Chapter 3

Reservoir Operations Policy Alternatives

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3.1 Introduction

The National Environmental Policy Act (NEPA) requires federal agencies to evaluate a reasonable range of alternatives and the alternative of taking no action. This chapter describes the process TVA used to develop reservoir operations policy alternatives; the rationale used to develop, screen, and select a range of policy alternatives; and the policy alternatives selected for detailed analysis. Each policy alternative is compared to the other policy alternatives and to the Base Case.

For the purposes of this 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. The process used to formulate and select policy alternatives is presented in Section 3.2.

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 Preferred alternatives leading to the development of the Preferred Alternative, which is analyzed in this FEIS

Eight reservoir operations policy alternatives (seven policy alternatives and the Base Case) were selected and carried forward for detailed evaluation in the DEIS. A description of each of these alternatives is given in Section 3.3. A number of other alternatives and actions were considered but not carried through detailed analyses; the reasons for their elimination from further consideration are presented in Section 3.4. After receiving comments on the eight alternatives in the DEIS and conducting further analysis to address adverse effects of those alternatives, TVA formulated and analyzed a Preferred Alternative.

Identifying and quantifying the trade-offs between competing reservoir operating objectives were essential to evaluating the policy alternatives. In Section 3.5, the benefits achieved by each alternative and its consequences to the natural and human environment are summarized and compared. (See Chapter 5 for detailed analyses of potential impacts associated with each policy alternative.) This section also compares the public benefits that would result from implementation of any of the policy alternatives, including the Base Case.

3.2 Alternatives Development Process

TVA developed policy alternatives with extensive involvement by the public, governmental agencies, and non-governmental organizations. This process resulted in two important inputs for establishing alternatives:

- **Objectives—**public benefits to be emphasized by reservoir operations, such as increasing recreation, reducing flood risk, and improving tailwater aquatic habitat conditions. See Section 1.6.2 inset box and Table 1.6-03 for objectives identified during scoping.

- **Policy elements (or operating options)—**distinct reservoir control operations or practices suggested by the public, such as changing summer pool levels and increasing tailwater flows, that could be combined into various reservoir operations policy alternatives. These elements are identified in Table 1.6-04.

Using these operating objectives and policy elements, a large number of possible operational changes were considered and formulated into potential policy alternatives. These alternatives were narrowed to a smaller set based on the evaluation process described in the following sections.

3.2.1 Formulating Policy Alternatives

During the EIS scoping process, individuals and representatives of various agencies identified a range of issues concerning TVA's existing reservoir operations policy and possible changes that could be made. The most common and widely supported suggestions concerned changing summer and winter pool elevations and water releases to provide reservoir and tailwater recreational opportunities while protecting the environment, aquatic life, and water quality (Section 1.6.2). These issues and suggested changes were analyzed and translated into a list of objectives and a list of policy elements or operating options.

TVA reservoir operations staff then reviewed the list of operating options and combined them, along with appropriate operations terminology, to form more complete policy alternatives. This process (see the discussion of the scoping process in Section 1.6) produced 65 preliminary policy alternatives with different levels of refinement. Some alternatives involved changing or adjusting a single operations practice while others involved changing multiple practices.

3.2.2 Screening Preliminary Policy Alternatives

Each of the 65 preliminary policy alternatives could have been evaluated as a discrete, stand-alone alternative, or combined with one or more alternatives in various ways to produce innumerable alternatives to TVA's existing reservoir operations policy. To narrow the scope of the analysis to a reasonable range of alternatives, TVA used an iterative screening and evaluation process to review and refine the initial alternatives. This process yielded a range of preliminary policy alternatives for further analysis.

TVA began the screening process by considering whether any of the 65 preliminary alternatives would be impossible to implement, given the physical configuration and operational capabilities of the projects (dams and reservoirs) being studied. None of the 65 preliminary alternatives were eliminated because of such constraints.

The alternatives were then screened to identify those expected to result in substantially adverse impacts in terms of issues raised during scoping (Table 1.6-02). TVA staff used the 11 major issues as evaluation criteria for this screening process.

Using a scale of –10 to +10 for each evaluation criterion, the alternatives were screened by TVA technical staff. The score for each criterion indicated a positive or negative change from existing reservoir operations (the Base Case equaled a score of 0). A score of –5 or +5 (or greater) represented a substantial change from the Base Case. The scores for all criteria were then summed for each alternative, and the total scores for all alternatives were compared.

Those alternatives that received a positive total score were retained for further screening. Those alternatives with substantial negative impacts (–5 or a greater negative number) for any single criterion (except flood risk) were eliminated from further consideration. TVA comprehensively reevaluated flood risk as part of the ROS and did not want to eliminate alternatives on the basis of unacceptable flood risk impacts in the Tennessee River watershed prior to completing this evaluation.

When an alternative was eliminated as a result of a substantial negative impact, the screening process was stopped to determine whether any of the elements of that alternative could be added to one or more of the remaining alternatives. TVA used this approach so that specific reservoir policy elements that were important to evaluate could be carried forward for further screening and possible detailed evaluation. This process was repeated until no new alternatives could be created. TVA staff deviated from this process only to preserve, where possible, specific elements that had been supported by a substantial number of stakeholders.

Screening process results were provided to the members of the IAT and PRG. Individuals in both groups endorsed the process after having the opportunity to conduct an independent evaluation of the screening results. The initial screening of the 65 alternatives resulted in a condensed set of 25 preliminary alternatives. The list of 65 preliminary alternatives, including screening results, is part of the ROS administrative record.

3.2.3 Selecting Policy Alternatives

Starting with the condensed set of 25 preliminary policy alternatives, TVA further screened the alternatives to select those to be analyzed in detail. The 25 policy alternatives were screened using a similar process and the same major evaluation criteria that were used to screen the 65 preliminary policy alternatives. TVA staff again reviewed the alternatives to identify sets of compatible policy alternatives (or policy elements) that could be combined. For example, increasing releases to enhance hydropower generation would be compatible with increasing minimum flows to enhance water quality and aquatic resources, depending on how hydropower releases are made. The goal of this task was to combine as many policy alternatives as possible in order to reduce the list of alternatives to a more manageable number for detailed evaluation, while maintaining a reasonable range of policy alternatives that would identify the potential for greater overall public value. Some policy alternatives that resulted in substantially less improvement in overall public value compared to other similar alternatives were eliminated from consideration. Other policy alternatives were formulated during this process, but the number of alternatives retained for the next step of the evaluation process coincidentally remained at 25. (The operating guidelines that comprise the refined set of 25 alternatives are described in Appendix B.)

RESERVOIR OPERATIONS POLICY ALTERNATIVES EVALUATED IN DETAIL IN THE DEIS

Alternative Name	Number Code
Base Case	-
Reservoir Recreation A	2A
Reservoir Recreation B	3C
Summer Hydropower	4D
Equalized Summer/ Winter Flood Risk	5A
Commercial Navigation	6A
Tailwater Recreation	7C
Tailwater Habitat	8A

After the refined set of 25 policy alternatives had been screened, TVA staff performed computer simulations to determine the effect of these 25 reformulated alternatives on selected system operating parameters. These included reservoir elevations, streamflow conditions, and water availability during wet, normal, and dry years; and, for some alternatives, the cost of power and power reliability. These key parameters are associated with a range of environmental and economic issues. The outputs from these computer simulations also provided a basis for a preliminary assessment of potential impacts on other system operating objectives, including water quality and reservoir and tailwater recreation.

