

Final Programmatic Environmental Impact Statement

Future Water Supply Needs in the Upper Duck River Basin

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Future Water Supply Needs in the Upper Duck River Basin

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Lead Agency:
Tennessee Valley Authority (TVA)

Cooperating Agencies:
TN Duck River Development Agency
TN Department of Environment and Conservation
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service

Abstract: TVA and the cooperating agencies have prepared this Analysis and programmatic Environmental Impact Statement to document the evaluation of the need for water in the upper Duck River watershed over a 50-year planning period (to the year 2050), to identify potential ways to meet any identified water need in part or all of this river basin, and to evaluate the environmental and socioeconomic impacts of several possible ways to meet the future water needs within the basin. A Needs Analysis report, issued in August 1998, indicated that the minimum flow being provided by Normandy Dam is expected to meet the water supply and water quality control needs of the Bedford County and Marshall County water service areas throughout the study period. Future demand in the Maury/southern Williamson County Water Service Area above 40 cfs (increasingly likely to occur in the years after 2015) would have to be met from other water supply sources which would have to be able to supply as much as 22 cfs of water by 2050. The four conceptual alternatives developed to meet this water supply need include two which could be implemented within the service area (a reservoir on Fountain Creek, and a downstream intake on the Duck River), one that would affect other parts of the Duck River watershed (raise the Normandy pool level), and one that would affect an area outside of the Duck River basin (a pipeline from Tims Ford Reservoir). In general, the extent of potential environmental effects of the action alternatives would be related to the amount of land area that would be modified or disturbed. The two alternatives which would involve the least amount of land disturbance (Downstream Water Intake, and Tims Ford Pipeline) also appear likely to have the least potential for adverse effects on the environment (almost exclusively short-term effects associated with construction of the pipelines and other facilities). Both of the other alternatives (Fountain Creek Reservoir, and Raise Normandy Pool Level) would involve modifications in much larger areas and would have substantially more potential for adverse environmental effects. Each of the action alternatives also would result in some benefits to water quality, aquatic life, and recreation on parts of the Duck River where the minimum flow would be higher than under the No Action alternative. TVA has concluded the preferred alternative in this programmatic EIS is that one or more action alternatives should be pursued to meet the future water needs in the Maury/southern Williamson County Water Service Area. TVA is not proposing to design or construct any of these facilities; however, as a regional water resource agency, TVA can assist in evaluating available alternatives and encourage cooperation among all communities that are dependent on common water resources. Local utilities, government agencies in the upper Duck River watershed, and other interested parties will be the ones to actually decide which alternative(s) should be pursued to meet their future water needs.

Request copies from: Linda B. Oxendine
Tennessee Valley Authority
400 W. Summit Hill Drive, WT 8C
Knoxville, Tennessee 37902

EXECUTIVE SUMMARY

The Tennessee Valley Authority (TVA), Tennessee Duck River Development Agency (DRDA), Tennessee Department of Environment and Conservation (TDEC), U.S. Army Corps of Engineers (USACE), and U.S. Fish and Wildlife Service have cooperated to prepare this analysis and programmatic Environmental Impact Statement (EIS). Members of the public and various other agencies have participated in this process by attending public meetings and providing comments on the scope of the EIS. TVA is the lead agency in the preparation of this document.

This document has three related purposes. It evaluates the need for water in the upper Duck River watershed over a 50-year planning period (to the year 2050), identifies potential ways to meet any identified water need in part or all of this river basin, and evaluates the environmental and socioeconomic impacts of several possible ways to meet the future water needs within the basin. The project area includes parts of Bedford, Marshall, Maury, and Williamson counties in southern middle Tennessee.

In an initial step, TVA worked with the local water utilities, the TDEC Divisions of Water Supply and Water Pollution Control, DRDA, USACE, and the U.S. Geological Survey to analyze the water supply needs in the Bedford, Marshall, and Maury/southern Williamson County water service areas. That Needs Analysis Report, issued in August 1998, described the present level of water use in the area, the water sources involved, and up-to-date projections of water supply demand for these three water service areas through the year 2050. The needs analysis indicated that the minimum flow being provided by Normandy Dam is expected to meet the water supply and water quality control needs of the Bedford County and Marshall County water service areas during worst case flow conditions throughout the study period (to the year 2050). The minimum flow being provided by Normandy Dam, accompanied by anticipated future return flows from wastewater treatment plants in the area, can be expected to supply up to 40 cubic feet per second (cfs) for water supply use to the Maury/southern Williamson County Water Service Area. Future demand above 40 cfs (increasingly likely to occur in the years after 2015) would have to be met from other water supply sources. By the year 2050, those other sources would have to be able to supply as much as 22 cfs.

The four action alternatives developed to meet the water supply need in the Maury/southern Williamson County Water Service Area include two which could be implemented within the service area (a reservoir on Fountain

Creek, and a downstream intake on the Duck River), one that would affect other parts of the Duck River watershed (raise the Normandy pool level), and one that would affect an area outside of the Duck River basin (a pipeline from Tims Ford Reservoir). These alternatives would provide water at different locations along the length of the Duck River. Each of these action alternatives assumes that future water demand in these water service areas would not adversely affect the flow projections in the river made in the Needs Analysis; assumes that Normandy Dam would continue to discharge up to 165 cfs for water quality control and water supply use in the Bedford County Water Service Area; and assumes that no new, large, water-consuming industries would locate in any of the water service areas in the upper Duck River basin.

In this programmatic EIS, these action alternatives have been generally described in light of their conceptual nature at this early stage. If and when a decision is made to provide some additional water for the Maury/southern Williamson County Water Service Area, the sponsors would determine the specific purposes of each project and would develop site-specific plans for the various facilities. As those plans are developed and proposals are made, detailed, site-specific evaluations of environmental effects would be conducted, if required and as appropriate, under the National Environmental Policy Act.

Adoption of **Alternative A** would mean that no new source of water would be developed to meet the projected future needs of the Maury/southern Williamson County Water Service Area. More than likely, the Spring Hill and Columbia water treatment plants would be expanded to withdraw and treat as much water from the river as possible; however, the worst case needs of this water service area are projected to exceed the available flow in the river during drought conditions some time after 2015. As the demand for water approached the available supply, treatment of area wastewater would become more difficult and expensive, and economic growth in the area probably would slow or stop. If the demand for water continued to rise and no additional water supply source for the area was developed, drought conditions probably would bring the imposition of water conservation measures and pleas to TDEC for permission to withdraw more water from the river. Large withdrawals from the river during drought conditions would result in adverse effects to aquatic life and recreational use of the river for several miles downstream from the Columbia water supply intake. Eventually, the increasing demand is likely to lead to the development of one or more additional water sources for the Columbia area.

Adoption of **Alternative B** would result in the construction of a water supply reservoir in the downstream part of the Fountain Creek watershed and an approximate 5-mile pipeline to transport water from this reservoir to a new treatment plant and on to the existing water distribution system. If this reservoir was built with a full pool at elevation 629 feet and if it included all of the adjacent land up to the probable maximum flood level, the project would affect approximately 3,600 acres, of which 800 acres is not already in public ownership and would have to be acquired. Construction of this project would create a relatively small, nutrient-rich reservoir which would have to be grouted to avoid significant leakage into the ground water. The reservoir would substantially change aquatic habitats, terrestrial habitats, land use, visual character, and recreational activities in the immediate area; however, the nature and extent of some of those changes would depend on how the reservoir and surrounding land were managed. The reservoir would support much lower diversity of aquatic life than the existing creeks; however, some species capable of living in standing-water habitats would be more abundant in the area than they are now. Construction of the reservoir could result in a net loss in local wetland functions and significant adverse effects on the extensive archaeological resources that are likely to be present in the area. If all of the future water demands of the Columbia area were to be met from the Fountain Creek reservoir, the flow not withdrawn from the river would help maintain acceptable water quality conditions for fish and aquatic life and recreational uses downstream from the water intake, as well as provide more initial dilution for the Columbia wastewater treatment plant discharge. If constructed and operated appropriately, this reservoir could meet all of the projected water supply needs of the Maury/southern Williamson County Water Service Area through at least 2050 and would not impede the anticipated level of local economic growth.

Adoption of **Alternative C** would lead to the construction of a water supply intake and pumping station on the Duck River downstream from the mouth of Catheys Creek (possibly near River Mile 104) and an associated 13-mile pipeline and booster station to transport water to a new treatment plant and to the existing water distribution system. If this project was constructed as described, it would have only short-term and minor effects on ground water, wetlands, floodplains, terrestrial life, endangered species, land use, visual character, natural areas, and cultural resources. Operation of the project would not be likely to cause any adverse effects on water quality or aquatic life at the intake site and the flow not withdrawn from the river would help maintain aquatic life and recreation downstream from the Columbia water intake during drought conditions. If withdrawals from the river between

Normandy and the Columbia area did not exceed present projections, this intake and pipeline could provide enough additional water to meet the anticipated water supply needs of the Maury/southern Williamson County Water Service Area through 2050 and would not impede the anticipated level of local economic growth.

Adoption of **Alternative D** would result in raising the pool level on Normandy Reservoir and increasing the minimum discharge from Normandy Dam. If this project was constructed as described, it would have only short-term and minor effects on terrestrial life, endangered species, and land use, and could result in minor beneficial effects on water quality and aquatic life in the Duck River downstream from Normandy Dam. Raising the pool level in Normandy Reservoir is likely to result in minor adverse effects on wetlands and cultural resources around the reservoir and significant adverse effects on visual character, existing recreation facilities around the reservoir, and on three acres supporting important features in the Short Springs State Natural Area. If constructed and operated appropriately, these modifications to Normandy Reservoir and its discharge could make additional water available in the Duck River. If withdrawals from the river between Normandy and the Columbia area did not exceed present projections, the augmented minimum flow in the river would provide up to 56 cfs for water supply to the Maury/southern Williamson County Water Service Area, enough to meet the water demand estimated to occur in that area around the year 2035. Water conservation and/or some other supply source would be required to meet the projected additional 6 cfs of demand by 2050 without impeding the anticipated level of local economic growth.

Adoption of **Alternative E** would lead to the construction of a water supply intake and pumping station on a northern embayment of Tims Ford Reservoir and an associated 20-mile pipeline and booster station to transport water to a discharge point on the Duck River near Shelbyville. If this project was constructed and operated as described, it would have only short-term and minor effects on ground water, wetlands, floodplains, terrestrial life, endangered species, land use, visual character, recreation, natural areas, and cultural resources. When this water transfer system was operating (only during drought conditions), it could have beneficial effects on surface water quality and aquatic life in the Duck River downstream from the discharge point. If withdrawals from the river between the discharge point and the Maury/southern Williamson County Water Service Area did not exceed present projections, this alternative would provide enough additional water to meet drought-condition needs of the service area

through 2050 without impeding the anticipated level of local economic growth.

In general, the extent of potential environmental effects of the four action alternatives seem to be related to the amount of land area that would be modified or disturbed. The two alternatives which would involve the least amount of land disturbance (Alternative C: Downstream Water Intake, and Alternative E: Tims Ford Pipeline) also appear likely to have the least potential for adverse effects on the environment (almost exclusively short-term effects associated with construction of the pipelines and other facilities). Both of the other alternatives (Alternative B: Fountain Creek Reservoir, and Alternative D: Raise Normandy Pool Level) would involve modifications in much larger areas and would have substantially more potential for adverse environmental effects. Each of the action alternatives also would result in some level of benefits to water quality, aquatic life, and recreation on parts of the Duck River where at least the minimum flow would be higher than under the No Action alternative.

TVA has concluded that one or more action alternatives should be pursued to meet the future water needs in the Maury/southern Williamson County Water Service Area. This is the TVA preferred alternative in this programmatic EIS. TVA is not proposing to design or construct any of these facilities; however, as a regional water resource agency, TVA can assist in evaluating available alternatives and encourage cooperation among all communities that are dependent on common water resources. Local utilities, government agencies in the upper Duck River watershed, and other interested parties will be the ones to actually decide which water supply alternative(s) should be pursued. Those local agencies and the publics they serve must determine how they want to address water needs in this river basin and how those systems will be operated.

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CHAPTER 1 - INTRODUCTION

1.1 PURPOSE

The Tennessee Valley Authority (TVA), Tennessee Duck River Development Agency (DRDA), Tennessee Department of Environment and Conservation (TDEC), U.S. Army Corps of Engineers (USACE), and U.S. Fish and Wildlife Service (USFWS) have cooperated to prepare this analysis and Environmental Impact Statement (EIS). TVA is the lead agency in preparing this document.

This analysis and EIS document has three related purposes. The first purpose is to evaluate the need for water in the upper Duck River watershed over a 50-year planning period (to the year 2050). A second purpose is to identify potential ways to meet any identified water need for part or all of this river basin. The third purpose is to evaluate the environmental and socioeconomic impacts of several possible ways to meet the future water needs for communities within this river basin. As a whole, this document is intended to present facts and figures about the future demand for water in the upper Duck River basin and evaluations of several possible ways of meeting the projected needs.

The EIS evaluation has been conducted at a rather general (programmatic) level because specific locations and facility designs have not been proposed for any of the possible water supply projects and each project would affect only a relatively small part of a wide geographic area. In addition, several of the alternatives would not have to be built for a number of years. A programmatic review such as this can identify the types of environmental and socioeconomic issues which could be affected by each of the alternatives and the relative amount of impact each alternative could have. This level of review can help agencies and the public make basic decisions about the kind of project which should be built. Such a review also can serve as an early warning about the important environmental and socioeconomic issues which should be considered and addressed during the design and detailed review of a project intended to meet the overall need.

TVA and many of the same cooperating agencies have recently completed a related EIS on alternative uses of the land that TVA acquired to be part of Columbia Dam and Reservoir. The final Land Use EIS was issued in April 1999 (TVA, 1999). Work on both of these EIS documents is being conducted in accordance with NEPA, Council of Environmental Quality regulations, and TVA implementing procedures.

1.2. COLUMBIA PROJECT HISTORY

Much of the pertinent history of the Columbia Dam Project is presented in the Land Use EIS (TVA, 1999). The following extract of that history is focused on the water supply aspects.

Duck River Project

In 1964, the leaders in Maury, Marshall, Bedford, and Coffee Counties (Figure 1) organized the Upper Duck River Development Association to request assistance under the TVA tributary area development program. Local leaders also saw the need to develop an organization with broad legal powers which had official recognition in the governmental structure of the area. In response to that need, the Tennessee Legislature created the Tennessee Upper Duck River Development Agency (later expanded to become the Duck River Development Agency - DRDA) in March 1965 and gave it broad responsibilities for formulating and carrying out plans and programs for improving the economy of the area.

In 1966, DRDA proposed the development of a water supply grid system to serve the four-county area. It included plans for interconnecting the five major cities (Columbia, Lewisburg, Shelbyville, Tullahoma, and Manchester) for greater economy, to aid industries requiring treated water, and to supply water to small communities and rural areas of the four counties. Federal grants, supplemented by municipal bonds, were obtained to construct the grid system which is now partially completed. With the local organizations concentrating on the water grid system and other concerns, TVA was requested to investigate water resource development.

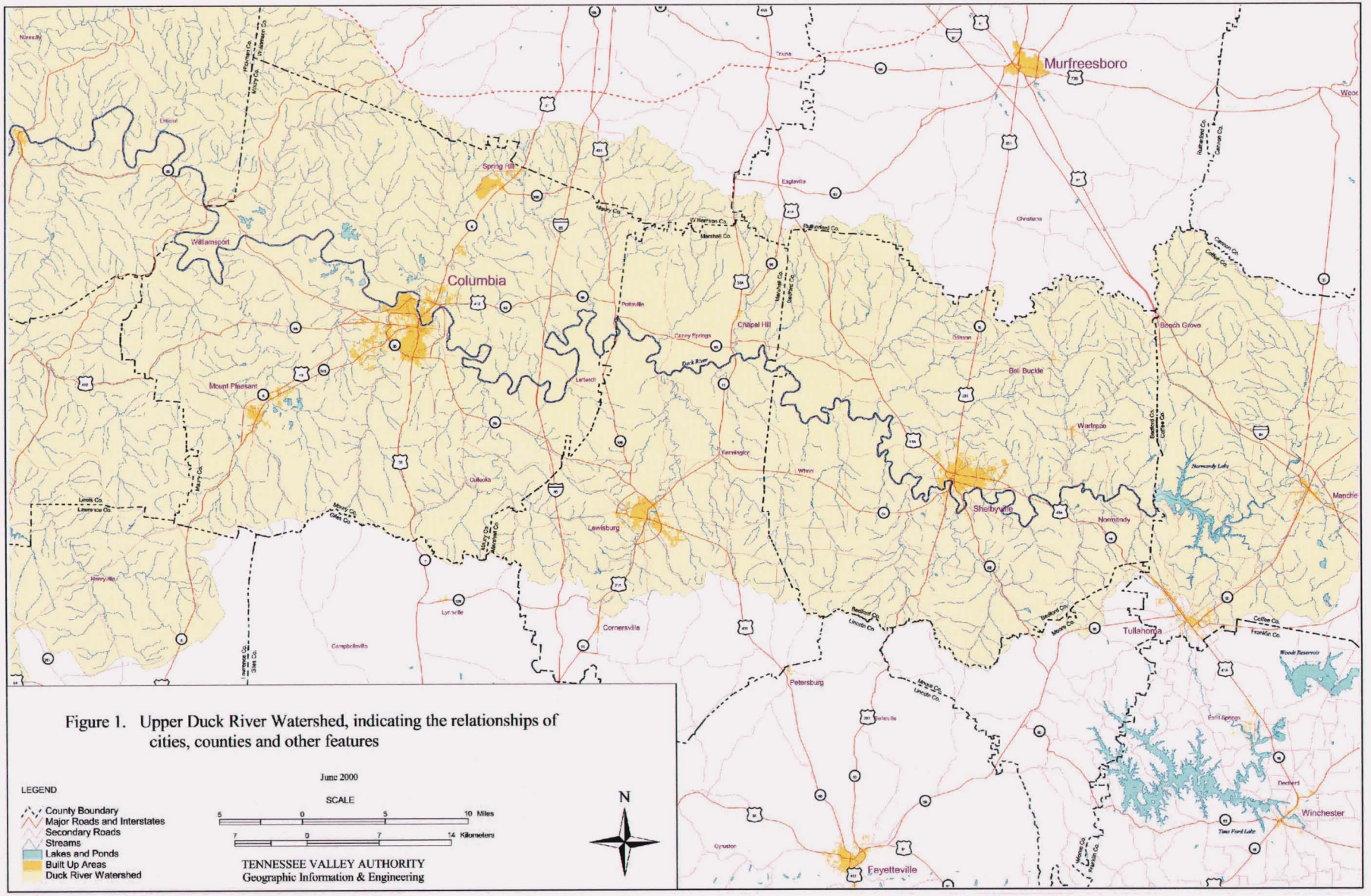


Figure 1. Upper Duck River Watershed, indicating the relationships of cities, counties and other features

TVA determined that multipurpose reservoir development on the main stem of the Duck River offered the best potential. A reconnaissance study in 1965 identified three dam sites on the Duck River which, if developed, could control the river and provide new opportunities for recreation and lakeshore development. These sites were the Columbia site at River Mile 136.7, the County Line site at River Mile 191.3, and the Normandy site at River Mile 248.6. Feasibility appraisals indicated that the Columbia and Normandy sites should be considered in more detail. The County Line site was less attractive because of apparent foundation problems and was eliminated from further consideration.

A planning report issued by TVA in August 1967 recommended building a dam at Columbia. Further studies proved the feasibility of a dam and reservoir at the Normandy site. The two dam and reservoir projects were then presented as units of the Duck River Project in a 1968 planning report (TVA, 1968). In that report the project was justified on the basis of enhanced employment (29 percent), recreation (25 percent), water supply (16 percent), flood control (7 percent), and water quality control (7 percent). The original construction cost of the Duck River Project was estimated at $73.5 million, of which $50 million was for the Columbia Dam and Reservoir. The benefit-cost ratio for the two-unit project was estimated at 1.2 to 1. For the Columbia unit, the benefit-cost ratio was 1 to 1. Congress began appropriating money for the Duck River Project in December 1969.

In 1971, TVA entered into an agreement with DRDA covering local participation in the overall project. In part, this agreement recognized a TVA commitment to include provisions for certain projected water supply needs in the area in the project design. The DRDA, in turn, committed to repay TVA a portion of the costs of the project. This payment was to consist of proceeds from the sale of specified quantities of water to the cities of Manchester, Tullahoma, Shelbyville, Lewisburg, and Columbia for a period of 50 years. A 5 cent per thousand gallon surcharge for water use has been charged since January 1972 to cover this repayment obligation. The DRDA total repayment obligation was set at $16.2 million, with $5.7 million due ten years after completion of Normandy Dam and the remaining amount of the principal due ten years after completion of Columbia Dam.

Following enactment of NEPA in 1970, TVA issued a draft EIS on the Duck River Project in June 1971. A public hearing on the project was held in August 1971 and a final EIS on the project was published in April 1972 (TVA, 1972). A supplement to the final EIS was issued in June 1974 (TVA, 1974).

Construction of Normandy Dam and Reservoir began in June 1972 and was completed in 1976, at a cost of $37.4 million. Since closure in January 1976, operation of Normandy Dam has reduced a number of downstream floods on agricultural land and at Shelbyville, Tennessee, and has supplemented low flows as necessary to meet water supply and water quality control needs at Shelbyville. In addition, Normandy Dam has assisted in meeting water quality control requirements and provided additional flow for water supply at Columbia.

Construction of the Columbia Dam and Reservoir was begun in August 1973. Original plans for Columbia called for a multipurpose reservoir to serve Maury and Marshall Counties with a summer pool at elevation 630 feet mean sea level and a winter drawdown to elevation 603 feet. The drawdown was to have sufficient flood detention capacity in the reservoir to reduce the flood of record at the city of Columbia to essentially a non-damaging stage. The reservoir also was intended to serve as a water supply source for Maury County, including an extensive industrial complex then located downstream from the city. Water released from Normandy Reservoir for water quality control requirements, together with additional water from storage in Columbia Reservoir, was to be released as necessary to help meet future water quality control and water supply needs in Maury County. Columbia Reservoir, with four times the surface area of Normandy Reservoir during the summer months, was expected to attract a diversity of recreational activity.

Endangered Species Act

Following passage of the Endangered Species Act (in 1973), the USFWS began listing species determined to be either endangered or threatened throughout all or a significant portion of their ranges. In 1976 and 1977, the USFWS added a number of freshwater mussels to the list of endangered species, including five species that had been known to occur in the Duck River. Consultation between TVA and USFWS resulted in a February 1977 Biological Opinion (USFWS, 1977a) which indicated that

completion of the Columbia Dam project would jeopardize the continued existence of two endangered mussels (the birdwing pearlymussel, *Conradilla caelata* [= *Lemiox rimosus*]; and the Cumberland monkeyface pearlymussel, *Quadrula intermedia*).

In 1978, the Office of Management and Budget (OMB) asked TVA to examine alternatives to completing Columbia Reservoir as originally planned that would provide project benefits but would not jeopardize the endangered species. In the report on that study (TVA, 1979), TVA found the two alternatives evaluated (a river development option and a low pool option at elevation 600 feet) to be unacceptable. The description of the project as planned (at elevation 630 feet) outlined a conservation program that could be implemented to benefit the endangered species and other endemic mollusks. As part of a September 1979 revision of the Biological Opinion (USFWS, 1979), the USFWS accepted the conservation program concept and made it a component of a reasonable and prudent alternative that would allow completion of a full-pool Columbia Reservoir. A significant constraint associated with this alternative was that the conservation program for the two endangered species had to be proven successful before the reservoir could be filled. In 1984, TVA and USFWS concluded that the conservation program was not likely to succeed because several established criteria had not been met.

Clean Water Act

TVA requested a Clean Water Act Section 404 permit for Columbia Dam from the USACE in October 1977. The USACE delayed action on the permit because of questions about water quality and endangered species. In December 1979, the Tennessee Commissioner of Public Health certified to the USACE that completion of Columbia Dam would not violate Tennessee water quality standards. The certification was appealed by the Environmental Defense Fund, Inc., and others to the State Water Quality Control Board. In April 1981, the state board issued a decision which found that the construction and operation of Columbia Dam would not violate state water quality standards nor cause any water quality degradation.

In August 1981, USACE issued the Section 404 permit for the Columbia Dam Project. Consistent with the Section 404 permit and the USFWS Biological Opinion, construction resumed on the project; however, the work was limited to roads and bridges which would be useful even if the project was not completed. The approved work was finished in September 1983 and all construction was halted.

Present Status

From 1983 through 1998, the Columbia Dam segment of the Duck River Project remained about 45 percent complete. The concrete portion of the dam was about 92 percent complete and the earth-filled section was about 60 percent complete. Approximately 46 percent of the land required for the reservoir (12,800 of 27,500 acres) had been acquired, and approximately half of the 45 miles of roads affected by the reservoir had been relocated. (However, the major relocation, replacing two Interstate 65 bridges crossing the Duck River, had not been started.) Through fiscal year 1984, some $80 million had been spent on the Columbia Project. When last calculated (in 1986), the total project cost was estimated to be approximately $238 million based on a 1992 completion date. At that time, the remaining cost to complete the project was around $123 million.

Early in 1995, TVA determined that the Columbia Dam Project could not be completed as a dam and reservoir due to the presence of endangered species and lack of present national support for projects of its kind. That decision prompted the preparation of the Land Use EIS to consider the potential environmental effects of various alternative uses for the land, and the preparation of this EIS to evaluate the effects of alternative ways to meet future water needs in the Columbia area. As part of the association between these two documents, TVA agreed that each alternative in the Land Use EIS would include the potential for using the land holdings in the Fountain Creek watershed as part of a water supply project. This EIS includes an evaluation of that alternative.

1.3 DECISIONS TO BE MADE

TVA will use the results of this analysis and EIS to make decisions both now and at pertinent times in the future. Results of the Needs Analysis (discussed in Chapter 2) will allow TVA to determine if various parts of the upper Duck River basin are likely to need additional water some time in the future. If a future need for water does exist in part or all of this basin, results of the EIS will help TVA understand the potential environmental effects of several alternatives being evaluated in detail. Results of the EIS also will help TVA decide which alternatives to recommend to DRDA, water systems in the area, and other local interests as reasonable ways to meet some or all of the projected water needs. If a specific proposal is made to build one or more water supply projects in the upper Duck River basin, the results of this EIS will provide substantial information to help TVA evaluate the potential effects associated with modifying part of the Tennessee River system and the issuance of permits under Section 26a of the TVA Act.

DRDA, area water systems, and a variety of government agencies in the upper part of the Duck River watershed are likely to use the results of this evaluation to help determine which of the alternatives should be pursued to meet any future water needs. At some point in time, those organizations will have to decide how and where to construct any facilities required to provide additional water for their customers.

TDEC, USACE, and USFWS are likely to use the results of this evaluation to clarify the potential environmental effects if and when any of the water supply alternatives are proposed. Information presented in this document should assist these regulatory agencies (among others) in making or evaluating long-term water development plans for the upper Duck River watershed.

1.4 SCOPING PROCESS

Public participation in determining the scope of the Water Supply EIS began on March 9, 1995, when TVA published a Notice of Intent in the *Federal Register* (TVA, 1995a). The Notice indicated that TVA intended to prepare this EIS and invited comments on the scope. The Notice also provided background information on the reason for the EIS and

presented initial ideas about alternatives and issues it was likely to include. In addition, the Notice announced that a public meeting would be held on May 2, 1995, to receive oral comments, and that written comments should be submitted before June 5, 1995.

The Water Supply EIS public meeting was conducted on May 2, 1995, at the Culleoka School in southeastern Maury County. During that meeting, 130 people filled out registration cards. Participants in the meeting had the opportunity to look at a variety of exhibits describing the project and pick up several handouts. After a short overview presentation, the attendees were invited to provide comments in one of five breakout sessions. Facilitators helped people record their comments on flip chart pages and, at times, noted when people endorsed comments which had already been recorded.

A similar Notice of Intent for the Land Use EIS was published in the *Federal Register on* February 25, 1995, and a public meeting about that EIS was conducted at the Culleoka School on April 18, 1995. That meeting, which followed the same format as the Water Supply public meeting, had 119 registered participants.

Another form of public participation on this project involved members of the Columbia Project Steering Committee. TVA invited representatives from federal, state, and local entities to review various aspects of Columbia-related projects and provide their individual perspectives as those projects moved forward. About the time the Notice of Intent was published, Steering Committee members were briefed on the intent of the Water Supply EIS. They offered a number of useful comments.

In addition to providing comments at the public meetings, agencies and members of the public sent a number of letters to TVA about Columbia Dam and these two EIS evaluations. By June 20, 1995, TVA had received a total of 364 letters commenting on these actions. These letters came from three federal agencies, seven state agencies, two municipalities, eight state-level non-governmental agencies, four local-level non-governmental agencies, and 339 individuals. The comments included in those letters were given the same consideration as comments made during the public meetings in setting the scope of this EIS.

Many of the written and oral comments addressed issues related to both the Water Supply EIS and the Land Use EIS. Once TVA realized this combining and mixing had occurred, all of the Columbia-related comments and letters were reviewed to help establish the scope of both documents.

The public identified a number of perspectives and environmental issues to be addressed in the Water Supply EIS. These perspectives and issues were summarized in a draft scoping document which was reviewed by members of the Columbia Projects Steering Committee. Comments from the Committee members were used to prepare a final scoping document that was printed and distributed in October 1995 (TVA, 1995b).

Major Themes in Public Comments

Several recurring thoughts were present in the oral and written comments concerning these two EIS projects. Many of these thoughts were based on different perspectives about completion of Columbia Dam and the need for additional water in the Columbia area. With regard to this EIS, the following thoughts were present:

- The region needs additional water.
- The area does not need additional water, especially if the Columbia wastewater treatment plant, aboveground storage capacity, and pumps are upgraded.
- Columbia Dam should be completed at elevation 630 feet or, if absolutely necessary, at elevation 600 feet.
- Columbia Dam should not be completed at all.
- An impoundment on Fountain Creek might meet area water needs.
- Land acquisition and disposition issues will have to be addressed.
- Conflicts between existing facilities and uses, as well as future needs and resources will have to be covered.
- Personal and family ties to farms and land acquired for the Columbia Reservoir cannot be ignored as this project continues to evolve.
- Resolution of these issues should be thorough, accurate, and completed in a timely manner.

All of these thoughts were considered as the scope of this evaluation was developed and, as appropriate, have been addressed in this EIS.

1.5 ISSUES TO BE ADDRESSED IN DETAIL

While this EIS includes information on a wide variety of subject areas, only a few subjects are focus points within the document. Discussions among TVA staff and various comments from the local water systems, other agencies, and individuals suggests that the following issues should be addressed in detail in this EIS:

Water Supply - The primary focus of this EIS is the future water supply needs in the Columbia area. As part of this evaluation, a needs analysis has been conducted to determine if, when, and how much water would be required to meet projected residential, commercial, and industrial water needs in the middle reach of the Duck River watershed throughout the next 50 years. The results of the needs analysis (discussed in Chapter 2) form the basis for completing the remainder of this evaluation.

Water Quality - Good water quality is important to the human population in this area because the Duck River is the source of several area water supplies and the potential focus of substantial recreational development. The quality of water in the Duck River system also is important to the survival of aquatic life in the area, including several endangered species.

Socioeconomic Effects - An adequate water supply is essential for the continued viability and economic growth of the region. This Water Supply EIS also should address the socioeconomic effects of each alternative approach to meeting the additional water supply needs.

Recreation - The impacts of each alternative on recreation and recreational opportunities should be identified and compared, in part because much local recreation is focused on the river.

Archaeological, Cultural, and Historic Resources - The Duck River watershed contains an abundance of prehistoric and historic cultural resources. Federal agencies are required to consider the impacts of various alternatives on these important resources.

Endangered Species - Several endangered or threatened species are known to occur in the counties which could be affected by water supply development for the Columbia area. Federal agencies are required to determine the possible effects of their activities on listed species and to protect and promote the recovery of listed species whenever possible.

1.6 STUDY AREA

The geographic focus of this evaluation is Columbia, Tennessee, and the surrounding Maury/southern Williamson County Water Service Area (Figure 1); however, a wider geographic area has been included in this evaluation to cover several ways of meeting the anticipated water need. Many of the resource areas covered in this EIS include all of the Duck River watershed from the Hickman/Maury county line (on the west) upstream to Normandy Reservoir in Coffee County (on the east). The northern and southern boundaries of this study area typically are the limits of the Duck River watershed, extended to include the southern part of Williamson County served as a part of the Maury/southern Williamson County Water Service Area, and two embayments on Tims Ford Reservoir (in Moore County) which are being evaluated as a possible water supply source. The geographic scope of this study area is illustrated on Figure 1. The reach of the Duck River included in this study area extends from approximately River Mile 100, at the Hickman County Line, upstream to the headwaters of Normandy Reservoir, River Mile 267.

1.7 RELATED DOCUMENTS

Several documents include information pertinent to the subjects covered in this EIS. These documents include:

- 1968 TVA Duck River Project planning report (TVA, 1968).
- 1972 Final EIS on the Duck River Project (TVA, 1972).
- 1999 Final EIS on alternative uses of the Columbia Project lands (TVA, 1999).
- U. S. Geological Survey report on future water demand in the upper Duck River basin (USGS, 1996).

- U. S. Army Corps of Engineers report on hydrology and hydraulics of a possible Fountain Creek reservoir (USACE, 1997a).
- U. S. Army Corps of Engineers report on geologic conditions in the area of the possible Fountain Creek Dam (USACE, 1997b).
- TVA Water Supply Needs Analysis for part of the upper Duck River watershed (TVA, 1998a).
- TVA and TDEC draft EIS on the use of land surrounding Tims Ford Reservoir (TVA and TDEC, 1999).

Pertinent information in these documents is incorporated by reference in sections throughout this EIS. Full citations for each of these documents is provided in Section 6.3, References.

1.8 REVIEW AND CONSULTATION REQUIREMENTS

A number of federal, state, and local laws and regulations would apply to the construction and operation of any of the action alternatives considered in this EIS. These laws and regulations are intended to provide safeguards against various types of impacts to the environment and other resources or activities in the area. Most of these laws and regulations would apply whether TVA, a state agency, a private company, or an individual was proposing a specific development action; however, the nature of the reviews and restrictions could vary depending on the kind of action that was being proposed and, at times, the type of agency proposing to build and operate the project. Many of these restrictions also include opportunities for public review and comment.

National Environmental Policy Act (NEPA)

NEPA, 42 U.S.C. 4321 et seq., requires all federal agencies, including TVA, to consider the potential environmental impacts of proposed actions before deciding whether to proceed. Under the TVA procedures for implementing NEPA and the regulations promulgated by the Council on Environmental Quality, there are three levels of environmental review: categorical exclusions, environmental assessments, and environmental impact statements (EIS). The kind of action and significance of the potential impacts dictate which level of review is to be used. Analyses become more detailed and public involvement more

extensive as an agency moves from a review for a categorical exclusion to an environmental impact statement.

This programmatic EIS includes only general evaluations of the potential environmental effects associated with the action alternatives. These evaluations are based on a variety of assumptions about the likely components of each project and assume that environmental, regulatory, and economic conditions would remain unchanged until each project was constructed. If and when a federal agency participates in building one or more of these alternatives, a subsequent NEPA document would have to be prepared. That categorical exclusion, environmental assessment, or EIS document would confirm or revise the potential environmental effects of the specific activities that were, then, proposed to be built and operated.

Construction Permit Reviews

The state of Tennessee requires potential dischargers of stormwater to obtain a National Pollutant Discharge Elimination System (NPDES) storm water runoff permit before site preparation and construction activities can commence. NPDES permit limits are set to protect water quality and water uses that have been identified by the state for stream reaches. The Environmental Protection Agency (EPA) has an opportunity to review and comment on proposed NPDES permits, as does the general public.

Under each of the action alternatives, appropriate NPDES stormwater permits would have to be obtained once specific components of the projects were developed. Compliance with NPDES construction and operational permit conditions would be required and monitored by the state.

Protection of Wetlands and Floodplains

Because of their biological value, wetlands receive special protection under federal law. Before most wetlands can be disturbed, a permit must be obtained from the USACE under Section 404 of the Clean Water Act. The EPA and the public typically have opportunities to review and comment on the proposed permits. As part of the permitting process, Tennessee would be asked to determine whether the proposed action would violate state water quality standards. Under Executive Order No.

11990 (Protection of Wetlands), federal agencies are required to avoid impacting wetlands with new construction to the extent practicable and to otherwise minimize potential wetland impacts. Alteration of streams and wetlands are controlled at the state level by the Tennessee Aquatic Resource Alteration Permit program.

Under Executive Order No. 11988 (Floodplain Management), federal agencies are directed to avoid occupying or modifying floodplains to the extent practicable and to otherwise minimize potential impacts to floodplain values. At the local level, Maury, Marshall, and Moore counties, and Columbia and Shelbyville have adopted regulations that control development in floodplains.

This EIS includes general evaluations of the action alternatives on wetlands and floodplains based on present assumptions about the likely components of each project. If and when one or more of these water supply alternatives are proposed to be built, more detailed reviews of the potential impacts on wetlands and floodplains would have to be conducted in accordance with regulations in effect at that time.

Cultural Resources

A number of federal laws protect cultural and archaeological resources, including the National Historic Preservation Act and the Archaeological Resources Protective Act. Before disturbing cultural and archaeological resources that have historical significance, TVA and other federal agencies are required to consult with the State Historic Preservation Officer and, in some circumstances, the Federal Advisory Council on Historic Preservation. The state of Tennessee also has adopted archaeological resource protection requirements for lands under the control of the state or local governments and for the excavation of the remains of Native Americans. While very general evaluations of the potential for adverse effects on cultural resources are presented in this EIS, more detailed review of the specific locations which could be disturbed would have to be conducted when one or more of the action alternatives was proposed to be built.

Endangered Species

Under the Endangered Species Act, 16 U.S.C. 1536 et. seq., federal agencies are to ensure that their actions are not likely to jeopardize the

continued existence of any endangered or threatened species or adversely modify any critical habitat of such sensitive species. If a proposed action may affect an endangered or threatened species, the agency must consult with the USFWS and obtain that agency's determination of the potential for impacting these species. In addition to the responsibilities of federal agencies, the Endangered Species Act prohibits the "taking" (harming) of listed species by any person. The state of Tennessee also has established regulatory protections for state-listed species which would apply to private developments.

This EIS identifies the federal- and state-listed endangered and threatened species which are known or are considered likely to occur in this general project area. The EIS also includes general evaluations of the potential effects of the action alternatives on these species. These evaluations would have to be reviewed when one or more of the action alternatives were further defined and proposed to be built. The evaluations also would have to be focused on the species protected at the federal and state level at that time and comply with the laws and regulations as then in existence.

Farmland Protection

Under the Farmland Protection Policy Act, federal agencies are required to identify and take into account potential adverse effects of a proposed action on farmlands. In addition, the state of Tennessee has enacted the Agricultural District and Farmland Preservation Act, TCA §§43-34-101 - 108 (1995), which provides limited protection of farmlands that have been specially designated under the act. This EIS includes general evaluations of the likely effects of the action alternatives on farmlands; however, those results would have to be updated or revised when one or more of the action alternatives was proposed to be built.

Environmental Justice

Executive Order (EO 12898) directs some federal agencies to consider whether the effects of their actions would cause a disproportionate burden on the health or environment of any segment of the human population. While TVA is not required to comply with Executive Order 12898, this EIS includes a discussion about where low income and minority groups live in the general project area and an evaluation of the likely effects of the alternatives on those segments of the population.

That evaluation probably would be reviewed and updated when one or more of the action alternatives were proposed to be built.

Other Review and Permit Processes

A number of other review and permit processes may be pertinent to one or more of the action alternatives, depending on the nature of the specific development proposals or their potential environmental effects. These include reviews under or involving:

- structures in or along the Duck River or its tributaries (River and Harbor Act and the TVA Act, Section 26a),
- the federal Safe Drinking Water Act and Tennessee drinking water regulations,
- the federal Clean Air Act,
- the federal Toxic Substances Control Act,
- the federal Insecticide, Fungicide, and Rodenticide Act,
- the federal Comprehensive Environmental Response, Compensation, and Liability Act,
- solid and hazardous waste laws and regulations, and
- city and county zoning regulations.

Appropriate review and compliance actions might be required under these and other pertinent federal, state, and local laws and regulations before one or more water supply projects could be constructed and/or operated.

1.9 EIS OVERVIEW

In many ways, this document follows a fairly standard EIS format. Chapter 2 is a somewhat atypical part of an EIS because it presents a summary of the information included in the water supply needs analysis for the upper Duck River basin. Chapter 3 indicates how the water supply alternatives were developed, describes each alternative evaluated in detail, and presents a summary of their potential environmental effects. Chapter 4 is a systematic description of the existing environmental features within the study area, and Chapter 5 is a parallel description of the potential effects on those features which could occur if each alternative was built. Chapter 6 provides supporting information, primarily the list of preparers of this text, a glossary of terms, and the references used in this evaluation.

Five appendices follow the EIS text. The first three include detailed information about water quality (Appendix A), aquatic life (Appendix B), and endangered and threatened species (Appendix C) not available from other sources. The fourth appendix (Appendix D) presents all of the public and agency comments that were received concerning the draft EIS and TVA responses to those comments. The final appendix (Appendix E) includes copies of letters from the U.S. Fish and Wildlife Service and the Tennessee Historic Preservation Office indicating that preparation of this programmatic EIS has complied with requirements of the Endangered Species Act and the National Historic Preservation Act.

CHAPTER 2 - NEEDS ANALYSIS

2.1 INTRODUCTION

Many people in the Columbia area believe they have an extremely limited water supply. The widespread nature and depth of feelings about this need for water was clearly indicated in comments submitted during the public review of the draft Land Use EIS (TVA, 1999). However, before examining ways to augment a water supply, planners need to know the answers to two fundamental questions: 1) how much additional water does the area need, and 2) when will it be needed. As an initial step in preparing this EIS, TVA worked with the local water utilities, the TDEC divisions of Water Supply and Water Pollution Control, DRDA, USACE, and U.S. Geological Survey to analyze the water supply needs in the Bedford, Marshall, and Maury/southern Williamson County water service areas. That report, issued in August 1998 (TVA, 1998a), describes the present level of water use in the area, the water sources involved, and up-to-date projections of water supply demand for these three water service areas through the year 2050. The following information, largely derived from the Needs Analysis, indicates how the analysis was conducted and what it means with regard to future water needs in this part of the Duck River watershed.

2.2 WATER BACKGROUND

The upper Duck River watershed receives over 50 inches of rainfall in a typical year. The wettest months usually are December, March, April, and May, while the driest months are August, September, and October. From 1900 to 1995, there have been nine droughts in the Columbia area when the total annual rainfall was 39 inches or less. During seven of these droughts, the cumulative rainfall for the four-month period from July through October was less than 10 inches. In 1953, for example, the total rainfall in the Columbia area during August, September, and October was 3.55 inches.

Soils in the three Tennessee counties bordering the Duck River between Shelbyville and Columbia (Bedford, Marshall, and Maury Counties, Figure 1) are relatively shallow, have a high clay content, and retain very

little ground water. In addition, the limestone bedrock which underlies most of this area contains many solution channels that quickly carry away ground water. The lack of groundwater storage means that relatively few of the tributary streams in this part of the Duck River basin flow all year. In October 1953, during that summer drought, the USGS found there was no flow in any tributary entering the Duck River within the river reach between Shelbyville and Columbia.

Before Normandy Reservoir was completed, the seasonal rainfall pattern; shallow, porous soils; and lack of groundwater discharge could combine to produce very low flows in the Duck River at Columbia. Prior to the closure of Normandy Dam, the seven-day, ten-year minimum flow in the Duck River at Shelbyville was estimated to be 50 cubic feet per second (cfs). The comparable pre-Normandy estimated seven-day, ten-year minimum flow at Columbia was 30 cfs, even though Columbia is 90 river miles further downstream and receives water from a drainage area 800 square miles larger than above Normandy. During drought conditions before Normandy Reservoir was built, the Duck River would actually contain less water at Columbia than it would near Shelbyville.

2.3 OPERATIONAL EFFECTS OF NORMANDY DAM

Normandy Reservoir was designed to provide a variety of recreation, flood protection, water supply, and water quality benefits both upstream and downstream from the dam. Water users upstream from Normandy Dam (primarily Tullahoma and Manchester) are served from a water intake located in Normandy Reservoir. For downstream water users, Normandy was designed to provide an instantaneous minimum flow of up to 165 cfs at Shelbyville (up to 10 cfs for water supply and 155 cfs for water quality control). The water quality control volume to be provided at Shelbyville also would meet most of the water quality control need at Columbia.

Normandy Dam was closed in January 1976 and has been operated to meet its water supply objectives at Manchester, Tullahoma, and Shelbyville, and its water quality control objectives at Shelbyville and Columbia. Stream gauges operated by the USGS near Shelbyville and Columbia show that the extreme low flows characteristic of the Duck

River prior to the closure of Normandy Dam no longer occur, and that the minimum flow objective for the Duck River at Shelbyville is consistently being met. Normandy Reservoir does not have a specific minimum flow objective to be met at Columbia; however, meeting the objective at Shelbyville results in at least 135 cfs of flow in the river at Columbia. This is a significant increase over the 30 cfs of minimum flow at Columbia that would have occurred before Normandy Reservoir was built.

Two changes have been made in the minimum discharge objectives for Normandy Dam since it started operating. During a drought in 1980-1981, the Tennessee Division of Water Pollution Control concurred with a TVA decision to reduce the winter and early spring (December through May) minimum flow objective at Shelbyville from 155 to 80 cfs. This change was made so that more water could be held in the reservoir for water supply, recreation, and to benefit fish and aquatic life. In 1991, in response to a request from the city of Shelbyville, TVA increased the minimum flow during the winter and early spring months from 80 to 120 cfs. This level of minimum flow helps the Shelbyville wastewater treatment plant meet discharge permit requirements. Neither of these changes has had an adverse effect on the water in the Duck River at Columbia because higher runoff from the land and colder water temperatures, both of which normally occur in winter, help maintain flow and water quality in the river. The minimum flow objective from Normandy Dam from June through November has remained unchanged (to provide up to 10 cfs for water supply use in the Shelbyville area and 155 cfs downstream from the Shelbyville wastewater discharge for water quality control).

Since Normandy Dam started maintaining a minimum flow in the Duck River, the Division of Water Pollution Control has regulated the Columbia wastewater discharge (located at River Mile 127.2) based on a minimum flow of 130 cfs in the river. The use of this flow rate has allowed the city to spend less on wastewater treatment compared to what the cost would have been if only the pre-Normandy minimum flow (30 cfs) was present in the river.

During 1996, in response to questions about the ability of the Duck River to meet additional water supply needs, the TDEC Division of Water

Pollution Control evaluated the minimum instream flow required to maintain recreation and fish and aquatic life uses in the Duck River at Columbia. Their analysis resulted in a requirement that the one-day average streamflow should not fall below 100 cfs at Duck River Mile 132.8, just downstream from the Columbia water supply intake (at River Mile 133.9). This minimum flow requirement establishes a state-identified limit below which no additional water should be withdrawn from the river. This 100 cfs requirement at River Mile 132.8 was recognized as a control point in the Needs Analysis.

2.4 EXISTING WATER USES

The sources and users of water in this part of Tennessee can be thought of as occurring in three water service areas (Figure 2). These areas, which roughly correspond to the county boundaries and the limits of the Duck River watershed, are the Bedford County, Marshall County, and Maury/southern Williamson County Water Service Areas. Public water supplies serve approximately 116,000 people in these three service areas (Table 1).

Four small water distributors listed in Table 1 (Wartrace, Bell Buckle, Chapel Hill, and Mount Pleasant) use wells or springs as their supply sources. All four of these distributors will likely continue to use ground water as their primary water source in the future. Together, these systems served about 7,900 people and withdrew about 1.66 million gallons of water per day (mgd) in 1993.

The Duck River is the source of drinking water for the other 108,000 people served by public water supplies in these three water service areas. The four public water supply intakes located on the Duck River between Shelbyville and Columbia (indicated by the **bold** entries in Table 1), withdrew a total of 16.4 mgd in 1996. These four water distributors, plus six other systems which purchase water from them, serve all of these people and the commercial and industrial users.

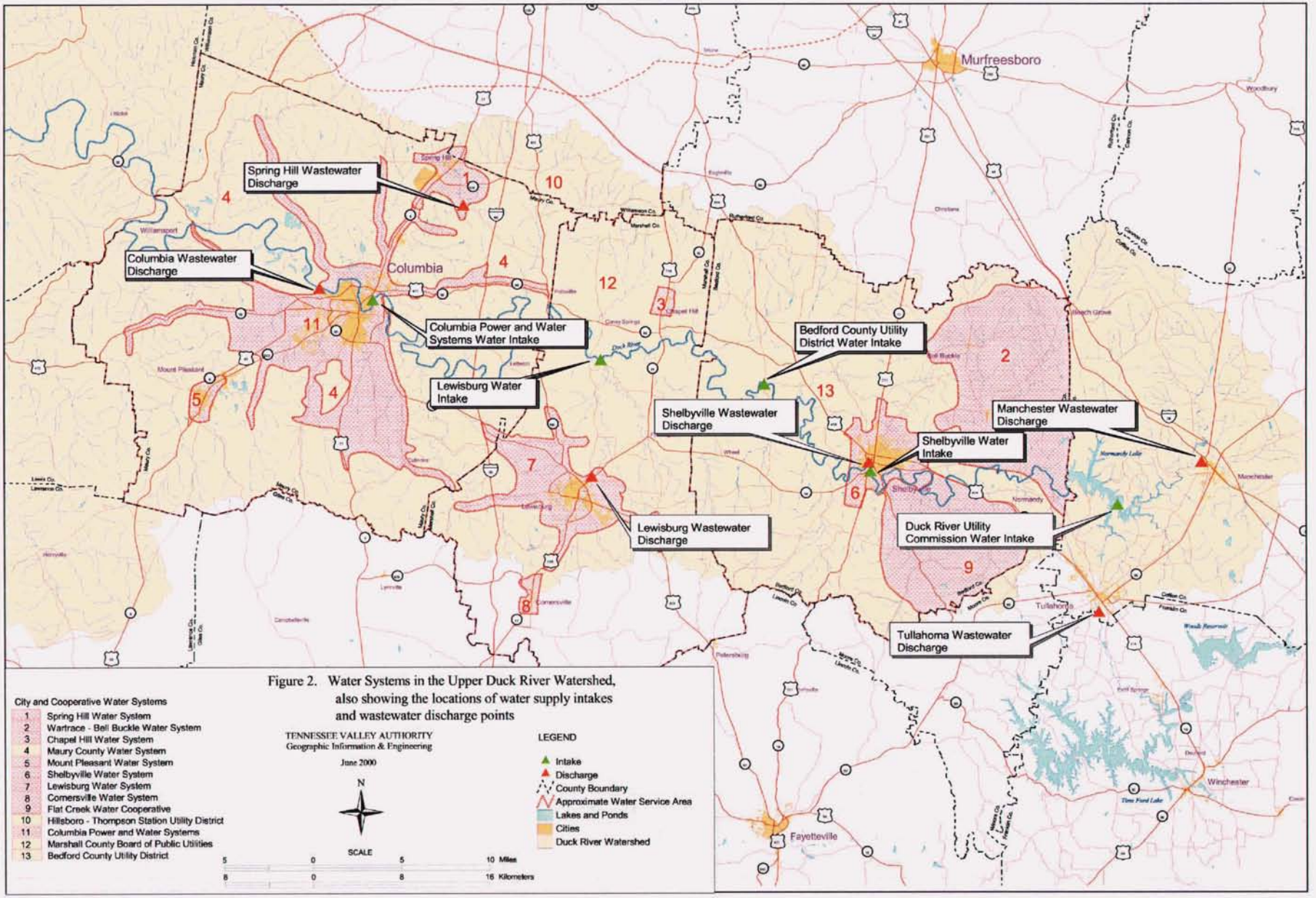


Figure 2. Water Systems in the Upper Duck River Watershed, also showing the locations of water supply intakes and wastewater discharge points

Table 1. Public water supplies in the Bedford County, Marshall County, and Maury/southern Williamson County Water Service Areas.

Water Service Area Water System	Population Served (in 1996)	Average Daily Use in 1996 (mgd)	Water Source
Bedford County Water Service Area			
Shelbyville Pwr., Wtr., & Sew.	15,000	**3.93**	**Duck River Mile 221.9**
Bedford Co. Utility District	13,000	**0.75**	**Duck River Mile 202.4**
		0.24	Purchased from Shelbyville
Flat Creek Water Cooperative	1,460	0.13	Purchased from Shelbyville
Wartrace Water System	*	*	Cascade Spring
Bell Buckle Water System	*	*	Purchased from Wartrace
Marshall County Water Service Area			
Lewisburg Water System	10,075	**2.30**	**Duck River Mile 181.04**
Marshall Co. Bd. of Pub. Util.	4,250	0.43	Purchased from Lewisburg
Cornersville Water System	1,030	0.12	Purchased from Lewisburg
Chapel Hill Water System	*	*	Well
Maury/so. Williamson Co. Water Service Area			
Columbia Power & Water Sys.	42,800	**9.48**	**Duck River Mile 133.92**
Maury County Water System	9,120	0.88	Purchased from Columbia
Spring Hill Water System	5,500	0.83	Purchased from Columbia
Mount Pleasant Water System	*	*	Springs
Hillsboro/Thompson Sta. Util. Dist.	5,000	0.36	Purchased from Spring Hill

* Information for 1996 not obtained

The Needs Analysis report provides specific information about each water supply system and wastewater treatment system in this part of the Duck River watershed. The majority of this information was supplied by the water distribution and wastewater treatment systems in response to questionnaires and interviews provided by TVA.

No self-supplied industrial water users withdraw water from the Duck River between Shelbyville and Columbia. The amount of water withdrawn for agricultural irrigation is not known, but given the intensive agricultural land use in the three-county area, significant amounts could be withdrawn during an extended drought.

The amount of water in the Duck River near Columbia is affected by all of the inflows and withdrawals which occur further upstream. During low rainfall periods in late summer and fall, most of the flow in the river

comes from the minimum release supplied by Normandy Dam, accompanied by return flows from the Shelbyville and Lewisburg wastewater treatment plants. Summer flow in the river is reduced by evaporation, irrigation, and withdrawals at the Shelbyville, Bedford County, Lewisburg, and Columbia water treatment plants. Planners considering new water withdrawals from the river need to be aware of all existing and proposed water uses, both upstream and downstream from their proposed withdrawal site.

2.5 FUTURE WATER NEEDS

In 1990 and 1993, the USGS gathered population statistics, economic data, and water use information from the area, then used modeling techniques to estimate the likely demand for water in each of the three water service areas at various dates in the future (USGS, 1996). These estimates, which cover a 50-year period from the year 2000 to the year 2050, are for municipal demand (including residential, commercial, industrial users, and public/unaccounted use).

The USGS estimates of future water demand in the three water service areas are presented in Table 2. The USGS calculated single sets of estimates for the Bedford County Water Service Area and for the Marshall County Water Service Area, assuming steady growth in each of these areas throughout the 50-year period. However, for the Maury/southern Williamson County Water Service Area, the potential for additional industrial and residential development suggested that two scenarios might be more appropriate: one reflecting a growth pattern comparable to that calculated for the Bedford County and Marshall County areas, and an "Additional Development" scenario to reflect an expectation of additional residential and industrial growth in the area. Beyond the projected growth rates, the USGS estimates did not include any water for new, self-supplied industries or major expansions of agricultural water use in any of the three water service areas. If a new, large volume water user (beyond the capacity increases described in Table 2) was to locate along this part of the Duck River, the demand for water in the area could increase beyond the estimates calculated by the USGS.

Table 2. Estimated water demand in the Bedford County, Marshall County, and Maury/southern Williamson County Water Service Areas over the period 2000 through 2050 (data from USGS, 1996).

Sector	2000	2015	2025	2035	2050
	in million gallons per day (mgd)				
Bedford County Water Service Area - Steady Growth					
Residential	2.2	3.3	--	--	--
Commercial	1.0	1.3	--	--	--
Industrial	1.2	1.3	--	--	--
Public/unaccounted	0.8	1.0	--	--	--
Total water demand	5.2	6.9	7.6	8.2	9.4
Maximum daily use	7.8	10.0	11.0	12.0	14.0
Marshall County Water Service Area - Steady Growth					
Residential	1.3	2.1	--	--	--
Commercial	0.6	0.8	--	--	--
Industrial	0.5	0.9	--	--	--
Public/unaccounted	0.4	0.7	--	--	--
Total water demand	2.8	4.5	4.8	5.2	6.0
Maximum daily use	4.2	6.8	7.2	7.8	9.0
Maury/so. Williamson Co. Water Service Area - Steady Growth					
Residential	5.0	7.3	--	--	--
Commercial	1.6	2.0	--	--	--
Industrial	3.2	3.9	--	--	--
Public/unaccounted	1.7	2.3	--	--	--
Total water demand	12.0	16.0	17.0	19.0	22.0
Maximum daily use	18.0	24.0	26.0	29.0	33.0
Maury/so. Williamson Co. Water Service Area - Additional Development					
Residential	5.5	8.1	--	--	--
Commercial	1.6	2.0	--	--	--
Industrial	3.4	4.2	--	--	--
Public/unaccounted	1.9	2.5	--	--	--
Total water demand	12.0	17.0	20.0	23.0	27.0
Maximum daily use	19.0	26.0	30.0	35.0	40.0

The estimates presented in Table 2 indicate, for example, that water demand in the Bedford County Water Service Area could be 6.9 mgd by 2015, and 9.4 mgd by 2050. Using the assumption that maximum daily use is about 1.5 times the average use, the maximum daily use for the Bedford County Water Service Area (also presented in Table 2) is estimated to be 10 mgd by 2015 and 14 mgd by 2050. Similarly, the Additional Development estimates for the Maury/southern Williamson

County Water Service Area presented in Table 2 indicate that water demand in that area could be 17 mgd by 2015 (with a maximum daily use of 26 mgd) and 27 mgd by 2050 (with a maximum daily use of 40 mgd). The maximum daily use values are important parts of these estimates because they indicate the maximum withdrawals from the river which could occur during extended hot and dry conditions.

2.6 EFFECTS ON RIVER FLOW - 1996

Table 3 was prepared to help determine if the Duck River could provide the water needed to meet these projected future demands. In Table 3, the maximum daily use volume for each of the three water service areas has been linked to where the water would be withdrawn from the river (one location each in the Marshall County and Maury/southern Williamson County Service Areas, but two locations in the Bedford County Service Area). Similarly, the volumes of average future wastewater discharges (estimated using conservatively low rates of wastewater collection system expansion in the service areas) have been linked to where the water would reenter the river. These estimates of how the various water systems actually would operate in some specific future year are based on the locations and capacities of the present systems and plans provided by the systems concerning their future capabilities.

The value of the estimates provided in Table 3 is that they can be used to calculate what the flow in various parts of the river could be at critical low-flow times in the future (presented in Table 4). As a baseline, the 1996 column in Table 4 indicates the flow in the Duck River which would have occurred in a (hypothetical) drought period during August or September 1996. This would have been a time when Normandy Dam was meeting its summer minimum flow objectives, Fountain Creek was the only tributary with any natural flow, all of the water distributors were withdrawing enough water to meet their maximum daily use needs, and wastewater systems were discharging average amounts of treated effluent. This would be a worst case situation so far as flow in the river is concerned; however, that is when potential water use problems could occur.

Table 3. Estimated Duck River maximum daily water withdrawals and wastewater discharges during the period 1996 through 2050. Volumes are presented in both millions of gallons per day and cubic feet per second (in parentheses).

Water Service Area	Actual	Estimates for the Years				
Water System	1996	2000	2015	2025	2035	2050
Bedford County Service Area						
Shelbyville						
Water Supply Intake (River Mile 221.9)	5.9 (9.1)	5.7 (8.8)	6.0 (9.2)	6.6 (10.2)	7.2 (11.1)	8.0 (12.3)
Wastewater Discharge (River Mile 221.3)	2.7 (4.2)	2.7 (4.2)	3.8 (5.9)	4.4 (6.7)	4.9 (7.6)	4.9 (7.6)
Bedford County Utility District						
Water Supply Intake (River Mile 202.4)	1.1 (1.7)	2.1 (3.2)	4.0 (6.2)	4.4 (6.8)	4.8 (7.4)	6.0 (9.2)
Marshall County Service Area						
Lewisburg						
Water Supply Intake (River Mile 181.0)	3.4 (5.3)	4.2 (6.5)	6.8 (10.5)	7.2 (11.1)	7.8 (12.0)	9.0 (13.9)
Wastewater Discharge (Rock Creek Mile 16)	1.2 (1.9)	1.3 (2.0)	1.4 (2.1)	1.4 (2.2)	1.4 (2.2)	1.5 (2.3)
Maury/southern Williamson County Service Area						
Columbia						
Water Supply Intake (River Mile 133.9)	14.3 (22.0)	19.0 (29.3)	26.0 (40.0)	30.0 (46.2)	35 (53.9)	40.0 (61.6)
Wastewater Discharge (River Mile 127.2)	5.2 (8.0)	5.8 (9.0)	10.0 (15.4)	11.0 (17.0)	12.0 (18.5)	14.0 (21.6)
Spring Hill						
Wastewater Discharge (Rutherford Creek Mile 19)	0	0.3 (0.4)	1.0 (1.5)	1.5 (2.3)	2.0 (3.1)	2.5 (3.9)

Table 4. Estimated maximum daily water withdrawals, average daily wastewater plant discharges, and flow volumes in the Duck River which could occur during drought conditions in various years within this study period (1996 - 2050).

Duck River Mile	Activity	1996		2000		2015		2025		2035		2050	
		Flow (cfs) in (+) or out (-)	Flow in River (cfs)	Flow (cfs) in (+) or out (-)	Flow in River (cfs)	Flow (cfs) in (+) or out (-)	Flow in River (cfs)	Flow (cfs) in (+) or out (-)	Flow in River (cfs)	Flow (cfs) in (+) or out (-)	Flow in River (cfs)	Flow (cfs) in (+) or out (-)	Flow in River (cfs)
222.0	upstream of Shelbyville		164.1		163.8		164.2		165.0		165.0		165.0
221.9	Shelbyville withdrawal	- 9.1	155.0	- 8.8	155.0	- 9.2	155.0	- 10.2	154.8	- 11.1	153.9	- 12.3	152.7
221.3	Shelbyville discharge	+ 4.2	159.2	+ 4.2	159.2	+ 5.9	160.9	+ 6.7	161.5	+ 7.6	161.5	+ 7.6	160.3
202.4	Bedford Co. withdrawal	- 1.7	157.5	- 3.2	156.0	- 6.2	154.7	- 6.8	154.7	- 7.4	154.1	- 9.2	151.1
181.0	Lewisburg withdrawal	- 5.3	152.2	- 6.5	149.5	- 10.5	144.2	- 11.1	143.6	- 12.0	142.1	- 13.9	137.2
180.4	Big Rock Creek inflow	+ 1.9	154.1	+ 2.0	151.5	+ 2.1	146.3	+ 2.2	145.8	+ 2.2	144.3	+ 2.3	139.5
166.0	Spring Hill withdrawal	- 0.0	154.1	- 0.0	151.5	- 4.6	141.7	- 5.8	140.0	- 7.5	136.8	- 9.2	130.3
145.9	Fountain Creek inflow	+ 1.7	155.8	+ 1.7	153.2	+ 1.7	143.4	+ 1.7	141.7	+ 1.7	138.5	+ 1.7	132.0
133.9	Columbia withdrawal	- 22.0	133.8	- 29.3	*123.9*	- 35.4	*108.0*	- 40.4	*101.3*	- 46.4	***92.1***	- 52.7	***79.6***
130.4	Rutherford Creek inflow	+ 0.0	133.8	+ 0.4	*124.3*	+ 1.5	*109.5*	+ 2.3	*103.6*	+ 3.1	***95.2***	+ 3.9	***83.5***
127.2	Columbia discharge	+ 8.0	141.8	+ 9.0	133.3	+ 15.4	*124.9*	+ 17.0	*120.6*	+ 18.5	*113.7*	+ 21.6	*105.1*

As indicated in Table 4, the flow in the river during this hypothetical drought period would have been 159 cfs downstream from the Shelbyville wastewater discharge (River Mile 221.3) and 134 cfs at the Columbia gauge (River Mile 132.8). [For comparison purposes, the average flow at Columbia during the driest month of the year (September) is 470 cfs, 3.5 times what it could be during a severe drought.] In this hypothetical 1996 drought, the flow at the Columbia gauge would have been 134 cfs, 34 cfs more than the Division of Water Pollution Control one-day minimum flow requirement (100 cfs), and very close to the 130 cfs level presently used by the Division to establish treatment requirements at the Columbia wastewater plant.

2.7 NEW SPRING HILL FACILITIES

As indicated in Section 2.4, the town of Spring Hill presently purchases water from the Columbia Power and Water System. Spring Hill also sells some of this water to the Hillsboro-Thompson Station Utility District. In the fall of 2000, Spring Hill decided to develop its own water intake and treatment system and, once those facilities are in operation, to discontinue purchasing water from the Columbia system. The Hillsboro-Thompson Station Utility District is likely to continue to be served by Spring Hill when the new system becomes operational. The proposed new system would include a raw water intake and pumping station at Duck River Mile 166.0, an 18-inch diameter, 9-mile long pipeline to transport water to a water treatment plant near town, and an initial plant capacity of 3 mgd (4.6 cfs). Spring Hill has approval from TDEC to withdraw up to 6 mgd (9.2 cfs) from the Duck River at River Mile 166.0 and the treatment plant probably would be expanded up to this capacity as demand grows. Spring Hill now plans to start construction of this new system in mid-April 2001 and to have the water treatment plant in operation in October 2002.

This new water treatment system would not result in any changes in the future use projections made by the U.S. Geological Survey because the water demand for both the Spring Hill and the Hillsboro-Thompson Station Utility districts already were included in the estimates for the Maury/southern Williamson County Water Service Area (presented in Tables 2 and 3). The construction and use of this intake would add a

new withdrawal point at River Mile 166.0 and would affect flows in the river between there and the Columbia withdrawal point (River Mile 133.9). Estimated future water withdrawals at the existing Columbia Power and Water System intake would be reduced by the amount of water that would be withdrawn at Duck River Mile 166.0. The effects of these changes have been made in Table 4 and are incorporated in the remainder of this chapter. As indicated, the new capacity of the Spring Hill water treatment plant would reduce the demand presently being met by the existing Columbia Power and Water System treatment plant.

