle was illegally shot in Pennsylvania. These transmitters will allow UGA researchers to track movements and determine if these birds remain onsite and develop AVM in the future or if they move offsite to another location.

Table 1 (Wilde et al. 2014) lists reservoirs where AVM has occurred in connection with invasive aquatic plants. Note AVM has now been documented in nineteen locations in the southeastern U.S.

Table 1: Reservoir locations with confirmed AVM and invasive aquatic vegetation occurrences, 1994 – 2012 (Wilde et al. 2014)				
Year	Reservoir	State	Plants	Max Coverage (%)
1994	DeGray	AR	egeria/hydrilla	95
1996	Quachita	AR	hydrilla	95
1997	Hamilton	AR	milfoil	25
1998	Thurmond	SC/GA	hydrilla	95
1998	Juilette	GA	hydrilla/egeria/milfoil	50
1998	Woodlake	NC	hydrilla	50
1998	Par Pond	SC	milfoil	25
1998	L Lake	SC	milfoil/hydrilla	25
1999	Murray	SC	hydrilla	25
1999	Sam Rayburn	TX	hydrilla	10
2003	Davis Pond	SC	hydrilla	95
2003	Emerald Lake	GA	hydrilla	75
2005	Lake Horton	GA	hydrilla	95
2005	Smith Reservoir	GA	hydrilla	25
2005	Coachman’s Trail	NC	hydrilla	95
2007	Troup County			
2007	Lake Varnar	GA	hydrilla	95
2010	Upper Towaliga	GA	hydrilla	95
2011	Longbranch	GA	hydrilla	95
2011	Morgan County	GA		
2012	Lake Tohopekaliga	FL	hydrilla	50

1.4.2 2014 EA On New Operating Agreement With Duke Energy Power

Savannah District prepared an EA in 2014 that described hydrilla infestation and management at JST and is incorporated herein by reference (USACE, Savannah District, October 2014. Final Environmental Assessment, New Operating Agreement between U.S. Army Corps of Engineers, Southeastern Power Administration, and Duke Energy Carolinas, LLC).

<http://www.sas.usace.army.mil/About/DivisionsandOffices/PlanningDivision/PlansandReports.aspx>

1.4.3 Several Blogs on JST and Hydrilla

CESAS has posted blogs about hydrilla on the district web site: Balancing the Basin, <http://balancingthebasin.armylive.dodlive.mil/2014/06/17/jsthydrillaupdate/>

1. December 18, 2013 blog reports hydrilla has been present in JST since the mid-90's and USACE has been using herbicides to control infestations in accordance with its Aquatic Plant Management Plan (APMP).

2. June 17, 2014 blog reports Corps staff will monitor hydrilla growth throughout the summer growing season (May through September). USACE will identify and prioritize treatment needs (via herbicides), but funding may only be available to treat major Corps boat ramps that have serious hydrilla impacts. The treatment plans will be coordinated with the Georgia and South Carolina Departments of Natural Resources, local agencies and affected out-grantees.

JST staff are in the early phases of putting together a bi-state team to develop a new AVM Management Plan to address AVM at Thurmond Lake. Hydrilla treatment is managed according to the Corps' Aquatic Plant Management Plan, but this new project would create a separate management plan solely focused on hydrilla and AVM with support and expertise from state natural resource agencies. In the spring of 2014, the Corps met with representatives from the Georgia and South Carolina DNRs to discuss this action.

3. May 20, 2015 blog reports that development of an Environmental Assessment (EA) is underway to evaluate treatment alternatives and potential impacts to the resource. The USFWS and Georgia and South Carolina DNRs have offered technical assistance. Georgia DNR wanted the additional details regarding treatments and potential impacts to be further evaluated through the EA process.

1.5 NEPA Scoping

Resources of concern at JST have been identified through a survey sent to stakeholders within twelve adjoining counties who fell within one of the following five user groups: fishing license holders, state waterfowl stamp holders, registered boaters, campground visitors, and shoreline permit holders. The surveys were targeted to

identify users' knowledge of AVM, its association with hydrilla, and opinions on potential management options to control hydrilla.

The survey identified the following concerns with reducing SAV including hydrilla:

- Reduced fish habitat
- Reduced waterfowl habitat
- Impacts to native vegetation and organisms
- Impacts to largemouth bass fishery
- What if it doesn't work
- Will biological control eliminate current herbicide treatments
- Accidental introduction of non-sterile carp
- AVM transference from carp to other organisms
- Economic impacts
- Human health risks
- Impacts to water quality
- Recreation impacts

Complete results of the survey are available on the Thurmond Project website: http://www.sas.usace.army.mil/Portals/61/docs/lakes/thurmond/UGA%20Perception%20Survey_Final%20Report.pdf. Generally, users were supportive of stocking grass carp to control hydrilla.

2.0 ALTERNATIVES TO THE PROPOSED ACTION

USACE considered two action alternatives in detail (which were Biological control (stocking CSTGC) and Chemical control) in addition to the No Action alternative and the Proposed Action. Implementation of any alternative other than no action is funding dependent. The District is developing a budget package to compete in the government funding process, however the competition for funding is severe in these times of constrained budgets with many highly deserving project.

In addition, the following seven action alternatives were initially considered but eliminated from detailed analysis. These alternatives were:

Biological control:

One biological control alternative that was considered but then eliminated from detailed consideration was the use of Pakistani flies (*Hydrellia pakistanae*), also known as Asian leaf-mining flies. Pakistani flies were used to treat dioecious hydrilla infestations in a USACE hydropower and flood control impoundment -- DeGray Lake -- in Arkansas. Pakistani Flies are host-specific feeders and lay their eggs on hydrilla. The larvae eat the hydrilla, causing enough damage to reduce photosynthetic productivity, leading to decreased hydrilla abundance (Balclunas, 1985). However, a different biotype of hydrilla -- monoecious hydrilla -- occurs in JST. The monoecious type grows in dense mats horizontally along the bottom of a lake before branching up vertically. This differs from dioecious hydrilla which grows vertically upwards before branching out across a lake surface. Pakistani flies are not currently considered an effective control method for

monoecious hydrilla since the majority of the vegetative biomass exists below the surface and is inaccessible to the flies (Grodowitz et al., 2010).

Another biological control is the harassment of coots or eagles. Coot harassment is not practical with 600+ miles of shoreline where hydrilla occurs; also would impact ducks and other waterfowl. Eagle harassment to discourage nesting would require a permit and likely be ineffective (too many alternate nest sites around Thurmond). Also, this alternative would not prevent AVM in eagles that are not nesting.

Mechanical control:

Mechanical control (including removal by hand) has not proven to be an economically feasible or technically viable option for aquatic plant management on other large reservoirs due to (1) the high cost per acre to remove and dispose of vegetation and (2) the short duration of the results. Hydrilla fragments that escape during the harvesting process can drift to other areas and establish new hydrilla populations. The abundance of submerged obstacles in the lake and the undulating bottom substrate makes operating the harvesting equipment difficult. Mechanical harvest cutting depth is limited to 5 or 6 feet deep. Mechanical removal is not considered an effective treatment. Therefore, the mechanical control alternative was also eliminated from further consideration. In addition harvesting equipment is not selective and could impact native SAVs.

Lake level management:

Drawdowns can be effective in reducing the vegetative portions of plants such as hydrilla and elodea. If the draw down is timed to coincide with winter freezing, root structures may also be killed. However, studies at the Corps Waterways Experiment Station have found that hydrilla tubers can survive up to six years in hydrated soils and establish new growth when inundated. Reoccurring droughts and corresponding low lake levels (greater than 15 feet below summer pool) since 1995 have not had a long term impact on hydrilla growth. Short-term drawdowns and herbicide treatment of hydrilla patches exposed by the drawdowns would be more effective than drawdowns only. Drawdown impacts other project purposes (i.e., recreation and hydropower) and also would negatively impact native SAV.

There is considerable anecdotal evidence that lake filling during late fall and early winter severely limits the growth and exposure to cyanobacteria because hydrilla is no longer "topped-out." More deeply submerged "infected" hydrilla would likely be less accessible to foraging coots. Lake filling is hydrology dependent and the fall is typically our driest time of the year. This would also create a loss of flood storage in winter at Thurmond. Therefore, water level management was also eliminated from further consideration.

100% Hydrilla removal:

An integrated approach with incremental grass carp stocking and herbicide use targeting 100% Hydrilla removal was examined but eliminated due to the lack of practicality, cost, and the significant impact on fisheries, wildlife, and recreation.

As a result, Savannah District did not include these alternatives in those that it evaluated in detail. Therefore, two action alternatives to the proposed action and No Action alternative will be examined in detail.

2.1 No Action Alternative - Future without Project Condition.

In the Future Without Project Condition (i.e. No-Action), the proposed action would not be conducted. Hydrilla and the associated toxic cyanobacteria would likely persist resulting in AVM occurrence in certain species and potential mortalities.

In accordance with the APMP, USACE would likely continue spot herbicide treatments (if funding is available) at high public use areas such as boat ramps, courtesy docks, swimming beaches and in other instances where nuisance vegetation is causing conflict with authorized project purposes. JST Project staff routinely monitor hydrilla growth in potential treatment areas beginning in May. By mid to late August, they have identified and prioritized the hydrilla treatment needs associated with recreation areas. The USACE coordinates annual treatment plans with the GADNR, SCDNR, local agencies, and affected out-grantees prior to implementation. Hand and mechanical removal of aquatic invasive vegetation could be used as described in the APMP.

2.2 Biological Control Alternative.

Under this alternative, CSTGC would be stocked at standard stocking rates of 20 per vegetated acre for approximately 10 years with maintenance stocking to offset mortality followed by maintaining 1 grass carp per 8 surface acres (Kirk and Manuel, 2012). Fish would be obtained from a certified supplier to ensure sterility. CSTGC would be at least 10-12 inches in total length (TL) to reduce predation. In 1985, the USFWS issued a Biological Opinion stating that use of triploid grass carp for aquatic weed control is environmentally safe and that triploid grass carp may be stocked in closed or open waters (USFWS 1987). The USFWS oversees certification of triploid grass carp via the National Triploid Grass Carp Inspection and Certification Program (NTGCICP). Certified triploid grass carp should not be confused with other types of Asian carp that are considered invasive species including bighead carp, black carp, silver carp (jumping carp), and diploid (non-sterile) grass carp. CESAS would obtain the necessary permits to stock triploid grass carp. The intent is to reduce the spread of AVM through hydrilla management. The goal of this alternative is to reduce the acreage of hydrilla throughout JST substantially (by 50%) within 2 to 3 years of the initial stocking. The hydrilla consumption rate will vary based on the rate of growth and mortality of the fish. Due to the demonstrated preference for grass carp feeding on hydrilla and concentration of hydrilla in JST, USACE anticipates that the stocked grass carp will tend to remain along reaches with high densities of hydrilla.

USACE would restock grass carp based on the monitoring plan (hydrilla survey 3-years post treatment) to maintain control of hydrilla. Any restocking deemed necessary would depend on the availability of funding. Restocking rates would be based on monitoring vegetation and triploid grass carp populations in Year 6. The location of restocking

releases would be selected based on target areas and site conditions. Because of the ability of hydrilla to re-grow from tubers and turions that persist in the bottom sediments for many years, it is likely that under this alternative the stocking of triploid grass carp would be a permanent part of the JST AVM Management Plan. However, if aquatic vegetative surveys show hydrilla management actions to be successful, maintenance stocking at a reduced rate may be appropriate.

Due to the sensitive nature of this activity, USACE does not permit private individuals and organizations to stock grass carp or any other species of fish in JST.

2.3 Chemical Control Alternative.

Under this alternative, herbicide applications would be employed across all areas of hydrilla infestation in accordance with the AVM Management Plan. Aquatic plant management activities would be planned in an environmentally minded manner and conducted within U.S. EPA guidelines and appropriate label recommendations to minimize any adverse impacts from large scale vegetation management activities. The safe and effective use of aquatic herbicides to reduce nuisance levels of aquatic plants has been demonstrated nationwide. While herbicides applied in large reservoirs generally do not eradicate nuisance plants but could provide long term management. The results of the applications do reduce water user conflicts without negative impacts to the natural resources. However, USACE has experienced varying costs of approximately \$175+ per acre, so annual applications would be cost prohibitive and would prevent herbicide alone from being a viable alternative.

3.0 AFFECTED ENVIRONMENT

3.1 General

3.1.1 Environmental Setting

JST is a man-made lake bordering Georgia and South Carolina on the Savannah, Broad, and Little Rivers. The lake is created by the Thurmond Dam, located on the Savannah River 22 miles above Augusta, Georgia, and 239.5 miles above the mouth of the Savannah River. The lake extends 39.4 miles up the Savannah River, 29 miles up the Little River, and 6.5 miles up the Broad River in Georgia, and 17 miles up the Little River in South Carolina. At full pool elevation, JST comprises nearly 71,100 acres of water and 1,200 miles of shoreline. The Thurmond Project was designed for flood control, hydropower, fish and wildlife, water quality, water supply, downstream navigation and recreation. The Seneca and Tugaloo rivers join to form the Savannah River near Hartwell, Georgia, approximately 90 miles north of JST. There are 316,144 acres in the extended watershed; 201,296 acres or 63.7% are outside of South Carolina. The South Carolina portion is within the Piedmont physiographic region. Land use/land cover in the South Carolina portion of the watershed includes: 64.5% forested land, 18.5% water, 8.5% agricultural land, 7.1% urban land, 1.8% barren land, and 0.6% forested wetland (swamp). JST is located in the Piedmont geographical

region. The USACE operates the three major dams located along the Savannah River; Hartwell, Richard B. Russell, and JST.