Based on the results of the simulations, 18 of the refined preliminary alternatives were eliminated from the list. At the conclusion of this process, eight policy alternatives (including the Base Case or No-Action Alternative) were retained for detailed analysis in the DEIS.

During the process of formulating and evaluating alternatives, a reference number/letter designation was assigned to each policy alternative. The names shown in the inset box on the preceding page were assigned to those alternatives selected for detailed analysis.

3.2.4 Developing a 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, especially the potential substantial impacts related to flood damages, water quality, power costs, aquatic resources, wetlands, and migratory waterfowl and shorebirds. The Preferred Alternative would establish a balance of reservoir system operating objectives that is more responsive to the values expressed by the public during the ROS and consistent with the operating priorities established by the TVA Act.

Resolving flood risk issues was a central 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 in the Tennessee Valley. Addressing flood risk was the first step in creating the Preferred Alternative. TVA used an iterative series of eight blended alternatives to eliminate increases in average annual flood damages at critical locations. TVA also used this series of alternatives to develop a more equitable way of balancing pool levels among the tributary reservoirs. Each iteration included modifications to individual project flood guides and/or regulating zones that were intended to address problem areas while preserving changes in reservoir pool levels that would enhance a range of benefits. Individual project guide curves were changed to resolve flood damage issues immediately downstream of certain projects and further downstream at damage centers.

As the flood risk issues were addressed, TVA included enhancements to reservoir and tailwater recreation and navigation, while considering impacts on low-cost/reliable electricity, water quality, and water supply. As part of these iterations, TVA investigated using both specified flow (i.e., including higher minimum flows in June, July, and August) and target reservoir elevation constraints as mechanisms for restricting drawdown from June 1 through Labor Day. The results of these iterations indicated that operating objectives could best be met by using flow constraints that reduce impacts on water quality and power system costs. Flood risk considerations indicated that earlier fill of tributary and mainstem projects was not feasible. No changes in seasonal water levels on Kentucky Reservoir were included as part of this alternative in response to concerns expressed by the USACE, the USFWS, state agencies, and some members of the public.

3.3 Alternatives Evaluated in Detail

Table 3.3-01 includes a summary of the existing reservoir operating guidelines (guide curves) and water release guidelines under the Base Case. Detailed information concerning the Base Case (for example, fill and drawdown target levels for specific reservoirs) is included in

Appendix A. Following the description of the Base Case, Table 3.3-01 lists the proposed changes to the existing guide curves and water release guidelines under each of the policy alternatives. Appendix B contains more detailed information about the policy alternatives (e.g., the specific reservoirs that would be affected by proposed changes).

Each of the alternatives is described in detail in the following sections according to its purpose, proposed operational changes, and effects on operating objectives.

- **Purpose.** The purpose statement describes the primary operating objective that was emphasized in developing the policy alternative and for which the alternative is named (e.g., reservoir recreation). Because each alternative represents a balance among operating objectives, the secondary objectives or constraints used to formulate the alternative are also identified.

- **Changes in Operations.** The changes in reservoir levels, flow releases, and other operations are identified for each policy alternative (see Appendix B for full details). Because many policy elements would remain the same across all alternatives, the descriptions below focus on how the alternatives would differ from the Base Case.

- **Achievement of Objectives.** This brief description states how the policy alternative is expected to meet the primary objective(s) of the reservoir system. Details concerning impacts on other operating objectives and environmental resources are described in Chapter 5 and are summarized in Section 3.5.

Although no alternatives are specifically designed (or named) to enhance water quality, water supply, and other objectives discussed in Chapter 1, these topics have been fully addressed in the policy alternatives that were analyzed. The policy alternatives selected for detailed analysis include a sufficiently wide range of operating conditions, including reservoir levels, flows, and timing, to address the potential impacts on these other operating objectives. Water quality in the reservoirs and regulated stream reaches is generally closely related to the timing and rate of flow through the reservoirs and tailwaters during summer and early fall. The nine alternatives (including the Base Case) examined in detail provide a wide range of operations—from maintaining higher water levels in the reservoir system into the fall to balancing drawdowns and flow through the system to be more evenly distributed over the seasons.

Under all policy alternatives, during critical power system situations—including but not limited to Power System Alerts or implementation of the Emergency Load Curtailment Plan, reservoir operations may temporarily deviate from normal system operating guidelines to meet power system needs. In such situations, water stored in the reservoirs would be used to the extent practicable to preserve the reliability of the power system.

Table 3.3-01 General Description of Operations under the Policy Alternatives That Were Evaluated in Detail

Policy Alternative	Reservoir Operating Guidelines (Guide Curves)	Water Release Guidelines
Base Case	• Continue to fill tributary reservoirs (TR) to summer pool levels by June 1 and restrict drawdown during June and July [1] • Continue to begin unrestricted TR drawdown on August 1 [1] • Continue to fill and drawdown mainstem reservoirs (MR) by targeted dates [1] • Continue to meet winter pool levels by January 1 on TR and MR [1] • Maintain MR winter pool levels until current dates [1] • Maintain 2-foot normal winter operating range on MR	• Continue established minimum flows (such as Chickamauga Reservoir releases at 13,000 cfs bi-weekly average minimum flow from June to August; 7,000 bi-weekly average minimum flow for May and September, and 3,000 daily average minimum flow for October through April) • Continue tailwater recreation releases below Watauga/Wilbur, Apalachia, Tims Ford, Ocoee #2, and Ocoee #3 Reservoirs
Reservoir Recreation Alternative A	• Extend TR summer pool levels through Labor Day • Extend MR summer pool levels to August 1 and slope MR drawdown curve by 1 foot from August 1 through Labor Day • Delay unrestricted TR drawdown until after Labor Day • Raise TR winter flood guides equal to Base Case March 15 levels • Raise MR winter flood guides by 2 feet (with a 1-foot operating range) to create 13-foot navigation channel (11 feet with 2 feet overdraft) • Reduce MR winter operating range to 1 foot	• Release only Base Case minimum flows from June 1 to August 1 • Establish weekly average Chickamauga Reservoir releases at 25,000 cfs from August 1 through Labor Day

Table 3.3-01 General Description of Operations under the Policy Alternatives That Were Evaluated in Detail (continued)

Policy Alternative	Changes to Reservoir Operating Guidelines (Guide Curves)	Changes to Water Release Guidelines
Reservoir Recreation Alternative B	• Extend TR summer pool levels to Labor Day and restrict drawdown until after Labor Day • Extend MR summer pool levels through Labor Day • Raise TR winter flood guides to levels needed to store only inflow volume of the 7-day, 500-year storm [2] • Raise MR winter flood guides by 2 feet (with a 1-foot operating range) to create 13-foot navigation channel (11 feet with 2 feet overdraft)	• Release only Base Case minimum flows from June 1 to Labor Day
Summer Hydropower Alternative	• Fill TR and MR to current full summer pool levels by June 1 • Begin TR and MR unrestricted drawdown on June 1 • No guaranteed TR and MR summer pool levels • Raise TR winter flood guides to levels needed to store only inflow volume for 7-day, 500-year storm [2]	• Establish weekly average Chickamauga Reservoir releases at 35,000 cfs from June 1 through September 15 • Provide scheduled tailwater recreation releases only for Ocoee #2
Equalized Summer/ Winter Flood Risk Alternative	• Establish year-round TR and MR flood guides at levels needed to store only inflow volume for critical-period, 500-year storm [3]	• Release only Base Case minimum flows from June 1 to August 1 • Establish weekly average Chickamauga Reservoir releases at 25,000 cfs from August 1 through Labor Day
Commercial Navigation Alternative	• Raise MR winter flood guides by 2 feet (with a 1-foot operating range) to create 13-foot navigation channel (11 feet with 2 feet overdraft)	• Increase continuous minimum instantaneous flows at Kentucky (25,000 cfs); based on elevation, increase minimum instantaneous flows at Pickwick (18,000 cfs) and Wilson (18,000 cfs) Reservoirs • Limit maximum flow at Barkley Reservoir to 28,000 cfs, except when higher flow levels are required to maintain flood storage allocation