2.8 EFFECTS ON RIVER FLOW - FUTURE YEARS

The other columns in Table 4 present estimated flows in the river during similar worst case conditions in the years 2000, 2015, 2025, 2035, and 2050, respectively. In the year 2000, the flow downstream from the Shelbyville discharge is projected to be essentially unchanged from the 1996 value (approximately 159 cfs), and the flow at Columbia would be approximately 123 cfs, roughly 20 cfs above the 100 cfs one-day minimum flow requirement. The flow at the Columbia gauge would be 7 cfs below the 130 cfs minimum presently used by the Division of Water Pollution Control to establish treatment requirements at the Columbia wastewater treatment plant.

In the year 2015, the flow downstream from the Shelbyville wastewater discharge is projected to be slightly above 160 cfs, largely because of an anticipated increase in the discharge volume at the Shelbyville wastewater treatment plant. At the Columbia gauge, the flow is projected to be just under 110 cfs, very near the 100 cfs minimum flow requirement. Given the accuracy of streamflow measurements and the likelihood of some loss from the river just upstream from Columbia, this amount of withdrawal (40 cfs) would appear to be all that could be removed from the river without taking a chance of going below the 100 cfs one-day minimum flow limit. This estimated drought condition flow also would be used as a base for treatment requirements at the Columbia wastewater treatment plant.

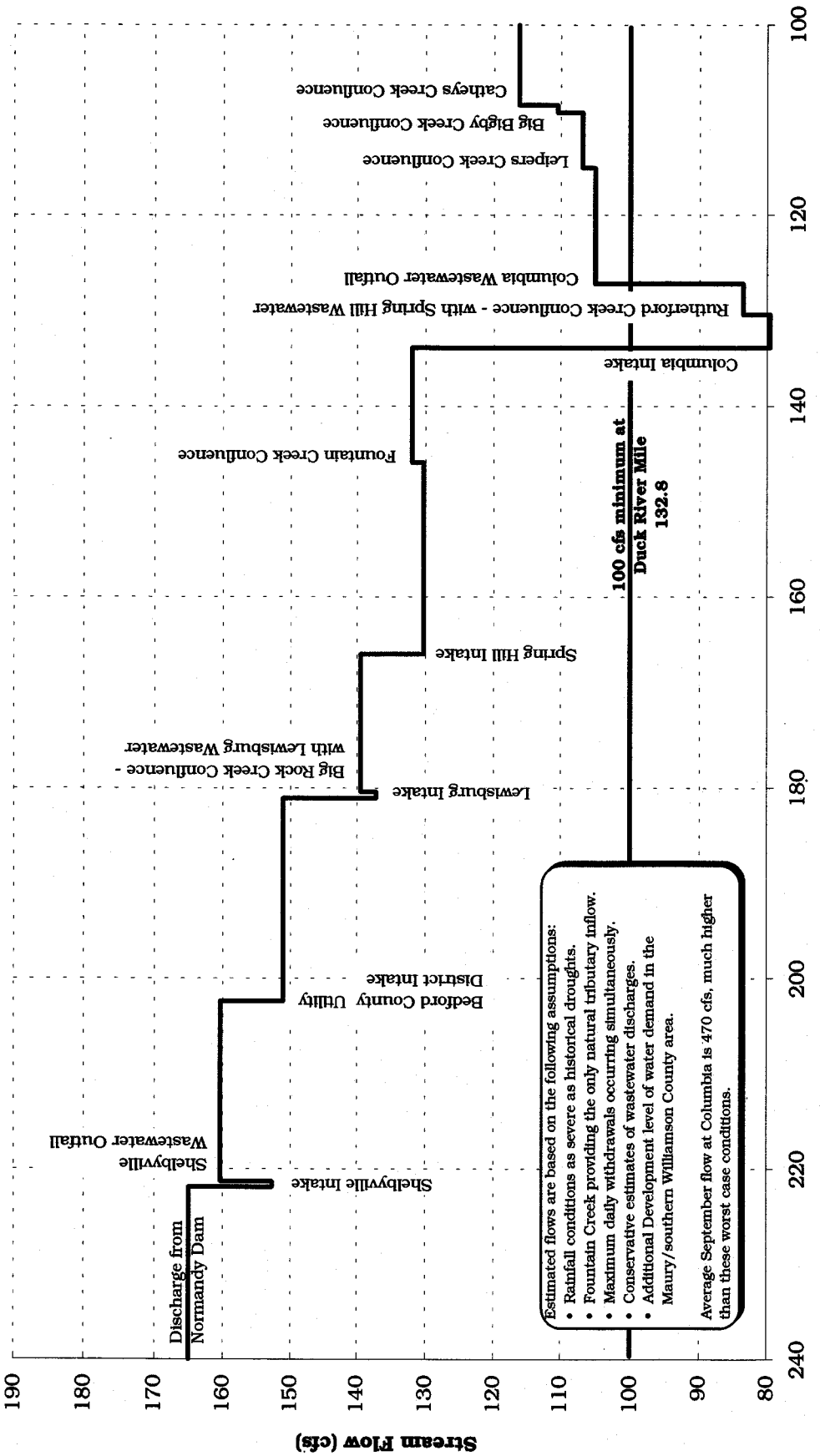


Figure 3. The potential effects of anticipated water supply withdrawals and wasterwater discharges on flows in the Duck River during possible drought conditions in 2050.

The columns in Table 4 labeled 2025, 2035, and 2050 indicate that the minimum flows from Normandy Reservoir, supplemented with the discharge from the Shelbyville wastewater treatment plant, could meet the anticipated maximum drought condition demands for the Bedford County and Marshall County Water Service Areas during in each of those years and still not adversely affect other uses of the river. However, future demands of the Maury/southern Williamson County Water Service Area above the estimated 2015 withdrawal volume (40 cfs) could not be met without taking a risk of going below the 100 cfs one-day minimum flow limit at the Columbia gauge (River Mile 133.8). In 2025, the part of the maximum use demand (46.2 cfs) which could not be met would be approximately 6 cfs. By 2035, the unmet demand would be approximately 14 cfs, and by 2050, the unmet demand would be approximately 22 cfs. Throughout this entire period, the flow in the Duck River during drought conditions would be much less than the 130 cfs minimum presently being used to establish treatment requirements at the Columbia wastewater treatment plant.

Figure 3 is a graph illustrating what the potential flow levels in the Duck River could be during severe drought conditions in 2050. As indicated in Figure 3, the effects of the water withdrawals and discharges in the Bedford County and Marshall County Water Service Areas would reduce the initial discharge from Normandy Dam down to about 140 cfs from the mouth of Big Rock Creek downstream to the Spring Hill intake (River Mile 166) and down to about 130 cfs from there to the Columbia area (River Mile 133). If the Spring Hill intake was withdrawing its proposed maximum of 9.2 cfs and all of the remaining demand for water in the Maury/southern Williamson County Water Service Area would be met by withdrawing water from the river at the present Columbia Power and Water withdrawal site, the remaining flow would be around 80 cfs in the six-mile reach from the Columbia water intake downstream to the Columbia wastewater discharge. From there, the flow in the river would rise with the input from several creeks to about 138 cfs at River Mile100.

2.9 EFFECTS ON NORMANDY RESERVOIR

The projections about flow in the Duck River during future years assume that Normandy Reservoir could always provide 165 cfs of flow at Shelbyville during low rainfall periods. Normandy Reservoir also is where the Duck River Utility Commission (DRUC) withdraws water to meet the needs of Tullahoma and Manchester, in Coffee County. Water demand in Coffee County also will continue to grow in future years, and those potentially competing demands have to be included in this evaluation.

During the drought of 1987-1988, the annual rainfall total for the Duck River watershed above Normandy Dam was less than 30 inches (an historic low). Discharges from the dam to meet downstream flow objectives caused the water level in the reservoir to drop nearly 10 feet below its normal operating target by late fall 1987. Reductions in the discharge volume during the winter months of 1987-1988 helped to minimize the decline in lake level. In spite of the drought, DRUC was able to meet its average daily withdrawal of 3.8 mgd (5.9 cfs) in both 1987 and 1988.

By 1996, the DRUC average daily withdrawal from Normandy Reservoir had grown to 4.7 mgd (7.3 cfs) and the system was considering an expansion to 15 mgd (23.2 cfs). TVA evaluated what would happen to the reservoir elevation if DRUC had been withdrawing 15 mgd for water supply during the 1987-1988 drought. This evaluation assumed that the present level of minimum discharges from Normandy Dam were in effect (120 cfs in winter, 165 cfs in summer). The results showed that the water level in Normandy Reservoir would have been drawn down to 12 feet below the normal operating target by November 1, 1988. This water level would not have prevented DRUC from meeting its water demand; however, poor water quality conditions existing in the deeper water of Normandy Reservoir might have made treatment more difficult and more expensive. These results show that, even during a severe drought, Normandy Reservoir is capable of providing 165 cfs of water to meet downstream flow objectives and supplying water to meet the future demands of Coffee County.

2.10 CONCLUSIONS

The Needs Analysis documented that the minimum flow being provided by Normandy Reservoir, supplemented by wastewater treatment plant discharges, is expected to meet the water supply and water quality control needs of the Bedford County and Marshall County Water Service Areas during worst case flow conditions throughout the study period (to the year 2050). Even at the end of this 50-year period, the flow remaining in the river downstream from the Lewisburg water withdrawal point would be at least 139 cfs, which should be sufficient to ensure that classified uses in that part of the river are not precluded or threatened.

The minimum flow being provided by Normandy Dam, accompanied by anticipated future return flows from wastewater treatment plants, is expected to supply up to 40 cfs for water supply use to the Maury/southern Williamson County Water Service Area. This level of demand is projected to occur in this service area during drought conditions starting after the year 2015. Withdrawals equivalent to the estimated 2015 demand would reduce the worst case river flow to 108 cfs downstream from the Columbia water supply intake, all that could be withdrawn from the river without taking a chance of going below the 100 cfs one-day instream flow limit. Future demand above 40 cfs (increasingly likely to occur in the years after 2015) would have to be met by other water supply alternatives. If the additional future demand was to be met from one or more water supply sources, the estimates indicate that the new sources would need to supply as much as 14 mgd (22 cfs) by the year 2050.

During drought conditions, water demand in the Maury/southern Williamson County Water Service Area is estimated to reach 20 mgd (30 cfs) after the year 2000. If the Spring Hill intake and water treatment plant are brought into service and are operated as presently proposed, the demand on the Columbia Power and Water plant could reach this volume during drought conditions some time between 2000 and 2015. Information provided by Columbia Power and Water Systems indicates that space limitations may prevent expansion of their existing water treatment plant beyond about 20 mgd capacity. This space limitation may become an important consideration during any discussion about alternative ways to meet the future water needs of the service area.

Around the year 2000, withdrawals to meet the water supply needs of the Maury/southern Williamson County Water Service Area during drought conditions may cause the flow in the Duck River to drop below the 130 cfs level now used to regulate the Columbia wastewater plant discharge. If flow in the river at the wastewater discharge point does fall below 130 cfs, the plant may need to meet more stringent (and more expensive) wastewater treatment requirements.

Overall, the Needs Analysis indicates that the Duck River can meet the water supply needs in the Bedford County and Marshall County Water Service Areas throughout the 50-year study period. For the Maury/southern Williamson County Service Area, the analysis identified both when unmet needs would begin to occur (after about 2015) and the estimated additional need for water that would have to be met in some way during various years (as much as 4 mgd [6 cfs] in 2025, 9 mgd [14 cfs] in 2035, and 14 mgd [22 cfs] in 2050). These amounts of water would be needed only during extended drought conditions, when demand was at its maximum and nearly all of the flow in the river was supplied by the minimum discharge from Normandy Dam.

CHAPTER 3 - ALTERNATIVES

3.1 INTRODUCTION

This chapter focuses on what has been done to identify and evaluate alternatives that would meet the future needs for water in the Maury/southern Williamson County Water Service Area. Four action alternatives have been evaluated in detail, and each of those alternatives is described, along with the no action alternative. The chapter includes a comparison of these alternatives and a summary of their potential environmental effects. The last section in this chapter indicates the present status concerning the identification of a preferred alternative for meeting future water needs in this service area.

3.2 ALTERNATIVES CONSIDERED

Draft results of the needs analysis were reviewed and discussed by TVA staff and representatives from several federal, state, local, and water supply agencies before the final version of that report was prepared. All of the individuals who reviewed the Needs Analysis report were invited to suggest ways of meeting the additional water supply needs it identified. Once similar concepts were combined, the list of possibilities included 37 different suggestions. These suggestions were sorted into groups based on whether they would apply within the Maury/southern Williamson County Water Service Area, within the remainder of the Duck River basin, or involve some area outside of this watershed (Table 5). Brief descriptions of these suggestions were evaluated by TVA staff members familiar with water supply issues to identify the most viable suggestions based on whether they would provide sufficient water to the Columbia area without involving obviously unacceptable impacts on the environment or the local economy.

The four alternatives that developed during this evaluation process included two which would be implemented within the local water service area (a reservoir in the Fountain Creek watershed, and a downstream intake on the Duck River), one that would affect other parts of the Duck River watershed (raise the Normandy pool level), and one that would affect an area outside of the Duck River basin (an intake on Tims Ford

Table 5. Suggested ways of meeting the anticipated need for additional water supply in the Maury/southern Williamson County Water Service Area.

Suggestions within the Maury/southern Williamson County Water Service Area

- Finish Columbia Dam
- Build Fountain Creek Reservoir [at Elevation 630]
- Build some other full-pool reservoir in the area
- Build a run-of-the-creek reservoir on Fountain Creek [elev. 600]
- Increase capacity of the pool upstream from the existing Columbia City dam
- Construct a water intake at River Mile 163 to supply the Maury County and southern Williamson County water systems
- Construct a water intake at River Mile 108 to help supply this service area
- Ground water - intercept 5 to 10 cfs loss along Duck River
- Improve the river habitat downstream from River Mile 133 and request a wavier from the State for that reach during droughts [down to 80 cfs]
- Discharge the Columbia wastewater closer to the water intake
- Pump water downstream of the sewage outfall to the Columbia City dam pool
- Recycle waste water
- Go to a closed-loop system at Columbia

Suggestions within the Duck River watershed

- Higher discharge from Normandy Reservoir
- Re-evaluate Normandy guide curve
- Raise Normandy pool elevation
- Build off-stream storage to harvest flood water (active or passive filling)
- Raise and repair Lillard Mill dam to augment its use as a source
- Relocate the Lewisburg wastewater outfall to the Duck River
- Drill wells in the watershed
- Reduce irrigation withdrawals and develop a plan to compensate farmers
- Require industrial water conservation
- Require return of all withdrawals from the Duck River
- Impose mandatory reductions during droughts
- Water conservation through pricing and other measures; withdrawal charges
- Water rates - Jack price up past 7000 gpd use; index to rainfall records
- Promote better cooperation between water systems (consolidations?)
- Water allocation formula - consensus approach
- Manage future growth; recognize water limits
- Restrict future growth
- Educate the public about the integrated nature of water use
- Establish an [annual] intensive water use/availability assessment program

Suggestions involving a wider area

- Pipe water in from some other source (inter-basin transfer)
- Pipeline between Tims Ford and Normandy Reservoirs
- Discharge Arnold Engineering cooling water into Duck
- Buy water from nearby systems
- Search for nearby groundwater source(s)

Reservoir). These alternatives would provide water at different locations along the length of the Duck River. Each of these four action alternatives, along with the no action alternative, is described in a following section of this chapter.

All of the action alternatives included in this evaluation incorporate three basic assumptions. Each of these alternatives assumes that future water demand in these water service areas will not exceed the projections made by the USGS (USGS, 1996) or adversely affect the flow projections in the river made in the Needs Analysis (TVA, 1998, summarized in Chapter 2). These alternatives also assume that Normandy Dam will continue to discharge at least 155 cfs for water quality control at Shelbyville and up to 10 cfs for water supply use in the Bedford County Water Service Area. Finally, these alternatives, like the USGS projections, assume that no new, large, water-consuming industries would locate in any of the water service areas in the upper Duck River basin. If any of these assumptions cease to apply during the remainder of the planning period (through 2050), the amount of water available for use in the Columbia area could be reduced. Each action alternative includes the flexibility to adjust to the actual water demand during earlier years of the planning period; however, the amount of water each alternative could provide would be limited by the water source or the capacity of the supply system, especially later in the planning period.

The descriptions of the action alternatives presented in this programmatic EIS are not as detailed as descriptions in other, more specific EIS documents for two reasons: 1) none of these projects would have to be in operation until water demand in the Columbia area exceeds the available minimum supply (some time after 2015), and 2) TVA is not proposing to design or construct any of these facilities. In this EIS, these action alternatives have been generally described in light of their conceptual nature at this early stage. If and when a decision is made to provide some additional water for the Maury/southern Williamson County Water Service Area, the sponsors would determine the specific purposes of each project and would develop site-specific plans for the various facilities. As those plans are developed and proposals are made, detailed, site-specific evaluations of environmental effects would be conducted, if required and as appropriate, under NEPA.

If the basic plans for that project are similar to one of the alternatives covered in this programmatic EIS, many parts of that evaluation could use information presented here.

As indicated in Section 1.1, the purposes of this EIS are to evaluate the need for water in the upper Duck River area, identify possible ways to meet that need, and to evaluate the potential environmental effects of several viable alternatives. Exhaustive detail about the possible components of these alternatives is not required to complete this preliminary evaluation (programmatic review) of their potential effects on natural and cultural resources present in the area.

3.3 ALTERNATIVE A - CONTINUE TO USE PRESENT SOURCES (NO ACTION)

Under this alternative, no additional sources would be used to augment the existing water supply for the Maury/southern Williamson County Water Service Area. The Spring Hill water treatment plant probably would come on line and would expand to its proposed design capacity of 6 mgd (9 cfs). Columbia Power and Water Systems probably would increase the capacity of the existing water treatment plant as much as the available space would allow (up to 20 mgd [30 cfs]). If the demand for water increases beyond either the capacity of the treatment plant or the 26 mgd (40 cfs) available from the minimum flow in the Duck River provided by the releases at Normandy Dam, local officials would have to use rationing or other conservation measures to maintain water service during drought conditions. Under severe drought conditions, TDEC might consider additional withdrawals from the river, leaving less than 100 cfs of minimum flow to support instream uses. By 2050, drought condition flows in the river could be similar to what is illustrated in Figure 3.

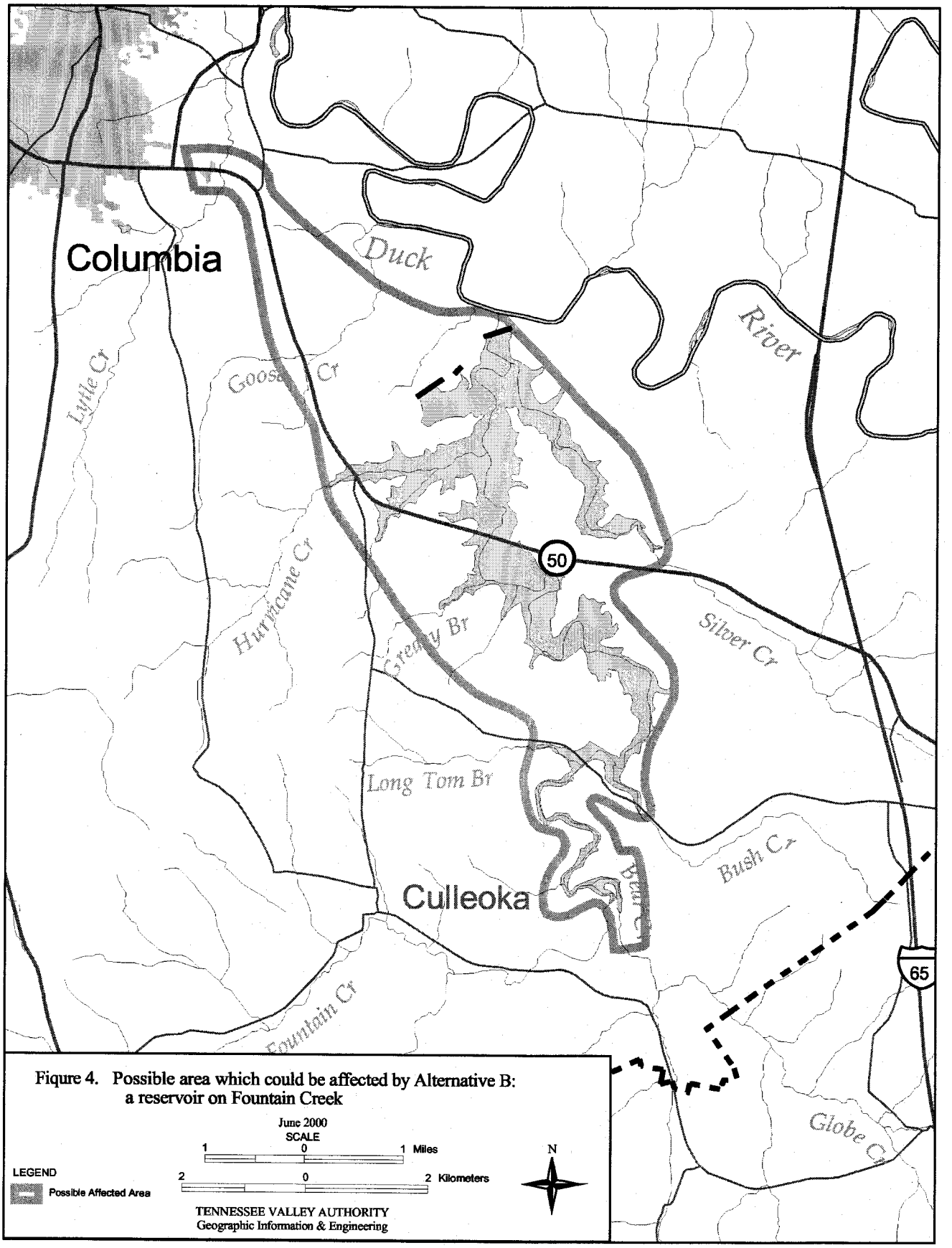
Adoption of this alternative would not have any definable additional cost; however, it also would not supply any additional water to meet projected needs of this water service area. Some expense would be required to expand the existing water treatment plant in Columbia to handle all of the water presently available in the river.

3.4 ALTERNATIVE B - FOUNTAIN CREEK RESERVOIR

Under this alternative, a reservoir would be constructed on Fountain Creek with sufficient storage capacity to meet the future water supply demand of the Maury/southern Williamson County Water Service Area. The possible project evaluated in this EIS assumes that a dam would be constructed at Fountain Creek Mile 0.2, just upstream from its mouth at Duck River Mile 145.8. At that location, the Fountain Creek watershed includes approximately 102 square miles (USACE, 1997a). The main dam would be about 1500 feet long and two saddle dams would have to be built across low points west of the main dam. All three of these dams probably would be earthfill or rockfill structures; however, the source of the fill material has not yet been identified. A spillway would be constructed, perhaps excavated in rock just east of the main dam site.

If the normal full pool of this reservoir was at elevation 629 feet, it would cover approximately 2,200 acres of land when filled. Because earthfill and rockfill dam structures are not designed to be overtopped during floods, the reservoir also would have to include the capacity to hold flood water and pass it over the spillway. Preliminary studies suggest that the reservoir property would have to include enough land to contain the water during a possible maximum flood (USACE, 1997a). This would increase the total reservoir property to include approximately 3,600 acres of land. Approximately 2,800 acres of this land already is in public ownership because it was acquired to be part of Columbia Reservoir. The remaining approximately 800 acres of land required for this concept of a Fountain Creek reservoir would have to be acquired from private owners. The likely area in which this project would be built is illustrated in Figure 4.

Actual construction of the reservoir would involve both clearing activities over at least 2,200 acres and extensive construction work at specific sites. Buildings, bridges, and other potential underwater hazards in the proposed reservoir pool area would be removed or leveled. The existing vegetation in the pool area would be knocked down or cut, marketable timber would be sold, and much of the remaining woody debris would be burned. Each of the dam structures would be constructed by moving rock and earth from the borrow sites to the desired location, where it would be placed and shaped appropriately. During each part of the



Fiqure 4. Possible area which could be affected by Alternative B: a reservoir on Fountain Creek

construction process, a variety of erosion control measures would be used to minimize impacts to the adjacent streams and as required by the NPDES permits for the project.

This reservoir would likely be required to provide a continuous release of at least five cfs to support existing uses in the short reach of Fountain Creek downstream from the dam. Preliminary evaluations indicate that, even with the five cfs continuous release, the reservoir would be capable of supplying a constant water withdrawal of 48 mgd (74 cfs), including during severe drought conditions (USACE, 1997a). This amount of water production from the reservoir assumes that appropriate measures would be taken to minimize potential water losses through leakage into the ground (USACE, 1997b). The water supply intake would need to be a multi-level structure located in the deepest part of the reservoir. Water from this intake probably would be piped to a new treatment facility, then to the existing finished water distribution system. While no location for the new water treatment plant has been identified, the length of the probable 54-inch pipeline would be about five miles. The techniques that would be used to build this pipeline would be the same as those described under Alternative C (Section 3.5).

An order of magnitude cost of this alternative (in FY 2000 dollars) is $50 million, including the cost of buying the additional land and building the reservoir, the multi-level intake, and the pipeline. This estimate does not include the costs of the additional water treatment plant or any operational costs. It does include acquiring approximately 800 acres of land for the reservoir, approximately 20 acres of permanent pipeline easement, and approximately 30 acres of construction easement along the pipeline route. The anticipated 48 mgd of sustained withdrawal available from this reservoir would be enough water (by itself) to meet the projected needs of the Maury/southern Williamson County Water Service Area through at least 2050. The possible effects of this alternative on flows in the Duck River during drought conditions in 2050 are illustrated on Figure 5.

DRDA and the local water systems are beginning to consider a possible variation of this alternative that would modify where and how water would be withdrawn and treated. Under this variation, the dam would be modified to include a multi-level intake structure and more than a

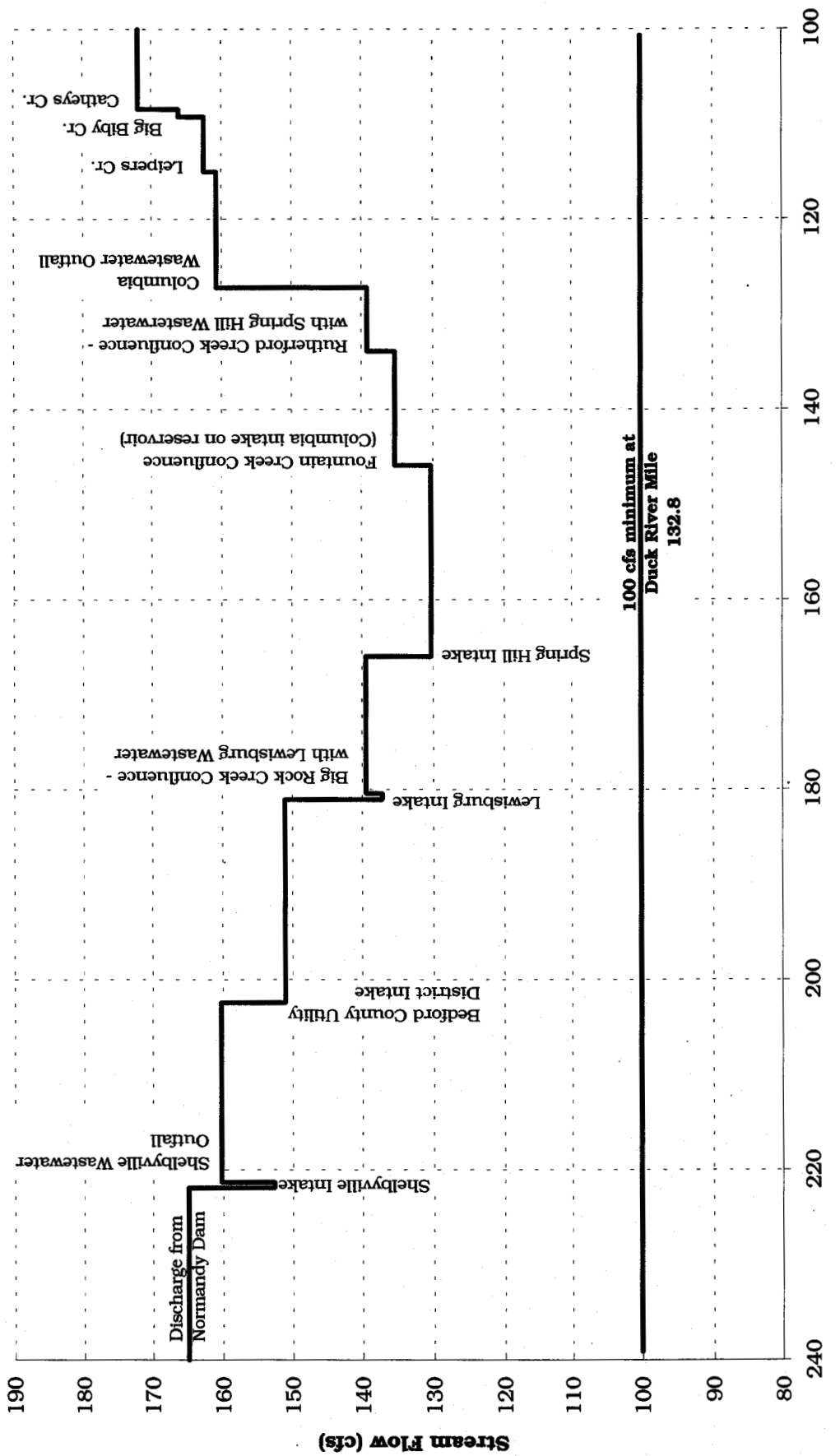


Figure 5. The potential effects of Fountain Creek Reservoir water supply source (Alternative B) on flows in the Duck River during possible drought conditions in 2050.

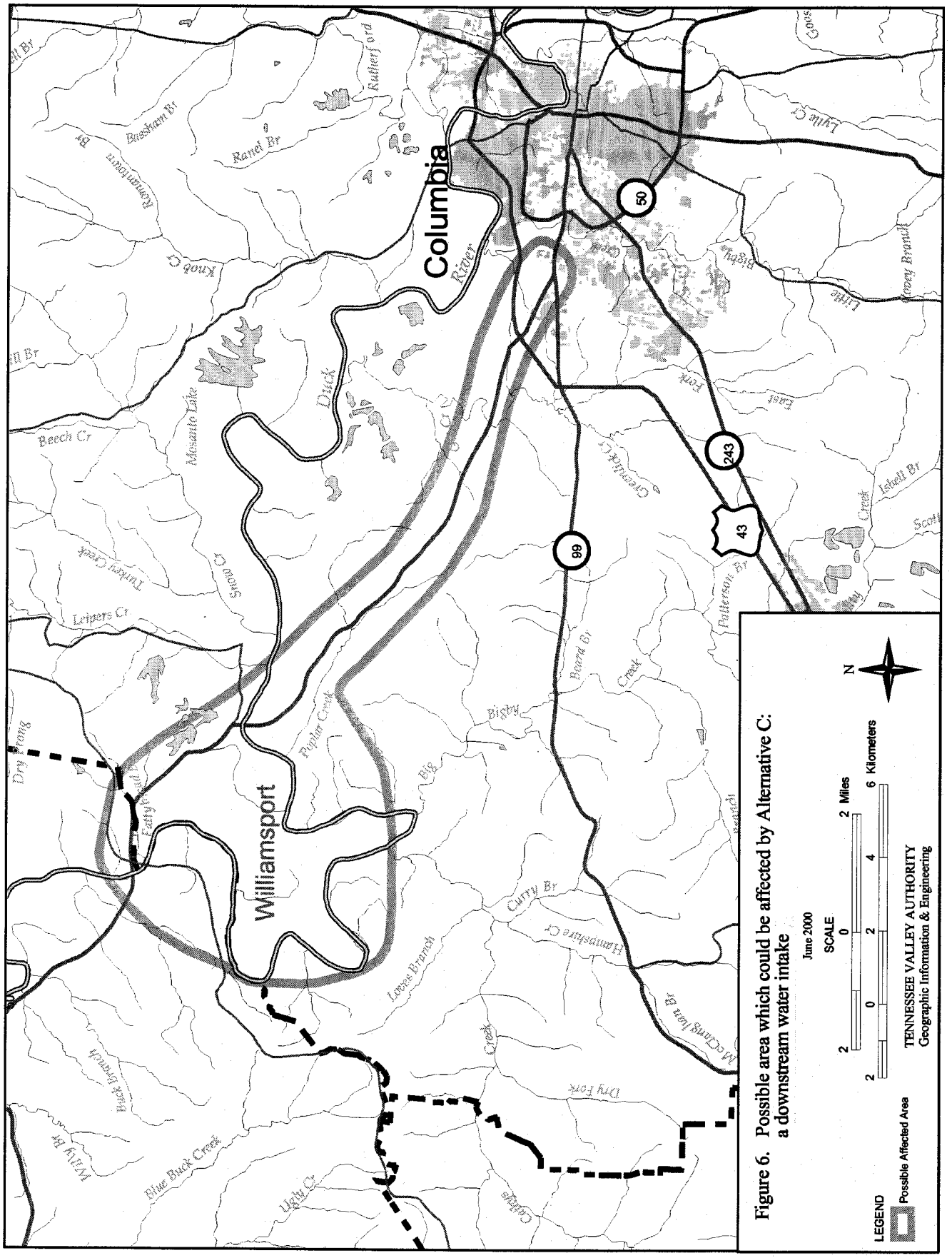
minimum amount of water would be discharged into the lower part of Fountain Creek and the Duck River. The additional water would be withdrawn from the river at or near the existing raw water intake in Columbia and would be treated in or near the existing treatment plant.

No new raw water pipeline would be required; however, additional intake and treatment capacity would have to be constructed at or near the site of the existing treatment plant. This variation has not been evaluated in this EIS because no projections have yet been made concerning the necessary changes in the design of the dam or how the reservoir would be operated during normal and drought conditions. If the basic concept of building a water supply reservoir in the Fountain Creek watershed is pursued, this and other variations could and should be evaluated as part of the development of the detailed project proposal.

3.5 ALTERNATIVE C - DOWNSTREAM WATER INTAKE

Under this alternative, future water needs in the Columbia area would be met by withdrawing water at two locations along the length of the Duck River. Columbia Power and Water Systems Systems would continue to use the water supply intake at Duck River Mile 133.9 to the maximum capacity of that treatment plant (20 mgd after planned modifications). When water demand grows beyond this capacity, a raw water intake structure and an associated pumping station would be constructed on the Duck River somewhere downstream from the mouth of Catheys Creek (Duck River Mile 108.4), perhaps in the vicinity of Kettle Mill, Duck River Mile 104. A pipeline (approximately 13 miles long) would be built from the intake location to the site of a new water treatment plant and to connect to the existing water distribution system. More than likely, a booster station also would have to be built to move the water over a high point along the pipeline route. The new water treatment plant could be constructed at any suitable location along the pipeline route, and could be built in phases, to reach the anticipated 20 mgd (31 cfs) capacity by 2050. The area likely to be affected by this alternative is illustrated in Figure 6.

The intake and pumping station would occupy approximately one acre of land adjacent to the river. The booster station also would occupy an approximate one acre site. Construction of the intake would involve


Columbia
Williamsport
Duck River
Mosanic Lake
Beech Cr
Tinker Creek
Leipers Cr
Snow Cr
Knob Cr
Rutherford
Rainel Br
Bastham Br
Kenmboam Br
Dry Prong
Earhart Br
Poplar Creek
Big Bigby Creek
Beard Br
Patterson Br
Curry Br
Hamshire Cr
Lucas Branch
Dry Fork
McCamy Hart Br
Blue Buck Creek
Ugly Cr
Cattle Creek
Black Branch
Wally Br
Greenbrier Cr
Little Bigby Creek
Little Creek
Isbell Br
East Fork
Lytle Cr
Grassy Branch
50
99
43
243
Figure 6. Possible area which could be affected by Alternative C: a downstream water intake
June 2000
SCALE
2 0 2 4 6 Kilometers
2 0 2 Miles
N
LEGEND
Possible Affected Area
TENNESSEE VALLEY AUTHORITY
Geographic Information & Engineering

disturbing a small area in and along the shore of the river and building a concrete or similar structure in the water. Both pumping stations would be fairly typical buildings constructed to house two or more pumps, electrical controls, and, probably, backup power generation equipment.

The pipeline that would connect these facilities to the new treatment plant and existing water distribution system probably would be built more or less along the State Highway 50 right-of-way. If this pipeline did follow State Highway 50, it would cross the Duck River near Williamsport and various smaller streams in the Poplar Creek and Greenlick Creek watersheds. To be capable of supplying up to 20 mgd of water, this pipeline would need to be approximately 36 inches in diameter.

This pipeline (and the pipelines described as parts of other alternatives) would likely be built using ductile iron pipe completely buried in the ground. The pipeline would likely require a permanent easement approximately 30 feet in width and a short-term construction easement about 50 feet wide.

During construction of the pipeline, appropriate erosion control measures, such as silt fencing and hay bales, would be installed in accordance with applicable best management practices and terms of the required NPDES construction stormwater discharge permits. Trees and brush within the right of way would be cleared, marketable timber would be sold, and other woody debris would be burned or buried. Backhoes, trenching machines, mechanical rippers, and/or drilling and blasting would be used to excavate a trench about six feet deep. Soil removed from the trench would be stockpiled for later use and, in agricultural areas, topsoil would be segregated from deeper soil layers.

Once the trench was dug, segments of pipe would be laid end to end using special stringing equipment. Crews would connect individual segments together to form longer sections which would be lowered into the trench by side-boom tractors. Rock and soil removed during trenching would be used to fill the ditch, then the surface would be graded and revegetated to approximate original contour and to meet specific agreements with the landowners.

Different construction techniques would be required where the pipeline would have to be laid across major roadways, railroads, or streams. Boring and directional drilling techniques, often used to cross linear features such as major roads or railroads, would allow the pipeline to be built without disturbing activities on the ground surface. The flume crossing technique, sometimes used to cross flowing creeks, involves building temporary dams upstream and downstream from the crossing site and passing the stream flow through flumes during the short period of time when the pipeline is being built using a fairly conventional trenching technique.

Before various parts of the pipeline would be placed in service, they would be flushed and hydrostatically tested. Water would be pumped into the line and pressurized for several hours to determine if any leaks were present. Most likely, water for this hydrostatic testing would be drawn from the future supply source.

The order of magnitude cost of this alternative (in FY 2000 dollars) is $11 million. This estimate includes the cost of building the intake, the pumping station, booster station, and the 13-mile pipeline but excludes the cost of the new water treatment plant. Approximately one acre of land for the intake, approximately one acre of land for the booster station, approximately 50 acres of permanent pipeline easement, and approximately 80 acres of construction easement would have to be acquired. Much of the pipeline could be built along existing highway rights-of-way; however, some easements over private property would have to be acquired. If withdrawals from the river between Normandy and the Columbia area did not exceed the projections described in Section 2.8, the 20 mgd capacity of this pipeline could provide enough additional water to meet the projected needs of the Maury/southern Williamson County Water Service Area through 2050. The possible effects of this alternative on flows in the Duck River during drought conditions in 2050 are illustrated on Figure 7.

3.6 ALTERNATIVE D - RAISE NORMANDY POOL LEVEL

This alternative would provide more water to the Columbia area by increasing the minimum flow that could be released from Normandy

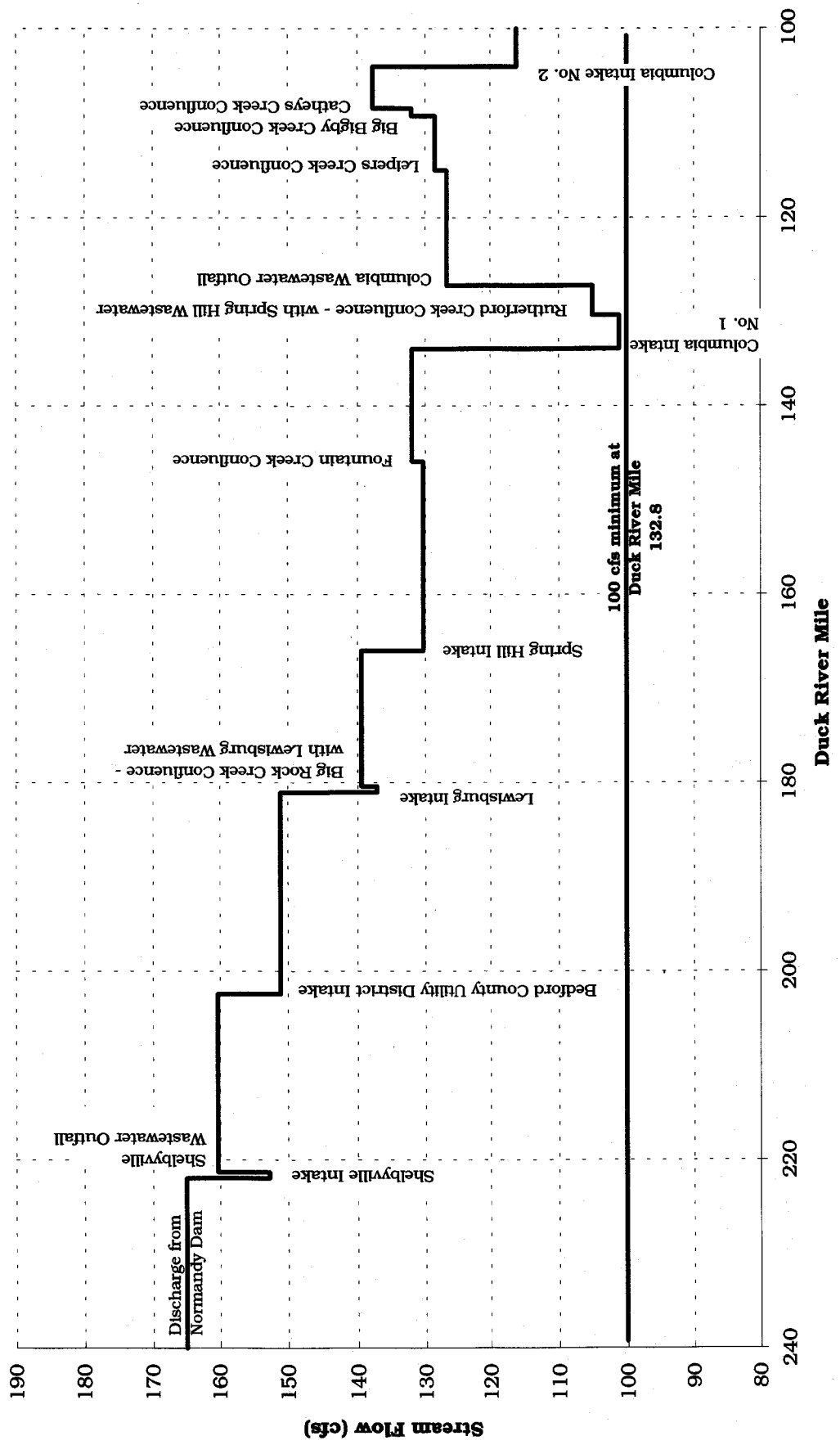


Figure 7. The potential effects of a downstream water supply source (Alternative C) on flows in the Duck River during possible drought conditions in 2050.

Reservoir. The additional flow would be made possible by raising the height of Normandy Dam, increasing the volume of water that could be stored in the reservoir, and using that additional water to increase the minimum discharge to the Duck River. If the earthen and concrete portions of Normandy Dam were raised by five feet (from elevation 895 to 900 feet), the normal maximum pool elevation of the reservoir could be increased from 875 to 880 feet and the normal minimum pool elevation would be increased from 864 to 869 feet. The surface area of the full pool reservoir would increase by 230 acres (from 3,230 acres to 3,460 acres). The increase in the volume of the reservoir would provide the space to store an additional 5,500 million gallons of water, which could be used to increase the minimum summer season discharge from 165 to 181 cfs. The area affected by this alternative is illustrated on Figure 8.

Adoption of this alternative would involve construction activity at Normandy Dam and at locations all around the margins of the reservoir. At Normandy Dam, additional earth and rock would be added to raise the height and strengthen the earthfill part of the dam. In addition, the concrete spillway would be rebuilt to raise it to the new operating height. At present, the quantities of concrete and fill material required for this work have not been determined and the source of the fill material has not been identified.

A variety of roads and recreational facilities around Normandy Reservoir would have to be modified or relocated if the normal pool level was raised. The Riley Creek Road bridge over the reservoir would have to be raised, along with the approaches to that bridge. Some of the roads and buildings in the Barton Springs and Cedar Point public use areas would have to be raised or relocated. At least some of the six existing boat launching ramps and associated parking lots around the reservoir would have to be modified or relocated. In addition, the band of existing shoreline all around the reservoir which would become part of the normal pool would have to be cleared. All of this construction activity would be conducted using appropriate methods to minimize the potential impacts and comply with the construction NPDES permits.

Preliminary TVA modeling studies suggest that, even during a severe drought, this alternative could provide an additional 16 cfs of minimum flow in the river without drawing the Normandy Reservoir pool elevation

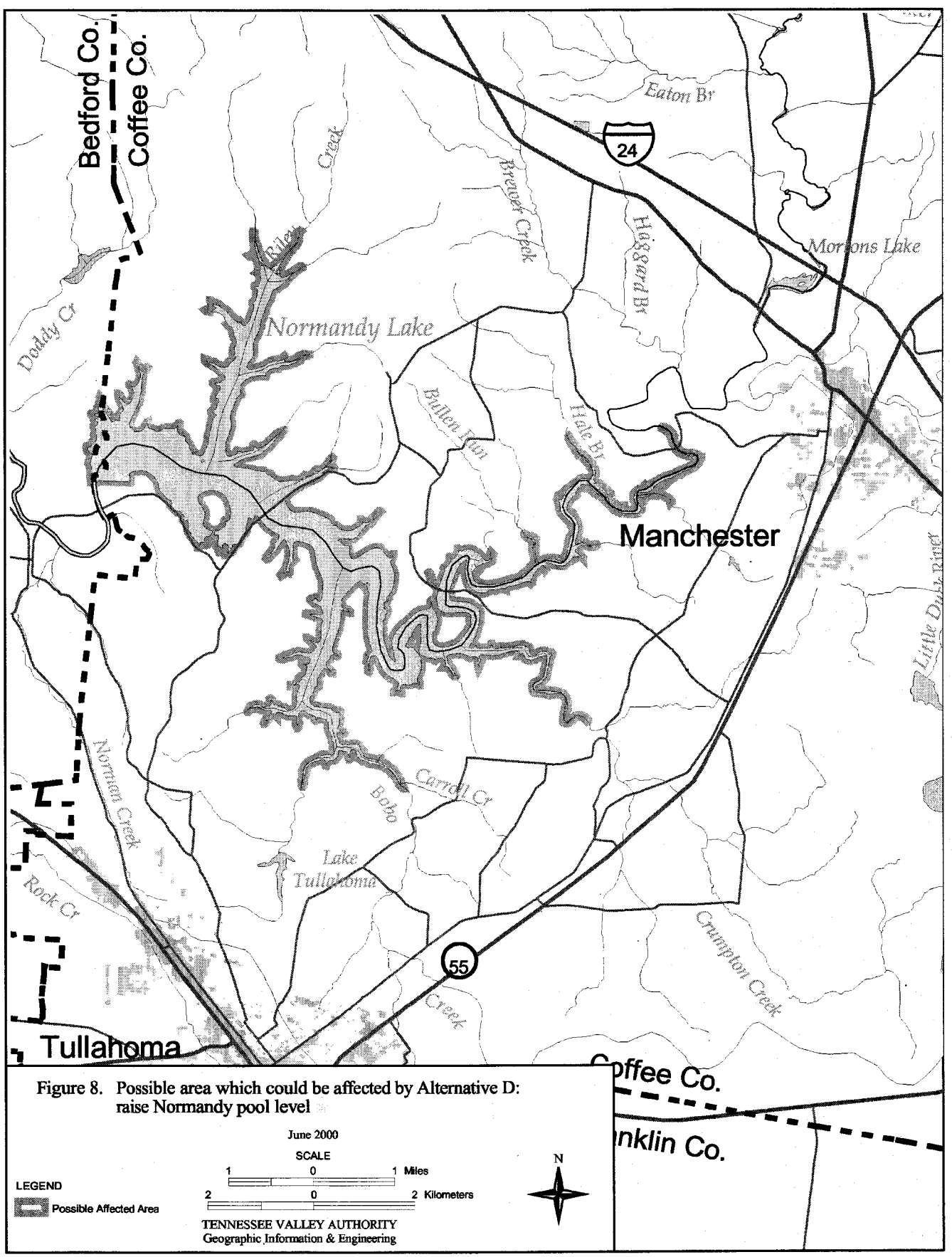


Figure 8. Possible area which could be affected by Alternative D: raise Normandy pool level

any lower in October and November than would occur under present conditions. If withdrawals from the river between Normandy and the Columbia area did not exceed the projections described in Section 2.8, the increased minimum flow in the river could provide up to 36 mgd (56 cfs) for water supply to the Columbia area, enough to meet the water demand estimated to occur in that service area around the year 2035 (Table 4). This level of minimum flow, however, would be 4 mgd (6 cfs) short of the total demand in the Maury/southern Williamson County Water Service Area that is estimated to occur by 2050. When the full 40 mgd (62 cfs) demand does occur, other supply or conservation measures would have to be developed to meet the last 10 percent of this need. The potential effects of this alternative on flows in the Duck River during drought conditions in 2050 are illustrated on Figure 9.

An order of magnitude cost of this alternative (in FY 2000 dollars) is $8 million. This estimate includes all necessary structural modifications to Normandy Dam and all associated roadway and facility changes around Normandy Reservoir. The estimate excludes the cost of any additional water treatment capacity. No additional land would have to be acquired to implement this alternative because all of the affected area is part of the Normandy Dam reservation.

3.7 ALTERNATIVE E - TIMS FORD PIPELINE

This alternative would involve meeting the future demand in the Maury/southern Williamson County Water Service Area by augmenting the flow of the Duck River with water from Tims Ford Reservoir (in the Elk River watershed). Under this alternative, a raw water intake and pumping station would be constructed on either of two northern arms of Tims Ford Reservoir (the Lost Creek or Hurricane Creek embayments). In addition, an approximate 20-mile pipeline would be constructed to move the water to a suitable discharge point on the Duck River, perhaps near the State Highway 82 bridge crossing near Shelbyville (River Mile 224). A second pumping station would be required to boost the water over the Elk/Duck watershed divide. Likely areas to be affected by this alternative are illustrated in Figure 10.

Construction of this alternative would include building the intake, initial pumping station, booster station, pipeline, and discharge. The multi-

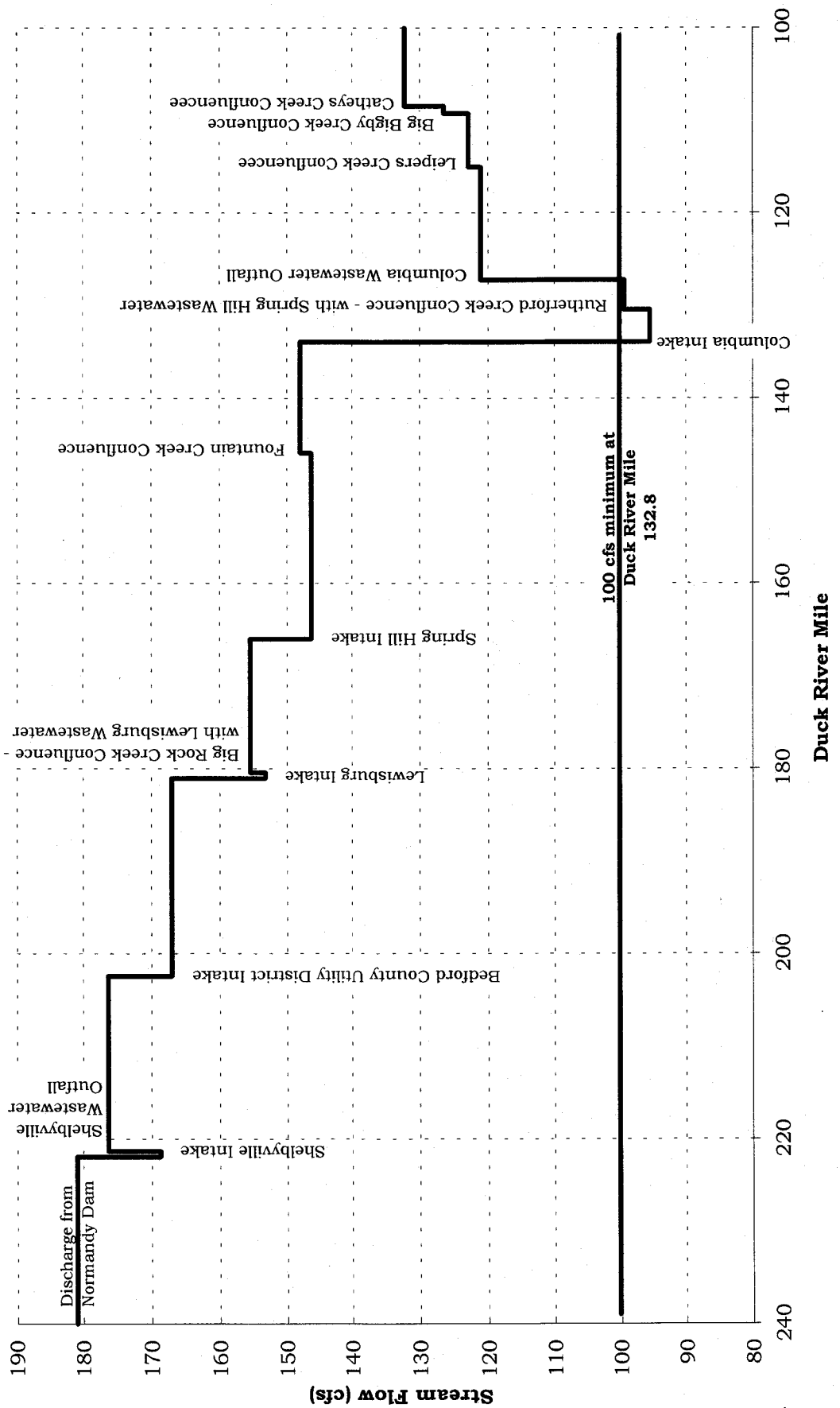


Figure 9. The potential effects of raising the Normandy pool level (Alternative D) on flows in the Duck River during possible drought conditions in 2050.

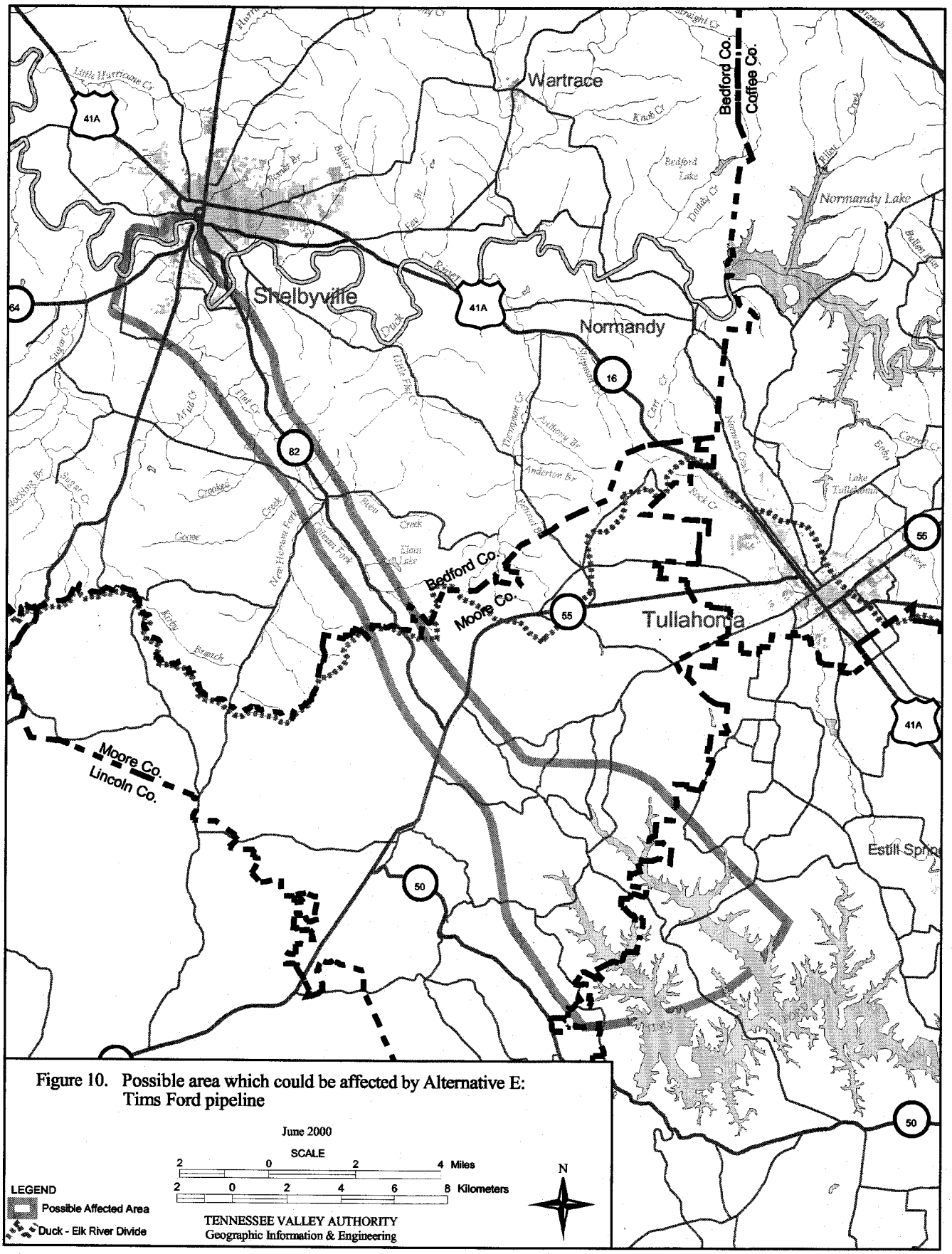


Figure 10. Possible area which could be affected by Alternative E: Tims Ford pipeline

level intake would be built out in the embayment and the associated pumping station would be built on high groundalong the shore. Construction of the intake would involve disturbing a small area in the reservoir where a concrete or similar structure would be built. The pumping station would be a fairly typical building constructed to house two or more pumps, electrical controls, and, probably, backup power generation equipment. The booster station, to be located at a convenient site along the pipeline route, would be similar to the pumping station along the reservoir.

The pipeline probably would be built more or less along existing road rights-of-way, including State Highway 80. If this pipeline was routed to follow State Highway 80, it would cross East Fork Mulberry Creek and several small tributaries in the Flat Creek watershed. This pipeline probably would need to be about 30 inches in diameter to transport up to the 22 cfs of additional water projected to be needed by the year 2050. The techniques that would be used to build this pipeline would be the same as those described under Alternative C (Section 3.5). All of the construction activities associated with this alternative would be conducted in ways that would minimize the potential impacts to streams and comply with their NPDES permits.

The purpose of this water transfer system would be to augment the minimum flow in the reach of the Duck River near Columbia. Water would be withdrawn from Tims Ford Reservoir only in event of severe drought; it would not be required on a routine basis. The frequency of these droughts is about one in every ten years, and then typically only during the period from June through October. Preliminary TVA modeling studies suggest the use of this pipeline to transfer as much as 22 cfs of water to the Duck River during even an extended drought would not affect releases from Tims Ford Dam but would lower the pool elevation in Tims Ford Reservoir by about eight inches over what would occur without the transfer. If withdrawals from the Duck River between the discharge point and the Maury/southern Williamson County Water Service Area did not exceed the projections described in Section 2.8, this alternative would provide enough additional water to meet drought-condition needs of the Columbia area through 2050. Figure 11 illustrates the likely effects of this alternative on flows in the Duck River during drought conditions in 2050.

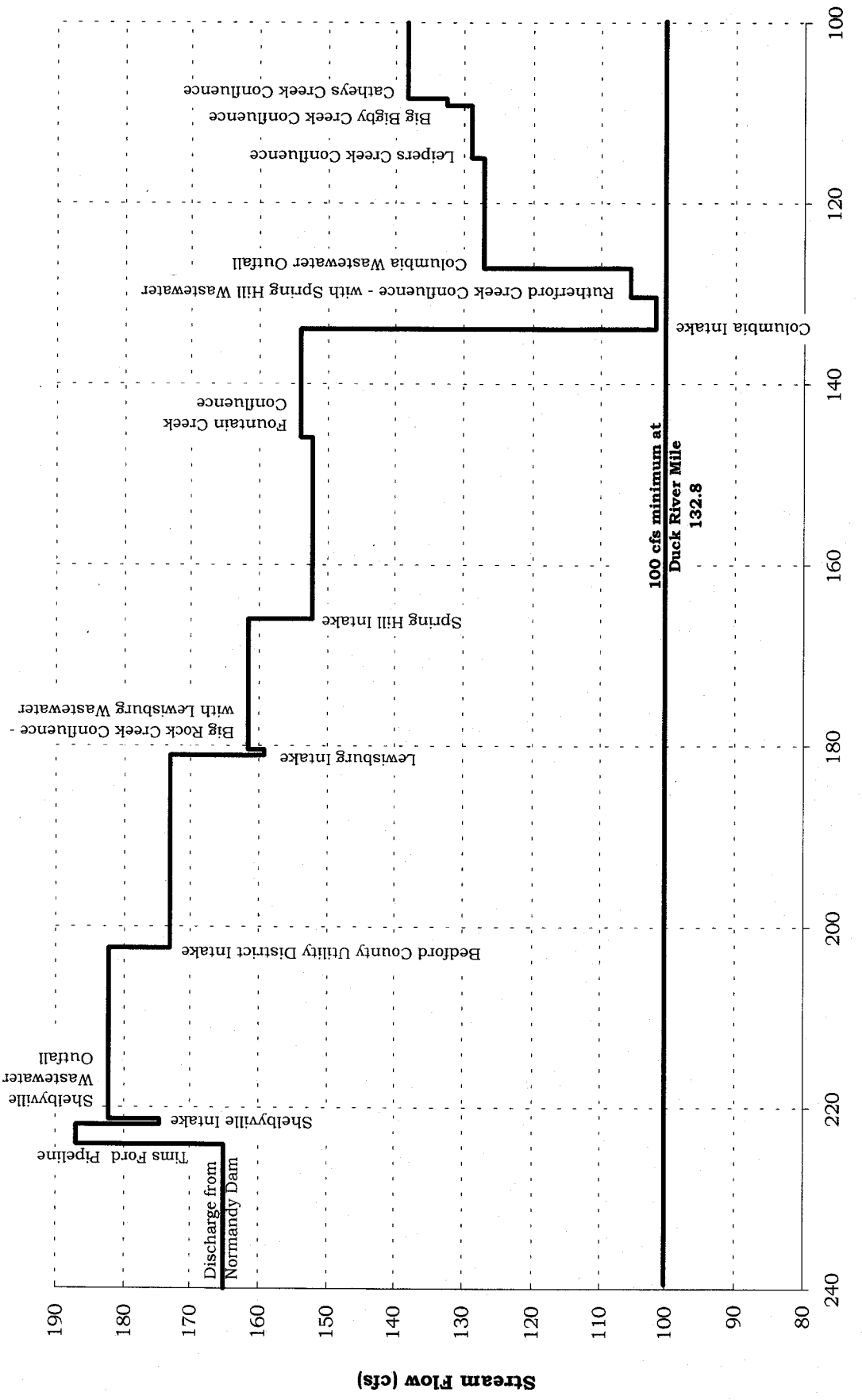


Figure 11. The potential effects of a pipeline from Tims Ford Reservoir (Alternative E) on flows in the Duck River during possible drought conditions in 2050.

An order of magnitude cost of this alternative is $13 million (in FY 2000 dollars). This estimate includes construction of the intake, pumping stations, pipeline, and discharge, but excludes the cost of operating the pipeline and of any additional water treatment capacity. The intake and associated pumping station would likely be built on existing public land along Tims Ford Reservoir; however, approximately one acre of land would have to be acquired for the booster station. Approximately 75 acres of permanent easement and approximately 125 acres of temporary (construction) easement would have to be acquired. Much of the pipeline could be built along existing highway rights-of-way; however, some easements over private property would have to be acquired.

3.8 ALTERNATIVES NOT EVALUATED IN DETAIL

The 37 suggested ways to meet the water supply needs of the Columbia area presented in Table 5 include several groups of ideas that were not selected for detailed evaluation in this EIS. The reasons these suggestions were excluded from detailed analysis are presented in the following paragraphs.

Finish Columbia Dam

Many people who commented on the scope of this EIS spoke or wrote forcefully in favor of completing the Columbia Reservoir as it had been proposed initially -- an impoundment on the Duck River with a full pool at elevation 630 feet. If the reservoir could not be completed at elevation 630 feet, some indicated they would settle for a Duck River reservoir filled to elevation 600 feet. Both of these alternatives have been evaluated previously, first with regard to their impacts on endangered species (USFWS, 1979) and, later, with regard to benefits and costs (TVA, 1986). In both respects, these alternatives were found to include negative effects which would impede completion of the impoundment. Economic aspects of these alternatives have not been reviewed in recent years, but a 1988 survey of aquatic endangered species (Jenkinson, 1988) indicated the potential adverse effects of a reservoir at either elevation had become more severe because an additional endangered species was found in a part of the river both alternatives would impound. In 1995, TVA concluded that a reservoir could not be built on the Duck River upstream from Columbia and, in 1999, the concrete part of the dam was demolished.

Build Some Other Reservoir

If a reservoir cannot be built on this part of the Duck River, several commenters on the scope of this EIS and some of the ideas presented in Table 5 suggest that a water supply reservoir could be built on Fountain Creek or some other tributary watershed near Columbia. As indicated in the Land Use EIS (TVA, 1999), TVA acquired approximately 3,800 acres of land in the Fountain Creek watershed, some of which could be used as part of a water supply project. As indicated in Section 3.4, construction of a water supply reservoir on Fountain Creek is evaluated as part of this EIS. The closeness of the Fountain Creek watershed to Columbia and the fact that some of the land already is in federal ownership makes a tributary reservoir on Fountain Creek the most logical representative of these suggestions to be evaluated in detail.