<http://www.sas.usace.army.mil/About/DivisionsandOffices/OperationsDivision/JStromThurmondDamandLake.aspx>

3.1.2 Description of the Watershed

The Savannah River Basin consists of 34 watersheds. JST is located in three hydrologic units (HUC) (Figure 3). They are HUC 03060103 (Upper Savannah, 1,830 sq. mi), HUC 03060104 (Broad, 1,500 sq. mi.), and HUC 03060105 (Little, 766 sq. mi.). <http://www.scdhec.gov/HomeAndEnvironment/Docs/60103-07.pdf>.

3.1.1 Climate

Hot, humid summers and mild, pleasant winters characterize the heavily wooded area on the shores of Thurmond Lake. A mixed pine and hardwood forest covers the site, providing summer shade and fall color. Elevation of the region is approximately 345 feet above sea level. The following climate data for 1974-2012 were taken from weatherspark.com. Augusta, Georgia has a warm humid temperate climate with hot summers and no dry season. The area within 25 miles of this station is covered by croplands (49%), forests (34%), grasslands (11%), and built-up areas (5%). Over the course of a year, the temperature typically varies from 33°F to 92°F and is rarely below 21°F or above 98°F. The warm season lasts from May 22 to September 19 with an average daily high temperature above 85°F. The hottest day of the year is July 18, with an average high of 92°F and low of 71°F. The cold season lasts from December 1 to February 23 with an average daily high temperature below 63°F. The coldest day of the year is January 19, with an average low of 33°F and high of 56°F. Over the entire year, the most common forms of precipitation are thunderstorms, light rain, and moderate rain.

Thunderstorms occur during 37% of the days with precipitation. They are most likely around July 23, when it is observed during 36% of the time. Light rain occurs during the 31% of the days with precipitation. This type of rain is most likely around January 12, but occurs 17% of all days. Moderate rain occurs on 20% of those days with precipitation. It is most likely around January 8, when it is observed during 12% of all days. During the warm season, which lasts from May 22 to September 19, there is a 44% average chance that precipitation will be observed at some point in a given day. When precipitation does occur, it is most often in the form of thunderstorms (64% of days with precipitation have at worst thunderstorms), light rain (19%), moderate rain (11%), and heavy rain (5%).

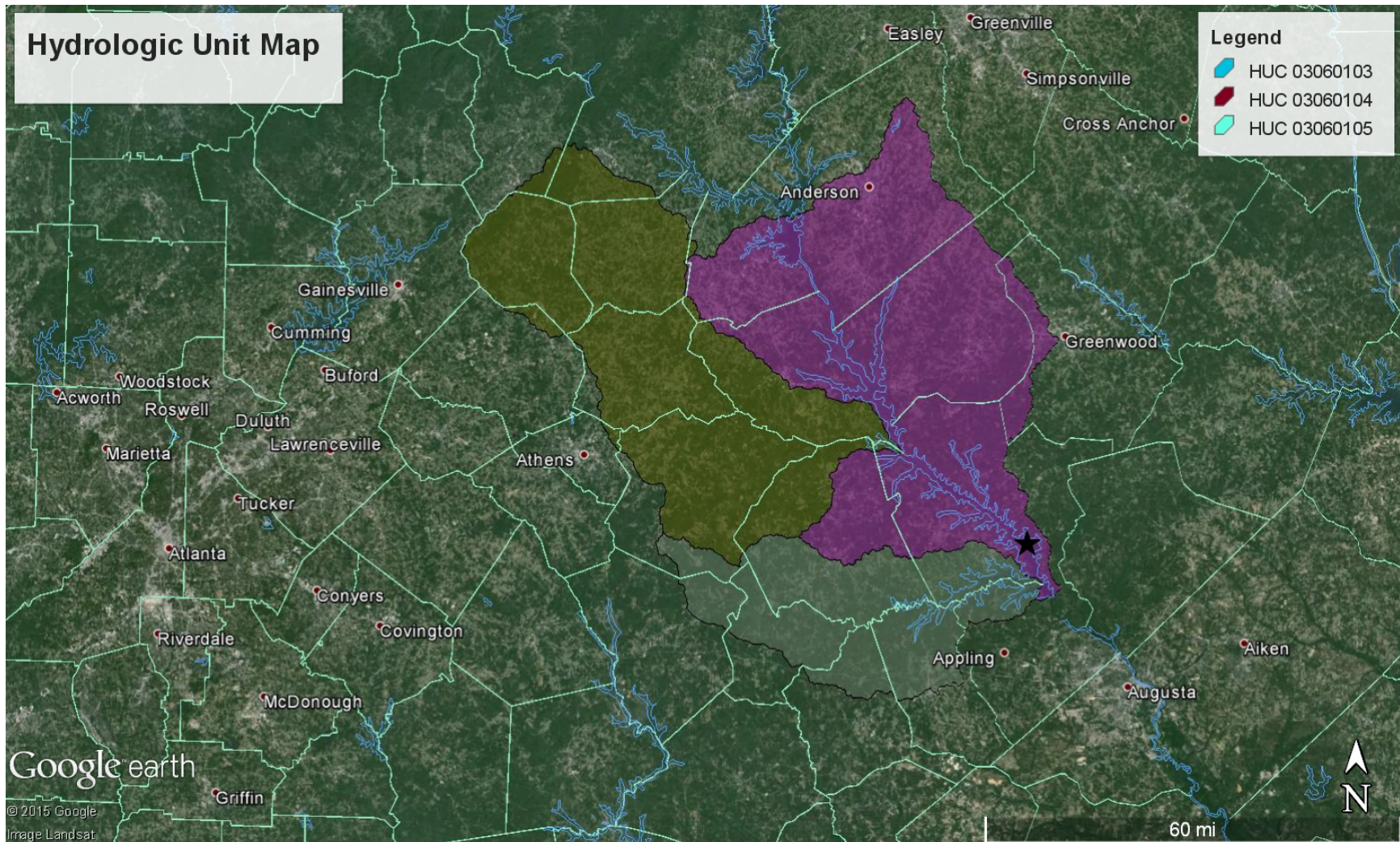


Figure 3: Hydrologic Units Upper Savannah, Broad, and Little
 ★ = JST or Clarks Hill Reservoir

During the cold season, which lasts from December 1 to February 23, there is a 36% average chance that precipitation will be observed at some point during a given day. When precipitation does occur during this period, it is most often in the form of light rain (41% of days with precipitation have light rain), moderate rain (30%), heavy rain (10%), and thunderstorms (8%).

The dew point is often a better measure of how comfortable a person will find the weather than relative humidity because it more directly relates to whether perspiration will evaporate from the skin, thereby cooling the body. A lower dew points feel drier and higher dew points feel more humid. Over the course of a year, the dew point typically varies from 25°F (dry) to 74°F (very muggy) and is rarely below 9°F (dry) or above 77°F (oppressive). There are two periods in the year that are most comfortable: The first is between March 19 and May 24 and the second is between September 27 and November 21. The air feels neither too dry nor too muggy during these periods.

Over the course of the year, the typical wind speeds vary from 0 mph to 14 mph (calm to moderate breeze), rarely exceeding 21 mph (fresh breeze). The highest average wind speed of 7 mph (light breeze) occurs around March 3, at which time the average daily maximum wind speed is 14 mph (moderate breeze). The lowest average wind speed of 5 mph (light breeze) occurs around August 17, at which time the average daily maximum wind speed is 11 mph (gentle breeze). The wind is most often out of the west (12% of the time), north (11% of the time), and south (10% of the time).

Snowfall is rare at JST. The South Carolina State Climatology Office (www.dnr.sc.gov/climate/sco/ClimateData/countyData/county_mccormick.php) reported the following climate summaries and severe weather events for McCormick County, SC in table 2.

Table 2: Weather Summaries and Severe Events	
Temperature Summary (1952-2011)	
Highest Maximum	109 F, July 29, 1987; Clarks Hill
Lowest Minimum	-2 F, January 21, 1985; Clarks Hill
Precipitation Summary (1952-2011)	
Highest Daily Rainfall	9.40 Inches, October 12, 1990; Clarks Hill
Annual Average Rainfall	46.02 Inches
Wettest Year	76.28 Inches, 1964
Driest Year	24.28 Inches, 1954
Highest Daily Snowfall	8.0 Inches, February 24, 1989
Severe Weather Events	
Tornado	15 Tornadoes (1950-2013) Tornado damage: \$509,000 4 tornado related injuries 0 tornado related fatalities
Thunderstorm Winds	74 Wind events (winds exceeding 50 knots or 58 miles per hour, 1955-2013) Hail (>1.0 inch) 23 Hail events (1955-2013)
Lightning	3 Lightning events (1993-2013) Lightning damage: \$275,000 0 Lightning related fatalities

Flood	5 Flood Events (1993-2013)
Snow and Ice	12 Winter frozen precipitation events (1993-2013)

3.1.2 Geology

The following information is incorporated by reference from the Savannah River Basin Watershed Protection Plan 2001, GA DNR-EPD.

Physiography

The Savannah River basin contains parts of the Blue Ridge, Piedmont, and Coastal Plain physiographic provinces, which extend throughout the southeastern United States. Similar too much of the Southeast, the basin's physiography reflects a geologic history of mountain building in the Appalachian Mountains and long periods of repeated land submergence in the Coastal Plain Province. The Fall Line is the boundary between the Piedmont and Coastal Plain provinces. This boundary approximately follows the contact between older crystalline metamorphic rocks of the Piedmont Province and the younger unconsolidated Cretaceous and Tertiary sediments of the Coastal Plain Province. As implied by the name, streams flowing across the Fall Line can undergo abrupt changes in gradient, which are marked by the presence of rapids and shoals. Geomorphic characteristics of streams differ between the Piedmont and Coastal Plain provinces. In the Coastal Plain, streams typically lack the riffles and shoals common to streams in the Piedmont and exhibit greater floodplain development and increased sinuosity.

Geology

The Savannah River basin is located within three physiographic provinces: the Blue Ridge, Piedmont and the Coastal Plain provinces. The Blue Ridge and Piedmont provinces, which constitute approximately 60 percent of the Savannah River basin, are underlain by crystalline metamorphic and igneous rocks. The metamorphic rocks originally were sedimentary, volcanic, and igneous plutonic rocks that have been altered by several stages of regional metamorphism as well as several episodes of granite intrusion. The majority of the exposed rocks of the Savannah River basin consist of several types of gneiss, largely made up of biotite gneiss, granite gneiss, and amphibolite. Granites are locally important in the basin as are metasedimentary rocks such as metagraywackes, quartzites, and schists. Less than 0.1 percent of the Savannah River basin is occupied by ultramafic rock units. Coastal Plain sediments are constitute approximately 40 percent of the Savannah River basin. Approximately 80 percent of the sediments are sands and clays. The rest include calcareous sediments and Quaternary alluvium. The Coastal Plain sediments overlap the southern edge of the Piedmont Province at the Fall Line and those sediments nearest to the Fall Line are Cretaceous to Eocene in age. They are dominantly terrestrial to shallow marine in origin and consist of sand, kaolinitic sand, kaolin, and pebbly sand. These sediments host the major kaolin deposits in Georgia with many of these deposits found within the Savannah River basin. Much of the southeastern Piedmont is covered by deeply weathered bedrock called saprolite. Average saprolite thickness in the Piedmont rarely

exceeds 20 meters, but the thickness can vary widely within a short distance. A considerable amount of ground water flows through the saprolite and recharges streams in the Piedmont. Saprolite is easily eroded when covering vegetation and soil are removed. Extensive erosion of soil and saprolite caused by agricultural practices during the 1800s and early 1900s contributed a vast quantity of sediment into stream valleys, choking the streams and raising the streams base level. As conservation practices stabilized erosion, streams began to reestablish grade and cut into the thick accumulations of sediments, remobilizing them into the major rivers and eventually into reservoirs.

Soils

The Savannah River watershed in Georgia crosses 5 Major Land Resource Areas (MLRA's) Soils vary widely across the watershed, ranging from nearly level to very steep, from shallow to very deep, from excessively drained to very poorly drained, and from sandy to clayey. There are some general trends with soils across the watershed. Going from north to south, degree of slope decreases, water tables are generally higher, and soil textures go from loamy in the Blue Ridge, to clayey in the Southern Piedmont, to sandy or sandy over loamy in the Sand Hills, Coastal Plain, and Atlantic Coast Flatwoods. About 6 percent of the watershed is in the Blue Ridge MLRA. Most of the soils in this area formed from weathered granite, gneiss, and schist. These are the steepest soils in the watershed, with slopes in most areas ranging from 25 to 60 percent. Soils on the steeper slopes and higher elevations are commonly loamy throughout, are brown to yellowish red, and are shallow or moderately deep to bedrock. Deep to very deep, red clayey soils are common in less sloping areas at lower elevations. About 60 percent of the watershed is in the Southern Piedmont MLRA. Most of the soils in this region are very deep, well drained, red clayey soils that formed from felsic, high grade metamorphic or igneous rocks. There is a significant area in the central part of this region that contains soils formed from intermediate and mafic crystalline rocks. These soils have slower permeability and are less acid than typical Piedmont soils. Also significant is an area in the lower portion of the Piedmont that has soils formed from Carolina slate. These soils are still clayey, but have a higher silt content than typical Piedmont soils. About 8 percent of the watershed is in the Carolina and Georgia Sand Hills MLRA. Soils in this area formed primarily in sandy and loamy marine sediments, which occasionally overlie residual Piedmont materials. There are two major groups of soils in this area. One group consists of deep sands ranging from 40 to more than 80 inches deep. The other group consists primarily of soils that have a sandy surface and a loamy subsoil, often exhibiting dense or brittle properties. Soils in this MLRA are generally less developed than soils in other parts of the watershed. About 17 percent of the watershed is in the Southern Coastal Plain MLRA. Soils in this part of the watershed are more variable than in other parts, particularly with regards to textures and water table depths. Typically, soils have a sandy surface layer that overlies a red to yellow, loamy subsoil. The depth of the sandy surface is quite variable. Soils in this region are on more gently sloping landforms than in previously mentioned MLRA's. There is a continuum of soils ranging from well drained soils on ridges and hillsides to poorly drained soils in depressions and along drainage ways.