Table 3.3-01 General Description of Operations under the Policy Alternatives That Were Evaluated in Detail (continued)

Policy Alternative	Changes to Reservoir Operating Guidelines (Guide Curves)	Changes to Water Release Guidelines
Tailwater Recreation Alternative	• Extend TR and MR summer pool levels to Labor Day once Base Case minimum flows and tailwater recreation flows are achieved (if not achieved, maintain minimum flows first, then tailwater recreation flows) • Delay TR and MR unrestricted drawdown until Labor Day • Increase TR winter flood guides to levels needed to store only inflow volume for 7-day, 500-year storm [2] • Raise MR winter flood guides by 2 feet (with a 1-foot operating range) to create 13-foot navigation channel (11 feet with 2 feet overdraft)	• Release recreation flows June 1 to Labor Day once Base Case minimum flows are achieved • Adjust flows to provide additional recreation opportunities for selected tailwaters at Norris, Watauga, Wilbur, Apalachia, South Holston, Ocoee #1, and Melton Hill Reservoirs
Tailwater Habitat Alternative	• Determine summer TR and MR pool levels by retaining 75 percent of inflow • Eliminate TR minimum operations guides • Raise TR winter flood guides equal to Base Case March 15 targeted levels • Raise MR winter flood guides by 2 feet (with a 1-foot operating range) to create 13-foot navigation channel (11 feet with 2 feet overdraft)	• Release Base Case minimum flow or 25 percent of inflow—whichever is greater—or as needed to stay below flood guides on TR and MR year round • Release 25 percent of inflow at a continuous rate; no turbine peaking allowed
Preferred Alternative	• Subject to each project meeting its minimum flow requirements and a proportionate share of the system minimum flow requirements, maintain reservoir elevations as close as possible to the flood guides on 10 tributary reservoir projects during summer (June 1 through Labor Day) • Begin unrestricted tributary reservoir drawdown after Labor Day • Maintain Base Case summer operating zone through Labor Day for Chickamauga, Guntersville, Pickwick, and Wheeler	• Adjust weekly average system flow from Chickamauga as follows: ▸ If water in storage is above the system Minimum Operations Guide (system MOG), increase weekly average flow each week during June and July (beginning with 14,000 cfs the first week in June, increasing to 25,000 cfs the last week in July) ▸ If water in storage is below the system MOG, release 13,000 cfs weekly average minimum flow during June and July

Table 3.3-01 General Description of Operations under the Policy Alternatives That Were Evaluated in Detail (continued)

Policy Alternative	Changes to Reservoir Operating Guidelines (Guide Curves)	Changes to Water Release Guidelines
Preferred Alternative (continued)	• Raise winter flood guide to elevations based on flood risk analysis for 10 tributary reservoir projects • Great Falls—Fill reservoir to summer pool by Memorial Day • Raise minimum winter pool elevation by 0.5 foot at Wheeler • Follow the Base Case fill schedule during the first week in April for Chickamauga, Fort Loudoun, and Watts Bar. Then delay the fill to reach summer operating zone by mid-May	▸ Release 29,000 cfs weekly average flow from August 1 through Labor Day if water in storage is above the system MOG or 25,000 cfs if it is below the system MOG ▸ 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. • Provide continuous minimum flows up to 25,000 cfs at Kentucky, as needed, to maintain minimum tailwater elevation of 301 feet • Maintain Base Case minimum flow commitments with additional scheduled tailwater recreation releases • Provide 25 cfs in Apalachia Bypass reach from June 1 through November 1

Notes:

The above information is a general description. Reservoir-specific information can be found in Appendices A and B.

Refer to Appendix A, Table A-02 for specific flood guide elevations under the Base Case. See Sections 2.1 through 2.3 for a complete description of the Base Case and Appendix B for a complete description of each policy alternative.

cfs = Cubic feet per second.
MOG = Minimum Operations Guide.
MR = Mainstem reservoir.
TR = Tributary reservoir.

Table 3.3-01 General Description of Operations under the Policy Alternatives That Were Evaluated in Detail (continued)

[1] Wherever fill and drawdown target dates for the Base Case are referenced, the specific dates can be found in Appendix A, Table A-08.

[2] The 7-day, 500-year storage for a given reservoir is the storage volume required to store the maximum 7-day average local inflow from a storm expected to occur no more frequently than once every 500 years. The storage volume required for a specific reservoir assumes no releases from upstream projects

[3] The critical-period, 500-year storage for a given reservoir is the maximum storage volume required to store the inflow from a storm expected to occur no more frequently than once every 500 years. The storage volume required for a specific reservoir also takes into account the reservoir's natural inflow/discharge and inflows from upstream projects.

3.3.1 Base Case

The Base Case (required by NEPA to be evaluated in an EIS as the No-Action Alternative) serves to document the existing reservoir operations policy. Under the Base Case, TVA would continue to operate its water control system in accordance with existing reservoir operating guidelines (guide curves), water release guidelines, other guidelines, and project commitments and constraints. (Existing operations and the structure of the water control system are described in detail in Sections 2.1 through 2.3.)

> **Base Case—**operates the reservoir system in accordance with existing reservoir operating guidelines, water release guidelines, other guidelines, and project commitments and constraints.

The Base Case also involves a number of other actions that would occur regardless of changes in the reservoir operations policy, including the continued implementation of ongoing TVA programs and meeting the existing contractual and other commitments for operation of the system. The following sections describe the ongoing programs and conditions that were included in the Base Case and each of the eight action alternatives.

2030 Consumptive Water Use

According to the USGS, the Tennessee River basin has the lowest rate of consumptive water use (water withdrawn but not returned to the river system) in the United States. Basin-wide consumptive use is presently about 5 percent of the water withdrawn. Increase in consumptive uses is not expected to exceed 7 percent or 331 million gallons each day by 2030 (Hutson et al. 2003). Once water is consumed, it is not available for use within the TVA system and must be accounted for in the evaluation of each alternative. TVA used the USGS estimates of 2030 consumptive water use by sub-basin (Appendix A, Table A-06) and accounted for future reductions in the amount of water available in its hydrologic modeling for all alternatives. Consumptive water use was assigned to the TVA system in sub-basins where use was projected to occur. Therefore, the analyses presented in this FEIS for all policy alternatives have accounted for the anticipated future consumptive water use.

Hydro Modernization Projects

In 1991, TVA began to rehabilitate and upgrade its hydropower generation facilities. Eventually, as many as 92 hydro turbine units at 26 plant sites may be rehabilitated and modernized. The goal of TVA's HMOD projects is to provide for a safer and more reliable hydropower system, improved operational efficiency, and increases in system capacity at an acceptable economical cost and return to TVA. The HMOD projects that were designed and funded, implemented, or completed on or before October 2001 are considered in this EIS as part of the Base Case (see Appendix A, Table A-09). The projects yet to be designed or implemented as of October 2001 are considered in the cumulative impacts analysis.