Withdraw/Capture Additional Water from the Duck River

Some of the ideas presented in Table 5 suggest that new intakes could be built or modifications could be made to existing structures on the Duck River to increase the amount of water that could be withdrawn to meet the needs of the Columbia area. Several of these ideas could be implemented; however, the initial evaluation indicated they would either not result in capturing any additional water (beyond what is already available in the river) or they were not likely to capture enough water to meet the estimated additional needs of the area. The one idea which might capture a substantial quantity of water (off-stream storage) would require so much storage area that it would become a reservoir, a suggestion considered to be adequately represented by the Fountain Creek Reservoir alternative.

Use Ground Water

The idea of using ground water sources is represented in all three parts of the list included in Table 5. This set of suggestions has been excluded because the available information (summarized in USGS, 1996, and in Section 4.3 of this EIS) indicates that an adequate ground water source is quite unlikely to be found in or adjacent to the upper Duck River basin.

Use Water Conservation

Virtually all of the remaining ideas presented in Table 5 involve one method or another of addressing the projected future water needs by

reducing the demand or, otherwise, conserving the water that already is available in the Columbia area. Water conservation is just beginning to emerge as an issue (and an opportunity) in Tennessee and other eastern states and, in the future, may become an important component in water resource planning. Water conservation has proven to be effective in reducing water demand in areas with constrained water sources and allows water systems to save money by deferring or avoiding investments in water infrastructure. Basic measures which can be conducted include universal metering, water accounting and loss control, costing and pricing reform, and public education. Additional measures beyond the basic level could include water use audits, retrofits of inefficient plumbing fixtures, pressure management, and the promotion of low water use landscaping. Conservation measures probably could produce at least a ten percent reduction in water use in the Duck River region. This would preserve some of the valuable water resources; however, it would not prevent the need for additional water supply before 2050. In addition, if water conservation measures were not adopted throughout a broad geographic area in middle Tennessee, residents in the Maury/southern Williamson County Water Service Area would be unlikely to accept strictly local, long-term water use restrictions as a viable alternative to augmenting their water supply.

3.9 COMPARISON OF ALTERNATIVES

Table 6 presents a brief summary of the concepts and components of each of the five water supply alternatives. The abbreviated entries in this table are derived from the information presented in Sections 3.3 through 3.7. The geographic areas likely to be affected by all four of the action alternatives are indicated on Figure 12.

The following paragraphs and the entries in Table 7 present a summary of the potential effects of the alternatives on the full range of environmental resources. All of the effects information in these summaries is derived from the discussions presented in Chapter 5. These summaries also assume that the various projects would be built subject to present laws, regulations, and knowledge about the status of resources in the project areas. The concluding paragraphs in this section present a comparison of the likely environmental effects of these alternatives.

Table 6. Summary comparison of the five water supply alternatives being evaluated in detail. Table entries are derived from information presented in Sections 3.3 through 3.7.

Components	A: Use Present Sources (No Action)	B: Fountain Creek Reservoir	C: Downstream Water Intake	D: Raise Normandy Pool Level	E: Tims Ford Pipeline
Basic Concept	No new source	Build a water supply reservoir	Add another Duck River intake	Augment minimum river flow	Augment minimum river flow
Additional Water Source	None	Fountain Creek Reservoir	Duck River ~ River Mile 100	Enlarged Normandy Reservoir	Tims Ford Reservoir
Additional Water Volume	None	74 cfs	46 cfs	16 cfs	22 cfs
Would Meet Water Needs Through	2015	2050 +	2050 +	2035	2050
New Treatment Capacity Required?	Yes	Yes	Yes	Yes	Yes
Estimated Pipeline Length	None	5 miles	13 miles	None	20 miles
Additional Land Required	None	800 acres (+ 2,800 acres already in public ownership); also 50 acres of easements along pipeline route	2 acres; also 130 acres of easements along pipeline route	None (affected areas already in public ownership)	1 acre (+ 1 acre already in public ownership); also 200 acres of easements along pipeline route
Order of Magnitude Construction Cost (FY 2000 $)	None	$ 50 Million	$ 11 Million	$ 8 Million	$ 13 Million
Estimated Added Cost to Operate	None	Not Determined	Not Determined	None	Not Determined

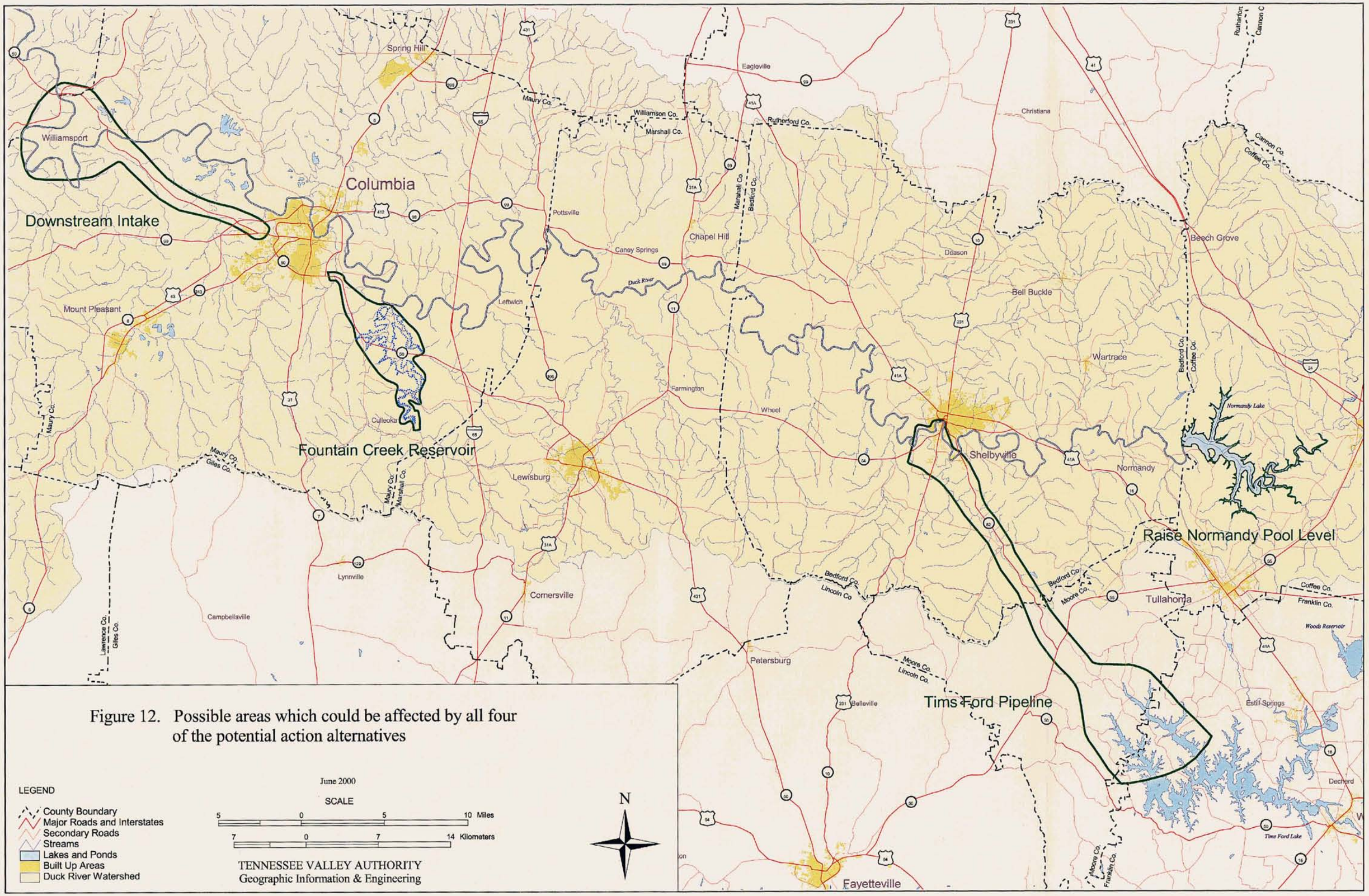


Figure 12. Possible areas which could be affected by all four of the potential action alternatives

Table 7. Summary of the potential environmental effects of the five water supply alternatives being evaluated in detail. Table entries are derived from the identified sections in Chapter 5.

Resource Areas	A: Use Present Sources (No Action)	B: Fountain Creek Reservoir	C: Downstream Water Intake	D: Raise Normandy Pool Level	E: Tims Ford Pipeline
Ground Water (Section 5.3)	No immediate effects	Higher local ground water; lower quality	Probably minimal construction effects	Probably minimal effects	Probably minimal construction effects
Surface Water (Section 5.4)	No immediate effects; potential drought impacts	Nutrient-rich small reservoir; need to protect supply use	Probably minimal construction effects; flow benefits	Probably minimal construction effects; flow benefits	Probably minimal construction effects; flow benefits
Aquatic Life (Section 5.5)	No immediate effects; potential drought impacts	Species diversity in reservoir would be lower than streams	Probably minimal construction effects; some flow benefits	Possible community changes in reservoir and downstream	Probably minimal construction effects; flow benefits
Wetlands (Section 5.6)	No effects	Net loss in wetland areas and functions	Probably minimal construction effects	Possible changes in wetland sites	Probably minimal construction effects
Floodplains (Section 5.7)	No effects	Higher upstream flood levels; lower levels downstream	Probably minimal construction effects	Probably minor changes in flood elevations	Probably minimal construction effects
Terrestrial Life (Section 5.8)	No immediate effects	Significant change in area habitats	Probably minimal construction effects	Some local changes in area effects	Probably minimal construction effects
Endangered and Threatened Species (Section 5.9)	No immediate effects	Possible effects related to changes in area habitats	Probably minimal construction and operational effects	Probably minimal construction and habitat effects	Probably minimal construction effects
Land Use/ Prime Farmland/ Community Noise (Section 5.10)	No immediate effects	Approx. 800 acres would be acquired; major changes in use on 3,600 acres	Probably minimal construction and operational effects	Only local changes in use would occur	Probably minimal construction and operational effects
Visual/Recreation/ Natural Areas (Section 5.11)	No immediate effects	Significant local changes in character and use	Probably minimal construction and operational effects	Significant changes in character, facilities and a natural area	Probably minimal construction and operational effects
Cultural Resources (Section 5.12)	No immediate effects	Potential for significant effects at sites on 3,600 acres	Probably minimal construction effects	Potential for adverse effects at sites on 230 acres	Probably minimal construction effects
Socioeconomics (Section 5.13)	Potential future limit on economic growth	Most construction employment benefit	Minor construction employment benefit	Some construction employment benefit	Minor construction employment benefit

Adoption of **Alternative A** would mean that no new source of water would be developed to meet the projected future needs of the Maury/southern Williamson County Water Service Area. More than likely, the Spring Hill and Columbia water treatment plants would be expanded to withdraw and treat as much water in the river as possible; however, the worst case needs of this water service area are projected to exceed the available flow in the river during drought conditions some time after 2015 (Sections 2.8 and 5.4). As the demand for water approached the available supply, treatment of area wastewater would become more difficult and expensive (Section 5.4), and economic growth in the area probably would slow or stop (Section 5.13). If the demand for water continued to rise and no additional water supply source for the area was developed, drought conditions probably would bring the imposition of water conservation measures and pleas to TDEC for permission to withdraw more water from the river (Section 5.4). Large withdrawals from the river during drought conditions would result in adverse effects to aquatic life and recreational use of the river for several miles downstream from the Columbia water supply intake (Sections 5.5 and 5.11). Eventually, the increasing demand is likely to lead to the development of one or more additional water sources for the Columbia area.

Adoption of **Alternative B** would result in the construction of a water supply reservoir in the downstream part of the Fountain Creek watershed and an approximate 5-mile pipeline to transport water from this reservoir to a new treatment plant and on to the existing water distribution system. If this reservoir was built with a full pool at elevation 629 feet and if it included all of the adjacent land up to the probable maximum flood level, the project would affect a total area of approximately 3,600 acres, of which 800 acres is not already in public ownership and would have to be acquired (Section 3.4). Construction of the reservoir would create a relatively small, nutrient-rich reservoir (Section 5.4) which would have to be grouted to avoid significant leakage to the ground water (Section 5.3). The reservoir would substantially change aquatic habitats, terrestrial habitats, land use, visual character, and recreational activities in the immediate area (Sections 5.5, 5.8, 5.10, and 5.11); however, the nature and extent of some of those changes would depend on how the reservoir and surrounding land were managed (Sections 5.4, 5.10, and 5.11). The reservoir would support much lower

diversity of aquatic life than the existing creeks; however, some species capable of living in standing-water habitats would be more abundant in the area than they are now (Section 5.5). Construction of the reservoir could result in a net loss in local wetland functions (Section 5.6) and significant adverse effects on the extensive archaeological resources that are likely to be present in the area (Section 5.12). If all of the future water demands of the Columbia area were to be met from the Fountain Creek reservoir, the flow not withdrawn from the river would help maintain acceptable water quality conditions for fish and aquatic life and recreational uses downstream from the water intake, as well as provide more initial dilution for the Columbia wastewater treatment plant discharge (Section 5.4). If this alternative was pursued, future planning for the reservoir would have to include ways to avoid or minimize potential adverse effects on ground water, surface water, aquatic life, wetlands, terrestrial life, endangered species, land use, recreation, natural areas, and cultural resources (Sections 5.3, 5.4, 5.5, 5.6, 5.8, 5.9, 5.10, 5.11, and 5.12). If constructed and operated appropriately, this reservoir could meet all of the projected water supply needs of the Maury/southern Williamson County Water Service Area through at least 2050 (Section 3.4) and would not impede the anticipated level of local economic growth (Section 5.13).

Adoption of **Alternative C** would lead to the construction of a water supply intake and pumping station on the Duck River downstream from the mouth of Catheys Creek (possibly near River Mile 104) and an associated 13-mile pipeline and booster station to transport water to a new treatment plant and to the existing water distribution system. If this project was constructed as indicated in Section 3.5, it would have only short-term and minor effects on ground water, wetlands, floodplains, terrestrial life, endangered species, land use, visual character, natural areas, and cultural resources (Sections 5.3, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, and 5.12). Operation of the project would not be likely to cause any adverse effects on water quality or aquatic life at the intake site and the flow not withdrawn from the river would help maintain aquatic life and recreation downstream from the Columbia water intake during drought conditions (Sections 5.4, 5.5, and 5.11). If this alternative was pursued, future planning for the project would have to include ways to avoid or minimize potential adverse effects on ground water, surface water, aquatic life, wetlands, terrestrial life, endangered

species, land use, visual character, and cultural resources (Sections 5.3, 5.4, 5.5, 5.6, 5.8, 5.9, 5.10, 5.11, and 5.12). If withdrawals from the river between Normandy and the Columbia area did not exceed the projections described in Section 2.8, this intake and pipeline could provide enough additional water to meet the anticipated water supply needs of the Maury/southern Williamson County Water Service Area through 2050 (Section 3.6) and would not impede the anticipated level of local economic growth (Section 5.13).

Adoption of **Alternative D** would result in raising the pool level on Normandy Reservoir and increasing the minimum discharge from Normandy Dam. If this project was constructed as indicated in Section 3.6, it would have only short-term and minor effects on terrestrial life, endangered species, and land use (Sections 5.8, 5.9 and 5.10), and could result in minor beneficial effects on water quality and aquatic life in the Duck River downstream from Normandy Dam (Sections 5.4 and 5.5). Raising the pool level in Normandy Reservoir is likely to result in minor adverse effects on wetlands and cultural resources around the reservoir (Sections 5.6 and 5.12) and significant adverse effects on visual character, existing recreation facilities around the reservoir, and on three acres supporting important features in the Short Springs State Natural Area (Section 5.11). Future planning for this project would have to include more detailed evaluations of the potential effects on ground water, surface water, aquatic life, flood elevations upstream from Normandy Dam, visual character, recreation facilities, and natural areas (Sections 5.3, 5.4, 5.5, 5.7, and 5.11). If constructed and operated appropriately, these modifications to Normandy Reservoir and its discharge could make additional water available in the Duck River (Section 3.6). If withdrawals from the river between Normandy and the Columbia area did not exceed the projections described in Section 2.8, the augmented minimum flow in the river could provide up to 36 mgd (56 cfs) for water supply to the Maury/southern Williamson County Water Service Area, enough to meet the water demand estimated to occur in that area around the year 2035 (Section 3.6). Water conservation and/or some other supply source would be required to meet the projected additional 6 cfs of demand by 2050 without impeding the anticipated level of local economic growth (Sections 5.4 and 5.13).

Adoption of **Alternative E** would lead to the construction of a water supply intake and pumping station on a northern embayment of Tims Ford Reservoir and an associated 20-mile pipeline and booster station to transport water to a discharge point on the Duck River near Shelbyville. If this project was constructed and operated as described in Section 3.7, it would have only short-term and minor effects on ground water, wetlands, floodplains, terrestrial life, endangered species, land use, visual character, recreation, natural areas, and cultural resources (Sections 5.3, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, and 5.12). When this water transfer system was operating (only during drought conditions), it would have only minimal effects on the water level in Tims Ford Reservoir and could have beneficial effects on surface water quality and aquatic life in the Duck River downstream from the discharge point (Sections 5.4 and 5.5). If this alternative was pursued, future planning for the project would have to include ways to avoid or minimize potential adverse effects on ground water, surface water, aquatic life, wetlands, terrestrial life, endangered species, land use, visual character, recreation, and cultural resources (Sections 5.3, 5.4, 5.5, 5.6, 5.8, 5.9, 5.10, 5.11, and 5.12). If withdrawals from the river between the discharge point and the Maury/southern Williamson County Water Service Area did not exceed the projections described in Section 2.8, this alternative would provide enough additional water to meet drought-condition needs of the service area through 2050 (Section 3.7) without impeding the anticipated level of local economic growth (Section 5.13).

Comparison

In general, the extent of potential construction effects of each of the four action alternatives seem to be related to the amount of land area that would be modified or disturbed and the flexibility available when locating specific project components. Construction or modification of a reservoir (Alternatives B and D) would affect all of the land within a fixed project area. Under both of these alternatives, it would be difficult to avoid having some impact on any resource feature that existed within the project area. In contrast, the construction of intakes, pumping stations, discharges, and pipelines (Alternatives C and E) would affect only narrow corridors of land within a general project area. The locations of the end point facilities and the route of the pipeline could be adjusted to avoid or minimize potential impacts to many types of resource features.

In similar general terms, operation of these alternatives would result in effects on resources based primarily on when, where, and how much the water flow would be changed in the affected streams and rivers. Alternative C would essentially recirculate some water within a relatively short reach of the Duck River. Alternatives B and D would involve harvesting more water in the Duck River basin during high flow events and discharging or using that water during minimum flow periods. Alternative E would involve using water from the Elk River basin to augment the minimum flow in the Duck River from the Shelbyville area downstream to Columbia. In virtually all cases, increasing the flow in some part of the Duck River would benefit water quality, aquatic life, and recreation in that area. The overall effects of reducing or modifying the flow at the water sources would depend on how much the preexisting conditions would be changed.

3.10 PREFERRED ALTERNATIVE

As indicated in Section 1.3, TVA, DRDA, a variety of local water systems, and other agencies have participated in completing this analysis and programmatic EIS to achieve three purposes. These purposes are: 1) to document if one or more of the three water service areas in the upper Duck River basin has a projected need for additional water before about 2050, 2) to identify various ways that would meet the future additional need for water in one or more of those service areas, and 3) to determine the likely environmental effects of the five conceptual alternatives that have been evaluated in detail.

The first of these purposes has been met by gathering and evaluating information about existing water use, anticipated population growth, and future demands for water in the upper Duck River area. The results from the Needs Analysis (summarized in Section 2.10) indicate that the present releases from Normandy Dam would be sufficient to meet the projected water needs in the Bedford County and Marshall County water service areas through 2050. The Needs Analysis also indicated that additional water supply would be required to meet future needs in the Maury/southern Williamson County Water Service Area, starting some time after 2015. Given these results, TVA has concluded that one or more action alternatives should be pursued to meet the future water

needs in the Maury/southern Williamson County Water Service Area. This is the TVA preferred alternative in this programmatic EIS.

The second and third purposes have been met by gathering ideas and conducting a generic evaluation of four different ways to meet the projected water needs in the Maury/southern Williamson County Water Service Area. Three of the four alternatives evaluated in detail would provide enough additional water to meet the projected needs through at least 2050, while the present concept of the fourth alternative (Raise Normandy Pool Level) would meet the needs through at least 2035. Local utilities, government agencies in the upper Duck River watershed, and other interested parties will be the ones to actually decide which water supply alternative(s) should be pursued. Those local agencies and the publics they serve must determine how they want to address water needs in this river basin and how those systems will be operated. TVA is not proposing to design or construct any of these facilities; however as a regional water resource agency, TVA can assist in evaluating available alternatives and encourage cooperation among all communities that are dependent on common water resources.

CHAPTER 4 - AFFECTED ENVIRONMENT

4.1 INTRODUCTION

This chapter presents descriptions of the variety of environmental resources and local features which exist in areas that could be affected by one or more of the water supply alternatives. Some resources or features that are unlikely to affect or be affected by the alternatives (e.g., climate and geology) are described rather briefly while resources or features identified during the scoping process as important issues are described in much more detail. The arrangement of topics and the numbering of sections in this chapter is the same as the arrangement of these topics and section numbers used in Chapter 5 (Environmental Consequences).

4.2 CLIMATE, GEOLOGY, AND SOILS

Climate

Maury, Marshall, Bedford, and adjacent counties in middle Tennessee are affected by warm, humid summers and cool winters. Average precipitation is 53.6 inches per year, with the heaviest rainfall (4.5 to 6 inches per month) occurring in March, April, May, and December (TVA, 1998a). About 50 to 70 percent of precipitation is returned to the atmosphere by evaporation from the land and plants (USGS, 1995). Winds are relatively light, especially in the summer and early fall. Climate statistics, presented in Table 8, characterize temperature, precipitation, snowfall, relative humidity, thunderstorm events, and wind speed in this area. The Lewisburg agricultural experiment station is the most representative weather station for the area, but the information collected there is limited to temperature, precipitation, and snowfall (U.S. Department of Commerce, 1961-1994). For the other three variables in the table, data for the Nashville, Tennessee, and Huntsville, Alabama, National Weather Service stations are provided (U.S. Department of Commerce, 1994b; 1994c). Of the two, Nashville is the more representative station for the study area.

Geology

Most of the area that could be affected be the action alternatives is located within the Central Basin Section of the Interior Low Plateau Physiographic

Table 8. Climate statistics representing the Columbia Project area. Data from U.S. Department of Commerce sources.

Month	Temperature Normals Lewisburg (1961-1990)		Precipitation Normals Lewisburg (1961-1990)		Average Snowfall Lewisburg (1961-1994)		Average Relative Humidity (%) at four selected times of the day (CST) Nashville (1966-1994)				Huntsville (1968-1994)				Average Thunderstorm Days Nashville (1942-1994)	Huntsville (1968-1994)	Average Wind Speed Nashville (1942-1994)		Huntsville (1968-1994)	
	°F	°C	inches	cm	inches	cm	00	06	12	18	00	06	12	18			mph	km/h	mph	km/h
Jan	34.8	1.6	4.49	11.4	2.9	7.4	75	80	63	65	78	82	64	68	1.2	1.1	9.1	14.6	9.3	14.9
Feb	38.5	3.6	4.12	10.5	1.6	4.1	73	80	59	60	75	81	59	61	1.6	2.1	9.3	14.9	9.7	15.6
Mar	47.7	8.7	5.97	15.2	0.5	1.3	71	78	53	54	73	81	56	57	4.0	4.3	9.9	15.9	10.1	16.2
Apr	57.1	13.9	4.67	11.9	T		72	80	51	52	75	83	52	52	5.1	4.7	9.3	14.9	9.3	14.9
May	65.3	18.5	5.66	14.4	0.0		82	86	55	58	83	87	56	60	7.2	7.1	7.6	12.2	8.1	13.0
Jun	73.3	22.9	3.85	9.8	0.0		84	87	55	59	85	88	56	61	8.2	8.5	7.1	11.4	7. 0	11.3
Jul	76.9	24.9	5.19	13.2	0.0		85	89	57	62	87	90	59	65	9.5	10.3	6.5	10.5	6.3	10.1
Aug	76.0	24.4	3.25	8.3	0.0		85	90	57	62	87	91	58	66	7.7	8.2	6.2	10.0	5.9	9.5
Sept	69.7	20.9	3.79	9.6	0.0		85	90	58	64	87	91	59	68	3.6	4.9	6.5	10.5	6.8	10.9
Oct	58.0	14.4	3.81	9.7	0.0		81	86	54	60	83	87	55	65	1.6	2.1	6.8	10.9	7.5	12.1
Nov	48.4	9.1	4.85	12.3	0.5	1.3	77	81	59	64	79	84	58	65	1.7	2.3	8.4	13.5	8.6	13.8
Dec	39.1	3.9	5.05	12.8	0.8	2.0	76	80	63	67	78	82	63	69	1.1	1.1	8.9	14.3	9.3	14.9
Annual	57.1	13.9	54.70	138.9	6.3	16.0	79	84	57	61	81	86	58	63	52.6	56.9	8.0	12.9	8.2	13.2

Province as described by Fenneman (1938). The northwestern and southwestern corners of Maury County and nearly all of Coffee County are located in the western and eastern parts of the Highland Rim (respectively), also sections of the Interior Low Plateau. The Interior Low Plateau is a relatively level area; however, some sections have been substantially eroded. This eroded plateau extends from the Cumberland Plateau (on the east) to the Mississippi embayment of the Coastal Plain Physiographic Province (on the west). The Interior Low Plateau is bordered on the north by the Till Plains section of the Central Lowlands Physiographic Province.

The Central Basin is a plain with an elevation of 550 to 700 feet which is completely surrounded by the Highland Rim. Geologically, this Basin was formed when part of the Highland Rim was pushed up and began to erode faster than the surrounding area. Because this erosion is incomplete, the Central Basin contains knobs and ridges which rise as much as 200 feet above the basin floor.

The rocks of the Central Basin and adjacent parts of the Highland Rim consist of massive, clayey limestones and dolomites, some of which include thin lenses of brown shale. Several different geologic formations are present in different parts of the area (Figure 13). Nearly flat rocky areas with very little soil, commonly called glades, occur throughout the Central Basin. The thick limestone layers often include fractures which may have been eroded and enlarged by the moving water. In some locations, sinkholes or caves of various sizes may exist. Only a few larger caves are known to exist in this area.

Soils

The U.S. Department of Agriculture has conducted surveys of the soils in Maury and Bedford Counties (U.S. Department of Agriculture, 1959; and 1947, respectively). Soil surveys have not been conducted in Marshall and other adjacent counties in the area; however, the general patterns within this part of the Duck River basin are likely to be quite similar.

Soils in both Maury and Bedford counties can be grouped into classes, generally related to streams and terrain. The soils in the bottoms along the Duck River are Huntingdon-Lindside-Armour (Terrace Phases)-Egam soils which are well- to moderately well-drained, silty, loamy soils. These are moderately to highly productive agricultural soils and are suitable for most row

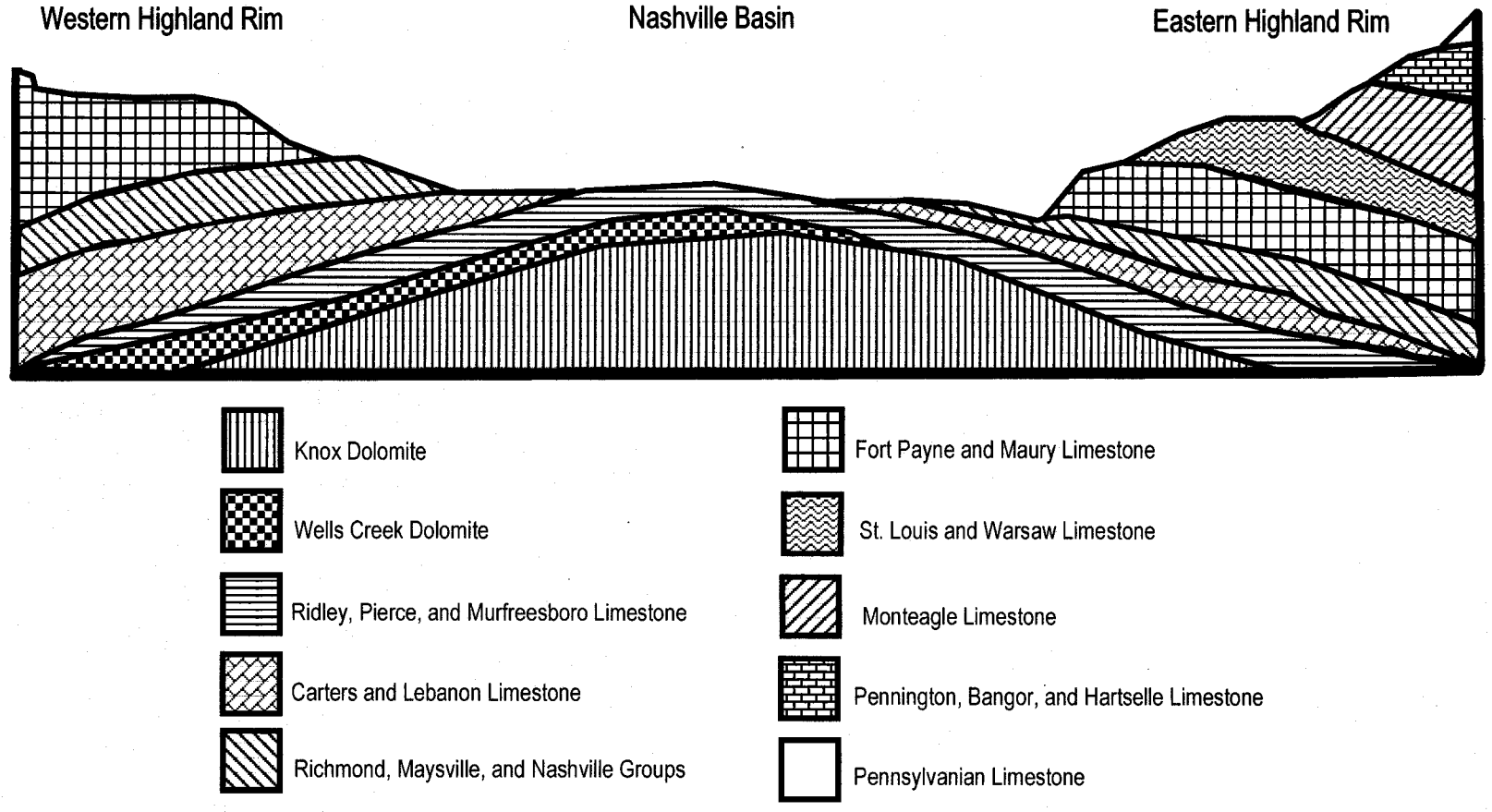


Figure 13. Upper Duck Region, Schematic Geologic Cross Section. Redrawn from Duck River Project Final Environmental Impact Statement figure, April 28, 1972, TVA Office of Health and Environmental Science.

crops. Some Huntingdon and Armour soils are considered prime farmland soils (see Section 4.10).

Scattered along both sides of the river are fairly large pockets of Etowah-Huntingdon (local alluvial phosphatic phases)-Emory soils. They occur in gently sloping areas and are well-drained, moderately deep to deep, silty, loamy soils. These soils are very productive and are suitable for a wide variety of crops and pasture.

Two soil associations cover the majority of the upland areas within the inner Central Basin in the eastern quarter of Maury County. These are the Rockland-Talbott-Hagerstown (Rocky) and the Talbott-Hagerstown-Rockland association. These are similar rocky and thin soils with limestone outcrops and, as the names imply, differ only in the percentage of each soil type present. They are generally covered with red cedars and drought resistant hardwoods. Although some areas are suitable for small grains, the predominant uses of cleared areas are hay and pasture.

The predominate soils of the east-central part of Maury County are of the Inman-Culleoka-Hicks-Maury (coarse phases) association. These soils are acidic, high in phosphorus, and moderately low in other plant nutrients. They occupy sloping to steep parts of ridges of the outer Central Basin and extend into the lower lying inner Central Basin.

The Braxton-Maury-Armour association covers most of the central portion of Maury County. These soils are deep, well-drained, productive, high in phosphorus, organic matter, and plant nutrients. They occur within the outer Central Basin. Many parts of this area have been commercially mined for phosphate, particularly near Columbia and Mount Pleasant, TN.

The predominate soils surrounding the Braxton-Maury-Armour area are of the Dellrose-Frankstone-Mimosa (cherty) association. These soils occupy cherty knobs, steep slopes, and narrow cherty valleys of the outer Central Basin. They are acid, medium to high in phosphorus, and medium to low in other plant nutrients. Most of these soils have moderate to rapid drainage, although the lower subsoil of the Mimosa soils are more clayey and less permeable.

The Bodine-Mountview (shallow phases) -Pace and Mountview-Dickson associations occupy the Highland Rim area of the northwestern and

southwestern portions of Maury County. These soils are low in lime, natural fertility, and moisture-supplying capacity. They are generally shallow and cherty.

Upland soils predominate in Bedford County. They are characterized by the Highland Rim escarpment soil association, the outer Central Basin soil association, and the inner Central Basin soil association. Colluvial lands cover the smallest portion of the county. Soils of the terraces are mostly weathered limestones. Bottomland soils are derived from recently deposited alluvial materials largely washed from soils underlain by limestone. Generally, bottomland soils are medium acid; Central Basin upland soils are medium to strongly acid; and soils of the Highland Rim escarpment are strongly to very strongly acid.

4.3 GROUND WATER

As indicated in Section 4.2, this part of the Duck River basin receives an average of 53.6 inches of precipitation per year. Information presented in Section 4.4 indicates that runoff in this area averages from 20 to 30 inches per year. At least some of the rest of the rain and snow moves down through soil and rock and becomes part of the ground water. Because rain water is slightly acidic, as it moves into the ground it dissolves the limestone and other carbonate rocks along existing cracks and layers. Springs are common in the outer Central Basin and ground water makes up an important part of the low flow in the streams in this part of the watershed.

The geology of the groundwater system in central Tennessee is relatively well defined. Most of the area is underlain by carbonate rocks, primarily limestone with some dolomite. Some shale zones exist in these rocks, as well as phosphate-rich layers and several thin clayey beds. Shale and clay beds can block or redirect the movement of water in the bedrock. Most of the water in limestone and dolomite rocks is stored and moves through solution fractures. The amount of space water could occupy in these beds is estimated to be less than 0.5 percent of total rock volume (USGS, 1995). The flow system is generally limited to the top 300 feet or less below the ground surface (USGS, 1986). In general, the number of connected cracks and spaces through which water could move decreases with depth into the ground.

The principal water-bearing rocks underlying this area include the Ridley, Lebanon, and Carters limestone formations (Figure 13). The Ridley limestone is considered a local aquifer which generally produces low well yields. The Lebanon limestone also is considered a local aquifer, but shale zones can restrict ground water movement in this formation. Water yields from the Carters limestone are highly variable. Although the formation generally provides low yields (less than 5 gpm) to domestic wells, yields in excess of 100 gpm have been encountered (USGS, 1986).

Ground water is used throughout the area as a source for domestic and farm use. Present usage is approximately 6,300 cubic meters per day (1.66 mgd), which supplies about 7,900 people (TVA, 1998a). Data furnished by the Tennessee Division of Water Supply based on drillers' records for the three-county area are summarized in Table 9. A few cautionary notes are in order to put these data into perspective:

- All information has been supplied by individual well drillers without any independent verification.
- Many of the wells were installed over 30 years ago. It is unknown how many of these wells remain in operation.
- Reported results reflect conditions at the time of installation. Conditions, particularly related to well yield, can change over time.

The information summarized in Table 9, indicates that well drilling results are relatively similar in all three counties. Average well depth is shallowest in Bedford County (165 feet) and deepest in Maury County (342 feet). Average well yield (11 to 14 gpm) is very similar in all three counties. In all three counties, between one and two percent of the wells (about which the yield is known) have been reported to produce 100 gpm or more (0.1 mgd), and fewer than one-tenth of one percent produce 500 gpm or more (0.7 mgd). Between 10 and 20 percent of the documented wells (about which the yield is known) produced less than one gpm. Seventy percent of all wells were reported to be used for domestic water supply and three percent were listed to be used for municipal, community, or multi-family water supplies. While previous investigations have identified several sites within the area with potential for additional ground water development (USGS, 1993), even the largest reported yields from wells in these three counties (0.7 mgd) suggest there is little

likelihood of drilling individual wells that could provide enough ground water to supply large communities.

Table 9. Summary of drill records for water wells in Maury, Marshall, and Bedford Counties. Most values in the table are averages, with minimum and maximum values presented in parentheses. (Tennessee Division of Water Supply unpublished data)

Statistics	Maury County	Marshall County	Bedford County
Number of well records	2,095	2,364	1,896
Average Well Depth (feet)	342 (21 - 6400)	237 (5 - 1400)	165 (0 - 1500)
Average Depth to Water Bearing Zone (feet)	267 (0 - 1630)	163 (0 - 1340)	115 (0 - 1175)
Average Yield (gallons per minute - gpm)	11 (0 - 500)	11 (0 - 406)	14 (0 - 500)
Wells yielding less than 1 gpm (unknowns excluded)	173 (10.4 %)	441 (21.6 %)	336 (20.5 %)
Wells yielding 100 gpm or more (unknowns excluded)	27 (1.6 %)	36 (1.2 %)	32 (2.0 %)
Wells yielding 500 gpm or more (unknowns excluded)	2 (0.1 %)	0	2 (0.1 %)

Very little information is available on the quality of ground water in the region. Because the groundwater table tends to be close to ground surface throughout much of the area, generally with little soil cover, groundwater quality tends to resemble surface water quality (personal communication Gordon Corruthers, TDEC Groundwater Management Section, 1999). Surface runoff moves through cracks or solution features into the shallow aquifers.

Ground water in the region tends to be highly mineralized, possibly due to the presence of soluble salts in the limestone. The USGS measured hardness levels (in ppm of $CaCO_3$) in the Lebanon limestone from locations throughout this project area (USGS, 1936). Results were from 310 to greater than 500 ppm in Maury County, from 20 to greater than 600 ppm in Marshall County,

and from 10 to 320 ppm in Bedford County. In a later study (USGS, 1986), water having total dissolved solids levels greater than 10,000 mg/L was found in the same formation within several miles of water with concentrations less than 500 mg/L. In addition to hardness, high levels of hydrogen sulfide have been found in many wells. This indicates that the quality of ground water within the project area can vary from location to location.

More recent data are available from Bedford County (Roman-Mas, et al., 1991). Water samples from 89 wells were analyzed for pH, fecal coliform and streptococcus bacteria, nitrate, chloride, sulfate and specific conductance. Most pH values were in the neutral range (6.5 - 7.5), bacterial levels ranged from less than 1 to "too numerous to count", nitrate levels ranged from less than 1 to 26.1 mg/L (with most values less than 5 mg/L), chloride levels ranged from 1.5 to 75.8 mg/L, sulfate levels from less than 2 to 1,697 mg/L (with most values less than 50 mg/L), and specific conductance levels (an indirect measure of dissolved solids) ranged from 12 to 2550 μS/cm. This information adds to the idea that there is considerable variation in the quality of ground water in the area.

Groundwater quality data available from the state are very generalized, and wells are described based on substances which can be found in a water sample, such as lime, iron, sulfur, salt, oil, gas, or "other." In addition, the water quality is listed as bad, fair, or good. The most common substances found in ground water in Maury County were either hydrogen sulfide or something that fell into the "other" category. Hydrogen sulfide was found in many wells across the county and in neighboring counties, and was generally independent of well depth (Tennessee Division of Water Supply, unpublished data).

Much of the land in the area contains sinkholes which provide avenues of direct groundwater recharge. Sinkholes also sometimes are used as disposal sites for trash and other wastes. Material dumped or allowed to flow into sinkholes can contaminate ground water and any surface water into which it flows. The amount of present dumping into sinkholes in this part of the Duck River basin is unknown and no information is available about any contamination of ground water which might be occurring from sinkhole sources.

To summarize, in this project area ground water is used predominantly for individual home and agricultural purposes. Most wells provide low yields, generally less than 10 gpm, and very few wells produce more than 20 gpm. In addition, the quality of ground water varies throughout the area, at times including total dissolved solids, bacteria, and hydrogen sulfide. While sufficient ground water seems to be present to supply individual residences, there is very little likelihood of drilling wells that could produce enough high quality ground water to supply large communities.

4.4 SURFACE WATER

The surface water resources involved in this evaluation include the upper Duck River watershed and a small part of the Elk River watershed. The Duck River watershed upstream from the Hickman/Maury county line includes an area of approximately 1,700 square miles. Much of this watershed consists of small streams that drain directly into the Duck River; however, the basin does include five tributaries that each drain 100 square miles or more (Garrison Fork [130 square miles], Big Bigby Creek [129], Big Rock Creek [121], Rutherford Creek [116], and Fountain Creek [103]). Normandy Reservoir is the only large impoundment in the watershed [3,230 acres at full pool); however, at least four run-of-the-river dams still impound some water on the mainstem (from downstream: Columbia City Dam, Lillard Mill Dam, Shelbyville Dam, and Courtner's Mill Dam).

After Normandy Reservoir was completed in 1976, the average annual flow in the Duck River has been 843 cfs at Shelbyville and 2155 cfs at Columbia. TVA operates Normandy Dam to provide a continuous minimum flow of 40 cfs immediately downstream from the dam, and 155 cfs of minimum flow at Shelbyville. The 40 cfs of minimum flow downstream from Normandy Dam helps maintain aquatic life in the upper part of the river. The 155 cfs at Shelbyville maintains water quality below the Shelbyville wastewater discharge. As indicated in Section 2.2, Normandy Reservoir has sufficient storage to provide up to an additional 10 cfs of flow to meet water supply needs at Shelbyville. During drought conditions, the water released from Normandy Dam is essentially the only streamflow available in the Duck River to maintain aquatic life and meet water supply and recreational uses. During drought conditions, all but one of the tributary streams between Shelbyville and

Columbia cease to flow and water withdrawals and evaporative losses result in a reduction in streamflow in the 90-mile reach (TVA, 1998a).

The Duck River is considered a warmwater stream except for the 4.6 mile reach just downstream from Normandy Dam which is maintained as a coldwater reach. Dissolved oxygen concentrations in the river are normally 5.0 mg/L or higher, especially upstream from Columbia. Downstream from about Duck River Mile 160, the slope of the river becomes very flat (1.3 feet per mile) and the river is very sluggish. During dry months, natural oxygen replenishment is low in this reach and the combination of high sediment oxygen demand and extensive algal growth reduce dissolved oxygen levels, particularly in long pools.

The parts of the Elk River watershed involved in this evaluation include two embayments of Tims Ford Reservoir and an adjacent reach of East Fork Mulberry Creek. Tims Ford Dam, located at Elk River Mile 133.3, forms a 10,600 acre reservoir that receives water from an area of 529 square miles. The two larger embayments on the northwestern edge of this reservoir, Lost Creek and Hurricane Creek embayments, are separated by Chestnut Ridge. The Jack Daniel Distillery and Lynchburg, Tennessee, operate a joint water intake on the Lost Creek embayment of Tims Ford Reservoir. East Fork Mulberry Creek runs along State Route 55 northeast of Lynchburg, and drains approximately 17 square miles of area just west of the Lost Creek and Hurricane Creek basins. The East Fork flows southwest into Mulberry Creek, which empties into the Elk River near Fayetteville (at River Mile 101).

Water Use

As indicated in Chapter 2, the Duck River is the most important water source for people living in this area. Municipal water intakes are located at Duck River Miles 133.9 (Columbia), 202.4 (Bedford County), 221.9 (Shelbyville), and 255.0 (Duck River Utility Commission) (see Figure 2).

The Duck River also receives most of the discharge from municipal wastewater treatment systems in the area. Wastewater discharges on the river are located at Duck River Miles 127.2 (Columbia), 221.3 (Shelbyville), and 268.5 (Manchester). In addition, the Spring Hill wastewater is discharged into Rutherford Creek 19 miles upstream from its mouth at Duck River Mile 130.4, and the Lewisburg wastewater is discharged into Big Rock Creek 16 miles upstream from its mouth at Duck River Mile 180.4. The only operating

industrial wastewater discharge in the area is located on Big Bigby Creek about 15 miles above its confluence with the Duck River at River Mile 109.2. Several organic and inorganic chemicals regulated under the Safe Drinking Water Act as primary drinking water contaminants are present in the industrial effluent. The company provides a high treatment level for its wastewater, including carbon absorption, to remove organics. The volume of wastewater is small (0.13 cfs) in comparison with the low flow of the creek (3.6 cfs) and the treatment protects the use of Big Bigby Creek for water supply.

As more and more water is withdrawn from the Duck River, the amount of water available for assimilation of treated wastewater is reduced and water supply and waste assimilation actually begin to compete with each other. Furthermore, instream flow needs to maintain recreation and aquatic life also are in competition for the limited remaining water. In recognition of the need to balance all of these uses, TDEC has determined that future water withdrawal at Columbia should not reduce the one-day average flow in the Duck River below 100 cfs (TVA, 1998a).

Classified Uses

TDEC has identified beneficial uses for all surface waters in the state of Tennessee and has established water quality criteria which specify the minimum level of quality necessary to support each use. Nearly all of the Duck River from River Mile 71.5 upstream to its origin has been classified for the following uses: domestic water supply, industrial water supply, fish and aquatic life, recreation, irrigation, and livestock watering and wildlife. Two of the three exceptions along the river are short reaches just downstream from the municipal wastewater discharges at Columbia and Shelbyville. The domestic water supply use classification was excluded in these areas because TDEC previously considered stream reaches immediately downstream from municipal wastewater discharges to be unsuitable for domestic water supply withdrawal. TDEC no longer considers the first five miles of stream reach downstream from a wastewater discharge to be unsuitable for domestic water supply use and would reclassify the reach to protect that use if requested to do so. The third exception is the 4.6-mile reach of the Duck River just downstream from Normandy Dam. This reach is classified as a trout stream and is expected to have higher dissolved oxygen levels and a lower maximum temperature than water classified for warmwater fish and aquatic life.

All tributary streams flowing into the Duck River within this project area have been classified for the following uses: fish and aquatic life, recreation, irrigation, and livestock watering and wildlife. In addition, six of the larger tributaries (Garrison Fork, Big Rock Creek, Rutherford Creek, Little Bigby Creek, Big Bigby Creek, and Catheys Creek) have been classified for domestic and industrial water supply use. Although these streams are classified for these uses, the mainstem Duck River is the only stream in this part of the watershed that is presently being used as a domestic or industrial water supply source. The classification means that the quality of water in these streams should be maintained at a level capable of supporting all of the identified uses, in this case including domestic and industrial water supply.

As a whole, Tims Ford Reservoir is classified for the following uses: domestic water supply, industrial water supply, fish and aquatic life, recreation, irrigation, and livestock watering and wildlife. The specific parts of Tims Ford Reservoir in the Hurricane Creek and Lost Creek embayments are classified for the following uses: fish and aquatic life, recreation, irrigation, and livestock watering and wildlife. East Fork Mulberry Creek is classified for industrial water supply, fish and aquatic life, recreation, irrigation, and livestock watering and wildlife.

Water Quality - Upper Duck River Watershed

TDEC regularly evaluates water quality conditions in streams to determine if conditions are capable of supporting the classified uses. In the 1998 assessment (TDEC,1998), several stream reaches in the upper Duck River watershed were identified as having some degree of use impairment. These stream reaches, their recent ratings, and the listed reasons why water uses are not being fully met are presented in Table 10. All of the other reaches of the Duck River and its tributaries in this project area were found to be fully supporting their classified uses.

Although several tributary streams in this project area only partially support their classified uses, these effects are typically confined to the tributaries themselves and have little impact on the mainstem Duck River. Like many other parts of Tennessee, soil erosion along roadsides, cropland, and denuded stream banks cause widespread fluctuations in turbidity, suspended solids, and other water quality indicators in this watershed. Soil erosion in several of the tributaries also contributes to the high turbidity levels observed in the river following major runoff events.

Table 10. Stream segments in the upper Duck River watershed that were not supporting their classified uses in 1998 (TDEC, 1998).

Stream Segment	Rating	Apparent Cause
Coffee County		
Duck River mainstem below the mouth of the Little Duck River	Not Supporting	bacteria contamination from the Manchester municipal wastewater collection system, urban runoff
Bedford County		
Duck River below Normandy Dam to (the upper) Flat Creek	Partially Supporting	non-point sources, high levels of iron and manganese in releases from Normandy Dam
Doddy Creek	Partially Supporting	agricultural non-point sources
Wartace Creek	Partially Supporting	agricultural non-point sources, Bell Buckle municipal wastewater treatment plant discharge
Bell Buckle Creek	Partially Supporting	agricultural non-point sources, Bell Buckle municipal wastewater treatment plant discharge
Thompson Creek (including Bennett Branch and Anderton Branch)	Partially Supporting	agricultural non-point sources, landfill leachate
Fall Creek	Partially Supporting	agricultural non-point sources
North Fork Creek	Partially Supporting	agricultural non-point sources
Alexander Creek	Partially Supporting	agricultural non-point sources
Weakley Creek	Partially Supporting	agricultural non-point sources
Clem Creek	Partially Supporting	agricultural non-point sources
Spring Creek	Partially Supporting	agricultural non-point sources
Caney Creek	Partially Supporting	agricultural non-point sources
Marshall County		
Big Rock Creek	Partially Supporting	Lewisburg municipal wastewater treatment plant, urban runoff
Maury County		
Fountain Creek (including Silver and Globe creeks)	Partially Supporting	agricultural non-point sources
Catheys Creek (including Curry Branch)	Partially Supporting	agricultural non-point sources
unnamed tributary to Little Bigby Creek	Not Supporting	urban non-point sources from Columbia
Lytle Creek	Partially Supporting	industrial point sources
unnamed tributary to Lytle Creek	Not Supporting	industrial point sources
Rutherford Creek	Partially Supporting	industrial point sources, mining
Sugar Creek	Not Supporting	landfills, an industrial point source, and mining

Nitrogen and phosphorus levels in the upper Duck River watershed, consistently in the upper range of values observed in Tennessee River watersheds (TVA, 1984), strongly suggest contributions from non-point sources. Total iron and total manganese concentrations also are high in comparison to other watersheds in the Tennessee Valley (Parr, 1991). Most of the iron and manganese is in a relatively insoluble form and can be easily removed from drinking water by conventional treatment processes. High levels of bacteria in tributary streams are a major source of bacteria observed in the Duck River after rainfall events.

Organic compounds from point and non-point sources, combined with inputs from natural sources such as tree leaves and algae, can cause high levels of organic material to be present periodically in the streams within the upper Duck River watershed. When water suppliers add chlorine to the water as part of their treatment procedures, the chlorine reacts with the organic material to form disinfection byproducts such as trihalomethanes and haloacetic acids. New, more stringent standards resulting from the 1996 amendments to the Safe Drinking Water Act are scheduled to go into effect in December 2001 for larger water treatment systems and in December 2003 for smaller systems. Some water systems which use the Duck River as a water source may not be able to reach the new standards without modifying their present treatment methods. Two water systems have already been identified by TDEC as not being able to meet the new standards using their present treatment methods.

On a more site-specific basis, starting at the upstream end of the watershed, water quality impacts have been identified in the Little Duck River and Duck River as a result of sewage collection system problems at Manchester. The state of Tennessee advises against water contact in the Little Duck and Duck rivers in the vicinity of Old Stone Fork State Park.

TVA has monitored the ecological health of Normandy Reservoir several times since 1993 (TVA, 1998b). The ecological health of this reservoir has consistently been rated fair each time it has been evaluated, largely because of severe dissolved oxygen depletion and poor rating for the benthic community. Typically from late May through October, the dissolved oxygen concentrations in the reservoir are below 1mg/L in all but the upper 15 feet of the water column. Normandy Reservoir has one of the worst dissolved oxygen depletion problems in the TVA reservoir system. The absence of dissolved oxygen also causes an increase in dissolved iron and manganese levels in the deeper water

of Normandy Reservoir and in the water released from the dam. High concentrations of iron and manganese also make water in the lower part of the reservoir less desirable for water supply withdrawal. In 1998, the average summer chlorophyll-a concentration was 12.6 ug/L which was higher than in any of the other previous year and indicates a higher degree of algae production than in the past (TVA, 1998b).

Bacteriological sampling conducted in the summer of 1999 at two Normandy Reservoir recreation areas indicated some contamination at both sites. At the Barton Springs Public Use Area, two samples collected in June exceeded the state of Tennessee water quality recreation individual sample criterion (1,000/100mL fecal coliform). This criterion also was exceeded once in June at the Cedar Point Public Use Area. The other Tennessee water quality recreational site bacterial criterion (geometric mean value of 200/100mL of 10 samples taken over a 30-day period) was not exceeded at either of these sites. These occasional episodes of bacterial contamination may be associated with the large number of waterfowl that congregate around both of these public use areas.

During summer and fall, the releases from Normandy Reservoir produce high levels of iron and manganese in the Duck River just downstream from the dam. Iron and manganese coatings on river rock extend as far downstream as Duck River Mile 239.9 (Tennessee Technological University, 1983). Iron and manganese impact the use of the Duck River for water supply and aquatic life from Normandy Dam to the confluence of Garrison Fork (Duck River Mile 239.6). In 1993, bacteriological testing by TVA at four locations between Normandy Dam and Shelbyville (Duck River Mile 221.4) showed that fecal coliform bacteria levels exceeded the Tennessee water quality criterion for recreational use. Bacterial levels were highest after rainfall, suggesting non-point source contributions. As indicated in Table 10, TDEC has determined that the Duck River from River Mile 236.9 to 219.1 is only partially supporting its recreation and aquatic life use classifications due to bacteria and siltation from agricultural and urban non-point sources.

Agricultural activities are extensive in the upper Duck River watershed, primarily in Marshall and Bedford Counties. Runoff from dairy and livestock operations, along with soil erosion from roadsides, cropland, and denuded stream banks, are the principal non-point sources in this part of the watershed. These sources cause wide fluctuations in water quality indicators

such as turbidity, suspended solids, and fecal coliform bacteria. Residential development in the watershed area also has been linked to bacteria contamination in the surface waters. The substantial bacterial contamination observed in Fall Creek and North Fork Creek (Table 10) appear to be the result of a combination of agricultural and septic system non-point sources. Bacteriological sampling conducted by TVA during the summer of 1995 indicated that similar increases occur in eastern Maury County (TVA, 1999). Those data also indicated that almost every increase in bacterial counts in the water could be traced to a rainfall event upstream from the sampling location. Reductions in bacterial numbers to low levels following one or two days of dry weather suggested that non-point sources were responsible for the high levels.

Big Rock Creek is impacted periodically by the Lewisburg wastewater discharge. During dry months, the very low flow in Big Rock Creek provides insufficient initial dilution for the assimilation of the municipal wastewater discharge. This results in low dissolved oxygen concentrations and organic enrichment impacts downstream from the treatment plant; however, these impacts do not extend into the Duck River downstream from the mouth of Big Rock Creek.

As indicated in Table 10, TDEC has determined that water quality criteria are being exceeded in the Fountain Creek watershed, apparently from agricultural non-point sources. During the summer of 1998, TVA measured water quality in Fountain Creek and at six tributary sites. The data collected during this study are presented in Appendix A. Results from that study indicated that fecal coliform bacteria at two sites on Fountain Creek exceeded the Tennessee water quality criterion of 1,000/100mL in an individual sample on three different sampling dates. The same criterion was exceeded at a site on South Fork on two sampling dates. Other sampling locations showed elevated levels of bacteria suggesting impacts from agricultural non-point sources. The study was conducted during an extended dry period in August-November so the observed bacteria levels were probably lower than what would have been observed during or immediately following a rainfall event.

TDEC monitors water quality at Duck River Mile 113.9 in Maury County on a quarterly basis. Results since 1990 show that fecal coliform levels have periodically exceeded 1,000/100mL during and immediately following major rainfall events. These high bacterial levels probably are related to the large number of farm animals present in the watershed and their accessibility to the

river system. High levels of fecal coliform bacteria indicate the potential for disease-causing organisms to be present and are a concern for recreation and water supply uses.

Water Quality - Tims Ford Reservoir Area

TDEC has determined that all streams in the Elk River watershed area covered by this analysis, as well as Tims Ford Reservoir, are fully supporting designated uses. Bacteriological sampling in June 1999 at four recreation sites on Tims Ford Reservoir showed all sites met the Tennessee water quality criteria for water contact recreation use (TVA, 1999).

TVA has monitored the ecological health of Tims Ford Reservoir several times since 1992 (TVA, 1998b). The resulting ecological health ratings for Tims Ford Reservoir have declined from fair in 1992, 1993, 1994 and 1995 to poor in 1996 and 1998. Recent poor ratings are the result of low concentrations of dissolved oxygen during the months of June through October, poor benthic community results, and increased chlorophyll-a levels over previous years. Dissolved oxygen levels were less than 2 mg/L throughout most of the lower water column and at or near zero on the bottom of the reservoir from July to October. The consistent low dissolved oxygen levels at the bottom of the reservoir help explain the poor condition of the aquatic organisms living there. Low concentrations of dissolved oxygen would extend into deeper portions of the Hurricane Creek and Lost Creek embayments of Tims Ford Reservoir. Also, increased levels of dissolved iron and manganese would be expected to be associated with low concentrations of dissolved oxygen.

4.5 AQUATIC LIFE

Information presented in the Columbia Land Use EIS (TVA, 1999) indicates that the Duck River supports some of the most species-rich aquatic communities in North America. Most recent surveys of aquatic life conducted in this watershed, however, have focused on the middle reach of the Duck River, the part that would have been affected by completion of the Columbia Reservoir Project. The four action alternatives included in this EIS could affect other parts of the mainstem Duck River, ranging from near the Hickman County Line (River Mile 100) upstream to Normandy Reservoir (as far upstream as River Mile 265). In addition, these alternatives could affect some Duck River tributary streams and, under the Tims Ford Pipeline Alternative, small parts of the upper Elk River watershed.

The following discussion covers the aquatic life present in this study area but uses a number of techniques to abbreviate and clarify the presentation for most general readers. The discussion is divided into two major parts: the Duck River and other "big water" habitats, and Fountain Creek and the other tributary streams. Within each of these parts, individual paragraphs describe what is known about the major groups of aquatic plants and animals that are present. This text is accompanied by just two tables which summarize the data; however, all of the supporting lists of species are presented in Appendix B. The intent of this section is to describe the types of aquatic habitats that are present in this study area and to indicate the diversity of species that occur in each of them.

River and Reservoir Habitats

The Duck River is the major aquatic habitat within this study area; however, various parts of the river have different habitat characteristics and support different types of aquatic communities. For this discussion, the Duck River is considered to consist of three parts: a more downstream reach, a middle reach, and an upstream reach. The downstream reach included in this evaluation extends from near the Hickman/Maury County line (about River Mile 100) upstream through the City of Columbia and the pool of the Columbia City Dam (to approximately River Mile 135). As indicated in Section 4.4, this 35-mile reach of the river has a rather low gradient and consists of long pools and well-defined runs or riffles. Near its upstream end, this river reach also receives wastewater and other discharges from the developed areas around Columbia.

The middle reach of the Duck River included in this evaluation extends from the upstream end of the Columbia City impoundment (around River Mile 136) upstream to Lillard Mill Dam (River Mile 179). This 44-mile river reach consists of somewhat shorter pools and a large number of well-defined riffles, runs, and island complexes. At its upstream end, Lillard Mill Dam forms a barrier to upstream fish movement (except under high flow conditions). Much of this reach meanders through the Columbia Project lands, relatively little of which has been cultivated or affected by extensive human development since most of the land was acquired about 20 years ago.

The upstream of these Duck River reaches extends from above Lillard Mill Dam (about River Mile 180) upstream to Normandy Dam (River Mile 249). The physical habitat in this 70-mile river reach is similar to the middle reach; however, the flow regime and temperature of the water are both affected by releases from Normandy Dam (See Section 4.3). This reach also receives wastewater and other discharges from the area around Shelbyville.

Two additional habitats are included in this part of the discussion, primarily out of convenience. Normandy Reservoir is an impoundment on the Duck River located at River Mile 249. As indicated in Sections 1.2 and 4.4, Normandy Dam was closed in 1976, and forms a 3,230-acre impoundment. At the summer pool level, this reservoir is 87 feet deep; however, the level is drawn down 11 feet during the winter.

Tims Ford Reservoir is an impoundment on the Elk River at River Mile 133. As indicated in Section 4.4, this reservoir is located in Moore County, just south of Bedford County and the upstream part of the Duck River basin. Tims Ford Dam, which was closed in 1970, forms a 10,600-acre reservoir at summer pool and is 130 feet deep adjacent to the dam. The winter drawdown is 23 feet.

Table 11 presents a summary of the numbers of species or other taxonomic levels that have been encountered in each of these five river or reservoir reaches during the last 30 years. As indicated in this table, between 44 and 436 different forms of aquatic life have been identified from these areas. The following paragraphs address several of the major groups of plants and animals that are included.

Table 11. Summary of numbers of aquatic species known from three reaches of the Duck River, Normandy Reservoir, and Tims Ford Reservoir. Supporting data and references are presented in Appendix B.

Plant and Animal Groups	**DRM 100 - 135**	**DRM 136-179**	**DRM 180 - 249**	**Normandy Reservoir**	**Tims Ford Reservoir**
Plankton	NS	123	118	NS	NS
Plants	NS	10	12	NS	NS
Insects	NS	142	81	3	7
Other Invertebrates	NS	27	17	5	5
Mollusks	22+	54	23	1+	NS
Fish	56	80	72	35	36
Totals	**78+**	**436**	**323**	**44+**	**48+**

NS - Community not sampled in this reach

Plankton and Periphyton

The small (generally microscopic) plants and animals which live floating in the water make up the plankton community. Some of these same microscopic species or genera also live in the periphyton, the thin layer of living things that forms on rocks, twigs, and other material in the water. Between 1979 and 1983, TVA staff conducted a great deal of biological work in the Duck River (and elsewhere) as part of the Cumberlandian Mollusk Conservation Program (CMCP, see Section 1.2). Two of 15 sites examined in detail as part of the CMCP work were located in the Columbia Reservoir area (Sowell Ford, River Mile 156; and Lillard Mill, River Mile 179). Two other CMCP sites (Halls Mill, River Mile 202; and Dement Bridge, River Mile 243) were located between the proposed reservoir area and Normandy Dam. During the CMCP evaluation, plankton and periphyton samples were collected monthly at the four Duck River CMCP sites from July through September 1980, and from April and June through September 1981 (Wade and Webb, 1986). No detailed plankton or periphyton identification data are available from the Duck River downstream of Columbia or in either Normandy or Tims Ford reservoirs.

The names of the various species or genera found in these two river reaches are presented in Appendix B (Tables B-1 and B-2) and the numbers of species are summarized in Table 11. With regard to the overall number of species or genera present, about the same number of plankton plants and animals were found in the middle and upper river reaches (123 and 118 taxa, respectively). The more detailed data presented in Tables B-1 and B-2 indicate that about 25 percent more types of planktonic plants were found in the middle reach than upstream but about 20 percent more types of planktonic animals were found in the upstream reach than in the middle one. These differences could be caused by a number of things; however, colder water might limit the variety of planktonic plants that could live in the upstream reach, and a wide variety of fish predators (see below) might reduce the abundance of planktonic animals in the middle reach.

Macrophytes

During the CMCP evaluation, TVA staff also identified the larger plants which routinely live in the water (the aquatic macrophytes). The macrophytes which occurred in the river in the vicinity of each CMCP site were examined during a float survey, and the plants at the specific evaluation sites were carefully documented during a mapping study (Wade and Webb, 1986).

The macrophyte species found at or near the four Duck River CMCP sites are presented in Appendix B, Table B-3, and are summarized in the middle and upper reach columns in Table 11. No comparable sampling has been conducted in the downstream stream reach or in either of the reservoirs. The detailed data show that eight plant species were found in both the middle and upper river reaches, suggesting a fairly uniform aquatic plant community in at least those two parts of the river.

Insects and Other Invertebrates (except Mollusks)

The larger aquatic insects and other types of animals without backbones (invertebrates) which live in the middle reach of the Duck River have been examined several times in recent years by TVA staff and others. Much of this work was done in the early 1980s as part of the CMCP evaluations (primarily Barr et al., 1986); however, other studies were conducted both earlier (TVA, 1975) and later (e.g., Ahlstedt and Saylor, 1992). The bottom-dwelling (benthic) invertebrates present in both Normandy and Tims Ford reservoirs have been sampled several times during the 1990s as part of the TVA Vital Signs Monitoring Program (Dycus, et al., 1999). Unfortunately, neither of these groups of invertebrates have been sampled in the downstream reach of the Duck River included in this assessment. Usually, the animals were preserved in the field and, later, identified using a variety of references. The ease with which these animals could be identified down to the genus or species level depended on the taxonomic group involved, the expertise of the staff making the identifications, and the purpose of the specific project. In virtually all of these groups, there are probably many more species present than have been identified.

The extensive lists of invertebrate species (or higher taxonomic categories) which have been found in at least some of these river and reservoir reaches are presented in Appendix B, Table B-4. All of these records are summarized in two rows of Table 11, in part to help identify some of the differences that are present. The summary numbers for both the insects and the other invertebrates indicate that the most taxa were encountered in the middle reach of the Duck River (142 and 27 taxa, respectively), just over half that many taxa were found in the upstream reach, and very few taxa were found in either of the reservoirs (for example, only three insect taxa and five other invertebrate taxa have been found in Normandy Reservoir). The very few types of insects and other invertebrates encountered in these two reservoirs is typical of tributary reservoirs within the Tennessee Valley (and elsewhere), and probably

indicates the small number of bottom-dwelling species which are able to survive in the slow-moving, relatively cold, at times oxygen-deficient habitats that occur in those reservoirs. The fewer number of taxa present in the upstream reach may be related to effects of the relatively low temperature of the water released from Normandy Dam, perhaps accompanied by some effects from the farms and businesses in the upstream part of the watershed.

Mollusks

Freshwater mollusks are represented in the Duck and Elk River basins by river snails, native mussels, fingernail clams, and the Asiatic clam. These typically large aquatic invertebrates are seldom collected with the dredge or net sampling techniques routinely used to sample insects and other bottom-dwelling invertebrates. During the last 30 years, TVA staff and a few others have conducted several surveys specifically to document the distribution and abundance of the mussels and, occasionally, the aquatic snails which live in the middle and upper reaches of the Duck River. As part of the preparations for this EIS, TVA staff sampled the native mussel species present at two locations in the downstream reach of the river. The results of these studies are summarized in Table 11, and the details are presented in Appendix B, Table B-5.