Approximately 9 percent of the watershed is in the Atlantic Coast Flatwoods MLRA. Landforms in this part of the watershed are nearly level. Water tables are generally closer to the surface in this area than in other parts of the watershed. Typically, soils have a sandy surface layer that is 20 to 40 inches deep over a loamy subsoil. This varies considerably, however. Characteristic of part of this MLRA are sandy soils that have an accumulation of an organic matter-aluminum complex.

3.2 Existing Conditions

This section contains a description of the existing conditions of relevant resources that could be impacted by the project. The important resources (Table 3) described in this section are those recognized by laws, executive orders, regulations, and other standards of National, state, or regional agencies and organizations; technical or scientific agencies, groups, or individuals; and the general public. The following resources have been considered and found to not be affected by the recommended alternative, stocking triploid grass carp and herbicide treatment of hydrilla, because they do not occur in the project area: coastal wetlands, cypress tupelo swamp, coastal marshes, estuarine waters, coastal wooded ridges, barrier islands, hard bottoms, essential fish habitat and desert plains.

The important resources listed below are those that are frequently encountered: wetlands; aquatic resources/fisheries; terrestrial resources; bottomland hardwood forests; wildlife; threatened and endangered species; beaches; water supply; cultural and archaeological resources; and water quality. The appendix D lists common species found around the JST project.

3.2.1 Wetlands and Aquatic Vegetation

There are approximately 1,331 acres of various types of wetlands adjacent to JST. Approximately 358 acres are classified as palustrine emergent wetland habitat, 187 acres as palustrine scrub-shrub wetland habitat, and 786 acres as estimated to be palustrine forested wetland.

There is approximately 68,013 acres of lacustrine habitat created by the dam. An aquatic vegetation survey conducted at JST in 2010 found hydrilla present in 11,271 acres of JST's 71,000 acres. Based on an acoustic survey to determine the actual bottom coverage, hydrilla covered an average of 44% of the area where it has been located. The 2010 annual update of the APMP also noted 32 acres of water primrose, 72 acres of alligator weed, 600 acres of slender pondweed, and approximately half of an acre of the state-listed threatened shoals spider-lily. The 2015 survey determined that hydrilla was present on 10,644 acres with a density of 22.2% so actual hydrilla coverage is 2,363 acres. The frequency of other SAVs and wetland plants are attached in Table 1 of the Appendix B. Plant growth varied greatly across the reservoir. In most areas, the hydrilla seldom exceeded three feet in height and was not problematic during the peak of the recreation season. Hydrilla has not impacted hydropower production operations.

Table 3: Relevant Resources			
Resource	Institutionally Important	Technically Important	Publicly Important
Wetlands	Clean Water Act of 1977, as amended; Executive Order 11990 of 1977, Protection of Wetlands; Coastal Zone Management Act of 1972, as amended; and the Estuary Protection Act of 1968., EO 11988, and Fish and Wildlife Coordination Act.	They provide necessary habitat for various species of plants, fish, and wildlife; they serve as ground water recharge areas; they provide storage areas for storm and flood waters; they serve as natural water filtration areas; they provide protection from wave action, erosion, and storm damage; and they provide various consumptive and non-consumptive recreational opportunities.	The high value the public places on the functions and values that wetlands provide. Environmental organizations and the public support the preservation of marshes.
Aquatic Resources/ Fisheries	Fish and Wildlife Coordination Act of 1958, as amended.	They are a critical element of many valuable freshwater and marine habitats; they are an indicator of the health of the various freshwater and marine habitats; and many species are important commercial resources.	The high priority that the public places on their aesthetic, recreational, and commercial value.
Bottomland Hardwood Forest	Section 906 of the Water Resources Development Act of 1986 and the Fish and Wildlife Coordination Act of 1958, as amended.	Provides necessary habitat for a variety of plant, fish, and wildlife species; it often provides a variety of wetland functions and values; it is an important source of lumber and other commercial forest products; and it provides various consumptive and non-consumptive recreational opportunities.	The high priority that the public places on its aesthetic, recreational, and commercial value.
Wildlife	Fish and Wildlife Coordination Act of 1958, as amended and the Migratory Bird Treaty Act of 1918	They are a critical element of many valuable aquatic and terrestrial habitats; they are an indicator of the health of various aquatic and terrestrial habitats; and many species are important commercial resources.	The high priority that the public places on their aesthetic, recreational, and commercial value.
Threatened and Endangered Species	Endangered Species Act of 1973, as amended; Marine Mammal Protection Act of 1972; and Bald and Golden Eagle Protection Act of 1940 (as amended in 1962).	USACE, USFWS, NMFS, NRCS, USEPA, GADNR, and SCDNR cooperate to protect these species. The status of such species provides an indication of the overall health of an ecosystem.	The public supports the preservation of rare or declining species and their habitats.
Cultural and Archaeological Resources	National Historic Preservation Act of 1966, as amended; Native American Graves Protection and Repatriation Act of 1990; and Archeological Resources Protection Act of 1979	State and Federal agencies document and protect sites. Their association or linkage to past events, to historically important persons, and to design and construction values; and for their ability to yield important information about prehistory and history.	Preservation groups and private individuals support protection and enhancement of historical resources.

Table 3: Relevant Resources			
Resource	Institutionally Important	Technically Important	Publicly Important
Recreation Resources	Federal Water Project Recreation Act of 1965 as amended and Land and Water Conservation Fund Act of 1965 as amended	Provide high economic value to local, state, and national economies.	The public places a high value on public fishing, hunting, and boating areas.
Aesthetics	USACE ER 1105-2-100, and National Environmental Policy Act of 1969.	Visual accessibility to unique combinations of geological, botanical, and cultural features that may be an asset to a study area. State and Federal agencies recognize the value of beaches and shore dunes.	Environmental organizations and the public support the preservation of natural pleasing vistas.
Socio-Economic Resources	River and Harbor Flood Control Act of 1970 (PL 91-611).	N/A	Social concerns and items affecting area economy are of significant interest to community.
Environmental Justice and Protection of Children	Executive Order 12898 and the Department of Defense's Strategy on Environmental Justice of 1995, E.O. 13045, Protection of Children from Environmental and Safety Health Risks	The social, environmental health, and economic welfare of minority, children, and low-income populations may be positively or disproportionately impacted by the tentatively selected plans.	Public concerns about the fair and equitable treatment (fair treatment and meaningful involvement) of all people with respect to environmental, safety, and human health consequences of federal laws, regulations, policies, and actions.
Air Quality	Clean Air Act of 1963	State and Federal agencies recognize the status of ambient air quality in relation to the NAAQS.	Virtually all citizens express a desire for clean air.
Hydrology, Water Quality, and Water Supply	Clean Water Act of 1977; Fish and Wildlife Coordination Act; Coastal Zone Mgt Act of 1972; and Water Supply Act of 1958 (43 US Code §390b)	USACE, USFWS, NMFS, NRCS, USEPA, and State DNR and wildlife/fishery offices recognize value of fisheries and good water quality. National and state standards have been established to assess water quality. State and Federal agencies recognize the value of drinking water and maintain a reliable source of clean water.	Environmental organizations and the public support the preservation of water quality and fishery resources and the desire for clean drinking water. This legislation gives communities throughout the Savannah River Basin the option to receive water supply allocations from the reservoirs. In total, the entire basin supplies drinking water to more than 1.2 million people in Georgia and South Carolina from its headwaters to the estuary.

3.2.2 Aquatic Resources /Fisheries

JST supports popular warmwater and coolwater fisheries. The reservoir is populated by a variety of native species of freshwater fish, crustaceans, and fresh water mussels, many endemic to the Savannah River system. Popular game fish within the reservoir are largemouth bass, striped bass, black crappie, hybrid bass (white bass crossed with striped bass), bluegill, redear sunfish, channel catfish, and flathead catfish. Some game fish are also stocked (striped bass, hybrid bass) within the reservoir to support recreational fishing. Other fish naturally enter the system from the reservoir's tributaries. Blueback herring and threadfin shad are important forage fish in JST.

The lower reaches of the Tallulah River and Chattooga River are impounded by a series of hydroelectric dams. The fish fauna within these Savannah River tributary reservoirs is composed of both coolwater and warmwater species. Sunfish (Centrarchidae) and minnows (Cyprinidae) account for nearly one half of the species diversity. In the upper Savannah River basin, at least 50 species of fish representing 11 families have been documented. Reservoir fish biomass typically ranges from 40 to 120 lbs/acre. The sport fisheries of these impoundments are dominated by largemouth bass, crappie, catfish, and hybrid bass. Hybrid bass and striped bass are produced at the Richmond Hill State Fish Hatchery and stocked as fingerlings into these and other Georgia reservoirs. On average, 750,000 to 1,000,000 total striped and hybrid striped bass are stocked in JST each year (USACE 2008). The fishery resources of JST have been extensively studied by the USACE, with the Georgia Cooperative Fish and Wildlife Research Unit (GA COOP) performing baseline studies of fishery resources in JST as early as 1986. These studies included cove rotenone sampling, gillnet sampling, electrofishing, and telemetry. The Clemson University Cooperative Fish and Wildlife Research Unit (CU COOP) conducted a commercial creel estimate and a population estimate of blueback herring. SC DNR has conducted fisherman creel surveys on JST since 1991 (USACE 2008).

The robust redhorse is among the largest of the redhorses, reaching lengths over 700 mm and 8 kg. It is a mainstem river species that exhibits potamodromous behavior and spawns in high velocity, shallow water over gravel substrates (Breder & Rosen 1966; Grabowski & Isely 2006; Fisk 2010). After being described by Edward Cope in 1870 from a collection in the Pee Dee River basin, the species was misidentified and overlooked by the scientific community for 120 years before again being detected in Georgia, North Carolina, and South Carolina rivers in the 1980s and 1990s (Bryant et al. 1996). The species is currently protected by state endangered status in Georgia and North Carolina, but it has no official listing in South Carolina (GADNR 2015; SCDNR 2015). Stocking programs were initiated in Georgia in the 1990s and in South Carolina in the first decade of the 21st century to supplement existing robust redhorse populations and to establish new populations in suspected historical reaches <http://gap2.onlinelibrary.wiley.com/doi/10.1111/fme.12050/pdf>.

Stocked juvenile Robust Redhorse have been collected in the Thurmond Reservoir and in slower Coastal Plain river runs. One wild spawn juvenile was collected in Savannah

River tidal freshwater. Adults in Georgia's Broad River use the downstream reservoir outside of spawning season. These reservoir collections tend to indicate a tolerance of, or a preference for, lentic habitat during a portion of the life cycle (RRCC 2000). Recent telemetry observations in both the Santee River drainage (Supplemental Volume: Species of Conservation Concern, SC SWAP 2015) and Georgia's Broad River support the hypothesis that adults select cooler water temperatures during the summer. Habitat loss and disruption of spawning migrations resulting from dams and impoundments; predation and competition by introduced non-native species like buffalo, flathead catfish and blue catfish; and significant deterioration of water quality due to sedimentation and pollution are believed to have contributed to the decline of the Robust Redhorse. Additionally, the limited range of known populations and low rates of recruitment to the adult population represent challenges to the species' future (RRCC 2004). (Supplemental Volume: Species of Conservation Concern SC SWAP 2015 Contributors (2005): Scott D. Lamprecht and Jason Bettinger [SCDNR] Editors (2013): Scott D. Lamprecht and Mark C. Scott [SCDNR]).

The Savannah River downstream from the JST Reservoir supports an abundant and diverse fish community including resident freshwater, euryhaline, and diadromous species. Augusta Shoals and other gravel bars downstream from JST are known spawning habitats for many fish species including striped bass, American shad, endangered sturgeon, suckers, and other riverine species (Duncan et al. 2003). Sufficient river flows during spawning runs, larval drift and juvenile outmigration, and overwintering are important for completion of diadromous and resident fish life cycles. Summer low flow periods, particularly during drought years can reduce wetted perimeters and limit instream habitats. These periods create stressful conditions for fish and mussel species and during extreme circumstances can result in fish and mussel mortalities. Mean monthly flows were used to assess potential effects on critical time periods for fish and mussel communities in the lower Savannah River downstream from JST (USACE Duke 2014).

Wetland habitats support many aquatic species of frogs including the bullfrog, green frog, southern leopard frog, several species of tree frogs, cricket frogs, and chorus frogs. Turtles found in the wetlands include the river cooter, Florida cooter, eastern chicken turtle, snapping turtle, and common musk turtle. Snakes found in the wetlands include the water snakes and eastern mud snake (USACE 2008).

3.2.3 Forest Resources

JST is situated near the southeastern margin of the Piedmont Plateau Region. Lands acquired for JST Reservoir were generally owned by small landowners, forest industries, and power companies. In many cases, the land had been used for agricultural purposes prior to the Depression era but has been allowed to revert to forest growth. At the time of acquisition, most forested areas were supporting second growth pine with a mixture of regional hardwoods. Most river bottom hardwoods were inundated when Thurmond reservoir was constructed.

Five basic forest types may be identified on project lands: shortleaf pine, shortleaf pine-hardwood, loblolly pine-shortleaf pine, loblolly pine, and loblolly pine-hardwood. For practical silviculture, these five types are consolidated into three types: pine, pine-hardwood, and hardwood. The pine forest type is made up of shortleaf pine, loblolly pine, and scattered small stands of longleaf pine, occurring naturally or have been planted.

