

Executive Summary

Tennessee Valley Authority
Reservoir Operations Study – Final Programmatic EIS



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ES.1 Introduction

The Tennessee Valley Authority (TVA) has conducted a comprehensive Reservoir Operations Study (ROS) to determine whether changes in how it operates the Tennessee River system would produce greater overall public value for the people of the Tennessee Valley. TVA, the U.S. Army Corps of Engineers (USACE), and the U.S. Fish and Wildlife Service (USFWS) have cooperated to prepare this Final Programmatic Environmental Impact Statement (FEIS) for the ROS. Representatives of other agencies and members of the public participated in this process by attending public meetings and providing comments on the scope of the document and the Draft Programmatic Environmental Impact Statement (DEIS). TVA also established two groups—a 17-member Interagency Team and a 13-member Public Review Group (IAT/PRG)—to ensure that agencies and members of the public were actively and continuously involved throughout the study. As the lead agency, TVA was primarily responsible for the preparation of this document.

Following public and agency review and comment on the DEIS, TVA has prepared a response to comments and a set of recommendations—the Preferred Alternative—which is included in this FEIS. After receiving comments on this FEIS, the TVA Board of Directors (Board) will decide whether TVA's reservoir operations policy will be changed and the nature of the change. In making its decision, the Board will consider the recommendations of TVA staff, this FEIS, public comments, and other factors. The Board will make a decision following the Notice of Availability of this FEIS and after consideration of public comments on the FEIS. The final decision will be documented in a Record of Decision and made available to the public. Decisions made by other federal agencies would be appropriately documented by the respective agency.

ES.2 Background

The Tennessee Valley Authority is a multi-purpose federal corporation responsible for managing a range of programs in the Tennessee River Valley (the Valley) for the use, conservation, and development of the water resources related to the Tennessee River. In carrying out this mission, TVA operates a system of dams and reservoirs with associated facilities—its water control system (Figure ES.2-01). As directed by the TVA Act, TVA uses this system to manage the water resources of the Tennessee River for the purposes of navigation, flood control, power production. Consistent with those purposes, TVA uses this system to improve water quality and water supply, and provide recreational opportunities and a wide range of other public benefits.

Public participation in the ROS EIS began in January 2002, when TVA mailed letters describing the ROS to over 60,000 stakeholders across the Valley and TVA Power Service Area, including representatives of agencies and Indian tribes that might be affected or interested. On February 25, 2002, TVA published a notice in the Federal Register, indicating the agency's intent to prepare a programmatic EIS on its reservoir operations policy and inviting interested parties to comment on its scope.

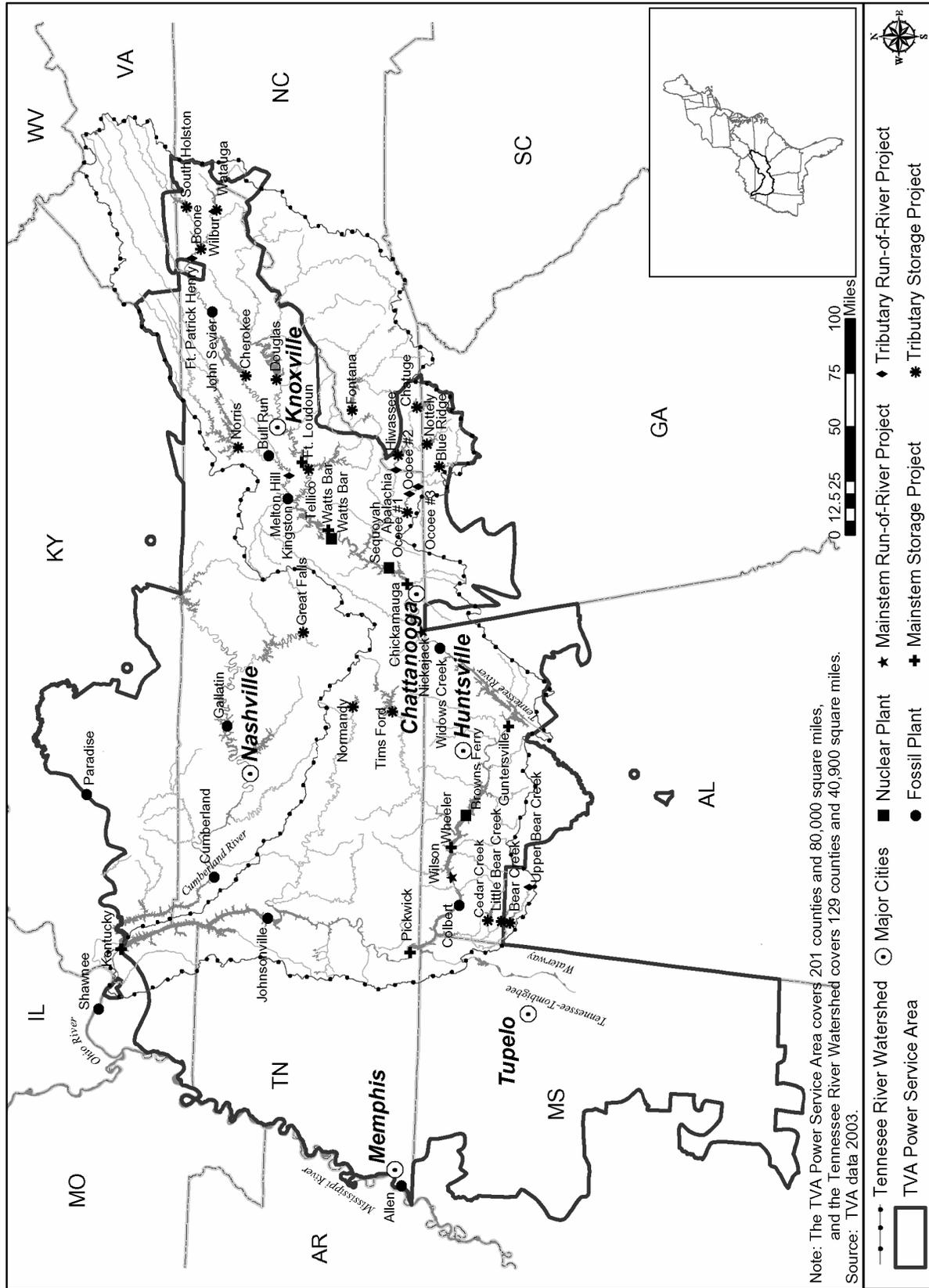


Figure ES.2-01 Tennessee River Watershed and TVA Power Service Area

During the 2-month comment period, more than 1,300 members of the public attended 21 community workshops held across the region; and several thousand wrote letters or submitted comments to TVA by mail, e-mail, fax, or telephone. When the comment period closed on April 26, 2002, TVA had received more than 6,000 individual comments, copies of form letters from approximately 4,200 individuals, and petitions signed by over 5,400 individuals. In addition, 3,600 residents in the TVA Power Service Area responded to a random telephone survey conducted by an independent research firm. The telephone survey was designed to sample a representative cross section of the populace served by TVA. TVA posted a copy of the DEIS on its web site and distributed approximately 1,500 copies to affected tribal governments, agencies, organizations, and individuals in July 2003. The Notice of Availability of the DEIS was published in the Federal Register on July 3, 2003. The comment period closed on September 4, 2003, but TVA continued to accept comments through mid-October from tribes and persons informing the agency that their comments would be late.

Including form letters and petitions, TVA received a total of 2,320 sets of comments on the DEIS. These sets of comments included input from almost 7,000 individuals, 7 federal agencies, 14 state agencies, 1 tribal government, and other groups and organizations. TVA has carefully reviewed and responded to all of the substantive comments on the DEIS, and used this input to improve the content of the FEIS.

ES.3 Purpose and Need

The purpose of the ROS is to enable TVA to review and evaluate its reservoir operations policy to determine whether changes in the policy would produce greater public value. TVA's reservoir operations policy guides the day-to-day operation of the Tennessee River system. It affects how much reservoir levels rise and fall, when changes in reservoir levels occur, and the amount of water flowing through the reservoir system at different times of the year. The policy sets the balance of trade-offs among competing uses of the water in the system.

Changing TVA's reservoir operations policy would modify the present balance among the various operating objectives for the system. These modifications would involve changing the existing reservoir system operating guidelines. In addition, because TVA receives no appropriations (money) from Congress, changes to its operations policy that require additional capital or operating expenditures would need to be funded by TVA or others.

TVA has periodically changed and adjusted its reservoir operations policy to achieve greater overall value for the public. Past policy changes reflected factors such as the public's changing needs and concerns, requests from citizens and regional groups, environmental quality issues, changes in the power industry, and TVA's own mission and planning needs. The reservoir operations policy also reflects a growing experience and understanding of the challenges and limitations imposed by annual variations in rainfall and runoff, especially during droughts and floods.

The last major evaluation of the environmental and socioeconomic impacts of TVA's reservoir operations policy was included in the Tennessee River and Reservoir System Operation and

Executive Summary

Planning Review EIS, also known as the Lake Improvement Plan, which was completed in 1990. In 1991, the Board approved changes that included extending reservoir levels on 10 tributary reservoirs to August 1 in order to increase recreational opportunities. TVA also increased minimum flow requirements for many of its mainstem and tributary projects, and began a program to increase dissolved oxygen (DO) concentrations in the releases from 16 TVA dams. Following that evaluation, TVA continued to receive requests for changes to reservoir levels and other operations. As more and more users requested studies for their particular reservoir or tailwater, TVA decided that a piecemeal approach raised questions of fairness in how each reservoir would be treated. A comprehensive review was needed to examine the effects of changes in the reservoir operations policy on all of the operating objectives for the system across the entire TVA region.

ES.4 Scope of the ROS

TVA owns or operates 49 dams and reservoirs (called projects) in the Tennessee River and Cumberland River watersheds. The scope of the ROS EIS included evaluating the operations of 35 of these projects—projects for which TVA schedules water releases and reservoir levels in accordance with its reservoir operations policy. The remaining 14 projects not included in the ROS are one pumped storage project and several small water retention dams that are essentially self-regulating. These projects have little impact on the operation of TVA's water control system. In addition, physical removal of or major structural modifications to TVA dams and power plants was not included in the scope of the EIS.