The numbers of mollusk species presented in Table 11 indicate that the most species (54) were found in the middle reach of the river, approximately half that many were found in both the downstream and upstream reaches, and only one mollusk species was encountered in Normandy Reservoir. Very few mollusks probably occur in the reservoirs for the same reasons few other bottom-dwelling invertebrates are found there; they are not adapted to the slow-moving, relatively cold, sometimes oxygen-deficient habitats that exist in tributary reservoirs. The relatively large number of mussel and snail species found in the middle reach have been known to occur in that part of the Duck River for a long time (e.g., Isom and Yokley, 1968) and represent much of the diversity that was present at least 100 years ago (Ortmann, 1924). The lower numbers of species present in the downstream and upstream river reaches appear to represent reductions from the original diversity probably caused by past pollution events and human disturbances in the watershed (van der Schalie, 1973).

Fish

The fish species which occur in the Duck River have been surveyed more extensively and more often than any other parts of the aquatic communities. The most intensive of these surveys were conducted as part of the CMCP work (summarized in Barr et al, 1986); however, a variety of other surveys or site visits also have contributed many occurrence records (especially Burr et al., 1993; Nieland, 1982; and Scott and Gardner, 1995). During the 1990s, TVA crews also have sampled the fish communities in Normandy and Tims Ford reservoirs as part of the Vital Signs Monitoring Program (Dycus, et al., 1999). All of the fish species encountered during these surveys are listed in Appendix B Table B-6. A summary of this information is included in Table 11.

The numbers of fish species presented in Table 11 indicate more similarity among the river reaches and reservoirs than was apparent for the insects, other invertebrates, or mollusks. The middle reach still yielded the most species (80), but the upstream and downstream reaches were found to have only slightly fewer (72 and 56 species, respectively), and the reservoirs yielded nearly half as many as the middle reach (35 and 36 species). In this case, the raw numbers are somewhat misleading, especially with regard to the reservoirs. The detailed data (presented in Appendix Table B-6) indicate that 25 fish species were found in four or all five of these river or reservoir areas; however, most of the other 77 species occurred only in reaches with more restricted types of habitats. Two families of fishes (the minnows and the darters) were represented by many more species in the river reaches (together between 28 and 42 species) than in the reservoirs (5 or 8 species). Conversely, a few fishes were found only in the reservoirs (e.g., threadfin shad, yellow bass, and yellow perch). In general, the middle reach of the river yielded the most species, with additions or deletions in the other areas depending on the presence or absence of different habitat characteristics (e.g., rainbow trout were found only in the upstream reach, the reach receiving the cold water discharge from Normandy Dam).

River and Reservoir Summary

The total numbers of species (and other taxonomic levels) encountered in these three reaches of the Duck River and Normandy and Tims Ford reservoirs are presented at the bottom of Table 11. These numbers indicate that the middle reach of the river supports the most types of aquatic life (436), followed relatively closely by the upstream reach (323). The numbers of species known from the downstream reach and the two reservoirs are much lower, in part because some major aquatic groups have not been sampled in those areas.

Information presented in the previous paragraphs indicates that, where sufficient sampling has been done, the reservoir habitats support many fewer species than any of the flowing water reaches. Among the three reaches of the Duck River, the upstream reach supports more planktonic animals than the middle reach but fewer species of planktonic plants, insects, other invertebrates, mollusks, and fishes. The most often mentioned possible reason for these differences is the cold water released from Normandy Dam. The downstream reach is represented only by numbers for mollusks and fishes and, in both cases, yielded fewer species than either the middle or upstream reaches. At least with regard to the mollusks, this reach seems not to have completely recovered from the effects of earlier pollution and other human disturbances in the area.

Tributary Habitats

The four action alternatives included in this evaluation could affect several Duck River tributaries if one or more of them were adopted. Poplar and Greenlick creeks occur along the most likely pipeline route from a downstream intake site to the City of Columbia, Fountain Creek and several of its tributaries exist in the watershed which could be impounded to form a Fountain Creek reservoir, and Flat Creek flows along the most likely route of a pipeline between a Tims Ford intake and the closest part of the Duck River (near Shelbyville). Of these streams, Fountain Creek drains the largest watershed (103 square miles), followed by Flat Creek (50 square miles), Greenlick Creek (23.6 square miles), and Poplar Creek is the smallest (6.4 square miles) (TVA, 1970).

Existing and new information about the aquatic life present in these three groups of Duck River tributaries is summarized in Table 12. The detailed information upon which this summary is based is presented in Appendix B, Tables B-7 through B-14. As indicated in Table 12, several taxonomic groups have not been sampled in some of these tributary streams. The information that is available, however, is sufficient to indicate the general quality of these communities and the types of aquatic life that is present.

The numbers of species or other taxonomic levels of the plankton, insects and other invertebrates in the Fountain Creek watershed is derived from sampling conducted by University of Tennessee staff at the Tennessee Route 50A bridge (east of Culleoka) in September 1981 and June 1982 (Etnier, et al., 1983). As indicated in Appendix B Table B-7, the plankton sampling included only the

microscopic plants; the planktonic animals were not sampled. While no similar survey information is available for these parts of the aquatic communities from the downstream or upstream tributaries, incidental observations about the more obvious representatives of these groups was made during rather focused sampling for mollusks and fishes that was conducted by TVA staff in June 1999. For comparative purposes, the numbers of insects and other invertebrates encountered in Fountain Creek (a total of 100 taxa) is comparable to the total for these groups found in the upstream reach of the Duck River (98 taxa, total) but is substantially less than was found in the middle reach of the river (169 taxa).

Table 12. Summary of numbers of aquatic species known from three groups of Duck River tributaries. Supporting data and references are presented in Appendix B.

Plant and Animal Groups	**Greenlick and Poplar Creeks**	**Fountain Creek Watershed**	**Flat Creek Watershed**
Plankton	NS	27+	NS
Plants	NS	NS	NS
Insects	NS	88	NS
Other Invertebrates	NS	12	NS
Mollusks	2	5	8
Fish	25	50	38
Totals	**27+**	**182+**	**46+**

NS - Community not sampled in this reach

Mollusks and fishes in the downstream creeks and Flat Creek were sampled during June 1999 (TVA unpublished data). Mollusk information from the Fountain Creek watershed was collected during the University of Tennessee study (Etnier, et al., 1983) and a TVA survey conducted in 1990 (TVA unpublished data). Most of the mollusks encountered in these creeks were snails; Flat Creek was the only one of these streams found to support as many as four freshwater mussel species. Even though Flat Creek has slightly smaller watershed than Fountain Creek, it was found to support more mollusk species than any of the other tributaries included in this examination.

The fish species occurring in these creeks, like the Duck River, have been the subject of relatively more collection effort and study. In addition to the results of the recent TVA sampling in Poplar, Greenlick, and Flat creeks, several collections have been made in various parts of the Fountain Creek watershed. Perhaps because of the more extensive sampling effort, Fountain Creek yielded the most fish species (50); however, the total for Flat Creek (38) was only slightly lower. Poplar and Greenlick creeks yielded 19 and 16 species, respectively (Appendix B, Table B-14), for a composite total of 25 species.

Tributary Summary

The total numbers of species (and other taxonomic levels) presented at the bottom of Table 12 indicate that the most types of aquatic life were encountered in the Fountain Creek watershed (182+); however, that total included information about several major groups that had not been sampled in the other watersheds. With regard to mollusks and fishes, both of which had been the subject of specific searches in each of these watersheds, the 46 species in these two groups found in the relatively small Flat Creek watershed probably represents the least disturbed of these streams. The 19 fish species found in Poplar Creek, draining a very small watershed, also seems to represent a relatively undisturbed stream. The 55 species of fishes and mollusks found in the Fountain Creek watershed and the 18 species in Greenlick Creek seem lower than expectations would predict. The site sampled on Greenlick Creek, in particular, seemed to have an excessive amount of fine sediment and many species were represented only by single individuals.

4.6 WETLANDS

Wetlands are areas that are wet or covered by shallow water for at least part of the year. Their soil conditions, and the plant and animal life they support, are determined mainly by the presence of water. Most wetlands are dominated by plants that can live in areas that are frequently flooded or have water present for long periods of time. These habitats are generally teeming with life because of the abundant water and nutrient supplies that are available to a wide variety of aquatic and terrestrial plant and animal species. Established wetlands also are important in controlling erosion, preventing flooding and storm damage, improving water quality, and helping to recharge ground water.

Wetlands are protected under both state and federal laws because of the benefits they provide. These "jurisdictional wetlands" (wetlands that meet specific criteria: having wetland plants, wetland soils, and wetland hydrology) are protected under Section 404 of the Clean Water Act. This law is administered by USACE. In addition, Executive Order 11990 (Protection of Wetlands) addresses wetlands located on federal property or affected by federal projects. In Tennessee, activities in wetlands also are regulated by TDEC under the authority of the Tennessee Water Quality Control Act of 1977.

The USFWS has produced a series of National Wetland Inventory (NWI) maps for much of the United States using a habitat-based classification system (Cowardin et al., 1979). This classification system starts out by identifying whether the wetland is basically part of a marsh (palustrine), part of a lake (lacustrine), or part of a stream (riverine). The classification system also identifies more detailed features of the habitat and the vegetation that is present.

Identification of wetlands in the project area was based on the NWI maps and existing color infrared photography of the Fountain Creek watershed. According to the available information, wetlands in the project area fall into three classification types: palustrine forested broad-leaved deciduous wetlands, palustrine scrub-shrub broad-leaved deciduous wetlands, and palustrine emergent, persistent [vegetation] wetlands. The following paragraphs indicate what is known at present about the wetlands that might be affected by each of the action alternatives.

Fountain Creek Reservoir Area

Wetland resources in the possible area of a Fountain Creek reservoir were identified based on an aerial inventory using color infrared photography, in addition to the information on the NWI maps. The results indicate that there are approximately 200 acres of palustrine forested wetlands, and approximately 25 acres of mixed palustrine forested and scrub/shrub wetlands in the project area. These wetland areas typically occur in narrow strips located along Goose Creek, Hurricane Creek, Silver Creek, and Greasy Branch.

Downstream Water Intake Area

The NWI map indicates palustrine forested wetlands associated with Gin Branch, Poplar Creek, and John Branch. There is also an extensive area of forested wetlands associated with the Duck River on the west side of Shelby

Bend and east of Greenfield Island. Several areas of palustrine emergent wetlands occur near the mouth of Poplar Creek. Palustrine scrub-shrub wetlands occur in a small area near the mouth of Poplar Creek and in the north section of Shelby Bend on the Duck River. All together, these areas amount to approximately 90 acres.

Normandy Reservoir Area

The NWI indicates the majority of wetlands are confined to the shallow heads of embayments around the reservoir. Many linear palustrine forested areas occur where tributary streams flow into the reservoir. The NWI indicates two small palustrine emergent wetlands in the Riley Creek embayment, one in the Barton Spring embayment, and another in the upper end of the lake northeast of Bullen Run. Two areas of palustrine scrub-shrub wetlands are located in an embayment just north of the dam. All together, these areas amount to approximately 220 acres.

Tims Ford Pipeline Area

The NWI indicates a number of palustrine forested wetlands in the most likely area where this alternative could be built. These are primarily linear wetlands associated with Flat Creek and its tributaries, and along the Long Creek and Hurricane Creek embayments on Tims Ford Reservoir. Three small palustrine emergent wetlands are indicated in embayments associated with Long Creek and Turkey Creek. Together, these areas amount to approximately 270 acres.

These initial descriptions of possible wetlands associated with the action alternatives were based on NWI map information compiled using high-altitude aerial photography (some of which is more than ten years old), accompanied by more recent data and limited field reconnaissance. While the existing information forms a good starting point, many wetland areas are small and/or hard to identify from high-altitude photographs. In addition, wetlands can change into other types of habitats over time, especially when landowners want to use the land for other purposes.

4.7 FLOODPLAINS/FLOOD CONTROL

Information exists about Duck River floods in the Columbia area from as early as 1814, but the first flood for which any elevation data are available occurred in 1874. The largest known flood in Columbia occurred in February 1948

when the Duck River exceeded bank-full stage by almost 20 feet. Other information about the flood history of the area is available in records maintained by the U.S. Geological Survey and TVA.

The Federal Emergency Management Agency coordinates the identification of floodplains and the preparation of Floodplain Maps in cooperation with local governments all across the country. Communities and other local agencies use the Floodplain Maps to establish the limits of floodplain areas in the community and to adopt specific floodplain regulations as the basis for their zoning or other flood protection planning measures.

Within this general project area, Maury, Marshall, and Moore counties, and Columbia and Shelbyville participate in the National Flood Insurance Program (NFIP) and have adopted the 100-year flood as the basis for their local floodplain regulations. Bedford and Coffee counties do not participate in the NFIP; however, some floodplain areas have been identified in parts of these counties.

With regard to the streams in this study area, floodplains have been identified and Floodplain Maps have been prepared for all of the included reach of the Duck River and for numerous other streams. This information has been made available to the counties and cities, and is being used in their floodplain management programs. The following paragraphs describe floodplain-related features specific to each of the action alternatives.

Fountain Creek Reservoir Area

The area most likely to be affected by the construction of this reservoir would be Fountain Creek between Creek Miles 0.2 and 14, Silver Creek between Creek Miles 0.0 and 5.0, Globe Creek between Creek Miles 0.0 and 2.5, and other minor tributaries in that part of the Fountain Creek watershed. The 100-year floodplain for Fountain Creek varies from elevation 604.1 feet mean-sea-level (msl) at the mouth (Creek Mile 0.0) to elevation 662.9 feet msl at Creek Mile 13.87. The 500-year (or "critical action" floodplain) on Fountain Creek varies from elevation 608.7 feet msl at the mouth to elevation 664.2 feet msl at Creek Mile 13.87.

With regard to the Fountain Creek tributaries, the 100-year floodplain on Silver Creek varies from elevation 604.1 feet msl at its mouth to elevation 660.6 feet msl at Silver Creek Mile 4.67. The 500-year floodplain on Silver Creek varies

from elevation 608.7 feet msl to elevation 661.1 feet msl at Creek Mile 4.67. The Globe Creek 100-year floodplain varies from elevation 648.9 feet msl at the mouth to elevation 657.1 feet msl at Creek Mile 2.24. The Globe Creek 500-year floodplain varies from 652.4 feet msl at the mouth to elevation 658.6 feet msl at mile 2.24. There is no flood information available for the other tributaries; however, the published Floodplain Maps for this area show the approximate 100-year floodplains for several streams.

Downstream Water Intake Area

Construction of a water intake downstream from the mouth of Catheys Creek and an associated pipeline would occur more or less along the Duck River from River Mile 104.4 to about River Mile 125 or 130. The approximate 100-year floodplain at Duck River Mile 104.4 is the land below elevation 538 feet msl and the approximate 500-year floodplain is the area below elevation 544 feet msl. The pipeline route would cross several streams, and the 100-year floodplains of these streams could be impacted by this construction. There is no flood information available for these tributary streams; however, the published Floodplain Maps for this area show the approximate 100-year floodplains for several of them. Detailed flood information is available for Greenlick Creek and Little Bigby Creek.

Normandy Reservoir Area

Under this alternative, the height of the existing Normandy Dam at Duck River Mile 248.6 would be raised to increase the volume of water that could be stored behind the dam. The 100- and 500-year floodplains on Normandy Reservoir are the areas below elevation 880.0 feet msl. The approximate floodplain area is shown on the published Coffee County, Tennessee, and Bedford County, Tennessee Floodplain Maps.

Tims Ford Pipeline Area

The area most likely to be affected by construction of an intake on Tims Ford Reservoir and an associated pipeline would extend from Tims Ford Reservoir to Shelbyville, Tennessee. The 100-year floodplain for Tims Ford Reservoir is the land below elevation 894.2 feet msl and the 500-year floodplain on the reservoir is the area below elevation 894.7 feet msl. The pipeline route would cross several small streams in the Flat Creek watershed and the 100-year floodplains of these streams could be impacted by this construction. No flood information is available for these streams; however, the published Floodplain Maps for this area show the approximate 100-year floodplains for some of them.

4.8 TERRESTRIAL LIFE

As indicated in Section 4.2, this project area occurs in the Central Basin Section of the Interior Low Plateau Province and adjacent parts of the Western and Eastern Highland Rim as described by Fenneman (1938). The Central Basin consists of areas with fertile soils, especially near the main rivers and less fertile areas with thin, rocky soils. Near its boundary with the Central Basin, the Highland Rim consists of rolling hills and incised valleys.

The terrestrial plant and animal communities that occur in this area all exist within the Western Mesophytic Forest Region (Braun, 1950). This forest region roughly coincides with the Interior Low Plateau but, in Tennessee, extends westward to the loess bluffs adjacent to the Mississippi River. This is a transitional region between the Mixed Mesophytic Region to the east, where numerous tree species share the canopy in mature forests, and the Oak-Hickory and Southeastern Evergreen Forest Regions to the west, both of which include few canopy tree species in mature forests. Forests of the Western Mesophytic Region have several dominant tree species in the canopy and a relatively large number of oak and hickory species. Many of the trees that help characterize the Mixed Mesophytic Region (such as yellow buckeye, basswood, hemlock, and white pine) are uncommon or absent in Western Mesophytic Region forests.

Many distinct terrestrial communities occurred in this area before European settlement of the region. During the past 200 years, human activities have greatly altered the previous vegetation and have produced a complex mixture of vegetation types. The most significant change from pre-settlement conditions has been the decrease in forest cover and the increase in pastures and croplands. Even in pre-settlement times, however, open areas existed in the form of limestone glades, barrens, and other areas kept open by fires, either started by lightning or set by Native Americans.

The terrestrial communities in this project area can be broadly categorized as bottomland hardwoods, mixed hardwoods, cedar-hardwoods, cedar forests, agricultural lands, brushy thickets (including fencerows), limestone glades, and barrens. In addition, communities associated with seepage areas, bluffs and cliffs, and caves are extremely uncommon but quite important to the regional biodiversity. These categories, although somewhat artificial and intergrading, cover the range of terrestrial communities which occur in the area. These

communities, arranged from wettest to driest, are described in the following paragraphs. The types of terrestrial communities that could be affected by each of the action alternatives are indicated in paragraphs near the end of this section.

Bottomland hardwood communities occur along the Duck River and its major tributaries. Such forests typically have various mixtures of box elder, red maple, sweet gum, river birch, sycamore, willow oak, water oak, and river cane. Depending on the extent and nature of the flooding, the herb and shrub layer may be extremely sparse or well-developed. Areas with a well developed herb/shrub layer may contain such species as chickweed, corn salad, bedstraw, field garlic, buttercups, violets, trillium, hen-bit, and coral-berry.

Bottomland hardwoods provide breeding sites and travel corridors for migrating neotropical birds, along with providing roosting and foraging habitat for a variety of semi-aquatic animals. Species of wildlife commonly found in these areas include belted kingfisher, blue-gray gnatcatcher, muskrat, beaver, mink, gray squirrel, white-tailed deer, and a variety of reptiles. Woodland depressions in bottomland hardwoods that are periodically inundated during winter months provide important breeding sites for numerous species of woodland salamanders including spotted and marbled salamanders. These woodland depressions are rare in middle Tennessee.

Seepage areas typically occupy less than one acre and normally occur on level or gently sloping sites. They may or may not be forested. These communities are vulnerable to habitat disturbances and changes in the hydrological regime. Seepages are often used extensively by large numbers of amphibians such as dusky and long-tailed salamanders.

Mixed hardwood stands are found most commonly on lower and mid-slope terrain and on sites where deeper soils have accumulated. Typical tree species in these stands include white oak, northern red oak, shumard oak, chinquapin oak, post oak, sugar maple, mockernut hickory, pignut hickory, shagbark hickory, black cherry, persimmon, hop-hornbean, and slippery elm. Shrub species characteristic of these areas include fragrant sumac, Carolina buckthorn, coral-berry, and leafy hypericum.

Mixed hardwood forests provide habitat for a variety of wildlife. Species such as white-tailed deer, gray squirrel, southern flying squirrel, and wild turkey are

typical of these areas. Many species of neotropical birds also nest and migrate in mixed hardwood forests.

Bluff or cliff areas occur along various parts of the Duck River in this project area. These habitats are typically very steep and may be partially or completely forested. Depending on where they occur, these habitats can vary from moist, dripping cliff faces to extremely dry bluff tops.

Bluffs can provide nesting and roosting habitat for black and turkey vultures and a variety of bat species. Crevices in bluff faces provide habitat for a variety of salamanders such as long-tailed, green, and slimy salamanders.

Agricultural lands include hayfields, pasture lands, and tracts in row crops such as cotton, soybeans, and corn. These lands typically have the featured agricultural crop and additional native or exotic weed species. Depending upon characteristics of the individual tract, these weeds may include sericea lespedeza, broom-sage, Japanese honeysuckle, buttercups, chickweed, smartweeds, numerous grasses, and dandelion.

Although heavily modified by man, agricultural lands provide habitat for many species of wildlife. Common species include eastern meadowlark, northern mockingbird, song sparrow, eastern cottontail rabbit, least shrew, and hispid cotton rat.

Brushy thicket communities are found in areas that have been severely disturbed and are revegetating. Disturbance in these areas is usually five to 20 years old, and woody plants are dominant in dense thickets of shrubs and tree saplings. Common species usually found in these areas include eastern red cedar, winged elm, persimmon, Carolina buckthorn, redbud, hackberry, osage-orange, sugar maple, Japanese honeysuckle, coral-berry, and sericea lespedeza. Because of the similarity of species which occur in these areas, fencerows are included in this cover type.

Common wildlife found in thickets include a variety of birds such as field sparrows, indigo bunting, eastern meadowlark, and prairie warbler. Common mammals include white-footed mice, skunk, opossum, woodchuck, least shrew, and hispid cotton rat. A variety of amphibians and reptiles including upland chorus frogs, American toad, and fence lizard can be found in these habitats.

Barrens are dynamic communities typically maintained by disturbance, such as fire. These areas are sparsely forested with oaks and have abundant grasses and herbs as a ground cover. Barrens communities usually occur on relatively level ground on the Highland Rim and have restricted water flow under the soil surface. On the eastern Highland Rim in Tennessee, the habitat types historically associated with barrens are oak woodland, oak savanna, shrub-grassland, and prairie-like openings.

Animals that favor early successional habitats, such as prairie warbler and indigo buntings, are often found in barrens habitats. Amphibians, such as upland chorus frogs, northern cricket frogs and American toads, often breed in temporary pools that form in these areas during frequent spring rains.

Cedar-hardwood forests have essentially the same tree and shrub species as the mixed hardwood forests of the region. They differ, however, in that eastern red cedar makes up one-third or more of the stand canopy. In addition, cedar-hardwood forests tend to have less white oak, scarlet oak, and black cherry, and more chinquapin oak, post oak, hop-hornbean, leafy hypericum, and fragrant sumac compared to the mixed hardwood forests. Cedar-hardwood is probably the most abundant forest type in the Central Basin portion of the project area.

Cedar forests occur on various sites in the area. Although any plant species encountered in cedar-hardwood forests could be found in small numbers in cedar forests, these stands are dominated by eastern red cedar. Cedar forests typically occur in areas where conditions are extremely favorable for their establishment and growth. Where dense stands are at least 40 years old, there is sparse undergrowth on the forest floor, partly due to dry conditions usually associated with such habitats and partly because of the dense shade created by a closed cedar canopy.

Dense stands of cedars are often used as nesting and roosting sites for birds such as common grackle. Cedar forests are used extensively as cover by white-tailed deer and eastern cottontail rabbit.

Cedar glade communities are open, rocky, treeless areas that are typically surrounded by eastern red cedar trees. Glades occur where particular types of limestone bedrock are covered with such shallow soil that trees cannot become established. Cedar glades are found only in limited areas of a few southeastern

states. In addition to the rarity of this habitat type, many of the plant species found within these glades have extremely limited ranges. Glades in the project area are important from a state and regional perspective. Large, undisturbed glades or those having rare species warrant special protection.

Wildlife commonly found in cedar glades include those species commonly found in early successional habitats such as yellow breasted chat, prairie warbler, indigo bunting, eastern cottontail rabbit, and fence lizards.

Caves are unique terrestrial habitats. Caves are very fragile ecosystems that often provide habitat for a variety of animal species. Wildlife commonly found in caves include a variety of bats, small mammals, and amphibians. Several caves are known from this general project area; however, few caves in the vicinity have been surveyed to determine which animals are present.

Fountain Creek Reservoir Area

As indicated in Section 4.9, much of the area that would be affected by construction of this reservoir is presently maintained as agricultural fields and pastures. Natural communities remaining on parts of this land include bottomland hardwoods, seepage areas, bluff or cliff areas, and cedar glades. Most of the bottomland hardwoods and seepage areas occur along Fountain and Silver creeks. Bluff and cliff habitats are not present in the Fountain Creek watershed but do occur along the Duck River downstream from the mouth of Fountain Creek and may exist along the pipeline corridor route. Cedar glades occur along the northwestern edge of the area that could be affected by this alternative.

Although much of Fountain Creek flows through agricultural lands, several well established forested riparian zones exist within the watershed. These areas are used as travel corridors and nesting sites for neotropical birds, bats, and a variety of other wildlife species.

Downstream Water Intake Area

Construction of a new water intake on the Duck River in the vicinity of Kettle Mills and an associated pipeline to connect to the water distribution system probably would affect existing road rights-of-way for most of its length. Much of this area, especially along the highways, is now managed as agricultural land. Native communities in this area include bottomland hardwoods, seepage areas, and bluff or cliff areas.

Bottomland hardwood communities occur along the part of the Duck River that could be affected by this alternative. Specific seepage areas have not been identified within this area but, if they are present, would most likely be found along the Duck River and its tributaries. Bluff or cliff habitats have not been encountered in this area; if these habitats are present, they would be found along the Duck River. Wildlife in this area consists of species that are locally and regionally abundant.

Normandy Reservoir Area

Lands immediately adjacent to Normandy Reservoir vary from forested slopes to open agricultural fields and residential developments. Forests adjacent to Normandy Reservoir are predominately upland hardwoods, cedar-hardwoods, pure stands of eastern red cedar, and bottomland hardwoods. Uncommon natural communities that may be associated with this alternative include bottomland hardwood forests, seepage areas, bluffs and cliffs, and barrens.

Bottomland hardwood communities and seepage areas are not presently known within the area likely to be affected by this alternative. If such habitats are present they would most likely be found along the Duck River below Normandy Dam, along the Normandy Reservoir shoreline, or along the tributaries flowing into Normandy Reservoir. No bluff, cliff areas, or barrens communities are presently known to occur within the footprint of this alternative and no likely locations for such communities have been identified (Call, 1998). Several caves are known to occur in the vicinity of Normandy Reservoir.

Tims Ford Pipeline Area

Forest lands around this reservoir include upland hardwoods, cedar-hardwoods, and bottomland hardwoods. The remaining forest lands are dominated by pure stands of eastern red cedar. Bottomland hardwoods and wetlands are both extremely rare on Tims Ford Reservoir. Bottomland hardwoods are dominated by box elder, sycamore, river birch, and hop-hornbeam. Upland hardwoods are dominated by oaks (white, black, scarlet, and chestnut), blackgum, sourwood, and hickory. Beech, sugar maple, basswood, and yellow poplar are common on more moist sites. Large mature deciduous forest are rare on Tims Ford and occur primarily in areas that were too steep to easily log or develop.

Most wildlife habitat associated with this alternative consists of agricultural fields and upland hardwood forests. Uncommon terrestrial communities

include bottomland forests, seepage areas, bluffs and cliffs, cedar glades, and barrens. Bottomland hardwood communities are uncommon and exist mostly along the Elk River downstream from Tims Ford Dam. One bottomland hardwood forest exists just upstream of Tims Ford Reservoir along the Elk River. This bottomland hardwood forest has been identified as a significant breeding site for woodland salamanders.

Rocky seepage areas are known to occur at several locations in the area likely to be affected by this alternative. These seepages, which occur in mid-age and mature woodlands, vary in slope, and continuously discharge water from fractured rock formations. The outcrops usually include both limestone and shale layers. A variety of mosses, liverworts, herbaceous plants, and woody plants occur at these sites. A variety of woodland salamanders also occur in these areas.

Bluff or cliff areas are known from along the shoreline of Tims Ford Reservoir, as well as along the Elk River where it enters the reservoir. These areas are often used as day roosts by bald eagles during winter months and are extensively used by a variety of small mammals and amphibians. No barrens communities are presently known to occur within the footprint of this alternative; however, barrens do occur on the Arnold Engineering Development Center, approximately four miles northeast from the possible intake locations (Call, 1998).

4.9 ENDANGERED AND THREATENED SPECIES

As discussed in Sections 4.5 and 4.8, the descriptions of aquatic and terrestrial life indicate that a wide diversity of plant and animal species occur in this part of Tennessee. Some of the species known from this region are protected under federal and state endangered species laws. In fact, available information suggests that 115 species now protected under federal and/or Tennessee endangered species laws have been reported from the five counties which could be affected by one or more of the action alternatives (Maury, Marshall, Bedford, Coffee, and Moore counties). The names and county occurrence information for all of these species are presented in Appendix C. Table 13 presents a brief summary of this information focused on their federal or state protection status.

Table 13. Summary of the numbers of federal and Tennessee endangered, threatened, and other categories of protected species known from the five counties included in this evaluation. Some of these species are protected at both the state and federal level and are counted in both summaries.

Categories	Animals	Plants	Totals
Federal Status			
Endangered	15	3	18
Threatened	1	1	2
Identified Candidates	1	0	1
Federal Totals	17	4	21
Tennessee Status			
Endangered	16	22	38
Threatened	8	26	34
Other Status	23	20	43
Tennessee Totals	47	68	115

The tables included in Appendix C also indicate the one or two types of habitats in which each protected species is typically found. This information, summarized in Table 14, indicates that most of the protected species occur only in a few of the habitats that exist in this project area. Of the identified habitats, wet meadows and creeksides contain the most protected species (26, all plants; 23 percent of the overall total), followed by rivers, where 20 species (17 percent of the total, all but one animals) are found. If similar habitats are grouped together, rivers and creeks support 35 species (30 percent of the protected species, all but one animals), followed closely by the 31 species which occur in wet meadows, creeksides, and seepage areas (27 percent of the total, all plants). Bottomland and mixed forests account for 18 percent of the total (half animals, half plants), cedar glades 11 percent (all plants), disturbed areas (agricultural areas, old fields, thickets, and barrens) eight percent (mostly plants), and bluffs and cliffs four percent (again mostly plants). Only one percent of the protected species occur on reservoirs (the bald eagle) and no protected species are reported as routinely occurring in cedar forests.

Table 14. Summary of the numbers of protected species known from the major habitat types present in the five counties included in this evaluation.

Habitat Associations	Animals	Plants	Totals
Aquatic			
Creeks	15		15
Rivers	19	1	20
Reservoirs	1		1
Underground Streams	1		1
Terrestrial			
Wet Meadows, Creeksides		26	26
Seepage Areas		5	5
Bottomland Forests	6	5	11
Mixed Hardwoods	3	7	10
Bluffs and Cliffs	1	4	5
Agricultural Areas	2	1	3
Old Fields, Thickets, Fencerows		1	1
Barrens		5	5
Cedar Forests			
Cedar Glades		13	13

Federal Protected Species

The information presented in Table 13 indicates that 21 species known from this 5-county area are protected under the federal Endangered Species Act. Some of these species, however, no longer occur in these counties and some of them occur only in parts of the counties that would not be affected by any of the action alternatives. Because of their federal protection status, these 21 species are individually identified in Table 15 and their potential to occur in the project area is described in the following paragraphs.

Plants

Chaffseed (*Schwalbea americana*) was listed as a federal endangered species in 1992 (USFWS, 1992). Primarily a coastal plain species, chaffseed was last observed in Tennessee in 1879. Although this species still survives in the coastal plains of New Jersey, North and South Carolina, Georgia, and Florida (USFWS, 1994), it is highly unlikely chaffseed persists within the project area.

Table 15. Federal endangered, threatened, and formal candidate species known from the five county area which could be affected by one or more of the action alternatives.

Common Name	Scientific Name	Federal Status	Likely in Project Area?
Plants			
chaffseed	*Schwalbea americana*	E	No
Eggert's sunflower	*Helianthus eggertii*	T	No
leafy prairie-clover	*Dalea foliosa*	E	Yes
yellow-eyed grass	*Xyris tennesseensis*	E	No
Mollusks			
birdwing pearlymussel	*Lemiox rimosus*	E	Yes
cracking pearlymussel	*Hemistena lata*	E	No
Cumberland combshell	*Epioblasma brevidens*	E	Yes
Cumberland monkeyface	*Quadrula intermedia*	E	Yes
Cumberland pigtoe	*Pleurobema giberum*	E	No
orange-footed pearlymussel	*Plethobasus cooperianus*	E	No
oyster mussel	*Epioblasma capsaeformis*	E	Yes
pale lilliput pearlymussel	*Toxolasma cylindrellus*	E	Yes
shiny pigtoe	*Fusconaia cor*	E	No
slabside pearlymussel	*Lexingtonia dolabelloides*	C	Yes
tan riffleshell	*Epioblasma walkeri*	E	Yes
tuberculed-blossom pearlymussel	*Epioblasma t. torulosa*	E	No
turgid-blossom pearlymussel	*Epioblasma turgidula*	E	No
yellow-blossom pearlymussel	*Epioblasma f. florentina*	E	No
Birds			
bald eagle	*Haliaeetus leucocephalus*	T	Yes
Mammals			
gray bat	*Myotis grisescens*	E	Yes
Indiana bat	*Myotis sodalis*	E	Yes

Eggert's sunflower (*Helianthus eggertii*) was listed as a federal threatened species in 1997 (USFWS, 1997b). This species is associated with dry, upland, acidic pH, barren habitats in the Highland Rim Province. It is known from twelve counties in Tennessee, four counties in Kentucky, and one county in Alabama (USFWS, 1996 and unpublished information). One of the Tennessee populations occurs in Maury County, approximately 12 miles southwest of Columbia. This sunflower was not found during extensive surveys of the Columbia Project lands and is not known to occur in the Central Basin Physiographic Province. The limestone barrens in the Central Basin produce a habitat with a basic pH, substantially different from the acid barrens on the Highland Rim where Eggert's sunflower sometimes occurs (USFWS, 1998a).

The **leafy prairie-clover** (*Dalea foliosa*), a member of the bean family that stands 12 to 24 inches in height, has bluish-purple flowers and blooms in July and August (USFWS, 1996). Leafy prairie-clover was listed as a federal endangered species in 1991 (USFWS, 1991b). This species occurs in seven middle Tennessee counties, two counties in north Alabama, and a single county in Illinois (USFWS, 1996). Four populations have been found on the Columbia Project lands, two of which are among the healthiest and largest known. The larger of these populations was discovered after the recovery plan was approved. The leafy prairie-clover is found along intermittent streams bordering limestone glades rather than on the bare rock of the glades themselves.

Yellow-eyed grass (*Xyris tennesseensis*), listed as a federal endangered species in 1991 (USFWS, 1991a), is a perennial typically found on seepage-slopes, springy meadows, or the banks of small, gravelly streams (USFWS, 1994b). This species is known from twelve locations within the Highland Rim physiographic province in Tennessee. The single record from the counties involved in this project occurs approximately eight miles from Normandy Reservoir, outside of the area which could be affected by any of the alternatives.

Mollusks

Seven of the 14 freshwater mussel species included in Table 14 have been found in the upper Duck River watershed within the last 25 years. Each of those species is described in one or more of the following paragraphs. The other seven mussel species fall into three groups. Three of these species (tuberculed-blossom, turgid-blossom, and yellow-blossom) have not been encountered in any part of their former habitats in the last thirty years and are presumed to be extinct (Williams, et al., 1993). Three others (cracking, orange-footed, and shiny pigtoe) survive in the lower Elk River and in other river reaches; however, none of them are known to persist in the parts of the Duck or Elk river watersheds which could be affected by one or more of the action alternatives. The remaining species (Cumberland pigtoe) is generally assumed to be restricted to the Collins River and, possibly, other nearby streams in the Cumberland River basin; however, an individual identified as this species was found in 1993 in the upper Elk River basin (Parmalee and Bogan, 1998).

The **birdwing pearlymussel** (*Lemiox rimosus* = *Conradilla caelata*), listed as a federal endangered species in 1976 (USFWS, 1976), is the most abundant of the endangered mussel species known from the Duck River. During detailed surveys conducted in both 1979 and 1988 (Ahlstedt, 1986; Jenkinson, 1988), the birdwing was found from Duck River Mile 147 upstream to River Mile 179 and was the fourth (in 1979) or sixth (in 1988) most abundant mussel species encountered in the quantitative samples that were taken (Jenkinson, 1988). More recent sampling indicates this species continues to occur throughout this river reach (Aquatic Resources Center, 1995b) and continues to be one of the more abundant species (Aquatic Resources Center, 1997). This species has not been found in the Duck River downstream from River Mile 147 or in any Duck River tributary. Outside of the Duck River basin, native populations of the birdwing pearlymussel occur (but are extremely rare) in a short reach of the Elk River and in longer reaches of the Powell and Clinch Rivers (Ahlstedt, 1984a).

In 1982, TVA staff transplanted members of this species from the Duck River to sites on the Buffalo, Nolichucky, and North Fork Holston Rivers, and to a site on the upper Duck River near Shelbyville (Jenkinson, 1983). Results of monitoring studies indicate that numbers at all four transplant sites have declined to very low levels; however, the recovery of a few young individuals suggests the introduced birdwings have successfully reproduced in both the North Fork Holston and Nolichucky Rivers (Aquatic Resources Center, 1994a; 1996a).

The **Cumberland combshell** (*Epioblasma brevidens*) was added to the federal endangered species list in 1997 (USFWS, 1997a). This species survives in the Clinch, Powell, and Duck Rivers in the Tennessee River basin and in Buck Creek and the Big South Fork in the Cumberland River basin. A few, old specimens of the Cumberland combshell also may persist in the main Cumberland River downstream from Cordell Hull Dam (USFWS, 1997a). This species was rare but routinely found in the middle reach of the Duck River through the mid-1970s (Ahlstedt, 1981); however, only two live animals have been encountered in this river in recent years (Ahlstedt, 1986; Jenkinson, 1988; Aquatic Resources Center, 1994b; 1996b; 1997; USFWS, 1998b).

The **Cumberland monkeyface** pearlymussel (*Quadrula intermedia*) was placed on the federal endangered species list in 1976 (USFWS, 1976). During various surveys and field activities in the Duck River starting in 1979, no more than 15

live individuals of this species (out of several thousand live mussels) have been found at sites between River Mile 162 and River Mile 179 (Ahlstedt, 1986; Jenkinson, 1988; Aquatic Resources Center, 1994b; 1996b; 1997). In addition to the Duck River, the species survives in very low numbers in a 40-mile reach of the Elk River and in a 30-mile reach of the Powell River (Ahlstedt, 1984b; Ahlstedt, 1986; TVA, unpublished data). This species typically occurs in medium and larger rivers; no individuals have been found in any Duck or Elk River tributaries.

The **oyster mussel** (*Epioblasma capsaeformis*), added to the federal endangered species list in 1997 (USFWS, 1997a), was found in the middle reach of the Duck River during the 1970s (Ahlstedt, 1981). For several years in the 1980s only a few specimens of the oyster mussel were collected in this area (USFWS, 1997a), but, more recently, Aquatic Resources Center staff have encountered this species routinely not far downstream from Lillard Mill Dam (Aquatic Resources Center, 1994b; 1996b; 1997; USFWS, 1998b). Outside of the Duck River watershed, the oyster mussel survives in the Clinch, Powell, and, possibly, Nolichucky River systems in the Tennessee River basin, and in Buck Creek and the Big South Fork in the Cumberland River basin (USFWS, 1997a).

The **pale lilliput pearlymussel** (*Toxolasma cylindrellus*) is known to occur in Rock Creek (a Duck River tributary); however, it has not been found anywhere in the main Duck River or in any other part of this project area within the last 25 years (Parmalee and Bogan, 1998). Outside of Big Rock Creek, the pale lilliput is only known from the Paint Rock River in north Alabama (Ahlstedt, 1984c). It was listed as a federal endangered species in 1976 (USFWS, 1976).

The **slabside pearlymussel** (*Lexingtonia dolabelloides*) is not presently protected under federal or Tennessee endangered species laws; however, it is an identified federal candidate for potential listing (USFWS, 1999). This species occurs in the middle and lower sections of the Duck River included in this evaluation and in the Elk River some distance downstream from Tims Ford Dam (Ahlstedt, 1986). The slabside pearlymussel has not been encountered in any Duck River tributaries in recent years (TVA unpublished data). Outside of the Duck and Elk River systems, the slabside pearlymussel still occurs in parts of the Clinch, Powell, Holston, Hiwassee, and Paint Rock rivers (Parmalee and Bogan, 1998).

The **tan riffleshell** (*Epioblasma walkeri*) was added to the federal endangered species list in 1977 (USFWS, 1977b) and, for several years, was thought to survive only in the Middle Fork Holston River (Neves, 1984). Now, the species is also known to be present in a short reach of the upper Clinch River (USFWS, unpublished data), in the Hiwassee River just downstream from Apalachia Dam (Parmalee and Hughes, 1994), and, may be present in part of the Big South Fork of the Cumberland River (S. A. Ahlstedt, personal communication). In 1988, TVA staff found a young, fresh-dead tan riffleshell in the Duck River at River Mile 151 (Jenkinson, 1988). No other members of this species have been found in more recent sampling on the Duck River (Aquatic Resources Center, 1994b; 1995b; 1997). This species apparently survives in the Duck, Clinch, Hiwassee, Big South Fork, and Middle Fork Holston Rivers but at extremely low numbers in each stream.

Bird

The **bald eagle** (*Haliaeetus leucocephalus*), presently listed as a federal threatened species, is known to occur in this area, at least on an occasional basis. Southern populations of bald eagles were listed as a federal endangered species in 1967 (USFWS, 1989) and, recently, have been proposed for de-listing (USFWS, 1999). Bald eagles typically nest along rivers or reservoirs. Both Tims Ford and Normandy Reservoirs are suitable nesting and foraging areas for bald eagles. Migrating bald eagles are regularly observed on both reservoirs during winter months, and a pair of bald eagles attempted to nest near Normandy Reservoir.

Mammals

The **gray bat** (*Myotis grisescens*), listed as a federal endangered species in 1976, is a colonial bat that roosts in caves year-round (Brady et al., 1982). Gray bats typically roost in caves along rivers and reservoirs within a range primarily restricted to the karst regions of the southeastern United States. Gray bats have been reported to roost in a cave on the Columbia Project lands as they migrate through the area in spring and autumn. Large ceiling stains found in several rooms within this cave suggest that large numbers of bats could be involved. Gray bats probably also use other caves along the Duck River as temporary roosting areas. Gray bats breed during the fall migration, making transition caves (such as those along the Duck River) important to the survival of the species. They also probably feed over the Duck River and its tributaries when they are in the area.

The **Indiana bat** (*Myotis sodalis*) also is likely to occur in this area. This bat was listed as a federal endangered species in 1967 (USFWS, 1967). These colonial bats hibernate in caves during winter months, and form small maternity colonies in hollow trees and beneath exfoliating bark during the summer (USFWS, 1983). Indiana bats are known only from the eastern half of the United States and, apparently, are more abundant in Indiana and Missouri than in Tennessee and Alabama. Recent discussions with Indiana Bat Recovery Team members indicate that population levels of Indiana bats are decreasing throughout their range. Indiana bats have been reported from a cave in Maury County approximately nine miles from part of the Columbia Project lands. Although no Indiana bats were encountered during recent cave surveys on the Columbia Project lands, members of this species may forage and roost in forested areas in this part of Maury County during summer months.

4. 10 LAND USE/PRIME FARMLAND/COMMUNITY NOISE

Land Use

As indicated in Section 1.6, this project area includes various parts of the upper Duck River watershed. Most of this watershed area presently is being used as forest land and agricultural land. The larger cities within the area are Columbia, in Maury County; Shelbyville, in Bedford County; and Tullahoma, in Coffee County. Several of the alternatives would affect land in the Columbia area, and the possible construction of a reservoir in the Fountain Creek watershed would affect the largest amount of land.

Information available from the Environmental Protection Agency's BASINS watershed database (USEPA, 1998) helps characterize how the land in this watershed is presently being used. As indicated in Table 16, 48.1 percent of the upper Duck River watershed is covered by various types of forests (also see Section 4.8), 45.1 percent of the land is used for agriculture, and 2.9 percent of the land is in residential use. All other uses of the land in the upper Duck River watershed affect only 3.9 percent of the area. The 1992 Census of Agriculture data for Maury County indicated that 245,681 acres of land was occupied by farms. This is 62.5 percent of the total area in the county. Similar figures compiled in 1982 indicated that 281,802 acres were in farmland, suggesting a 9.2 percent decrease in farm acreage within Maury County during that 10-year period.

When just the land in the Fountain Creek watershed is considered, forests occupy 39.8 percent of the land, agricultural use occurs on 51.6 percent, and 4.2 percent is in residential use (Table 16). Other uses of the land in the Fountain Creek watershed affect only 4.4 percent of the area.

Table 16. Land use in the Upper Duck River watershed, and in the Fountain Creek watershed.

Land Use *	Upper Duck River Watershed *		Fountain Creek Watershed **	
	Acres	Percent	Acres	Percent
Agriculture Use	2,251,774	45.1	33,913	51.6
Forestland	2,401,725	48.1	26,163	39.8
Residential	145,710	2.9	2,776	4.2
Transitional Areas/Shrub & Brush	83,085	1.7	1,330	2.0
Industrial/Commercial/ Other Built-Up Areas	42,666	0.9	946	1.4
Wetlands	20,709	0.4	459	0.7
Water Bodies/Streams	37,177	0.7	186	0.3
Strip Mines/Disturbed Areas	7,236	0.1	12	0.1
Total Area	4,990,080	100.0	65,785	100.0

* - Environmental Protection Agency, "Upper Duck, BASINS Core Data", 1998 (http://www.epa.gov/OST/BASINS/HUCS/06040002/)
** - TVA unpublished data

Prime Farmland

Prime farmland soils, as defined by the U.S. Department of Agriculture, have properties needed for the economic production of sustained high crop yields. These soils have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. Soils identified as prime farmland soils may presently be in use as cropland, pasture land, range land, forest land, or other uses, but cannot be in use as urban or built-up land. Of the total 392,960 acres of land in Maury County, approximately 112,000 acres (28 percent) is considered prime farmland soils.

The conversion of farmland and prime farmland soils to industrial and other nonagricultural uses essentially precludes producing crops on the land for the

foreseeable future. The 1981 Federal Farmland Protection Policy Act recognized the serious impacts of prime farmland loss on food and fiber production and established requirements for evaluating land prior to permanent conversion from farmland as a result of a federal action. The Act requires that a Farmland Conversion Impact Rating form be completed by federal agencies with assistance from the U.S. Department of Agriculture's Natural Resource Conservation Service. The evaluation rating is based on soil characteristics and site assessment criteria. Land with a rating of at least 160 (out of a possible score of 260) must be given consideration for protection. The Act only suggests that the land be protected and that other sites be considered; there is no legal requirement to do so.

Community Noise

As indicated above, most of the land in the upper Duck River watershed outside of the larger cities is predominantly light to moderate density rural residential and appears to be a broad mixture of old to new and low- to high-cost homes. Landowners primarily use their land for domestic, agricultural, and recreational purposes. These uses would include noise sources such as vehicles, lawn mowing equipment, agricultural equipment, chain saws, dogs, and recreational activities. Some parts of this area border major highways, such as Interstate 65, State Route 50, and State Route 41A. Vehicles are the dominant noise sources in these areas.

A few noteworthy departures from this typical pattern exist in the area. These departures represent the types of local variations that can occur in a rural, unzoned environment and can affect community noise impacts. Active quarrying of limestone is occurring in at least two areas: just north of Iron Bridge Road, across from the former Columbia dam site, and just off of Blue Springs Road near State Route 50. Typical quarrying and industrial noise is coming from both of these sites, along with vehicle noise produced by the heavy trucks which travel the adjacent roads to access these facilities.

A different type of departure from the typical noise pattern has occurred due to the completion of Tom Hitch Parkway between State Routes 412 (on the north) and 50 (on the south). Frontage land along this parkway is being developed for commercial uses, resulting in increased construction noise. As the area continues to develop, operational noises will increase from the new commercial and industrial facilities and vehicle noise will increase as the traffic count grows.

Fountain Creek Reservoir Area

Within the Fountain Creek watershed, 2,254 acres of land could be converted into a reservoir if the full pool elevation was at 629 feet. All of this area is presently zoned A-2, Rural Residential District. Of this acreage, 42.6 percent of the land use is presently in agricultural use and 34.4 percent is forest land (Table 17). Wetlands occupy 10.1 percent and shrub/brush land another 8.2 percent of the area. Two cemeteries (Harris Cemetery and Lancaster Cemetery) are located on the perimeter of the reservoir and three others are located within 500 feet of the full pool elevation (Atkinson Cemetery, Pleasant Mount Cemetery, and Bethany Cemetery). State Highways 50 and 373 intersect the reservoir at several places, and a variety of other roads traverse the reservoir area (including Moore Lane, Old Highway 50, Vaughn Road, Bryant Road, and Seavy Hight Road). A Southern Railroad line extends through a portion of the reservoir area at a point west of the Glendale Community. A transmission line connecting to a substation southeast of Columbia travels along the northeastern perimeter and intersects the northern part of the possible reservoir area.

Of the 2,254 acres which might be included in a Fountain Creek reservoir, 1,272 acres (56.4 percent) are prime farmland soils (Table 17). Of the 1,272 acres of prime farmland, 53.4 percent is presently in agricultural use, forest grows on 25 percent of the area, 11.2 percent is in wetlands, 6.1 percent in shrub and brush land, and 4.3 percent is in other land uses. In this area, the most prevalent prime farmland soils are Huntington silt loam, phosphatic phase (see Section 4.2). Other prime farmland soils in this potential reservoir area are Armour silt loam, eroded gently sloping terrace phase; Captina silt loam; Egam silty clay loam; Etowah silt loam; Hagerstown silt loam; Lindside silt loam; and Maury silt loam.

Other Alternatives

Each of the other alternatives would affect much smaller tracts of land, typically only in narrow corridors. The downstream water supply alternative would involve construction of a pipeline extending approximately 13 miles along State Highway 50 between Williamsport and Columbia. Approximately 70 percent of the area bordering that highway is agricultural land, 27 percent is forestland, and 3 percent is residential. The Tims Ford pipeline alternative would include construction of a pipeline (approximately 20 miles long) from Tims Ford Reservoir, in Moore County, to discharge into the Duck River near Shelbyville, in Bedford County. The pipeline would be constructed along

Table 17. Present total land use and present use of prime farmland soils within the possible impoundment area of a Fountain Creek reservoir (at elevation 629).

Land Use *	All Land *		Prime Farmland **	
	Acres	Percent	Acres	Percent
Agriculture	961	42.6	679	53.4
Forestland	776	34.4	318	25.0
Wetlands	227	10.1	142	11.2
Shrub/Brush	186	8.2	77	6.1
Water Bodies/Streams	79	3.5		
Residential	2	0.1		
Industrial/Commercial/ Other Built-Up Areas	23	1.0		
Other Use			55	4.3
Totals	2,254	100.0	1,272	100.0

* - TVA unpublished data
** - USDA, Soil Survey of Maury County, Tennessee, 1959

existing State Highway 82 and other road rights of way. State Highway 82 is bordered by about 75 percent agricultural land and about 25 percent residential land use. The majority of the land use bordering the other possible roads is forest land.

The raise Normandy pool alternative is somewhat different in that it would affect a band of land all around Normandy Reservoir located in Bedford and Coffee counties. This land is managed as a natural resource area and includes two camping areas (Cedar Point and Barton Springs) and several boat launching ramps (see Section 4.11). Two roads traverse the reservoir: Hiles Road and Mountview Road.

None of the potential pipeline corridors along state highways or other road rights of way would be classified as prime farmland. However, any non-highway pipeline easements, locations for water intakes, and locations for new water treatment plants could contain some prime farmland. The extent of prime farmland along these corridors has not been estimated because no specific sites or routes have been identified. About 25 percent of the soil on the perimeter of the Normandy Reservoir is classified as prime farmland (USDA,1999).

4.11 VISUAL CHARACTER, RECREATION, AND NATURAL AREAS

Visual Character

The physical, biological, and cultural features of an area combine to make the visual landscape character both identifiable and unique. Scenic integrity indicates the degree of unity or wholeness of the visual character. Where and how the landscape is viewed will affect the more subjective aspect of its aesthetic quality and sense of place. Views of a landscape are described in terms of what is seen in foreground, middleground, and background distances. In the foreground, an area within one half-mile of the observer, details of objects are easily distinguished in the landscape. In the middleground, normally between a mile and four miles from the observer, objects may be distinguishable but their details are weak and they tend to merge into larger patterns. Details and colors of objects in the background, the distant part of the landscape, are not normally discernible unless they are especially large and standing alone. The impressions of an area's visual character can have a significant influence on how it is appreciated, protected, and used.

The visual character of the upper Duck River watershed is typical of many central Tennessee river valleys. Much of the river corridor is bordered by tall bluffs and steep, rocky, forested banks. The land away from the river consists primarily of gently rolling topography and relatively shallow, gently flowing tributary streams. The countryside is a varied mix of woodland, open pastures, crop land, and mostly small communities, with little industry and relatively few major highways. Together, the natural and cultural elements in this area provide attractive scenic variety and form a relatively harmonious rural landscape.

The four action alternatives considered in this evaluation would each affect only part of the study area. The following paragraphs describe the present visual setting in which these alternatives would be placed.

Fountain Creek Reservoir Area

The possible 2200-acre reservoir would occupy part of a bottomland drainway averaging about 2000 feet wide, with a meandering stream, several smaller tributaries, and little elevation change. Within this area, open land originally bought for Columbia reservoir is mostly covered with recent-growth brush and trees. The remainder of the area is a mix of pasture and woodland. A few old roads remain, some of which are blocked to traffic and the bridges have been

removed. The reservoir area is surrounded by a gently rolling rural landscape consisting of woodlands, pastures, and sparse residential development. The elevation difference averages about 140 feet. Scenic integrity is moderately high. The natural and cultural elements together provide harmony, coherence, and scenic attractiveness in this area of rural countryside.

Homes are clustered on the higher elevations around the Scribners, Fountain Heights, and Crews Hill areas. The valley floor can be seen in the near foreground by these residents, as well as from a few farms. Motorists see the area in the foreground from local roads and Brush Creek Road bridge. They also see this area in both the foreground and middleground from the Highway 50 bridge. Traffic maps prepared by the Tennessee Department of Transportation show an average of 9,100 vehicles per day on this portion of Highway 50 and about 240 vehicles per day on Brush Creek Road. The potential reservoir area is also seen in the immediate foreground by those using the land for recreational activities.

Downstream Water Intake Area

The potential pipeline corridor generally follows Highway 50 and some local roads which run through a primarily rural countryside. The topography is gently rolling with an elevation difference along the route of about 220 feet. The corridor also runs through a small area of urban and industrial development on the northwest side of Columbia. The route crosses several streams and the Duck River near Williamsport. This area includes pasture lands, occasional woodlands, light residential development, churches, schools, and some revegetated strip mine areas. A variety of homes, farms, and several small subdivisions are located along the highway and adjoining local roads. Scenic integrity is moderate. The natural and cultural elements together provide variety, scenic attractiveness, and visual harmony with few contrasting elements in this corridor of rural landscape.

Residents and motorists view the potential pipeline corridor in the immediate foreground and beyond. Traffic maps show an average of 4,430 vehicles per day on Highway 50 from Columbia to the Sawdust community, and 2,800 vehicles per day from Sawdust north to Williamsport. A Duck River crossing would be seen in the immediate foreground of those using the adjacent river section for recreation activities and, possibly, by motorists on the highway bridge.

Normandy Reservoir Area

The potential project area includes Normandy Reservoir and a band of the surrounding property, all owned by TVA. Most of the surrounding land is steeply sloping, with five percent or less sloping gently enough for comfortable human use. The elevation difference from the full pool reservoir to the ridgetops averages about 230 feet. About 80 percent of the shoreline is wooded. The back-lying rural landscape has similar steep slopes with gently rolling ridgetops. The lands include pastures, woodlands, sparse residential development, and a few farms. Residential growth is occurring, especially on ridgetops that have views of the reservoir. Scenic integrity is moderately high. The natural and cultural elements together provide variety, scenic attractiveness, and visual harmony around this rural reservoir.

The reservoir is seen in the foreground by residents located on ridgetops and back-lying slopes near the shoreline. The visiting public views the areas from TVA facilities at the dam reservation and other recreation areas on the reservoir. Motorists see the reservoir in the foreground from Riley Creek Road, Wards Chapel Road, Powers Bridge Road, and other local roads. Traffic maps show an average of 1,790 vehicles per day on Riley Creek Road. The reservoir shoreline is also seen in the foreground by those using the lake for recreation activities.

Tims Ford Pipeline Area

The potential pipeline corridor generally follows local roads from Tims Ford Reservoir to the intersection of State Routes 55 and 82, then follows Route 82 to the Duck River near Shelbyville. The possible intake areas are located on embayments with mostly wooded shoreline and very few residences. The pipeline corridor runs through rather hilly rural countryside from Tims Ford Reservoir to about the Flat Creek community, and more gentle topography from there to the Duck River. Elevation difference along the route is about 400 feet. The study route crosses several streams, and includes pastures, woodlands, light residential development, several churches, and a school. A variety of homes and farms are located along the roadways. Scenic integrity is moderate. The natural and cultural elements together provide variety, scenic attractiveness, and visual harmony within this corridor of rural landscape.

Residents and motorists along the route view the corridor in the immediate foreground and beyond. Traffic maps show 850 vehicles per day along Chestnut Ridge Road near the embayments, 1,800 vehicles per day south to

Highway 55, and over 3,100 vehicles per day on Highway 82 from Flat Creek to Shelbyville. Potential areas for the intake can be seen by motorists on local roads crossing near the head of the reservoir embayments. The discharge area near Shelbyville is seen by residents on both sides of the river and from the highway bridge. These terminal points of the corridor are also seen in the foreground of those using adjacent sections of Tims Ford Reservoir and the Duck River for recreation activities.

Recreation Activities

Local residents and people from surrounding counties enjoy many types of recreational activities within the upper Duck River watershed. Water-based recreation activities include fishing in several habitats and boating on both the streams and reservoirs. Land-based recreation includes hunting, camping, and other individual activities, as well as group activities in a wide variety of parks and other facilities.

On a scale ranging from unattractive, uninspiring, pretty, beautiful, and spectacular, Sehlinger and Lantz (1983) described the middle section of the Duck River as "pretty." The same authors rated the Elk River "mostly pretty with some beautiful spots;" the Buffalo River "mostly beautiful with some pretty spots;" the Harpeth River "beautiful in spots;" and Richland Creek is rated "pretty." This part of the Duck River has few obstructions and is an easy canoeing stream. The American Whitewater Association (AWA) would consider this to be a Class I River, meaning there is moving water with a few riffles and small waves with few or no obstructions (AWA, 1977).

Several improved access points help people enjoy recreational time on the river. DRDA and TWRA have developed a concrete boat ramp and parking area on the river at Iron Bridge Road. A similar facility has been discussed for a site at Carpenters Bridge. The Iron Bridge ramp is used as a bass boat access to that section of the river and as a staging area for local weekly bass tournaments. Other access points at Williamsport, Chickasaw Trace, Columbia, Leftwich Bridge, Lillard Mill, Hardison Mill, Henry Horton State Park, Shelbyville, Three Forks Bridge, Dement Bridge, Cortners Mill, and Normandy Dam are used for canoeing and float fishing in those river sections. Carpenters Bridge has historically been used as a take out point for the eight miles of river downstream from Hardison Mill, the section which has been the most popular for canoeing.

TWRA maintains a year-round trout fishery in the Duck River just downstream from Normandy Dam by stocking trout from March through December. Stocking is concentrated near the dam, but the fishery extends to approximately Three Forks Bridge, eight miles downstream. A warmwater fishery for black bass (smallmouth bass, largemouth bass, spotted bass), sunfish (rock bass, bluegill, and crappie), and catfish develops several miles downstream from Normandy Dam, where the water temperatures return to normal, and continues throughout the remainder of the river. The warmwater sport fishery downstream from the Columbia City Dam also includes sauger and striped bass which migrate into that part of the river during their spawning season. Migrating redhorse and other sucker species also are caught throughout the Duck River by snag fishermen.

Normandy and Tims Ford reservoirs are popular water bodies for sport fishing. During 1996, an estimated 232,955 total hours were spent by fishermen at Normandy Reservoir (TWRA, 1997). Targeted species were primarily black bass, crappie, and catfish, although walleye/sauger and white bass were also sought. Tims Ford Reservoir supported over twice as much fishing pressure (509,571 hours) in 1996 as Normandy (TWRA 1997). In Tims Ford, the targeted species included black bass, striped or hybrid striped bass, and crappie, with lesser effort spent on walleye/sauger, sunfish, catfish, and white bass.

TVA's sport fishing index values indicate that Normandy Reservoir ranks among the best fishing lakes in the Tennessee and Cumberland River valleys. In 1998, Normandy ranked above average for largemouth bass, spotted bass, white bass, bluegill and channel catfish (TVA unpublished data). The index value for walleye/sauger fell to below average, and sample sizes for smallmouth bass and crappie were too small for a reliable calculation. Tims Ford Reservoir ranked above average for white bass and walleye/sauger and below average for largemouth and smallmouth bass, striped bass, bluegill and channel catfish. Small sample sizes for spotted bass and crappie precluded index calculations in those categories.

Hunting is the most identifiable form of land-based recreational activity in this project area. The public lands just east of Columbia and around Normandy Reservoir are fairly heavily used by people hunting for deer, turkey, rabbit, squirrel, and quail. Many private lands also are used during the hunting seasons. During 1998, over 8,800 deer and 1,000 turkeys were harvested in the 5-counties within this project area (TWRA unpublished data). Maury

County ranked eighth among Tennessee counties in total deer harvested during the 1998 season, and sixth during the 1997 season (TWRA unpublished data).

Several state and county recreational facilities exist within a 30-minute drive of the Columbia area, including five county parks west of Columbia. Maury County Park and Chickasaw Trace Park are the largest and most developed. Maury County Park is a 200-acre park serving both passive and active recreation needs. The park serves open space needs as well as picnicking, equestrian, various levels of league baseball, and Maury County Football Stadium. Chickasaw Trace Park is a large county park oriented toward family picnicking, open space, and river access.

Henry Horton State Park is located along the Duck River between Columbia and Shelbyville. This 1,140-acre park provides opportunities for camping, sport fishing, canoeing, and hiking. There is also a 72-room inn, a swimming pool, a championship golf course, and the only skeet and trap range in the Tennessee State Park system.

Near Shelbyville, TVA owns a small parcel of land where Highway 82 crosses Duck River that was acquired as a possible river access area. Although this site is presently undeveloped, TVA recently has received inquiries from Bedford County about proceeding to develop this access to the river.

Recreation facilities around Normandy Reservoir include two developed public campgrounds and a variety of other facilities. Barton Springs Campground includes 65 campsites with picnic tables and fire rings, three bathhouses with heated showers and flush toilets, a beach, a picnic pavilion and other picnic tables, and a boat ramp with a courtesy pier. Cedar Point Public Use Area has 50 campsites with picnic tables and fire rings, two bathhouses with heated showers and flush toilets, a picnic pavilion and 14 other picnic spaces, a beach, and a boat ramp. Four additional lake access areas, each with paved parking lots and boat ramps, exist on the dam reservation and at sites on Boyd's Branch, Ward's Chapel, and Powers Bridge. On the downstream side of the Normandy Dam Reservation is a public access area with paved parking and bank fishing facilities, as well as a canoe launch area. This access area is the upstream end of a 28-mile scenic floatway on the Duck River below the dam with public access areas at six locations.

Tims Ford State Park, located on the northern shore of Tims Ford Reservoir, contains approximately 1,680 acres, 20 cabins, 50 campsites with tables, grills, and electrical and water hookups. A lakeside picnic area has 50 individual tables and grills plus two picnic shelters with fireplaces, grills and numerous tables. The park, operated by TDEC, also includes a marina which provides equipment and supplies for boating and fishing, a boat launching ramp and dock, and rental boats. A double L-shaped swimming pool features a 12-foot diving pool, children's wading pool, bathhouse and concession stand. There are five miles of paved trails for hiking and cycling. An 18-hole golf course with pro-shop and driving range is expected to open soon.

Other public facilities located on Tims Ford Reservoir include two municipal parks (Winchester City Park and Estill Springs Park), Devils Step Campground, a swimming beach, and seven public boat launching facilities. Two commercial marinas on the reservoir provide boat storage, fuel, and boating supplies. There are several informal lake access areas and numerous informal recreation use areas.

Three wildlife management areas and two state scenic river segments are located within a one-hour drive of the Columbia area. Normandy State Wildlife Management Area is an approximately 750-acre area that is managed by TWRA for hunting and fishing. Located on Normandy Reservoir along Riley Creek, this wildlife management area provides a tract of relatively undeveloped shoreline that enhances the quality of the outdoor experience for lake users. Laurel Hill and Middle Tennessee State University Wildlife Management Areas are located somewhat further away in Lawrence and Hickman counties, respectively.

Natural Areas

Several identified natural areas occur in or near this part of the Duck River watershed. These areas have been recognized and, to various degrees, are being protected because they contain unique natural resources or scenic values. The following paragraphs describe each of these natural areas and their relationships to the possible action alternatives.

The **Duck River State Mollusk Sanctuary** includes all of the mainstem Duck River upstream to Normandy Dam and continuing into the headwaters. Mollusk sanctuaries are designated and protected by TWRA to aid in the conservation of native aquatic mollusks. Various sites and reaches along the Duck River could be affected by the action alternatives.

Jackson Falls Potential National Natural Landmark is located between Delk and Baker Bluffs along the Duck River near River Mile 102. The National Natural Landmark Program, administered by the National Park Service, was established in the 1970s and is intended to identify nationally significant examples of ecologically pristine or near-pristine landscapes. The program has been mostly inactive for several years, and many potentially qualifying sites such as Jackson Falls have not been formally designated as National Landmarks. Jackson Falls is formed where Jackson Branch flows through a small gorge-like valley. This waterfall is a classic example of stream piracy, a geologic phenomenon where the headwaters of one stream (Jackson Branch) capture a portion of another stream (unnamed stream) that is in close proximity. Jackson Falls is near the area that could be affected by the Downstream Water Intake Alternative.