The pine-hardwood forest type includes the pine species given above associated with hardwood species such as sweetgum, yellow-poplar, white oak, post oak, southern red oak, other red oaks, white ash, winged elm, and other regional hardwoods. Minor constituents of this type include sourwood, American holly, sycamore, and red maple.

Understory species vary widely and include *Viburnum* spp., *Rhus* spp., *Sassafras* spp., several species of blackberry, greenbriar, dogwood and redbud. Japanese honeysuckle is abundant throughout the area but is kept in check by whitetail deer. Kudzu and wisteria are problematic in some areas. Other exotics found on project lands include chinaberry, princess tree, privet, climbing fern, tallow tree, bamboo, giant reed, and periwinkle.

Only a small percentage of the total land area is open or unforested. A few of the open areas maintained in open condition for operational use and utility right of ways, but most exist under the wildlife management program.

JST has always implemented an intensive forest management designed to provide increased user benefits by creating and maintaining a healthy, mixed forest. Silvicultural treatments are prescribed for forest management activities each year. Selective tree thinnings and regeneration harvest are made to improve wildlife habitat, diversify habitat, and enhance values for low density recreational use. Special consideration is given to high density recreation areas and other areas with unique or cultural values. Detailed information on management of vegetation and land cover can be found in the JST Master Plan.

3.2.4 Wildlife

Wildlife species can be found in various habitats within and immediately adjacent to the reservoirs. Habitats include open water; wetlands (emergent, shrub/scrub and forested); and uplands (forested, open/field, and disturbed). Some of these habitats can be affected by fluctuations in reservoir levels and others are likely to remain unaffected. Upland habitats are less likely to be impacted by water level changes due to their distance from the reservoirs. In addition, wetland habitats not dependent on reservoir level as a source of hydrology are less likely to be impacted. However, open water and wetland habitats dependent on reservoir level for hydrology and primary productivity, such as fringe wetlands, are affected by reservoir fluctuations (e.g. 10 feet or more). Therefore, wildlife species using those habitats are also affected. Reservoir Dependent Wetland (RDW) habitats are composed of emergent, shrub/scrub, and forested wetland

habitats existing due to the water level in the reservoirs. As with the open-water habitat, RDW are widely used by wildlife during various parts of their life cycle.

Reptiles and amphibians use open water habitats of reservoirs. Species such as Eastern painted turtle, common musk turtle, snapping turtle, spiny softshell turtle, yellow-bellied slider, water snakes, newt, and frogs are predominantly associated with the shallow water areas of reservoirs. These species use the open water habitats for breeding, foraging, and hibernation. Reptiles and amphibians use RDW habitats near the shorelines of reservoirs. For example, a variety of turtles and snakes use RDW for feeding and basking, and numerous amphibians breed, lay eggs, forage, and undergo their aquatic larval stage in these habitats. Some species, such as the Eastern newt, could spend their entire life cycle in RDW habitats.

Similar to reptiles and amphibians, birds use the shoreline and shallow open water habitats within reservoirs. These open water habitats are used as migration stopovers (resting habitat) for numerous species of ducks and geese as well as wading birds such as egrets, herons, and sandpipers. During the migration stopover, these species also use these areas for feeding prior to continuing their migration. Some of these migratory species use the reservoirs as overwintering habitat including Bonaparte's and ring-billed gulls, common loons, and hooded mergansers. In addition to the use of these habitats for feeding and overwintering by migratory species, resident avian species use open water for feeding. Examples of birds identified in the study area using the reservoir for feeding during the winter include belted kingfishers and great blue herons feeding in the shallow waters of the open water habitat. Avian species use RDW habitats adjacent to reservoirs as a migration stopover. Examples include numerous species of ducks and geese, as well as Neotropical migrants such as flycatchers, vireos, thrushes, and warblers. During the migration stopover, these species also use vegetated areas for feeding prior to continuing their migration. Some of these migratory species use RDW habitats as their overwintering habitat including swamp sparrows, yellow-rumped warblers, and Wilson's snipe. In addition, RDW habitats also provide food and nesting for resident avian species. Song sparrows, yellow warblers, eastern kingbirds, mallard, wood duck, and Canada geese are a few examples of species that nest and raise their young in RDW habitats. Some of the same mammals using open water habitats also use RDW habitats. Several of the most common bird species noted in the immediate vicinity of JST include red-shouldered hawk, red-tailed hawk, ruby-throated hummingbird, Eastern kingbird, blue jay, American crow, Carolina chickadee, tufted titmouse, white-breasted nuthatch, American robin, Northern mockingbird, brown thrasher, Northern cardinal, red-winged blackbird, ring-necked duck, lesser scaup, and brown-headed cowbird (USACE 2008 and USACE 1981). Additionally, some avian species commonly seen or heard in the surrounding uplands include: wild turkey, American bittern, great blue heron, osprey, mourning dove, whip-poor-will, belted kingfisher, red-headed woodpecker, Eastern bluebird, gray catbird, and Northern parula (USACE 2008 and USACE 1981).

Mammals commonly use open water habitats. Bats are one of the most common mammals to feed over the reservoirs. In addition, furbearers such as mink, American

beaver, muskrats, and other semi-aquatic mammals use shallow water for feeding as a means of transportation to other habitats. Bats feed over the wetland habitats as they forage for flying insects such as midges and mosquitoes. In addition, the opossum, white-tailed deer, mink, American beaver, and other semi-aquatic mammals use RDW habitats for foraging and raising young (USACE 2014). Around JST, furbearers and other mammals are an important component of these wetlands and include American beaver, muskrat, mink, northern river otter, and gray fox. White-tailed deer, and even black bear in the more isolated areas, use the bottomlands. Palustrine emergent wetlands also provide excellent habitat for furbearing mammals. Terrestrial species from surrounding areas often use the fresh marsh edge for shelter, food, and water. These include Northern raccoon, Virginia opossum, cottontails, nine-banded armadillo, coyote, and bobcat (USACE 2008 and USACE 1981).

The Thurmond Lake Operational Management Plan prescribes active management for maintenance of diverse habitats for game and non-game wildlife species. A total of 54,086 acres of project lands are managed as wildlife management areas, including 7,984 acres leased to SC DNR, 18,362 acres leased to GA DNR, and the remaining 27,740 acres managed by USACE.

3.2.5 Threatened, Endangered And Other Protected Species

This section cover species and their critical habitat that have been listed under the Threatened and Endangered Species Act, as well as those protected by other Federal and state laws. The USFWS Information, Planning, and Conservation System (<http://ecos.fws.gov/ipac/>) website provided a current inventory of federally-listed species within the JST Reservoir area. Table 4 identifies Federally-listed species and otherwise protected species that are known to be in the area. The list also includes the bald eagle (*Haliaeetus leucocephalus*) which is protected under the Federal Bald and Gold Eagle Protection Act, and the Migratory Bird Treaty Act.

Table 4: Federally and State Proposed and Protected Species Located in the Savannah River Basin Impact Study Area			
Common Name	Scientific Name	Federal Status	State Status
BIRDS			
Bald eagle	<i>Haliaeetus leucocephalus</i>	BGEPA/MBTA	T (SC, GA)
Wood stork	<i>Mycteria americana</i>	T	T (SC, GA)
Red-cockaded woodpecker	<i>Picoides borealis</i>	E	E (SC, GA)
American Kestrel	<i>Falco sparverius paulus</i>	MBTA	R (GA)
American Bittern	<i>Botaurus lentiginosus</i>	MBTA	
Bachman's sparrow	<i>Aimophila aestivalis</i>	MBTA	
Blue-winged warbler	<i>Vermivora pinus</i>	MBTA	
Brown-headed nuthatch	<i>Sitta pusilla</i>	MBTA	
Chuck-will's-widow	<i>Caprimulgus carolinensis</i>	MBTA	
Fox Sparrow	<i>Passerella iliaca</i>	MBTA	
Kentucky Warbler	<i>Oporonis formosus</i>	MBTA	
Least Bittern	<i>Ixobrychus exilis</i>	MBTA	

Loggerhead Shrike	<i>Lanius ludovicianus</i>	MBTA	
Painted Bunting	<i>Passerina ciris</i>	MBTA	
Prairie Warbler	<i>Dendroica discolor</i>	MBTA	
Prothonotary Warbler	<i>Protonotaria citrea</i>	MBTA	
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	MBTA	
Rusty Blackbird	<i>Euphagus carolinus</i>	MBTA	
Sedge Wren	<i>Cistothorus platensis</i>	MBTA	
Wood Thrush	<i>Hylocichla mustelina</i>	MBTA	
Worm Eating Warbler	<i>Helmitheros vermivorum</i>	MBTA	
Peregrine Falcon	<i>Falco peregrinus</i>	MBTA	E (SC) T (GA)
Mammals			
Northern Long-eared bat	<i>Myotis septentrionalis</i>	T	
Reptiles			
Gopher Tortoise	<i>Gopherus polyphemus</i>	C	E (SC) T (GA)
Mollusks			
Carolina Heelsplitter	<i>Lasmigona decorate</i>	E	E (SC)
Fish			
Robust Redhorse	<i>Scartomyzon robustus</i>		E (GA)
Flowering Plants			
Little Amphianthus	<i>Amphianthus pusillus</i>	T	T (SC, GA)
Miccosukee Gooseberry	<i>Ribes echinellum</i>	T	T (SC)
Michaux's Sumac	<i>Rhus michauxii</i>	E	E (SC, GA)
Relict Trillium	<i>Trillium reliquum</i>	E	E (SC, GA)
Shoals Spider-Lily	<i>Hymenacallis coronaria</i>		T (SC, GA)
Ferns and Allies			
Mat-forming Quillwort	<i>Isoetes tegetiformans</i>	E	
Source: NC NHP 2010, SC DNR 2006b, GA DNR 2007. Notes: E = Endangered, T = Threatened, R= Rare, C= Candidate, BGEPA = Bald & Golden Eagle Protection Act, MBTA = Migratory Bird Treaty Act			

There are several federally-listed fish species, including those classified as endangered, threatened, species of concern, or candidates for listing that occur in the lower Savannah River below JST. These include the shortnose sturgeon, Atlantic sturgeon, American eel, robust redhorse, bluebarred pygmy sunfish, and blueback herring. Three mussel species recently collected in the lower Savannah River (the Atlantic pigtoe, Savannah lilliput, and yellow lampmussel) are considered federal species of concern. The Altamaha arc-mussel and brother spike are two other federal species of concern.

The shoals spider-lily, a Federal species of concern and state threatened species, is present in the Savannah River along the rapids between the Stevens Creek Dam and Augusta, GA and on Project lands in the Anthony Shoals portion of Broad River.

The following comments were submitted in accordance with the Fish and Wildlife Coordination Act (44 Stat. 401, 16 U.S.C. 661), the ESA of 1973, the BAGEPA (16

U.S.C. 668-668d), and the Migratory Bird Protection Act (16 U.S.C. 703-712) in a letter dated December 2, 2014;

ESA Comments:

- Federally listed species are not likely to occur within the lake project area. Several protected species may occur on lake edges, in uplands adjacent to the lake, in river/creek areas up or downstream including: Wood stork, Carolina heel splitter, Miccosukee gooseberry, Michaux sumac, relict trillium, and northern long-eared bat.

BGEPA and MBTA Comments:

- In 2007, the Service removed the bald eagle from the list of threatened and endangered species under the ESA (72 FR 37345, July 9, 2007), but the species continues to be protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act (the Eagle Act). A condition of the delisting requires the Service to work with State wildlife agencies to monitor eagles. If at any time, it appears that the bald eagle again needs the Act's protection, the Service can propose to relist the species. The goal of Service eagle management under the Act is to maintain stable or increasing eagle populations.
- Current declines of bald eagles at JST warrants conservation action. Between 1998 and 2014, at least 80 dead eagles were recovered at JST with either confirmed or suspected AVM-related mortality (Wilde 2014). This determination is further evident from GADNR eagle nesting survey data acquired in the 2013/2014 nesting season, which showed a varied age class of eagles, including sub-adults and adults coming to JST at the start of the nesting season, but only two pairs remaining to breed at the northern end of the reservoir. These two pairs occupied nesting territories and produced young at the northern end of the reservoir.

The bald eagle (<http://www.fws.gov/midwest/eagle/>) is a large raptor with a wingspan of approximately seven feet (2 meters). Adult individuals of this species have a mainly dark brown plumage with a solid white head and tail. Primary habitat for the bald eagle is undisturbed riparian zones including coastal, river, and lakeshore areas. Bald eagle nest sites within the southeast are usually located in living pine or cypress trees. Nest sites are often located in the largest living trees within the area commanding an open view of the surrounding terrain. Nest sites are generally located within one-half mile of open water with a clear flight path leading to the water. A tagging program has been employed to track eagle movements within JST. A 2016 survey by GA DNR documented 201 successful bald eagle nests in the state, the second year eagle nests exceeded 200 breaking historical nesting records. Many of the bald eagles using JST

are transients. There are 3 active eagle nests. Since 1998, eighty bald eagle deaths (33 confirmed from AVM) have occurred in the Thurmond area with four mortalities recorded during the winter of 2014 and no mortalities during the winter of 2015/2016.