Hydro Automation Program

The purpose of the Hydro Automation Program is to install systems at TVA hydro plant sites to enable all control functions, such as starting, stopping, loading, and protecting the generating units, to be handled by remote and local computers. The hydro plants will be dispatched through the transmittal of operating schedules from the Hydro Dispatch Control Cell, located in the Power System Operations Center in Chattanooga. This central point of dispatch for the entire hydro system, in addition to local computers at the plants actually handling the operation of the generating units, allows for rapid system-wide response to varying power demands. Once complete in 2004, the program will greatly improve the flexibility TVA has to control all 109 of its conventional hydro generating units. This flexibility will allow TVA to reduce overall operating expenses and increase operating efficiencies. Upon completion of the program, TVA will be able to provide rapid, automatic, real-time dispatching of the generating units. This change in the operation of the system has been included in the evaluation of the Base Case and all of the policy alternatives.

Browns Ferry Nuclear Plant

In 2002, TVA decided to refurbish and restart Unit 1 at its Browns Ferry Nuclear Plant. TVA is also seeking to extend operation of all three units at the facility for an additional 20 years by renewing the operating licenses for Units 1, 2, and 3 prior to their expiration in 2013, 2014, and 2016, respectively. Coincident with the license renewal and Unit 1 refurbishment efforts, TVA is also uprating the capacity of all three units. Restart of Unit 1 could occur as early as 2007. Restart and operation of Unit 1 will require construction of an additional cooling tower and increasing intake flow rates by approximately 10 percent. The plant will be operated to ensure that the maximum cooling water discharge temperature and the temperature rise between intake and discharge remain within permitted limits. Use of cooling towers will increase and, on infrequent occasions when the cooling towers are unable to meet thermal limits, the plant will be derated to remain in compliance with the established limits. These operational revisions at Browns Ferry have been included in the evaluation of the Base Case and all of the policy alternatives.

3.3.2 Reservoir Recreation Alternative A

Purpose. The purpose of Reservoir Recreation Alternative A is to evaluate the balance of public benefits that would result if the reservoir system is operated to increase reservoir recreational opportunities while maintaining a degree of power system reliability. This alternative would maintain some summer contribution of hydropower to support power system reliability but at levels less than under the Base Case. Higher winter pool levels that may better support navigation on mainstem reservoirs and winter recreation are secondary components of this alternative.

> **Reservoir Recreation Alternative A—** operates the reservoir system to increase reservoir recreational opportunities while maintaining a degree of power system reliability.

Changes in Operations. Reservoir Recreation Alternative A would extend the summer pool period and would 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 to Labor Day.

To maintain summer pool levels, reservoir releases during summer would be generally limited to those necessary to meet project and system minimum flow[1] requirements and to maintain flood storage allocation. However, the bi-weekly average releases from Chickamauga Reservoir under the Base Case would be increased and limited to 25,000 cubic feet per second (cfs) weekly average from August 1 to Labor Day, providing sufficient flow through the mainstem reservoir system to minimize additional derating of nuclear and coal power plants.

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 targeted March 15 levels under the Base Case (Appendix A, Table A-02). On five mainstem reservoirs (Chickamauga, Fort Loudoun, Pickwick, Wheeler, and Watts Bar), the minimum winter elevation would be raised by 2 feet to provide a 13-foot navigation channel (11 feet with a 2-foot overdraft protection), 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.

Achievement of Objectives. Extending the period of summer pool and limiting releases during this period is expected to increase reservoir recreational opportunities. Reservoirs at or near summer pool elevation during the primary recreation period provide the greatest surface area for recreation; maximize access to the water via docks, marinas, and boat ramps; and generally increase reservoir and shoreline access. Higher winter reservoir levels are expected to increase recreational opportunities during off-peak recreation seasons but also may increase flood risk.

Limitations on discretionary reservoir releases between June 1 and Labor Day are expected to help maintain summer pool levels but are likely to reduce tailwater recreational opportunities and production of hydropower during the summer peak period. Reservoir Recreation Alternative A would likely improve the scenic beauty of the reservoirs during summer and reduce the exposure of flats and areas of dry reservoir bottom, contributing to an improved overall recreational experience. This alternative is expected to benefit recreation by increasing

[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 avoid 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.

the likelihood of achieving the June 1 target levels in the tributaries, which are expected to improve flatwater recreational activities.

Adoption of Reservoir Recreation Alternative A would likely reduce operational benefits achieved by the system in several areas. Maintaining reservoir levels longer in summer may reduce some early-fall flood storage volume, incrementally increasing flood risk. Extending summer pool levels is expected to delay the availability of water for discretionary releases to produce hydropower, possibly when peaking power is needed most. The reduction in summer hydropower production may be offset to some extent by maintaining the average weekly 25,000-cfs flow at Chickamauga Reservoir that would provide cooling water for power plants and minimize summer power plant derates. The additional water that is expected to be available for releases after Labor Day could reduce the need to derate power production at coal and nuclear plants that may occur during fall. Raising mainstem winter pools and reducing the range of fluctuation in reservoirs are expected to benefit navigation.

3.3.3 Reservoir Recreation Alternative B

Purpose. The purpose of Reservoir Recreation Alternative B is to evaluate the balance of public benefits that would result if the reservoir system is operated to increase reservoir recreational opportunities while maintaining a lower degree of power system reliability than under Reservoir Recreation Alternative A.

Reservoir Recreation Alternative B— operates the reservoir system to increase reservoir recreational opportunities.

Changes in Operations. As under 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 (a month longer than under the Base Case). 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.

Under Reservoir Recreation Alternative B, the method of flood storage allocation would be changed to provide adequate storage for the 7-day, 500-year inflow.[2] 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 (as under the Base Case).

[2] The 7-day, 500-year storage for a given reservoir is the storage volume required to store the maximum 7-day average local inflow from 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 under Reservoir Recreation Alternative B than under the Base Case but by an amount that would vary among reservoirs, depending on the level needed to store the volume of the 7-day, 500-year storm inflow. On mainstem reservoirs, the minimum winter elevation would be raised 2 feet, where possible, to create a 13-foot navigation channel (11 feet with a 2-foot overdraft). 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.

Achievement of Objectives. Under Reservoir Recreation Alternative B, extending the summer pool period and limiting releases between June 1 and Labor Day are expected to result in increased reservoir recreational opportunities—by a greater amount than under Reservoir Recreation Alternative A. The changes in operations during winter drawdown are likely to result in higher but more variable spring reservoir elevations as compared to the Base Case. Extended summer and increased winter reservoir levels may increase recreational opportunities beyond what would occur under Reservoir Recreation Alternative A.

Limitations of discretionary reservoir releases after June 1 would help maintain summer pool levels but would likely reduce tailwater recreational opportunities and production of hydropower during the summer peak period. Reservoir Recreation Alternative B is also expected to increase flood risk and reduce hydropower generation. Navigation benefits should be the same as those described for Reservoir Recreation Alternative A, except for increased benefit at Kentucky Reservoir. Continuation of releases from Chickamauga Reservoir at the present 13,000-cfs level, coupled with higher flood guides for tributary reservoirs, would likely reduce overall power generation and could, at times, reduce the availability of hydropower to meet summer peak loads. Maintaining only existing minimum flows at Chickamauga Reservoir, coupled with the shift of hydropower generation from summer to fall, may also increase the frequency of derating coal and nuclear plants.

3.3.4 Summer Hydropower Alternative

Purpose. The purpose of the Summer Hydropower Alternative is to evaluate the balance of public benefits that would result if the reservoir system is operated to increase production of hydropower during the peak summer demand period.

Summer Hydropower Alternative— operates the reservoir system to increase the production of hydropower during the peak summer demand period.