The **Natchez Trace Parkway,** administered by the National Park Service, includes approximately 450 miles of historic and scenic highway. This parkway was established in 1938 to commemorate the original Natchez Trace, an old trail stretching 500 miles through the wilderness from Natchez, Mississippi, to Nashville, Tennessee. The original trace followed Native American trails and was used by boatmen, traders, and explorers returning to the eastern states after sailing down the Mississippi River. Later, the trace was used as a federal postal road and for troop movements during the War of 1812. Natural, cultural, and historic resources along the Trace are managed to provide quality recreation experiences for visitors. The Natchez Trace Parkway crosses the northwest portion of the area that could be affected by the Downstream Water Intake Alternative.

Columbia Glade Natural Area provides protection for several endemic plants, including at least one federally-listed endangered plant species. Columbia Glade, which at one time probably occupied more than 1,000 acres, presently covers approximately 327 acres. This property, part of the former Columbia Project lands, is now being managed jointly by TWRA, TDEC, and TVA. Columbia Glade lies along the northwestern edge of the area that could be affected by the Fountain Creek reservoir Alternative.

Normandy Fish Hatchery is a 205-acre facility managed by TWRA that is used primarily for the propagation of warmwater game fish. This facility produces fish that are stocked to support the increasingly-important sport fishing industry in Tennessee. The Normandy Fish Hatchery is located just

downstream from Normandy Dam, in an area that could be affected by the Raise Normandy Pool Level Alternative.

Short Springs State Natural Area is a 421-acre site that is managed jointly by the City of Tullahoma, Tullahoma Utilities Board, Friends of Short Springs, TDEC, and TVA. This natural area is significant from botanical, geological, and historical standpoints. An exceptional variety and abundance of wildflowers occurs on this site, including two Tennessee state-listed endangered plants. The geological features include a 60-foot high waterfall, several cascades, and numerous dripping springs and rock formations. Historically, the area has ties to many of the pioneering families of the region. Especially appreciated for its abundance of spring wildflowers, this natural area receives heavy year-round use by outdoor enthusiasts. Part of the Short Springs Natural Area lies along the existing shoreline on Normandy Reservoir, within the area that could be affected by the Raise Normandy Pool Level Alternative.

Old Stone Fort State Archaeological Area is a 2,000-year-old Native American site. The mounds and walls that were built on high ground where the Duck and Little Duck rivers flow together form an enclosure that measures 1.25 miles around. This site is believed to have been used as a ceremonial gathering place over a period of at least 500 years. The present State Archaeological Area, managed by TDEC, includes a 50-site campground, picnic area, visitor center, and a 9-hole golf course. The Old Stone Fork area harbors a diversity of topography, soils, plants, and animals and is a potential National Natural Landmark (see Jackson Falls area description, above). Old Stone Fort State Archaeological Area includes land just upstream from Normandy Reservoir and probably would not be affected by the Raise Normandy Pool Level Alternative.

Arnold Engineering and Development Center (AEDC) includes 39,000 acres of rich and diverse terrestrial and aquatic habitats. Approximately 88 percent of AEDC is largely undeveloped and provides habitat for at least 68 protected or rare plant and animal species. In addition, AEDC includes **Woods State Wildlife Management Area** which is managed by TWRA for large and small game and waterfowl hunting. Several federal, state, and private conservation organizations are working together to implement an ecosystem management plan for most of the AEDC lands. This area is located approximately four miles southeast of Normandy Reservoir, outside of the area that could be affected by either the Raise Normandy Pool Level or the Tims Ford Pipeline alternatives.

4.12 CULTURAL RESOURCES

The physical cultural resources of an area include archaeological sites, historic structures, and sites where historic events took place but where no remains of the event are still present. A great deal of cultural research has been conducted in this project area, in part associated with the completion of Normandy Reservoir and in preparation for the construction of Columbia Reservoir. Surveys and excavations in this region have identified a large number of cultural sites and have confirmed human existence in the area from the earliest known Native Americans through the present.

Archaeological Resources

Archaeological time periods are identified based on differences in the styles of the artifacts that remain and changes in housing and land use patterns that are thought to have taken place. In the Central Basin, cultural history is generally divided into four broad time periods: Paleo-Indian, Archaic, Woodland, and Mississippian. The Paleo-Indian period (12,000-8,000 B.C.) represents the first documented human occupation, a time when the area was dominated by highly mobile bands of hunter/gatherers. In the Archaic Period (8,000-1,000 B.C.), people lived at dispersed campsites in the uplands during the fall and winter but started to stay along streams during the spring and summer where they gathered food from the water and bottomlands, and began to take care of some types of useful plants. During the Woodland Period (1000 B.C.-A.D. 900), the people in this region lived in clusters of more permanent dwellings (typically located on the floodplains), made and used pottery, and began to rely on plants they grew. When Europeans first encountered Native Americans in this area, the end of the Mississippian Period (A.D. 900-1600), they saw organized societies that farmed corn and other crops while living in permanent settlements (typically located just above the floodplains).

The first Europeans started living in the Duck River Valley in the late 18th century and settled there in increasing numbers during the first half of the 19th century. Rather quickly, agriculture became an important part of the local economy, with cotton and tobacco the most important crops before the Civil War; however, grain and livestock replaced cotton in the late 19th century (Lightfoot, 1998). Mill sites located along the Duck River are associated with the increasing importance of grain crops.

During the Civil War, numerous skirmishes occurred in the upper Duck River watershed area but no major battles were fought there. Prior to and

immediately following the Civil War, African-Americans accounted for almost 50 percent of the population of Maury and surrounding counties (Jolley and Newman, 1982). In the late 19th and early 20th centuries, the African-American population in the area declined as people left for higher paying jobs in cities and to the north.

The Tennessee Division of Archaeology collects information from surveys and maintains files on archaeological sites all across Tennessee. These files indicate that 1,092 archaeological sites have been identified in the four counties involved in this project (Table 18). The relatively large number of sites reported from Maury and Coffee counties probably reflects the extensive amount of archaeological research conducted in those counties as parts of the Normandy and Columbia reservoir projects.

Table 18. Known prehistoric, historic, or multi-component sites in Tennessee counties that could be affected by one or more of the action alternatives. Entries in the table may not add up to the totals given for each county because of uncertainties about what exists at each site.

Time Periods	Maury County	Bedford County	Coffee County	Moore County
Paleo-Indian	30	2	19	5
Archaic	476	61	443	27
Woodland	294	44	239	22
Mississippian	27	2	4	2
Historic	61	34	29	1
Total Number of Sites	560	217	278	37

Historic Structures

Historic structures include standing buildings and other structures (such as bridges and dams) that are more than 50 years old and have significant historical associations. Systematic surveys of potential historic structures have been conducted in Maury, Bedford, and Moore counties (Steve Rogers, Tennessee Historical Commission, personal communication 1999). In 1987, a total of 3,133 historic structures was recorded in Maury County. A total of 690 historic structures has been recorded in Bedford County. Results of a 1979

survey in Moore County conducted by Middle Tennessee State University included 201 historic structures. No systematic survey of Coffee County has been undertaken; however, at least 15 historic structures are known to occur there.

Each of the four action alternatives would occur only in small parts of the general area covered by this evaluation. The following paragraphs focus on what is known about cultural resources in these specific areas.

Fountain Creek Reservoir Area

Most of the archaeological survey and testing work that was done as part of the Columbia Reservoir project in the 1970s and 1980s focused on the mainstem of the Duck River. In the Fountain Creek watershed, 68 prehistoric archaeological sites were found on 240 acres, approximately 15 percent of the total area (Dickson, 1976; Evans, 1972). Two historic structures on or eligible for listing on the National Register of Historic Places (the Giles Harris House and the lime kiln on Silver Creek) also are located in the part of the Fountain Creek watershed acquired to be part of Columbia Reservoir (Jolley and Newman, 1982). While this work might have identified the most important cultural sites in the watershed, the remainder of any area affected by this alternative would have to be surveyed to know the full extent of the archaeological and historical resources that are present.

Downstream Water Intake Area

No systematic survey of this potential project area has been conducted, in part because no specific intake site and no specific pipeline route have been identified. A large number of archaeological sites and historical structures are known to occur in Maury County, some of which are likely to occur along the Duck River and State Route 50. The specific area affected by this alternative would have to be surveyed to know the full extent of the archaeological and historical resources that are present.

Normandy Reservoir Area

Before Normandy Reservoir was completed, the University of Tennessee identified the archaeological and historical sites in the area (Faulkner and McCollough, 1973) and excavated sites that contained important archaeological resources (Faulkner and McCollough, 1977: 1978; and 1982). All of the structures that occurred on Normandy Project land were removed before the reservoir was filled. However, during a recent survey of 10 miles of Normandy Reservoir shoreline, 11 archaeological sites were found on relatively flat lands

in tributary hollows (John Cable, 1999, personal communication). The recent information suggests that some additional archaeological resources could occur in the area that would be affected by this alternative.

Tims Ford Pipeline Area

No systematic survey of this potential project area has been conducted, in part because no specific intake site and no specific pipeline route have been identified. Limited archaeological research was conducted in the area before Tims Ford Reservoir was completed (Faulkner, 1968). Additional archaeological surveys have been conducted as part of the TVA Shoreline Management Initiative and prior to development around the reservoir. In all, approximately 118 archaeological and historical sites have been recorded within the immediate Tims Ford Reservoir area. Twelve of these sites are located on the Hurricane Creek embayment and three are located on the Lost Creek embayment. A recent survey of approximately one-third of the TVA property on Lost Creek above the reservoir pool did not identify any additional prehistoric archaeological resources (DuVall, 1998). Away from Tims Ford Reservoir, the pipeline would likely have to cross several small streams and the Duck River floodplain. Flat areas along these streams are likely to have been suitable sites for prehistoric settlements. The specific area affected by this alternative would have to be surveyed to know the full extent of the archaeological and historical resources that are present.

4.13 SOCIOECONOMICS

The purpose of this project is to provide additional water to meet the future needs of the Maury/southern Williamson County Water Service Area. This Water Service Area includes virtually all of Maury County and the adjacent part of southern Williamson County (Figure 1). These two counties lie south of Davidson County (Nashville), and west to southwest of Rutherford County (Murfreesboro). Interstate 65 runs north and south through the eastern part of both Williamson and Maury counties. Interstate 840, now under construction, will pass through the southern part of Williamson County near the Maury County line and connect to Interstate 40 both east and west of Nashville. Interstate 840, which is now open from Interstate 40 east of Nashville to Interstate 24 near Murfreesboro, eventually will serve as a southern bypass for Nashville and provide much easier access east and west from the Columbia area. Given these various associations, an appropriate labor market area for this project would include both Maury and Williamson counties and all of the

counties adjacent to each of them. The nine counties in this Maury/southern Williamson County Labor Market Area are listed in Table 19.

According to the latest estimates prepared by the Bureau of the Census, the population of Maury County was 69,633 in 1998 (Table 19). If confirmed during the 2000 Census, this would amount to a 27 percent increase over the population counted in 1990. The 1998 population estimate for Williamson County (117,569) indicates that county grew even faster, experiencing a 45.1 percent increase since 1990. Rutherford County is the other county in the Maury/southern Williamson County Labor Market Area that added tremendously to its population, with an estimated increase of 40.0 percent since 1990. Overall, the state of Tennessee is estimated to have grown by 11.3 percent since 1990, while the national population increased by 8.7 percent. During the period from 1980 to 1990, the population in Maury County grew at a rate of 7.3 percent, while Williamson County grew at a rate of 39.4 percent. Growth in both counties was faster than Tennessee as a whole and the rate in Williamson County was much faster than the national average.

In 1997, the average income in Maury County ($19,304) was about 85 percent of the state average and 76 percent of the national average (Table 20). The average income in Williamson County was substantially higher ($33,760), at 149 percent of the state average and 134 percent of the national average. High average incomes in both Williamson and Davidson Counties raise the overall Maury/southern Williamson County Labor Market Area value above the state and national averages. During the period from 1979 to 1997, per capita income in Williamson County and the whole labor market area grew faster than in the state or the nation, while income in Maury County grew more slowly than both the state and national averages.

Table 19. Population statistics for counties in the Maury/southern Williamson County Labor Market Area . Data from U. S. Department of Commerce, Bureau of the Census

Counties in Labor Market Area:	1980	1990	1998	Percent Change 1980-90	Percent Change 1990-98
Davidson	477,811	510,786	533,967	6.9	4.5
Giles	24,625	25,741	28,925	4.5	12.4
Hickman	15,151	16,754	20,553	10.6	22.7
Lawrence	34,110	35,303	39,358	3.5	11.5
Lewis	9,700	9,247	10,868	- 4.7	17.5
Marshall	19,698	21,539	26,302	9.3	22.1
Maury	**51,095**	**54,812**	**69,633**	**7.3**	**27.0**
Rutherford	84,058	118,570	166,035	41.1	40.0
Williamson	**58,108**	**81,021**	**117,569**	**39.4**	**45.1**
Totals: Labor Market Areal	774,356	873,773	1,013,210	12.8	16.0
Tennessee	4,591,023	4,877,203	5,430,621	6.2	11.3
United States (X 1,000)	226,542	248,765	270,299	9.8	8.7

Table 20. Per Capita Personal Income (in 1997 dollars) for counties in the Maury/southern Williamson County Labor Market Area. Data from U. S. Department of Commerce, Bureau of Economic Analysis

Counties in Labor Market Area:	1979	1997	Percent Change 1979-1997
Davidson	19,870	30,723	54.6
Giles	15,849	19,526	23.2
Hickman	13,415	16,400	22.3
Lawrence	15,239	18,207	19.5
Lewis	10,366	14,627	41.1
Marshall	16,191	20,405	26.0
Maury	**16,399**	**19,304**	**17.7**
Rutherford	16,238	22,762	40.2
Williamson	**22,242**	**33,760**	**51.8**
Totals: Labor Market Area	18,753	27,472	46.5
Tennessee	16,508	22,699	37.5
United States (X 1,000)	20,158	25,288	25.4

The dominant sector of the economy in Maury County is manufacturing, primarily the automobile industry (Table 21). This dominance is particularly apparent with respect to income, where manufacturing accounts for 51.9 percent of the earnings total. The service, retail trade, and governmental sectors also account for important parts of the economy in Maury County.

In contrast, the economy of Williamson County is much more oriented toward the service sector, which accounts for 33.1 percent of employment and 36.6 percent of earnings in the county. Other important sectors in Williamson County include the financial and retail trade sectors.

Table 21. Employment and Earnings by Place of Work in Maury and Williamson counties, Tennessee in 1997. Data from U. S. Department of Commerce, Bureau of Economic Analysis

	Employment		**Earnings**	
Place of Work	Maury (Percent)	Williamson (Percent)	Maury (Percent)	Williamson (Percent)
Agriculture, Forestry, and Fishing	2,114 (5.0)	3,123 (4.6)	1,511 (0.1)	22,153 (1.1)
Mining	68 (0.2)	159 (0.2)	2,121 (0.1)	5,526 (0.3)
Construction	2,076 (4.9)	5,026 (7.3)	65,455 (4.6)	189,304 (9.3)
Manufacturing	11,733 (28.0)	5,645 (8.3)	735,529 (51.9)	186,912 (9.1)
Transportation and Public Utilities	1,595 (3.8)	1,873 (2.7)	65,064 (4.6)	95,543 (4.7)
Wholesale Trade	1,242 (3.0)	2,111 (3.1)	39,680 (2.8)	111,467 (5.4)
Retail Trade	5,897 (14.1)	11,625 (17.0)	91,935 (6.5)	220,223 (10.8)
Finance, Insurance, Real Estate	2,621 (6.2)	10,821 (15.8)	57,537 (4.1)	312,908 (15.3)
Services	9,457 (22.5)	22,648 (33.1)	209,959 (14.8)	748,205 (36.6)
Government	5,161 (12.3)	5,392 (7.9)	148,557 (10.5)	153,484 (7.5)
Total	41,964 (100.0)	68,423 (100.0)	1,417,348 (100.0)	2,045,725 (100.0)

Some of the action alternatives would involve construction and related activities in parts of counties outside of the Maury/southern Williamson County Labor Market Area. The counties that might be affected (Bedford, Coffee, Franklin, and Moore counties) are all located in the upstream part of the Duck River watershed or in the adjacent part of the Elk River watershed. Recent estimates about population, income, and employment statistics in these counties are presented in Table 22. Per capita personal income in each of these counties is below the average in the Maury/south Williamson County Labor Market Area. County population totals range from 5,196 in Moore County to 45,767 in Coffee County. Manufacturing accounts for almost 31 percent of jobs in Bedford County while employment in the other counties is predominantly service-oriented.

Table 22. Population, income, and employment information for other counties which might be affected by one or more of the action alternatives. Data from U.S. Department of Commerce, Bureau of the Census and Bureau of Economic Analysis

Measure (date of estimate)	Bedford County	Coffee County	Franklin County	Moore County
Population (1998)	34,533	45,767	37,465	5,196
Per Capita Personal Income (1997)	$19,130	$20,388	$18,420	$16,887
Employment (1997)	18,888	31,169	15,081	2,188
Manufacturing (%)	30.7	16.6	13.6	8.0
Trade (%)	15.7	20.3	18.3	n/a
Services (%)	17.8	36.1	31.6	n/a
Government (%)	11.9	10.8	11.6	32.8
Other (%)	24.0	16.2	24.9	n/a *

* - not available

4.14 ENVIRONMENTAL JUSTICE

Environmental justice refers primarily to ensuring that no segment of the population bears a disproportionate burden of health or environmental impacts of society's activities. Some studies suggest that poor, predominantly minority, populations are exposed disproportionately to adverse health and environmental impacts because of siting decisions for facilities with potential adverse effects. Other studies dispute these findings. Because of such

concerns, Executive Order No. 12898 directed certain federal agencies and requested others to consider environmental justice in environmental reviews.

The purpose of this project is to provide additional water to meet the future needs of the Maury/southern Williamson County Water Service Area. The part of Williamson County included in the study area is located in the southern parts of the Bethesda and Boston Census Divisions, as defined by the U. S. Bureau of the Census. The Bethesda Division includes the southeastern corner of the county. The Boston Division includes the remainder of southern Williamson County, including the part of the Town of Spring Hill that is located in Williamson County (most of the town is located in Maury County).

Information available from the 1990 Bureau of the Census indicates that both Maury and Williamson counties have smaller nonwhite populations and lower poverty rates than the state of Tennessee as a whole (Table 23). This is also true of the Bethesda and Boston Census divisions. Within Williamson County, the poverty rates in the Bethesda and Boston divisions are both higher than the county as a whole. The percent of nonwhite population in the Bethesda Division is higher than in the remainder of the county or in the Boston Division.

Table 23. Population in the Maury/southern Williamson County Water Service Area by race and poverty rates in 1990. Data from U.S. Department of Commerce, Bureau of the Census, Census of Population, 1990, File STF1A and File STF3A.

	Maury County Total	Williamson County			Tennessee Total (X 1,000)
		Total	Bethesda Division	Boston Division	
Population	54,812	81,021	4,252	3,945	4,877.2
White	45,868	74,903	3,792	3,784	4,048.3
Nonwhite	8,944	6,118	460	161	828.9
Percent Nonwhite	16.3	7.6	10.8	4.1	20.5
Percent below the poverty level	13.2	5.8	12.6	7.9	15.7

Some of the action alternatives would involve construction and related activities in parts of counties outside of the Maury/southern Williamson County Labor Market Area. The counties that might be affected (Bedford,

Coffee, Franklin, and Moore counties) are all located in the upstream part of the Duck River watershed or in the adjacent part of the Elk River watershed. Information about race and poverty rates in these counties from the 1990 Census is presented in Table 24. All four of these counties have smaller nonwhite populations than the state as a whole or in Maury County. Poverty rates are similar to those in the state as a whole, except for Moore County where the poverty rate is much lower than elsewhere in Tennessee.

Table 24. Population by race and poverty rates in 1990 for other counties which might be affected by one or more of the action alternatives. Data from U.S. Department of Commerce, Bureau of the Census, Census of Population, 1990, File STF1A and File STF3A.

	Bedford County	Coffee County	Franklin County	Moore County	Tennessee (X 1,000)
Population	30,411	40,339	34,725	4,721	4,877.2
White	27,117	38,233	32,501	4,536	4,048.3
Nonwhite	3,294	2,106	2,224	185	828.9
Percent Nonwhite	10.8	5.2	6.4	3.9	20.5
Percent below the poverty level	16.0	15.2	14.4	6.5	15.7

CHAPTER 5 - ENVIRONMENT CONSEQUENCES

5.1 INTRODUCTION

This chapter discusses the potential environmental consequences which could occur if each of the water supply alternatives was pursued. The components, possible locations, and likely construction measures involved in each of these alternatives are presented in Sections 3.3 through 3.8. The four action alternatives focus on different ways of making more water available to the Maury/southern Williamson County Water Service Area.

Each section in this chapter presents an evaluation of the potential impacts on a resource area that would be likely to occur during the construction and operation of the alternatives as presented in Chapter 3 given the existing state of that resource as presented in Chapter 4. The sections in this chapter address the same topics as those described in Chapter 4 and they are presented in the same order. Within each section, any general discussion is followed by an evaluation of each alternative. These evaluations assume that no changes would have occurred in present laws, regulations, and knowledge about the status of resources in the area. All of the evaluations presented in this chapter are summarized in Section 3.9.

5.2 CLIMATE, GEOLOGY, AND SOILS

The local climate, geology, and general characteristics of the soils in and around the upper Duck River basin would not be affected by construction and operation of any of the water supply alternatives. The presence of sinkholes and cracks in the rocks near the surface and the associated effects on ground water would have to be considered when specific sites and routes were being selected for any facilities that would be built (see Section 5.3) Similarly, soils that contributed to the quality of prime farmland would have to be considered as part of any proposed changes in land use (see Section 5.10).

5.3 GROUND WATER

Sections 4.2 and 4.3 indicate that much of the area which could be affected by the various water supply alternatives is underlain by limestones and dolomites that contain some ground water. Many of the surface rock layers

also contain sinkholes and cracks through which water can move into and out of the ground. Sinkholes and water-conducting channels in the bedrock could make it easy for surface water and a variety of pollutants to get into the ground water. Construction projects involving large areas (such as building or enlarging reservoirs) or extending for some distance (such as building pipelines) could increase the connections between the surface and ground water and could lead to various types of effects. Site-specific planning for any water supply project in this area would have to include a careful evaluation of the potential for leakage into the ground, adverse effects on ground water, and the use of appropriate measures to minimize both of these potential effects. More focused comments about each of the water supply alternatives are presented in the following paragraphs.

Alternative A - Continue to Use Present Sources (No Action)

In comparison with the other options, this alternative might result in the greatest long-term impact on existing groundwater resources. If the future water demand in the Columbia area does exceed what can be withdrawn from the Duck River and no other additional source of water is developed, attempts could be made to withdraw more water from the ground.

As of 1993, ground water supplied less than 10 percent of total public water use in the area (1.66 mgd). Information collected by the USGS (USGS, 1995) suggests that groundwater supplies in or near the project area are not available to meet that much of the future demand for water. Attempts to increase groundwater withdrawals could exceed the recharge capacity of the known water-bearing rock layers and could significantly reduce the amount of available ground water, causing adverse effects to the ground water and existing groundwater users in the area.

Alternative B - Fountain Creek Reservoir

Building a reservoir on Fountain Creek could result in both construction and operational effects on groundwater resources. During the construction period, appropriate erosion and pollution control measures would be required to prevent sediment, trash, and pollutants (e.g. spilled fuel) from flowing into the ground and the ground water. Available information (USACE, 1997b) also suggests that grouting of potential routes into the ground water would be required to slow water losses from the reservoir. All wells in the footprint of the new reservoir also would have to be properly abandoned before the area was flooded.

After the reservoir was filled, the level of water in the ground would be expected to rise. While this could improve the yield of wells in the immediate area, sediment and other materials from the reservoir could degrade the quality of the existing ground water. Grouting to hold more water in the reservoir could prevent or minimize much of this effect.

Alternative C - Downstream Water Intake

Construction of a new water intake and pumping station along the Duck River near the western edge of Maury County and a new approximate 13-mile pipeline and booster station would require that careful attention be given to the presence of potential groundwater access points. Once the proposed structures were properly located and designed, appropriate construction practices could be used to avoid or minimize effects to groundwater resources in the area.

Alternative D - Raise Normandy Pool Level

Raising the height of Normandy Dam by approximately five feet could lead to potential losses of reservoir water to the ground through caves, sinkholes, and cracks in the local bedrock. Losses to the ground water could be slowed or prevented by grouting the likely routes into the ground. Any wells in the expanded reservoir area also would need to be properly abandoned before the higher water level was reached. The use of these preventative measures would minimize or avoid any adverse effects of this alternative on groundwater resources.

Alternative E - Tims Ford Pipeline

The construction of a raw water intake and pumping station along the northern side of Tims Ford Reservoir and an approximate 20-mile pipeline and a booster station to discharge water into the Duck River near Shelbyville would require that careful attention be given to the presence of potential groundwater access points. Once the proposed structures were properly located and designed, appropriate construction practices could be used to avoid or minimize effects to groundwater resources in the area.

Comparison of Alternatives

All four of the action alternatives could be designed, constructed, and operated in ways that would avoid or substantially minimize adverse effects on ground water. Alternatives C and E are likely to have the fewest potential impacts on groundwater resources because both of these projects

could be built and operated in ways that would avoid or minimize any adverse effects on sinkholes or groundwater systems. Alternative B, which would include the construction of a new reservoir, has the potential for more groundwater effects than the modifications to an existing reservoir which would occur under Alternative D. While Alternative A would not have any immediate effects on ground water, it has the potential to impact this resource the most if attempts were made to meet future water needs by withdrawing more water from the limited underground supplies.

5.4 SURFACE WATER

The information presented in Chapter 2 and Section 4.4 describes how the water in the upper Duck River basin is controlled and affected by Normandy Reservoir and the several water supply and wastewater systems that exist all along the length of the river. With that information as a background, it should not be surprising to learn that each alternative which would provide more water for the Columbia area would have some effect on the water resources and water users throughout most of the rest of the basin.

Information presented in Section 4.4 also indicates that the upper Duck River watershed consistently has relatively high levels of nitrogen, phosphorus, iron, and manganese. While all four of these elements are relatively abundant in the rocks and soils in this watershed, nitrogen and phosphorus also are being added to the water from point source discharges, agricultural practices, and other non-point sources. In a few places throughout the upper Duck River watershed, these materials and other pollutants are making the water less than fully suitable for its classified uses (Table 10). The 1996 amendments to the federal Safe Drinking Water Act require water systems to identify source water protection areas, inventory potential sources of contaminants, determine the susceptibility of the water supply to potential contamination, and develop plans to protect their sources from potential contamination. The amendments to that law also require water systems to pay more attention to the chemicals formed when chlorine reacts with natural carbon-containing compounds. These amendments to the Safe Drinking Water Act require water systems to take an active role in making sure the water they distribute is free of watershed-related contaminants that have potential to affect human health.

Three of the action alternatives would involve the construction of some length of pipeline to transfer water from one location to another. The construction of any pipeline could result in temporary adverse effects on the water quality in each stream along its route. As the pipeline is constructed adjacent to or across a stream, the work could cause temporary increases in the amount of suspended solids, sediment, and other materials in the stream. Under each of these alternatives, the location, design, and construction of the pipelines and any other related structures would include measures to avoid or minimize adverse effects on streams and water quality (see Section 3.5). Where the construction of a pipeline and other structures would have to occur in or immediately adjacent to a stream, the work would be planned to minimize the duration of the impact and, when possible, to be conducted during a typically low-flow season of the year.

The following paragraphs present specific reviews of the potential effects of each alternative on surface water resources.

Alternative A - Continue to use Present Sources (No Action)

Under this alternative, no additional source would be developed to meet the projected future water demands of the Maury/southern Williamson County Water Service Area. When required, the existing intake and treatment facilities in Columbia would be expanded or supplemented to withdraw and treat more of the water available in the river. The potential construction-related effects of these activities on surface water probably would be minor, especially if the work was done in compliance with appropriate NPDES permits. If the demand for water did exceed the amount presently allowed to be withdrawn from the Duck River, some action would have to be taken to curtail use or find additional water to meet at least critical needs. One possible way to meet future critical needs would be to request approval from TDEC to reduce the flow in the Duck River below 100 cfs during drought periods. Additional withdrawals from the river would reduce the amount of natural flow in the 6-mile reach between the Columbia Power and Water intake and the wastewater plant discharge (Figure 3). This reduction in flow would allow the water temperature to rise more than normal and the dissolved oxygen level probably would decline. If the reduced flows continued for very long and water quality did decline, impacts could occur to designated uses such as aquatic life and recreation. Over time, if the required volume of additional withdrawals from the river increased as the

need for water continued to grow in the Columbia area, adverse effects on designated uses would occur more often and would be more severe.

Alternative B - Fountain Creek Reservoir

Building a reservoir on the downstream part of Fountain Creek would meet the additional need for water in the Maury/southern Williamson County Water Service Area. The construction and operation of this reservoir also would have a variety of effects on water supply and water quality both in the reservoir area and downstream into the Duck River.

Construction of this reservoir would involve soil disturbance activities on up to 3,600 acres of land and heavy equipment activity adjacent to the streams in the affected part of the Fountain Creek watershed. During the construction period, particular attention would have to be given to the timing of clearing activities, the way earthmoving work was conducted, and how erosion control measures should be used to minimize potentially adverse impacts on water quality in Fountain Creek and the adjacent reach of the Duck River. Careful planning of the various construction stages of the project could minimize water quality impacts by isolating areas before extensive earthmoving work would be done and by rerouting the streamflow into stabilized channels instead of having equipment operate in the flowing water. If this alternative was proposed to be built, the planning leading up to the construction of a reservoir in the Fountain Creek watershed would include a detailed evaluation of ways to minimize adverse effects on the water in the streams passing through the area and the adjacent reach of the Duck River. The results of that planning effort would be reviewed by TDEC, USACE, and other agencies and, if approved, would be addressed in the NPDES permit for the construction work.

Once the reservoir was constructed and filled, the decay of vegetation left in the pool area and the oxygen demand of the flooded soil would reduce the amount of dissolved oxygen in the water during much of the first two or three years. This potential adverse effect could be minimized by removing much of the woody vegetation from the area before the reservoir was filled. That potential water quality benefit might have to be balanced against the potential benefits to aquatic life of leaving some trees in the reservoir (see Section 5.5).

In the summer, the surface water of the reservoir would be warmer and the water on the bottom would be cooler than nearby flowing streams. A water supply reservoir on Fountain Creek would experience strong thermal layering (stratification) similar to that observed in Normandy Reservoir. Reservoirs with low flows and high volumes have low flushing rates, that is the average number of times the reservoir volume is replaced each year. The estimated flushing rate for a Fountain Creek reservoir would be 2.6 times per year while the flushing rate for Normandy is 2.8 times per year. Thus, water quality conditions associated with thermal stratification would be similar for both reservoirs, with conditions in a Fountain Creek reservoir possibly being more severe because of the slower flushing rate. The amount of oxygen in the lower layers of the reservoir probably would begin to drop in early May and there would likely be no oxygen present below a depth of about 15 feet from June to some time in October, when all of the water in the reservoir would mix once again.

Chemical changes associated with the absence of dissolved oxygen on the bottom would cause iron and manganese to become dissolved in the deeper water of the reservoir. There is sufficient iron and manganese in the inflow to the reservoir (0.2 mg/L and 0.095 mg/L, respectively - See Appendix A) to produce high levels in the deeper water during thermal stratification. High levels of dissolved iron and manganese in finished (tap) water can stain laundry and plumbing fixtures. If the water system had to withdraw water from the lower depths of a Fountain Creek reservoir, additional treatment processes would be required to remove iron and manganese from the finished water.

Throughout the life of a reservoir, the amounts of nitrogen, phosphorus, and other nutrients in the water serve to control how much algae are present. Excessive algal growth can cause wide daily variations in pH and dissolved oxygen levels in the upper layers of a reservoir, contribute to oxygen depletion in the deeper water, produce taste and odor in water supplies, and lead to the use of alternative disinfection methods to avoid undesirable reactions of natural carbon-containing substances with chlorine (commonly used in water treatment processes). Information presented in Section 4.4 indicates that the Fountain Creek watershed contains relatively high levels of nitrogen and phosphorus from natural sources, as well as non-point sources. These nutrient levels would be quite likely to support excessive algal growth in the upper layers of the reservoir.

The combination of excessive algal growth in the upper layers of the water and high concentrations of dissolved iron and manganese in the water near the bottom would make it important for the water system to be able to withdraw water from a variety of depths. The construction and use of a multi-level intake structure in the deepest part of the reservoir would make it possible for the water system to withdraw the best quality water that was available and minimize this potential adverse effect. The multiple levels in the intake structure also would have to be used as the reservoir was drawn down during the drier months of normal years and, especially, during drought conditions.

A Fountain Creek reservoir would be relatively small in comparison to most reservoirs in the Tennessee River system. For example, it would hold about 1/3 the volume of water as Normandy Reservoir, also one of the smaller reservoirs in the system. Because of its relatively small volume, the water would be very susceptible to contamination from pollution sources. Recent amendments to the Safe Drinking Water Act would require a water system withdrawing from a Fountain Creek reservoir to prepare a source water assessment and to protect the water source from potential contaminants. On a reservoir the size of Fountain Creek, source water protection actions might need to include reducing agricultural and other types of non-point source pollution in the watershed, restricting recreational uses which could cause contamination of the water, and controlling activities on the land around the reservoir to prevent the introduction of more contaminants such as nutrients and bacteria. The potential for contaminant effects on the water supply and the ramifications of various ways to avoid those effects would have to be important parts of a more detailed evaluation of this alternative if it was proposed to be built.

The dam probably would have to provide a continuous release of at least five cfs of water to maintain water quality and support aquatic life in the downstream reach of Fountain Creek. That amount of minimum release, which would be approximately three times the natural 7-day, 10-year minimum flow in Fountain Creek, could improve water quality in the downstream part of the creek. Careful planning about the amount and quality of this water would be important to avoid adverse effects on aquatic life in the tailwater of this dam and in the adjacent reach of the Duck River.

If this alternative resulted in a net increase in the amount of water in the Duck River at Columbia, it would have a positive effect on water quality in the river. If, for example, all of the future water demand of the Columbia area were to be met from the Fountain Creek reservoir, there could be at least 43 cfs of additional flow in the river as it passed through town (Figure 5). The additional flow would help maintain acceptable water quality conditions for fish and aquatic life and recreational uses downstream from the existing water intake, as well as provide more initial dilution for the discharge from the Columbia wastewater treatment plant. This increase in initial dilution also would help maintain reasonable wastewater treatment costs for Columbia.

In summary, construction and use of a Fountain Creek water supply reservoir would create a relatively small, nutrient-rich reservoir which probably would have to be carefully monitored and the watershed strictly managed to protect the quality of the source water. Water suitable for domestic use could be withdrawn from this reservoir if a multi-level intake structure was built and used to select the best water available from the various layers in the reservoir. This reservoir would not have any adverse construction or operational effects on water quality in the downstream reach of Fountain Creek or the adjacent reach of the Duck River if appropriate erosion and pollution measures were taken while the project was being built and if water for the minimum release was drawn from appropriate layers in the reservoir pool.

Alternative C - Downstream Water Intake

Construction of a new water intake and pumping station on the Duck River downstream from the mouths of Big Bigby and Catheys creeks and an approximate 13-mile pipeline and booster station to transport water to a new treatment plant and the existing distribution system could affect surface water quality in the Duck River adjacent to the intake site and in the various other streams that would be crossed by the pipeline. If these structures were built as described in Section 3.4, the construction effects on surface water would be only minor and temporary.

If this downstream intake was built, future water demands above the likely maximum capacity of the existing water treatment plant (30.8 cfs) would be met using water withdrawn at the downstream site. At that site, Big Bigby Creek, Catheys Creek, and other tributaries would have added at least 11

cfs of additional flow to the river, in addition to the water that would be returned to the system from the Columbia and Spring Hill wastewater treatment plants (Figure 7). The likely location of this intake is more than 25 river miles downstream from the Columbia wastewater treatment plant discharge (Duck River Mile 127.2) and at least 20 miles downstream from the industrial wastewater discharge on Big Bigby Creek (Creek Mile 15). At present, these well-treated effluents make up about 6 percent of the minimum flow near River Mile 100. The percentage from the Columbia wastewater treatment plant is projected to increase to 15 percent of the minimum flow by the year 2050. The Duck River near River Mile 100 presently meets all applicable water quality criteria and is classified for domestic water supply use. Previous water quality studies on the Duck River indicate that, even during low flow conditions, the wastewater from Columbia is completely assimilated in the 2.5 days it takes to reach Duck River Mile 116.0 (TVA, 1986).

Leaving additional water in the Duck River between the existing Columbia intake and the wastewater discharge would improve water quality conditions in that part of the river. Water quality in the river reach downstream from the wastewater discharge would be especially benefited by having more water available for initial dilution of the treated effluent.

Alternative D - Raise Normandy Pool Level

Increasing the amount of water that could be stored in Normandy Reservoir would require the dam and a variety of other structures on the reservoir to be raised by that same height. Construction activities associated with, or required by, raising the dam include adding a large volume of earth fill and riprap on the dam, rebuilding the roadway at the dam, raising the Riley Creek Road bridge and approaches, and raising or replacing a variety of roads, structures, and other facilities at existing recreation areas. The use of best management practices would be required at each of these construction sites to control runoff and prevent soil erosion which could adversely affect water quality in the reservoir or the tailwater.

Raising the level of the Normandy pool also would affect the immediate shoreline of the reservoir which, now, is typically covered with trees and woody vegetation. Virtually all of the vegetation would be cleared within the band of present shoreline that would become part of the higher reservoir pool. If the clearing of this area was conducted in ways that would

minimize erosion and sedimentation effects on the reservoir, it would minimize the potential for impacts on surface water quality. This would include making appropriate decisions about what to do with the cleared debris, taking into account its potential to increase nutrients and oxygen demand if some or all of that material was placed in the reservoir.

If the Normandy pool level was raised and an additional 16 cfs of water was discharged from the dam during the summer months, water quality conditions in the reservoir and the tailwater would change but, perhaps, only slightly. The larger discharge from the dam would tend to increase the flushing rate and reduce the volume of the cooler water in the lower layers of the reservoir. In the tailwater, the additional flow would not change water quality conditions near the dam; however, the cooler water from the dam discharge would affect a slightly longer reach of the river. Under extremely dry conditions, all of the cooler, low dissolved oxygen water in the bottom layer of the reservoir might be discharged, which would result in higher temperatures and other water quality changes in the tailwater. Further downstream from Normandy Dam, the additional 16 cfs of minimum summer flow in the river would provide some water quality benefit to the Shelbyville wastewater discharge (at River Mile 221.3) by providing more initial dilution for the treated wastewater. If this alternative is proposed to be built, detailed modeling studies of the proposed operating conditions might be required to determine how much water quality in the reservoir and the dam tailwater could change during typical and extremely wet or dry years.

At present, Normandy Reservoir is the most important water supply source in the upper Duck River watershed. If this alternative is proposed to be built and Normandy Reservoir is to provide more of the water used in this region, the protection of water quality in the reservoir would have to become a priority for each of the water systems it serves. Under the 1996 amendments to the Safe Drinking Water Act, each of the downstream water systems should take an active role in a source water assessment program for Normandy Reservoir. Such a program could help prevent impacts caused by agricultural non-point sources, residential shoreline development, other forms of urban or industrial development, and any other potential threats to water quality. In addition, the downstream water systems should exert leadership to improve and protect water quality in the Duck River from bacterial contamination, agricultural non-point sources, or

other potential impacts that exist in Bedford County, Marshall County, and the upstream part of Maury County.

Alternative E - Tims Ford Pipeline

This alternative could affect surface water quality during the construction of the intake, pump stations, and discharge structure; during the construction of the pipeline; and when this facility was moving water from Tims Ford Reservoir to the Duck River. The use of appropriate erosion and pollution prevention measures described in Section 3.4 would reduce the potential construction impacts to short-term and minor effects on water quality.

Water quality in both the Lost Creek and Hurricane Creek embayments would be suitable for water supply use. Neither Hurricane Creek or Lost Creek is presently classified for domestic water supply use; however, the Tennessee Water Quality Control Board could be petitioned to add that use to the classification for both of these streams. Operators of the Jack Daniel Distillery/Lynchburg joint water intake on the Lost Creek embayment report mostly favorable water quality conditions except during short time periods in the spring and late fall as a result of thermal stratification. Like Normandy Reservoir, Tims Ford Reservoir experiences strong thermal stratification, and the two embayments would become thermally stratified from May into October each year. To avoid potential problems associated with thermal stratification, the new intake would have to be able to withdraw water from various depths in the water column. No quality characteristics of the water in Tims Ford Reservoir would be incompatible with water quality in the Duck River.

If this transfer system was built, water probably would be withdrawn from Tims Ford Reservoir only during extreme dry periods which, in the upper Duck River watershed, typically occur in July through part of October. The results of initial modeling studies conducted by TVA indicate that if a water intake had been withdrawing 22 cfs from Tims Ford Reservoir during the severe drought which occurred in the region in 1987-1988, the water elevation in Tims Ford Reservoir would have been lowered 7 to 8 inches by the end of October each year. In future years, part of this estimated reduction in the Tims Ford elevation could be offset by an increase in the volume of water now discharged into the reservoir from the Tullahoma wastewater treatment plant. Tullahoma purchases water from the Duck River Utility Commission which withdraws water from Normandy Reservoir.

Tullahoma discharges treated wastewater into Rock Creek, a tributary to the Elk River which drains into Tims Ford Reservoir (at Elk River Mile 161.8). If Tullahoma grows and expands its wastewater collection system as anticipated, the additional wastewater discharged into Rock Creek could offset some of the reduction in the Tims Ford Reservoir elevation associated with this proposed withdrawal. If this alternative was proposed to be built, updated modeling studies should be conducted to confirm the possible effects on the elevation in Tims Ford Reservoir.

In the Duck River, the water from Tims Ford Reservoir would augment the existing flow only during extreme drought conditions (Figure 11). If this water was discharged upstream from Shelbyville, it would provide some water quality benefit to the Shelbyville wastewater discharge (at River Mile 221.3) by providing more initial dilution for the treated wastewater.

As indicated under Alternative D, the protection of water supply sources would have to become a priority for each of the water systems in this part of the basin. Under the 1996 amendments to the Safe Drinking Water Act, each of the downstream water systems would need to assure that each of its sources (in this case including Tims Ford Reservoir) was protected from agricultural non-point sources, residential shoreline development, other forms of urban or industrial development, and any other potential threats to water quality. In addition, the downstream water systems should exert leadership to improve and protect water quality in the Duck River from bacterial contamination, agricultural non-point sources, or other potential impacts that exist in Coffee, Bedford, Marshall, and Maury counties.

Comparison of Alternatives

The information about the potential effects that could occur if each alternative was proposed to be built also can be used to compare them. The construction of either Alternative C (Downstream Water Intake) or Alternative E (Tims Ford Pipeline) would have less potential for adverse impacts because both of these alternatives would result in only short-term and localized effects on surface water quality. Raising the Normandy Pool Level (Alternative D) would have more potential for construction impacts on surface water quality because of the larger scope of disturbance activities at the dam, along roadways, at a variety of recreation areas, and associated with clearing and inundating part of the existing shoreline. The construction of a new reservoir on Fountain Creek (Alternative B) would

involve the most disturbance of the land; would convert a free-flowing stream into a shallow, nutrient-rich reservoir; and would result in the most impacts on surface water quality of any of the action alternatives.

Even at the end of the planning period (around 2050), operation of all of the action alternatives would increase the minimum flow and, probably, improve water quality conditions in various lengths of the Duck River beyond what it would be under the No Action Alternative (Alternative A). Releasing more water from Normandy Dam (Alternative D) or moving water into the Duck River from Tims Ford Reservoir (Alternative E) would increase the flow by between 16 and 22 cfs along at least 85 miles of the river upstream from the Columbia water intake. Alternative E would maintain at least 100 cfs of flow in the river downstream from the water intake. Meeting all of the water needs of the Columbia area from a new reservoir in the Fountain Creek watershed (Alternative B) would result in a minimum flow of 137 cfs in the river from the existing Columbia water intake downstream to the wastewater discharge. Alternative B also would provide sufficient flows to meet water quality needs at both the Columbia water intake and wastewater discharge sites. Withdrawing some water at a downstream location (Alternative C) would involve the least modification in river flows but would allow at least 110 cfs of water to be left in the river downstream from the Columbia water intake.

Deciding to follow Alternative A (No Action) would not result in any construction-related impacts on surface water quality because no facilities would be built to provide an additional water source for the Columbia area. If the demand for water did exceed the amount presently allowed to be withdrawn from the Duck River, whatever action was taken to meet the future needs could result in some adverse effects on surface water quality.

5.5 AQUATIC LIFE

The information presented in Section 4.5 indicates that the streams and reservoirs in this project area support many types of aquatic life, as many as 436 species in the middle reach of the Duck River. Section 4.5 also indicates that the habitats and numbers of species vary quite a bit, ranging from small creeks and the reservoirs where relatively few species occur to the downstream and middle reaches of the Duck River where many species exist in a variety of flowing-water habitats. The different types of aquatic

habitats and diversity of aquatic life that occurs throughout this area would be affected in a variety of ways by the five water supply alternatives.

Three of the four action alternatives include the construction of some length of a pipeline to transfer water from where it was available to where it would be used. As indicated in Section 3.4, specific techniques would be used during the construction of these pipelines that would avoid or minimize potential adverse impacts on streams. If the route of the pipeline was carefully located, designed, and constructed, adverse impacts to streams and aquatic life would be minimal and would occur only during short periods of time. The subsequent review of more detailed plans for any of these alternatives proposed to be built would confirm or address the anticipated low level of construction effects.

Once it was built, each action alternative would be operated to hold water somewhere or move water from one location to another so it could be used to meet a water supply need. Each of these proposed changes in water flow also would have some effect on aquatic habitats and aquatic life, both at the source and in any receiving stream. The level of effect these changes could have on aquatic life would depend on when the transfer would occur during the year, how much the flow would be changed, and whether the change would modify the temperature and other water quality conditions. Most of the time, the volume of water that would be removed or introduced would be very small in comparison with what was left or was there initially. However, when the flow in a stream was extremely low (for example, during drought conditions), the amount being withdrawn or added could have important effects on the resident aquatic life.

The following paragraphs describe the potential effects of each alternative on aquatic life. The concluding paragraph in this section presents a summary and comparison of these potential effects.

Alternative A - Continue to use Present Sources (No Action)

If this alternative was followed, no additional source of water would be developed to meet the projected future needs of the Columbia area. Initially, this alternative would not have any effect on aquatic life because no structures would be built. Existing water quality and habitat conditions in the streams within this project area would not be changed from the way they are now. However, if the projected increased demand for water in the

Columbia area did occur at some time in the future, action would have to be taken to meet at least the critical needs for water. The most accessible way to meet a critical water need probably would be to withdraw more water from the Duck River than is presently allowed to be removed. As described in Section 5.4, the additional withdrawals from the Duck River could reduce the rate of flow in the six-mile reach between the intake and wastewater discharge (Figure 3), probably allow the water temperature to rise more than normal in that reach, and cause the dissolved oxygen level to drop. These water quality effects would stress aquatic life in the area and, under very low flow conditions, could result in fish kills and other losses in the aquatic life. These impacts could be minimized or avoided by finding other water sources to meet the future needs of the Columbia area.

Alternative B - Fountain Creek Reservoir

Construction of a reservoir in the Fountain Creek watershed would involve considerable modification of the aquatic habitat in the project area. Actual construction of the reservoir would require extensive modification of the land adjacent to the streams. These construction effects would allow more sunlight to raise the temperature of the water, increase the amount of sediment and nutrients in the streams, and result in the modification or destruction of the stream habitats. To minimize adverse effects on aquatic life in the reach of Fountain Creek downstream from the project area and in the adjacent reach of the Duck River, careful attention would have to be given to the timing of clearing activities, the way earthmoving work was conducted, and how erosion control measures should be used. These measures probably would become requirements included in the NPDES or other permits for the construction work.

After the reservoir was filled, the stream-dwelling aquatic life in the project area would be replaced by species capable of living in the standing-water habitats of a reservoir. More than likely, the 182+ species now living in the downstream part of the Fountain Creek watershed would be replaced with an aquatic community similar to the 44+ to 48+ species known to occur in Normandy and Tims Ford reservoirs. A reservoir on Fountain Creek would probably have an abundant plankton community, a bottom community composed of just a few types of insects and other tolerant species, and a fish community composed of a few plankton feeders and a few predatory species. Some of these species could become relatively abundant,

depending upon the nutrients available in the water and how the reservoir was managed.

If the reservoir was required to provide some minimum flow into the short reach of Fountain Creek downstream from the dam site, aquatic life in that area and in the adjacent reach of the Duck River would be affected by the temperature and quality of the water being released. If the dam release was consistently colder or warmer than it is now, if it had low dissolved oxygen levels, or if it contained large amounts of dissolved iron, manganese, or other materials not typically found now in Fountain Creek, the aquatic community would likely be different from what occurs there now. If all of the water needs of the Columbia area were met by withdrawing water from a Fountain Creek reservoir, the minimum flow in the Duck River, especially in the 6-mile reach between the present water intake and the wastewater discharge point, would be substantially higher than it would be under Alternative A (Figure 5). Aquatic life in that part of the river and in the river reach downstream from the wastewater discharge would benefit from the higher flow, increased water quality conditions, and increased dilution of the wastewater discharge (see Section 5.4). If this alternative was proposed to be built, careful planning would have to be given to the location, design, and operation of the discharge to minimize the potential for adverse effects on aquatic life in the downstream part of Fountain Creek and the adjacent reach of the Duck River. The results of this effort also probably would become a requirement included in the TDEC Aquatic Resource Alteration Permit for this project.

Alternative C - Downstream Water Intake

Construction of an intake and pumping station on the Duck River somewhere near River Mile 100 and a 13-mile pipeline and booster station from the intake site to somewhere in the Columbia area could have adverse impacts on aquatic life in the river and in each of the tributary streams that would be affected. However, if the intake facilities and pipeline route were located appropriately and the construction techniques described in Section 3.4 were followed, this alternative could be built with only minor and short-term effects on aquatic life. The subsequent review of detailed plans for this project would confirm or address the minimal construction effects on aquatic life that are likely to occur.

The withdrawal of as much as 31 cfs of water from the Duck River downstream from the mouths of Big Bigby and Catheys creeks would not have an adverse impact on aquatic life in that part of the river. As indicated in Section 3.4, the minimum flow in that reach of the river is approximately 147 cfs and, even during drought conditions, the withdrawal would amount to 21 percent of the flow. This modest reduction in the minimum flow (down to 116 cfs), would not be likely to change the characteristics of any habitats in the river or cause adverse effects on aquatic life.

Aquatic life living in the 30-mile reach of the Duck River between the Columbia water intake and the mouth of Catheys Creek could benefit if this intake and other area water-related facilities were used appropriately. Water withdrawn near Duck River Mile 100 would make it possible for at least 100 cfs of flow to be left in the river between the existing intake at River Mile 133 and the wastewater treatment plant at River Mile 127 (Figure 7). This amount of flow would help aquatic life process the nutrients in the wastewater discharge more quickly than would occur under Alternative A (No Action).

Alternative D - Raise Normandy Pool Level

Modifying the height of Normandy Dam, raising the pool level in Normandy Reservoir, and increasing the minimum flow in the tailwater could have a variety of effects on aquatic life, both in the reservoir and downstream in the river. The general nature of most of these effects can be predicted based on the description of this alternative presented in Section 3.5; however, these generalities should be confirmed or amended as part of the subsequent evaluation of a more detailed plan if this alternative is proposed to be built.

Construction effects on aquatic life likely to be associated with this alternative include temporary habitat disruptions and sedimentation effects that could occur during almost any project. In this case, the construction impacts could occur when the dam was modified, when roads and bridges were being raised, when recreation facilities were being modified or relocated, and when the shoreline vegetation was being removed in preparation to be flooded. Adverse impacts to aquatic life in the tailwater and the reservoir could be avoided or minimized with the use of appropriate measures to control erosion and sedimentation.

Raising the elevation of Normandy Reservoir could have a variety of effects on the aquatic life living in the reservoir pool. Some of the potential effects on aquatic life would be caused by changes in the operational plan dictating how water would be held and discharged. The range of possible changes in the flushing rate and the amount of cooler, low dissolved oxygen water in the lower layers of the reservoir are discussed in Section 5.4. Any substantial change in water quality conditions in the reservoir would affect the amount of habitat available to support fish and other aquatic life. Similarly, the suitability of the band of new shoreline habitat around the reservoir would be affected by the kinds and amount of trees and other material that would be left there when it was flooded. Raising the maximum pool level also could change the amount of shallow water habitat that would be available when different fish and other species were spawning. If this alternative was proposed to be built, the subsequent review would include a careful evaluation of changes in the operational plan for the reservoir and the effects those changes would have on water quality, aquatic habitats, and aquatic life in the reservoir pool.

Increasing the minimum flow in the discharge from Normandy Dam would benefit aquatic life in the Duck River downstream from this dam. In the first few miles downstream from the dam, the minimum flow determines how much bottom habitat is always available for use by aquatic life. Further downstream, the minimum flow from the dam continues to provide some stability in the amount of bottom habitat, especially during drought conditions. If the minimum flow was increased, more habitat would be available and more aquatic life could live there. One possible negative effect of maintaining a higher minimum flow from Normandy Dam (described in Section 5.4) would be the possibility that all of the cooler water in the bottom layer of the reservoir could be discharged before the end of a particularly dry summer. If that occurred, coldwater conditions in the first few miles of the dam tailwater would not be maintained and aquatic life adapted to those conditions (such as rainbow trout) might not be able to survive there. If this alternative was proposed to be built, modeling studies might be required to determine how often water quality conditions in the tailwater could change enough to adversely affect resident aquatic life adapted to coldwater conditions.

Alternative E - Tims Ford Pipeline

The construction of an intake and pumping station on a northern embayment of Tims Ford Reservoir and an approximate 20-mile pipeline (with a booster station) to discharge water into the Duck River somewhere near Shelbyville could affect aquatic life adjacent to the intake site in the reservoir, in the streams along the pipeline route, and in the Duck River at the discharge location. If the pipeline route essentially followed State Highway 82 towards Shelbyville, the effects of pipeline construction could occur in part of the East Fork Mulberry Creek watershed and at several sites all along the length of the Flat Creek watershed. If the intake facilities and pipeline route were located appropriately and the construction techniques described in Section 3.4 were followed, this alternative could be built with only minor and short-term effects on aquatic life. The subsequent review of detailed plans for this project would confirm or address the minimal construction effects on aquatic life that are likely to occur. Avoiding or effectively minimizing adverse impacts on aquatic life at each potential impact site would be much more important in the Flat Creek basin because the pipeline could affect several sites in that small watershed.

An intake structure could be built in either of the two northern embayments of Tims Ford Reservoir (Hurricane Creek and Lost Creek embayments) with little or no adverse effect on aquatic life. Much of the work could be scheduled to occur when the reservoir was at winter pool, and lower elevation work probably would occur during a short-term drawdown. Aquatic life in Tims Ford Reservoir is adapted to periodic fluctuations in the water level and would not be adversely affected by this construction activity.

Construction of the discharge structure on the Duck River also could be completed without significant or long-term effects on aquatic life. The location and design of the discharge structure would have to include some consideration of river bank stability in the area where it would be built. Actual construction of the discharge structure also would have to be planned to occur during low flow conditions and to include ways to prevent erosion and sedimentation effects on aquatic life.

As indicated in Section 3.7, this water transfer system would likely be used only during severe drought conditions in the Duck River watershed and, as described in Section 5.4, would be likely to reduce the elevation in Tims

Ford Reservoir by no more than seven or eight inches. That amount of water level reduction would not have any adverse effect on aquatic life in Tims Ford Reservoir.

When this transfer system was operating, it would add approximately 22 cfs of flow to the Duck River somewhere near Shelbyville (Figure 11). This additional flow would supplement the 165 cfs of minimum flow being discharged from Normandy Dam. This new level of minimum flow during drought conditions would benefit aquatic life in the river. If this additional flow was added upstream from the Shelbyville wastewater discharge (River Mile 221), it would help aquatic life process the nutrients in the discharge more quickly. The increased minimum flow also would mean that more of the river bed would always be under water, making slightly more habitat available for aquatic life.

Comparison of Alternatives

Based on the available information about the intent and general concepts of each alternative, Alternatives C, D, or E probably could be constructed with only minimal and short-term adverse effects on aquatic life in local areas. For each of these alternatives, however, a careful review of the location, design, and proposed construction techniques associated with each component would be required to confirm that no avoidable or long-term effects on aquatic life would occur. Alternative A would not have any adverse construction effects on aquatic life because no water supply facilities would be built. The construction of a reservoir in the Fountain Creek watershed (Alternative B) would adversely affect the resident aquatic life in the project area; however, the use of appropriate erosion and pollution control measures could prevent or minimize adverse effects in the downstream reach of Fountain Creek and the adjacent reach of the Duck River.

The most significant operational adverse effects on aquatic life associated with any of these alternatives would occur under Alternative B (Fountain Creek Reservoir). The relatively large number of aquatic species now living in flowing-water habitats in part of the Fountain Creek watershed would be replaced by considerably fewer species adapted to life in the standing-water conditions in the reservoir. Species capable of living in the reservoir would become more abundant in the area because up to 2,200 acres of terrestrial habitats would be converted into standing water. Alternatives D and E

would both have the potential to affect aquatic life in an existing reservoir; however, the effect of Alternative E on aquatic life in Tims Ford Reservoir probably would be substantially less than the effect of Alternative D on aquatic life in Normandy Reservoir.

Away from the reservoirs, operational effects of the action alternatives on aquatic life probably would be beneficial because each alternative would tend to increase minimum flows in various reaches of the Duck River. Alternative B could result in substantially increased flows in the part of the river which passes through Columbia and could benefit aquatic life in that area. Alternatives D and E would result in smaller increases in flows and benefits to aquatic life in the Duck River from Normandy or the discharge point near Shelbyville downstream to the Columbia water intake. Alternative C would result in increased flows and benefits to aquatic life from the Columbia water intake downstream to near River Mile 100 and, more than likely, only insignificant decreases in the flow and no detectable adverse effects on aquatic life downstream from there.

5.6 WETLANDS

Preliminary information about the types and locations of wetlands present in areas that could be affected by the action alternatives is presented in Section 4.6. That section also describes the federal and state laws and regulations which protect wetlands: Section 404 of the Clean Water Act, Executive Order 11990 (Protection of Wetlands), and the Tennessee Water Quality Control Act of 1977.

Three of the action alternatives include the potential to affect wetlands during the construction of pipelines. The types of impacts that could occur include vegetation removal, temporary removal of soils, sedimentation, soil compaction, and alteration of drainage patterns. If a pipeline is properly sited, designed, and constructed, it should have few or no adverse impacts on wetlands. The impacts that might occur would be greatest during and immediately following construction of the pipeline. In emergent wetlands, the construction impacts would be relatively brief because the non-woody vegetation would regenerate quickly. In forested and scrub-shrub wetlands, the impacts would last longer because woody vegetation takes longer to re-establish.

All proposed wetland impacts would be subject to the requirements of state water quality regulations; a Section 404 permit issued by the USACE; and, if federal funds are involved, compliance with the wetlands Executive Order. Mitigation to offset wetland impacts might be required, depending on the amount and types of wetlands that would be affected. That mitigation would have to be completed in accordance with permit requirements after consultation with the USACE. The functions of disturbed or modified wetlands would be expected to return over time, as wetland hydrology is restored and natural revegetation and succession occur.

Alternative A - Continue to Use Present Sources (No Action)

This alternative would not have any effect on wetlands because no facilities would be built to provide additional water for the Columbia area. If the demand for water increases as expected in future years, additional withdrawals from the Duck River or whatever other alternatives are developed might eventually have some effect on wetlands.

Alternative B - Fountain Creek Reservoir

The construction of an impoundment in the Fountain Creek watershed as described in Section 3.4 would inundate approximately 200 acres of palustrine forested wetlands and approximately 25 acres of mixed palustrine forested and scrub/shrub wetlands. Once the reservoir was filled, some new wetland areas would likely develop in the area, particularly along the shorelines of embayments and in tributary bottomlands. While it is difficult to predict the types and extent of the new wetlands which would develop, it is likely they would not perform the same level of ecological function as the wetlands which would be lost. If that is true, construction and operation of this alternative would result in a net loss of wetland functions in the project area and would require mitigation as directed by the USACE and state water quality regulations administered by TDEC.

Alternative C - Downstream Water Intake

Construction of a new intake and pumping station on the Duck River and an approximately 13-mile pipeline and booster station has the potential to affect some known wetlands in the area. Proper siting, design, and construction of the facilities would substantially reduce or eliminate the potential for adverse impacts on wetlands. A review of the potential for wetlands impacts would be part of the subsequent evaluation of detailed plans for this project if this alternative is proposed to be built.

Alternative D - Raise Normandy Pool

Raising the water level in Normandy Reservoir by approximately five feet would inundate several forested wetlands that now occur at the upstream ends of some reservoir embayments. In the short term, although some of these areas could be flooded more than many wetland species can tolerate, the effect in these embayments might not result in the loss of the present communities. Small increases in water levels could expand the zone of soil saturation in some riparian and shoreline areas, particularly along embayment shorelines and tributary bottomlands. Over the long term, if these areas were wet long enough during the growing season, the wetland boundary could expand in these areas. If this alternative was proposed to be built, confirmation of this likely result on wetlands would have to be conducted as part of the subsequent evaluation of the detailed plans for the project.

Alternative E - Tims Ford Pipeline

Construction of a new intake and pumping station on Tims Ford Reservoir and an approximately 20-mile pipeline to the Duck River near Shelbyville have the potential to affect some known wetlands in the area, especially along Flat Creek. Building this alternative could have few or no adverse impacts on wetlands if the facilities are properly sited, designed, and constructed.

This alternative also would result in a slightly lower pool level within Tims Ford Reservoir during a severe drought event; however, the change would be within the normal annual and seasonal variability in lake level and is no different from the range of conditions under which the wetlands have developed in these areas. Therefore, this alternative would have little or no adverse effect on the wetlands around the margins of Tims Ford Reservoir.

Comparison of Alternatives

Four of the five alternatives (Alternatives A, C, D, and E) are likely to result in few or no adverse impacts to wetlands. Most impacts associated with these alternatives would be temporary and associated with the various aspects of pipeline construction. Construction of a reservoir on Fountain Creek (Alternative B) would displace approximately 225 acres of forested and scrub/shrub wetlands. Even assuming that new wetlands would develop around the edge of the reservoir and mitigation requirements would be met, building Alternative B is likely to result in a net loss of wetland

acreage and wetland functions. That loss would have to be mitigated as part of the project.

5.7 FLOODPLAINS/FLOOD CONTROL

As indicated in Section 4.7, Maury, Marshall, and Moore counties, and Columbia and Shelbyville participate in the National Flood Insurance Program (NFIP) and have adopted the 100-year flood as the basis for their local floodplain regulations. Bedford and Coffee counties do not participate in the NFIP. The construction of any project in the floodplain would have to comply with applicable local floodplain regulations. Under these regulations, development in the floodplain that would be subject to flood damage must be elevated so that it would be a minimum of one foot above the 100-year flood elevation at that location. Under the NFIP, any activities that would include construction in a floodplain or floodway would have to be approval by the local floodplain administrator before construction started.

As indicated in Section 1.8, any project involving federal funds also would be subject to the requirements of Executive Order 11988 (Floodplain Management). This Executive Order states that all proposed facilities must be located outside the limits of the 100-year floodplain unless an evaluation supports a determination of "no practicable alternative" to siting within the floodplain. If this determination can be made, adverse floodplain impacts would have to be minimized during design of the project.

Because water supply is the purpose of this project, each of the action alternatives is likely to involve the construction of an intake, a pipeline, or some other types of structures in the floodplain of one or more streams. There would be no practicable alternative to the construction of these types of structures in floodplains. To comply with the Executive Order, water intakes and discharges in floodplains would have to be designed and built so they would not be damaged during a flood. The pipelines also would be constructed using best management practices, revegetated where natural vegetation is removed, and the corridor would be returned to pre-construction conditions after completion of the project.

Pumping stations, water treatment plants, and other structures that might not have to be located in a floodplain would either be built outside of the

100-year floodplain or alternatives would be evaluated and documented to support a determination of "no practicable alternative" to siting them in the floodplain. If a floodplain location was selected for any part of a proposed project, items and/or equipment subject to flood damage would have to be either located above the 100-year flood elevation or floodproofed consistent with local floodplain regulations. The intent of these commitments is to make sure that any project which is constructed complies with all of the requirements of Executive Order 11988 and the National Flood Insurance Act.

The following paragraphs describe floodplain and flood control aspects of each of the water supply alternatives.

Alternative A - Continue to Use Present Sources (No Action)
This alternative would not have any effect on floodplains or flood elevations in the study area because no new water supply facilities would be constructed. Floodplains in the area would continue to be protected from, or impacted by, ongoing activities and development projects not related to water supply activities described in this EIS.

Alternative B - Fountain Creek Reservoir
Under this alternative, the construction of a new reservoir, a water intake, and most of a five-mile pipeline probably would take place within the limits of the 100-year floodplain. These structures would be constructed in ways that would minimize adverse impacts to floodplains and, specifically, would comply with requirements of the National Flood Insurance Act and, if appropriate, Executive Order 11988. Construction of the dam would increase flood elevations upstream along Fountain Creek and several of its tributaries. These new flood elevations would be determined and mapped. Land that would be located below the top of the dam or within a selected floodplain would be purchased or flood easements would be obtained to prevent flood damages on non-project lands.

Downstream from the dam, flood elevations along the short reach of Fountain Creek and part of the Duck River downstream from the mouth of Fountain Creek could be reduced because a large volume of water could be held in the reservoir. If necessary, revised 100-year flood elevations for these areas would be developed and provided to Maury County and Columbia for their use. Studies also probably would be performed to

determine the potential impacts of a failure of the new dam and to document that the project would comply with all state and local dam safety requirements.