The geographic area potentially affected by changes in the reservoir operations policy includes the Tennessee River watershed and the larger TVA Power Service Area. This area covers almost all of Tennessee and parts of Alabama, Kentucky, Georgia, Mississippi, North Carolina, and Virginia. The Tennessee River watershed includes 129 counties and encompasses 40,900 square miles; TVA's Power Service Area comprises 201 counties and covers approximately 80,000 square miles. Analyses of some resource areas (e.g., Navigation and Air Quality) included parts of the Ohio and Mississippi River systems and other areas outside the Valley and TVA Power Service Area to ensure a comprehensive analysis.

As is typical of water resource planning and management studies of this type, the ROS and this EIS used a long-range planning horizon (to the year 2030).

ES.5 Issues Considered

The scoping process for the EIS identified a broad range of issues and values to be addressed and alternatives to be evaluated in the ROS. Overall, the public placed a high value on recreation, a healthy environment, production of electricity, flood control, and water supply. After all public feedback was evaluated, TVA identified 11 major issues for evaluation in the EIS (Table ES-01). Other issues typically addressed in EISs were also incorporated into the analysis of each policy alternative.

Table ES-01 Public Feedback Provided during the Scoping Process

Major Issues	Concerns Expressed by the Public
Reservoir and downstream water quality	Dissolved oxygen concentrations, temperature, ammonia levels, wetted area (the area of river bottom covered by water), velocity, algae, and waste assimilation capacity
Environmental resources	Aquatic resources, shoreline erosion and sedimentation, visual resources, cultural resources, federal- and state-listed species, wetlands, vegetation, wildlife, and ecologically significant areas
Reservoir pool levels	Reservoir pool elevations and the annual timing of fill and drawdown, and their effects on reservoir recreation, property values, and aesthetics
Recreation flows	TVA's ability to schedule releases for tailwater recreation, including fishing, rafting, canoeing, and kayaking
Economic development	Recreation, property values, navigation, power supply, and water supply
Water supply	Reservoir and downstream intakes and potential inter-basin transfers
Navigation	Impacts on channel depth, speed of currents, and water levels
Flood risk on regulated waterways	Available reservoir space for storing floodwaters, how fast space can be recovered after a flood, and costs related to property damage and jobs lost or disrupted
Power reliability	Availability of cooling water at coal-fired and nuclear plants, fuel delivery by barges for coal-fired plants, and restrictions on hydropower production during critical power demands
Cost of power	Hydropower production, including total megawatt hours, seasonal availability, and value during high-cost periods
Capital costs	Changes to reservoir operations, including modifications and upgrades to—as well as additions to and removal of, various structures and equipment

ES.6 Objectives

To develop, screen, and select a range of policy alternatives for detailed evaluation, TVA established a set of objectives incorporating the issues that were identified by the public and interested parties during the scoping phase. TVA also considered other objectives, such as reducing the cost of treating water for municipal and assimilation-capacity uses, maintaining existing dam safety margins, and improving air quality.

ES.7 Alternatives Considered

The National Environmental Policy Act (NEPA) requires that TVA evaluate a reasonable range of alternatives and the alternative of taking no action. For the purposes of the ROS EIS, a policy alternative refers to a set of system-wide operational changes that would re-balance the TVA reservoir system to emphasize certain operating objectives, such as increased opportunities for recreation, hydropower production, or navigation. To be considered reasonable, an alternative was required to be capable of adjusting the balance of operating objectives in response to expressed public values; continuing basic reservoir system benefits of flood control, navigation, and power production; and being environmentally, economically, and technically feasible.

Eight reservoir operations policy alternatives (seven policy alternatives and the Base Case) were selected for detailed evaluation in the DEIS. The Preferred Alternative was created after extensive public review of the DEIS and additional analyses. The goal was to enhance public value while minimizing impacts on the environment and other operating objectives. The Preferred Alternative combines and adjusts elements of the alternatives identified in the DEIS to preserve desirable characteristics and to avoid or reduce adverse impacts associated with those alternatives in order to create a more feasible, publicly responsive alternative. The following sections summarize the reservoir operations of each policy alternative. The alternative names reflect their primary emphasis, but each alternative was designed to achieve multiple objectives.

ES.7.1 Base Case

As required by NEPA, the Base Case (the No-Action Alternative) documents the existing reservoir operations policy against which the policy alternatives were compared. Under the Base Case, TVA would continue to fill tributary reservoirs to summer pool levels by June 1, restrict drawdown during June and July, and begin unrestricted drawdown on August 1. Fill and drawdown dates, and target elevations for mainstem reservoirs would not change. TVA would

OBJECTIVES IDENTIFIED DURING SCOPING FOR THE ROS EIS

- Supplying low-cost, reliable electricity
- Increasing revenue from recreation
- Reducing flood risk and flood-related damages
- Lowering the cost of transporting materials on the commercial waterway
- Providing enough water for municipal, agricultural, and industrial purposes
- Improving recreation on reservoirs and tailwaters
- Improving water quality in reservoirs and tailwaters
- Improving aquatic habitat in reservoirs and tailwaters
- Minimizing erosion of reservoir shoreline and tailwater riverbanks
- Increasing protection for threatened and endangered species
- Protecting and improving wetlands and other ecologically sensitive areas
- Protecting and improving the scenic beauty of the reservoirs

maintain the 2-foot normal winter operating range on mainstem reservoirs. Established minimum flows, including 13,000 cubic feet per second (cfs) bi-weekly average minimum flows at Chickamauga Reservoir from June to August, would continue. TVA would also continue recreation releases below Watauga/Wilbur, Apalachia, Tims Ford, Ocoee #2, and Ocoee #3 Reservoirs.

The Base Case also involves a number of other actions that would occur regardless of changes in the reservoir operations policy. These actions include existing water use patterns, taking into account increasing water supply demand in the future (through 2030); modernization and automation of TVA's hydro plants; operation of Browns Ferry Unit 1 and continued operation and uprate of Units 2 and 3; and operation of the Tennessee-Tombigbee Waterway at full capacity.

ES.7.2 Reservoir Recreation Alternative A

Reservoir Recreation Alternative A would extend the summer pool period and delay unrestricted drawdown on 10 tributary reservoirs (Blue Ridge, Chatuge, Cherokee, Douglas, Fontana, Hiwassee, Nottely, Norris, South Holston, and Watauga) until Labor Day (a month longer than under the Base Case). For Great Falls, the summer fill period would be completed by Memorial Day. On six mainstem reservoirs (Chickamauga, Guntersville, Kentucky/Barkley, Pickwick, Watts Bar, and Wheeler), the summer pool period would be extended to August 1 and then reduced by 1 foot from August 1 through Labor Day.

Process for Development of Alternatives

- Conducted public outreach to identify public's preferred reservoir operation priorities
- Compiled comments received during public scoping about suggested changes to the reservoir operations policy
- Identified major and minor issues
- Compiled operating options suggested by the public
- Developed, screened, and evaluated 65 preliminary policy alternatives
- Eliminated from further consideration those alternatives that did not meet operating objectives or were not practicable
- Formulated condensed set of 25 preliminary alternatives
- Obtained Interagency Team and Public Review Group review and comment on the condensed set of 25 preliminary alternatives
- Revised condensed set of 25 preliminary alternatives and developed a refined set of 25 alternatives
- Modeled the refined set of 25 alternatives to confirm technical and economic feasibility
- Screened and narrowed the number of alternatives to be considered by combining similar alternatives and bounding the range of possibilities
- Selected eight alternatives for further consideration (the Base Case and seven policy alternatives)
- Reexamined the eight alternatives to determine whether any additional operating objectives or policy elements should be included
- Analyzed and discussed the eight alternatives in the DEIS
- Compiled and reviewed comments on the DEIS
- Conducted additional analyses and developed a series of blended alternatives leading to the development of the Preferred Alternative, which is analyzed in this FEIS

Executive Summary

To maintain summer pool levels, reservoir releases during the summer pool period would be generally limited to those necessary to meet project and system minimum flow requirements¹ and to maintain flood storage allocation. However, the bi-weekly average releases from Chickamauga Reservoir would be increased and limited to 25,000 cfs weekly average from August 1 to Labor Day, providing sufficient flow throughout the reservoir system to minimize additional derating of nuclear and fossil power plants located on the reservoirs.

Under Reservoir Recreation Alternative A, the winter flood guide levels would be increased on 10 tributary reservoirs (Blue Ridge, Chatuge, Cherokee, Douglas, Hiwassee, Nottely, Norris, South Holston, Tims Ford, and Watauga) to the pool level targeted to be reached by March 15 under the Base Case. On five mainstem reservoirs (Fort Loudoun, Watts Bar, Chickamauga, Wheeler, and Pickwick), the minimum winter elevation would be raised by 2 feet, and the typical 2-foot winter fluctuating zone under the Base Case would be reduced to 1 foot for these five mainstem reservoirs under Reservoir Recreation Alternative A.

ES.7.3 Reservoir Recreation Alternative B

Reservoir Recreation Alternative B is similar to Reservoir Recreation Alternative A. Targeted summer pool levels would be extended to Labor Day on 10 tributary reservoirs (Blue Ridge, Chatuge, Cherokee, Douglas, Fontana, Hiwassee, Nottely, Norris, South Holston, and Watauga) by delaying the beginning of unrestricted drawdown to Labor Day. On six mainstem reservoirs (Chickamauga, Fort Loudoun, Guntersville, Kentucky/Barkley, Pickwick, Wheeler, and Watts Bar), the summer pool elevations would be extended to Labor Day (as compared to August 1 under Reservoir Recreation Alternative A). In contrast to Reservoir Recreation Alternative A, Reservoir Recreation Alternative B would have no allowance for mainstem drawdown between August 1 and Labor Day.

For Reservoir Recreation Alternative B, the method of flood storage allocation would be changed to provide adequate storage for the 7-day, 500-year inflow². Reservoir releases would be limited to only minimum flows from June 1 to Labor Day. Chickamauga Reservoir minimum releases would remain at 13,000 cfs (the Base Case).