3.2.6 Cultural Resources

The Savannah River Basin has a long history of human occupation with earliest evidence of settlement dating as far back as the Paleoindian Period, ca. 9,500 B.P. The basin has long been an area of archaeological interest for researchers. Prior to the impoundment and subsequent inundation of JST (aka Clark Hill) cultural resources investigations of varying degrees of comprehensiveness were conducted. Recent archaeological investigations at JST have focused primarily on the upland areas (i.e., above 335 ft. msl), although smaller shoreline surveys have been conducted at JST. Archaeological fieldwork conducted in the late 1940s and early 1950s through the Smithsonian Institution's River Basin Survey identified more than 200 sites at JST, with limited excavation conducted at a minimum of 21 of the sites by former Smithsonian Institution and University of Georgia personnel (Elliott 1995). The survey focused on site visits to locales reported by local collectors, previously recorded sites and visits to likely village sites as determined through archival research and previous experience of working in similar environmental settings. Some of the recorded sites were discovered during excavation of the reservoir. Nearly 100 of the sites were determined to be flooded by the inundation of JST (i.e., at or below 335 msl) and almost the same number was situated outside of the flood pool.

More recent shoreline surveys of JST have been conducted that resulted in the recordation of numerous previously unrecorded archaeological sites. In 1983-84 the U.S. Forest Service identified 54 sites, 38 of which had been previously unrecorded. Sites ranged from the Early Archaic period (8,000 B.C. – 6,000 B.C) to the early 20th century (Elliott 1995). Anderson et al. (1994) conducted a terrestrial and underwater survey of a two mile section of lake shore and a 440-acre upland tract that identified 14 upland sites, 32 sites along the shoreline as well as one underwater site. Only the underwater site had been previously located by the River Basin Survey in the 1940s-1950s.

Archaeological surveys conducted in the mid-late 1990s at JST by cultural resources firms contracted by Savannah District have focused exclusively on upland areas. These large-scale surveys were conducted to comply with Section 110 of the National Historic Preservation Act, as amended (NHPA) in areas that were managed for timber. As a result of the surveys, over 1600 archaeological sites, isolated finds and rock piles have been recorded. A wide array of site types are represented at JST, ranging from prehistoric camp sites to 19th-20th century mills and cemeteries.

3.2.7 Recreational Resources

Recreational opportunities at JST include camping, biking, picnicking, hunting, hiking, wildlife viewing, outdoor sports activities, water sport/leisure activities (boating,

swimming, fishing, skiing, etc.), and horseback riding. JST offers recreation to more than two million visitors every year. Currently, JST provides 24 recreation areas, including six state parks, nine county parks, seven USACE-operated campgrounds, and five major USACE-operated day use areas. JST also provide 32 boat ramps, six marinas, and 16 quasi-public recreation areas that are currently leased to universities, churches, civic groups, and scout organizations. Two additional areas are leased to the Army and the National Guard for recreation and training purposes. JST has 14 campgrounds and recreation areas with designated swimming areas. These manmade sand beaches provide recreational benefits but little benefits to wildlife. In FY 2012 JST had 5,041,679 visitors.

3.2.8 Aesthetics (Visual Resources)

JST is one of the few civil works projects possessing a large land base consisting primarily of woodlands. Boaters can view miles of undisturbed shoreline free of docks, marinas, cabins and other signs of human habitation. These extensive woodlands provide a pleasant visual experience and serve to minimize conflicting activities.

The natural beauty of JST is a recreational asset which offers almost unlimited opportunities for outdoor oriented activities such as sightseeing and hiking as well as provides a pleasant environment for campers, mountain bikers, horseback riders, hunters, and fishermen. The impressive hydropower dam (Figure 4) is another element in the viewshed.



Figure 4: JST Dam

3.2.9 Socio-Economic

The 380 megawatt JST Project is located on the Savannah River 22 miles upstream from Augusta, Georgia, and 239.5 miles upstream from the mouth of the Savannah River. The project has 1,045,000 acre-feet of usable storage capacity, 1,200 miles of shoreline, and approximately 71,000 surface acres of water at a normal pool elevation

of 330 feet AMSL. The project was the first of the three USACE projects built in the Savannah River Basin and it was constructed from 1946 through 1954. Filling of JST began in July 1951 and was completed in October 1952. The power plant began commercial operation in November 1952.

The authorized purposes of the JST Project are to provide flood control, fish and wildlife habitat, water quality enhancement, water supply, recreation, and hydroelectric power. The project has 18 feet of conservation storage from an elevation of 312 to 330 feet AMSL. The project has seasonal drawdowns of the conservation pool. Operations at the JST Project are similar to the operations at the Hartwell Project, with the additional requirement of operating the gates at the New Savannah Bluff Lock and Dam. The power produced at the JST power plant is sold through the Southeast Power Administration. The JST power plant is operated primarily as a peaking plant to meet electric needs during peak demand hours.

Approximately 78,885 acres of project land surrounding Thurmond Reservoir are above the normal full pool of 330 feet msl and are classified for the following land uses based on the current project JST Master Plan (updated in 1995):

- Environmental Sensitive Areas – 5,671 acres
- Flowage Easements – 4,683 acres
- Multiple Resource Management – 54,039 acres
- Mitigation (for Richard B. Russell Project) – 6,877 acres
- Project Operations – 193 acres
- Recreation Facilities (more details in Section 3.2.7) – 12,725 acres
- Recreation (Quasi-Public and Private Clubs) – 2,830 acres

Within the vicinity of the Reservoir, land use is primarily forest and agriculture. While residential development is primarily low density and scattered.

3.2.10 Environmental Justice And Protection Of Children

Executive Order 12898 directs Federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law (Table 5). The order also directs each agency to develop a strategy for implementing environmental justice. The Department of Defense's Strategy on Environmental Justice of 1995, directs Federal agencies to identify and address any disproportionately high adverse human health or environmental effects of Federal actions to minority and/or low-income populations. Minority populations are those persons who identify themselves as Black, Hispanic, Asian American, American Indian/Alaskan Native, and Pacific Islander. A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population. No environmental justice communities exist within the project area based on the 2014 census data (Table 5).

Table 5: Percent of Population by County							
	Abbeville Co., SC	McCormick Co., SC	Elbert Co., GA	McDuffie Co., GA	Lincoln Co., GA	Wilkes Co., GA	Columbia Co., GA
Race and Hispanic Origin							
White alone, percent, July 1, 2014, (V2014) (a)	69.7	49.6	68.2	56.8	66.6	54.9	77.4
White alone, percent, April 1, 2010 (a)	69.6	48.7	65.9	57.2	65.7	53	72.4
Black or African American alone, percent, July 1, 2014, (V2014) (a)	28.3	48.6	29.4	40.7	31.6	42.6	13.2
Black or African American alone, percent, April 1, 2010 (a)	28.3	49.7	29.5	39.8	32.1	42.8	12.6
American Indian and Alaska Native alone, percent, July 1, 2014, (V2014) (a)	0.3	0.2	0.4	0.4	0.4	0.2	1.2
American Indian and Alaska Native alone, percent, April 1, 2010 (a)	0.2	0.1	0.2	0.3	0.4	0.2	0.9
Asian alone, percent, July 1, 2014, (V2014) (a)	0.4	0.5	0.9	0.5	0.5	0.8	5.4
Asian alone, percent, April 1, 2010 (a)	0.3	0.3	0.6	0.3	0.4	0.5	4.8
Native Hawaiian and Other Pacific Islander alone, percent, July 1, 2014, (V2014) (a)	0	0.1	0	0.1	0	0	0.2
Native Hawaiian and Other Pacific Islander alone, percent, April 1, 2010 (a)	Z	0.1	Z	0.1	Z	Z	0.2
Two or More Races, percent, July 1, 2014, (V2014)	1.2	1.1	1.1	1.5	0.9	1.6	2.5
Two or More Races, percent, April 1, 2010	1.1	0.9	1	1.4	0.9	1.5	2.9
Hispanic or Latino, percent, July 1, 2014, (V2014) (b)	1.2	1.2	5.5	2.8	1.3	3.9	17.4
Hispanic or Latino, percent, April 1, 2010 (b)	1	0.8	4.8	2.2	1.2	3.4	16.3
White alone, not Hispanic or Latino, percent, July 1, 2014, (V2014)	68.8	48.7	63.7	54.7	65.6	51.7	62.1
White alone, not Hispanic or Latino, percent, April 1, 2010	69.1	48.3	64.2	56.3	65	51.9	63.7
Income and Poverty							
Persons in poverty, percent	20.3	21.9	23.4	23.7	22.3	24	14.8
<p>The vintage year (e.g., V2014) refers to the final year of the series (2010 thru 2014). Different vintage years of estimates are not comparable. (a) Includes persons reporting only one race (b) Hispanics may be of any race, so also are included in applicable race categories. Z: Value greater than zero but less than half unit of measure shown. QuickFacts data are derived from: Population Estimates, American Community Survey, Census of Population and Housing, Current Population Survey, Small Area Health Insurance Estimates, Small Area Income and Poverty Estimates, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits.</p> <p>http://www.census.gov/quickfacts/</p>							

Executive Order 13045, (Protection of Children from Environmental Health Risks and Safety Risks) requires each federal agency, to the extent possible, to make it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children; and ensure its policies, programs, activities, and standards address disproportionate risks to children resulting from environmental health or safety risks (White House Press Release 1997).

3.2.11 Air Quality

JST extends into several counties; McCormick and Abbeville counties in South Carolina; and parts of Columbia, McDuffie, Warren, Wilkes, Lincoln and Elbert Counties in Georgia. All of these counties are considered in attainment for all federal air quality standards (<http://www3.epa.gov/airquality/greenbk/astate.html>). Despite being in compliance for these standards, portions of the area that contain the reservoir are at times subjected to temporary impacts to air quality resulting from activities such as large-scale construction projects and prescribed burning.

Air quality within the project boundary is influenced by exhaust from motor vehicles and boats, the use of grills and fire pits, and other regional activities (such as large-scale construction projects, prescribed burning as well as timber industry logging operations). The large open area created by the reservoir allows strong air currents to reduce and/or eliminate localized air quality concerns caused by these pollutants. Air quality is strongly influenced by external factors such as urban areas and factories located as far away as Augusta and Atlanta, GA.

Air quality is regulated by the Clean Air Act Section 176 (c) and implemented by the EPA, SC DHEC, and GA DNR-EPD. Air quality standards are defined in the National Ambient Air Quality Standards. Actions which result in increased emissions may require a permit issued by SC DHEC or GA DNR-EPD.

3.2.12 Hydrology, Water Quality and Water Supply

Water quality in JST is measured by Georgia and South Carolina natural resource state agencies. There are nine SC DHEC monitoring stations (Figure 5) along Lake Thurmond (**CL-040, RL-05405, RL-05407, RL-03357, RL-05463, SV-291, RL-06423, RL-04385, CL-041**). Currently, both states have identified fish consumption advisories for Largemouth bass on JST due to potential mercury levels resulting from outside sources. Additionally, the state of South Carolina has designated JST as a No Discharge Lake.

The headwaters of JST back up to the Richard B. Russell (RBR) Dam. As a result, water released from RBR Dam affects water quality in JST. USACE conducts an annual water quality sampling program in both RBR and JST to evaluate the impacts of USACE project operations on water quality in the reservoir and immediate tailrace areas.

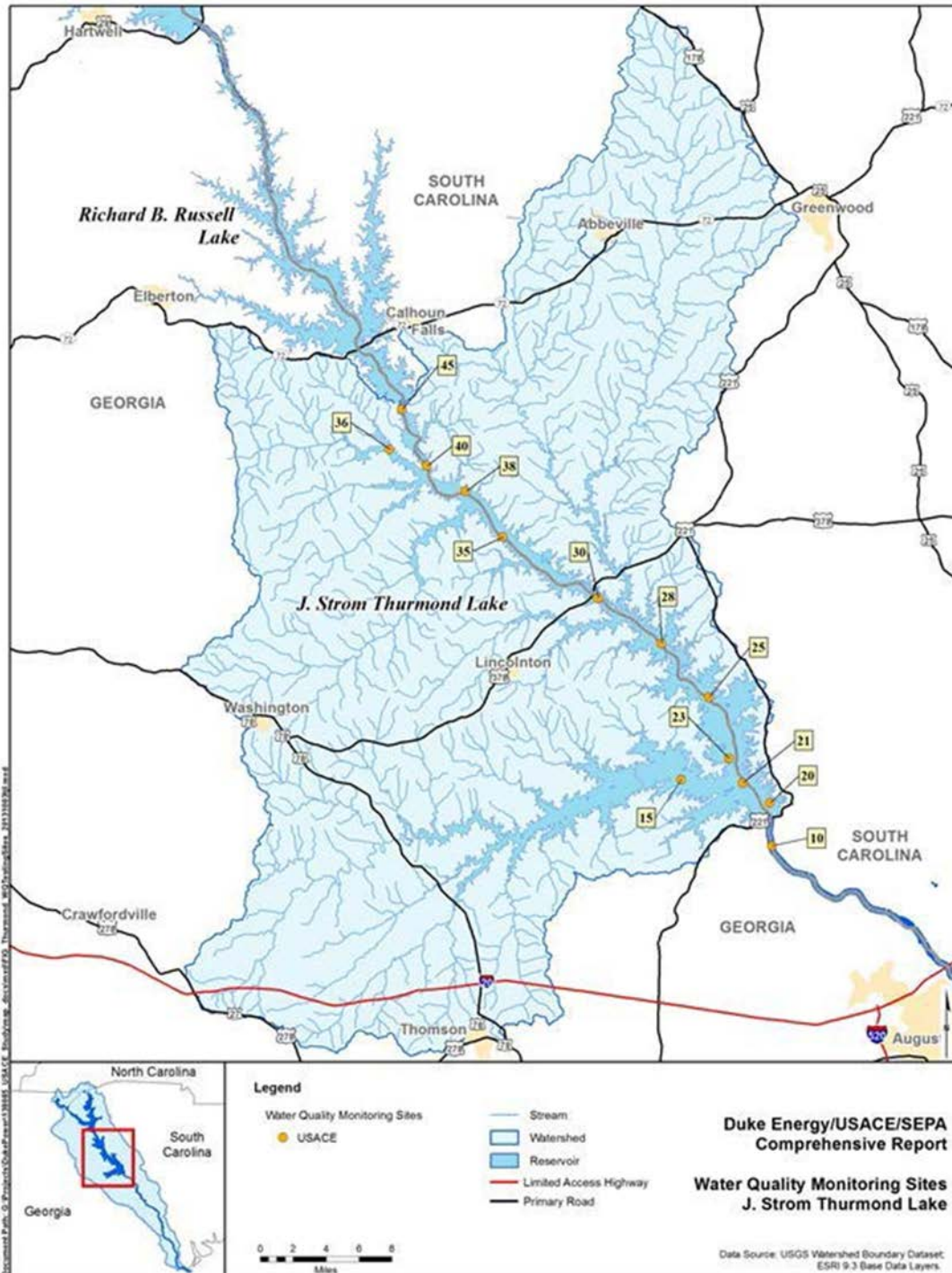


Figure 5: Water Quality Monitoring Sites

Similar to RBR Lake, the JST experiences thermal stratification being present from April to September. Thermal stratification in the downstream region of the reservoir usually beginning in late-April with the establishment of a thermocline (20-26 feet) in mid-May. Temperatures ranged from 57.2 to 86°F and the thermocline remained near a depth of

26 to 33 feet throughout the stratification period. The thermocline begins to weaken in late-September when seasonal cooling begins, until the reservoir conditions are almost completely isothermal by mid-October. Temporal regimes in the mainstem can be influenced by flow releases from RBR Lake.