Alternative C - Downstream Water Intake

Construction of the intake and at least parts of the 13-mile pipeline would occur in floodplains of the Duck River and other streams. If this alternative was proposed to be built, all of the project components would be located, designed, and constructed in ways that would minimize adverse impacts to floodplains and, specifically, would comply with requirements of the National Flood Insurance Act and, if appropriate, Executive Order 11988.

Alternative D - Raise Normandy Pool Level

Under this alternative, the height of Normandy Dam would be raised and additional water would be stored in the reservoir which could be released to increase the summer season minimum flow in the Duck River. If the dam was raised by five feet, the normal maximum reservoir elevation could be increased from 875 feet to 880 feet.

If this alternative was proposed to be built, studies would be performed to determine the new full-pool elevation of the reservoir and the anticipated flood elevations upstream from the dam. The results of these studies would indicate if any additional land rights would have to be obtained to control development and prevent an increase in upstream flood damages as a result of this project. These results also would indicate if existing structures around the reservoir would have to be relocated or floodproofed to remain in compliance with local regulations.

Downstream from the dam, present flood elevations might be reduced because of the larger storage volume that could be held in the reservoir. If necessary, revised 100-year flood elevations for these areas would be developed and provided to Bedford County and Shelbyville for their use. Studies also would be performed to determine the potential impacts of a failure of the modified dam and to document that the project would be consistent with all state and local dam safety requirements.

Alternative E - Tims Ford Pipeline

Under this alternative, a raw water intake and pumping station would be constructed on either of two northern arms of Tims Ford Reservoir and an

approximate 20-mile pipeline would be built to discharge water into the Duck River near Shelbyville. If this alternative was proposed to be built, all of the project components would be located, designed, and constructed in ways that would minimize adverse impacts to floodplains and, specifically, would comply with requirements of the National Flood Insurance Act and, if appropriate, Executive Order 11988.

Federal funds could not be used in constructing the pipeline and the discharge structure on the Duck River unless Bedford County decides to participate in the NFIP. The National Flood Insurance Act provides that "[n]o Federal officer or agency shall approve any financial assistance for acquisition or construction purposes" for use in a floodplain unless the community is participating in the NFIP (42 U.S.C. § 4106).

Comparison of Alternatives

Among the alternatives, Alternative A (No Action) would not have any impact on floodplains and flood control because no additional water source would be developed, at least initially. Alternatives C (Downstream Water Intake) and E (Tims Ford Pipeline) are likely to have negligible impacts on flood elevations and floodplain values. The pipelines that would be built under those alternatives would not result in adverse floodplain impacts because disturbed areas would be returned to pre-construction conditions after completion of the project. Proposing to build Alternative D (Raise Normandy Pool Level) would cause minor changes in flood elevations upstream and downstream from Normandy Dam. Alternative B (Fountain Creek Reservoir) would involve construction and operation of a new dam. Upstream flood elevations would be increased substantially and impacts on downstream flood elevations would have to be determined once the specific design of the project was available. Natural and beneficial floodplain values would be destroyed in the area covered by the reservoir pool and new floodplain areas would be created upstream of the dam.

5.8 TERRESTRIAL LIFE

Information presented in Section 4.8 indicates that a wide variety of terrestrial habitats and species occur in the areas where the water supply alternatives could be built. The most common terrestrial habitats in these areas are associated with agricultural development and other human modifications of the natural communities that once occupied these parts of

the Central Basin and Highland Rim. Remnant areas of natural habitats, including cedar glades and other unusual communities, still occur throughout this area. Under most of the alternatives, construction activities would occur on small sites and in narrow corridors and would result in only short-term and local effects on widespread and common terrestrial species. If one or more of the action alternatives was proposed to be built, the subsequent review of the detailed plans would confirm that only widespread communities would be affected or would address any potential effects to unusual natural communities.

The following paragraphs focus on the potential effects of each of the water supply alternatives.

Alternative A - Continue to use Present Sources (No Action)
This alternative would not have any effect on terrestrial life because no facilities would be built to provide additional water for the Columbia area. If the demand for water increases as expected in future years, additional withdrawals from the Duck River or whatever other alternatives are developed to meet the additional needs of the human population might eventually have some effect on terrestrial plant and animal communities.

Alternative B - Fountain Creek Reservoir
Construction of a reservoir on the downstream part of the Fountain Creek watershed would displace all of the existing terrestrial communities in the area that would be flooded. Available information suggests that the plants and animals which occur in this area are common and widespread species in middle Tennessee and would not be adversely affected by the loss of these populations. If this alternative was proposed to be built, field surveys would be conducted to confirm this determination; however, if unique communities or unusual species were found, appropriate measures would be included in the project to address any potential adverse effects to those communities or populations. In addition, planning for the project should include activities to protect and enhance natural communities and species populations on the land surrounding the reservoir. Invasive plant species management, plantings to enhance wildlife species, and long term planning to reverse forest fragmentation also should be considered as important parts of the ancillary activities associated with this project.

Alternative C - Downstream Water Intake

The construction of a water intake and pumping station along the Duck River west of Columbia and the construction of a pipeline and a booster station largely along existing highway rights-of-way are unlikely to have more than local and short-term adverse effects on terrestrial life. The plant and animal species known to occur in these areas are widespread and common throughout middle Tennessee. If this alternative was proposed to be built, field surveys would be conducted to locate any uncommon terrestrial communities or species in the impact area and, if any are found, appropriate avoidance or minimization measures would be included in the project plans.

Alternative D - Raise Normandy Dam

The vegetation and animal communities which occur around Normandy Reservoir are thought to be common and representative of that portion of Tennessee. If this alternative was proposed to be built, it is unlikely to cause more than local adverse effects on these species or their populations in the area. To confirm and support this initial determination, the actual areas that would be affected by the modification of the dam and higher pool level in the reservoir would be surveyed for the presence of caves and uncommon terrestrial plant and animal species before any construction activity begins. If important surface or cave communities or unusual populations were found, appropriate measures to avoid or minimize any adverse effects to them would be included in the project.

Alternative E - Tims Ford Pipeline

Construction of a water intake and pumping station on Tims Ford Reservoir and an associated pipeline largely along existing highway rights-of-way to discharge into the Duck River near Shelbyville are unlikely to have more than local and short-term adverse effects on terrestrial life. The plant and animal species known to occur in these areas are widespread and common throughout middle Tennessee. If this alternative was proposed to be built, field surveys would be conducted to locate any uncommon terrestrial communities or species in the impact area and, if any were found, appropriate avoidance or minimization measures would be included in the project plans. Along the southern part of this area, particular care would be given to surveying seepages and possible caves which might support unique communities or uncommon species.

Comparison of Alternatives

The available information suggests that, even though none of the five alternatives would have significant long-term effects on terrestrial plant and animal communities, some alternatives would have less effects than others. Alternative A (No Action) would not involve any effects on terrestrial life because no facilities would be built. Alternatives C (Downstream Water Intake) and E (Tims Ford Pipeline) would have only localized and short-term effects on terrestrial plant and animal populations during the construction of the pipelines and associated facilities. Alternatives D (Raise Normandy Pool Level) and B (Fountain Creek Reservoir) would involve construction activities and long-term modifications in areas around an existing reservoir or to create a new reservoir; however, less habitat modification would occur around Normandy Reservoir under Alternative D than would occur where a Fountain Creek reservoir would be built under Alternative B.

5.9 ENDANGERED AND THREATENED SPECIES

The information presented in Section 4.9 indicates that 115 species (68 plants and 47 animals) reported from the five counties in this general project area are now protected under federal and state endangered species laws. Of these 115 species, 21 (4 plants and 17 animals) are protected under the federal Endangered Species Act. A number of the protected species reported from these counties either have not been seen in this area in over 50 years or are unlikely to occur where the action alternatives could affect them. For example, among the 21 federal protected species, only 11 species (one plant, and 10 animals) are likely to occur in the possible project areas (Table 15).

Although some of the protected species reported from these counties (such as the bald eagle and the Indiana bat) can occur in a wide variety of habitats, most protected species are typically associated with specific habitat types. Information presented in Appendix C and summarized in Section 4.9 indicates that 35 of the protected species (30 percent) occur in rivers and creeks, 31 (27 percent) occur in wet meadows, creeksides, and seepage areas, 21 (18 percent) occur in bottomland and mixed hardwood forests, and 13 (11 percent) occur in cedar glades. The fact that these four broad habitat types are the most likely places to find 89 percent of the protected species reported from this five-county area is useful in evaluating the potential effects of each alternative.

The likely effects of the alternatives on all of the aquatic and terrestrial life in the project area are presented in Sections 5.5 and 5.8. The initial evaluations of possible impacts on protected species described in the following paragraphs assume that the projects would be built before any changes would have occurred in present laws, regulations, or knowledge about the status of these plants and animals. While this assumption applies to all of the sections in this chapter (see Section 5.1), its limited value is particularly important with regard to protected species. New information about the distribution and habitat requirements of protected species is continually being discovered and several species which occur in this area could be either added to or removed from the federal and state protected lists before any of the action alternatives would have to be built. Whenever one or more of the action alternatives was designed and proposed to be constructed, an up-to-date evaluation of the potential for impacts on protected species would have to be part of the more detailed environmental review of the project. If federal agencies or federal endangered or threatened species could be involved, the more-detailed, up-to-date, evaluation also would have to be reviewed by the USFWS in accordance with the Endangered Species Act.

Alternative A - Continue to use Present Sources (No Action)

If no new water source was developed for the Columbia area, there would be no effects on endangered, threatened, or other protected species. If the need for water in the Columbia area increases beyond what could be withdrawn from the adjacent part of the Duck River without degrading its other uses, the approach used to meet area needs during drought conditions could have adverse effects on any protected species living in the affected area. The potential effects that action might have on protected species would have to be evaluated and, if appropriate, reviewed by the USFWS when it was being proposed.

Alternative B - Fountain Creek Reservoir

The construction of a reservoir in part of the Fountain Creek watershed would substantially modify the existing aquatic and terrestrial habitats in the proposed reservoir pool area and on the surrounding land. At present, no endangered or threatened aquatic species are known from the stream habitats in the likely reservoir area; however, at least one federal endangered plant (leafy prairie-clover, *Dalea foliosa*) and a variety of state protected terrestrial plants and animals are known to occur in cedar glades

and other habitats on land surrounding the possible reservoir. If this alternative was proposed to be built, appropriate measures would be included in the construction plans to avoid and protect cedar glade habitats where endangered and other protected plants occur. In addition, field surveys would be conducted during appropriate seasons of the year to search for previously unknown populations of federal- or state-listed species which could be adversely affected by construction of the project.

Once the project was built, management of the reservoir and the surrounding land probably would be required to include activities to protect and enhance any federal- or state-listed endangered or threatened species in the area. Depending on water levels and land use in the area, some protected species (presently including bald eagles, gray bats, and Indiana bats) could have additional forage and roosting habitats. Habitats around the reservoir in which protected species occurred (such as cedar glades) would be protected as part of the management plan for the land. Similarly, the quality and quantify of water released from the reservoir would be controlled to avoid adverse effects on any protected species living in Fountain Creek downstream from the dam or in the adjacent reach of the Duck River. Withdrawing enough water to meet all of the water needs of the Maury/southern Williamson County Water Service Area from a Fountain Creek reservoir would result in substantially increased flows in the part of the Duck River in the Columbia area. If other aquatic habitat characteristics were suitable, protected aquatic species might become established in this area.

If this alternative was to be built, known populations of the leafy prairie-clover in the area would have to be protected and enhanced. In addition, site-specific surveys might have to be conducted to update whether other suitable habitats in the affected area support populations of endangered or threatened species. If any potential adverse effects to endangered or threatened species could occur, those potential effects would be addressed during the subsequent review of the project once it was described in more detail.

Alternative C - Downstream Water Intake

Construction of a water intake and pumping station near Duck River Mile 100 and an approximate 13-mile pipeline and booster station to connect the intake to a treatment plant and the existing water distribution system

would not be likely to have adverse effects on federal endangered or threatened species because no federal protected species are known to exist within the habitats through which this project might be built. Several state-listed species and an identified candidate for federal protection (the slabside pearlymussel, *Lexingtonia dolabelloides*) are known to exist in Maury County (see Appendix C) and could be impacted by the project if it affected habitats in which they occur.

The operation of this possible additional water intake near Duck River Mile 100 is not expected to have adverse effects on protected terrestrial plants and animals and could lead to beneficial effects on protected aquatic species. As indicated in Section 5.5, the projected withdrawal of as much as 31 cfs of water from that part of the river is unlikely to have adverse effects on aquatic life, including resident endangered or threatened species, because it would constitute no more than a 21 percent reduction in the minimum flow in the river at that location. In addition, the use of this intake could raise the minimum flow level and improve conditions for protected species in the first few miles of the river downstream from the Columbia water intake.

These initial determinations about the potential effects of this alternative on endangered and threatened species would have to be reviewed as part of the subsequent evaluation when details of the proposed project were known. Site-specific surveys might be required to determine if suitable habitats along the project route did support populations of federal- or state-listed endangered or threatened species.

Alternative D - Raise Normandy Pool Level

Construction activities associated with raising the height of Normandy Dam, raising or relocating facilities around the reservoir, and preparing part of the present reservoir shoreline to be flooded would be unlikely to have adverse effects on endangered, threatened, or other protected species. Most of the habitats that would be disturbed are unlikely to support populations of protected species. Some unusual habitats or populations of protected species might occur within or adjacent to the shoreline area that would be flooded. When specific changes were proposed for the Normandy Reservoir pool level, field surveys would be conducted during the appropriate seasons of the year to document whether any federal- or state-listed species actually could be impacted.

Operation of Normandy Reservoir at a higher maximum pool level would be unlikely to affect any protected species populations around the reservoir that were not affected by the construction work. As indicated in Section 5.5, the increased minimum flow in the Duck River downstream from the dam could result in beneficial effects on aquatic life, potentially including any protected species that were present. The potential effects of this alternative on endangered, threatened, and other protected species would have to be confirmed during the subsequent environmental evaluation of the specific plans for this project.

Alternative E - Tims Ford Pipeline

Construction of a water intake and pumping station in one of the northern embayments of Tims Ford Reservoir and an approximate 20-mile pipeline and booster station to pump water to a discharge point on the Duck River near Shelbyville would be unlikely to have adverse effects on endangered, threatened, and other protected species because no federal protected species are known to exist within the habitats through which this project might be built. Any construction-related impacts on state-listed endangered or threatened species known or likely to occur in the specific impact areas would be temporary and avoidable.

The operation of this pipeline during drought conditions is unlikely to affect protected species in and around Tims Ford Reservoir because the withdrawal is projected to have only a minimal effect on the reservoir level. As indicated in Section 5.5, the additional amount of flow in the Duck River could help prevent drought-related adverse impacts to aquatic life, including any resident protected species. If this additional flow was added upstream from the Shelbyville wastewater discharge (River Mile 221), it could make the adjacent reach of the river more suitable habitat for endangered and other protected species. These determinations about the potential effects of this alternative on protected species would have to be verified as part of the more detailed environmental review of the specific project components.

Comparison of Alternatives

Information presented in the preceding parts of this section suggests that adverse biological effects associated with building the pipelines and associated structures probably can be avoided or minimized. Effects associated with the operation of the water withdrawal or transfer systems

appear to be either minor or, in places, could be beneficial to protected aquatic species. At present, the potential for adverse effects of the alternatives seems to be related to the amount of natural habitat that would be destroyed or permanently modified.

These generalizations suggest that Alternatives C (Downstream Water Intake) and E (Tims Ford Pipeline) would be the least likely to have adverse effects on protected species because they would involve the fewest long-term changes in the terrestrial and aquatic habitats. Alternative D (Raise Normandy Pool Level) appears to have somewhat more potential for adverse effects, mostly because it would involve the flooding of additional land around Normandy Reservoir. Among the action alternatives, Alternative B (Fountain Creek Reservoir) seems to have the most potential for adverse effects on protected aquatic species because it would involve the conversion of natural terrestrial and flowing-water aquatic habitats into standing-water conditions of a reservoir. Depending on water levels and land use around this reservoir, bald eagles and endangered bats might gain some additional forage and roosting habitats.

The potential effect of Alternative A (No Action) on endangered and threatened species is difficult to compare with the action alternatives because, if the projected need for water in the Columbia area does develop, some source would have to be developed. There is no way to predict how that need would be met and what the effects of that action would be on protected species.

On September 19, 2000, TVA submitted a copy of the draft EIS to the USFWS and requested their concurrence with a determination that this programmatic evaluation of possible impacts of future water supply projects would not have any effects on federal endangered and threatened species. On December 20, 2000, the USFWS sent a letter to TVA concurring with that determination, in part because detailed, site-specific endangered and threatened species studies would have to be conducted if any of the alternatives were proposed to be built (see Appendix E).

5.10 LAND USE/PRIME FARMLAND/COMMUNITY NOISE

The present uses of the land, the occurrence of prime farmlands, and the typical community noise patterns in this project area are all described in

Section 4.10. For most of the action alternatives, a majority of the potential impacts to existing land use and noise patterns would occur during the construction of the intakes, pumping stations, and pipelines that would be involved in harvesting water and moving it to where it would be treated and used. Generally, these construction effects would be temporary disruptions in the land use and noise patterns, and these patterns would return to pre-construction conditions within a few days or weeks after the construction work was completed. Where new buildings or other surface facilities such as intakes or pumping stations would be built, small areas would be affected by long-term changes in land use and operating noise levels. In many cases, the location and design of these facilities could include ways to avoid or minimize impacts on adjacent uses.

Alternative A - Continue to use Present Sources (No Action)

If this alternative was followed, there would be no immediate impact on land use, prime farmland, or noise levels in the project area. If no additional water source was developed and the demand for water in the Columbia area did increase beyond the amount that could be withdrawn from the Duck River, industrial, commercial, and residential development would be unlikely to alter the present use patterns in the area.

Alternative B - Fountain Creek Reservoir

The construction and operation of this alternative would have the greatest impact on land use, prime farmland, and community noise patterns among the four action alternatives. As described in Section 3.4, the reservoir property (including necessary flood storage capacity) would occupy approximately 3,600 acres of land. Approximately 2,800 acres of this land already is in public ownership; however, approximately 800 acres of land now in private ownership would have to be acquired. All cemeteries within the project area would have to be relocated, and all of the homes, affected roads, and other developed structures would have to be moved or prepared for flooding. Existing uses of the land in the affected area would be converted to water supply use, including land which is now occupied by prime farmland soils. The final amount of land that would be included would be determined during the detailed planning process and would depend on the specific purposes of the project. Detailed planning toward the construction of this alternative would have to include the completion of Form AD 1006 with assistance from the U.S. Department of Agriculture's

Natural Resource Conservation Service to determine the rating associated with the prime farmland conversion that would be involved.

Construction activities associated with clearing the reservoir land and building the dam and other components of this project would generate noise that would be heard in the affected areas. This noise would be generated primarily by heavy equipment such as trucks, bulldozers, and earthmovers. It would be similar to the noise presently produced by the rock quarry and crushed stone operation along Blue Springs Road. The noise level probably would peak during the period when the reservoir was being cleared and when earth and rock were being hauled to the dam site. Along the pipeline route, noise levels would peak during the excavation and refilling of the construction trench. The noise level could be lessened by restricting construction to daylight hours and by requiring proper maintenance of engines and muffler systems. The construction noise might be annoying to some neighboring residents, but would not be hazardous to their hearing.

Once the reservoir was built, the purposes of the project would have a substantial effect on the use of adjacent land, including any prime farmland that was present, and on the noise levels that could occur. Development of the land surrounding the reservoir for residential, recreational, or commercial use could encourage the conversion of adjacent land to similar uses. Restrictions on the use of land within the project area (for example, intended to protect the quality of the water supply -- see Section 5.4), might minimize any change in the present uses of the surrounding land. Wide-ranging restrictions or zoning changes on the reservoir property (for example, to further protect the quality of the water supply) might lead to more controlled uses of the land adjacent to this project area. Each of the possible uses of the reservoir land would result in different noise levels, most likely related to the types and amount of recreational use that would occur. Substantial recreational activity could result in engine noise from boats and personal watercraft that would be heard in the areas immediately around the reservoir. If this alternative was proposed to be built, the potential land use and noise aspects of the project would be addressed during the more detailed evaluation of the specific proposal.

Alternative C - Downstream Water Intake

The construction of an intake, pumping stations, and a pipeline that would transport water from the western part of Maury County more or less along

State Highway 50 to a treatment plant near Columbia could have short-term adverse effects on land use, prime farmland, and community noise levels. Construction of these facilities would involve clearing areas, excavating a trench, laying the pipeline, and restoring the work site (see Section 3.4); however, the location, design, and construction of these facilities should be adaptable enough to avoid or minimize those effects on existing land uses. If the permanent use of more than 10 acres of land would be required for this alternative, then Form AD 1006 would have to be completed to determine the rating associated with the conversion of prime farmland. During construction of the pipeline, heavy equipment use, blasting, and increased truck traffic would raise local noise levels. These effects could be lessened by restricting construction to daylight hours and by requiring proper maintenance of engines and muffler systems.

Operation of the pumping station would involve some noise associated with the use of electric motors and pumps. Noise emissions from the facility could be reduced to insignificant levels if low-noise equipment was specified and if the buildings were designed and constructed to absorb and block escaping noise. Properly located, designed, and constructed, this alternative would have insignificant effects on land use, prime farmland, and noise.

Alternative D - Raise Normandy Pool Level

Raising the pool level on Normandy Reservoir would involve increasing the height of the dam structure and modifying or replacing existing roads and recreation facilities around the reservoir. Existing trees and other vegetation also would have to be removed from the band of land around the reservoir that would become part of the enlarged pool. The affected area is all part of the Normandy reservation and there would not be any change in the use of most of the land (however, see Section 5.11 concerning changes that would occur at recreation sites and a natural area).

Construction activities related to raising the dam and modifying the roads, bridges, and recreation facilities around the reservoir would generate noise impacts in the immediate areas of the work sites. This construction noise would come from the trucks and other heavy equipment involved in these activities. The overall impact of the noise could be reduced by minimizing the length of the construction period and having the heavy equipment operate only during daylight hours. Noise emissions also could be reduced

by requiring the engines and mufflers to meet manufacturers original specifications and appropriate maintenance programs. The operation of this alternative would not include any additional noise effects.

Alternative E - Tims Ford Pipeline

The construction of an intake, the pumping stations, and a pipeline that would transport water from Tims Ford Reservoir more or less along State Highway 82 to empty into the Duck River near Shelbyville could have short-term adverse effects on land use, prime farmland, or community noise levels. Construction of these facilities would involve clearing areas, excavating a trench, laying the pipeline, and restoring the work site (see Section 3.4); however, the location, design, and construction of these facilities should be adaptable enough to avoid or minimize those effects on existing land uses. If the permanent use of more than 10 acres of land would be required for this alternative, then Form AD 1006 would have to be completed to determine the rating associated with the conversion of prime farmland. Local noise levels would increase during the construction of the pipeline. These noise effects, generated by heavy equipment, blasting, and additional truck traffic, could be lessened by restricting construction to daylight hours and by requiring proper maintenance of engines and muffler systems.

Operation of the pumping stations would involve some noise associated with the use of electric motors and pumps. Noise emissions from the facility could be reduced to insignificant levels if low-noise equipment was specified and if the buildings are designed and constructed to absorb and block escaping noise. Properly located, designed, and constructed, this alternative would have insignificant effects on land use, prime farmland, and noise.

Comparison of Alternatives

Alternative A (No-Action) would not have any adverse impact on land use, prime farmland, or community noise. The construction of Alternatives C (Downstream Water Intake), D (Raise Normandy Pool Level), or Alternative E (Tims Ford Pipeline) would have short-term adverse effects on these resource areas during the construction period. These alternatives would have little or no long-term adverse impacts on these resources if appropriate measures were taken to avoid or minimize effects on local land uses, areas of prime farmland, and noise emissions.

Construction and operation of Alternative B (Fountain Creek Reservoir) would have the most effect on land use, prime farmland, and community noise. Construction of a reservoir on part of the Fountain Creek watershed would involve buying approximately 800 acres of land, converting approximately 2,200 acres of land from the existing uses to a water supply reservoir, and could affect the use of land surrounding that reservoir. Noise levels in the area would increase during the construction period and, depending upon the specific uses of the area, after the reservoir was completed.

5.11 VISUAL CHARACTER, RECREATION, AND NATURAL AREAS

Information presented in Section 4.11 indicates the visual setting, recreational background, and descriptions of the natural areas which exist in the parts of the Duck and Elk River watersheds that could be affected by one or more of the water supply alternatives. Most of the area has an attractive, harmonious, rural character that supports a wide variety of recreational uses and a diverse group of natural areas. Each of the water supply alternatives could result in some level of impact on these aesthetic, recreational, and natural resources.

Three of the action alternatives would include the construction of various types of intakes, pumping stations, and some length of a pipeline. The types of activities which could occur during the construction of these structures include increased traffic, heavy equipment use, vegetation removal, excavation work, and reclamation of the area. These disruptions would be most likely seen in the foreground by local residents and by motorists using the adjacent highways. The construction work would add temporary visual discord, while reducing coherence and harmony in the rural landscape. Local scenic integrity would be low during the construction period. If these project components were located, designed, and built as described in Section 3.4, the construction activity would only result in short-term effects on visual and recreation resources. Under each of the alternatives involving a pipeline, the detailed planning for the project would include measures to avoid natural areas and minimize adverse construction effects on visual and recreational resources. The overall effects of the proposed measures on these resource areas would be evaluated as part of the subsequent environmental review of the projects.

The operation of the intakes and pumping stations also could result in long-term changes in the character and use of small areas along the streams and in the landscapes where these structures would be built. Visual harmony and scenic integrity might be reduced in the foreground views of local residents, motorists, and others who encounter these structures. These impacts could be minimized with proper attention to the relationship of these facilities to their proposed settings and preexisting uses of the land.

Alternative A - Continue to use Present Sources (No Action)

Initially, at least, following this alternative would not result in any adverse effects on visual character, public recreation, or natural areas. If the anticipated additional needs for water in later years were met by withdrawing more water from the reach of the Duck River at Columbia, temporary adverse effects on water-oriented recreational opportunities could occur in the area. Scenic integrity along the river would be reduced if larger amounts of the bank are exposed for long time periods. The additional withdrawal also could adversely affect the portion of the Duck River Mollusk Sanctuary in the Columbia area (see Section 5.5).

Alternative B - Fountain Creek Reservoir

Construction of a reservoir in part of the Fountain Creek watershed would substantially impact the visual character and recreational use of the project area; however, the Columbia Glade Natural Area would be protected from adverse effects associated with the construction and operation of this reservoir. Removing the existing vegetation, altering the surface water flow, and building the dams and other structures would be highly discordant with the existing rural countryside and would substantially reduce recreational use of the affected area throughout the construction period. The large-scale earthwork, related construction activities, and increased traffic congestion would provide adverse visual contrast, while reducing coherence, harmony, scenic integrity, and tranquillity in the landscape. These visual changes would impact the foreground and middleground views of area residents and motorists using local roads, highways, and bridges.

The completed reservoir would be a major change in the visual landscape character, replacing views of pastures and woodland with a large expanse of water surface. In general, water bodies are highly desired visual assets which enhance scenic attractiveness and the value of properties from which they are viewed. The reservoir would add some uniqueness, variety, and

compatible contrast to the landscape without substantially reducing visual harmony. This reservoir also would provide some negative visual impacts during the summer, fall, and winter seasons including a wide band of bare earth exposed during water supply drawdowns, shoreline erosion, and, possibly, disruption of visual tranquillity by motorized water sports. Homes with foreground views would receive the greatest impact. For those with middleground views, negative impacts would be lessened and positive impacts would be enhanced by the greater viewing distance.

With regard to recreation, the reservoir could provide a variety of lake-oriented opportunities not otherwise available this close to Columbia. The extent of new boating, fishing, and other recreational opportunities on this reservoir would depend on several factors including water level fluctuations, water quality, lake access, and the results of any actions required to protect the water source from potential contamination (see Section 5.4). If this alternative was proposed to be built, all of the potential construction and operational effects on visual resources, recreation, and natural areas would be addressed as part of the environmental review of the specific project that was being proposed.

Alternative C - Downstream Water Intake

Building an intake, pumping stations and a pipeline from somewhere near Duck River Mile 100 to a new treatment plant and the existing water distribution system would likely have only short-term and minor effects on visual character, recreational resources, and natural areas. The possible adverse effects associated with pipeline construction and ways to avoid or minimize them are discussed in the introduction to this section. The construction work would be seen in the foreground by residents and motorists using Highway 50 between Williamsport and Columbia. Scenic integrity would return to a moderate level once construction and reclamation were completed.

Operation of this alternative could have a local impact on visual quality because the intake structure would be a feature essentially out of character with the rural countryside. Recreational uses and natural areas would not be affected by the operation of this intake and pipeline.

Alternative D - Raise Normandy Pool Level

Both the construction and subsequent operation of Normandy Reservoir at a higher maximum pool level could have significant effects on the visual character, existing recreational resources, and adjacent natural areas. During the construction period, the existing landscape character would be disrupted by the work being done on the dam, recreation areas, and bridges, in addition to the vegetation being removed from a band of land all around the reservoir. This visual discord would be seen in foreground views from area homes, local motorists, and boat traffic on the reservoir. Once the modifications were complete, the visual changes might only be discernible to frequent visitors and recreational users who were familiar with water levels and facilities as they had been in the past. Scenic integrity probably would return to a moderately high level after reclamation.

Recreational users on Normandy Reservoir would notice substantial changes associated with raising the maximum pool level because most of the recreational activity around this reservoir is focused on where the water meets the land. As indicated in Section 3.6, raising the maximum pool level would require the modification or relocation of some roads, bridges, boat ramps, and existing facilities in the Barton Springs and Cedar Point recreation areas. Changes in the way water was managed in the reservoir also could lead to changes in the abundance of various fish populations and where they could be found at different times of the year (Section 5.5). During the construction period, many recreation facilities probably would be closed for various lengths of time while modifications were being made. When the construction work was completed, recreational users would have to become familiar with the modified or replaced facilities and new habitat conditions in the reservoir.

Downstream from the dam, the additional flow would improve recreational use of the tailwater, probably including recreational fishing. The additional flow also could provide some habitat improvement benefits to parts of the Duck River Mollusk Sanctuary.

With regard to natural areas, Short Springs State Natural Area extends down to the present summer pool level on Normandy Reservoir. Raising the reservoir level would result in significant flooding and erosion effects on three acres within the floodplain area that supports large populations of many wildflower species which contribute to the importance of this site.

The higher pool level also would adversely affect water levels in the creeks on this natural area and the present foot trail adjacent to the impounded creek shoreline. If this alternative was proposed to be built, these potential adverse effects would be evaluated and addressed during the subsequent review of the detailed project that was being proposed.

Alternative E - Tims Ford Pipeline

Building an intake, pumping station, and a pipeline from one of the northern embayments on Tims Ford Reservoir to the Duck River near Shelbyville would be likely to have only short-term and minor effects on visual character, recreational resources, and natural areas. The potential adverse effects associated with pipeline construction and ways to avoid or minimize them are discussed in the introduction to this section. The construction work would be seen in the foreground by residents, nearby boat traffic in the affected embayment, and motorists using Highway 82 between Flat Creek and Shelbyville. Scenic integrity could return to a moderate level after reclamation of the construction sites.

Operation of this alternative is likely to have few or no adverse effects on visual character, recreational uses, or natural areas. A new intake and pumping facility on a Tims Ford embayment and a new discharge structure on the Duck River could have local impacts on visual quality because one or both structures would be out of character with the existing setting. Operation of this pipeline would not have any adverse effects on recreation or natural areas around Tims Ford Reservoir because little or no change in water levels would occur. The additional flow in the Duck River during drought conditions, however, could provide some benefits to recreational use and the part of the Duck River Mollusk Sanctuary downstream from the discharge point.

Comparison of Alternatives

The information presented in this section suggests that both Alternative C (Downstream Water Intake) and Alternative E (Tims Ford Pipeline) are not likely to have any adverse effects on natural areas and would result in only short-term and minimal adverse effects on visual character and recreational resources.

With regard to the two other action alternatives, both Alternatives B (Fountain Creek Reservoir) and D (Raise Normandy Pool Level) would

involve construction activity over fairly wide areas and would produce a variety of changes in the visual character and recreational potential of the affected areas. The changes which could result from building a new reservoir in the Fountain Creek watershed (Alternative B) appear to have more potential for effects on these resources than would occur during the modifications to the existing Normandy Reservoir (Alternative D). With regard to Natural Areas, Alternative B probably could be built and operated with no adverse effects on the Columbia Glade; however, construction and operation of Alternative D probably would have significant adverse effects on an important part of Short Springs.

Initially, at least, Alternative A (No Action) would have no adverse effect on these resources; however, that situation might not last into the future. If additional water is needed for the Columbia area, some source would have to be developed. The potential long-term effects of whatever that alternative might be cannot be evaluated at this time.

5.12 CULTURAL RESOURCES

The information presented in Section 4.12 indicates that a large number of cultural resource sites occur throughout this 5-county area. In Maury County alone, the available information suggests there are more than 4,000 identified archaeological sites and historic structures. Section 106 of the National Historic Preservation Act requires that any federal project sponsor or permitting agency consider the potential impacts of projects on important cultural resources and take steps to avoid or minimize adverse effects.

While a large number of cultural sites do exist in this project area, nearly all of these sites occupy relatively small plots of ground and could be avoided during the planning phase of many types of projects. Using the results of appropriate preliminary surveys, the locations of intakes, pumping stations, and pipelines could be adjusted to prevent or minimize the disturbance of important cultural sites. Operating under the requirements of the National Historic Preservation Act, federal agency sponsors or permitting staffs would have to consult with the Tennessee State Historic Preservation Office about the plans for any project that could affect cultural resources. Federal agency sponsors also would be required to consult with the state preservation office on mitigation measures that would eliminate or reduce the potential for adverse effects. These requirements would apply to each of

the action alternatives included in this EIS which involved a federal agency, either as a participant or as a permitting agency.

Even though archaeological and other historic resources are known to exist in many parts of this general project area, none of the action alternatives has been developed in enough detail for field crews to know where to survey for cultural resources which could be affected by specific construction activities. Given this lack of site-specific information, it is premature to attempt to describe any adverse effects that might be caused by proposing to build one or more of the action alternatives.

At this stage in the evaluation, however, an initial comparison of the potential for adverse impacts among the four alternatives can be based on the acreage that would have to be disturbed to construct each project. Information provided in Sections 3.4 through 3.7 and summarized in Table 6 indicates that Alternative C (Downstream Water Intake) and Alternative E (Tims Ford Pipeline) would disturb small amounts of land during the construction of intakes, pumping stations, and a discharge point (approximately two acres, each) and more land along the routes of the related pipelines. If the density of cultural sites in these project corridors was relatively consistent, the 13-mile length of pipeline (and approximately 130 acres of land disturbance) associated with the downstream water intake would suggest that Alternative C could have somewhat less potential for impacts on cultural resources than could occur under Alternative E along the 20-mile pipeline (and approximately 200 acres of land disturbance) from Tims Ford Reservoir to the Shelbyville area.

Construction of a reservoir in the Fountain Creek watershed (Alternative B) is estimated to affect approximately 3,600 acres of land. Approximately 230 acres of land would be affected by raising the pool level on Normandy Reservoir (Alternative D). Again, assuming that cultural resource sites are evenly distributed, Alternative B (Fountain Creek Reservoir) appears to have more potential for adverse impacts on cultural resources than Alternative D (Raise Normandy Pool Level).

Alternative A (No Action) would not involve any construction activity and, initially at least, would not have any adverse effects on cultural resources. However, Alternative A also would not meet the projected need for

additional water in the Columbia area and, if that need developed, some action alternative would have to be implemented.

While this perspective might be useful in comparing the potential impacts of these conceptual alternatives, a more detailed evaluation of effects would have to be conducted for any alternative proposed to be constructed. That evaluation would have to include a description of the specific cultural sites which could be impacted, results of the consultations with the State Historic Preservation Office, and any measures which would be taken to avoid or minimize potential adverse effects.

On October 11, 2000, TVA sent a letter to the Tennessee State Historic Preservation Office requesting their concurrence with our determination that completion of this programmatic EIS would have no effect on historic properties and that TVA has met present obligations under Section 106 of the National Historic Preservation Act. In a letter dated October 19, 2000, the State Preservation Office concurred with this determination, in part because the "review is limited to the drafting of the Programmatic EIS for future project implementation. Upon selection, the chosen alternative from the EIS must undergo independent Section 106 review" (see Appendix E).

5.13 SOCIOECONOMICS

Existing population, income, and employment information for the counties included in this project area is presented in Section 4.13. Each of the alternatives could have some effect on population and local economic conditions both during whatever construction period was involved and based on the change in available water supply.

Alternative A (No Action) would not have any immediate effect on population or economic conditions because the water supply in the Columbia area should be adequate until severe drought conditions some time after 2015. However, if the demand for water continues to increase, population growth and economic activity in the area eventually would be impacted, with important negative effects on the local economy. If enough water was not available to meet the increasing needs of the area, population, employment, and income would grow much more slowly than they have in recent years or would not grow at all. New businesses and industries, as well as some existing ones, might choose to locate in other areas where sufficient water

was available. Although some change might be made toward less water-intensive economic activities, the net result could be lower than projected population, income, and employment levels, especially if reliable water supplies were available elsewhere.

Each of the action alternatives would involve some level of construction activity. In general, construction activity would generate short-term positive impacts on employment and income in the area, as well as a range of impacts on community services, local government revenues, and expenses. The duration and extent of the construction benefits would vary with the complexity of the project, more or less matching the projected cost of each alternative. On that basis, proposing to build Alternative B (Fountain Creek Reservoir) would have the most construction benefit, followed in order by Alternative D (Raise Normandy Reservoir Pool), Alternative E (Tims Ford Pipeline), and Alternative C (Downstream Water Intake). A more detailed analysis of the socioeconomic impacts of each action alternative could be conducted when more project-specific details were available.

Proposing to build Alternative D (Raise Normandy Pool Level) is likely to meet the projected need for water through 2035, while Alternatives B, C, or E would meet the needs in the Columbia area at least through 2050, the end of the present planning period. As with Alternative A, whenever enough water was not available to meet the increased needs of the service area, population, employment, and income could grow much more slowly than in earlier years or, perhaps, not grow at all. Near the end of this planning period or 2035 (if Alternative D was completed), water supply agencies would have to conduct a new analysis of future water needs in light of economic conditions and growth projections at that time. The results of that evaluation would indicate how well the existing sources would meet future needs and, if appropriate, how much additional water would be required in the future to avoid adverse effects on the local economy.

5.14 ENVIRONMENTAL JUSTICE

Available information about the percentages of nonwhite and low income residents in this project area is presented in Section 4.14. Construction activities associated with the action alternatives could result in disproportionate impacts on disadvantaged populations depending on how decisions would be made concerning the locations of structures and the

routing of pipelines. The analysis of whether particular segments of the population might be adversely affected would require more information about the locations of structures and proposed pipeline routes than is available at present. That analysis would be conducted as part of the subsequent environmental review of any action alternative proposed to be constructed and depending on the extent of federal agency participation in the project. At this time and based on the data shown in Tables 23 and 24, we do not anticipate disproportionate impacts on any segment of the population.

The lack of an adequate water supply in the area would have negative effects on all segments of the population in the water service area. At this time, there is no reason to believe that future additions to the water supply would be more available to some segments of the population than to others.

5.15 INDIRECT AND CUMULATIVE EFFECTS

This EIS evaluation is the most recent in a long series of studies and projects related to using the Duck River as a water supply source for communities in the upper Duck River watershed. As indicated in Section 2.2, many of the historic low flow problems that once occurred in the Duck River were addressed in 1976 when Normandy Dam started to be used to maintain a higher than natural minimum flow level in the river. Results of the Needs Analysis conducted as part of this project (summarized in Section 2.10) indicate the present amount of minimum flow from Normandy Dam would be enough to meet projected water demands in the Bedford County and Marshall County Water Service Areas through the end of the study period (to 2050). Construction of any one of Alternatives B, C, E, or D (with the inclusion of some water conservation measures) would meet the projected water demands of the Maury/southern Williamson County Water Service Area through 2050. Meeting the projected demands for water in all three service areas for most or all of the next 50 years would eliminate the worry that many local residents have had about an adequate water supply. The cumulative effect of resolving local concerns about the quantity of the water supply probably would make people feel better about their communities and would allow economic growth to proceed at or near the Additional Development rate included in Table 2.

This evaluation also indicates that people living in and around the upper Duck River watershed have no other choice but to depend on the river and area reservoirs as their water supply sources, both now and into the future. The amount of water available for use in the Columbia area is, and will be, dependent on how much water is released from Normandy Dam (and any other dams feeding into the watershed), and how much water is withdrawn from and not returned to the river between Normandy Dam and the Columbia area. The quality of the water in the Columbia area also is and will be dependent on the types and amounts of nutrients and other materials that are allowed to flow into the river from point sources and from the land all along the creeks and the river upstream from the water intakes. Especially as more and more people move into the area, everyone in the watershed will have to realize that protection of the quantity and quality of the water supply will be critical to their health and the local economy. People living in different parts of the watershed also will have to work together to make sure each community has enough good quality water to meet their needs. The cumulative effect of this part of the evaluation will depend on how well individuals, communities, and agencies in the area understand this relationship and act on it to encourage or require cooperation among the water use organizations.

As indicated in Section 3.8, water conservation is just beginning to emerge as an issue (and an opportunity) in Tennessee and other eastern states. In the future, the realization that water resources really are limited may force conservation to become an important component in water resource planning. Present water conservation measures probably could produce at least a ten percent reduction in water use in the Duck River region, especially if people would accept and implement the measures that are already available. The identification of alternatives in this EIS which could meet the projected water demands in the upper Duck River watershed through 2050 might allow people and agencies in the area to virtually ignore water conservation until many years from now. Alternatively, the integrated nature of the reservoirs, river, and the water systems discussed in this document could help local agencies and the public realize they can protect and extend the use of their water sources far beyond 2050 by careful planning and adopting reasonable conservation measures. Only time will tell the cumulative effects of that aspect of this water supply project.

5.16 UNAVOIDABLE ADVERSE IMPACTS

Selection of Alternative A would not involve any additional unavoidable adverse impacts, at least not until severe drought conditions some time after 2015. When water demands in the Columbia area exceed the amount of water that can be withdrawn from the river without affecting other uses, adverse impacts could occur in the Duck River or whatever other source would be affected. If additional withdrawals were made from the Duck River, the potential adverse impacts could affect water quality, aquatic life, and recreational use of the river.

Unavoidable adverse impacts associated with Alternatives B, C, and E would each include the construction of some length of pipeline. Construction of one or more of these pipelines could result in localized, short-term impacts on aquatic, terrestrial, and cultural resources; however, many of those impacts could be avoided or minimized as the detailed plans for the projects were developed. Alternatives B and D would involve the construction or enlargement of a reservoir. In each case, these alternatives could include adverse impacts on water quality, aquatic life, archaeological sites, and historical structures in the areas, some of which could be avoided or minimized with careful planning. Alternative B also would require the acquisition of approximately 800 acres of land presently in private ownership.

5.17 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

All of the action alternatives included in this EIS are intended to address the long-term needs for water in the upper Duck River basin, especially the Maury/southern Williamson County Water Service Area where additional water is projected to be needed in future years. The evaluation of these alternatives is focused on identifying the full range of potential short-term construction effects and long-term operational impacts that could occur on the environmental and cultural resources in the affected areas. The intent of this analysis and programmatic EIS is to help the DRDA, local water systems, and the public understand the water needs that are projected to occur in this area through the year 2050, the various ways that are available to meet those needs, and the types of environmental effects that could occur if some of the most likely alternatives were proposed to be built. Proposing to build any of the action alternatives would meet the water supply needs of this area through at least 2035; proposing to build Alternatives B, C, or E would meet the needs through 2050.

5.18 IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

By itself, this programmatic EIS does not involve any irreversible or irretrievable commitment of resources because it is strictly an evaluation and early planning exercise. Proposing to build Alternatives B (Fountain Creek Reservoir) as described in Section 3.4 could be viewed as involving the irreversible and irretrievable commitment of approximately 2,200 acres of land to become a water supply reservoir. Approximately 56 percent of this land contains prime farmland soils and approximately 10 percent is wetlands (Section 4.10). This area also is likely to contain a large number of archaeological sites (Section 4.12). If a Fountain Creek reservoir was constructed as described in Section 3.4, all of the land would be converted to water supply use and all of the existing archaeological sites and wetlands in the pool area would be inundated (however, some new wetland areas probably would develop around the reservoir – see Section 5.6). Protection of the water supply source also might include restrictions on the use of the land surrounding the reservoir and elsewhere in the Fountain Creek watershed (see Section 5.4). An undetermined amount of rock, earth, other building materials, and fuel would be used in the construction of the reservoir.

Proposing to build Alternative D (Raise Normandy Pool Level) would involve the irreversible and irretrievable commitment of 230 acres of land, some existing wetlands, and archaeological sites during the enlargement of Normandy Reservoir. All of the land potentially affected by that project already is part of the Normandy Dam Reservation. The quantities of rock, earth, other building materials, and fuel that would be used in the modifications to Normandy Reservoir also have not yet been determined.

Both of the two other action alternatives (Alternatives C and E) would require much smaller irreversible and irretrievable commitments of resources to build the intakes, pumping stations, and pipelines they would include. Both of these alternatives also would require long-term commitments of around two acres of land for the intake and pumping facilities and only short-term use of the land surface along the route of the pipelines. Fuel, building materials, and other resources would be used during these projects; however, the quantities that would be involved have not yet been estimated

CHAPTER 6 - SUPPORTING INFORMATION

6.1 LIST OF PREPARERS

Steven F. Amick

Position:	Civil Engineer, TVA River Operations
Education:	B.S., Civil Engineering
Background:	23 years experience in hydraulic modeling and water resources
Contribution:	Floodplains material

Judith P. Bartlow

Position:	Natural Areas Coordinator, TVA Resource Stewardship
Education:	B.S., Outdoor Recreation
Background:	19 years experience in natural area identification and management
Contribution:	Natural Areas material

Larry R. Clark

Position:	Senior Environmental Engineer, TVA River Operations
Education:	B.S., Civil Engineering
Background:	32 years experience in water quality and environmental engineering
Contribution:	Water guidance, alternative descriptions, and surface water sections

J. Leo Collins

Position:	Senior Botanist, TVA Resource Stewardship
Education:	Ph.D., Biology
Background:	24 years experience in terrestrial vegetation and rare plant impact assessment
Contribution:	Terrestrial life and endangered species material

Andrew J. Danzig

Position:	Environmental Engineer, TVA Environmental Engineering Services
Education:	M.S., Environmental Engineering
Background:	9 years experience in groundwater resource evaluation
Contribution:	Groundwater sections

James H. Eblen

Position:	Economist, TVA Economic Development (retired)
Education:	Ph.D., Economics
Background:	33 years experience in economic analysis
Contribution:	Socioeconomics sections

Daniel H. Ferry

Position:	Program Manager, TVA River Operations
Education:	B.S., Health Physics/Industrial Safety
Background:	24 years experience in property management, health, safety, construction management, project engineering and regional water supply development
Contribution:	Project direction and coordination

T. Hill Henry

Position:	Terrestrial Biologist, TVA Resource Stewardship
Education:	M.S., Zoology
Background:	9 years experience in monitoring terrestrial endangered species
Contribution:	Terrestrial life and endangered species material

John J. Jenkinson

Position:	Senior Malacologist, TVA Resource Stewardship
Education:	Ph.D., Zoology
Background:	21 years experience in aquatic life and aquatic endangered species impact assessment
Contribution:	Document organization, editing, aquatic life sections, and parts of endangered species sections

Jimmie J. Kelsoe

Position:	Senior Environmental Scientist, TVA Energy Research & Technology Applications
Education:	B.S., Industrial Chemistry, Mathematics
Background:	25 years experience in soil fertility, land reclamation, and waste utilization; 5 years experience in NEPA evaluations of farmland
Contribution:	Land use and prime farmland material

John J. McFeters

Position:	Industrial Hygienist
Education:	M.S., Engineering
Background:	26 years experience in health and safety; 16 years in community/environmental noise assessments
Contribution:	Community/environmental noise material

Jack D. Milligan

Position:	Environmental Engineer, TVA Environmental Engineering Services
Education:	M.S. Environmental Engineering
Background:	24 years experience in groundwater resource evaluations
Contribution:	Groundwater coordination and editing

Roger A. Milstead

Position:	Technical Specialist, TVA River Operations
Education:	B.S., Civil Engineering
Background:	24 years experience in floodplain and environmental impact evaluation. Registered Professional Engineer
Contribution:	Floodplains sections

Danny E. Olinger

Position:	Archaeologist, TVA Resource Stewardship
Education:	M.A., Anthropology
Background:	27 years experience in archaeological field research and cultural resource management.
Contribution:	archaeological material

Linda B. Oxendine

Position:	Senior NEPA Specialist, TVA Environmental Policy and Planning
Education:	Ph.D., Botany
Background:	23 years experience in environmental education and environmental review requirements.
Contribution:	NEPA perspective, interagency coordination, and editing.

Richard L. Pflueger

Position:	Land Use Specialist (Recreation), TVA Resource Stewardship
Education:	M.S., Business Administration
Background:	22 years experience with TVA in recreation planning, economic and community development
Contribution:	Recreation facilities material

Kim Pilarski

Position:	Wetland Biologist, TVA Resource Stewardship
Education:	M.S. Geography
Background:	9 years experience in wetland regulation and assessment, water quality, and watershed assessment
Contribution:	Wetlands sections

Ralph L. Porter

Position:	Senior Landscape Architect, TVA Resource Stewardship
Education:	B. LA., Landscape Architecture
Background:	32 years experience in land planning and site design; Registered Professional Landscape Architect
Contribution:	Visual and aesthetic resource material

Edwin M. Scott, Jr.

Position:	Aquatic Biologist, TVA Resource Stewardship
Education:	M.S., Biology
Background:	24 years experience in aquatic field collections and biomonitoring techniques
Contribution:	Aquatic life data, fishing and hunting material

Peggy W. Shute

Position:	Aquatic Biologist, TVA Resource Stewardship
Education:	M.S., Zoology
Background:	13 years experience in fish ecology and reproduction
Contribution:	Endangered and threatened species information

Charles R. Tichy

Position:	Historic Architect, TVA Resource Stewardship
Education:	M.A., Historic Preservation
Background:	32 years experience in historic restoration and preservation
Contribution:	Historic structures material

6.2 GLOSSARY OF TERMS

action alternative - one of the alternatives that would involve doing something to meet the purpose(s) of the project. Opposite: No Action Alternative

algae - small (generally microscopic) plants which live either floating in the water or attached to submerged objects.

best management practices - construction or maintenance practices which have been shown to be the most effective and practical ways of preventing impacts to environmental resources.

cfs - cubic feet per second. Typically used as a measure of flow in a stream.

CMCP - Cumberlandian Mollusk Conservation Program - a TVA program (active in 1980 through 1984) originally intended to mitigate the likely impacts of building Columbia Reservoir on the endangered and other mussel and snail species living in the Duck River.

Columbia Dam Project - the part of the Duck River Project which, originally, was intended to be the construction of a dam and reservoir at Duck River Mile 137.

Columbia Project lands - land acquired by TVA to be part of Columbia Dam and Reservoir.

designated uses - categories of beneficial uses of water in a stream that have been specifically identified by the Tennessee Department of Environment and Conservation (TDEC).

DRDA - the Duck River Development Agency.

Duck River Project - originally, a TVA project to construct two dams (Normandy and Columbia) on the Duck River. Funded by federal appropriations starting in 1969.

EIS - environmental impact statement. This is the most detailed type of environmental assessment document identified in the National Environmental Policy Act (NEPA).

endangered species - an animal or plant which is in danger of extinction throughout all or a significant part of its range.

Endangered Species Act - a federal law, first passed in 1973, establishing federal lists of endangered and threatened wildlife and plants, and which requires federal agencies to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species.

Executive Order 11988 - an order to federal agencies signed by the president requiring them to avoid or mitigate any actions which could result in impacts to the floodplains of streams.

Executive Order 11990 - an order to federal agencies signed by the president requiring them to avoid or mitigate any actions which could harm wetlands.

Executive Order 12372 - intergovernmental review of federal programs, provides for federal agencies to consult with state and local elected officials regarding federal development activities and programs that may affect community and area development planning and to accommodate their comments in the form of recommendation to the greatest extent possible. TVA and most states have a "Single Point of Contact" (SPO) for Executive Order 12372. TVA's SPO is the NEPA staff representative involved in the project.

Executive Order 12898 - federal actions to address environmental justice in minority populations and low-income populations, signed by President Clinton on February 11, 1994.

floodplain - the part of a stream valley which is covered with water during a flood situation. Typically used associated with a flood which could occur at a given frequency (for example, the edges of a 100-year floodplain would be covered with water only during floods expected to occur less frequently than once in 100 years).

genus (plural: genera) - the next larger grouping of animal or plant species which are assumed to be closely related to each other.

glade - a terrestrial habitat where extremely shallow soils and, usually, little moisture hinder the growth of trees and shrubs but favor the growth of smaller plants which can survive there.

gpm - gallons per minute. Typically used as a measure of water use or availability.

invertebrates - animals which do not have backbones. Used to refer to all animals except fish, amphibians, reptiles, birds, and mammals.

karst - an irregular limestone region with sinks, underground streams, and caverns.

Land Use EIS - the abbreviated title for the 1999 TVA EIS "Use of Lands Acquired for the Columbia Dam Component of the Duck River Project."

mgd - million gallons per day. Typically used as a measure of water treated or handled in some facility.

minimum flow - the amount of water that would be expected or, in the case of a controlled stream, would be released to flow in a stream during dry conditions.

Needs Analysis - an evaluation of the present water use in an area accompanied by the estimation of future water demand based on anticipated population and economic growth in the area.

NEPA (National Environmental Policy Act) - a 1970 federal law which requires agencies to determine the environmental impacts of proposed actions, to consider alternatives to those actions, and to include a consideration of the environmental impacts when deciding which actions to conduct.

NHPA (National Historic Preservation Act) - A federal law which requires agencies to avoid or mitigate impacts to significant archaeological or historic resources.

OMB (Office of Management and Budget) - an Executive Branch office which authorizes the use of funds provided by the Congress.

order of magnitude cost estimate- a cost estimate based the cost of previous projects adjusted up or down for the size or capacity of new project. When comparable data are not available for one or more project components, a separate cost estimate is developed. This type of cost estimate, with an likely accuracy of $\pm$ 30 percent, is less accurate than any of the three other recognized cost estimate levels (conceptual, preliminary, and definitive).

periphyton - aquatic life which lives attached to material submerged in the water.

plankton - small (generally microscopic) animals and plants which live floating in the water.

PMF - probable maximum flood.

programmatic review - a type of environmental review that looks at a broad class of possible projects, typically in more general terms, instead of evaluating specific ways of meeting a particular need.

pumping station - a structure housing two or more pumps used to move water through a pipeline from one location to another over some higher elevation.

scoping - an early part of the NEPA process when agencies and members of the public are encouraged to help focus the planned evaluation on important subject areas.

sinkhole (sink) - a place on the earth where surface water is able to flow down into the ground and has created an obvious depression.

taxon (plural: taxa) - a general term used to refer to an unknown or unspecified level of animal or plant classification. Typically used as a plural when a total includes a mixture of species, genera, and higher taxonomic categories ("28 insect taxa were found").

TDEC - the Tennessee Department of Environment and Conservation.

threatened species - animal or plant which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

TVA - the Tennessee Valley Authority.

TWRA - the Tennessee Wildlife Resources Agency.

USACE - the U.S. Army Corps of Engineers.

USFWS - the U.S. Fish and Wildlife Service.

USGS - the U.S. Geological Survey.

wastewater discharge - water released into a stream or reservoir after being processed through a wastewater (sewage) treatment plant.

water intake - a pipe or more complex structure designed and used to withdraw water from a stream or reservoir.

water quality - the physical, chemical, and biological characteristics of water compared to recognized standards of quality necessary to maintain certain uses.

Water Service Area - typically, the area served by a public water supply utility. In this document, modified slightly to include more than one utility located in essentially the same area. The three water service areas discussed extensively in this document have boundaries closely associated with the county lines.

water supply - water removed from a stream or reservoir for municipal or industrial use.

wetlands - land areas adjacent to, or away from flowing streams which support plants and animals that have high water requirements.

zooplankton - small (usually microscopic) animals which live floating in the water.

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APPENDIX A

Results of water quality sampling conducted by TVA in the Fountain Creek watershed from August through November 1998

Table A-1. Results of water quality sampling conducted by TVA in the Fountain Creek watershed in August through November 1998

Stream	Sample (Stream Mile)	Date	Time Central	Discharge (cfs)	Depth (meters)	Temp. (°C)	Dissolved Oxygen (mg/1)	pH
Fountain Creek	FC-1 (17.1)	08/26	8:00	2.74	0.2	21.0	7.1	8.0
		09/29	9:25	1.25	0.2	21.5	7.1	7.9
		10/20	9:22	1.76	0.2	13.9	8.7	8.0
		11/17	14:00	1.35	0.2	13.6	10.4	8.1
Fountain Creek	FC-2 (14.5)	08/26	9:15	5.94	0.2	21.6	6.9	7.8
		09/29	10:15	3.70	0.2	21.6	6.2	7.7
		10/20	9:50	2.74	0.2	14.6	8	7.8
		11/17	14:40	2.29	0.1	13.3	9	7.9
Fountain Creek	FC-3 (8.95)	08/26	9:06	15.90	0.2	22.8	6.8	7.9
		09/30	10:30	4.56	0.1	22.3	6.1	7.9
		10/21	12:10	1.26	0.1	15.1	9.1	8.0
		11/17	12:45	7.81	0.1	10.9	10.1	8.2
Fountain Creek	FC-4 (0.5)	08/27	12:30	13.50				
		09/30	9:15	4.21	0.1	22.4	7.2	8.1
		10/20	10:36	8.71	0.2	14.7	9.4	8.1
		11/17	11:40	7.53	0.1	11.1	10.2	7.9
South Fork	SF-1	08/26	8:40	3.71	0.1	22.5	6.5	7.8
		09/30	10:45	3.90	0.1	23.0	6.8	7.8
		10/20	10:15	2.12	0.1	15.7	8.1	7.8
		11/17	11:10	2.08	0.1	11.3	9.2	7.9
East Fork	EF-1	08/27	10:50	1.64	0.1	25.0	9.1	8.2
		09/30	12:15	0.35	0.1	23.8	6.1	7.9
		10/21	11;09	0.68	0.1	14:0	8.8	8.0
		11/17	10:00	0.63	0.2	8.1	9.6	8.1
Globe Creek	GC-1	08/26	10:00	4.98	0.2	23.1	6.8	8.1
		09/30	11:35	0.87	0.3	22.4	5.7	7.8
		10/20	10:40	2.04	0.2	13.7	8.1	8.0
		11/17	10:40	2.42	0.2	8.2	9.6	8.0
Brush Creek	BC-1	08/26	10:05	0.22	0.1	21.4	6.6	7.4
		09/30	11:40	0.00	0.1	22.0	5.6	7.6
		10/20	12:40	0.05	0.1	15.2	6.7	7.2
		11/17	12:10	<0.02	0.1	10.2	9	7.8
Hurricane Creek	HC-1	08/26	11:36	3.15	0.1	24.5	11.3	8.5
		09/30	9:55	0.75	0.1	22.2	9.2	8.4
		10/20	11:30	0.47	0.1	16.0	10.6	8.4
		11/17	12:45	0.87	0.1	16.0	10	8.2
Silver Creek	SC-1	08/26	10:40	0.14	0.1	23.9	5.1	7.7
		9/90		0.00				Dry
		10/20	9:40	0.03	0.1	14.3	4.25	7.6
		11/17	13:15	0.27	0.1	14.0	7.8	8.0

Table A-1. (Continued)

Stream	Sample (Stream Mile)	Date	Alkalinity mg/l as CaCo3	Conductivity umhos/cm	ORP (mv)	Fecal Coliform no/100ml	BOD-5 (mg/l)	BOD-10 (mg/l)
Fountain Creek	FC-1 (17.1)	08/26	200	387	264	1220	<2.0	NA
		09/29	180	366	340	1750	<2.0	NA
		10/20	160	365	348	5260	<2.0	<2.0
		11/17	190	283	351	<1	<2.0	<2.0
Fountain Creek	FC-2 (14.5)	08/26	200	419	256	1490		
		09/29	200	404	351	1690	<2.0	NA
		10/20	190	403	345	<1	<2.0	<2.0
		11/17	190	383	286	>3210	<2.0	2.1
Fountain Creek	FC-3 (8.95)	08/26	200	410	213	390	<2.0	NA
		09/30	200	396	349	240	<2.0	NA
		10/21	190	405	349	130	<2.0	<2.0
		11/17	190	383	324	120	<2.0	<2.0
Fountain Creek	FC-4 (0.5)	08/27						
		09/30	190	388	345	270	<2.0	NA
		10/20	180	401	346	270	<2.0	<2.0
		11/17	190	422	NA	120	<2.0	<2.0
South Fork	SF-1	08/26	160	362	261	1220	<2.0	NA
		09/30	170	359	340	1040	<2.0	NA
		10/20	170	357	342	200	<2.0	<2.0
		11/17	170	338	269	110	7	<2.0
East Fork	EF-1	08/27	210	442	247	740	<2.0	NA
		09/30	230	481	353	250	<2	NA
		10/21	200	478	354	140	<2.0	<2.0
		11/17	230	462	265	140	<2.0	<2.0
Globe Creek	GC-1	08/26	190	429	253	350	<2.0	NA
		09/30	190	402	347	590	<2.0	NA
		10/20	190	426	349	190	<2.0	<2.0
		11/17	220	401	260	160	<2.0	<2.0
Brush Creek	BC-1	08/26	200	429	236	110	<2.0	NA
		09/30	230	445	363	210	<2.0	NA
		10/20	220	458	361	30	<2.0	<2.0
		11/17	210	415	270	20	<2.0	<2.0
Hurricane Creek	HC-1	08/26	230	441	212	530	<2.0	NA
		09/30	220	464	344	180	<2.0	NA
		10/20	210	443	348	50	<2.0	<2.0
		11/17	230	505		70	<2.0	<2.0
Silver Creek	SC-1	08/26	220	446	228	280	<2.0	NA
		9/90	No	Flow				
		10/20	170	429	344	410	5	5.7
		11/17	230	444	384	410	<2.0	2.2

Table A-1. (Continued)

Stream	Sample (Stream Mile)	Date	BOD-20 (mg/l)	BOD-30 (mg/l)	BOD-50 (mg/l)	TOC (mg/l)	DOC (mg/l)	Suspended Solids (mg/l)
Fountain Creek	FC-1 (17.1)	08/26	NA	NA	NA	1.4	1.4	4
		09/29	NA	NA	NA	2.3	2.2	<1.0
		10/20	2.2	2.6	3.1	2.2	2.2	3
		11/17	<2.0	2.3	2.7	2.3	2.1	<1.0
Fountain Creek	FC-2 (14.5)	08/26				2	1.8	5
		09/29	NA	NA	NA	2.8	2.8	2
		10/20	2.5	2.9	3.6	2.6	2.6	3
		11/17	2.7	3.4	4	3.1	2.9	1
Fountain Creek	FC-3 (8.95)	08/26	NA	NA	NA	1.9	1.8	3
		09/30	NA	NA	NA	2.9	2.8	2
		10/21	<2.0	<2.0	<2.0	2.6	2.6	2
		11/17	2.1	2.6	3.2	3.2	3.2	<1.0
Fountain Creek	FC-4 (0.5)	08/27						
		09/30	NA	NA	NA	3	2.9	<1.0
		10/20	<2.0	<2.0	<2.0	2.5	2.5	<1.0
		11/17	<2.0	2.2	2.9	3.5	3.5	<1.0
South Fork	SF-1	08/26	NA	NA	NA	1.7	1.8	2
		09/30	NA	NA	NA	2.2	2.2	<1.0
		10/20	<2.0	<2.0	2.4	2.1	2.1	<1.0
		11/17	<2.0	<2.0	2.3	2.3	2.3	<1.0
East Fork	EF-1	08/27	NA	NA	NA	2.9	2.6	18
		09/30	NA	NA	NA	3.7	3.7	5
		10/21	2.3	2.9	3.6	3.3	3.3	3
		11/17	<2.0	2.3	2.8	2.9	2.9	2
Globe Creek	GC-1	08/26	NA	NA	NA	2.4	2.3	2
		09/30	NA	NA	NA	4	3.9	<1.0
		10/20	2.3	2.8	3.5	3.6	3.6	2
		11/17	<2.0	2.3	3.1	3.4	3.4	<1.0
Brush Creek	BC-1	08/26	NA	NA	NA	2.3	2.2	10
		09/30	NA	NA	NA	3.6	3.5	2
		10/20	2.4	2.8	3.6	3.7	3.7	1
		11/17	<2.0	<2.0	2.3	3.5	3.2	<1.0
Hurricane Creek	HC-1	08/26	NA	NA	NA	2	2	<1.0
		09/30	NA	NA	NA	3.7	3.6	<1.0
		10/20	<2.0	2.3	3	3.7	3.7	3
		11/17	2.2	2.8	3.4	3.3	3.3	3
Silver Creek	SC-1	08/26	NA	NA	NA	3.1	2.9	2
		9/90		Dry	No	Flow		
		10/20	8.5	9.8	11.7	9.4	9.4	3
		11/17	2.9	3.6	4.7	6	6	<1.0

Table A-1. (Continued)

Stream	Sample (Stream Mile)	Date	TKN (mg/l)	Nitrate + Nitrate (mg/l)	Total Phosphorus (mg/l)	Ortho Phosphorus (mg/l)	Total Iron (ug/l)	Dissolved Iron (ug/l)
Fountain Creek	FC-1 (17.1)	08/26	0.26	0.74	0.35	0.30	220	<10
		09/29	0.21	0.64	0.33	0.30	110	<10
		10/20	0.12	0.33	0.35	0.31	220	10
		11/17	0.11	0.32	0.34	0.29	140	10
Fountain Creek	FC-2 (14.5)	08/26	0.37	0.80	0.39	0.33	250	<10
		09/29	0.27	0.41	0.45	0.37	230	20
		10/20	0.14	0.35	0.39	0.35	260	10
		11/17	0.11	0.30	0.42	0.38	170	30
Fountain Creek	FC-3 (8.95)	08/26	0.29	0.50	0.38	0.33	180	<10
		09/30	0.19	0.12	0.38	0.37	120	410
		10/21	0.11	0.12	0.39	0.34	70	<10
		11/17	0.11	0.04	0.37	0.35	70	10
Fountain Creek	FC-4 (0.5)	08/27						
		09/30	0.19	0.08	0.37	0.34	70	<10
		10/20	0.12	0.04	0.34	0.32	50	<10
		11/17	0.13	0.01	0.39	0.37	60	10
South Fork	SF-1	08/26	0.30	0.77	0.32	0.28	120	<10
		09/30	0.16	0.48	0.35	0.32	60	<10
		10/20	0.30	0.43	0.31	0.30	70	10
		11/17	0.09	0.02	0.28	0.26	50	10
East Fork	EF-1	08/27	0.42	0.12	0.37	0.34	110	<10
		09/30	0.39	<0.01	0.47	0.43	170	<10
		10/21	0.21	<0.01	0.36	0.35	150	10
		11/17	0.13	<0.01	0.36	0.32	120	10
Globe Creek	GC-1	08/26	0.36	0.39	0.37	0.34	140	<10
		09/30	0.29	0.05	0.42	0.41	70	<10
		10/20	0.20	0.02	0.35	0.34	100	<10
		11/17	0.11	0.02	0.40	0.38	70	10
Brush Creek	BC-1	08/26	0.39	0.10	0.29	0.22	620	<10
		09/30	0.29	<0.01	0.27	0.19	150	<10
		10/20	0.14	<0.01	0.30	0.23	80	10
		11/17	0.11	<0.01	0.30	0.26	50	<10
Hurricane Creek	HC-1	08/26	0.29	0.58	0.32	0.30	80	<10
		09/30	0.27	0.02	0.37	0.36	40	<10
		10/20	0.33	<0.01	0.36	0.32	100	<10
		11/17	0.13	<0.01	0.40	0.37	190	<10
Silver Creek	SC-1	08/26	0.52	0.08	0.25	0.23	260	<10
		9/90						
		10/20	1.20	<0.01	0.33	0.31	150	40
		11/17	0.29	<0.01	0.40	0.36	100	10

Table A-1. (Continued)

Stream	Sample (Stream Mile)	Date	Total Manganese (ug/l)	Dissolved Manganese (ug/l)
Fountain Creek	FC-1 (17.1)	08/26	49	22
		09/29	30	20
		10/20	51	20
		11/17	63	23
Fountain Creek	FC-2 (14.5)	08/26	96	68
		09/29	90	80
		10/20	100	55
		11/17	92	48
Fountain Creek	FC-3 (8.95)	08/26	26	<5
		09/30	30	1500
		10/21	16	<5
		11/17	15	<5
Fountain Creek	FC-4 (0.5)	08/27		
		09/30	<5	<5
		10/20	10	<5
		11/17	11	<5
South Fork	SF-1	08/26	50	23
		09/30	30	20
		10/20	34	11
		11/17	28	<5
East Fork	EF-1	08/27	33	5
		09/30	60	20
		10/21	34	<5
		11/17	20	<5
Globe Creek	GC-1	08/26	27	5
		09/30	30	20
		10/20	23	<5
		11/17	13	<5
Brush Creek	BC-1	08/26	95	6
		09/30	140	100
		10/20	51	33
		11/17	12	<5
Hurricane Creek	HC-1	08/26	5	<5
		09/30	5	<5
		10/20	10	<5
		11/17	22	<5
Silver Creek	SC-1	08/26	62	20
		9/90		
		10/20	120	80
		11/17	28	<5

APPENDIX B

Aquatic Life Known From Three Reaches of the Duck River and Other Streams Which Could be Affected by One or More of the Action Alternatives

Table B-1. Genera of algae identified from plankton and periphyton samples collected during the early 1980s in three reaches of the Duck River. Data from Wade and Webb (1986).