¹ System minimum flows are indicators of total flow through the system to meet specific system requirements for navigation, water supply, waste assimilation, and other benefits—including the assurance that adequate cooling water is provided to reduce derates at TVA's nuclear and coal-fired plants. System minimum flows are measured at the Chickamauga, Kentucky, and Pickwick Dams, and other locations. These flows include a bi-weekly average minimum flow in summer and a daily average minimum flow in winter. If the total of the project minimum flows plus any additional runoff from the watershed is insufficient to meet these system minimum flows, additional water must be released from upstream reservoirs to make up the difference.

² The 7-day, 500-year flood storage allocation for a given reservoir is the flood storage volume required to store the maximum 7-day average local inflow for a storm with a probability of occurrence in any given year of 0.002 (commonly referred to as the 500-year flood). The storage volume required for a specific reservoir assumes no releases from upstream projects.

In most cases, winter reservoir levels on tributary reservoirs would be higher, but by an amount that would vary among reservoirs depending on storage needed for the 7-day, 500-year inflow. On mainstem reservoirs, the minimum winter elevation would be raised 2 feet where possible. The typical 2-foot winter fluctuating zone under the Base Case would be reduced to 1 foot for these mainstem reservoirs under Reservoir Recreation Alternative B.

ES.7.4 Summer Hydropower Alternative

Under the Summer Hydropower Alternative, unrestricted drawdown would begin immediately after June 1 to increase power production and flood storage volume on both tributary and mainstem reservoirs.

Under the Summer Hydropower Alternative, the method of flood storage allocation would be revised to provide adequate storage for inflow for the 7-day, 500-year storm—allowing flood guides on tributary reservoirs to be raised in some cases. Weekly average releases from Chickamauga Reservoir would be increased to 35,000 cfs (compared to 13,000 cfs bi-weekly average under the Base Case). The only scheduled tailwater releases would occur at Ocoee #2 Reservoir.

ES.7.5 Equalized Summer/Winter Flood Risk Alternative

The principal changes to system operations under the Equalized Summer/Winter Flood Risk Alternative would involve establishing year-round flood guides for tributary and mainstem reservoirs that would vary by reservoir and month, depending on the anticipated runoff. These flood guides would be based on a reservoir's capacity to store inflow from the critical-period, 500-year storm³ and would equalize the level of flood risk in all seasons. For tributary projects, a year-round flood guide would generally result in higher winter reservoir levels and lower summer reservoir levels, compared to the Base Case. For mainstem projects, the guide curves were modified to begin fill on April 1 and reach summer pool elevation by the end of May. A year-round flood guide would generally result in increased winter reservoir levels and reduced summer reservoir levels, in comparison to the Base Case.

Reservoir releases from June 1 to Labor Day would be limited to only those necessary to maintain minimum flows. Releases from Chickamauga Reservoir would be increased from the 13,000-cfs bi-weekly average under the Base Case to a 25,000-cfs weekly average from August 1 to Labor Day under the Equalized Summer/Winter Flood Risk Alternative.

ES.7.6 Commercial Navigation Alternative

Under the Commercial Navigation Alternative, changes to operations would primarily affect mainstem reservoirs. Raising the winter flood guides by 2 feet on mainstem reservoirs, where

³ The critical-period, 500-year storage for a given reservoir is the maximum storage volume required to store the inflow from a storm, with a probability occurrence in any given year of 0.002 (commonly referred to as the 500-year storm). The storage volume required for a specific reservoir also takes into account the reservoir's natural inflow/discharge and inflows from upstream projects.

Executive Summary

possible, would increase the navigation channel depth to 13 feet (providing an 11-foot navigation channel with a 2-foot overdraft). The mainstem winter operating range would be modified to allow only a 1-foot fluctuation on those mainstem reservoirs raised 2 feet in winter.

To further support navigation operations, minimum flows would be increased at several key projects with major navigation locks. Specific instantaneous minimum flows, would be provided at Kentucky, Pickwick, and Wilson Dams to reduce the difficulty of navigation at certain locations. At Pickwick and Wilson Dams, these flows would also be tied to pool elevation. A limitation on maximum flow (except in flood control situations) would be imposed at Barkley Reservoir, when practical, to reduce high-flow navigation hindrances.

ES.7.7 Tailwater Recreation Alternative

Under the Tailwater Recreation Alternative, tailwater recreation releases would have higher priority than maintaining water levels for reservoir recreation. This alternative would include extending the summer pool period to Labor Day; changing winter tributary flood guides to the 7-day, 500-year storm inflow; and raising winter mainstem reservoir levels by 2 feet, where possible. From June 1 to Labor Day, two types of reservoir releases would occur. Releases would be made to maintain minimum flows, and additional releases would be scheduled to increase tailwater recreational opportunities at a five projects (Apalachia, Norris, Ocoee #1, South Holston, and Watauga/Wilbur).

ES.7.8 Tailwater Habitat Alternative

Under the Tailwater Habitat Alternative, the principal change to system operations would involve releasing Base Case minimum flows or 25 percent of the inflow—whichever is greater—as a relatively continuous minimum flow with no turbine peaking. Hydroturbine pulsing would continue to be used to provide minimum flows. Minimum Operations Guides (MOGs) would be eliminated on tributary reservoirs. Tributary and mainstem reservoirs would use operating guide curves similar to the ones used under Reservoir Recreation Alternative A. Mainstem winter operating ranges would be limited to 1 foot for those projects raised 2 feet in winter.

Under this alternative, reservoir releases into tailwaters would produce flows, water depths, and velocities throughout the year that would be more similar to natural seasonal variability. Actual flows, limits, and changes would be determined by the inflow conditions. During high inflows, water would be released to keep elevations below the flood guides. During low inflows, existing project minimum flows would be met. In the intermediate inflow ranges, 25 percent of the inflow would be passed. Hydropower operations would occur when water is released from the dams.

ES.7.9 Preferred Alternative

Under the Preferred Alternative, each project would meet its own Base Case minimum flow requirements and share the responsibility for meeting increased system minimum flow requirements. After meeting those requirements, elevations on 10 tributary reservoirs (Blue Ridge, Chatuge, Cherokee, Douglas, Fontana, Nottely, Hiwassee, Norris, South Holston, and Watauga) would be maintained as close as possible to the summer flood guide from June 1

through Labor Day, resulting in restricted drawdown during this period. When rainfall and runoff are insufficient to meet system flow requirements, the needed water would be released from the upstream tributary reservoirs to augment the natural inflows, resulting in some drawdown of all of these projects. This would be expected to occur in about 90 percent of the years.

Reservoir balancing guides established for each tributary storage reservoir would be used under the Preferred Alternative to ensure that the proportional water releases for downstream system needs are drawn from the tributary reservoirs equitably. A balancing guide is a seasonal reservoir pool elevation that defines the relative drawdown at each tributary reservoir when downstream flow augmentation is required. Subject to variations in rainfall and runoff across the projects, and the necessity to ensure at least minimal hydropower capacity at each tributary project (up to a water equivalent of 17 hours of use per week at best turbine efficiency from July 1 through Labor Day), water would be drawn from each tributary reservoir so that elevation of each reservoir would be similar relative to its position between the flood guide and the balancing guide. Summer operating zones would be maintained through Labor Day at four additional mainstem projects (Chickamauga, Gunterville, Pickwick, and Wheeler). Base Case minimum flows, except for the increases noted below, and the DO targets adopted following completion of the 1990 Lake Improvement Plan would continue to be met.

Subject to flood control operations or extreme drought conditions, scheduled releases would be provided at five additional tributary projects (Ocoee #1, Apalachia, Norris, Watauga/Wilbur, and South Holston) to increase tailwater recreational opportunities. Under the Base Case, recreational releases are not formally scheduled at these five projects and are made only after other operating requirements have been met.

Under the Preferred Alternative, the weekly average system flow requirement from June 1 through Labor Day measured at Chickamauga Dam would be determined by the volume of water in storage at 10 upstream tributary reservoirs relative to a system Minimum Operations Guide (MOG). This guide is a seasonal storage guide that defines the combined storage volume for those 10 tributary reservoirs (Blue Ridge, Chatuge, Cherokee, Douglas, Fontana, Nottely, Hiwassee, Norris, South Holston, and Watauga). If the volume of water in storage is more than the system MOG, the weekly average system flow requirement would be increased each week from 14,000 cfs the first week of June to 25,000 cfs the last week of July. Beginning August 1 and continuing through Labor Day, the weekly average flow requirement would be 29,000 cfs. If the volume of water in storage is less than the system MOG, only 13,000 cfs weekly average flows would be released between June 1 and July 31, and only 25,000 cfs weekly average flows would be released from August 1 through Labor Day. During normal operations June through Labor Day, weekly average system flows would not be lower than the amounts specified to ensure adequate flow through the system. Also, they would not be higher than the specified amounts to maintain pool levels as close as possible to the flood guides on 10 tributary reservoirs. After periods of high inflow, higher flows would be released as necessary to recover allocated flood storage space. Continuous minimum flows would be provided in the Apalachia Bypass reach from June 1 through November 1.

Executive Summary

The winter flood guide levels would be raised on 10 tributary reservoirs (Boone, Chatuge, Cherokee, Douglas, Fontana, Hiwassee, Norris, Nottely, South Holston, and Watauga) based on the results of the flood risk analysis. On Wheeler Reservoir, the minimum winter elevation would be raised by 0.5 foot to better ensure an 11-foot minimum depth in the navigation channel. Steady water releases up to 25,000 cfs of flow would be provided as necessary at Kentucky Dam to maintain a tailwater elevation of 301 feet. Great Falls Reservoir would be filled earlier to reach full summer pool by Memorial Day. On Fort Loudoun, Watts Bar, and Chickamauga Reservoirs, the fill period would follow the Base Case fill schedule during the first week in April. Then, the fill schedule would be delayed to reach summer operating zone by mid-May.

ES.8 Other Actions Considered

TVA considered a number of other possible actions during formulation of the policy alternatives. They included actions that exist or could be implemented independent of changes in reservoir operations policy, such as continuing operation of the Bear Creek and Normandy Projects under existing guide curves, changes in hydroturbine ramping rates, and operations to support fish spawning and improve habitat and biodiversity. TVA also considered but did not include a number of other actions, including major structural modifications to dams, levee construction, maintaining summer reservoir levels year-round, reducing minimum flows from tributary dams or filling tributary reservoirs by March 1, and delaying drawdown until after October. Other actions considered but not included in any of the policy alternatives were reducing the navigation channel to 9 feet or dredging the navigation channel, strengthening TVA's regulatory authority, and constructing or relying on new alternative energy sources and incentives for energy and water conservation. Some of these actions were not within the overall scope of the ROS, were not feasible, would clearly result in unacceptable environmental impacts, or have been considered in previous TVA studies.