Similarly, temporal and spatial gradients of dissolved oxygen (D.O.) were observed in the mainstem of the reservoir during stratification (1984–1988 monitoring period). D.O. concentrations remained near 8 to 10 mg/L, gradually decreasing towards the downstream area of the reservoir. Anoxic conditions were established in the downstream hypolimnion area from mid-to-late August continuing until late October. Anoxic conditions remained within 33 feet of the surface. Concentrations of D.O. did not fall below 4 mg/L in the mid-region of the reservoir. The oxygenated waters during stratification can be attributed to the well-oxygenated flow releases from RBR Dam. Anoxic conditions may also be the result of the proximity of major and secondary tributaries entering JST. Temperature and D.O. concentrations in the water releases showed similar trends to those of the forebay. During fall mixing, D.O. levels were near 10 mg/L in the tailrace (Ashby et al. 1994).

The turbines at JST Dam were replaced during a major rehabilitation effort that was completed in 2007. The new turbines include a self-aspirating design that is an advanced form of turbine venting. This venting adds 2 to 3 mg/l of DO to the water as it passes through JST Dam. In addition to turbine venting, the Corps installed an oxygen injection system in JST that began operating in 2011. This system is located in the Modoc, SC area of JST approximately 5.5-miles upstream of JST Dam. The primary objective of this system is to improve coolwater fishery habitat in the lower 1/3 of JST, but the system also improves the DO of water immediately upstream of JST Dam. Thus the operation of the JST DO system in combination with the turbine venting at JST Dam results in the DO concentration below JST Dam remaining near or above 5 mg/l throughout the year.

Since 2006, the USACE Engineering Research and Development Center (ERDC) has monitored designated stations along the mainstem and major tributary embayments in JST. In situ measurements of temperature, D.O., and specific conductance are obtained monthly at these stations. Data from these discrete sampling locations is used to estimate the volume of available aquatic habitat on a monthly basis in the reservoir. Similar to RBR Lake, the vertical and longitudinal patterns of temperature and D.O. in JST show substantial year-to-year and seasonal variation, driven in large part by the volume of water flowing through the system and the seasonal patterns of vertical stratification (USACE 2009). July and August are of particular interest in JST because this is the period that puts the most severe limits of temperature and D.O. on habitat for striped bass in the reservoir. Since 2005, the ERDC has made quantitative estimates of available striped bass habitat during the critical summer periods. Minimum habitat typically occurs in July through August and into early-September, with between 20 percent and 40 percent of the reservoir volume categorized as available habitat during low flow years. Conditions improve during the fall, and a majority of the reservoir volume has suitable striped bass habitat by October. August 2007, with relatively low flow conditions, experienced the least available habitat (<20 percent) during the four-

year period from 2006 to 2009 (USACE 2009). In addition to the monthly sampling program, temperature and D.O. are monitored continuously in the JST penstock and immediate tailrace area to determine when to operate the turbine venting system. In general, during the summer months, tailrace D.O. concentrations are approximately 2.7 mg/L higher than the penstock D.O. concentrations. During the summer 2009 monitoring period, penstock D.O. concentrations dropped to almost 0 mg/L in August, but tailrace D.O. concentrations remained above 3 mg/L due to the combined effects of turbine venting and other re-aeration effects in the tailrace area (USACE 2009).

Aquatic life and recreational uses are fully supported at all sites. At **SV-291**, there is however, a significant increasing trend in five-day biochemical oxygen demand. Significant decreasing trends in turbidity, total phosphorus concentration, and fecal coliform bacteria concentration suggest improving conditions for these parameters at this site. At the furthest downlake site (**CL-041**), there is a significant increasing trend in pH. A significant decreasing trend in turbidity suggests improving conditions for this parameter at this site.

Little River arm of Lake Thurmond (CL-039) – Aquatic life and recreational uses are fully supported.

Tributary to Baker Creek (RS-03510) – Aquatic life uses are fully supported based on macroinvertebrate community data and recreational uses are fully supported.

Hawe Creek – There are two SC DHEC monitoring stations along Hawe Creek (**SV-819, SV-066**). These are special study stations and only examined aquatic life uses. Aquatic life uses are fully supported at both sites.

Hawe Creek Tributary – There are two SCDHEC monitoring stations along the Hawe Creek tributary (**SV-818, SV-817**). These are special study stations and only examined aquatic life uses. Aquatic life uses are fully supported at both sites. Although pH excursions occurred at **SV-818**, due to the small sample size, aquatic life uses are considered fully supported.

<http://www.scdhec.gov/HomeAndEnvironment/Docs/60103-07.pdf>

Current total water withdrawals from the JST Reservoir (based on 2010 data) are 22.2 mgd (34.3 cfs), including withdrawals from eleven municipal raw water intakes. Current total water returns are 4.7 mgd (7.3 cfs) (HDR 2012). There are six users with permanent water storage contracts withdrawing from JST: McCormick, South Carolina; Lincolnton, Georgia; Thomson, Georgia; Columbia County, Georgia, Savannah Lakes Village, South Carolina; and Washington, Georgia. Of the 50,000 available ac-ft, these users account for 3,833 ac-ft (approximately 8 percent), leaving 46,167 ac-ft of the remaining available storage reallocation at JST.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Wetlands And Aquatic Vegetation

4.1.1 No Action Alternative

Without implementation of the proposed action, hydrilla may continue to spread. Emergent wetland plant species are not expected to be effected by hydrilla growth. We have observed annual fluctuations in the amount of SAV. The normal winter draw down for flood control of approximately four feet has some negative impact on emergent and submersed aquatic plants including hydrilla; however, summer drought conditions with associated low water levels likely has the greatest impact on annual differences in the amount of SAV.

4.1.2 Biological Control Alternative

With implementation of this alternative (stocking CSTGC), no direct or indirect adverse impacts to palustrine wetlands would be expected. Triploid grass carp are not likely to consume native emergent wetland plants, but will likely consume some native SAVs. Although quicker results could be obtained with the higher stocking rate of 20 fish per acre along with mortality stockings, there is also a significant risk of greatly reducing or eliminating SAV from the reservoir. The correlative negative impacts to a variety of species would be significant. Research has shown grass carp have a strong affinity for hydrilla. The objectives of Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands) were considered during the planning and evaluation of this project. The establishment of desirable native SAVs has been relatively unsuccessful.

4.1.3 Chemical Control Alternative

With implementation of this alternative (herbicide application across all areas of hydrilla infestation), direct short term adverse impacts to palustrine wetlands including native vegetation and the state listed shoals spider-lily may occur. These impacts would be mitigated by controlling the treatment boundaries adjacent to existing wetlands. The objectives of Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands) were considered during the planning and evaluation of this project. Most aquatic herbicides are non-selective, therefore SAVs will be negatively impacted in the treatment areas. No long term impacts to native wetland vegetation is anticipated if mitigation measures are used to prevent over spraying.

4.1.4 Proposed Action - Integrated Approach Alternative

With implementation of the proposed action (stocking CSTGC and limited herbicide application), the impacts would be of a combination of those impacts described for the biological control alternative and to a lesser degree those described for the chemical

control alternative. Spot herbicide treatments would be focused in areas where hydrilla is at or near the lake surface which would reduce direct impacts to existing wetlands.

4.2 Aquatic Resources /Fisheries

4.2.1 No Action Alternative

Without implementation of the proposed action, hydrilla may continue to spread. In the short term, there could be positive indirect benefits by providing structure for small organisms to hide and, in turn, feeding areas for predators. When the hydrilla mats become thick in individual coves, decomposition of the dense mats could cause water quality issue in those coves which can impact fish in those coves. Fisheries are likely to remain the same over time in the lake, as a whole.

4.2.2 Biological Control Alternative

With implementation of this alternative (stocking CSTGC), there could be negative short term indirect impacts on largemouth bass. Largemouth bass are attracted to vegetated areas but may also be found near other structures (snags, underwater objects) and school in the middle of lakes. Most research has found that largemouth bass production is enhanced with moderate SAV coverage (from 15-30% areal coverage).

CSTGC should not directly compete with the native fish because of their affinity for feeding on hydrilla. Since the CSTGC cannot reproduce, an invasive self-sustaining population of these fish cannot get established in JST or downstream of the dam. Recent studies regarding grass carp site fidelity predict they will remain in areas where there is high density of food, but that grass carp can escape the reservoir and enter other systems. The stocking density and monitoring will prevent 100% loss of SAV in the lake. As the goal of 50% is reached the stocking density will be reduced. Some fisheries habitat will be negatively affected if hydrilla is eliminated the goal of 50% reduction will minimize that impact.

4.2.3 Chemical Control Alternative

With implementation of this alternative (herbicide application across all areas of hydrilla infestation), indirect short term adverse impacts to fisheries would be expected. Removal or reduction in the size of stands of hydrilla would have temporary insignificant adverse impacts to fish using those stands for forage and cover. Chemical control is only effective for one growing season. Displaced fish may move to other available habitats. Localized increases in competition for cover and forage may occur. Over time, fish populations would fluctuate as the vegetation fluctuates in response to adaptive management actions and other factors including fishing pressure, lake levels, disease, and climate. Sammons et.al. (2003) data demonstrated that while largemouth bass do not leave an area when hydrilla is reduced with fluridone, their behavior does change.

Use of herbicide treatments on large areas of aquatic vegetation may result in long term indirect localized impacts by reducing the amount of dissolved oxygen in the water when dead vegetation decays, possibly leading to isolated fish kills. Reductions in dissolved oxygen would be minimized by following guidance on herbicide labels, including limiting the extent of vegetation die off at any one time by treating only sections of densely matted areas at a given time. Herbicide applications targeted at Hydrilla may also have a negative effect on other species of SAV within the treatment areas. Chemical applications may have short term direct negative effects on fisheries by (A) reducing the number of prey organisms, and (B) possible lethal effects to fisheries. Treatment of hydrilla by herbicides may also have short term, indirect impacts on aquatic invertebrates and fish due to water quality changes. These impacts will depend on the type of herbicide used and its concentration. These impacts would be mitigated by using only approved herbicides at their approved application rates. The potential secondary impacts to aquatic invertebrates and fish would be minimized through the use of best management practices such planning treatments outside spawning seasons and/or planning treatments to minimize dissolved oxygen issues. Long term impacts may affect these resources depending on how often herbicide treatment is performed. Mitigation measures such as monitoring and adapting herbicide application rates and locations may avoid long term impacts.

4.2.4 Proposed Action - Integrated Approach Alternative

With implementation of the proposed action (stocking CSTGC and limited herbicide application), fisheries, and aquatic resources would be impacted as described in the other action alternatives. Measures to avoid adverse impacts to fisheries and aquatic resources would consist of (A) limiting herbicide applications to those areas of JST that have the highest hydrilla abundance coupled with AVM occurrences, and (B) following proper herbicide label precautions to limit adverse impacts to aquatic organisms.

4.3 Wildlife

4.3.1 No Action Alternative

Without implementation of the proposed action, certain species of wildlife (primarily birds) would likely be adversely directly and indirectly affected over the long term. American coot, great horned owl, killdeer, Canada goose, mallard, ring-necked duck, bufflehead, bald eagles, and other species would continue to experience AVM health impairments and in some instances, death. Based on comments from USFWS, other wildlife such as painted turtles that ingest the toxic cyanobacterium exhibit the same symptoms associated with birds diagnosed with AVM. Recent camera studies have documented red fox, raccoon, opossum, red-tailed hawks, eagles, vultures; and crows scavenge coot carcasses at JST. These additional wildlife species may be at risk for AVM disease; however, Vacuolar Myelinopathy has not been confirmed in mammals. Hydrilla would continue to exist and the indirect impact due AVM associated mortalities and impairments in those affected species would persist.