Scientific Name	RM 100 - 135	RM 136 - 179	RM 180 - 249
Chlorophyta (46)	**NS**	**(40)**	**(30)**
Actinastrum		X	X
Ankistrodesmus		X	X
Arthrodesmus		X	
Bracteacoccus		X	
Carteria		X	X
Characium		X	
Chlamydomonas		X	X
Chlorella		X	X
Chlorogonium		X	X
Chodatella			X
Cladophora			X
Closteriopsis		X	X
Closterium		X	X
Coelastrum		X	X
Cosmarium		X	X
Crucigenia			X
Dactylococcus			X
Dictyosphaerium		X	X
Eudorina		X	
Franceia		X	X
Golenkinia		X	X
Gongrosira		X	
Gonium		X	
Hyalotheca		X	
Kirchneriella		X	X
Mougeotia		X	X
Oedogonium		X	
Oocystis		X	X
Pandorina		X	X
Pediastrum		X	X
Protococcus		X	
Pteromonas		X	
Pyramimonas		X	X
Rhizoclonium		X	

Table B-1 (Continued)

Scientific Name	RM 100 - 135	RM 136 - 179	RM 180 - 249
Scenedesmus		X	X
Schroederia		X	X
Selenastrum		X	
Spermatozoopsis		X	X
Spirogyra		X	
Spondylosium		X	
Staurastrum			X
Stigeoclonium		X	
Tetraedron			X
Tetrastrum		X	X
Truebaria		X	X
Ulothrix		X	
Chrysophyta (24)	**NS**	**(22)**	**(20)**
Achnanthes		X	X
Chaetoceros			X
Cocconeis		X	X
Cyclotella		X	X
Cymatopleura			X
Cymbella		X	X
Diatoma		X	X
Dichotomococcus		X	X
Dinobryon		X	
Epithemia		X	X
Gomphonema		X	X
Gyrosigma		X	X
Mallomonas		X	
Melosira		X	X
Meridion		X	
Navicula		X	X
Nitzchia		X	X
Pleurosigma		X	
Rhizosolenia		X	X
Rhoicosphenia		X	X
Stephanodiscus		X	X
Surirella		X	X
Synedra		X	X
Synura		X	X

Table B-1 (Continued)

Scientific Name	RM 100 - 135	RM 136 - 179	RM 180 - 249
Cryptophyta (1)	**NS**	**(1)**	**(1)**
Cryptomonas		X	X
Cyanophyta	**NS**	**(10)**	**(8)**
Anabaena		X	X
Anabaenopsis			X
Anacystis		X	X
Aphanizomenon		X	X
Calothrix		X	
Dactylococcopsis		X	X
Leptochaete		X	
Lyngbya		X	X
Merismopedia		X	X
Oscillatoria		X	X
Spirulina		X	
Euglenophyta (4)	**NS**	**(4)**	**(4)**
Cryptoglena		X	X
Euglena		X	X
Phacus		X	X
Trachelomonas		X	X
Pyrrophyta (3)	**NS**	**(3)**	**(2)**
Ceratium		X	
Glenodinium		X	X
Gymnodinium		X	X
Totals (89)	**NS**	**79**	**65**

NS - Reach not sampled for these species

Table B-2. Zooplankton taxa identified from plankton and periphyton samples collected during the early 1980s in three reaches of the Duck River. Data from Wade and Webb (1986).

Scientific Name	RM 100 - 135	RM 136 - 179	RM 180 - 249
Cladocera (18)	**NS**	**(11)**	**(12)**
Bosmina longirostrus		X	X
Bosminopsis sp.			X
Ceriodaphnia lacustris		X	X
Chydorus sp.		X	X
Daphnia ambigua			X
Daphnia parvula			X
Daphnia retrocurva			X
Diaphanosoma leuchtenbergianum		X	
Ilyocryptus imm.		X	
Leptodora kindtii			X
Leydigia acanthocercoides			X
Moina imm.		X	X
Moina minuta		X	
Pleuroxus denticulatus		X	X
Pleuroxus hamulatus		X	
Capholebris kingi		X	
Scapholebris kingi			X
Sida crystallina		X	
Copepoda (12)	**NS**	**(8)**	**(10)**
Callanoida imm.		X	
Cyclopoida imm.		X	X
Cyclops bicuspidatus thomasi			X
Cyclops varicans rubellus			X
Cyclops vernalis		X	X
Diaptomus reighardi			X
Elaphoidella bidens coronata		X	X
Ergasilus imm.		X	X
Eucyclops agilis		X	
Macrocyclops albidus			X
Mesocyclops edax		X	X
Tropoclops prasinus		X	X
Rotifera (35)	**NS**	**(25)**	**(31)**
Asplanchna amphora			X
Asplanchna herricki		X	X
Bdelloidea			X

Table B-2 (Continued)

Scientific Name	RM 100 - 135	RM 136 - 179	RM 180 - 249
Brachionus angularis		X	X
Brachionus budapestinensis		X	X
Brachionus calyciflorus		X	X
Brachionus caudatus		X	X
Brachionus havanaensis			X
Brachionus quadridentatus		X	X
Cephalodella sp.			X
Conochilcides sp.		X	X
Conochilus hippocrepis			
Epiphanes macrourus		X	X
Euchlanis sp.		X	X
Hexarthra mira		X	
Kellicottia bostoniensis			X
Keratella cochlearis			X
Keratella earlinea			X
Lecane sp.		X	X
Machrochaetus subquadratus		X	X
Monommata grandis			X
Monostyla quadridentata		X	X
Monostyla sp.		X	X
Mytilina sp.			
Notommata sp.		X	
Platyias patulus		X	X
Platyias quadricornis		X	X
Ploesoma truncata		X	X
Polyarthra sp.		X	X
Rotaria neptunia			X
Rotaria sp.			X
Synchaeta sp.		X	X
Testudinella sp.		X	X
Trichocerca sp.			X
Trichotria			X
Totals (65)	**NS**	**44**	**53**

NS - Reach not sampled for these species

Table B-3. Names of the larger aquatic plants observed in the Duck River near Sowell Ford (River Mile 159) and Lillard Mill (River Mile 179) in 1980 and 1981. Information from Wade and Webb (1986).

Common Name	Scientific Name	RM 100 - 135	RM 136 - 179	RM 180 - 249
Mosses and liverworts	**Bryophyta (3)**			
	Fissidens fontanus		X	X
	Porella pinnata		X	X
	Leptodictyum riparium			X
Flowering plants	**Angiospermae (11)**			
	Decodon verticillata			X
Canadian waterweed	*Elodea canadensis*		X	X
Mud-plantain	*Heteranthera dubia*		X	
Waterwillow	*Justicia americana*	X	X	X
Rice-cutgrass	*Leersia oryzoides*		X	X
	Nasturtium officinale			X
Threadfoot riverweed	*Podostemum ceratophyllum*		X	X
Leafy pondweed	*Potamogeton foliosus*		X	
Knotty pondweed	*Potamogeton nodosus*		X	X
Lizard's-tail	*Saururus cernuus*		X	X
	Scirpus americanus			X
Totals	**14**	**1+**	**10**	**12**

Table B-4. Larger aquatic invertebrates (except mollusks) encountered within the last 25 years in the middle reach of the Duck River. Data from Barr, et al. (1986), Scott, et al. (1996), and TVA (1975).

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Hydrozoa (1)	**NS**		**(1)**		
Hydridae			X		
Platyhelminthes (2)		**(2)**	**(1)**		
Dugesia tigrina		X			
Planariidae		X	X		
Nematoda (1)	**NS**	X **(1)**		X **(1)**	X **(1)**
Oligochaeta (9)	**NS**	X **(9)**	X **(4)**	X **(4)**	X **(4)**
Branchiura sowerbyi		X	X	X	
Dero					X
Limnodrilius				X	X
Lumbricidae		X			
Lumbriculus		X			
Lumbriculidae		X	X		
Nais bretscheri		X			
Oligochaeta		X			
Pristinella		X			
Tubificidae		X	X	X	X
Hirudinea (6)	**NS**	**(6)**	**(1)**		
Erpobdellidae		X	X		
Eropbella		X			
Glossiphoniidae		X			
Helobdella		X			
Placobdella multilineata		X			
Placobdella		X			
Crustacea (12)	**NS**	**(9)**	**(9)**		
Asellus			X		
Caecidotea		X	X		
Cambarus		X	X		
Crangonyx		X	X		
Cyclopidae			X		
Gammarus			X		
Gammarus fasciatus		X			

Table B-4 (Continued)

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Hyalella azteca		X	X		
Lirceus		X	X		
Lirceus fontinalis		X			
Orconectes		X	X		
Orconectes placidus		X			
Arachnoidea (1)	**NS**		**(1)**		
Hydracarina			X		
Plecoptera (21)	**NS**	**(17)**	**(12)**		
Acroneuria abnormis		X			
Acroneuria evoluta		X	X		
Agnetina capitata		X			
Brachyptera			X		
Capniidae		X			
Isoperla			X		
Leuctra			X		
Nemoura		X	X		
Neoperla		X	X		
Neoperla clymene		X			
Neophasganophora		X			
Perlidae		X	X		
Perlesta		X	X		
Perlesta placida		X	X		
Perlinella ephyre		X			
Perlinella		X			
Phasgnophora		X	X		
Phasgnophora capitata			X		
Pteronarcys		X			
Pteronarcys dorsata		X			
Taeniopteryx		X	X		
Odonata (24)	**NS**	**(21)**	**(12)**		
Argia		X	X		
Basiaeshna janata			X		
Boyeria		X	X		
Boyeria vinosa		X			

Table B-4 (Continued)

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Calopteryx		X	X		
Coenagrionidae		X	X		
Dromogomphus		X			
Dromogomphus armatus		X			
Enallagma		X			
Gomphus		X			
Hagenius brevistylus		X	X		
Hetaerina		X	X		
Hetaerina americana		X			
Ischnura		X	X		
Ladona		X			
Lathus		X			
Macromia		X	X		
Macromia alleghaniensis		X			
Neurocordylia yamaskanensis			X		
Ophiogomphus		X			
Ophiogomphus rupinsulensis		X	X		
Progomphus		X			
Somatochlora		X			
Stylogomphus albistylus			X		
Ephemeroptera (27)	**NS**	**(25)**	**(13)**		**(1)**
Baetis		X	X		
Baetisca			X		
Caenis		X	X		
Ephemerella		X	X		
Ephemeron		X			
Ephoron leukon		X			
Ephoron		X			
Eurylophella		X			
Heptagenia		X			
Hexagenia		X			X
Isonychia		X	X		
Leptophlebia		X	X		

Table B-4 (Continued)

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Leucrocuta		X			
Paraleptophlebia		X	X		
Potamanthus		X	X		
Potamanthus distinctus		X			
Pseudocloeon			X		
Rhithrogena		X	X		
Stenacron		X	X		
Stenacron interpunctatum		X			
Stenonema		X	X		
Stenonema femoratum		X			
Stenonema ithaca		X			
Stenonema mediopunctatum		X			
Stenonema modestum		X			
Stenonema terminatum		X			
Tricorythodes		X	X		
Hemiptera (5)	**NS**	**(5)**	**(2)**		
Corixidae		X			
Belostoma		X	X		
Ranatra		X			
Rhagovelia		X	X		
Trepobates		X			
Trichoptera (33)	**NS**	**(28)**	**(13)**		
Agapetus		X			
Brachycentrus		X			
Cheumatopsyche		X	X		
Cheumatopsyche btrona		X	X		
Chimarra			X		
Glossosoma		X	X		
Hydropsychidae		X	X		
Hydropsyche		X	X		
Hydropsyche demora		X			
Hydropsyche patera		X			
Hydropsyche simulans		X			
Hydroptila		X			

Table B-4 (Continued)

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Ironoquia		X			
Lepidostomata		X			
Limoephilus		X			
Lype			X		
Micrasema		X			
Nectopsyche candida		X			
Nectopsyche esquisita		X			
Neureclipsis		X			
Oecetis		X			
Philopotamidae			X		
Polycentropus			X		
Protoptila		X			
Psychomyia		X	X		
Pycnopsyche		X	X		
Rhyacophila			X		
Steodes incerta		X			
Seodes		X			
Symphitopsyche		X	X		
Symphitopsyche morosa		X			
Triaenodes injustus		X			
Traenodes tardus		X			
Megaloptera (4)	**NS**	**(4)**	**(3)**		
Corydalus cornutus		X	X		
Nigronia		X	X		
Sialis		X	X		
Sialis aequalis		X			
Diptera (40)	**NS**	**(29)**	**(16)**	**(3)**	**(6)**
Ablabesmyia		X			
Ablabesmyia mallochi		X			
Antocha			X		
Atherix variegata			X		
Bezzia				X	
Ceratipogonidae		X	X		
Chaborous			X		
Chironomidae		X	X		

Table B-4 (Continued)

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Chironomus		X	X	X	X
Clinotanypus		X			
Coelotanypus		X			
Conchapelopsis		X			
Cricotopus		X			
Cricotopus bicinctus		X			
Cricotopus tremulus		X			
Cryptochironomus		X	X		X
Dicrotendipes		X			
Empididae			X		
Endochironomus		X			
Eriocera		X			
Eukinefferiella		X			
Hexatoma		X			
Hydrobaenus					X
Microtendipes			X		
Nanocladius		X			
Orthocladius		X			
Parametriocnemus		X			
Polypedilum		X	X		X
Procladius				X	X
Rheotanytarsus		X			
Simulidae		X	X		
Simulium		X	X		
Stenochironomus		X			
Tabanus			X		
Tanytarsus		X			X
Tendipedidae		X			
Tipulidae		X	X		
Tipula			X		
Tipula acdominalis			X		
Tribelos		X			
Coleoptera (19)	**NS**	**(13)**	**(10)**		
Dubiraphia		X			
Dinetus		X	X		

Table B-4 (Continued)

Categories and Taxa	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Dinetus discolor		X			
Elmidae			X		
Ectoparia			X		
Helichus			X		
Macronychus			X		
Macronychus glabratus		X			
Microcylleopus pusillus		X			
Optioservus			X		
Oulimnius		X	X		
Pletodytes		X			
Promoresia elegans		X			
Psephenus		X	X		
Psephenus herricki		X			
Stenelmis		X	X		
Stenelmis crenata		X			
Stenelmis humerosa		X			
Tropisternus lateralis			X		
Total Taxa (207)	**NS**	**169**	**98**	**8**	**12**

Table B-5. Freshwater mollusks (snails, mussels, and other bivalves) found in reaches of the Duck River between the Hickman County line (near Duck River Mile 100) upstream to Normandy Dam (Duck River Mile 249) within the last 30 years (since 1970). Information from Ahlstedt (1981); Ahlstedt (1986); Aquatic Resources Center (1995); Barr, et al. (1986); Jenkinson (1988); TVA (1975); and TVA unpublished data. Nomenclature follows Turgeon, et al. (1988).

Scientific Name	Common Name	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Gastropoda	**Aquatic Snails (14)**	**NS**	**(13)**	**(8)**	**NS**	**NS**
Campeloma sp.	Campeloma		X	X		
Elimia edgariana	Cumberland elimia		X	X		
Elimia laqueata	Panel elimia		X	X		
Ferrissia sp.	Ancylid		X	X		
Gyraulus sp.	Gyro		X			
Leptoxis praerosa	Onyx rocksnail		X	X		
Lithasia duttoniana	Helmet rocksnail		X			
Lithasia geniculata	Ornate rocksnail		X	X		
Lithasia jayana	Rugose rocksnail		X			
Lymnaea sp.	Lymnaea		X	X		
Physa sp.	Physa		X			
Planorbella sp.	Rams-horn			X		
Pleurocera canaliculata	Silty hornsnail		X			
Somatogyrus sp.	Pebblesnail		X			
Bivalvia: Unionidae	**Native Mussels (44)**	**(21)**	**(40)**	**(13)**	**NS**	**NS**
Actinonaias carinata	Mucket		X			
Actinonaias pectorosa	Pheasantshell		X	X		
Amblema plicata	Threeridge		X	X		
Anodonta grandis	Giant floater	X	X			
Anodonta imbecillis	Paper pondshell	X	X			
Arcidens confragosus	Rock pocketbook	X				
Cyclonaias tuberculata	Purple wartyback	X	X	X		
Elliptio dilatata	Spike		X	X		
Epioblasma brevidens	Cumberland combshell		X			
Epioblasma capsaeformis	Oyster mussel		X			
Epioblasma triquetra	Snuffbox		X	X		
Epioblasma walkeri	Tan riffleshell		X			
Fusconaia barnesiana	Tennessee pigtoe		X	X		
Fusconaia ebena	Ebonyshell	X	X			
Lampsilis fasciola	Wavy-rayed lampmussel	X	X	X		
Lampsilis ovata	Pocketbook	X	X	X		
Lampsilis teres	Yellow sand shell	X				
Lasmigona complanata	White heelsplitter		X			
Lasmigona costata	Fluted-shell	X	X	X		
Lemiox rimosus	Birdwing pearlymussel		X			
Leptodea fragilis	Fragile papershell	X	X			

Scientific Name	Common Name	RM 100 - 135	RM 136 - 179	RM 180 - 249	Normandy	Tims Ford
Lexingtonia dolabelloides	Slabside pearlymussel	X	X	X		
Ligumia recta	Black sand shell	X				
Medionidus conradicus	Cumberland moccasinshell		X			
Megalonaias nervosa	Washboard		X			
Obliquaria reflexa	Threehorn wartyback	X	X			
Obovaria subrotunda	Round hickorynut		X	X		
Pleurobema cordatum	Ohio pigtoe		X			
Pleurobema oviforme	Tennessee clubshell		X			
Pleurobema pyramidatum	Pyramid pigtoe		X			
Potamilus alatus	Pink heelsplitter	X	X			
Ptychobranchus fasciolaris	Kidneyshell	X	X			
Quadrula c. cylindrica	Rabbitsfoot		X			
Quadrula intermedia	Cumberland monkeyface		X			
Quadrula p. pustulosa	Pimpleback	X	X			
Quadrula quadrula	Mapleleaf	X	X			
Strophitus undulatus	Squawfoot	X	X			
Toxolasma lividus	Purple lilliput		X			
Tritogonia verrucosa	Pistolgrip	X	X			
Truncilla donaciformis	Fawnsfoot		X			
Truncilla truncata	Deertoe	X	X			
Villosa iris	Rainbow		X	X		
Villosa taeniata	Painted creekshell		X			
Villosa v. vanuxemensis	Mountain creekshell	X	X	X		
Bivalvia: Others	**Clams (2)**	**(1)**	**(1)**	**(2)**		
Sphaeriidae	Fingernail Clams	NS	NS	X		
Corbicula manilensis	Asiatic clam	X	X	X	X	
Mollusk Totals	**61 taxa**	**22 +**	**54**	**23**	**1+**	**NS**

NS - Reach not sampled for these species

Table B-6. Freshwater fishes encountered in reaches of the Duck River, Normandy and Tims Ford Reservoirs within the last 30 years (since 1970). Data from ARC (1995); Barr et al. (1986); Burr et al. (1993); Nieland (1982); Saylor and Ahlstedt (1993); and Scott and Gardner (1995), Scott, et al. (1996), and TVA unpublished data.

Scientific Name	Common Name	RM 100-135	RM 136-179	RM 180-249	Normandy	Tims Ford
Petromyzontidae	**Lampreys (1)**		(1)	(1)		
Ichthyomyzon bdellium	Ohio lamprey		X	X		
Lepisosteidae	**Gars (2)**	(1)	(1)	(1)	(1)	(1)
Lepisosteus oculatus	Spotted gar		X			
Lepisosteus osseus	Longnose gar	X	X	X	X	X
Hiodontidae	**Mooneyes (1)**		(1)			
Hiodon tergisus	Mooneye		X			
Clupeidae	**Herrings (2)**	(1)	(1)	(1)	(2)	(2)
Dorosoma cepedianum	Gizzard shad	X	X	X	X	X
Dorsoma petenense	Threadfin shad				X	X
Cyprinidae	**Minnows (26)**	(16)	(21)	(22)	(4)	(3)
Campostoma oligolepis	Largescale stoneroller	X	X	X		
Clinstomus funduloides	Rosyside dace			X		
Cyprinella galactura	Whitetail shiner	X	X	X		
Cyprinella spiloptera	Spotfin shiner	X	X	X	X	X
Cyprinella whipplei	Steelcolor shiner	X	X			
Cyprinus carpio	Common carp		X	X	X	X
Erimystax dissimilis	Streamline chub	X	X	X		
Erimystax insignis	Blotched chub	X	X	X		
Hybopsis amblops	Bigeye chub	X	X	X		
Luxilus chrysocephalus	Striped shiner	X	X	X	X	
Lythrurus ardens	Rosefin shiner		X	X		
Lythrurus lirus	Mountain shiner		X	X		
Notropis ariommus	Popeye shiner		X	X		
Notropis atherinoides	Emerald shiner	X				X
Notropis boops	Bigeye shiner		X	X		
Notropis photogenis	Silver shiner	X	X	X		
Notropis rubellus	Rosyface shiner	X	X	X		
Notropis sp.	"Sawfin" shiner	X	X	X		
Notropis telescopus	Telescope shiner	X	X	X		
Notropis volucellus	Mimic shiner	X	X	X		
Phenacobius uranops	Stargazing minnow		X	X		
Pimephales notatus	Bluntnose minnow		X	X	X	
Pimaphales promelas	Fathead minnow			X		
Pimephales vigilax	Bullhead minnow	X	X			
Rhinichthys atratulus	Blacknose dace			X		
Semotilus atromaculatus	Creek chub	X				

Table B-6 (Continued)

Scientific Name	Common Name	RM 100-135	RM 136-179	RM 180-249	Normandy	Tims Ford
Catostomidae	**Suckers (14)**	**(9)**	**(11)**	**(9)**	**(7)**	**(9)**
Carpiodes carpio	River carpsucker					X
Carpiodes cyprinus	Quillback carpsucker		X			X
Carpiodes velifer	Highfin carpsucker		X			
Catostomus commersoni	White sucker			X		
Hypentelium nigricans	Northern hog sucker	X	X	X	X	
Ictiobus bubalus	Smallmouth buffalo	X	X			X
Ictiobus cyprinellus	Bigmouth buffalo			X		
Ictiobus niger	Black buffalo	X	X			X
Minytrema melanops	Spotted sucker	X	X	X	X	X
Mosostoma anisurum	Silver redhorse	X	X	X	X	X
Moxostoma carinatum	River redhorse	X	X	X	X	
Moxostoma duquesnei	Black redhorse	X	X	X	X	X
Moxostoma erythrurum	Golden redhorse	X	X	X	X	X
Moxostoma macrolepidotum	Shorthead redhorse	X	X	X	X	X
Ictaluridae	**Catfishes (9)**	**(4)**	**(8)**	**(5)**	**(3)**	**(3)**
Ameiurus melas	Black bullhead		X			
Ameiurus natalis	Yellow bullhead		X	X		
Ictalurus furcatus	Blue catfish			X	X	X
Ictalurus punctatus	Channel catfish	X	X	X	X	X
Noturus eleutherus	Mountain madtom	X	X			
Noturus exilis	Slender madtom		X	X		
Noturus flavus	Stonecat		X			
Noturus miurus	Brindled madtom	X	X			
Pylodictis olivaris	Flathead catfish	X	X	X	X	X
Salmonidae	**Trout (1)**			**(1)**		
Oncorhynchus mykiss	Rainbow trout			X		
Cyprinodontidae	**Topminnows (3)**	**(2)**	**(3)**	**(1)**		
Fundulus catenatus	Northern studfish	X	X	X		
Fundulus notatus	Blackstripe topminnow	X	X			
Fundulus olivaceus	Blackspotted topminnow		X			
Poecilidae	**Livebearers (1)**	**(1)**	**(1)**	**(1)**		
Gambusia affinis	Western mosquitofish	X	X	X		
Athernidae	**Silversides (1)**	**(1)**	**(1)**			**(1)**
Labidesthes sicculus	Brook silverside	X	X			X
Cottidae	**Sculpins (1)**	**(1)**	**(1)**	**(1)**		
Cottus carolinae	Banded sculpin	X	X	X		

Table B-6 (Continued)

Scientific Name	Common Name	RM 100-135	RM 136-279	RM 180-249	Normandy	Tims Ford
Moronidae	**Temperate Basses (3)**	**(2)**			**(1)**	**(3)**
Morone chrysops	White bass	X			X	X
Morone mississippiensis	Yellow bass					X
Morone saxatilis	Striped bass	X				X
Centrarchidae	**Sunfishes (12)**	**(7)**	**(11)**	**(11)**	**(12)**	**(11)**
Ambloplites rupestris	Rock bass	X	X	X	X	X
Lepomis auritus	Redbreast sunfish			X	X	X
Lepomis cyanellus	Green sunfish	X	X	X	X	X
Lepomis gulosus	Warmouth		X	X	X	X
[*Lepomis (hybrid)*]	[Hybrid sunfish]		[X]	[X]		
Lepomis macrochirus	Bluegill	X	X	X	X	X
Lepomis megalotis	Longear sunfish	X	X	X	X	X
Lepomis microlophus	Redear sunfish		X	X	X	
Micropterus dolomieu	Smallmouth bass	X	X	X	X	X
Micropterus punctulatus	Spotted bass	X	X	X	X	X
Micropterus salmoides	Largemouth bass	X	X	X	X	X
Pomoxis annularis	White crappie		X		X	X
Pomoxis nigromaculatus	Black Crappie		X	X	X	X
Percidae	**Perches (24)**	**(12)**	**(19)**	**(18)**	**(4)**	**(2)**
Etheostoma aquali	Coppercheek darter	X	X	X		
Etheostoma blennius	Blenny darter			X		
Etheostoma blennioides	Greenside darter	X	X	X		
Etheostoma caeruleum	Rainbow darter	X	X	X		
Etheostoma camurum	Bluebreast darter		X	X		
Etheostoma cinereum	Ashy darter		X	X		
Etheostoma crossopterum	Fringed darter		X			
Etheostoma flabellare	Fantail darter	X	X	X		
Etheostoma flavum	Saffron darter		X	X		
Etheostoma luteovinctum	Redband darter		X	X		
Etheostoma nigripinne	Blackfin darter		X	X		

Table B-6 (Continued)

Scientific Name	Common Name	RM 100-135	RM 136-179	RM 180-249	Normandy	Tims Ford
Etheostoma rufilineatum	Redline darter	X	X	X		
Etheostoma simoterum	Snubnose darter	X	X	X		
Etheostoma stigmaeum	Speckled darter	X	X	X		
Etheostoma striatulum	Striated darter		X			
Etheostoma tippecanoe	Tippecanoe darter		X	X		
Etheostoma zonale	Banded darter	X	X	X		
Perca flavescens	Yellow perch				X	
Percina caprodes	Logperch	X	X	X	X	X
Percina evides	Gilt darter	X				
Percina phoxocephala	Slenderhead darter	X	X			
Percina sciera	Dusky darter		X	X		
Stizostedion canadense	Sauger	X			X	
Stizostedion vitreum	Walleye			X	X	X
Sciaenidae	**Drums (1)**	**(1)**	**(1)**	**(1)**	**(1)**	**(1)**
Aplodinotus grunniens	Freshwater drum	X	X		X	X
Totals	(excluding hybrids) **102 Species**	**56**	**80**	**72**	**35**	**36**

Table B-7. Genera of algae identified from plankton and periphyton samples collected during the early 1980s in Fountain Creek at Tennessee Route 50A (Creek Mile 13.3). Data from Etnier, et al. (1983).

Scientific Name
Chlorophyta (4)
Ankistrodesmus
Closterium
Pachycladon
Rhizoclonium
Chrysophyta (20)
Achnanthes
Amphipleura
Cocconeis
Cyclotella
Cymatopleura
Cymbella
Diatoma
Fragilaria
Frustulia
Gomphonema
Gyrosigma
Melosira
Meridion
Navicula
Nitzchia
Pinnularia
Rhoicosphenia
Stauroneis
Surirella
Synedra
Cyanophyta (3)
Lyngbya
Merismopedia
Oscillatoria
Total 27 Genera

Table B-8. Larger aquatic invertebrates (except mollusks) encountered in the early 1980s at Fountain Creek at Tennessee Route 50A (Creek Mile 13.3). Data from Etnier, et al. (1983).

Platyhelminthes (1)
Planariidae
Nematoda (1)
Oligochaeta (4)
Lumbriculus
Oligochaeta
Pelescolex
Tubificidae
Hirudinea (1)
Glossiphoniidae
Crustacea (4)
Decapoda
Gammarus
Orconectes mirus
Orconectes placidus
Arachnoidea (1)
Hydracarina
Plecoptera (3)
Neoperla clymene
Neophasganophora
Perlesta placida
Odonata (18)
Argia
Basiaeshna janata
Boyeria vinosa
Calopteryx maculata
Chromagrion
Didymops transversa
Dromogomphus spinosus
Enallagma
Gomphurus vastas
Gomphus lividus
Gomphus quadricolor
Hagenius brevistylus
Ischnura
Lathus
Macromia
Macromia georgiana
Macromia illinoiensis
Neurocordylia yamaskanensis
Ephemeroptera (14)
Baetis
Caenis
Choroterpes hubbeli
Coroterpes
Heptagenia
Hexagenia
Isonychia
Leptophlebia
Neocloeon
Paraleptophlebia
Stenacron
Stenonema femoratum
Stenonema mediopunctatum
Tricorythodes
Hemiptera (6)
Gerris
Rhagovelia
Rheumatobates rileyi
Rheumatobates tenuipes
Rheumatobates trulliger
Trepobates pictus
Trichoptera (12)
Brachycentrus
Cheumatopsyche
Cheumatopsyche petiiti
Chimarra
Helicopsyche
Helicopsyche borealis
Hydropsyche
Hyroptila gunda
Hydroptila waubesiana
Mystacides septulchralis
Oecetis
Polycentropus

Table B-8 (Continued)

Megaloptera (2)
Corydalus cornutus
Sialis
Lepidoptera (1)
Petrophila
Diptera (25)
Antocha
Chironomidae
Cladotanytarsus
Conchapelopsis
Cricotopus
Cricotopus bicinctus
Cryptochironomus fulvus
Empididae
Eriocera
Hexatoma
Limnophora
Micropsectra
Microtendipes
Nioltanypus
Parametriocnemus lundbecki
Phaenopsectra obediens
Polypedilum convictum
Polypedilum halteralis
Polypedilum illinoense
Simulidae
Stenochironomus
Tabanus
Tanytarsus
Tendipedidae
Thienemanniella

Coleoptera (17)
Cyphon
Dubiraphia
Dinetus
Dinetus discolor
Estopria nervosa
Helichus
Hydroporus
Macronychus glabratus
Microcylleopus pusillus
Optioservus
Pletodytes
Psephenus
Psephenus herricki
Sperchopsis tessellatus
Stenelmis
Stenelmis sexlineata
Tropisternus lateralis

Total Taxa 110

Table B-9. Freshwater mussels found alive or as fresh shells in Poplar Creek, Greenlick Creek, and two sites in the Duck River, Maury County, TN, June 23 and 24, 1999.

Scientific Name	Common Name	Poplar Creek	Greenlick Creek	Duck River	
		Foster Chapel Road	TN 50 Bridge	Kettle Mills DRM 104	Williamsport DRM 116
Gastropoda	**Aquatic Snails (4)**		**(1)**	**(3)**	**NS**
Anculosa praerosa	Onyx rocksnail			X	
Elimia sp.	Elimia		X		
Lithasia sp.	Rocksnails			X	
Pleurocera canaliculata	Silty hornsnail			X	
Bivalvia	**Mussels and Clams**			**(10)**	**(21)**
Anodonta grandis	Giant floater				X
Anodonta imbecillis	Paper pondshell				X
Arcidens confargosus	Rock pocketbook				X
Cyclonaias tuberculata	Purple watryback				X
Fusconaia ebena	Ebonyshell				X
Lampsilis fasciola	Wavy-rayed lampmussel			X	X
Lampsilis ovata	Pocketbook			X	X
Lampsilis teres	Yellow sandshell			X	X
Lasmigona costata	White heelsplitter				X
Leptodea fragilis	Fragile papershell			X	X
Lexingtonia dolabelloides	Slabside pearlymussel				X
Ligumia recta	Black sandshell			X	X
Megalonaias nervosa	Washboard			X	
Obliquaria reflexa	Threehorn wartyback			X	X
Potamilus alatlus	Pink heelsplitter			X	X
Ptychobranchusfasciolaris	Kidneyshell				X
Quadrula pustulosa	Pimpleback				X
Quadrula quadrula	Mapleleaf				X
Strophitus undulatus	Squawfoot				X
Tritogonia verrucosa	Pistolgrip			X	X
Truncilla truncata	Deertoe				X
Villosa vanuxemensis	Mountain creekshell			X	X
Corbicula manilensis	Asiatic clam		X	X	X
Mollusk Taxa Total		**0**	**2**	**14**	**22+**

NS - Not sampled

Table B-10. List of fish species found in Greenlick Creek, Poplar Creek, and two sites in the Duck River, Maury County, TN, June 23-24, 1999.

Scientific name	Common Name	Poplar Creek	Greenlick Creek	Duck River	
		Foster Chapel Road	TN 50 Bridge	Kettle Mills DRM 104	Williamsport DRM 116
Lepisosteidae	**Gars (1)**			**(1)**	**(1)**
Lepisosteus osseus	Longnose Gar			X	X
Clupeidae	**Herrings (1)**			**(1)**	**(1)**
Dorosoma cepedianum	Gizzard shad			X	X
Cyprinidae	**Minnows (21)**	**(5)**	**(8)**	**(13)**	**(15)**
Campostoma oligolepis	Largescale stoneroller	X	X	X	X
Clinostomus funduloides	Rosyside dace	X	X		
Cyprinella galactura	Whitetail shiner	X		X	X
Cyprinella spiloptera	Spotfin shiner			X	X
Cyprinella whipplei	Steelcolor shiner			X	X
Erimystax dissimilis	Streamlined chub			X	X
Erimystax insignis	Blotched chub			X	X
Hybopsis amblops	Bigeye chub			X	X
Luxilus chrysocephalus	Striped shiner	X	X	X	X
Lythrurus ardens	Rosefin shiner		X		
Notropis atherinoides	Emerald shiner				X
Notropis photogenis	Silver shiner			X	
Notropis rubellus	Rosyface shiner			X	X
Notropis telescopus	Telescope shiner			X	X
Notropis volucellus	Mimic shiner			X	X
Notropis sp.	Sawfin shiner				X
Phoxinus erythrogaster	Southern redbelly dace	X			
Pimephales notatus	Bluntnose minnow	X			
Pimephales vigilax	Bullhead minnow			X	X
Rhinichthys atratulus	Blacknose dace	X			
Semotilis atromaculatus	Creek chub	X	X		X
Catostomidae	**Suckers (9)**	**(2)**	**(1)**	**(8)**	**(9)**
Hypentelium nigricans	Northern hog sucker	X	X	X	X
Ictiobus bubalus	Smallmouth buffalo			X	X
Ictiobus niger	Black buffalo			X	X
Minytrema melanops	Spotted sucker				X
Moxostoma anisurum	Silver redhorse			X	X
Moxostoma carinatum	River redhorse			X	X
Moxostoma duquesnei	Black redhorse			X	X
Moxostoma erythrurum	Golden redhorse		X	X	X
Moxostoma macrolepidotum	Shorthead redhorse			X	X
Ictaluridae	**Catfishes (5)**	**(1)**	**(1)**	**(2)**	**(3)**
Ameiurus natalis	Yellow bullhead	X			
Ictalurus furcatus	Blue catfish				

Table B-10 (Continued)

Scientific Name	Common Name	Poplar Creek	Greenlick Creek	Duck River	
		Foster Chapel Road	TN 50 Bridge	Kettle Mills DRM 104	Williamsport DRM 116
Ictalurus punctatus	Channel catfish		X	X	X
Noturus eleutherus	Mountain madtom			X	X
Pylodictis olivaris	Flathead catfish				X
Fundulidae	**Topminnows (2)**	**(1)**		**(2)**	
Fundulus catenatus	Northern studfish	X		X	
Fundulus olivaceus	Blackspot topminnow			X	
Poeciliidae	**Livebearers (1)**				**(1)**
Gambusia affinis	Western mosquitofish				X
Atherinidae	**Silversides (1)**				**(1)**
Labidesthes sicculus	Brook silverside				X
Cottidae	**Sculpins (1)**	**(1)**	**(1)**	**(1)**	**(1)**
Cottus carolinae	Banded sculpin	X	X	X	X
Moronidae	**Temperate basses (2)**				**(2)**
Morone chrysops	White bass				X
Morone saxatilis	Striped bass				X
Centrarchidae	**Sunfishes (7)**	**(2)**	**(4)**		
Ambloplites rupestris	Rock bass		X	X	X
Lepomis cyanellus	Green sunfish	X	X	X	X
Lepomis macrochirus	Bluegill	X	X	X	X
Lepomis megalotis	Longear sunfish		X	X	X
Micropterus dolomieu	Smallmouth bass			X	X
Micropterus punctulatus	Spotted bass			X	X
Micropterus salmoides	Largemouth bass			X	
Percidae	**Perches (15)**	**(5)**	**(3)**	**(10)**	**(9)**
Etheostoma aquale	Coppercheek darter			X	
Etheostoma blennioides	Greenside darter			X	X
Etheostoma caeruleum	Rainbow darter	X		X	
Etheostoma flabellare	Fantail darter	X	X		
Etheostoma flavum	Saffron darter	X	X		
Etheostoma luteovinctum	Redband darter	X			
Etheostoma nigripinne	Blackfin darter	X			
Etheostoma rufilineatum	Redline darter			X	X
Etheostoma simoterum	Snubnose darter			X	X
Etheostoma stigmaeum	Speckled darter				X
Etheostoma zonale	Banded darter			X	X
Percina caprodes	Logperch		X	X	X
Percina evides	Gilt darter			X	X
Percina phoxocephala	Slenderhead darter			X	X
Stizostedion canadense	Sauger			X	X
Sciaenidae	**Drums (1)**			**(1)**	**(1)**
Aplodinotus grunniens	Freshwater drum			X	X
Totals	**65 Species**	**19**	**16**	**46**	**50**

Table B-11. Freshwater mollusks (snails, mussels, and other bivalves) found in the Fountain Creek watershed within the last 30 years (since 1970). Information from Etnier, et al. (1983); and TVA unpublished data. Nomenclature follows Turgeon, et al. (1988).

Scientific Name	**Common Name**	**Fountain Creek Mi. 0.3**	**Fountain Creek Mi. 13.3**
Gastropoda	**Aquatic Snails**		**(4)**
Elimia laqueata	Panel elimia		X
Ferrissia sp.	Ancylid		X
Physella sp.	Physa		X
Planorbella sp.	Rams-horn		X
Bivalvia: Unionidae	**Native Mussels**	**(1)**	**(1)**
Lampsilis ovata	Pocketbook	X	
Corbicula manilensis	Asiatic clam		X
Sphaeriidae	Fingernail Clams	NS	
Mollusk Totals	**5**	**1**	**5**

Table B-12. Freshwater fishes encountered in the Fountain Creek watershed within the last 30 years (since 1970). Data from ARC (1995); Burr et al. (1993); Nieland (1982); Saylor and Ahlstedt (1993); and Scott and Gardner (1995); and TVA unpublished data.

Scientific Name	Common Name	FC #1	FC #2	Silver Creek	Hurricane Creek	S. Fk F C	Brush Creek
Clupeidae	**Herrings (1)**						
Dorosoma cepedianum	Gizzard shad		X				
Cyprinidae	**Minnows (15)**						
Campostoma oligolepis	Largescale stoneroller	X	X	X	X	X	X
Cyprinella galactura	Whitetail shiner		X		X		
Cyprinella spiloptera	Spotfin shiner	X	X		X		
Erimystax insignis	Blotched chub	X	X				
Hybopsis amblops	Bigeye chub		X				
Luxilus chrysocephalus	Striped shiner	X	X	X	X	X	X
Lythrurus ardens	Rosefin shiner		X	X	X	X	X
Lythrurus lirus	Mountain shiner	X	X				
Notropis ariommus	Popeye shiner						
Notropis boops	Bigeye shiner			X			
Notropis rubellus	Rosyface shiner						
Notropis telescopus	Telescope shiner	X	X			X	X
Notropis volucellus	Mimic shiner						
Pimephales notatus	Bluntnose minnow	X	X	X	X	X	X
Semotilus atromaculatus	Creek chub			X			
Catostomidae	**Suckers (6)**						
Catostomus commersoni	White sucker						
Hypentelium nigricans	Northern hog sucker	X	X			X	
Minytrema melanops	Spotted sucker						
Moxostoma duquesnei	Black redhorse	X	X			X	
Moxostoma erythrurum	Golden redhorse	X		X		X	
Moxostoma macrolepidotum	Shorthead redhorse						
Ictaluridae	**Catfishes (4)**						
Ameiurus melas	Black bullhead						
Ameiurus natalis	Yellow bullhead	X	X	X			
Noturus exilis	Slender madtom		X				
Noturus miurus	Brindled madtom						
Cyprinodontidae	**Topminnows (3)**						
Fundulus catenatus	Northern studfish	X	X	X	X	X	
Fundulus notatus	Blackstripe topminnow	X	X	X	X	X	X
Fundulus olivaceus	Blackspotted topminnow						

Table B-12 (Continued)

Scientific Name	Common Name	FC #1	FC #2	Silver Creek	Hurricane Creek	S. Fk. F C	Brush Creek
Poecilidae	**Livebearers (1)**						
Gambusia affinis	Western mosquitofish	X		X			
Athernidae	**Silversides (1)**						
Labidesthes sicculus	Brook silverside	X	X				
Cottidae	**Sculpins (1)**						
Cottus carolinae	Banded sculpin	X	X	X		X	
Centrarchidae	**Sunfishes (8)**						
Ambloplites rupestris	Rock bass		X				
Lepomis cyanellus	Green sunfish	X	X	X	X		
Lepomis gulosus	Warmouth						
Lepomis macrochirus	Bluegill	X	X			X	
Lepomis megalotis	Longear sunfish	X	X			X	
Micropterus dolomieu	Smallmouth bass		X				
Micropterus punctulatus	Spotted bass	X	X				X
Micropterus salmoides	Largemouth bass						
Percidae	**Perches (11)**						
Etheostoma aquali	Coppercheek darter	X	X				
Etheostoma blennioides	Greenside darter	X	X			X	
Etheostoma caeruleum	Rainbow darter	X	X				
Etheostoma crossopterum	Fringed darter	X	X	X	X	X	X
Etheostoma flabellare	Fantail darter	X	X	X	X	X	X
Etheostoma flavum	Saffron darter	X	X	X	X	X	X
Etheostoma luteovinctum	Redband darter			X			
Etheostoma rufilineatum	Redline darter	X	X				
Etheostoma simoterum	Snubnose darter	X	X				
Percina caprodes	Logperch		X				
Percina phoxocephala	Slenderhead darter						
Totals	**50**	**28**	**34**	**17**	**12**	**17**	**10**

Table B-13. Freshwater mussels found alive or as fresh shells in Flat Creek (three sites), Bedford County, TN, and East Fork Mulberry Creek, Moore County, TN, June 21 and 22, 1999.

Scientific name	Common Name	Flat Creek			East Fk. Mulberry Creek
		US 231	Old Center Church Road	New Center Church Road	TN 55 and TN 82 Bridges
Gastropoda	**Aquatic Snails**	**(2)**	**(2)**	**(1)**	
Elimia sp.	Elimia	X	X	X	
Lithasia sp.	Rocksnails	X			
Pleurocera canaliculata	Silty hornsnail		X		
Bivalvia	**Mussels and Clams**	**(3)**	**(1)**	**(4)**	
Fusconaia barnesiana	Tennessee pigtoe	X		X	
Medionidus conradicus	Cumberland moccasinshell	X	X	X	
Villosa iris spp.	Rainbows	X		X	
Villosa vanuxemensis	Mountain creekshell			X	
Corbicula manilensis	Asiatic clam	X			
Mollusks	**8 Species**	**6**	**3**	**5**	**0**

Table B-14. List of fish species found in Flat Creek (three sites), Bedford County, TN, and East Fork Mulberry Creek, Moore County, TN, June 21-22, 1999.

Scientific name	Common Name	Flat Creek			East Fk. Mulberry Creek
		US 231	Old Center Church Road	New Center Church Road	TN 55 and TN 82 Bridges
Cyprinidae	**Minnows (14)**	**(10)**	**(7)**	**(8)**	**(11)**
Campostoma oligolepis	Largescale stoneroller	X	X	X	X
Clinostomus funduloides	Rosyside dace				X
Cyprinella galactura	Whitetail shiner	X	X	X	X
Cyprinella spiloptera	Spotfin shiner	X		X	X
Cyprinus carpio	Common carp			X	
Hybopsis amblops	Bigeye chub	X	X	X	X
Luxilus chrysocephalus	Striped shiner	X	X	X	X
Lythrurus ardens	Rosefin shiner	X	X	X	X
Notropis boops	Bigeye shiner	X	X		
Notropis telescopus	Telescope shiner	X		X	X
Notropis volucellus	Mimic shiner				X
Phenacobius uranops	Stargazing minnow	X			
Pimephales notatus	Bluntnose minnow	X			X
Semotilis atromaculatus	Creek chub		X		X
Catostomidae	**Suckers (4)**	**(4)**	**(2)**	**(3)**	**(2)**
Hypentelium nigricans	Northern hog sucker	X	X	X	X
Moxostoma anisurum	Silver redhorse	X			
Moxostoma duquesnei	Black redhorse	X		X	
Moxostoma erythrurum	Golden redhorse	X	X	X	X
Ictaluridae	**Freshwater Catfishes(2)**	**(1)**	**(1)**		**(1)**
Ameiurus natalis	Yellow bullhead	X	X		
Noturus exilis	Slender madtom				X
Fundulidae	**Topminnows (1)**		**(1)**	**(1)**	**(1)**
Fundulus catenatus	Northern studfish		X	X	X
Poeciliidae	**Livebearers (1)**	**(1)**	**(1)**		
Gambusia affinis	Western mosquitofish	X	X		
Atherinidae	**Silversides (1)**		**(1)**		
Labidesthes sicculus	Brook silverside		X		
Cottidae	**Sculpins (1)**	**(1)**	**(1)**	**(1)**	**(1)**
Cottus carolinae	Banded sculpin	X	X	X	X
Centrarchidae	**Sunfishes (6)**	**(6)**	**(5)**	**(5)**	**(5)**
Ambloplites rupestris	Rock bass	X	X	X	X
Lepomis cyanellus	Green sunfish	X	X	X	X
Lepomis macrochirus	Bluegill	X	X	X	X
Lepomis megalotis	Longear sunfish	X	X	X	X
Micropterus dolomieu	Smallmouth bass	X			X
Micropterus punctulatus	Spotted bass	X	X	X	

Table B-14 (Continued)

Scientific name	Common Name	Flat Creek			East Fk Mulberry Creek
		US 231	Old Center Church Road	New Center Church Road	TN 55 and TN 82 Bridges
Percidae	**Perches (12)**	**(10)**	**(6)**	**(5)**	**(4)**
Etheostoma aquale	Coppercheek darter	X			
Etheostoma blennioides	Greenside darter	X	X	X	X
Etheostoma caeruleum	Rainbow darter	X	X	X	
Etheostoma cinereum	Ashy darter	X			
Etheostoma duryi	Black darter				X
Etheostoma flabellare	Fantail darter	X	X	X	X
Etheostoma flavum	Saffron darter	X	X	X	
Etheostoma nigripinne	Blackfin darter	X			X
Etheostoma rufilineatum	Redline darter	X			
Etheostoma simoterum	Snubnose darter	X	X	X	
Etheostoma stigmaeum	Speckled darter		X		
Etheostoma zonale	Banded darter	X			
Total	**42 Species**	**32**	**25**	**23**	**25**

APPENDIX C

Habitat and county occurrence information for the protected plant and animal species which could occur in areas affected by one or more of the action alternatives

Table C-1. Habitat and county occurrence information for the protected plant species which could occur in areas affected by one or more of the action alternatives. Occurrence data derived from TVA Regional Heritage database; habitat data provided by TVA staff specialists.

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Agalinis pseudophylla	Purple gerardia *	Z		E					X
Amsonia tabernaemontana var. *gattingeri*	Blue star *	G, Z		S	X				
Anemone caroliniana	Carolina anemone	G, N		E			X		
Arenaria fontinalis	Sandwort	W		E-PT		X			
Asclepias hirtella	Green milkweed	G, N		S					X
Astragalus tennesseensis	Tennessee milk-vetch	G		S	X	X	X		
Aureolaria patula	False foxglove	F, M		T					X
Carex barrattii	Sedge *	W, Z		E					X
Carex buxbaumii	Sedge *	W, Z		S					X
Cerastium velutinum	Starry cerastium	G		PE	X				
Croton alabamensis	Alabama croton	F		E-P					X
Dalea foliosa	Leafy prairie-clover	G	E	E	X	X	X		
Drosera brevifolia	Sundew *	Z		T					X
Drosera capillaris	Sundew *	Z		T					X
Echinacea pallida	Pale purple coneflower	G, N		T					X
Eupatorium leucolepis	Justice weed	Z		E					X
Festuca paradoxa	Fescue *	W, Z		S					X
Fimbristylis puberula	Hairy fimbristylis	Z		T					X
Gaylussacia dumosa	Dwarf huckleberry	M, N		T					X
Gentiana puberulenta	Downy gentian	N		PE					X
Gymnopogon brevifolius	Beardgrass	N		S					X

Table C-1 (Continued)

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Helianthus eggertii	Eggert's sunflower	H	T	T	X				X
Hieracium scabrum	Hawkweed *	M, N		T					X
Hydrastis canadensis	Goldenseal	M, G		S-C	X				X
Hypericum adpressum	Creeping St. John-wort	Z		T					X
Iris prismatica	Narrow blue flag	Z		T					X
Juncus brachycephalus	short-head rush	W, Z		S	X				
Lachnanthes caroliana	Red root	Z		E					X
Leavenworthia exigua var. *exigua*	Glade Cress *	G		E-P	X				
Leavenworthia exigua var. *lutea*	Pasture glade Cress	G		T	X	X	X		
Lespedeza angustifolia	Narrowleaf bush clover	N		T					
Lesquerella densipila	Duck River bladderpod	A		T	X	X	X		
Lesquerella globosa	Shorts bladderpod	F		PE	X				
Lilium michiganense	Michigan lily	M, H		T					X
Listera australis	Southern twayblade	B		E					X
Lobelia canbyi	Canby lobelia	B		T					X
Ludwigia sphaerocarpa	Globe-fruit ludwigia	B, Z		T					X
Lycopodiella alopecuroides	Foxtail clubmoss	Z		T					X
Lysimachia terrestris	Swamp loosestrife	B, Z		E					X
Mirabilis albida	Pale umbrella-wort	G, N		T	X				
Muhlenbergia torreyana	Torrey muhly	Z		E					X
Myriophyllum pinnatum	Water-millfoil *	R		T					X
Nestronia umbellula	Nestronia	M		E					X

Table C-1 (Continued)

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Neviusia alabamensis	Snow-wreath	F		T				X	
Panax quinquefolius	Ginseng	M		S-C				X	X
Panicum acuminatum var. *leucothrix*	Panic-grass *	I		S					X
Panicum hemitomon	Maidencane	Z		S					X
Pedicularis lanceolata	Swamp lousewort	Z		T					X
Phlox pilosa ssp. *ozarkana*	Downy phlox	G		S	X				
Platanthera flava var. *flava*	Southern rein orchid	Z, B		S					X
Platanthera integra	Yellow fringeless orchid	Z		E					X
Platanthera nivea	Snowy orchid	Z		E					X
Pogonia ophioglossoides	Rose pogonia	Z		T					X
Polygala nuttallii	Nuttall milkwort	N		E					X
Prunus pumila	Dwarf cherry	Z		E-PT					X
Rhynchospora perplexa	Beakrush	Z		T					X
Sagittaria graminea	Grass-leaf arrowhead	B, Z		T					X
Schoenolirion croceum	Sunnybell *	G		T	X	X			
Schwalbea americana	Chaffseed *	Z	E	E-P					X
Scleria verticillata	Low nut-rush	Z		S					X
Silphium brachiatum	Rosinweed *	M		E		X			
Talinum calcaricum	Limestone fame-flower	G		S	X	X			X
Tofieldia racemosa	False asphodel	Z		E					X
Woodwardia virginica	Virginia chain-fern	Z		S					X
Xyris fimbriata	Fringed yellow-eyed-grass	Z		E					X

Table C-1 (Continued)

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Xyris laxifolia var. *iridifolia*	Yellow-eyed-grass *	Z		S					X
Xyris tennesseensis	Yellow-eyed-grass *	Z, W	E	E					X
Zigadenus leimanthoides	Black snakeroot *	Z		T					X

Habitat Abbreviations:

A - Agricultural Areas, B - Bottomland Forests, C - Creeks, F - Bluffs and Cliffs, G - Cedar Glades, H - Thickets and Fencerows, J - Cedar Forests, M - Mixed Hardwoods, N - Barrens, R - Rivers, U - Caves, V - Reservoirs, W - Seepage Areas, and Z - Wet Meadows and Sandy Creeksides.

Status Abbreviations:

E - Endangered, E-P - Endangered but possibly extirpated, E-PT - Endangered but proposed for Threatened status, PE - proposed Endangered, S - Special Concern, S-C - Special Concern-commercially exploited, T - Threatened

Occurrence Abbreviations:

X - Known to occur in this county within the last 30 years,
X> - Not known from the parts of this county that could be affected by any of the action alternatives.

* = denotes common name for the genus; no common name is used of the individual species.

Table C-2. Habitat and county occurrence information for the protected animal species which could occur in areas affected by one or more of the action alternatives. Occurrence data derived from TVA Regional Heritage database; habitat data provided by TVA staff specialists.

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Insects									
Gomphus sandrius	Tennessee clubtail dragonfly	C			X		X		
Pseudanophthalmus bendermani	Benderman's cave beetle	U			X				
Pseudanophthalmus tullahoma	Duck River cave beetle	U							X
Snails									
Leptoxis praerosa	Onyx rocksnail	CR			X	X	X		X
Leptoxis subglobosa umbilicata	Umbilicate rocksnail	CR							X
Lithasia duttoniana	Helmet rocksnail	CR			X	X	X		X
Lithasia geniculata	Ornate rocksnail	R			X	X	X		X
Lithasia geniculata fuliginosa	Geniculate riversnail	R			X		X		X
Lithasia geniculata pinguis	Small geniculate riversnail	C							X
Lithasia jayana	Rugose rocksnail	R			X		X		X
Lithasia lima	Warty rocksnail	CR						X	X
Lithasia salebrosa	Rustic rocksnail	R			X				
Lithasia verrucosa	Varicose rocksnail	R					X		
Polygyra auriformis	Rockpile liptooth								X>

Table C-2 (Continued)

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Native Mussels									
Epioblasma brevidens	Cumberland combshell	R	E	E	X	X			
Epioblasma capsaeformis	Oyster mussel	R	E	E		X			
Epioblasma florentina florentina	Yellow-blossom pearlymussel	R	E	E	X		X		
Epioblasma torulosa torulosa	Tuberculed-blossom pearlymussel	R	E	E		X			
Epioblasma triquetra	Snuffbox	R			X	X			
Epioblasma turgidula	Turgid-blossom pearly mussel	R	E	E	X		X	X	X
Epioblasma walkeri	Tan riffleshell	R	E	E	X	X			
Fusconaia cor	Shiny pigtoe	R	E	E				X	
Hemistena lata	Cracking pearlymussel	R	E	E	X				
Lemiox rimosus	Birdwing pearlymussel	R	E	E	X	X			
Lexingtonia dolabelloides	Slabside pearlymussel	R			X	X	X	X	X
Medionidus conradicus	Cumberland moccasinshell	CR			X	X	X		
Obovaria subrotunda	Round hickorynut	R			X	X	X		
Plethobasus cooperianus	Orange-footed pearlymussel	R	E	E	X	X			
Pleurobema gibberum	Cumberland pigtoe	CR	E	E					X>
Pleurobema oviforme	Tennessee clubshell	R			X	X		X	X
Quadrula cylindrica cylindrica	Rabbitsfoot	R			X	X			
Quadrula intermedia	Cumberland monkeyface	R	E	E	X	X			
Toxolasma cylindrellus	Pale lilliput pearlymussel	C	E	E	X	X			X
Toxolasma lividum	Purple lilliput	CR			X				

Table C-2 (Continued)

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Fishes									
Cycleptus elongatus	Blue sucker	R		T	X>				
Etheostom aquali	Coppercheek darter	R		T	X	X	X		X>
Etheostoma cincereum	Ashy darter	CR		D		X	X		
Etheostoma forbesi	Barrens darter	C		E					X>
Etheostoma luteovinctum	Redband darter	C		D	X	X	X		X
Etheostoma microlepidum	Finescale darter	R		D			X>		
Etheostoma striatulum	Striated darter	CR		D	X	X	X		X
Etheostoma denoncourti	Golden darter	R		D	X	X	X		
Fundulus julisia	Barrens topminnow	C		T					X>
Hemitrema flammea	Flame chub	C		D	X	X	X		X
Notropis rupestris	Bedrock shiner	C		D			X		
Noturus sp.	Duck River saddled madtom	CR		T	X	X	X		
Percina burtoni	Blotchside logperch	CR		D			X		X>
Percina macrocephala	Longhead darter	CR		T			X		X>
Percina phoxocephala	Slenderhead darter	R		D	X	X	X		
Typhilchthys subterraneus	Southern cavefish	U		D					X>
Amphibians									
Ambystoma talpoideum	Mole salamander	B		D					X
Cryptobranchus alleganiensis	Hellbender	CR		D	X		X		X
Hemidactylium scutatum	Four-toed salamander	BW		D					X
Hyla gratiosa	Barking treefrog	BC		D					X
Rana capito sevosa	Dusky gopher frog								X>
Gyrinophilus palleucus	Tennessee cave salamander	U>		T					

Table C-2 (Continued)

Scientific Name	Common Name	Typical Habitat	Federal Status	State Status	Maury County	Marshall County	Bedford County	Moore County	Coffee County
Reptile									
Pituophis melanoleucus melanoleucus	Northern pine snake	M		T					X
Birds									
Ammodramus henslowii	Henslow's sparrow	H							X>
Ammodramus savannarum	Grasshopper sparrow	AH		D	X		X		X
Haliaeetus leucocephalus	Bald eagle	RV	T	T					X
Ixobrychus exilis	Least bittern	RV		D	X>				
Tyto alba	Barn owl	AF		D					
Mammals									
Corynorhinus rafinesquii	Eastern big-eared bat	BF		D					
Lutra canadensis	River otter	RC		T		X			
Myotis grisescens	Gray bat	VR	E	E	X		X	X	
Myotis sodalis	Indiana bat	BM	E	E	X		X		
Neotoma magister	Eastern woodrat	FU		D	X		X		
Sorex cinereus	Common shrew	MC		D	X>				X>
Sorex fumeus	Smoky shrew	MC		D					X>
Sorex longirostris	Southeastern shrew	BH		D					X
Zapus hudsonius	Meadow jumping mouse	CH		D					X

Habitat Abbreviations:

A - Agricultural Areas, B - Bottomland Forests, C - Creeks and Springs, F - Bluffs and Cliffs, G - Cedar Glades, H - Thickets and Fencerows, J - Cedar Forests, M - Mixed Hardwoods, N - Barrens, R - Rivers, U - Caves, V - Reservoirs, and W - Seepage Areas.

Status Abbreviations:

D - Deemed in Need of Management, E - Endangered, T - Threatened

Occurrence Abbreviations:

X - Known to occur in this county within the last 30 years,

X> - Not known from the parts of this county that could be affected by any of the action alternatives.

APPENDIX D

Comments on the Columbia Area Water Supply EIS

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Comments focused on the need for additional water supply for the area, ways to meet that need, and who should address it.

D - Alternative A - No Action **D-52**
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H - Alternative E - Tims Ford Pipeline **D-70**
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I - Climate, Geology, and Soils **D-76**
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A comment concerning the effects of the alternatives on floodplains which would be affected.

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A comment related to the effects of pipeline construction on wildlife, wildlife habitat, and their protection.

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Comments about federal- and state-protected species, and the presentation of this information in the document.

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Comments focused on the land which would be affected by one or more of the alternatives and the way that information is, or should be, presented in the EIS.

S - Visual, Recreation, & Natural Areas **D-99**
Mostly specific comments about the effects of raising the Normandy pool level on the Short Spring Natural Area.

T - Cultural Resources **D-101**
Comments associated with the identification and protection or archaeological and historical resources as presented in the draft EIS.

U - Socioeconomics **D-102**
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Introduction

The draft Environmental Impact Statement (EIS) on Future Water Supply Needs in the Upper Duck River Basin was distributed in August 2000. Members of the public and interested agencies provided comments on the draft EIS at a public meeting held on September 28, 2000, or by surface or electronic mail. Most comments on the draft EIS were received by October 30; however, some comments continued to arrive into early November 2000.

TVA received a total of 80 sets of comments on this draft EIS, including individual letters, letters from organizations and agencies, and verbal comments delivered either at the main session of the public meeting or in an individual comment room. These sets of comments include input from 57 individuals, one federal agency, seven state agencies, three identified county and local government agencies, and eight other organizations. Most of these sets of comments focused on only one or just a few issues; however, a few sets included many issues. The six sets of comments addressing ten or more separate issues have been reprinted here (starting on page D-4) to help clarify the full scope of those reviews of the draft EIS.

TVA has reviewed all of these sets of comments, has identified specific comments about the EIS contained in each of them, and has associated similar comments to produce the following list of 301 separate comments, each of which still identifies its original source(s). These comments are arranged in 21 sections, generally matching the major subject areas discussed in the EIS. Within each section, the comments are arranged with general issues first, then those for the subject action, then those opposed to it, followed by any alternative concepts. Usually simple comments are presented before longer ones, and basic comments are presented before complex ones. TVA staff have provided a response related to every comment, either individually or by clusters of clearly-related comments.

TVA and the cooperating agencies sincerely appreciate the time and thought a number of people have applied to the review of the draft EIS. Several concepts presented in these comments have been used to improve the content of the final EIS. These comments also will help the Duck River Agency and other local interests as they begin to make detailed decisions about how to meet future water needs of the upper Duck River basin.

Columbia Water Supply EIS Log Number 33
Environmental Science Graduate Students, University of Tennessee at Chattanooga

October 19, 2000

Linda B Oxendine
Tennessee Valley Authority
400 W Summit Hill Drive
Mailstop: WT 8C-K
Knoxville, Tennessee 37902

RE; DEIS - Future Water Supply Needs in the Upper Duck River Basin

Dear Ms. Oxendine,

Several Graduate Students of Environmental Science have reviewed the reference Draft Environmental Impact Statement (DEIS) and offer the following comments.