ES.9 Potential Impacts and Comparison of Alternatives

Identifying and quantifying the trade-offs between competing reservoir operating objectives were essential to evaluating the policy alternatives. TVA performed a comprehensive environmental and economic evaluation of each of the policy alternatives. Three separate evaluations were performed—one with respect to the objectives identified during from the public scoping process (see Table ES-02), a second to evaluate impacts on each of the environmental resources (see Table ES-03), and a third to calculate regional economic benefits (see Table ES-04).

ES.9.1 Objectives Identified during Scoping

TVA conducted an extensive scoping process to obtain public input on future operations of the water control system. The 12 operating objectives identified during scoping are identified in Section ES.6. Table ES-02 shows the performance for each of the policy alternatives selected for evaluation in relation to those objectives. This table shows how well each policy alternative performed in relation to reservoir operating objectives important to the public. Changes in power costs and flood damage are predicted to be in the range of 1 percent or less. Other

sectors, however, may experience greater changes. The one sector of direct economic effects that would increase for most alternatives is the change in recreation revenue. All of the alternatives that include increased recreation benefits would increase revenue approximately 20 percent. The Summer Hydropower Alternative and the Commercial Navigation Alternative would result in negative recreation revenues. In another category, shipper savings may be increased by 4 percent under the Commercial Navigation Alternative.

ES.9.2 Impacts on Resource Areas

At a more detailed level, TVA analyzed 24 resource areas that reflect a wide range of issues important to the residents of the Tennessee River basin. Table ES-03 (at the end of this summary) presents the effects of the policy alternatives on each of these resource areas.

This assessment of impact was made using seven impact levels, including No Change, Slightly Adverse/Slightly Beneficial, Adverse/Beneficial, and Substantially Adverse/Substantially Beneficial. The extent, duration, and intensity determined the level of impact. In some cases, the impact was listed as Variable for resources where impacts varied across the study area to a degree that they could not be classified within a single impact level.

DEFINITIONS OF IMPACT	
Level of Impact	Description
No change	Impact on the resource area is negligibly positive or negative but is barely perceptible or not measurable, or confined to a small area; or the extent of the impact is limited to a very small portion of the resource.
Slightly adverse/slightly beneficial	Impact on the resource area is perceptible and measurable, and is localized; or its intensity is minor but over a broader area and would not have an appreciable effect on the resource. This also can refer to impacts with short duration and not recurring.
Adverse/beneficial	Impact is clearly detectable and could have an appreciable effect on the resource area. Moderate impacts can be caused by combinations of impacts, ranging from high-intensity impacts over a smaller area to small to moderate impacts over a larger area. This also can occur with minor to moderate impacts that are recurring over a period of years.
Substantially adverse/substantially beneficial	Impact would result in a major, highly noticeable influence on the resource area—generally over a broader geographic extent and/or recurring for many years.

Table ES-02 Summary of Policy Alternative Performance by Objectives Identified during Public Scoping

Objective	Alternative								Preferred
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	
Low-cost/reliable electricity ¹	No change	\$30 M increase in power costs	\$67 M increase in power costs	\$3 M increase in power costs	\$108 M increase in power costs	\$11 M decrease in power costs	\$66 M increase in power costs	\$295 M increase in power costs	\$14 M increase in power costs
Revenue from recreation ²	No change (\$65.1 M existing revenue)	\$11 M (17%) increase in revenue	\$14 M (22%) increase in revenue	\$10 M (15%) decrease in revenue	\$1 M (2%) increase in revenue	\$1 M (2%) decrease in revenue	\$14 M (22%) increase in revenue	\$13 M (20%) increase in revenue	\$9 M (14%) increase in revenue
Flood risk and flood-related damages	No change	Increase	Substantial increase	Increase	No change	Increase	Substantial increase	Substantial increase	No change
Cost of transporting materials on the commercial waterway ³	No change (\$426 M existing costs)	No change in shipper costs	No change in shipper costs	\$12 M (3%) increase in shipper costs	\$1 M (<1%) increase in shipper costs	\$17 M (4%) decrease in shipper costs	No change in shipper costs	No change in shipper costs	\$2.5 M (1%) decrease in shipper costs
Water for municipal, agricultural, and industrial purposes ⁴	No change	No change	No change	\$12.5 M increase in costs	No change	\$3.4 M increase in costs	No change	No change	No change
Recreation on reservoirs and tailwaters ⁵	No change (6.57 million base user days)	1.34 M (20%) increase in user days	1.54 M (24%) increase in user days	1.27 M (19%) decrease in user days	0.24 M (4%) increase in user days	0.12 M (1.9%) decrease in user days	1.55 M (23%) increase in user days	1.44 M (22%) increase in user days	1.17 M (18%) increase in user days
Water quality in reservoirs and tailwaters	No change (natural variability from year to year)	No change to adverse effects on water quality	No change to substantially adverse effects on water quality	Adverse to beneficial effects on water quality	No change to adverse effects on water quality	No change to slightly beneficial effects on water quality	No change to substantially adverse effects on water quality	Adverse effects on water quality	No change to slightly adverse effects on water quality

Table ES-02 Summary of Policy Alternative Performance by Objectives Identified during Public Scoping (continued)

Objective	Alternative								
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	Preferred
Aquatic habitat in reservoirs and tailwaters	No change	Slightly adverse to slightly beneficial effects on aquatic habitat	Slightly adverse to slightly beneficial effects on aquatic habitat	Slightly adverse to slightly beneficial effects on aquatic habitat	Slightly adverse to slightly beneficial effects on aquatic habitat	Slightly beneficial effects on aquatic habitat	Adverse to slightly beneficial effects on aquatic habitat	No change to adverse effects on aquatic habitat	Slightly adverse to slightly beneficial effects on aquatic habitat
Erosion of reservoir shoreline and tailwater riverbanks	No change	Slightly increased erosion	Slightly increased erosion	No change to slightly reduced erosion	No change to slightly reduced erosion	No change	Slightly increased erosion	Slightly increased to increased erosion	Slightly increased erosion
Threatened and endangered species	No change	No change to slightly adverse effects	No change to slightly adverse effects	Adverse effects	No change to slightly beneficial effects	No change to slightly beneficial effects	No change to slightly adverse effects	Beneficial to slightly adverse effects	Slightly adverse to slightly beneficial effects
Wetlands and other ecologically sensitive areas	No change	Slightly adverse to slightly beneficial effects	Adverse to slightly beneficial effects	Substantially adverse effects	Adverse to substantially adverse effects	No change	Slightly adverse to slightly beneficial effects	Slightly adverse to slightly beneficial effects	Slightly adverse to slightly beneficial effects
Scenic beauty of reservoirs	No change	Improved	Substantially improved	Reduced	Slightly reduced	Slightly improved	Substantially improved	Substantially improved	Improved

Notes:

- 1 Millions of dollars annually.
- 2 Changes in recreational expenditures from outside the TVA region in millions of dollars annually for the year 2010 in 2002 dollars (percent change from Base Case for 2010 in 2002 dollars).
- 3 Change in shipping costs in millions of dollars annually (percent change from Base Case for 2010 in 2002 dollars).
- 4 Cost in millions of dollars (2002 dollars) to modify intakes on reservoirs with pool levels below TVA-published minimum elevations.
- 5 Total recreation use in user days (percent change from Base Case in user days).

Executive Summary

Tables ES-02 and ES-03 present different but closely related information. Table ES-02 focuses on the specific objectives identified by the public. Table ES-03 summarizes the results of technical analyses of the 24 resource areas by specialists, using more detailed metrics, modeling, and analysis. Table ES-02 is not derived directly from the more detailed results presented in Table ES-03.

Reservoir Recreation Alternative A—Reservoir Recreation Alternative B—Tailwater Recreation Alternative—Tailwater Habitat Alternative

These alternatives are similar in that they would produce benefits for recreational use of the reservoirs, substantially increased visual quality, and other beneficial resource improvements. However, these alternatives would also result in water quality impacts that would affect some aquatic resources, increase erosion and related impacts on cultural resources, and adversely affect the treatment of water supply. As a group, they represent a mixed set of impacts on environmental resources.

This group of alternatives would change, to various degrees, reservoir levels and flows through the reservoir system and their seasonal timing. These are the major factors driving the level of beneficial or adverse impacts on aquatic systems, wetland systems, and shoreline conditions, and the frequency and duration of thermal plant derates. Higher reservoir levels and reduced flows through the system would result in a suite of adverse and beneficial changes to the reservoir system. These would include some complex, inter-connected changes in the environment.

Holding summer pool levels higher later into summer and fall would result in increased thermal stratification in some reservoirs and in decreased water quality, low DO conditions, and anoxia—depending on the reservoir. Decreased water quality would adversely affect some aquatic resources and, at specific locations, threatened and endangered species. It would be costly to mitigate the water quality impacts resulting in low DO in project releases, and some impacts may be unavoidable.

Within this group of alternatives, Reservoir Recreation Alternative B, Tailwater Recreation Alternative, and the Tailwater Habitat Alternative would result in the most adverse impact on water quality because they would maintain summer pool levels longer and/or reduce flow through the system in summer to a greater extent. Reservoir Recreation Alternative A would achieve recreational and aesthetic benefits without the more substantial water quality impacts that accompany the other alternatives in this group. Maintaining summer pool levels longer would result in greater potential for shoreline erosion, with associated adverse effects on cultural resources and some shoreline habitats. Under all these alternatives, increased erosion would occur; erosion would be greatest under the Tailwater Habitat Alternative. Impacts on cultural resources under these alternatives would be slightly adverse to substantially adverse.

The alternatives in this group would result in variable and adverse impacts on wetlands overall because they would change the timing of inundation of various wetland, lowland, and shallow-water habitats.