Changes in Operation. The principal change under the Summer Hydropower Alternative would be to begin unrestricted drawdown immediately after June 1 in order 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 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 increase to 35,000 cfs as compared to 13,000 cfs bi-weekly under the Base Case. The only scheduled tailwater releases would occur at Ocoee #2 Reservoir.

Achievement of Objectives. Beginning unrestricted drawdown on June 1 is expected to provide releases for hydropower production throughout summer and into fall as long as sufficient water is available. Increased releases from Chickamauga Reservoir would likely provide sufficient flow through the reservoir system to substantially reduce the potential for derating of nuclear and coal power plants, at least as long as water is available. These releases should allow greater generation of hydropower and may also sustain higher flows in tailwaters, possibly supporting more tailwater recreational opportunities. Reducing the winter flood allocation for tributary reservoirs is expected to increase winter reservoir levels and may increase winter recreational opportunities.

Water now stored during the summer period would likely not be available in fall to maintain navigation flows or minimize derates at coal and nuclear power plants. Reduced winter tributary flood storage allocation may result in higher winter reservoir levels and increased risk of flood.

Increasing hydropower production is expected to reduce benefits from several other operating objectives. Reservoir recreational opportunities are expected to decrease throughout summer and fall, compared to the Base Case. Beginning unrestricted releases from reservoirs on June 1 and continuing through summer would lower reservoir levels and may decrease associated recreational opportunities. However, these lower levels would provide additional summer flood storage. Lower reservoir levels at the end of summer resulting from maximizing hydropower production may also provide less water to be released during fall in order to maintain water quality. In some years, less flow could be available to offset derating coal and nuclear power plant operations affected by thermal discharge permit limitations.

3.3.5 Equalized Summer/Winter Flood Risk Alternative

Purpose. The purpose of the Equalized Summer/ Winter Flood Risk Alternative is to evaluate the balance of public benefits that would result if the reservoir system is operated to adjust summer and winter reservoir elevations so that flood risk is similar throughout the year in all reservoirs.

> **Equalized Summer/Winter Flood Risk Alternative—**operates the reservoir system to seasonally equalize flood risk by adjusting summer and winter elevations.

Changes in Operations. 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 storm[3] 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

[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.

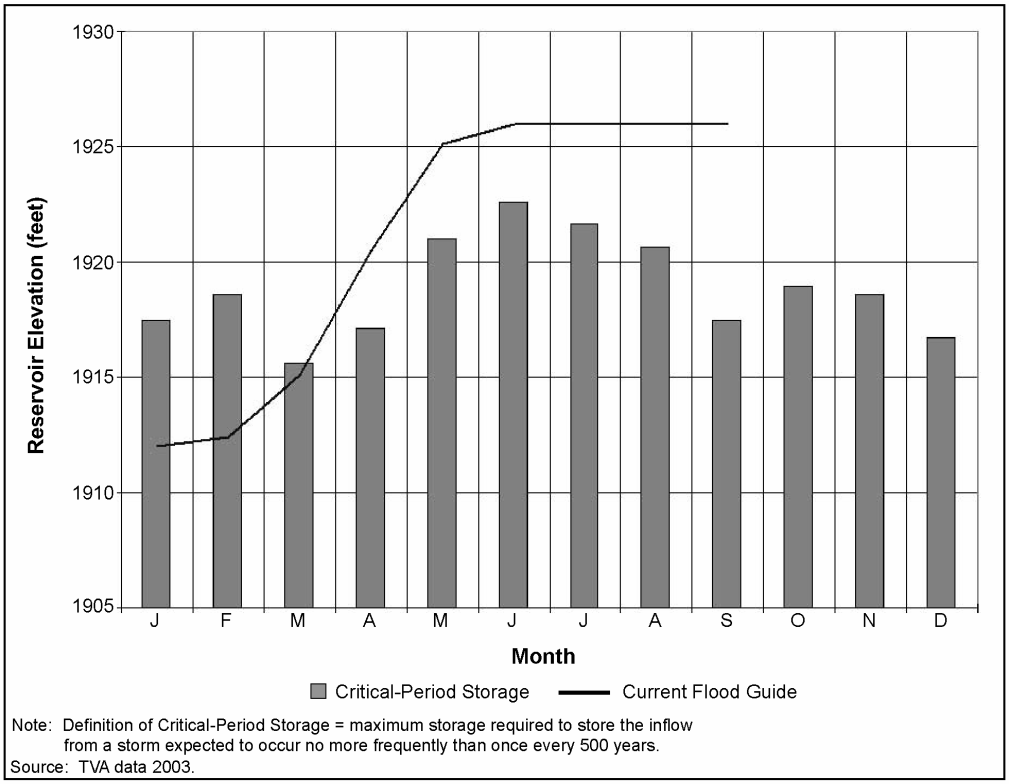

Figure 3.3-01 Example of Critical-Period Storage Versus Current Flood Guide at Chatuge Reservoir

end of May. Figure 3.3-01 is an example of the critical-period storage versus a current flood guide.

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.

Achievement of Objectives. Under the Equalized Summer/Winter Flood Risk Alternative, winter flood risk generally is expected to increase somewhat and summer flood risk would decrease. Lower summer reservoir levels would likely decrease summer recreational opportunities.

Limitations of discretionary reservoir releases between June 1 and Labor Day could help to maintain summer pool levels but would likely reduce tailwater recreational opportunities and production of hydropower during the summer peak period. Increasing flows from Chickamauga Reservoir to 25,000 cfs from August 1 to Labor Day may retain the ability to limit derates at nuclear and coal power plants at levels similar to what occurs under the Base Case.

3.3.6 Commercial Navigation Alternative

Commercial Navigation Alternative— operates the reservoir system to increase the reliability and reduce the cost of commercial navigation on the Tennessee River.

Purpose. The purpose of the Commercial Navigation Alternative is to evaluate the balance of public benefits that would result if the reservoir system is operated to increase the reliability and reduce the cost of commercial navigation on the Tennessee River.

Changes in Operations. Changes to operations would primarily affect the mainstem portion of the reservoir system. Raising the winter flood guides by 2 feet on mainstem reservoirs, where 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 elevations. A limitation on maximum flow (except in flood control situations) would be imposed at Barkley Reservoir, when practical, to reduce high-flow navigation hindrances.

Achievement of Objectives. Raising winter flood guides on mainstem reservoirs, where appropriate, and increasing minimum flows at selected projects is expected to increase the operating depth of most of the navigation channel. Increasing the depth of the navigation channel would likely provide increased access on the Tennessee River to larger or more heavily laden barges, reducing the cost of waterborne transportation.

Increasing the flood guide during the winter period would likely reduce the flood storage allocation in the mainstem reservoirs, thereby increasing flood risk. Achievement of other system benefits is not expected to change under the Commercial Navigation Alternative relative to the Base Case.

3.3.7 Tailwater Recreation Alternative

Tailwater Recreation Alternative— operates the reservoir system to increase tailwater recreational opportunities.

Purpose. The purpose of the Tailwater Recreation Alternative is to evaluate the balance of public benefits that would result if the reservoir system is operated to increase tailwater recreational opportunities. This alternative would be achieved by adopting the changes to system operations similar to those described for Reservoir Recreation Alternative B and also by scheduling reservoir releases at selected projects to increase tailwater recreational opportunities.

Changes in Operations. Under the Tailwater Recreation Alternative, tailwater recreation releases would have higher priority than maintaining water levels for reservoir recreation.