4.3.2 Biological Control Alternative

With implementation of this alternative (stocking CSTGC), bald eagles, American coots, great horned owl, killdeer, Canada goose, mallard, ring-necked duck and bufflehead would be indirectly positively impacted by reducing the vectors of the AVM disease. Recent research (Haynie, et al. 2013) considered grass carp as a possible vector for AVM. When fed hydrilla with *Aetokthonos hydrillicola*, grass carp developed lesions that look similar to those in affected birds, but the fish did not appear impaired and eliminated hydrilla in the experimental tanks and pond. In addition, these AVM-positive grass carp were used in a chicken feeding trial and the chickens did not develop AVM lesions. The proposed alternative would reduce the occurrence of hydrilla beds that are used by waterfowl and wading birds. Reduction in the extent of floating mats of hydrilla would displace waterfowl and wading birds currently using those mats. Birds may move to other stands of vegetation along the shoreline or other water bodies in the vicinity where habitat is available. Wintering waterfowl habitat will be negatively affected if hydrilla is eliminated; the goal of 50% reduction would minimize that impact. However, with the higher stocking rate of 20 fish per acre to achieve quicker results, there is a high likelihood that SAV will be reduced more than 50%.

4.3.3 Chemical Control Alternative

With implementation of this alternative (herbicide application across all areas of hydrilla infestation), wildlife would not experience significant long-term adverse impacts. This alternative would reduce the occurrence of hydrilla beds that are used by waterfowl and wading birds. Reducing the extent of floating mats of hydrilla would displace waterfowl and wading birds currently using those mats. Birds may move to other stands of native vegetation along the shoreline or other water bodies in the vicinity where habitat is available. Localized increases in competition for habitat may occur. Over time, wildlife populations would fluctuate as populations of native and invasive vegetation fluctuate in response to adaptive management actions and other factors, including lake elevation and climate. The herbicide applications target hydrilla and potentially temporarily promote native plant species. Controlling hydrilla densities would lead to decreased AVM occurrences.

4.3.4 Proposed Action - Integrated Approach Alternative

With implementation of the proposed action (stocking CSTGC and limited herbicide application), impacts to wildlife would be beneficial. Hydrilla presence would be reduced and AVM-linked diseases and mortalities to wildlife would be reduced. Indirect negative impacts may occur to waterfowl and other wildlife that use hydrilla mats for foraging and habitat. However, the overall impacts would be beneficial to species affected by AVM by reducing the SAV substrate used by the toxic epiphytic cyanobacteria.

4.4 Threatened, Endangered, and Other Protected Species

4.4.1 No Action Alternative

Without implementation of the proposed action, AVM mortalities and associated negative impacts to a protected species (specifically bald eagles) would continue. The USFWS stated in a 2 December 2014 letter that:

“Agency inaction can be as detrimental as direct action when continued loss of protected species occurs. Continuing to allow the hydrilla to grow uncontrolled, further leading to more eagle and migratory bird mortalities, is no longer sustainable. We encourage expedition of the collaboration that the ACOE has begun towards establishing a hydrilla control and/or eradication effort. The eagle mortality at JSTL is no longer sustainable to the regional population”.

The No Action alternative is not likely to adversely affect listed species or their critical habitat.

4.4.2 Biological Control Alternative

With implementation of this alternative (stocking CSTGC), AVM occurrences would be reduced in bald eagles (a protected species) feeding around JST. There is the possibility that grass carp may have a negative impact on the shoals spider-lily (state threatened species) if they migrate up Broad River to Anthony Shoals or downriver to the Augusta Shoals during periods of high flow when the plants are inundated. Migration is unlikely due to the lack of SAVs in the Broad River portion of the reservoir to attract the grass carp. This alternative is not likely to adversely affect listed species or their critical habitat.

4.4.3 Chemical Control Alternative

Implementation of this alternative (herbicide application across all areas of hydrilla infestation), would reduce AVM-related mortalities in bald eagles (a protected species). The shoals spider-lily only grows in the rapids of Anthony Shoals on the Broad River portion of the Project. Herbicide applications are impractical in this area due to river flow, inaccessibility, and rapids. This alternative is not likely to adversely affect the listed species, or their designated critical habitats. Minimization actions to reduce the likelihood of affecting the shoals spider-lily would be marking locations where the shoals spider-lily is present and avoiding herbicide application to those areas.

4.4.4 Proposed Action - Integrated Approach Alternative

Implementation of the proposed action (stocking CSTGC and limited herbicide application), should reduce AVM-related mortalities in bald eagles (a protected species). Impacts would be a combination of the Biological Control Alternative and Chemical

Control Alternative as described above. This alternative is not likely to adversely affect listed species, or their designated critical habitats.

The USFWS stated in a 2 December 2014 letter that:

“As the federal agency most responsible for the continued recovery and well-being of bald eagle populations, the Service strongly supports the ACOE's decision to seek funding to complete a management plan for JSTL and begin eradicating the hydrilla as soon as possible. We recommend that a management plan to eradicate the hydrilla be in place before the 2015/2016 nesting season and that eradication of the hydrilla begin soon after. We believe removal of this SAV is essential for bald eagle populations to begin nesting again around JSTL”.

Implementation of this alternative would demonstrate that Savannah District is a good steward of the diverse natural resources that we are entrusted with including fish, waterfowl, and protected species such as bald eagles.

4.5 Cultural And Archaeological Resources

4.5.1 No Action Alternative

Without implementation of the proposed action, no changes to cultural or archaeological resources are expected.

4.5.2 Biological Control Alternative

With implementation of this alternative (stocking CSTGC), no impacts to cultural or archaeological resources are expected.

4.5.3 Chemical Control Alternative

With implementation of this alternative (herbicide application across all areas of hydrilla infestation), no impacts to cultural or archaeological resources are expected.

4.5.4 Proposed Action - Integrated Approach Alternative

With implementation of the proposed action (stocking CSTGC and limited herbicide application), no impacts to cultural or archaeological resources are expected. Section 106 concurrence has been requested from the Georgia and South Carolina State Historic Preservation Offices.

4.6 Recreation Resources

4.6.1 No Action Alternative

Without implementation of the proposed action, impacts to additional boat ramps, docks, and manmade beaches around JST would occur as hydrilla continues to expand within the lake. Existing and new areas will sometimes continue to experience hydrilla coverage, making swimming and boating activities less desirable. Actions to reduce the impact of nuisance aquatic vegetation around major public recreation areas would still be undertaken in accordance with the APMP. Land-based recreation is not presently impacted by hydrilla in the lake.

4.6.2 Biological Control Alternative

With implementation of this alternative (stocking CSTGC), recreational resources would be improved. Reducing hydrilla infestations would benefit visitors by reducing and preventing interference with boating, swimming, paddling, fishing, water skiing, and other water sports. Anglers that prefer fishing dense mats of hydrilla would be negatively impacted by a reduction in the occurrence of these mats. Angler's effort and success rates would continue to fluctuate as populations of game fish fluctuate in response to management of invasive vegetation, climate, lake levels, and disease. Duck hunting could be similarly impacted. Hydrilla draws in coots, and other waterfowl which, in turn, attracts waterfowl hunters to these areas. The future success of waterfowl hunters and fishermen will be greatly diminished if hydrilla is eliminated rather than just reduced.

4.6.3 Chemical Control Alternative

With implementation of this alternative (herbicide application across all areas of hydrilla infestation), applications of herbicides as directed on the product label including adherence to restrictions on use relative to human activity and water use, would avoid impacts to public health and safety of recreation users. Anglers that prefer fishing dense mats of hydrilla would be negatively impacted by a reduction in the occurrence of these mats. Angler's effort and success rates would continue to fluctuate as populations of game fish fluctuate in response to management of invasive vegetation, climate, lake levels, and disease. Duck hunting could be similarly impacted. The AVMP would identify the potential location of herbicide treatments for each year. The location of swimming beaches and other recreation facilities would be taken into account in planning herbicide applications.

4.6.4 Proposed Action - Integrated Approach Alternative

With implementation of the proposed action (stocking CSTGC and limited herbicide application), recreational benefits would increase in all areas except possibly the largemouth bass fishery. That resource may be temporarily negatively impacted due to

loss of their preferred habitat, submerged aquatic vegetation. Duck hunting could be similarly impacted.

4.7 Aesthetics

4.7.1 No Action Alternative

Without implementation of the proposed action, no changes to aesthetics are anticipated. Hydrilla mats would still occur along shorelines from late summer through early winter.

4.7.2 Biological Control Alternative

With implementation of this alternative (stocking CSTGC), aesthetic resources would be improved over a 3 to 4 year period by reducing the occurrence of hydrilla mats floating near recreation facilities and viewable from the shoreline.

4.7.3 Chemical Control Alternative

With implementation of this alternative (herbicide application across all areas of hydrilla infestation), aesthetic resources would be improved by reducing the occurrence of hydrilla mats floating near recreation facilities and viewable from the shoreline.

4.7.4 Proposed Action - Integrated Approach Alternative

With implementation of the proposed action (stocking CSTGC and limited herbicide application), aesthetic resources would be improved by reducing the occurrence of hydrilla mats floating near recreation facilities and viewable from the shoreline. The greatest positive effects will be in areas where grass carp are stocked and/or herbicides are applied.

4.8 Socio-Economic Resources

4.8.1 No Action Alternative

Without implementation of the proposed action, adjoining property owners will sometimes continue to experience hydrilla coverage, making swimming and boating activities less desirable. Actions to reduce the impact of nuisance aquatic vegetation around private boat docks would still be undertaken in accordance with the APMP. Socio-economic resources would be negatively impacted by the cost to private shoreline residents who contract for herbicide applications. Current costs for treatment around swim beaches and boat ramps are around \$175 per acre; acreage treated varies depending on available funding. Additional costs include a couple of man-days to evaluate areas for treatment. The bald eagle is an icon for the United States and the disappearance from the skies around JST would negatively affect bird watching. Hydrilla has not impacted hydropower.

4.8.2 Biological Control Alternative

With implementation of this alternative (stocking CSTGC), socio-economic resources would be impacted. Unless additional appropriations are received from Congress, the funding necessary to implement this alternative must come from existing appropriations. As a result, funding for recreation area maintenance and natural resources management activities will be further reduced. This will be a tradeoff between existing employees working for the O&M contractor who will be negatively impacted by reduced working hours or job losses, and the companies engaged in raising and transporting grass carp. These companies will be positively impacted by the increase in business.

4.8.3 Chemical Control Alternative

With implementation of this alternative (herbicide application across all areas of hydrilla infestation), socio-economic resources would be impacted. Unless additional appropriations are received from Congress, the funding necessary to implement this alternative must come from existing appropriations. As a result funding for recreation area maintenance and natural resources management activities will be further reduced. Employees working for the O&M contractor will be negatively impacted with by reduced working hours or job losses. Companies engaged in aquatic herbicide application will be positively impacted by the increase in business.

4.8.4 Proposed Action - Integrated Approach Alternative

With implementation of the proposed action (stocking CSTGC and limited herbicide application), socio-economic resources would be impacted. Unless additional appropriations are received from Congress, the funding necessary to implement this alternative must come from existing appropriations. As a result, funding for recreation area maintenance and natural resources management activities will be further reduced. Employees working for the O&M contractor will be negatively impacted with by reduced working hours or job losses. Companies engaged in raising and transporting grass carp or applying aquatic herbicides will be positively impacted by the increase in business.

4.9 Environmental Justice And Protection Of Children

4.9.1 No Action Alternative

Without implementation of the proposed action, environmental justice would not be impacted. No environmental justice communities exist in the project area. Secondary impacts to human health and safety, including children could occur if sick or dying wildlife are encountered, resulting in traumatic experiences.

4.9.2 Biological Control Alternative

With implementation of this alternative (stocking CSTGC), no negative impacts to environmental justice or children's health and safety would occur.

4.9.3 Chemical Control Alternative

With implementation of this alternative (herbicide application across all areas of hydrilla infestation), would not have an environmental justice impact. There is some concerns for adverse impacts to human health (children) and safety could occur from application of the herbicide. To address those concerns and minimize those risks, herbicides would be applied at the surface primary and at concentrations within EPA-acceptable guidelines for each specific chemical.

4.9.4 Proposed Action - Integrated Approach Alternative

With implementation of the proposed action (stocking CSTGC and limited herbicide application), no impacts to environmental justice would occur. Some concerns for adverse impacts to human health (children) and safety could occur from application of the herbicide. To address those concerns and minimize those risks, herbicides would be applied at the surface (rather than by airplane or helicopter) and at concentrations within EPA-acceptable guidelines for each specific chemical. If aerial spraying is used spotters in boats will be used to assist with management of the public.

4.10 Air Quality

4.10.1 No Action Alternative

Without implementation of the proposed action, no impacts to air quality are anticipated.

4.10.2 Biological Control Alternative

With implementation of this alternative (stocking CSTGC), no impacts to air quality are anticipated.

4.10.3 Chemical Control Alternative

With implementation of this alternative (herbicide application across all areas of hydrilla infestation), temporary minor impacts to air quality would occur due to increased emissions from boat motors and sprayers.

4.10.4 Proposed Action - Integrated Approach Alternative

With implementation of the proposed action (stocking CSTGC and limited herbicide application), minor temporary increases in emissions may occur from boat motors and

sprayers during targeted herbicide applications but these impacts are expected to be insignificant.

4.11 Hydrology, Water Quality And Water Supply

4.11.1 No Action Alternative

Without implementation of the proposed action, no significant changes to hydrology, water quality, water supply are anticipated. Negative effects to drinking water, decreased dissolved oxygen, and increased pH have been attributed to hydrilla in cases of very dense hydrilla infestations has impacted a whole lake, this is not expected at JST. Decreased water quality could occur if hydrilla and its' associated toxic cyanobacteria are left untreated in individual coves. Decreased water quality would have negative indirect impacts on fisheries, recreation, and wildlife in those coves.

4.11.2 Biological Control Alternative

With implementation of this alternative (stocking CSTGC), water quality and hydrology would likely improve. By removing hydrilla, the negative effects to water quality identified in the previous paragraph would diminish. With implementation of this alternative, minor benefits to water supply are anticipated.