Summer Hydropower Alternative and Equalized Summer/Winter Flood Risk Alternative

These alternatives are similar in the fact that they would produce few beneficial or substantially beneficial environmental resource impacts overall within the TVA reservoir system but would result in a number of substantially adverse environmental effects. The Equalized Summer/Winter Flood Risk Alternative would produce benefits for private recreational use of the reservoirs but little change is projected for public and commercial recreation use. It would have slightly adverse impacts on scenic integrity. The Summer Hydropower Alternative would produce substantially adverse impacts on private recreational use of the reservoirs and slightly adverse impacts on public and commercial recreation use. It would have adverse impacts on scenic integrity.

A suite of environmental resources would be adversely affected, especially under the Summer Hydropower Alternative. Both the Summer Hydropower Alternative and the Equalized Summer/Winter Flood Risk Alternative would result in substantial impacts on wetland resources. The Summer Hydropower Alternative would result in additional adverse environmental impacts on water quality in some tributary reservoirs, adverse impacts on several threatened and endangered species, and water supply withdrawal structures and pumping costs.

Base Case and Commercial Navigation Alternative

These alternatives are similar in the fact that they would produce few changes in the balance of beneficial or substantially beneficial impacts overall within the TVA system but also would result in fewer adverse environmental effects than the other alternatives. The Commercial Navigation Alternative would increase shipper savings, result in some slightly adverse impacts on wetland plant communities, terrestrial ecology (use of flats and some bottomland hardwood wetlands), and cultural resources. In general, the Commercial Navigation Alternative would not result in any adverse effects on protected species and would provide beneficial effects on summer water temperatures, minimum mainstem water levels, and increased stability of wetland habitats in comparison to the Base Case.

Preferred Alternative

After extensive public review of the DEIS and additional analyses, TVA developed a Preferred Alternative. This alternative combines and adjusts elements of the alternatives identified in the DEIS to preserve desirable characteristics and to avoid or reduce adverse impacts associated with those alternatives. The Preferred Alternative establishes a balance of reservoir system operating objectives that is more responsive to public values expressed during the ROS and consistent with the operating priorities established by the TVA Act. Adjusting project flood guides and delaying the complete filling of upper mainstem projects until May 15 would reduce potential flood damage compared to all other alternatives except the Base Case. Based on computer simulations, the Preferred Alternative would not result in increased flood damages associated with flood events up to a 500-year magnitude at any critical location within the Tennessee Valley, including Chattanooga. A flood event with a 500-year magnitude has a 1 in 500 chance of happening in any given year. Resolving flood risk issues was a central

Executive Summary

component in formulating the Preferred Alternative because reducing flood damage is one of the most valuable benefits provided by the system. Except for the Base Case, all of the alternatives evaluated in the DEIS would result in unacceptable increases in the risk of flooding at one or more critical locations. The Preferred Alternative would also provide a more equitable way of balancing pool levels among the tributary reservoirs, increase the minimum depth of the Tennessee River navigation channel at two locations, and maintain power system reliability while lessening impacts on delivered cost of power.

Under the Preferred Alternative, providing a longer duration of higher pool levels during summer (June 1 through Labor Day) would result in a beneficial increase in recreational opportunities and use of the reservoirs and tailwaters. Substantial beneficial increase in user days is anticipated for private access sites, with a slightly beneficial increase in public user days. It would also provide for more reliable recreational releases. Less fluctuation and longer duration of higher pool elevations on tributary reservoirs would substantially increase the scenic integrity of the reservoir system. The resulting reservoir pool elevations would produce slightly adverse impacts on shoreline erosion and associated slightly adverse effects on cultural resources.

Under the Preferred Alternative, reservoir pool levels would be maintained in a manner that continues to support wetlands extent, distribution, and habitat connectivity at levels similar to conditions under the Base Case. The Preferred Alternative would reduce some of the adverse impacts on flats, scrub/shrub, and forested wetlands that are associated with water levels being held too long during the growing season, and would ensure timely seasonal exposure of flats habitats important to migratory shorebirds and waterfowl at some of the more important mainstem reservoirs. However, it would result in slightly adverse impacts on certain wetland types and locations. In some cases, impacts may vary from year to year—depending on the reservoir, annual rainfall conditions, and other factors. The Preferred Alternative would result in slightly adverse effects on some protected species that occur in wetland habitats on most reservoirs, but would result in effects similar to the Base Case with regard to protected species on Kentucky Reservoir.

Compared to the Base Case, higher system flows would be required under the Preferred Alternative June through Labor Day when the volume of water in storage is above the system MOG. During normal operations in this period, weekly average system flows would not be higher than these minimum requirements to maintain pool levels as close as possible to the flood guides on 10 tributary reservoirs. Therefore, actual flows would be lower most of the time during this period. The Preferred Alternative would have little effect on water quality in tributary reservoirs. Effects would vary among mainstem reservoirs—some would have volumes of low DO water similar to the Base Case and others a substantially larger volume. Effects on water quality would be slightly adverse. The Preferred Alternative would maintain tailwater minimum flows and DO targets while reducing impacts on reservoir water quality, as compared to some of the other alternatives that hold summer pool levels longer, and would provide for more balanced tributary reservoir levels across the system.

ES.9.3 Regional Economic Effects

The geographic scope of this study consists of the 201-county area bounded by the TVA Power Service Area and the Tennessee River Watershed. In 2000, the ROS area population was 9.2 million, total employment was 5.4 million jobs, total personal income was \$235 billion, and gross regional product (GRP) was \$275 billion (2002 dollars). The region attained these levels after strong growth over the 1990s, outpacing national economic growth. Gross regional product, population, employment, and income in the region grew at a faster rate than their national counterparts during the same period.

Under the Base Case, regional economic growth is projected to continue to outpace national economic growth over the rest of the decade. Overall, the region is projected to experience a GRP increase of 3.2 percent per year, compared to 3.0 percent nationally, from 2000 to 2010. Total employment is forecasted to grow at 1.2 percent while increasing at 1.0 percent nationally. With this job growth and with the region remaining a desirable place to live, regional population is also expected to continue to outpace national growth, increasing at 1.1 percent per year versus 1.0 percent for the nation.

To determine the economic effects of an alternative reservoir operations policy as compared to the Base Case, TVA evaluated several economic parameters. This evaluation integrated changes to the cost of power, revenues from recreation, shipper savings from river transportation, cost of municipal water supplies, and changes in property values into a measure of overall effects on the regional economy. Table ES-04 shows the effect of each of the reservoir operations policy alternatives as measured by change (from the Base Case) in the GRP, which is the sum dollar value of all goods and services in the economy that is commonly used as a broad measure of economic activity. The GRP includes direct economic effects, such as changes in power costs, and also includes the ripple effect of changed power costs on other economic sectors.

As measured by the GRP, only the Commercial Navigation Alternative is expected to positively affect the regional economy. All other action alternatives are expected to result in a negative regional economic effect. The actual magnitude of these effects, either negative or positive, would be small as a percent of the GRP. Effects for 2010 are shown in Table ES-04. The impacts for 2010 represent the effects after changes to the operations policy have been absorbed into the regional economy.

Executive Summary

Table ES-04 Annual Economic Effects of Policy Alternatives Based on Changes in Gross Regional Product (2010)

	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	Preferred
Change	[\$13.6 million]	[\$32.5 million]	[\$43.2 million]	[\$76.5 million]	\$54.0 million	[\$30.8 million]	[\$160.8 million]	[\$6.0 million]
Percent of gross regional product	-0.004	-0.01	-0.012	-0.02	0.02	-0.01	-0.043	-0.002

Note: Brackets indicate negative values.

ES.9.4 Cumulative Impacts

Relevant future trends and other reasonably foreseeable projects and actions were used in analyzing the cumulative impacts of changing TVA's reservoir operations policy. No material cumulative impacts are expected for Dam Safety, Invasive Plants and Animals, Aquatic Plants, Groundwater Resources, and Prime Farmland because changing TVA's system-wide operations policy is not expected to result in effects that would overlap or accumulate with them. The potential consequences of policy changes on Power and Navigation were determined to be primarily economic. The modeling of economic changes integrates cumulative effects and the results presented are cumulative in nature. Changes in TVA's reservoir system operations policy could affect Land Use, but these effects are also primarily economic and were captured by TVA's economic analyses. The cumulative effects of shoreline development were also presented in TVA's earlier programmatic EIS assessing shoreline development, the 1998 Shoreline Management Initiative.

Changing TVA's reservoir operations policy could have potential for cumulative impacts on Air and Climate, Water Quality, Water Supply, Aquatic Resources, Wetlands and Terrestrial Ecology, Vectors (mosquito breeding habitat), Threatened and Endangered Species, Managed Areas and Ecologically Significant Sites, Shoreline Erosion, Cultural Resources, Visual Resources, Flood Control, and Recreation. Compared to the other action alternatives, these potential cumulative effects would be avoided or substantially reduced under the Preferred Alternative. Through detailed analysis in this FEIS, TVA has determined that most changes under the Preferred Alternative would result in beneficial to slightly adverse impacts. Further, TVA has identified potential mitigation measures to address the few adverse and substantially adverse impacts associated with the Preferred Alternative.

ES.10 TVA's Preferred Alternative

Based on the evaluation included in this EIS, TVA staff will recommend that the TVA Board implement the ROS Preferred Alternative. This alternative would establish a balance of reservoir system operating objectives that is more responsive to values expressed by the public during the ROS and consistent with the operating priorities established by the TVA Act.

The Preferred Alternative would increase reservoir and tailwater recreation opportunities and visual quality. Based on computer simulations, the Preferred Alternative would not result in increased flood damage associated with flood events up to a 500-year magnitude at any critical location within the Tennessee Valley, including Chattanooga. A flood event with a 500-year magnitude has a 1 in 500 chance of happening in any given year. The Preferred Alternative would provide a more equitable way of balancing pool levels among tributary reservoirs. The Preferred Alternative would increase the minimum depth of the Tennessee River navigation channel at two locations and would maintain power system reliability while lessening impacts on the delivered cost of power compared to other alternatives.

The Preferred Alternative would maintain tailwater minimum flows and DO targets. Additionally, it would lessen impacts on reservoir water quality, as well as shoreline erosion and its associated adverse effects on cultural resources and some shoreline habitats—as compared to Reservoir Recreation Alternative A, Reservoir Recreation Alternative B, the Tailwater Recreation Alternative, and the Tailwater Habitat Alternative. Responding to flood control, wetland, and wildlife concerns expressed by the USACE, the USFWS, state agencies, and some members of the public, no changes in seasonal water levels on Kentucky Reservoir were included in the Preferred Alternative.