Changes under the Tailwater Recreation 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 releases would be scheduled to increase tailwater recreational opportunities at five projects (Apalachia, Norris, Ocoee #1, South Holston, and Watauga/Wilbur). Under the Tailwater Recreation Alternative, these releases would be formally scheduled; under the Base Case, most recreational releases are not formally scheduled and are made only after other operating requirements have been met.

Achievement of Objectives. An increase in tailwater flows to support tailwater-related recreational activities is expected to achieve the primary objective of increased tailwater recreational opportunities. Where additional releases are scheduled for recreation, the increased certainty that such flows would be available may also increase the attractiveness and reliability of those tailwaters for recreation. Other benefits described for Reservoir Recreation Alternative B are expected to occur, including increased reservoir recreational opportunities and increased boating access (although less than under Reservoir Recreation Alternative B because of the releases to the tailwaters).

The Tailwater Recreation Alternative may cause a decrease in power supply reliability by increasing the frequency of derating TVA's coal and nuclear power plants and by reducing the availability of water for discretionary production of hydropower—possibly during periods of peak demand.

3.3.8 Tailwater Habitat Alternative

Purpose. The purpose of the Tailwater Habitat Alternative is to evaluate the balance of public benefits that would result if the reservoir system is operated to improve conditions in tailwater aquatic habitats by adjusting tailwater flow conditions in relation to natural variations in runoff. Tailwater habitat would also be improved by decreasing the rate of river fluctuations associated with rapid changes in the number of turbines operated.

> **Tailwater Habitat Alternative—**operates the reservoir system to improve conditions in tailwater aquatic habitats.

Changes in Operations. 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 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 the Tailwater Habitat 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.

Achievement of Objectives. Decreased daily variability in tailwater flows is expected to improve aquatic habitat and tailwater water quality, increasing the viability of project tailwaters to support both aquatic plant and animal species and water-dependent wildlife species. A secondary benefit is expected to be increased tailwater recreational opportunities. Because tailwater flows would be more directly related to seasonal changes in runoff, tailwater benefits may be more related to variation in the hydrologic cycle. An increase in winter mainstem reservoir levels would likely increase navigational access and provide benefits through reduced waterborne transportation costs.

Limitations of discretionary reservoir releases are expected to help maintain summer pool levels but would likely reduce tailwater recreational opportunities and production of hydropower during the summer peak period. Obtaining additional habitat benefits may not reduce the total amount of hydropower generation but could result in a decrease in the capacity of hydropower production during the periods of peak demand. The frequency of coal and nuclear power plant derating also may be increased, especially during late summer, when derating is most likely to occur. These effects would affect the overall reliability of power supply.

3.3.9 Preferred Alternative

> **Preferred Alternative**—operates the reservoir system to provide increased opportunities for reservoir and tailwater recreation while meeting other operating objectives.

Purpose. The purpose of the Preferred Alternative is to establish a balance of system operating objectives that is more responsive to the values expressed by the public during the ROS and consistent with the operating priorities established by the TVA Act. 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 in order to create a more feasible, publicly responsive alternative. The Preferred Alternative was created after extensive public review of and comment on the DEIS and additional analyses.

Changes in Operations. 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, Guntersville, 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 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.

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.

Specific details of the Preferred Alternative are presented in Table 3.3-01 and Appendix B.

Achievement of Objectives. Adjusting flood guide elevations based on flood risk analysis and providing increased minimum flows during June, July, and August would avoid and reduce impacts related to the primary reservoir system operating objectives of flood control, navigation, and power generation that were associated with other alternatives identified in the DEIS. This alternative would not increase annual average flood damages at any critical location within the Tennessee Valley, including Chattanooga. It would provide a more equitable way of balancing pool levels among the tributary reservoirs. It would increase the minimum depth of the Tennessee River navigation channel at two locations and would maintain power system reliability while lessening impacts on delivered cost of power compared to other alternatives.

Maintaining reservoir pool elevations as close to the flood guide as possible during summer and delaying the unrestricted drawdown would provide greater recreational opportunities and use of the reservoirs. Higher winter pool levels are expected to increase recreational opportunities during off-peak recreation seasons as well as increase hydropower production. Where additional water releases are scheduled for recreation, the increased certainty that such flows would be available may also increase the attractiveness and reliability of those tailwaters for recreation.

With reservoir pool levels similar to the Base Case, impacts on wetland extent, distribution, and habitat connectivity would be reduced. Not changing the operating guide curves for Kentucky Reservoir would reduce the potential adverse effects on flood control, seasonal exposure of flats habitats, interference with the operation and integrity of managed areas, and impacts on adjacent forested wetlands compared to the other action alternatives.

As a result of higher minimum flows from June 1 through Labor Day, impacts on water quality would be reduced compared to the other action alternatives, except for the Commercial Navigation Alternative. Reducing water quality impacts would also benefit aquatic resources, because water quality is a major factor that influences the health of fisheries and the quality of aquatic habitat.

3.4 Other Actions Considered

Many policy elements were considered during formulation of the policy alternatives. Discussion of these elements revealed that some could be implemented independent of a change in TVA's overall reservoir operations policy while others were infeasible to be included in any reservoir operations policy. Actions that could be implemented independent of a change in the reservoir operations policy are discussed in Section 3.4.1. Elements that have not been included in any of the policy alternatives are discussed in Section 3.4.2. Alternatives that included these elements were determined to be unreasonable primarily because the negative effects outweighed the potential benefits, and overall public value of the reservoir system was not improved.

3.4.1 Actions That Exist or Could Be Implemented Independent of a Change in the Reservoir Operations Policy

Bear Creek and Normandy Projects

Although the Bear Creek (Bear Creek, Cedar Creek, Little Bear Creek, and Upper Bear Creek) and Normandy Projects are included in the 35 projects being studied in the ROS, it was determined that the operating guidelines already established for the five projects would not change as a consequence of a change in the overall reservoir operations policy for the following reasons:

- The guide curves for Normandy, Bear Creek, Cedar Creek, and Little Bear Creek have summer pool elevations that span from mid-April to mid-November.
- Guide curves for Normandy, Bear Creek, Cedar Creek, and Little Bear Creek already have a limited flood storage allocation, leaving little opportunity for further changing winter flood storage.
- The guide curve for Upper Bear Creek has little planned annual fluctuation and no flood storage allocation.
- Releases to the tailwaters of these five projects are already controlled to maintain appropriate water quality parameters (primarily DO) for water supply and fish hatchery needs below Normandy.

After review, TVA concluded that operation of these projects would not be modified under any of the policy alternatives.

Ramping Rates

The IAT/PRG members asked TVA to consider reducing ramping rates in order to moderate fluctuations in downstream tailwater flows. Existing ramping rates were designed to generate cost-effective hydropower during periods of peak electricity demand during the day. Some fluctuations in water releases must occur when bringing turbine units online to meet peak demands; at times, units may need to be ramped up quickly. Changing ramping rates was included as an element of the Tailwater Habitat Alternative. This alternative would reduce turbine peaking effects on tailwaters.

In addition to evaluating ramping rates in the ROS, TVA is automating most of its conventional hydropower generating units (see discussion of the Hydro Automation Program in Section 2.3

under Hydropower Generation Facilities). The automated system will enable TVA to operate turbines at several hydro plants at the same time to generate needed power rather than using multiple turbines at only a few hydro plants to achieve the same amount of generation. This new ability will allow TVA to more effectively shape water flows throughout the water control system.