4.11.3 Chemical Control Alternative

With implementation of this alternative (herbicide application across all areas of hydrilla infestation), hydrology would improve from removal of dense vegetative mats. Water supply may be temporarily negatively impacted by the application of herbicides across areas of JST with hydrilla infestations. Impacts to water quality would be avoided by using registered herbicides as directed on the product label and in compliance with state requirements. Certain herbicides would not be applied within required setback distances from potable water intakes. Depending on the type of herbicide application, drinking water withdrawals may be temporarily suspended at specific sites as specified on the product label.

4.11.4 Proposed Action - Integrated Approach Alternative

With implementation of the proposed action (stocking CSTGC and limited herbicide application), water quality, and hydrology would be improved. Water supply may be temporarily negatively impacted by the application of herbicides across areas of JST with hydrilla infestations. By using an integrated approach to reduce hydrilla and AVM, limited herbicide usage would be required. To minimize impacts to water supply, careful application of aquatic rated herbicides would follow the approved label instructions. Herbicides would not be applied within required setback distances from potable water intakes. Depending on the type of herbicide application, drinking water withdrawals may be temporarily suspended at specific sites.

4.12 Hazardous, Toxic, And Radioactive Waste

Under Engineer Regulation (ER) 1165-2-132, USACE assumes responsibility for the reasonable identification and evaluation of all Hazardous, Toxic, and Radioactive Waste (HTRW) contamination within the vicinity of proposed actions. That policy avoids the use of project funds for HTRW removal and remediation activities.

In accordance with ER 1165-2-132, Section 13b, USACE conducts ERGO (Environmental Review Guide for Operations) inspections every five years, using an external team. In addition, Savannah District performs an internal ERGO review annually. Those inspections include developed areas around the lake that are operated by the Corps of Engineers, as well as outgrant areas for commercial concession (marinas) and state parks. USACE tracks the results, findings, corrective actions of these inspections in the Operations and Maintenance Business Information Link (OMBIL) to better track any needed corrective actions.

HTRW sites on JST Project property have also been identified outside of the ERGO process. A DDT-contaminated site (a former airstrip operated by USACE) was identified in the mid-1990s and was added to the State of Georgia's Hazardous Site Index. Remediation efforts in 2010 removed the majority of the DDT-contaminated soil. A small amount identified during confirmatory sampling has not yet been removed due to funding constraints. An additional HTRW site was identified upon expiration of a marina lease in December 2011. This site included 5 abandoned underground storage tanks. During removal of the USTs in 2014, fuel-contaminated soil and groundwater was identified. The Thurmond Project is currently in the process of completing a corrective action plan, Part A and B (CAP-A and CAP-B) with the State of Georgia for removal of contaminated soil and long-term treatment and monitoring of the site.

USACE prepares an Environmental Condition of Property (ECP) report (in place of a Phase 1 Site Assessment in accordance with ASTM standards) on lands that the Corps leases to other agencies, non-profit organizations, and private entities.

The probability of encountering HTRW for the proposed action is low, based upon the above information. If a new environmental condition is identified in relation to the project site, CESAS would take the necessary measures to avoid that recognized environmental condition so that the probability of encountering or disturbing HTRW would continue to be low.

4.13 Cumulative Impacts

The Council on Environmental Quality (CEQ) regulations that implement NEPA (40 CFR 1508.7) require assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions.”

Past, present, and reasonably foreseeable future actions have and continue to contribute to the cumulative impacts of activities in and around JST. Past actions include the construction and operation of the reservoir, recreation sites surrounding the reservoir, as well as residential, commercial, and industrial facilities throughout the region. The JST Shoreline Management Plan and Operational Plan have also impacted natural resources. Both of these Plans are currently being updated and may be found on the following website:

<http://www.sas.usace.army.mil/About/DivisionsandOffices/OperationsDivision/JStromThurmondDamandLake.aspx>

All of these developments have had varying levels of impacts on the physical and natural resources in the region. Implementing these management plans help to ensure a balance between public uses and stewardship of the natural environment.

The Counties surrounding JST all have active economic development plans. The Clarks Hill Partnership of Georgia was formed from the counties of Columbia, Lincoln, McDuffie, Warren, and Wilkes to create a favorable environment for the retention of existing businesses and the location of new and expanded industry, trade, commerce, and residential development. This will lead to population growth and a reinvigorated local economy.

Columbia County, GA is part of a five-county region of South Carolina and Georgia that is predicted will need to fill more than 30,000 job openings over the next five years. A draft of Columbia County Vision for the next 20 years can be found at <http://www.columbiacountyga.gov/government-/county-divisions/planning-services-division/planning/vision-2035>

In 2014 McCormick County has launched the development of an Economic Development Strategic Plan to guide the county over the next five years which can be found on their website <http://www.mccormickcountysc.org/>.

The Upper Savannah Council of Governments was the first multi-county planning and development organization created in South Carolina and it is now a part of South Carolina's 10 sub-state regional Council of Governments system (www.sccogs.org). The Upper Savannah region includes six counties: Abbeville, Edgefield, Greenwood, Laurens, McCormick, and Saluda. Working closely with local government, economic development organizations, business, and citizens, Upper Savannah's Economic Development Division supports the development and implementation of projects that create permanent jobs and stimulate private sector investment.

The most recent development around Thurmond Lake has been the growth in resort communities and other real estate. In 2003, the Savannah Bay community was the first to release property and sold all of their 58 luxury home sites. Stillwater Coves - with 954 acres on the lake near Danburg, GA - sold all 340 home sites in November 2005. There are currently 5 or 6 more resort communities planned for development in the near future on the Georgia side of Thurmond Lake.

There are 82 subdivisions around Thurmond Lake, nine (9) of which are in Savannah Lakes Village. There are also 41 private club sites around the lake. These developments impact the economy of the surrounding counties. The newest developments begun since 2001 are Dogwood Ridge, Eagle Pointe, Longleaf Pointe, North Pointe Shores, Providence Ferry, Savannah Bay, Serenity Pointe, South Pointe Shores, Stillwater Coves. All of these subdivisions are in Lincoln County, GA. Only a few homes have been constructed in these new subdivisions.

These past developments and potential developments as well as the planned economic growth of the region will increase the pressure on the water supply and hydroelectric power being provided by the JST project. In addition, they will likely increase recreational use in the JST project area.

Impacts from implementing the proposed action that USACE identified during preparation of this EA are minor in magnitude and duration and should not have significant adverse cumulative effects on JST or any of its tributaries or the Upper Savannah River Basin. Implementation of the preferred alternative (incremental stocking of sterile triploid carp with limited herbicide applications), will complement current management actions to control invasive aquatic vegetation in the Savannah River Basin and at JST. Control of aquatic invasive vegetation and its associated toxic cyanobacterium would avoid and minimize potential adverse economic impacts to the federal government, state and local governments, and the local economy; and reduce AVM-related mortalities that would occur if no action were taken.

5.0 COORDINATION

The EA and draft Finding of No Significant Impact (FONSI) were coordinated with appropriate Congressional, Federal, state, and local interests, as well as environmental groups and other interested parties.

The EA was circulated for a 30-day review and comment period to the following concerned agencies and individuals.

Federal Agencies

- Advisory Council on Historic Preservation
- Federal Highway Administration
- National Center for Environmental Health
- National Marine Fisheries Service - Southeast Regional Office
- U.S. Department of Agriculture (USDA)
- U.S.D.A., Natural Resources Conservation Service
- U.S. Department of Energy
- U.S. Department of the Interior - Office of Environmental Policy & Compliance
- U.S. Department of Housing & Urban Development
- U.S. Environmental Protection Agency (EPA)
- U.S. Fish and Wildlife Service
- U.S. Forest Service - Southern Region

State Agencies

South Carolina

- SC State Historic Preservation Office
- SC Department of Health and Environmental Control
- SC Department of Parks, Recreation and Tourism
- SC Department of Natural Resources

Georgia

- GA State Historic Preservation Office
- GA Department of Natural Resources, Environmental Protection Division
- GA Department of Natural Resources - State Parks and Historic Sites
- GA Department of Natural Resources - Wildlife Resources Division

Local Agencies

South Carolina Counties: Abbeville, Edgefield, Greenwood, McCormick, Columbia
Georgia Counties: Elbert, Lincoln, McDuffie, Richmond, Taliaferro, Warren, Wilkes

Elected Officials

- All South Carolina & Georgia U.S. Senators and Local District Congressmen
- All Local State Senators and Representatives

Conservation Groups

- National Wildlife Federation
- The National Audubon Society
- The Nature Conservancy
- The Wilderness Society
- Trust for Public Land
- Savannah River Keeper

Please see the Appendix D for comments that were received and responses to those comments.

6.0 MITIGATION

The appropriate application of mitigation is to formulate an alternative that first avoids adverse impacts, then minimizes adverse impacts, and lastly, compensates for unavoidable impacts. In accordance with the National Triploid Grass Carp Inspection and certification Program and both State of Georgia and South Carolina's statutes, only certified sterile triploid grass carp will be used. The 50% reduction rate was chosen to reduce the amount of hydrilla while minimizing impacts to native plants, and significantly impacting fisheries in the lake. Impacts to palustrine wetlands and the state-listed shoals spider-lily will be avoided by controlling the treatment boundaries adjacent to existing wetlands to eliminate over-spraying. Impacts to water quality, water supply, and human safety from herbicide treatments would be avoided by using registered herbicides as directed on the product label and in compliance with state requirements. Herbicides would not be applied within required setback distances from potable water

intakes, and avoid areas where humans are congregating. After these avoidance and protective measures are included in the proposed action, the adverse impacts to natural resources and the human environment are expected to be minimal. No further (compensatory) mitigation is warranted. The proposed action is expected to benefit wildlife species that are presently subjected to AVM-related illness and death.

7.0 COMPLIANCE WITH ENVIRONMENTAL LAWS AND REGULATIONS

Table 6: Compliance of the Proposed Action with Executive Orders		
Executive Orders	Number	Compliance Status
Invasive Species	13112	In Compliance
Equal Opportunity	11246	In Compliance
Protection and Enhancement of Environmental Quality	11514/11991	In Compliance
Protection and Enhancement of the Cultural Environment	11593	In Compliance
Convict Labor	11755	In Compliance
Floodplain Management	11988	In Compliance
Protection of Wetlands	11990	In Compliance
Federal Compliance with Pollution Control Standards	12088	In Compliance
Environmental Effects Abroad of Major Federal Actions	12114	In Compliance
Federal Compliance with Right-To-Know Laws and Pollution Prevention	12856	In Compliance
Federal Actions to Address Environmental Justice and Minority and Low-Income Populations	12898	In Compliance
Implementation of the North American Free Trade Agreement	12889	In Compliance
Energy Efficiency and Water Conservation at Federal Facilities	12902	In Compliance
Federal Acquisition and Community Right-To-Know	12969	In Compliance

Table 6: Compliance of the Proposed Action with Executive Orders		
Executive Orders	Number	Compliance Status
Protection Of Children from Environmental Health Risks and Safety Risks	13045	In Compliance
Environmental Justice	12898	In Compliance
National Invasive Species Council	13112	In Compliance

The project is outside the coastal zone and will not have direct or indirect impact to the coastal zone. Therefore, this document constitutes a Negative determination under the Coastal Zone Management Act.

USACE would follow the terms of the States of Georgia's and South Carolina's general NPDES permit for the discharge of pesticides into public waters. A Section 401 Water Quality Certifications from the States of Georgia and South Carolina are not needed for the proposed action.

No dredging or sediment disposal activities are included in the proposed plan. Therefore, a Section 404(b)(1) evaluation under the Clean Water Act is not required.

Environmental compliance for the proposed action was achieved partially based upon:

- Coordination of this EA and draft Finding of No Significant Impact (FONSI) with appropriate agencies, organizations, and individuals for their review and comments.
- U.S. Fish and Wildlife Service (USFWS) letter dated May 27, 2016 confirming that the proposed action would not likely adversely affect any endangered or threatened species or their critical habitat.
- Concurrence by the Georgia and South Carolina State Historic Preservation Officers in the USACE's determination of No Effect on cultural resources was not required for this action. In accordance with the Historic Properties Management Plan and Programmatic Agreement, pesticide treatments are categorically excluded from SHPO review.
- An E-mail date June 17, 2016 from the Easter Shawnee Tribe THPO, stating that since this work will not include ground disturbance, the ESTO has no objections to this action.
- Coordination of this EA with the USFWS (May 27, 2016), and other Federal and state natural resource agencies under the Coordination Act. These letters can be found in Appendix E.
- Coordination of this EA with EPA (May 26, 2016), South Carolina (May 31, 2016), and Georgia (May 31, 2016) under the Clean Air Act.

8.0 CONCLUSION

The proposed action consists of incrementally stocking CSTGC with spot treatment of herbicides to reduce hydrilla abundance in JST by 50% to eliminate or reduce AVM related mortalities, specifically bald eagle mortalities. Implementation of this plan is funding dependent. The District is developing a budget package to compete in the government funding process, however the competition for funding is severe in these times of constrained budgets with many highly deserving projects. Savannah District has assessed the environmental impacts of the proposed action and concludes that the proposed action would have no adverse or beneficial impact upon cultural resources, the only natural resource that may be negatively impacted by the proposed action is the largemouth bass fishery. Beneficial impacts to bald eagles (a Federally-protected species) and water quality in some coves are expected from the proposed action. There are no cumulative adverse impacts associated with the proposed action.

9.0 PREPARERS

This EA and the associated FONSI were prepared by Nathan Dayan and Ellie Covington - Biologist, with relevant sections prepared by: Susan Boyd – HTRW; Julie Morgan - Cultural Resources; Jeff Brooks - Natural Resources. The address of the preparers is: U.S. Army Corps of Engineers, Savannah District, Planning Division, 100 West Oglethorpe Avenue, Savannah, GA 31401.

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11.0 APPENDICES