Once the formulation of the Preferred Alternative was complete, TVA initiated consultations on this proposed action with the USFWS regarding the Endangered Species Act and with the seven State Historic Preservation Officers regarding the National Historic Preservation Act. Results of the Endangered Species Act consultation (presented in Appendix G) indicate that adoption of the Preferred Alternative would not jeopardize the continued existence of any listed or candidate federal threatened or endangered species. The National Historic Preservation Act consultations resulted in development of a Programmatic Agreement (presented in Appendix H) that covers the identification and protection or mitigation of historic properties that could be affected by adoption of the Preferred Alternative.

ES.11 Potential Mitigation Measures

A mix of monitoring and adaptive response is an important component of TVA's programmatic approach to mitigating potentially adverse to substantially adverse impacts under the Preferred Alternative. TVA would continue its existing monitoring activities under its Reservoir Release Improvement and Vital Signs Monitoring Programs to look for water quality and ecological changes; with additional DO and temperature sampling at selected tailwater locations as determined by Vital Signs monitoring. A Wetlands Monitoring Program would be established to determine whether shifts of wetland plant communities occur as a result of extended water levels. TVA would extend the existing Vector Monitoring Program to identify any increase in the number of days that reservoir mosquito breeding habitat exists due to the extended time the mainstem reservoirs are held up.

If analysis or monitoring indicates that DO concentrations are declining below DO target levels, TVA would upgrade aeration equipment and operations at appropriate locations as necessary to meet the DO target levels established by the Lake Improvement Plan. This could include

Executive Summary

increased oxygenation, upgrading existing equipment, or installing additional equipment. Such measures would be initiated and completed within 1 year at Watts Bar and within 3 years at other locations where established targets are not being met. If holding mainstem reservoir levels up longer increases the number of days that reservoir mosquito breeding habitat exists TVA would extend the duration of reservoir level fluctuations for mosquito control.

Table ES-03 Summary of Impacts by Policy Alternative

Resource Area	Alternative										Preferred
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat			
Air Resources											
Air emissions	No change in projected annual emissions (in tons) of about 469,000 SO ₂ , 202,000 NO _x , 13,000 particulates, 10,000 CO, 1,200 VOCs, and 1.6 Hg	Slightly beneficial	Slightly adverse	Slightly adverse	Slightly adverse	No change	Slightly adverse	Beneficial (Due to non-emission generation)	No change to slightly adverse		
Climate											
Greenhouse emissions	No change in projected annual emission of 106.5 million tons CO ₂	Slightly beneficial	Slightly adverse	Slightly adverse	Slightly adverse	Slightly beneficial	Slightly adverse	Beneficial (Decrease of almost 2 million tons in annual CO ₂ emissions)	Slightly beneficial		
Water Quality											
Assimilative capacity – storage tributaries	No change in volume of water to assimilate oxygen-demanding waste	Slightly beneficial	Slightly beneficial	No change to slightly adverse	No change to slightly adverse	No change	Slightly beneficial	Slightly beneficial (Effects vary among reservoirs)	Slightly beneficial		
Assimilative capacity – transitional tributaries ¹	No change in volume of water to assimilate oxygen-demanding waste	No change to slightly adverse	No change	No change to slightly adverse	Slightly adverse	No change	No change	No change to slightly adverse	No change		

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative								Preferred	
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat		
Water Quality (continued)										
Assimilative capacity –mainstem reservoirs	No change in volume of water to assimilate oxygen-demanding waste	No change.	No change	No change to slightly adverse	No change	No change	No change	No change	No change	No change
Anoxia – storage tributaries	No change in volume of water with DO concentration less than 1mg/L	Slightly adverse	Slightly adverse	Slightly beneficial	Slightly beneficial (Effects vary among reservoirs)	No change	No change to adverse (Increase in volume of water with DO concentration less than 1mg/L)	Adverse (Increase in volume of water with DO concentration less than 1mg/L)	No change	No change
Anoxia – transitional tributaries	No change in volume of water with DO concentration less than 1mg/L	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	No change to slightly adverse	Slightly adverse to slightly beneficial (Effects vary among reservoirs)	No change to slightly adverse (Effects vary among reservoirs)	Slightly adverse to slightly beneficial (Effects vary among reservoirs)	Slightly adverse to slightly beneficial (Effects vary among reservoirs)
Anoxia – mainstem reservoirs	No change in volume of water with DO concentration less than 1mg/L	Adverse (Increase in volume of water with DO concentration less than 1mg/L)	Substantially adverse (Substantial increase in volume of water with DO concentration less than 1mg/L)	Substantially beneficial (Substantial decrease in volume of water with DO concentration less than 1mg/L)	Adverse to substantially adverse (Substantial increase in volume of water with DO concentration less than 1mg/L for some mainstem reservoirs)	Slightly beneficial	Substantially adverse (Substantial increase in volume of water with DO concentration less than 1mg/L for most mainstem reservoirs)	Adverse to substantially adverse (Substantial increase in volume of water with DO concentration less than 1mg/L for some mainstem reservoirs)	Slightly adverse	Slightly adverse

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative							Preferred	
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation		Tailwater Habitat
Water Supply									
Water supply delivery (costs)	No change in parameters affecting cost of water supply pumping from reservoirs and intake modifications due to lower reservoir levels	Slightly beneficial (Savings of \$1 million)	Slightly beneficial (Savings of \$1.4 million)	Substantially adverse (Additional cost of \$13 million)	Slightly beneficial (Savings of \$0.2 million)	Adverse (Additional cost of \$2.8 million)	Slightly beneficial (Savings of \$1.4 million)	Slightly beneficial (Savings of \$1.1 million)	Slightly beneficial (Savings of \$0.5 million)
Water supply quality (treatment)	No change in parameters affecting cost of water treatment of water withdrawn from TVA reservoirs	Slightly adverse	Adverse (High potential for soluble iron and manganese formation based on increase in volume of water with DO less than 1 mg/L)	No change to adverse (Wide variability in potential for soluble iron and manganese formation, depending on reservoir and year)	Slightly adverse	No change	Adverse (High potential for soluble iron and manganese formation based on increase in volume of water with DO less than 1 mg/L)	Adverse (High potential for soluble iron and manganese formation based on increase in volume of water with DO less than 1 mg/L)	No change to slightly adverse
Groundwater Resources									
Groundwater levels – reservoirs	No change in existing groundwater use	Slightly beneficial	Slightly beneficial	Slightly adverse	Slightly adverse	Slightly adverse	Slightly beneficial	Slightly beneficial	Slightly beneficial

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative								Preferred	
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat		
Aquatic Resources										
Biodiversity – tributary reservoirs	No change Benthic aquatic insect and mussel communities would still be affected by seasonal thermal stratification, low DO, and large water level fluctuations	No change	Slightly adverse	Adverse (Shoreline fluctuation would adversely affect shoreline habitat)	No change	No change	Slightly adverse	Slightly adverse	No change	No change
Biodiversity – mainstem reservoirs	No change Aquatic insect communities would remain fair, status of mussels in flowing portions would remain poor for riverine species and favorable for pool-adapted species	Slightly adverse	Slightly adverse	Slightly beneficial	No change to slightly adverse	Slightly beneficial	Slightly adverse	Slightly adverse	Slightly adverse to slightly beneficial (Effects vary among reservoirs)	No change to slightly adverse
Biodiversity – warm-water tailwaters ²	No change Biodiversity would continue to be limited due to the restraints of a regulated system	No change to slightly adverse	No change to slightly adverse	Adverse (Water quality and the stability of daily water elevations would decrease)	No change	No change	No change to slightly adverse	No change to slightly adverse	No change to slightly adverse	No change to slightly adverse

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative								Preferred	
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat		
Aquatic Resources (continued)										
Sport fish – tributary reservoirs	No change Conditions would continue to be stressful for cool-water species and favorable for warm-water species	No change to slightly beneficial	Slightly beneficial	Slightly adverse to slightly beneficial (Effects vary among reservoirs)	Slightly adverse	No change to slightly beneficial	Slightly beneficial	Slightly adverse	No change to slightly beneficial	Slightly beneficial to slightly adverse
Sport fish – mainstem reservoirs	No change Communities would continue to vary based on environmental conditions	No change to slightly adverse	No change to slightly adverse	No change to slightly beneficial	Slightly adverse	No change to slightly beneficial	No change to slightly adverse	Adverse (Lower DO, therefore less available habitat)	Slightly adverse	Slightly beneficial to slightly adverse
Sport fish – warm tailwaters	No change Communities would continue to vary based on environmental conditions	No change	No change to slightly beneficial	Slightly beneficial	Slightly adverse to slightly beneficial (Effects vary among reservoirs)	No change	No change to slightly beneficial	Slightly adverse to slightly beneficial (Effects vary among reservoirs)	Slightly adverse to slightly beneficial (Effects vary among reservoirs)	Slightly beneficial to slightly adverse
Sport fish – cool-to-warm tailwaters	No change Improvements would continue due to RRI initiatives; warm-water species would continue to be limited	Slightly beneficial to slightly adverse	Slightly beneficial to slightly adverse	Slightly beneficial	Slightly beneficial to slightly adverse	No change	Slightly beneficial to slightly adverse	Slightly beneficial to slightly adverse	Slightly beneficial to slightly adverse	Slightly beneficial to slightly adverse

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative								Preferred
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	
Aquatic Resources (continued)									
Sport fish – cool/cold tailwaters	No change Improvements would continue due to RRI initiatives	Slightly adverse	Slightly adverse	Adverse (Water temperatures would be higher in tributary reservoirs due to less cold water storage in late summer)	Slightly adverse	No change	Slightly adverse	Adverse (Increased hours with temperatures greater than 20°C)	Slightly beneficial
Commercial fisheries – reservoirs	No change Communities would continue to vary based on environmental conditions	Adverse (Increase in volume of water with poor water quality due to delayed summer drawdown)	Adverse (Increase in volume of water with poor water quality due to delayed summer drawdown)	Beneficial (Increase of flow through mainstem reservoirs, which would increase water quality)	Slightly adverse to adverse (Increase in yearly volumes of water with low DO)	No change	Adverse (Increase in volume of water with poor water quality due to delayed summer drawdown)	Adverse (Increased volume of water with low DO in mainstem reservoirs)	Slightly adverse to slightly beneficial (Effects vary among reservoirs)
Wetlands									
Location	No change Wetland extent and distribution are expected to follow existing trends	No change to slightly beneficial	Slightly beneficial	Substantially adverse (Less water would be available during the growing season for wetlands)	Substantially adverse (Less water would be available during the growing season for wetlands on tributary reservoirs)	No change	Slightly beneficial	No change to slightly beneficial	No change to slightly beneficial