Fish Spawning

Organized angling groups, individuals, and state fishery management agencies recommended filling reservoirs earlier and extending the period of stable water levels (see the discussion of fish spawning in Section 2.3.7) to enhance fish spawning success. Based on its analysis, TVA determined that this could not be done due to increased flood risk and impacts on achieving full summer pool. However, TVA plans to stabilize reservoir levels to the extent possible for 2 weeks during the spring spawning period (by limiting a drop in pool elevations to a maximum of 1 foot per week except for flood storage recovery or critical power situations) when water temperatures reach 60 °F (instead of the present trigger level of 65 °F). This will improve the spawning conditions of cooler water species (see Section 5.7, Aquatic Ecology, for further discussion).

Biodiversity Considerations

Diverse assemblages of aquatic species occur in the flowing-water habitats downstream from several tributary and mainstem dams. In some of these tailwater reaches, the abundance and diversity of these aquatic communities could be improved through a combination of operational and physical modifications to the dam. These modifications might involve changing project minimum flows; the timing of releases; or the quality of the released water, such as its temperature. For example, substantial flow and temperature fluctuations occur in the downstream part of the Elk River when the hydropower unit at Tims Ford Dam is operated. Changing operations at the hydropower plant could reduce variations in the tailwater habitat and could aid in the recovery of the diverse but sparse aquatic community in this river reach. Independent of the ROS, TVA is evaluating project-specific alternatives for operating Tims Ford Dam to improve the diversity of the aquatic community in the Elk River. Other project-specific actions to improve biodiversity could be analyzed on a case-by-case basis as the opportunity for habitat improvement is identified.

Under all of the action alternatives, TVA would provide a continuous minimum flow up to 25 cfs in the 13-mile reach of the Hiwassee River between Apalachia Dam and Apalachia Powerhouse from June 1 through November 1 to enhance the diversity of aquatic species in that waterbody. The augmented flow would increase the amount of and improve the quality of the habitats for aquatic life that exist or could be introduced to this part of the Hiwassee River (see Section 5.13, Threatened and Endangered Species, for further discussion).

Operations under Drought Conditions

During drought conditions, TVA must continue to meet water quality and water supply commitments, and, to the extent possible, uses the flexibility in its reservoir operations policy to maintain other minimum benefits. TVA is considering development of a formal drought management plan that would include other agencies and entities and provide revised guidelines for operating under drought conditions. Depending on the recommendations that may result from this effort, a supplement to the reservoir operations policy that TVA may adopt as a result of the ROS could be proposed. For the purposes of this EIS, simulated operations assumed continued operation at only minimum flows during drought conditions.

Adaptive Management

During the public scoping process, adaptive management was proposed as an implementation strategy to be included in a revised reservoir operations policy. Adaptive management involves monitoring and modifying system operations as appropriate in response to future changes in regulatory requirements, unanticipated trends in future water availability, the status of various sectors of the environment, and changes in technology. TVA currently practices adaptive management through the flexibility built into the guidelines for management of the water control system and extensive monitoring of the reservoir system. TVA uses this flexibility to adjust reservoir operations in response to variability in water availability and other environmental conditions.

Because TVA practices adaptive management, evaluation of adaptive management as a separate policy implementation strategy was not considered necessary. Regardless of the alternative selected, TVA would continue its ongoing adaptive management approach.

3.4.2 Actions Not Included in Any Policy Alternative

Structural Modification to Dams and Levee Construction

The ROS is a comprehensive evaluation of how TVA should operate its existing water control system to enhance its public value. Removal of or major structural modifications to project dams and levees was not carried forward as an element of any of the policy alternatives. Dam removal would result in lost power, recreational, and economic benefits, as well as increased flood risk—depending on the dam to be removed. TVA does not consider dam removal a reasonable alternative for detailed evaluation because it would not achieve the project purpose of increasing the overall public value of operating the existing reservoir system. Structural modifications at specific locations could be considered in the future, as appropriate, depending on identified needs.

Building a system of levees to provide additional flood protection for Chattanooga was considered in the original design of the flood control system for the eastern half of the Tennessee Valley. Instead of building these levees, Chattanooga city government and area residents assumed the risk of flood damages that cannot be prevented by TVA flood control operations. Land that is subject to flooding has been identified, and property owners can purchase flood insurance if eligible. In addition, the city of Chattanooga has made the river a focal point for the community. To build levees today would almost completely eliminate use and views of the river. TVA does not believe that such a levee system is likely to be constructed because of the extremely high construction costs and the probable adverse effects on such resources as aesthetics, water quality, and aquatic ecology.

Maintaining Year-Round Summer Reservoir Levels

Maintaining all reservoirs at summer pool level year-round would reduce flood storage allocation throughout the system in winter, the period of greatest runoff. This practice would increase flood risk and associated flood damage to unacceptable levels—for example, exposing Chattanooga and other cities to similar levels of flood risk that occurred before construction of the TVA system. Therefore, this element was not considered in the formulation of alternatives.

Reducing Minimum Flows from Tributary Dams

During the scoping process, reducing minimum flows from tributary dams was suggested to assist in maintaining higher summer pool levels. Minimum flows included in the existing operating guidelines are described in Chapter 2 and in Appendix A, Table A-03. These flows were designed to improve water quality conditions and protect aquatic habitat. The RRI Program and the 1990 Lake Improvement Plan were developed to address the operating objective of water quality. These initiatives concluded that water releases were directly connected with water quality and that improved water quality would be achieved by increasing minimum flows and using aeration techniques. Reducing minimum flows is inconsistent with the policy changes adopted as part of these prior evaluations and would negatively affect water quality (which was identified as an operating objective during public scoping). Therefore, reducing minimum flows was not included as an element of any of the policy alternatives that were evaluated in detail.

Earlier Filling and Later Drawdowns

During the formulation of the initial 25 alternatives, the ideas of raising reservoirs to summer pool levels by March 1 or April 1 and delaying unrestricted drawdown until October 1 or November 1 were evaluated but not carried forward. Filling reservoirs to summer pool by March 1 or April 1 was not considered for detailed analysis because filling reservoirs before the end of the flood season would compromise TVA's ability to control runoff in spring and consequently increase flood damage. Delaying unrestricted drawdown until October 1 or November 1 would reduce flows from the Tennessee and Cumberland Rivers during September and October, when water levels on the lower Ohio and Mississippi Rivers already are likely to be low. Effects on navigation, combined with shifts in power generation, impacts on power system reliability, and environmental effects, outweigh the potential benefits to be gained from improvements in scenery, reservoir fisheries, recreation, residential development, and associated economic growth around the affected reservoirs. Accordingly, this would not improve the overall public value of the reservoir system.

Providing Recreational Flows on the Ocoee River

Some recreational interest groups recommended providing additional recreational flows on the Ocoee River. Recreational flows for Ocoee #2 and Ocoee #3 were the subject of two separate EISs that included decisions concerning recreational releases to the Ocoee River and are not included in this FEIS (USDA et al. 1994, 1997). This EIS does consider recreational flows from Ocoee #1 and potential impacts of reservoir operations policy alternatives on the Ocoee River.

Reducing the Navigation Channel to 9 Feet

Reducing the commercial navigation channel on the Tennessee River to a 9-foot channel depth would impede navigation because the river would become narrower and shallower. A 9-foot channel depth would leave only a 7-foot draft for barge traffic. Shipments by barge from the Ohio and Mississippi Rivers would be required to trans-ship (transfer cargo from one barge to another) to smaller barges for the Tennessee/Cumberland Rivers portion of their trips. Similarly, shipments leaving the Tennessee/Cumberland Rivers could trans-ship to deeper draft barges. Both of these scenarios would result in barge terminal congestion and higher costs. In addition, less water would likely be available in drought years to fill the pools on the lower Ohio and Mississippi Rivers, impairing navigation on these rivers.