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative									
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	Preferred	
Wetlands (continued)										
Type	No change Shifts in wetland types are expected to follow existing trends	Slightly adverse	Adverse (Changes in the timing of the presence of water would adversely affect flats, scrub/shrub, and forested wetlands)	Substantially adverse (Changes in the timing of the presence of water would adversely affect all wetland types)	Substantially adverse (Changes in the timing of the presence of water would adversely affect all wetland types)	Slightly adverse	Adverse (Changes in the timing of the presence of water would adversely affect flats, scrub/shrub, and forested wetlands)	Slightly adverse	Slightly adverse	
Function	No change Slow decline in wetland functions are expected to continue	Slightly adverse	Adverse (Changes in wetland types would cause a moderate decrease in wetland functions)	Substantially adverse (Changes in water regimes and wetland types would cause a major decrease in wetland functions)	Substantially adverse (Changes in water regimes and wetland types would cause a major decrease in wetland functions)	No change	Adverse (Changes in wetland types would cause a moderate decrease in wetland functions)	Slightly adverse	Slightly adverse	
Aquatic Plants										
Tributary reservoirs	No change Aquatic plant coverage would continue to increase or decrease based on hydrologic and climatic events	Slight increase	Slight increase	Slight decrease	Slight increase to slight decrease (Effects vary slightly among reservoirs and years)	No change	Slight increase	Slight increase	Slight increase	

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative								Preferred	
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat		
Aquatic Plants (continued)										
Mainstem reservoirs	No change Aquatic plant coverage would continue to increase or decrease based on hydrologic and climatic events	No change	No change	Substantial decrease (Large reduction of aquatic plants in upper portion of drawdown zone)	Slight decrease	No change	No change	No change	No change	No change
Population abundance and spread of invasive emergent plants ³	No change Emergent invasive plants would continue to increase or decrease based on natural fluctuation associated with hydrologic and climatic events	Slightly adverse	Slightly adverse	Slightly beneficial	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Terrestrial Ecology										
Upland and lowland plant communities	No change Plant communities would continue to increase in biomass and biodiversity through natural succession	Adverse (Loss of bottomland hardwood communities from extended summer pool and higher winter pool)	Adverse (Loss of bottomland hardwood communities from extended summer pool and higher winter pool)	Substantially adverse (Loss of wetland plant communities due to early drawdown of summer pool and higher winter pool)	Adverse (Loss of lowland plant communities from extended summer pool and higher winter pool)	Adverse (Loss of bottomland hardwood communities from higher winter pool)	Adverse (Loss of bottomland hardwood communities from extended summer pool and higher winter pool)	Adverse (Loss of lowland plant communities from extended summer pool and higher winter pool)	Slightly adverse to adverse (Loss of bottomland hardwood communities from extended summer pool)	Slightly adverse to adverse (Loss of bottomland hardwood communities from extended summer pool)

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative								Preferred
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	
Terrestrial Ecology (continued)									
Migratory shorebirds and waterfowl	No change Flats would continue to be exposed during late summer	Adverse (Flats not exposed during late summer, resulting in loss of feeding habitat)	Adverse (Flats not exposed during late summer, resulting in loss of feeding habitat)	Substantially adverse (Extent of flats would be altered throughout TVA system)	Adverse (Flats not exposed during late summer, resulting in loss of feeding habitat)	Slightly adverse	Adverse (Flats not exposed during late summer, resulting in loss of feeding habitat)	Adverse (Flats not exposed during late summer, resulting in loss of feeding habitat)	Slightly adverse
Wildlife	No change Areas used by wildlife would continue to be available	Slightly beneficial to adverse (Slight increases in aquatic beds would benefit wildlife; changes in wetland communities would adversely affect species of wildlife)	Slightly beneficial to adverse (Slight increases in aquatic beds would benefit wildlife; changes in wetland communities would adversely affect species of wildlife)	Adverse (Loss in variety of lowland habitats)	Slightly beneficial to adverse (Slight increases in aquatic beds would benefit wildlife; loss of flats would adversely affect other species of wildlife)	No change to slightly adverse	Slightly beneficial to adverse (Slight increases in aquatic beds would benefit wildlife; changes in wetland communities would adversely affect species of wildlife)	Slightly beneficial to slightly adverse	Slightly beneficial to slightly adverse
Invasive Plants and Animals									
Population abundance and spread of invasive species ⁴	No change Present trends relative to rate of establishment and spread would continue	No change	No change	Slightly adverse	No change	No change	No change	No change	No change

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative								Preferred
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	
Vector (Mosquito) Control									
Population abundance	No change to the number of days mosquito breeding habitat would be present	Adverse (Increase in the number of days mosquito breeding habitat would be present)	Adverse (Increase in the number of days mosquito breeding habitat would be present)	Beneficial (Reduction in mosquito breeding habitat)	Slightly adverse	No change	Adverse (Increase in the number of days mosquito breeding habitat would be present)	Adverse (Increase in the number of days mosquito breeding habitat would be present)	Adverse (Increase in the number of days mosquito breeding habitat would be present)
Threatened and Endangered Species									
Flowing-water mainstem reservoirs and tailwaters	No change Continuation of existing trends could lead to eventual loss of some mussel species	Slightly beneficial	Slightly beneficial	Beneficial (Probably higher flows and DO levels)	No change	Beneficial (Higher minimum water levels on most tailwaters)	Beneficial (Higher minimum water levels on tailwaters)	Variable (Higher minimum water levels on tailwaters, larger volume of low DO water, longer time of low DO discharges at one dam)	No change

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative								Preferred
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	
Threatened and Endangered Species (continued)									
Flowing-water tributary reservoirs and tailwaters	No change Continuation of existing trends would include increasing diversity and reintroduction of protected species	Variable (Less natural water temperatures in some tailwaters, more natural in late summer temperature variation in some tailwaters)	Variable (Less natural water temperatures in some tailwaters, more natural in late summer temperature variation in some tailwaters)	Adverse (Probably more variable summer flows and water temperatures)	Beneficial (Less variation in June flow rates and less late summer temperature variation in some tailwaters, more natural summer water temperatures in most tailwaters)	Slightly beneficial	Variable (Less natural water temperatures in some tailwaters, more natural in late summer temperature variation in some tailwaters)	Beneficial (Less variation in June flow rates and less late summer temperature variation in some tailwaters, more natural summer water temperatures in most tailwaters)	Few changes from Base Case (Less natural water temperatures in some tailwaters, more natural in others)
Shorelines and lowland habitats	No change Continuation of existing trends would include the gradual loss of habitats and species populations	Slightly adverse	Slightly adverse	Adverse (Unreplaced loss of wetland habitats due to shorter duration of summer pool levels)	Adverse (Unreplaced loss of wetland habitats due to frequent changes in pool levels)	Slightly beneficial	Slightly adverse	Adverse (Unreplaced loss of scrub/shrub habitats due to higher summer pool levels)	Slightly adverse
Upland habitats	No change Existing trends would continue	No change	No change	No change	No change	No change	No change	No change	No change
Apalachia Bypass reach	No change Existing trends would continue	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative									
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	Preferred	
Threatened and Endangered Species (continued)										
Wide-ranging species	No change Existing trends would continue	Slightly beneficial	Slightly beneficial	Adverse (Potential adverse effects to gray bats)	No change	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial
Reservoir inflow areas	No change Existing trends would continue	No change	No change	No change	No change	No change	No change	No change	No change	No change
Cave aquifers	No change Existing trends would continue	No change	No change	No change	No change	No change	No change	No change	No change	No change
Managed Areas and Ecologically Significant Sites										
Integrity of sites	No change Continued difficulty in protecting integrity of bottomland hardwoods and some aquatic endangered species sites	Slightly adverse to slightly beneficial	Slightly adverse	Adverse (Shifts or losses in wetlands type and function)	Adverse (Shifts or losses in waterfowl subimpoundments, flats, scrub/shrub, and forested wet-lands, and some associated wildlife; slight benefits to some wildlife on tributary reservoirs)	Slightly adverse to slightly beneficial	Slightly adverse	Slightly adverse to slightly beneficial	Slightly adverse to slightly beneficial	Slightly adverse to slightly beneficial
Land Use										
Indirect effect on natural condition	No change Projected rate of shoreline residential development would continue	Slightly adverse	Slightly adverse	Slightly beneficial	No change to slightly beneficial	No change	Slightly adverse	No change to slightly adverse	Slightly adverse	Slightly adverse

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative								Preferred
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	
Shoreline Erosion									
Reservoir effects	No change Shoreline erosion would continue at existing rates	Adverse (Longer reservoir pool durations at summer levels and increased recreational boating would increase reservoir shoreline erosion)	Adverse (Longer reservoir pool durations at summer levels and increased recreational boating would increase existing erosion)	Beneficial (Shorter reservoir pool durations at summer levels and decreased recreational boating would decrease existing erosion)	Beneficial (Shorter reservoir pool durations at summer levels and higher winter pools would reduce reservoir shoreline erosion)	No change	Adverse (Longer reservoir pool durations at summer levels and increased recreational boating would increase reservoir shoreline erosion)	Substantially adverse (Substantially longer reservoir pool durations at summer levels and increased recreational boating would increase existing erosion)	Slightly adverse
Tailwater effects	No change Bank erosion would continue at existing rates	No change	No change	No change	No change	No change	No change	No change	No change
Prime Farmland									
Conversion of prime farmland	No change Current conversion rates would continue	Slightly adverse	Slightly adverse	Slightly beneficial	Slightly beneficial	No change	Slightly adverse	Slightly adverse	Slightly adverse

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative								Preferred	
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat		
Cultural Resources										
Indirect effects	No change Impacts would continue at existing rates due to land development	Slightly adverse	Slightly adverse	Slightly beneficial	Slightly beneficial	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Direct effects	No change Impacts would continue at existing rates due mainly to erosion	Adverse (Increase in shoreline erosion)	Adverse (Increase in shoreline erosion)	Beneficial (Decrease in shoreline erosion)	Beneficial (Decrease in shoreline erosion)	No change	Adverse (Increase in shoreline erosion)	Substantially adverse (Substantial increase in shoreline erosion)	Slightly adverse	Slightly adverse
Visual Resources										
Scenic integrity	No change Scenic integrity would remain as presently exists	Beneficial (Overall, less fluctuation and longer duration at higher pool elevations)	Substantially beneficial (Overall, longer duration of higher pool elevations and less fluctuation compared to Reservoir Recreation A)	Adverse (Overall reduction in duration of higher pool elevations)	Slightly adverse	Slightly beneficial	Substantially beneficial (Overall, longer duration of higher pool elevations and less fluctuation compared to Reservoir Recreation A)	Substantially beneficial (Overall, longest duration of higher pool elevations and less fluctuation in pool levels)	Substantially beneficial (Overall, tributary reservoirs would have less fluctuation and longer duration at higher pool elevations)	Substantially beneficial (Overall, tributary reservoirs would have less fluctuation and longer duration at higher pool elevations)
Dam Safety										
Reservoir-induced seismicity	No change in existing conditions	No change	No change	No change	No change	No change	No change	No change	No change	No change
Leakage	No change in existing conditions	No change	No change	No change	No change	No change	No change	No change	No change	No change
Design flood maximum reservoir levels	No change in existing conditions	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative								Preferred
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	
Navigation									
Change in annual shipper savings ⁵	No change Regional shipper savings of approximately \$378 million are expected to increase to \$597 million by 2030	No change \$0	No change \$0	Slightly adverse (Losses range from \$11 million in 2004 to over \$17 million in 2030)	Slightly adverse (Losses range from \$1 million in 2004 to \$1.9 million in 2030)	Slightly beneficial (Savings of \$15 million in 2004 to \$24 million in 2030)	No change \$0	No change \$0	Slightly beneficial (Savings of \$2.4 million in 2004 to \$3.8 million in 2030)
Flood Control									
Peak discharge—historical inflows	No change in existing conditions	Adverse (Increase in peak discharge)	Substantially adverse (Substantial increase in peak discharge)	Adverse (Increase in peak discharge)	No change	Adverse (Increase in peak discharge)	Substantially adverse (Substantial increase in peak discharge)	Substantially adverse (Substantial increase in peak discharge)	No change
Peak discharge—design storms	No change in existing conditions	Adverse (Increase in peak discharge)	Substantially adverse (Substantial increase in peak discharge)	Adverse (Increase in peak discharge)	No change	Adverse (Increase in peak discharge)	Substantially adverse (Substantial increase in peak discharge)	Substantially adverse (Substantial increase in peak discharge)	No change
Potential damage	No change in average annual flood related damages of approximately \$1,460,000	Adverse (29% increase in total average annual damages)	Substantially adverse (49% increase in total average annual damages)	Adverse (Approximately 25% increase in total average annual damages)	No change (3% increase in total average annual damages)	Adverse (37% increase in total average annual damages)	Substantially adverse (Approximately 40% increase in total average annual damages)	Substantially adverse (44% increase in total average annual damages)	No change (6% decrease in total average annual damages)

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative								Preferred
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	
Power									
Change in annual power cost ⁵	No change Annual power supply costs would continue as projected in the 2003 forecast	Slightly adverse Increase cost of \$30 million	Slightly adverse Increase cost of \$67 million	No change to slightly adverse Increase cost of \$3 million	Slightly adverse Increase cost of \$108 million	Slightly beneficial Decrease cost of \$11 million	Slightly adverse Increase cost of \$66 million	Adverse Increase cost of \$295 million	Slightly adverse Increase cost of \$14 million
Recreation^{5, 6}									
Change in annual recreation spending	No change Expenditure of \$65 million	Slightly beneficial Increase of \$11 million	Slightly beneficial Increase of \$14 million	Slightly adverse Decrease of \$10 million	Slightly beneficial Increase of \$1 million	Slightly adverse Decrease of \$1 million	Slightly beneficial Increase of \$14 million	Slightly beneficial Increase of \$13 million	Slightly beneficial Increase of \$9 million
Public access site use in reservoirs	No change Total use August through October is 670,000 user days	Slightly beneficial (Increase of ~21,000 user days [3%])	Slightly beneficial (Increase of ~40,000 user days [6%])	Slightly adverse (Decrease of ~15,000 user days [-2%])	No change (Decrease of 3,000 user days [-0.5%])	No change (Decrease of 1,000 user days [-0.1%])	Slightly beneficial (Increase of ~40,000 user days [5.9%])	Slightly beneficial (Increase of ~40,000 user days [5.9%])	Slightly beneficial (increase of 19,000 user days [2.8%])
Public access site use in tailwaters	No change Total use August through October is 200,000 user days	No change (Increase of approximately 1,000 user days [0.5%])	Slightly beneficial (increase of approximately 5,000 user days [3.0%])	Slightly adverse (Decrease of approximately 10,000 user days [-5.0%])	Slightly adverse (Decrease of approximately 11,000 user days [-5.5%])	No change (Decrease of less than 300 user days [-0.1%])	Slightly beneficial (Increase of ~5,000 user days [2.5%])	No change (Increase of 300 user days [-0.1])	No change Increase of 1,000 user days [0.6%])
Commercial site use ⁷	No change Total use August through October is 3,800,000 user days	Slightly beneficial (Increase of ~150,000 user days [4.0%])	Slightly beneficial (Increase of ~250,000 user days [7.0%])	Slightly adverse (Decrease of ~120,000 user days [-3.0%])	Slightly beneficial Increase of 47,000 user days [1.2%])	No change (Increase of 3,000 user days [0.1%])	Slightly beneficial (Increase of ~250,000 user days [7.0%])	Slightly beneficial (Increase of ~250,000 user days [7.0%])	Slightly beneficial (Increase of 110,000 user days [2.8%])

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative								Preferred
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	
Recreation (continued)									
Private access site use	No change in total use August through October is 1,850,000 user days	Substantially beneficial (Increase of ~1,100,000 user days [63%])	Substantially beneficial (Increase of ~1,200,000 user days [67%])	Substantially adverse (Decrease of ~1,100,000 user days [-61%])	Beneficial (Increase of 210,000 user days [11%])	Slightly adverse (Decrease of 120,000 user days [-6%])	Substantially beneficial (Increase of ~1,200,000 user days [67%])	Substantially beneficial (Increase of ~1,100,000 user days [61%])	Substantially beneficial (Increase of 1,040,000 user days [56%])
Social and Economic Resources									
Gross regional product	No change in forecasted GRP	Slightly adverse (\$13.6 million decrease in GRP)	Slightly adverse (\$32.5 million decrease in GRP)	Slightly adverse (\$43.2 million decrease in GRP)	Slightly adverse (\$76.5 million decrease in GRP)	Slightly beneficial (\$54.0 million increase in GRP)	Slightly adverse (\$30.8 million decrease in GRP)	Adverse (\$160.8 million decrease in GRP)	Slightly adverse (\$6.0 million decrease in GRP)
Personal income	No change in forecasted personal income	Slightly adverse (\$4.4 million decrease in PI)	Slightly adverse (\$11.5 million decrease in PI)	Slightly adverse (\$14.6 million decrease in PI)	Slightly adverse (\$31.1 million decrease in PI)	Slightly beneficial (\$15.8 million increase in PI)	Slightly adverse (\$10.9 million decrease in PI)	Adverse (\$63.7 million decrease in PI)	Slightly adverse (\$1.9 million decrease in PI)
Employment	No change in forecasted regional employment	Slightly adverse (Decrease of 43 workers)	Slightly adverse (Decrease of 220 workers)	Slightly adverse (Decrease of 413 workers)	Slightly adverse (Decrease of 745 workers)	Slightly beneficial (Increase of 408 workers)	Slightly adverse (Decrease of 201 workers)	Adverse (Decrease of 1,522 workers)	No change (Estimated increase of 2 workers)
Population	No change in forecasted regional population	Slightly adverse (408 residents leaving the region)	Slightly adverse (769 residents leaving the region)	Slightly adverse (372 residents leaving the region)	Slightly adverse (1,571 residents leaving the region)	Slightly beneficial (in-migration of 405 residents)	Slightly adverse (745 residents leaving the region)	Adverse (3,518 residents leaving the region)	Slightly adverse (191 residents leaving the region)

Table ES-03 Summary of Impacts by Policy Alternative (continued)

Notes:

Brackets indicate negative values.

- CO = Carbon monoxide
- CO₂ = Carbon dioxide.
- DO = Dissolved oxygen.
- GRP = Gross regional product.
- Hg = Mercury.
- HPA = Habitat protection area.
- mg/L = Milligrams per liter.
- NOx = Nitrogen oxides
- NWR = National wildlife refuge.
- PI = Personal income.
- RRI = Reservoir Release Improvement Program.
- SO₂ = Sulfur dioxide.
- VOCs = Volatile organic compounds.

¹ Transitional reservoirs are so categorized because they are unique cases that do not include all of the general characteristics of mainstem or tributary reservoirs described in Section 3.5. They include Boone, Fort Patrick Henry, Tellico, Apalachia, and Melton Hill Reservoirs.

² Cold-water tailwaters are not included because resident communities are minimal due to the cold-water releases, and no alternative would change this general condition.

³ A change in coverage includes either an increase or a decrease in the number of plant acres. Changes can be seen as adverse or beneficial, depending on the reader's perspective.

⁴ Terrestrial plants and animals and aquatic animals.

⁵ Projected costs in 2010 stated in 2002 dollars; indicative of trends.

⁶ Impacts are reported for the months of August, September, and October—the months for which the recreation analysis was completed.

⁷ Commercial whitewater rafting activity on Ocoee # 2 and Ocoee # 3 is considered in this summary. Under the Summer Hydropower Alternatives and the Tailwater Habitat Alternative, commercial whitewater releases would be suspended on Ocoee # 3. For purposes of this summary, it was assumed that this would result in the closure of commercial whitewater activities on Ocoee #3