Reducing the navigation channel also would result in environmental and economic impacts. Potential adverse environmental impacts would include shoreline erosion and sedimentation, impacts on water quality and aquatic habitats, damage to riparian habitats, loss of archaeological resources, and increased boating hazards. The economic impacts for firms or industries that ship or receive large volumes or bulk commodities would likely be substantial as they would be required to switch to alternative transportation modes. Given these potential adverse impacts and loss of overall public value, TVA did not evaluate this alternative in detail.

Dredging the Navigation Channel

Dredging the existing navigation channel to provide a 12- to 13-foot channel would require extensive excavation and blasting, interrupt shipping, be costly, and adversely affect the environment. Dredging and disposal would cost between $10 and $25 billion. The potential environmental effects of dredging would likely include adverse impacts on threatened and endangered species, commercial fisheries, and water quality. In addition, it is highly unlikely that government agencies and other constituents would approve such a project. TVA did not evaluate this alternative in detail for these reasons.

Improving Existing Facilities and Reservoir Access

During the scoping process, some members of the public recommended improving public access to TVA reservoirs by providing better maintenance for existing facilities, constructing new facilities at existing access sites, and developing new access points. These actions were not included as a policy element in any alternative that was evaluated in detail because they were considered outside the scope of a programmatic analysis of how TVA should operate its existing water control system. Each of these actions could be evaluated and undertaken on a project-by-project basis.

Strengthening TVA's Regulatory Authority to Enforce Laws and Control Pollution

During the scoping process, some commentors suggested giving TVA more regulatory authority to enforce laws related to water pollution. This issue was raised and addressed in the 1990 Lake Improvement Plan. Existing federal, state, and local government agencies have jurisdiction over water pollution issues. It is unlikely that the agencies with the authority to enforce water pollution laws or Congress would support legislation providing such authority to TVA; therefore, this policy element was removed from further evaluation.

Creating Incentives for Energy and Water Conservation

During the public scoping process, it was suggested that TVA investigate providing incentives for energy conservation as a way of reducing the need for more expensive forms of power generation. Although a valuable suggestion, public incentives for energy conservation are not within the scope of this EIS. The ROS study involves the review of the reservoir operations policy. In addition, incentives for energy conservation and demand-side management were considered in TVA's Energy Vision 2020 EIS.

Constructing or Relying on New and Alternative Energy Sources

TVA operates the river system for several reasons including hydropower production. Hydropower is the most economical form of electricity available on the TVA system. It offers versatility and dependability that cannot be equaled by any other type of capacity, and it is more efficient than any other form of power generation. Despite the numerous advantages of hydropower, obtaining permission to build and finance the construction of new dams would be difficult.

Alternatives to hydropower are likely to be expensive to install, more expensive to operate, and less flexible in supplying peaking power and coping with system emergencies. They also would require more backup capacity. Purchases of power from an interconnected power system are an option, but the supply and price of this interchange power have fluctuated widely. In addition, a range of alternative energy sources was fully evaluated in TVA's Energy Vision 2020 EIS.

3.5 Comparison of Alternatives

Identifying the trade-offs between competing reservoir operating objectives was essential to evaluating the policy alternatives. TVA performed a comprehensive environmental and economic evaluation of each of the policy alternatives, which are described by resource sector in Chapter 5. Three separate evaluations were performed—one with respect to the objectives identified during the public scoping process (see Section 3.5.1), a second to evaluate impacts on each of the environmental resources (see Section 3.5.2), and a third to calculate regional economic benefits (see Section 3.5.3).

3.5.1 Objectives Identified during Scoping

TVA conducted an extensive scoping process to obtain public input on future operations of the water control system. Through this process, TVA identified 12 objectives that were the basis of formulating and evaluating policy alternatives (see Sections 1.6 and 3.2). Table 3.5-01 shows how well each policy alternative performed in relation to these objectives.

3.5.2 Impacts on Resource Areas

TVA analyzed 24 resource areas that reflect a wide range of issues important to the residents of the Tennessee River basin. Table 3.5-02 compares the effects of the policy alternatives on each of these resource areas. This table summarizes the results of TVA's environmental analysis, which is documented in Chapter 5.

Tables 3.5-01 and 3.5-02 present different but closely related information. Table 3.5-01 focuses on the specific objectives identified by the public. Table 3.5-02 summarizes the results of technical analyses of the 24 resource areas by specialists, using more detailed metrics, modeling, and analysis. Table 3.5-01 is not derived directly from the results presented in Table 3.5-02.

Impacts on elements of the 24 resource areas were assessed using four impact levels, including No Change, Slightly Adverse/Slightly Beneficial, Adverse/Beneficial, and Substantially Adverse/Substantially Beneficial (see inset box for definitions). 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 3.5-01 Summary of Policy Alternative Performance by Objectives Identified during Public Scoping

Objective	Alternative								
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat	Preferred
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	$1M (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 3.5-01 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	Substan-tially 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).

Table 3.5-02 Summary of Impacts by Policy Alternative

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
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 3.5-02 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
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
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
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)
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

Table 3.5-02 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
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 3.5-02 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
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
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)
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

Table 3.5-02 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
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
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
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)
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

Table 3.5-02 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**
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 3.5-02 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 3.5-02 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
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
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
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)

Table 3.5-02 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
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 various species of wildlife)	Slightly beneficial to adverse (Slight increases in aquatic beds would benefit wildlife; changes in wetland communities would adversely affect various 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 waterfowl and 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 various 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 establish-ment and spread would continue	No change	No change	Slightly adverse	No change	No change	No change	No change	No change

Table 3.5-02 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
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 dis-charges at one dam)	No change
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 others, less late summer temperature variation in some tailwaters)	Variable (Less natural water temperatures in some tailwaters, more natural in others, less 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 others; less 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)

Table 3.5-02 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)									
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
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
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
Cave aquifers	No change Existing trends would continue	No change	No change	No change	No change	No change	No change	No change	No change

Table 3.5-02 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
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 subimpound-ments, flats, scrub/shrub, and forested wet-lands, and some asso-ciated 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
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

Table 3.5-02 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
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 3.5-02 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
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
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
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)
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
Leakage	No change in existing conditions	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

Table 3.5-02 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**
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 3.5-02 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**
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 3.5-02 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
Recreation (continued)									
Private access site use	No change 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 3.5-02 Summary of Impacts by Policy Alternative (continued)

Notes:

Brackets indicate negative values.

CO	=	Carbon monoxide
CO_2	=	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.

Reservoir Recreation Alternative A, Reservoir Recreation Alternative B, Tailwater Recreation Alternative, and 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 adverse and beneficial 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 decreased water quality and 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 from low DO in project releases, and some impacts may be unavoidable.

Within this group of alternatives, Reservoir Recreation Alternative B, the 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 result in 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 result in 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 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 compared to the Base Case. It would also provide for more reliable recreational tailwater 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.

Potential mitigation measures for TVA's Preferred Alternative have been specified in Table 7.4-01 for adverse to substantially adverse impacts. The mitigation measures listed in Table 7.4-01 are based on the incremental impacts as compared to the Base Case.

3.5.3 Regional Economic Effects

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 3.5-03 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.

Table 3.5-03 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.

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 3.5-03. The impacts for 2010 represent the effects after changes to the operations policy have been absorbed into the regional economy.

3.6 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.