This letter is in opposition to all the alternatives proposed in your Draft Environmental Impact Statement on the Future Water Supply Needs in the Upper Duck River Basin We regard the proposed alternatives as a highly undesirable course of action for several reasons. However, if any of the proposed alternatives must be chosen we support Alternative C: Downstream Water Intake. **[F14]** Included below are our comments in addition to our criticisms in reference to Alternative C. Lastly. we recommend our own Alternative which was not considered in the DEIS

Section 5.2 Climate, Geology, and Soils

Adoption of Alternative C entails the development of a 13-mile pipeline and the subsequent construction of its downstream Duck River booster station. The sinkholes and caves at this venue often form delicate conduits or natural water pipes. There are concerns that during construction the sinkholes and caves may be impacted. Such impacts during construction might involve irreversible collapsing of the fragile karst topography quite possibly increasing the likelihood of ground water contamination. **[J2]**

The soils that are present in the Duck River area range from well to moderately well drained silty/loamy soils to highly acidic and low nutrient content soils. The silty/loamy soils are productive for a variety of different crops and considered prime farmland. Grazing cattle frequently use such soils. The economic cost of changing the land use of these yew productive agricultural areas merits further investigations before implementing Alternative C. **[R2]**

Section 5.3 - 5.4 Ground and Surface Water

From a water-quality point of view, we believe Alternative C will have the Least Minimal Impact (LMI) on water quality from both the natural reservoir and the reservoir Construction area is minimal and does not run the risk of contaminating water from exposed soil runoff or wiping out entire communities of organisms. The amount of water transferred is sufficiently small enough, greatly reducing the risk of affecting nutrient cycling and thermal stratification or the lowered dissolved oxygen levels within certain population parameters. **[K15]**

On the other hand, Alternative B will have the greatest effects on the quality of surface and ground water. The large area necessary for construction will have adverse effects on a complex array of aquatic ecosystems For example, by destroying undetermined species within the large non-surveyed areas, we cannot be certain of the impacts that one or perhaps three or four species disappearance would have on the system as a whole. **[L2]**

The extraction of soils necessary for construction would subject the nearby waters to high amounts of dissolved metals, petroleum and organic acids that have been long since trapped within the soils. This contamination could effectively lower the pH, possibly affecting nearby ground water tables. In addition, increased amounts of freshly killed plant matter and the introduction of carbon rich humus into the heterogeneous waters may cause many species of heterotrophic bacteria to bloom. Collectively, potential effects of lowering the dissolved oxygen content in the reservoir as well as increasing the chance for an outbreak of dangerous bacteria such as *Cryptosporidium* sp., *E coli* and other fecal coliform merits further rejection of Alternative B. **[K11]**

The modification of introducing cold oxygen depleted bottom water into the system will possibly further deplete the dissolved oxygen - possibly disrupting the complex thermal stratification layers in the water. Such a disruption could also interfere with nutrient cycling - a necessity for all life in aquatic systems. Accurate impact assessments dealing with such intricately complex cycles and oxygen depletion effects (often exponential) in Alternative B should be approached with caution. **[K9]**

Additionally, many bivalent metal ions tend to dissolve out of solution and into the soils over time However. a lowered pH and depleted dissolved oxygen will cause many metals (calcium, manganese, etc) to dissolve back into the water. This alone can have a hazardous effect upon humans via primary ingestion, secondary, ingestion or prolonged contact. **[K10]**

These reasons alone brand Alternative B unacceptable because of its effects on water quality. The issue is not just the previously elucidated factors that present danger or caution, but the infinite unforeseeable factors that may cause the greatest damage.

Section 5.5 Aquatic Life

There appear to be few impacts on the aquatic fauna associated with the adoption of Alternative C. Of the alternatives suggested by TVA, Alternatives C and E appear to be the most reasonable alternatives concerning aquatic life. Due to the relatively low amount of water that is being withdrawn from the proposed site in Alternative C, few negative effects would be likely. Sedimentation from construction could present localized problems in terms of disturbing habitats of benthic and lithophilic species, especially certain percid and cyprind fishes which utilize these habitats for spawning (12 darter species and 16 shiner/chub species). **[L4]**

Additionally, there is concern that the project may pose some localized threats to the mollusk fauna, as they too are sensitive to sedimentation from construction activities Fortunately, the mollusk fauna at the potential withdrawal site (RM 104) does not contain some of the more sensitive mussel species *(Epioblasma* sp., *Lemiox* sp.). However, little or no survey data concerning the gastropod fauna from this rcach is available. Given the presence of an endemic gastropod in the Duck River system *(Lithasia genticulata),* and the rich species diversity present in the Duck, it is incumbent on TVA to conduct a gastropod inventory in this proposed withdrawal area. TVA needs to be aware of what aquatic fauna is to be reasonably affected by a withdrawal station. **[L5]**

Section 5.6 Wetlands

As previously stated in the DE1S, the implementation of Alternative C would have short-term minor effects on some known wetlands. The minor effects are further defined as probable minimal construction effects in the DEIS. The severity of the minor short-term effects is apparently dependent on the proper siting, design, and construction of the contiguous facilities. Long-term effects and net loss or total displacement assessments for those wetlands are not adequately addressed in the DEIS. The issues below merit investigations before selection of Alternative C, albeit it is the nominee. The wetlands in peril need proper denotations as either forested and scrub-shrub type or emergent type wetlands. **[M1]** Furthermore, a vascular and non-vascular inventory for endangered or threatened species is appropriate if not imperative. **[Q2]**

Section 5.7 Flood Plains

Since the purpose of this project is to supply water, the pipeline and the intake will have to be constructed in the flood plain because there is no other feasible alternative. This will cause some disruption to the areas around the construction of the pipeline, but if the disturbed areas are reverted back to their natural state there should not be any long term effects. The route chosen for the pipeline would take it across numerous streams. It is at these points that it will be crucial for the construction of the pipeline to follow best management practices to minimize the impacts of the crossings. The pipelines will also have to be constructed in a way to make them able to withstand flood like conditions and to comply with the National Flood Insurance Act.

Alternative C would effect only small areas during construction, but without any major impacts. There would be no change in the climate or the general characteristics of the geology of the Duck River area. The effects upon the soils and the flood plain will be negligible. **[N1]**

Section 5.8 Terrestrial Life

Given the length of the proposed pipeline (13 miles), certain species could be affected either by directly disturbing habitat or through disturbance of foraging ability, nesting, etc. Attention to sensitive species (such as the Indiana Gray Bat) should be considered. **[Q1]** Most importantly to consider are habitat fragmentation effects associated with a pipeline right-of-way. This would have the potential to destroy underground nests/burrows of terrestrial species and potentially impact a species metapopulation. TVA should address potential impact areas for whatever terrestrial species are located there, and provide some attempt to relocate species that most likely affected by pipeline construction. Additionally, TVA should investigate the possibility of co-locating the proposed pipeline in existing right-of-ways. **[P1]**

Section 5.9 Endangered and Threatened Species

Considering endangered or otherwise protected vascular plant species of Tennessee, the DEIS methodology of determining the potential for a protected species to occur in any of the Upper Duck River Basin alternative project areas is unacceptable. Furthermore, simply stating the likelihood of a protected species occurring in an affected area as either 'yes' or 'no' is also unacceptable. For example, *Helianthus eggertii* occurs in nine (not eight) Tennessee counties (Chester, E W, Wofford, B E., and Robert Kral, 1997. *Atlas of Tennessee Vascular Plants'.* Volume 2 Angiosperms: Dicets Miscellaneous Publication Number 13. The Center for Field Biology, Austin Peay University. Clarksville, Tennessee. 238 pp.). This composite, as noted in the DEIS, occurs approximately twelve miles SW of Columbia in Maury County. As stated in the DEIS, *H. eggertii* is not known to occur in the Central Basin Physiographic Province of Tennessee. However, significant portions of Maury, Bedford, and Davidson Counties each with a site record of the composite subsequently occur in the Central Basin Physiographic Province (Chester), including the station at Maury County. This alone establishes that the protected plant is not associated exclusively with the Highland Rim Provinces (East and West). Six counties in the Eastern and Western Highland Rim Provinces support *H. eggertii* (Chester *et al.*, 1997), not including the station at Coffee County as stated in the DEIS. Three of the nine known and documented Tennessee stations of the composite are supported in the Central Basin Province contradictory to statements issued in the DEIS. **[Q11]**

Considering that three of the populations occur in the Highland Rim Province and more importantly three in the Central Basin Province, should not a complete vascular plant inventory be conducted before any alternative is implemented? Although surveys were conducted on Columbia Project Lands. their methodologies are poorly if at all delineated in the DEIS - merely stated as extensive surveys were conducted. Did the surveys intend to find only *H. eggertii* or *all* the states listed and federal species? How is an extensive survey defined? Complete vascular inventories should entail a systematic collection within all affected areas, not merely probable habitats. Sampling should run through two growing

seasons depending on the area and number of habitats and documentation of specimens (voucher specimens if applicable for protected species or even pictures) and their respective locations should all be obtainable by the public. Furthermore, extensive surveys are not tantamount to baseline inventories. Surely, a single voucher specimen for every vascular plant encountered was collected and identified in the Columbia Project Lands area. If not, how can the species probability or likelihood of occurrence be stated with any confidence? **[Q12]**

Lastly, *Schwalbea americana* and *Xyris tennesseensis* found in Coffee and Lewis Counties respectively are both considered not potentially affected or likely to occur in any of the alternative project areas These assumptions are based on an 1879 site record and an eight-mile separation from a proposed alternative project area. The issue here does not concern itself with tangible distances and uncommonly intermittent records, or even distributions amongst physiographic provinces of protected plants near probable affected areas. But simply how can statements in the DEIS be made concerning the potential or likelihood *of at least* sixty-eight protected species occurring in alternative areas without a complete baseline vascular plant inventories. **[Q7]**

Section 5.10 Land Use

Alternative C would only have short-term adverse effects on land use, primarily because the location and construction of the pipeline, intake, and booster station can be adjusted so as to minimize their effects on prime farmland and other uses of the land in the area. Due to its minimum requirements for land (estimated to be 2 acres plus 130 acres of easement for the pipeline), this alternative is preferred over Alternative B which would require the disturbance of 3,600 acres of land. **[R1]**

Section 5.11 Recreation

Alternative C would have only a minimum impact upon the recreational use of the Duck River - and for only a brief period of time Only a very small (< 1 acre) would be required for the intake structure Also, neither the presence nor operation of the underground pipeline would negatively impact the recreational use of this river. **[S1]**

Section 5.12 Cultural Resources

When compared with Alternative E (requiring a 20-mile-long pipeline), and Alternative B (requiring the disturbance of 3,600 acres), Alternative C would only disturb a small amount of Land Therefore, assuming that the potential cultural resources are evenly distributed, the Alternative C would have the least impact on any existing cultural resources. In addition, after the site/route is reviewed by the Tennessee State Historic Preservation Office, the pipeline construction could be adjusted to minimize further disturbance to cultural resources under this alternative. **[T1]**

Section 5.13 - 5.18

Alternative C has some unavoidable adverse impacts which include the construction of 13 miles of pipeline and localized short-term impacts on aquatic, terrestrial, and cultural resources. It also has some irreversible and irretrievable resource commitments to build the intakes, pumping stations, and pipelines. There will be long-term commitments of around 10 acres of land for the intake and pumping facilities, and short-term use of the land surface along the routes of the pipelines.

However, an alternative that we feel would best fit this project was not considered. This alternative is as follows:

Alternative Not Considered

Given the potential serious impacts on aquatic fauna in several proposed alternatives, TVA is strongly urged to completely disregard Alternative B and D, and consider the possibility of constructing an offshore reservoir Page 58 of the DEIS stated that

this alternative was "adequately represented by the Fountain Creek Reservoir alternative" . However, our proposed alternative represents an entirely different scope than a tributary reservoir. TVA should not consider these alternatives to be the same.

Given the number of federally listed aquatic species in the Duck River system, and the relatively common nature of many of the terrestrial plants and animals, it makes much more sense to limit impacts to an offshore site. Impacts with this sort of alternative would likely only affect plant communities in the area. Since TVA has purchased the rights to 3,800 acres of land within the Fountain Creek watershed, surely a parcel of land exists where few sensitive plant or animal communities exist, or where these effects would be minimal. This alternative would preserve the biotic integrity of the aquatic fauna of the Fountain Creek system (182 spp.).

Additionally, this alternative could adequately meet water supply needs if the containment reservoir was built to accommodate a large volume of water (ca. I billion gallons). Such a reservoir allowed to fill slowly would minimize cubic feet per second (cfs) removal effects if the water withdrawal area were around Duck River Mile 140-200. Furthermore, this alternative could allow construction of the reservoir near the river (within a few miles), therefore eliminating the need for a 10-20 mile pipeline.

TVA should strongly consider including this alternative in their potential revisions or attachments to the DEIS. **[A25]** Besides Alternative C and E, this alternative would pose the least threat to the aquatic fauna

Sincerely,

Graduate Students - Environmental Science
University of Tennessee at Chattanooga

Columbia Water Supply EIS Log Number 43
Justin P. Wilson, Deputy to the Governor of Tennessee

October 20, 2000

Ms. Linda Oxendine
Draft EIS-Upper Duck River Basin
400 West Summit Hill Drive, WT 8C
Knoxville, Tennessee 37902

Dear Ms. Oxendine:

As the Governor's Lead Contact for State of Tennessee, National Environmental Policy Act (NEPA) reviews, I am providing comments in response to the Draft Environmental Impact Statement (DEIS), Future Water Supply Needs in the Upper Duck River Basin, August 2000. The attached comments from state agencies represent the complete and official response of the State of Tennessee. Please give these comments your full consideration.

A variety of unresolved issues and unmet obligations remained after the closure of the Columbia Dam project. First and foremost of these is the need to resolve the long-term water supply needs of the Upper Duck River Basin. In **Governor Don Sundquist's view, clean and dependable water for the Columbia region is as fundamental to the economic growth of the region as is dependable, low-cost electricity. This is the State's overriding concern. [C1]**

As we stated in our letter dated March 7, 1997 concerning the closure of the Columbia project, "The TVA should verify existing public water supply sources or finance new supplies at levels that meet local long-range water supply needs as defined by the Regional Water Supply Analysis for Southern Williamson, Marshall and Maury Counties or by the State." We also stated, "Although local interests have shared responsibility to support water supplies, the larger burden to verify or produce dependable water supplies is TVA's alone." These assertions remain true.

TVA's water analysis seriously examines regional water supply needs. It is a responsible effort to meet your obligations to the people of the Upper Duck River region. **[A10]**

The draft identifies a variety of alternatives ranging from a traditional impoundment, pipeline options and a dam improvement alternative. A single alternative or combination of options can provide water well into the future.

One or more of the alternatives addressed by the EIS may provide a long-term and reliable source of water. **[A19]** The following summarizes our view of the alternatives evaluated.

- The Fountain Creek Dam Alternative is fraught with both opportunity and limitations. This alternative appears to provide an adequate water supply. The Columbia Dam land use EIS, associated deed restrictions and agency agreements provide for environmental mitigation. Other permit issues must be resolved before project approval. Moreover, reservoir's shallow nature creates challenges for water quality. In no event, however, should the Fountain Creek Dam alternative be abandoned until provisions have been made for an adequate water supply through 2050. **[E29]**

- Based on information provided by the EIS, the Tennessee Department of Environment and Conservation's Division of Water Supply states that the Tim's Ford pipeline alternative provides the highest quantity and quality water. This alternative may also provide benefits to other communities along its route who face increasing water needs. **[H2]**

- Raising Normandy Dam has additional benefits independent of the water needs identified in this study. **[G22]**

The assumptions and conclusions in this document would be more complete if they included additional information and assessment. State agencies have identified a variety of concerns that may add greater clarity to future decisions, The following should be incorporated into the final draft:

- We do not accept the premise in the Draft EIS that there will be no growth in "new large, water consuming industries." The Tennessee Department of Economic and Community Development believes that industrial growth will be critical to the future growth of the region. **[U1]**

- Additional consideration of low-flow impacts from implementation of Alternative C, the pipeline to downstream reaches of the Duck River, should be further evaluated and discussed. All impacts should be weighed and assessed to contrast each alternative fully. **[F15]**

- Broader benefits provided by the Normandy reservoir option to increase flow in the Duck River and the potential for mitigation measures to protect Short Springs Natural Area should be documented in the EIS. **[S2]**

- The Summary Comparison Table 6 on page 60 should also document a brief summary of natural and environmental impacts since environmental permit issues will be a major consideration in balancing benefits with impacts. **[A18]**

Although it is not a specific part of this analysis, we commended TVA for meeting another state criteria to resolve its obligations for water. The setting aside of locally derived trust funds for regional water supply projects represents sound judgment and necessary fairness. These funds can play a significant role in the funding of an alternative addressed in the EIS. **[B14]**

Ultimately, the decision to make a proposal to replace the water that would have been provided by the Columbia dam and to offer it for federal and state permits resides with the community. The TVA has acted responsibly and prudently to aid the community to make the necessary decisions. We commend your leadership and offer our assistance for a final resolution. **[B9]**

Sincerely,

Justin P. Wilson
Deputy to the Governor

Attachments

Columbia Water Supply EIS Log Number 51
U. S. Environmental Protection Agency

October 26, 2000

Dr. Linda Oxendine
Tennessee Valley Authority
400 West Summit Hill Drive, WT 8C
Knoxville, TN 37902

EPA NEPA Comments on TVA DEIS for the "Future Water Supply Needs in the Upper Duck River Basin;" Bedford, Marshall, Maury and Williamson Counties, Tennessee; CEQ No. 000315

Dear Dr. Oxendine:

Consistent with Section 102(2)(C) of the National Environmental Policy Act (NEPA) and Section 309(a) of the Clean Air Act, the U.S. Environmental Protection Agency (EPA) has reviewed thc referenced Tennessee Valley Authority (TVA) Draft Environmental Impact Statement (DEIS) on various future water supply alternatives for the area.

The purpose of the DEIS is to: 1) determine the need for additional water supply in the Duck River watershed over the next 50 years for Bedford, Marshall, Maury and southern Williamson County, 2) identification of ways to meet any determined water needs, and 3) environmental and societal impacts associated with those ways of meeting any water needs.

We offer the following comments for TVA's consideration in the development of the Final ElS (FEIS):

NEPA Process - As suggested on page 1, the EIS is written much like a programmatic EIS since it generically explores a need for additional water supplies and leaves site-specific plans for the future. For example, the reservoir management plan for the Fountain Creek Reservoir alternative (B) was not developed, the environmental impacts of the new water treatment plant for the downstream intake alternative (C) were not included in the impact analysis, and the pipeline impacts for Alternatives C, E and B were also not disclosed. Page 39 also states that "TVA is not proposing to design or construct any of these facilities" and "[i]n this EIS, these action alternatives have been generally described in light of their conceptual nature at this early stage." Page 1 further states that "..., several of the alternatives would not have to be built for a number of years." While EPA agrees with the concept and need for programmatic EISs that are followed by site-specific NEPA documents, our concern is that this EIS was not titled as a programmatic EIS. This should be discussed. **[A13]**

It should also be noted that if the present EIS is not a programmatic EIS but rather is an action EIS, construction of the preferred alternative would need to be initiated within five years or a re-evaluation of impacts would be needed, If impacts were determined at that time to be significantly different, a supplemental EIS would be needed if the project was pursued. **[A14]**

Consistent with the *Federal Register,* public comments are due to TVA by 10/30/00 as opposed to the 10/20/00 date stated on the DEIS cover page. Accordingly, we recommend that TVA receive comments postmarked by the 10/30/00 date. **[A17]**

Purpose & Need - Although there seems to be a perceived need by some of the locals (pg. 10) for additional water supplies in the watershed, the actual need seems unjustified at this time for the Bedford and Marshall County service area through 2050, based on the needs analysis in the *DEIS.* However, for the Maury and southern Williamson County service area, water supply is expected to become a growing issue after 2015. The DEIS indicates (pg. 31) that by 2025 the unmet need would be 6 cfs (4 mgd), by 2035 it would be 14 cfs (9 mgd), and by 2050 it would be 22 cfs (14 mgd) beyond the 40 cfs available from the Normandy Reservoir. However, page 35 notes that "[t]hese amounts of water would be needed only during extended drought conditions, when demand was at its maximum and nearly all of the flow in the river was supplied by the minimum discharge from Normandy Dam." **[C9]**

The DEIS analyses assume that no new water-consuming industries were to site in the watershed and increase the water demands. In addition, it is somewhat unclear *if agricultural* needs were adequately included. Page 24 of the DEIS states that "[t]he amount of water withdrawn for agricultural irrigation is not known, but given the intensive agricultural land use in the three county area, significant amounts could be drawn during an extended drought." Similarly, page 25 states that the USGS, in their 1996 needs evaluation estimates, "...did not include any water for new, self-supplied industries or major expansions of agricultural water use in any of the three water service areas." The FEIS should further discuss agricultural needs and the potential for agricultural expansion and additional water-consuming industries siting in the area. **[V3]**

Given the apparent minimal immediate need for additional source water, the intended purpose of the reservoir may be more to enhance real estate and recreational value in the area more so (or rather than) creation of additional source water. If so, the focus of the EIS should be environmental impacts on actions associated with increased urbanization and residential sprawl into rural areas. **[A12]**

• **Alternatives -** In addition to the No (federal) Action Alternative (A), four action alternatives were considered: Fountain Creek Reservoir (B), Downstream Water Intake (C), Raise Normandy Reservoir Pool (D), and the Tims Ford Reservoir Pipeline (E). Alternative A would involve no new water supply although improvements of existing systems would proceed; Alternative B would involve construction of a new multipurpose reservoir on Fountain Creek near the confluence with Duck River; Alternative C would involve construction of a new water intake on the Duck River downstream of the confluence with Catheys Creek and include an associated 13-mile long pipeline (with a booster station) to a new water treatment plant; Alternative D would raise the pool of the existing Normandy Reservoir to augment flows in Duck River; and Alternative E would involve construction of a water intake in nearby Tims Ford Reservoir and include an associated 20-mile long pipeline to the Duck River (with a booster station) to augment river flows when needed. Overall, these alternatives would increase additional water volumes from none (A), to 16 cfs (D), to 22 cfs (E), to 46 cfs (C), to 74 cfs (B) and would meet perceived water needs until 2015 (A), 2035 (D), 2050 (E), or beyond 2050 (B and C). The most significant land use changes would be via construction of the Fountain Creek Reservoir (B) involving the clearcutting of some 225 acres of forested wetlands and flooding 2,200 acres of land at normal full pool as well as the construction of a short 5-mile long pipeline. The next most disruptive alternative would be raising the pool of Normandy Reservoir (D) some five feet involving loss of shoreline vegetation (including forested wetlands) and existing shoreline recreational amenities. Finally, the significant pipeline constructions associated with the water intakes for Alternatives C (13-mile pipeline) and E (20-mile pipeline) could be disruptive if environmental features within the ROW corridor are unavoidable. The No Action Alternative would involve only minor construction unless the existing water treatment plant were expanded to capacity (30.8 mgd), which seems likely. All action alternatives would increase Duck River flows at some point along the river and therefore increase downstream

wetted areas and benefit associated aquatic species. These alternatives would also allow maintenance of the minimum 100 cfs flows (at RM 132.8) required for the river system according to the TDEC.

From a practical perspective, implementation of the Fountain Creek Reservoir would utilize some 2,800 acres of the available Columbia lands previously acquired for the discontinued Columbia Dam and Reservoir. Such use would keep these lands in public ownership and under the direct purview of TVA. However, an additional 800 acres of land currently not in public ownership would need to be acquired for the reservoir. **[A16]**

· **Preferred Alternative** - No preferred alternative was selected by TVA in the DEIS, although TVA has indicated a non-preference for the No Action Alternative (A). While acceptable from a NEPA perspective and understandable in the sense that TVA and its cooperators might want additional public input before selecting a preferred alternative, we note that delaying the identification of TVA's selection until the FEIS stage is *late* in the NEPA process. At that stage, the public and resource agencies would not be able to comment on the preferred alternative until the FEIS comment period, which may or may not truly influence any modification of the preferred alternative and would reduce the probability of a different alternative being selected if the public so-requested. **[A24]**

EPA is not convinced that a water supply alternative is needed at this time for the area of concern, particularly the Bedford and Marshall County service areas. In regard to Maury and southern Williamson County, we believe the determined unmet need during droughts starting in 2015 through 2025 (4 mgd or 6 cfs) could and should be met through water conservation. The 2035 unmet need (9 mgd or 14 cfs) could arguably also be met through conservation. The unreel need for 2050 (14 mgd or 22 cfs), however, is approximately 50% above the 40 csf baseline Normandy flows, and therefore would likely require additional water supply. However, that need is many years away and would only apply during drought situations. As such, based on the DEIS, EPA believes the need for additional water supply is unfounded for the Bedford and Marshall Counties and can be met by conservation methods for some time (through approximately 2025 or 2035) for the Maury and southern Williamson Counties during droughts. At this time, therefore, EPA favors the No Action Alternative (A) for the near term. We recognize, however, the value of early planning for future needs in order to determine an adequate and environmental approach to additional source water. **[C10]**

If this approach is unacceptable to local water authorities or if additional agricultural or water-consuming interests can be expected to withdraw significant additional volumes from the Duck River, EPA recommends that the most environmental alternative be implemented by approximately 2025. Voluntary conservation methods should be encouraged and employed regardless of which alternative is selected, with incentives and disincentives should be provided by local authorities for complying customers. Conservation should target those activities that consume water (e.g., lawn watering) as opposed to those that return a large portion of the water to its source (e.g., wastewater). **[A31]**

Of the four presented action alternatives (B-E), EPA does not environmentally favor the construction of Fountain Creek Reservoir. This is due to the projected substantial loss of forested wetlands and uplands, potential ground-water effects due to local karstic geology, the potential for shoreline development and its associated impacts on water quality, the expectation for a small nutrient-rich reservoir with a slow flushing rate which may result in noncompliance with water quality standards associated with eutrophication, the potential for aquatic ecology effects downstream of the proposed dam due to reduced flows, the need to acquire an additional 800 acres of land, the uncertainty of the undocumented impacts of the new water treatment plant and associated five-mile long pipeline, and the existence of two nearby reservoirs (Normandy and Tims Ford) which might be utilized. **[E24]**

Conversely, however, we recognize that the Fountain Creek Reservoir would apparently become part of the TVA system and would therefore be managed by TVA, which has demonstrated significant expertise and success in reservoir management. **[E32]**

To help further assess the potential success or problems associated with the reservoir alternative, we suggest that water quality monitoring data for the nearby Normandy Reservoir (which by now has aged or equilibrated as a reservoir) be provided in the FEIS for comparison, to the extent the two reservoirs are similar. We have also enclosed an EPA Region 4 checklist *(EPA Section 404 Reservoir Review)* prepared by our wetlands section that should provide additional guidance in assessing potential reservoir projects. **[K9]**

The impacts of the remaining action alternatives (C, D & E) are uncertain since impacts of pipeline routes C & E) and specifics on treatment plants common to all action alternatives are not disclosed. **[A29]** Alternative E also proposed interbasin transfer of water from Tims Ford Reservoir to Duck Creek, with which there also could be some associated environmental issues. **[H23]** We recommend that a modification of Alternative E (which we name here as *Modified E)* be considered to the extent that it might be feasible. Modified E relates to the Tullahoma Wastewater Treatment Plant (Tullahoma) discussed on pages 152-153. Tullahoma purchases water from the Duck River Utility Commission which withdraws from the Normandy Reservoir. Tullahoma then discharges its treated wastewater into Rock Creek which is a tributary of the Elk River, which is connected to and drains into the Tims Ford Reservoir. As such, water is being removed from the Duck River system and discharged into Tims Ford and, with Alternative E, Tims Ford water is being withdrawn and discharged into the Duck River. We suggest that the potential for Tullahoma returning its Duck River water to Duck River as Modified E be explored. This would avoid interbasin transfer and the Tims Ford 20-mile pipeline (albeit, the logistics and volumes of Modified E are unclear and the need for a pipeline of uncertain length from Tullahoma to the Duck River exists). **[K26]** Given these considerations, our alternatives "preference" from most preferred to least is as follows: *A, Modified E (if feasible), C, E, D and B.* **[A30]**

· **Water Conservation** - The document fails to discuss water conservation as an alternative or supplement to the action or no action alternatives. Efficient use of existing supplies can save money, obviate the need for additional water storage capacity, and prolong the use of existing supplies during shortages. Successful implementation of water conservation measures depends on regulatory action by state and local governments and management decisions by the local utility. Typical measures are codes and ordinances that mandate water conservation through the use of plumbing fixtures, use of reclaimed water, installation of meters, leak detection programs, rate structure changes, and public education programs. As previously indicated, voluntary conservation methods should be encouraged and employed regardless of the alternative selected, with incentives and disincentives provided by local authorities for complying customers. Conservation should target those activities that consume water (e.g., lawn watering) as opposed to those that return a large portion of the water to its source (e.g., wastewater). **[C22]**

· Water Quality

* *Surface Water* - Page 147 indicates that the Fountain Creek watershed that would contain the reservoir proposed under Alternative B "...contains relatively high levels of nitrogen and phosphorus from natural sources as well as non-point sources." This page further states that "[t]hese levels of nutrients would be quite likely to support excessive algal growth in the upper layers of the reservoir." Page 149 similarly states that "...construction and use of the Fountain Creek water supply reservoir would create a relatively small, nutrient-rich reservoir which probably would have to be carefully monitored and the watershed strictly managed to protect the quality of the source water." Accordingly, EPA is concerned that the Fountain Creek Reservoir proposed under B could become eutrophic and not comply with the Clean Water Act. **[E23]**

As further discussed below under *Water Supply,* sediments and disinfection-by-products (THMs) have been a significant issue for the public water supply system currently using the Duck River as its source water. The source, effects and control of THMs should be discussed in the FEIS. **[K3]**

* *Ground Water* - The project area is generally karstic and as such has sinkholes and other natural conduits to the water table. Construction of a reservoir in these areas could promote contamination of ground water if the reservoir water quality and sediment quality becomes degraded and migrate into the water table. The DEIS mentions (pg. 142) the potential for grouting the bottom of the reservoir area during construction to prevent such interconnection. Special engineering methods would be needed in these karstic areas, particularly those involving excavation, low elevations, caves, and similar geologic features. The greatest potential for ground water impacts among the alternatives appears to be the construction of the reservoir. **[J1]**

· **Wetlands** - The greatest wetland losses are associated with B (reservoir) and D (raising Normandy pool). As previously indicated, B would result in the loss of some 225 acres of forested wetlands as well as the loss of the reach of Fountain Creek that would be inundated. It is unclear if perhaps other non-forested wetlands may also be lost within the 2,200 acres to be inundated for the reservoir (the FEIS should therefore total all the estimated jurisdictional wetlands that would be inundated by the reservoir). It should be noted that EPA considers both vegetated wetlands and creek water as wetlands, and water inundation of the reservoir wetlands and creek water is considered the same as filling wetlands with soil. **[M2]**

The 225 acres of wetlands were not precisely determined in the field but were estimated by aerial false-color infra-red photography. A jurisdictional determination of these wetland habitats needs to be made pursuant to Section 404/U.S. Army Corps of Engineer regulations. Following this determination, an avoidance or mitigation strategy should be provided. The mitigation strategies (pg. 163) indicated in the DEIS were general in nature and should be refined to indicate a more specific mitigation plan. Although not required, a draft mitigation plan should be included in the FEIS as well as a commitment to provide wetland compensation to the satisfaction of the resource agencies. **[M3]**

Implementation of Alternative D, which would raise the elevation of Normandy Reservoir by five feet, would result in the inundation of riparian vegetation including "...several forested wetlands that now occur at the upstream ends of some reservoir embayments" (pg. 164) as well as herbaceous fringe wetlands along the current Normandy shoreline. It is unclear what wetland losses or conversions may be associated with the pipeline alternatives C and E). The FEIS should be more specific as to the kind, quality and function of the wetlands that would be lost for each alternative. **[M4]**

Consistent with 404 (b)(l) guidelines, the loss of wetlands associated with B and D would need to be considered in the alternatives analysis, especially since other practicable alternatives with less wetland impacts exist. **[M5]**

· **Geotechnical and Soils** - EPA is concerned over the apparent lack of geotechnical studies in the document to determine the suitability of the site soils to hold water relative to the reservoir alternative (B). Local soils should ideally be relatively impermeable in order to retain desired water levels without creating zones of saturated soils adjacent to the project. Leakage and erosion of the proposed earthen dam are also a concern. The FEIS should contain estimates of impacts of water loss through the permeable parent soil materials that will make up the basin of the proposed reservoir. **[I1]**

· **Water Supply** - We offer the following comments and general questions regarding water supply:

* *Classified Uses:* We note from page 82 that: "The domestic water supply use classification is excluded in these areas because the State of Tennessee (TDEC) considers stream reaches immediately downstream from municipal wastewater discharges to be unsuitable for domestic water supply withdrawal." The state's criteria and scientific basis for this decision is unclear. How does TDEC determine where such an exclusion zone should no longer exist? Although not a TVA decision, we would appreciate some discussion on this matter in the FEIS. **[K2]**

* *Water Supply Designated Use* - Similarly, it is also unclear what criteria TDEC uses to determine that one stream segment is suitable for an industrial water supply designated use, and not for a municipal water supply designated use. **[K1]**

* *Source Water Protection* - As suggested above, sediments and disinfection-by-products (THMs) have been a significant issue for the public water supply system currently using the Duck River as its source water. THM precursors include algae and high Total Organic Carbon (TOC) levels, which are in turn related to elevated nutrients. We strongly recommend a TVA commitment for source water protection as part of the preferred alternative in the FEIS. We believe such protection should be part and parcel of any potential approval of a water supply project **[K4]** (also see below discussion under *Basin Management Plan* which includes the referenced *Randleman Watershed Management Rules,* as well as item #6.k. under the enclosed *EPA Section 404 Reservoir Review).*

* *Minimum Flows* - All minimum flows downstream of the proposed dam for Alternative B *should be consistent with the U.S. Fish and Wildlife (FWS) and EPA guidelines that include* minimum flow rates and variable flows consistent with sustainability requirements for fish and other aquatic inhabitants. **[L2]**

· **Basin Management** -The disposition, ownership, and management of the environs surrounding the reservoir proposal (B) are a major shortcoming of the DEIS. As other reservoir projects in the nation have experienced, control of nutrients in the reservoirs and lakes in the southern U.S. are a continuing challenge. Shallow, warm water bodies enriched with nutrients from farmland and agricultural runoff and natural sources quickly become colonized with mats of aquatic plants and algae. To control nutrient enrichment and Eutrophication, the drainage basin containing the reservoir will likely require management measures and land use controls including but not limited to: creation of buffer zones in perennial and intermittent streams in the watershed; timber cutting and agricultural use restrictions in buffer zones; lot size and housing density restrictions; policies on septic tank placement and maintenance, and other strategies to prevent pollutants and nutrients from entering the proposed reservoir. If Alternative B is selected by TVA as its preferred alternative, the FEIS should provide at least a draft basin management plan that includes TVA policies and procedures on shoreline management, water quality, monitoring, aquatic weed control, fisheries, etc. as they relate to the proposed Fountain Creek Reservoir.

As an example of reservoir management techniques that may be useful in addition to TVA's management EISs such as the recent *Shoreline Management EIS,* we have enclosed the watershed management rules that the State of North Carolina required for the Lake Randleman watershed *(Randleman Watershed Management Rules)* in 1998. **[R4]**

· **Fisheries** - As is typical for a reservoir project that impounds a stream reach, the biodiversity of the inundated stream would decrease as the system changes from a lotic to a lentic system, although the numbers of the remaining species would likely increase. For the reservoir alternative (B), the DEIS (pg. 156) indicates that the182+ species in Cane Creek are expected to be reduced to the 44+ to 48+ species living in nearby Normandy Reservoir.

· **Endangered Species** - Given the fact that endangered mussels caused the Columbia Dam to be discontinued, TVA should ensure that no such endangered species or other unresolvable "show-stoppers" exist in the nearby Fountain Creek watershed if the reservoir alternative (B) is pursued. **[Q6]**

· **Environmental Justice (E J)** - We note that the EJ Executive Order (EO 12898) was not listed on pages 16-17 under *Other Review and Permit Processes.* The FEIS should list it and, more importantly, consider potential EJ impacts relative to the alternatives. **[V1]**

Page 137 discusses demographics of the project area. It appears that minority and low-income percentages are similar among project counties and lower than the state average. One exception is the Bethesda Division of Williamson County for low-income groups, which is noticeable greater (12.6%) than that of the total county (5.8%). This should be considered during infrastructure construction of the alternative. However, since the overall effect of the project would be to increase water supply in these counties, this may or may not be a great EJ concern. **[V2]**

· **Cumulative/Secondary Impacts** -The relocation of Highway 50, any secondary roads, power transmission lines, water treatment plants and other related facilities of the presented alternatives, as well as other present, proposed and foreseeable future projects over a 10- to 20-year horizon in the region, should be considered and discussed in the FEIS. **[A28]**

· **Summary** - In summary, until a true water need can be demonstrated beyond what existing sources (Normandy flows and wastewater returns) and conservation methods can provide, EPA favors the No Action (A) for the near future. If this is considered unacceptable to local water authorities and implementation of one of the remaining alternatives (B-E) is pursued, we would not prefer implementation of the Fountain Creek Reservoir (B) or raising the pool of the Normandy Reservoir (D) due to their impacts. We also have environmental concerns about the alternatives with long pipelines (C and E) with unclear routes and undisclosed impacts. If the pipeline impacts could be minimized through alignment shifts and the impacts of new water treatment plants common to all action alternatives could also be minimized, we would favor C over E since it has a shorter pipeline than E, and E also involves interbasin transfer. However, we strongly suggest that the feasibility of a modification of E (Modified E) be considered, which returns additional wastewater to the Duck River as opposed to transferring it to the Tims Ford Reservoir. **[A32]**

· **EPA DEIS Rating** - Since no preferred alternative was selected, EPA has rated all alternatives individually. As previously indicated, our alternatives "preference" from most preferred to least is as follows: *A, Modified E (if feasible), C, E, D and B.*

We rate A as "LO" *(Lack of Objections)* due to the minimal environmental disruption and the acceptability of the water supply volumes for the near term, especially if water conservation methods are implemented in Maury and southern Williamson Counties during droughts. We rate Modified E, C and E as "EC-2" *(Environmental Concerns,* with additional information requested) due to the uncertain feasibility and impacts of Modified E, and the long pipelines of C and E plus the additional interbasin transfer aspect associated with E. We rate D and B as "EO-2" *(Environmental Objections,* with additional information requested) due to land use impacts such as loss of forested wetlands for B and loss of shoreline vegetation (including forested wetlands) and shoreline amenities for D. Overall, we also rate the DEIS as "EO-2" since two of the alternatives are rated "EO-2".

We were pleased to provide these comments. Should you have questions, feel free to contact Chris Hoberg of my staff at 404/562-9619.

Sincerely,

Heinz J. Mueller, Chief
Office of Environmental Assessment Environmental Accountability Division

Enclosures

Columbia Water Supply EIS Log Number 64
Andrew N. Barrass, Natural Heritage, Tennessee Department of Environment and Conservation

October 20, 2000

Ms. Linda B. Oxendine
Tennessee Valley Authority
400 West Summit Hill Drive
WT 8C
Knoxville TN 37902

Subject: Project review information for rare, threatened, or endangered species and critical or sensitive habitat; Draft Environmental Impact Statement, Future Water Supply Needs Upper Duck River Basin, Tennessee Valley Authority

Dear Ms. Oxendine:

As a part of our review of the subject **Draft Environmental Impact Statement** *(Draft ELS),* please be advised that we have reviewed our Departmental data bases and find recorded State and/or Federally listed species, within a one mile radius of the proposed Tennessee Valley Authority (TVA) project boundaries and within a one mile radius of the proposed managed lands (project alternatives). These species have very specific or rare habitat. Our records also indicate additional species occurrence records, sensitive ecological sites, and management areas, within an approximate four mile radius of the proposed project site(s). Your agency is aware of these records and we suggest that these records be further evaluated in cooperation with your Heritage Program in Norris, TN. **[Q3]**

Our Division reviewed the subject document and we offer these general comments as part of our review:

General comments;

In order to comply with the National Environmental Policy Act consideration should be given to the comprehensive and *cumulative* impacts associated with the project actions. Considering the information provided, it is probable that any proposed pipeline development will increase stream crossings, will affect instream, aquatic, and riparian habitat, and thereby significantly degrading habitat as part of proposed construction implementation. The TVA has not identified restoration nor reclamation actions to lessen any construction-related impacts, e.g., best management practices or bioengineering techniques. **[A27]**

We strongly support a *no-net-loss* (similar to our Tennessee Wetland Conservation Strategy and the wetland protection initiative) approach to the management of public lands and our State natural resources. Although TVA outlines some protection of natural resources as part of the description of the proposed Alternatives, these are not specific and do not address long term protection of natural resources, specific sensitive *habitat* and species *throughout* the planning corridor. **[A26]**

We also offer these specific comments related to the *Draft ElS* document and proposed Alternatives or management strategy of Federal lands and water supply.

Specific comments;

Alternative B proposes the construction of a reservoir on Fountain Creek. The Fountain Creek reservoir does not appear to be a viable alternative in light of the estimated cost and potential for eutrophication caused by the nutrient rich Fountain Creek basin. Both TVA and the Tennessee Department of Agriculture have identified many nonpoint source water pollution issues throughout the watershed. These water pollution issues could have long-term impacts on the biodiversity of the area, particularly aquatic species. Correction of these problems is not a documented cost nor included in the discussion of impacts of this proposed alternative. **[K13]**

Although not documented in the *Draft ElS,* there are numerous rare, threatened or endangered aquatic species records at the mouth of Fountain Creek and immediately downstream in the Duck River. Assuming suitable habitat exists within Fountain Creek, these species could be present in the watershed e.g., Coppercheek Darter *(Etheostoma aqua#)* and Slabside Pearlymussel *(Lexingtonia dolabelloides).* **[Q17]**

Also, this alternative would inundate known populations of a number of rare plant species and could impact several registered State Natural Areas. The Glade cress *(Leavenworthia exigua var. exigua),* Tennessee milk-vetch *(Astragalus tennesseensis),* and Limestone fame-flower *(Talinum calcaricum) are* Tennessee special concern plants, which occur in the area of proposed inundation by a reservoir on Fountain Creek. These limestone cedar glade plants, that are globally rare and the plant communities (habitat), would be destroyed by inundation. **[Q13]**

The Water stitchwort *(Arenaria fontinalis)* is a Tennessee threatened and obligate wetland plant *(OBI.). The Water stitchwort occurs in* seepages *and other wet* areas a/ong *creeks. The OBL* plant would not survive prolonged inundation. The Duck river bladderpod *(Lesquerella densipila)* is a Tennessee threatened and globally rare plant, which also occurs in the area ora proposed reservoir on Fountain Creek. Field surveys conducted in the spring of this year by the Division of Natural Heritage staff have documented serious declines in populations of this plant in the majority of its range. Several bottomland areas adjoining Silver Creek continue to support populations of this plant. *These populations would be inundated under the Drafi ElS,* Alternative B. **[Q8]**

It is important to note that the Division of Natural Heritage staff did not survey the area south of State Route 50 on Fountain Creek in the spring of this year for the *Duck* River *bladderpod. This* area could also support populations of the protected plant species (potentially inundated by the proposed Fountain Creek reservoir). **[Q9]**

A population of the Tennessee and Federally listed (endangered) Leafy prairie-clover *(Dalea foliosa)* occurs between 620 feet and 630 feet elevation in the Moore Lane Glade Registered State Natural Area. This area is outside of the Fountain Creek watershed, but would require protection from inundation (629-foot elevation) by the two proposed extension (saddle) dam structures west of the proposed Fountain Creek reservoir. **[Q14]**

The information presented indicates that the Moore Lane Glade Registered State Natural Area (west of State Route 50) will be directly affected by the proposed location of the dam and construction area. A raised water table resulting from the impoundment could effect stream flow throughout the proposed project area. Due to the karst features of the area, a small, unnamed tributary to the Duck River (within the Natural Area) could have increased flow from ground water *inflow. It is not clear how this change in hydrology would affect the Leafy* prairie clover populations, which occur within the Natural Area. **[Q15]**

The proposed Alternative C would construct a water supply intake at a point downstream from Columbia in the Duck River and downstream from Cathy's Creek. The *Draft EIS* outlines suggested short-term impacts to ground water, surface water, aquatic life, terrestrial life, endangered species, etc. The document fails to identify the probable impacts of the proposed construction and water withdrawal. Although the document discusses the withdrawal of approximately a fifth of the maximum flow, the document does not acknowledge the potential impacts to reduced flow as seen during the most recent drought and low flow conditions (summer flow gauge records for 1998-2000). **[L5]**

Under Alternative D, the suggested maximum pool of Normandy Lake would be raised from 875 feet to 880 feet. Alternative D would flood portions of Short Springs Designated State Natural Area along Bobo Creek at contours below 880 feet during the normal maximum pool elevation of the reservoir. The bottom-land habitat receives seasonal inundation. By raising the lake level there would be prolonged periods of occasional inundation as well as longer periods of more permanent flooding of the habitat. We would expect this habitat and associated biological diversity to change community type and floristic composition along with the associated forest habitat. The forest type is a high quality mesic area with rich displays of spring wildflowers along Normandy Lake between the 875 and 880-foot contours. These areas could be impacted by inundation under Alternative D and could significantly impact the natural area through the destruction of the flora and fauna depending upon the timing and duration of inundation. This impact is cited in table 7 on page 63; however, it is not mentioned in the impacts described under Alternative D pages 48 - 56. The environmental impact of flooding the bottomland riparian forest could be a violation of Natural Resources Areas Rules, {TCA Section, 0400-2-8-.08 Intrusions, 0400-2-8-.22 Water Level Control} and may require additional Departmental permits for wetland impacts. **[G21]**

In addition, there are a number of Tennessee endangered, threatened and special concern plants which occur on lands above the 900 foot contour, around Normandy Lake at sites known as Rutledge Falls, Copperas Branch, and Short Springs Designated State Natural Area. The Division of Natural Heritage has no records of Tennessee endangered, threatened or special concern plants below the 900-foot contour of Normandy Lake. **[Q16]**

A change in water flow rates (downstream) or significant water withdrawals from the reservoir could affect two rare plants that occur in the Duck River. These are Water stitchwort *(Arenaria fontinalis)* a Tennessee threatened and obligate wetland plant (OBL), and Limestone blue star *(Amsonia tabernaemontana var. gattingeri),* a Tennessee special concern listed species and a facultative wetland plant. Comparing these two rare species, the Water stitchwort is more dependent on water (an obligate wetland plant) and would be sensitive to changes in hydrology (reduced seepage and flow rates). Occurrences of both species are found in the Duck River watershed, both above and below the confluence of Fountain Creek. It is unclear how the rare plant populations in the Duck River would be affected under the different alternatives, however the increased minimum flow under Alternative D could be beneficial to these rare species. **[Q10]**

An increase in shoreline erosion associated with additional access to Federal lands, encouraged by the proposed raising of water levels, could result directly in an increase in water pollution (especially sedimentation). The *Draft EIS* does not provide documentation for adequate protection of natural resources that could result in net losses of the State's biological and natural resources as well as increases in shoreline erosion. Perhaps TVA could suggest shoreline management strategies that would be implemented to protect natural resources and biodiversity if this alternative were selected. **[G23]**

Additionally, the proposed Alternative D could increase shoreline erosion, decrease water quality, reduce aquatic habitat, manipulate and significantly reduce forested and riparian

habitat, and reduce contiguous forested tracts (communities) simply as a result of prolonged inundation by sustained higher lake levels. We suggest that TVA fully document these losses and compare them to anticipated habitat improvements associated with increasing the lake shoreline area by raising the lake levels.

Managed shorelines, with increased efforts toward restoring habitat (particularly by erosion control through bioengineering techniques), are paramount to long term water quality improvements and protection of the State's rare, threatened or endangered species. By utilizing specific reservoir-wide management strategies throughout Normandy Lake TVA could demonstrate habitat improvements associated by raising the lake levels with increasing the lake shoreline area. Additional documentation is needed to outline steps that will be taken by TVA to protect the current *recreational* uses and diverse habitat along the shoreline. **[G24]**

Alternative E proposes to transfer water from Tims Ford reservoir to a downstream site through a 20-mile pipeline and booster pumping station to the lower Duck River. The transfer of large volumes of water between watersheds (inter-basin) could result in artificial range extensions for aquatic species or increase the likelihood that exotic species could invade these watersheds e.g., zebra mussels. The *Draft EIS* does not consider these potential impacts. The long-term impact by minor but continued drawdowns is not fully addressed considering the reduction of water from Tims Ford reservoir as part of this proposal. The *Draft EIS* does not consider aquatic biodiversity impacts in the reservoir resultant from sustained water withdrawals during drought conditions. **[L7]**

Our Department has worked with TVA staff for many years to develop policy and procedures in order to protect large undeveloped tracts of Federal lands. The purpose of this protection is to prolong significant habitat and biodiversity, especially for those species that utilize shorelines.

In conclusion, the document clearly illustrates many *significant* environmental impacts associated with the proposed Alternative B. Alternatives that lessen environmental impacts have been defined and documented in Alternatives C and E. The TVA acknowledges potential environmental impacts should Alternative D be implemented, including flooding portions of the Short Springs Designated State Natural Area.

In summary, considering the Alternatives presented, we find Alternatives C and E least objectionable and these alternatives clearly present minimal environmental impacts when compared to other alternatives presented. We have concerns about the management of shoreline tracts (Alternative D) and decreased stream flows that could result from Alternative C. We suggest that these impacts be further addressed and documented in the Final *EIS* as well as the methods for avoiding impacts associated with implementing these Alternatives. **[A33]**

We appreciate the opportunity to assist you with your pre-project planning. Please contact me if we can be of further assistance with this project or provide additional information. Our office is in Nashville, telephone 615/532-0431.

Respectfully

Andrew N. Barrass, Ph.D.
Environmental Review Coordinator,
Division of Natural Heritage
Department of Environment and Conservation

Columbia Water Supply EIS Log Number 58
Marty Marina, Tennessee Conservation League

Ms. Linda B. Oxendine, Project Manager
Draft EIS - Upper Duck River Basin
Tennessee Valley Authority
400 West Summit Hill Drive, WT 8C
Knoxville, TN 37902

Reference: Water Supply Duck River Basin

Dear Linda:

Thank you for the opportunity to comment on alternatives for addressing future water supply needs of the Upper Duck River Basin. The League has investigated the choices and believes raising Normandy Dam to be the optimal choice. **[G2, part]** Let me explain by first addressing our global concerns, then speaking to each solution.

We recognize that this EIS -- like the TERDA EIS -- is burdened with years (and generations) of expectations, disappointment, and frustration. In this case it was created by the anticipated completion of the Columbia Dam and its subsequent abandonment. Fortunately, the final EIS can benefit from improvements in conservation science and the science of water (supply and quality) management gained through the intervening decades. It is imperative that decisions in the final EIS also anticipate ethical considerations in preventing and managing present and future social conflicts over natural resources on the Duck. **[A40]** For instance,

The draft EIS is geared to providing enough water for Columbia to grow at the present rate for the next 50 years. We believe the present rate was not anticipated when the dam was originally projected and cannot be sustained for so long a period. Further, planning for it (or failing to recognize this) will eventually negatively impact Colombians' quality of life and the economic viability of other counties in the watershed. Atlanta could serve as a poster child for unbridled development. **[H4]**

The draft EIS addresses anticipated water demand without considering the impacts of low flow scenarios - similar to those presently being experienced - on maintaining river function. TVA's experience this summer in managing the water supply for Chattanooga and northeast Tennessee speaks to what happens when God does not provide enough rain to create adequate runoff. **[C15]**

The draft EIS does not address cumulative impacts of projected development on water quality or the water supply needed to clean the anticipated Total Maximum Daily Load (TMDL) created by development. Failures to address this issue can be found among the many streams listed on the Tennessee Department of Environment and Conservation's 303D list. **[K5]**

A. Using the present resources is an untenable solution because the system is presently functioning near its limits. **[D5]**

B. Building Fountain Creek Reservoir is an expensive alternative, reminiscent of choices made in the '60s and '70s. TVA and its stakeholders will do well to learn from previous experience and save itself and the taxpayer's dollars by choosing another scenario. This area of Fountain Creek is not suited to a reservoir because of the shallow water depth. As noted in the draft EIS, the Fountain Creek Reservoir will be a shallow, nutrient rich reservoir. By definition, we believe it will provide a poor water supply and poor aquatic

habitat. It also has a potential for creating more public expectation and suffering the same sociological conflicts over resources presently experienced on TVA's Nickajack, Chickamauga and Guntersville reservoirs. These were unintended consequences in those areas. Neither TVA, the state or county governments can afford the cost of managing the natural resource conflicts and it would be inexcusable to knowingly create them. Further, building the reservoir will cause biological loss and maintaining it under low dissolved oxygen and low flow circumstances will likely to continue this trend. **[E27]** (See TWRA and TDEC statements).

C. Taking water from downstream of the Columbia discharge needs more information before it can be a viable choice. This EIS does not consider construction or low-flow impacts to ground water, surface water, aquatic life, terrestrial life, or endangered species. Further it does not address consequences to the supply or biological life from continuously recycling water so close to the outflow pipe. What will be the attendant cost of wastewater and freshwater treatment or biological loss? **[F17]**

D. Raising the Normandy pool level has a moderate cost and the best chance of answering short and mid-term supply, with minimal biological or sociological impacts. While there will be some short-term loss, this alternative seems to accommodate management of the State Natural Area for its intended purpose and other habitat concerns at the reservoir. It will also improve present habitat conditions on the Duck. **[G3]**

E. Building a pipeline from the Tims Ford Reservoir to the Duck River will unnaturally favor a county outside the Tims Ford Reservoir and handicap counties within they reservoir as they struggle to meet their existing and current demands for clean and plentiful water. There will also be negative impacts to flora and fauna as the pipeline is constructed and maintained over the years. **[H18]**

Again, thank you for soliciting and considering the League's comments. Please know that we also wholeheartedly endorse comments made by TWRA and TDEC's Natural Heritage Division. As usual, we look forward to supporting TVA in creating a well-balanced solution to this issue. **[G2, part]**

Sincerely,

Marty Marina
Executive Director
Tennessee Conservation League

Columbia Water Supply EIS Log Number 72
Wayne Romesberg
(from Transcript of Public Meeting)

First thing I would like to say this is a local issue and it should be solved by the local people. We don't need environmental groups from California (western states) and we don't need environmental organizations in the southeast to help solve our problems and we definitely don't need another attorney from Murphreesboro to try to solve our problem. We know what happened last time there besides him getting rich. I think anyone here tonight needs to speak, state who they are, where they live, and if they represent any organizations. **[B10]** I am Wayne Romesberg; I am with the Murray County Commission. I am basically a life-long resident of Columbia.

Going to the alternatives, on Alternative A, the alternative of doing nothing, to me that is not an answer, so we should not even consider that. **[D3]** Going to Alternative C, Alternative C is Cathy's Creek Pumping Station, I don't believe this is an acceptable alternative because I don't know about you all but I don't think the idea of drinking my own sewer water is acceptable and I understand the people in California have been doing that for years and we see some of the problems they have. **[F19]**

The Alternative D, raising Normandy, this may be semi-acceptable but it is definitely better for the upper reaches of the Duck River Agency and for the lower regions like Marshall, Murray, Hickman, Humphreys, that in the long run probably will not help solve us as well as they just said. We still have to do water conservation in 2035 so basically that means our children will have to be back in 2035 to try to find another answer that we didn't solve. **[C12]**

[T]he pumping station from Tims Ford, I don't believe that's good. I do not like the idea of taking water from one river valley, pumping it to another river valley. It sets a precedent. What could happen in the future there, if someone wants to come into the Duck River valley, take water out of the Duck River valley, say pump it into the Harpeth River valley, or maybe even go back to the Elk. That's entirely possible. If we take this action, then we are setting a precedent. I don't believe this is good, **[H27]** which leaves only one alternative, which is B.

I would like to say one thing here before I get to B. We do need to consider something for the long range. I don't want to say nothing about people in the past; but if in the 60's, if we'd had leadership (and I don't mean local leadership), our local leadership wanted the Columbia Dam, but if we had leadership up higher, especially in Washington, who had some backbone to stand up to some environmentalists, we wouldn't be here discussing this today. The option I am looking for is for our children and the next generation not to have to come back to this auditorium or one similar to it where they are going to have to discuss thing - what are going to have to do about water. We have our chance now to solve the water for a long range and we need to have the backbone to do it **[A39]**

So the solution I see is B, is Fountain Creek Dam. Granted it is more expensive but sometimes you do have to bite the bullet to solve a problem and this is the bullet. **[E7, part]** Some notes I was also taking as we were discussing these, the average depth would only be 19 feet. I don't know about you but I see a few sportsmen out here, 19 feet would be some pretty good fishing, especially for some Crappie and Brim and that's what I enjoy fishing for. We didn't talk about the recreational uses. There will be recreational uses for Fountain Creek. **[E37]**

Also, one thing I notice that was said, the $50M, the approximate $50M cost, it was also put in that could be plus or minus 30%. Well that means if we watch our construction cost, this dam could be completed for as little as $35M if we pinch pennies. If we don't pinch pennies, it could $65M, and I also noticed when we talked about the pipelines, we never did say if that was going to be plus or minus 30%, Being that it was not said, I am going to assume that it wasn't so when we are looking at possibly a $35M versus some of these $11M and $18M alternatives, hey we are in the neighborhood. **[E39]**

One thing I would like to say is to finish up, and Dan it is not your fault. but people in Murray County still have a sour taste about TVA. I know you had the project dumped in your lap and it's not your fault but there are a lot of people that still have a sour taste about the Columbia Dam fiasco, and that's what it was - a fiasco. It should have never happened, but it did. **[B2]**

But in the long haul, I do feel like Alternative B, the Fountain Creek, is our best alternative for us, our children, and generations to come. **[E7, part]** If we do decide to go with Alternative B, what we need to do is make a solid commitment behind it, no bailing out from pressures of any group; and if, I don't know if TVA will even have anything to do with it, but if they do I would like to make sure that TVA does fight for Fountain Creek like they did fight for Tellico years ago because when they fought for Tellico, they won all the way to the Supreme Court. **[E40]** I would like to thank you for your time.

Wayne Romesberg

A. General and EIS Process

A1. [W]*e want to express appreciation to TVA and cooperating agencies for the opportunity to participate in this review and input process.* **John R. Collier, Jr., Chairman, Board of Public Utilities of Columbia, Tennessee, 53c**

A2. *We concur with the TVA's assessment and forward-thinking approach to the water supply in middle Tennessee.* **Frank M. Tamberrino. President, Maury Alliance, 66b**

A3. *Thank you for a good report unaffected by political restraints. We continue to need your advise and experience as we do our planning.* **Charles Sanders, 15b**

A4. *I would like to commend the authors of this draft project report on their thoroughness in developing the data that outlines the project options.* **Richard E. Lockwood, 31a**

A5. *I have followed this through from the beginning since they got rid of the Columbia Dam issue. I first want to thank Dan Ferry and TVA. They have done a great job; they've done the best they could; I know they've taken a lot of hard hits but I appreciate all the work they've done and all the effort that's gone into it.* **Sharon Vaughn, 79a**

A6. *We appreciate your willingness to accept comments and to travel to Columbia. TVA has been a good utility and good corporate citizen for many years, and we look forward to our continued partnership for the betterment of this community, the middle Tennessee region and the State of Tennessee.* **Frank M. Tamberrino. President, Maury Alliance, 66c**

A7. *The . . . . Draft EIS captures the biological data that exists for the Duck River region, while effectively outlining the scope of the potential impacts of each action alternative. The Nature Conservancy believes this is a thorough preliminary review that can be utilized to evaluate the important environmental and socioeconomic issues that must be addressed.* **Leslie Colley, The Nature Conservancy of Tennessee, 44a**

Response to Comments A1 - A7: Comments noted. TVA appreciates your willingness to participate in reviews such as this and your openness to new ideas.

A8. *On behalf of the* [Tennessee Duck River Development] *Agency, I want to express my appreciation to TVA and the other cooperating agencies for their leadership and contributions to this draft of the future water supply needs in the Upper Duck River Basin (or water supply EIS) and for the opportunity to participate in the process. This document is an important milestone on our path towards developing additional water supply to meet the anticipated needs of the region. Our Board believes TVA has accomplished the stated goals of the EIS. It has evaluated the need for water in the Upper Duck River watershed, identified potential ways to meet the identified need, and evaluated the environmental and socioeconomic impacts of several possible ways to meet those needs.* **Linda Nannie, Chairman Duck River Agency, 20a and 71a**

A9. *The EIS document has accomplished the stated goals. It has evaluated the need for water in the Upper Duck River watershed, identified potential ways to meet*

and identify needs, and evaluated the environmental and socioeconomic impacts of several possible ways to meet those needs. It its very important to us, as a water utility serving customers in Lewisburg and Marshall County, that this document has established an outline of the environmental issues and concerns that must be addressed in the development of the alternatives and the ultimate selection and completion of a project solution without prematurely limiting alternatives. **Larry E. Jones, 1a**

A10. *As we stated in our letter dated March 7, 1997 concerning the closure of the Columbia project, "The TVA should verify existing public water supply sources or finance new supplies at levels that meet local long-range water supply needs as defined by the Regional Water Supply Analysis for Southern Williamson, Marshall and Maury Counties or by the State." We also stated, "Although local interests have shared responsibility to support water supplies, the larger burden to verify or produce dependable water supplies is TVA's alone." These assertions remain true. TVA's water analysis seriously examines regional water supply needs. It is a responsible effort to meet your obligations to the people of the Upper Duck River region.* **Justin P. Wilson, Deputy to the Governor,43b**

A11. *Tennessee Citizens for Wilderness Planning commends TVA and its four cooperating agencies for their professional and thorough effort in producing the DEIS. The document has three related purposes:*

(a) Evaluation of water-supply needs through the year 2050. Demands above 40 cfs (which can be supplied by the existing Normandy Reservoir plus return flows from wastewater plants) are increasingly likely to occur after the year 2015. The alternatives that have been developed in the DE1S are based on supplying an additional 22 cfs.

(b) Identification of potential ways to meet the water needs; no preferred alternative has been selected in the DEIS.

(c) Evaluation of the environmental and socio-economic impacts of the identified alternative.

Liane B. Russell, for the Tennessee Citizens for Wilderness Planning Board of Directors, 30a

Response to Comments A8 - A11: Comments noted. TVA appreciates comments indicating that we have defined and met the specific purposes of this EIS.

A12. *Given the apparent minimal immediate need for additional source water, the intended purpose of the reservoir may be more to enhance real estate and recreational value in the area more so (or rather than) creation of additional source water. If so, the focus of the EIS should be environmental impacts on actions associated with increased urbanization and residential sprawl into rural areas.* **EPA, 51f**

Response to Comment A12: As indicated in several sections of the draft EIS (in particular Sections 1.1, 3.1, and 3.9), the third purpose of this evaluation is to "evaluate the environmental and socioeconomic impacts of several possible ways to meet the future water needs for communities within this river basin." As indicated in Sections 5.4, 5.10, and 5.11, real estate and recreational development may occur associated with one or more of the action alternatives; however, those activities are acknowledged to generate potential conflicts with the purposes of this project.

A13. *As suggested on page 1, the EIS is written much like a programmatic EIS since it generically explores a need for additional water supplies and leaves site-specific plans for the future. For example, the reservoir management plan for the Fountain Creek Reservoir alternative (B) was not developed, the environmental impacts of the new water treatment plant for the downstream intake alternative (C) were not included in the impact analysis, and the pipeline impacts for Alternatives C, E and B were also not disclosed. Page 39 also states that "TVA is not proposing to design or construct any of these facilities" and "[i]n this EIS, these action alternatives have been generally described in light of their conceptual nature at this early stage." Page 1 further states that ".., several of the alternatives would not have to be built for a number of years." While EPA agrees with the concept and need for programmatic EISs that are followed by site-specific NEPA documents, our concern is that this EIS was not titled as a programmatic EIS. This should be discussed.* **EPA, 51a**

Response to Comment A13: This document is intended to be a programmatic EIS; however, that term conveys rather little meaning to members of the general public. Appropriate parts of the document (especially Sections 1.1 and 3.2) have been modified to clarify the intended programmatic intent of this EIS.

A14. *It should also be noted that if the present EIS is not a programmatic EIS but rather is an action EIS, construction of the preferred alternative would need to be initiated within five years or a re-evaluation of impacts would be needed, If impacts were determined at that time to be significantly different, a supplemental EIS would be needed if the project was pursued.* **EPA, 51b**

Response to Comment A14: Comment noted.

A15. *Your report also covers (albeit briefly) wetlands, archeological resources, aquatic life land recreational considerations. These are all well and good to consider, but if you need water to sustain the basics of life, then someone needs to get the priorities right.* **Jerry C. Lashlee, 26d**

Response to Comment A15: As indicated in Sections 1.3 and 3.2, the TVA role in this evaluation is to assist local agencies in determining their future need for water and evaluating possible ways to meet the identified needs. Under the National Environmental Policy Act (NEPA), documents such as this EIS are required to evaluate the effects of proposed projects on "the natural and physical environment and the relationship of people with that environment." The intent is "to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans."

A16. *From a practical perspective, implementation of the Fountain Creek Reservoir would utilize some 2,800 acres of the available Columbia lands previously acquired for the discontinued Columbia Dam and Reservoir. Such use would keep these lands in public ownership and under the direct purview of TVA. However, an additional 800 acres of land currently not in public ownership would need to be acquired for the reservoir.* **EPA, 51g**

Response to Comment A16: As indicated in Sections 1.3 and 3.2, the TVA role in this evaluation is to assist local agencies in determining the future

need for water and identifying ways to meet those future needs. Even if local interests decide a reservoir in the Fountain Creek watershed should be constructed, TVA has no plans to own, build, or operate that reservoir.

A17. *Consistent with the Federal Register, public comments are due to TVA by 10/30/00 as opposed to the 10/20/00 date stated on the DEIS cover page. Accordingly, we recommend that TVA receive comments postmarked by the 10/30/00 date.* **EPA, 51c**

Response to Comment A17: Comments were accepted into early November.

A18. *The Summary Comparison Table 6 on page 60 should also document a brief summary of natural and environmental impacts since environmental permit issues will be a major consideration in balancing benefits with impacts.* **Justin P. Wilson, Deputy to the Governor,43j**

Response to Comment A18: A summary of the environmental effects is included in Table 7, which is the companion to Table 6 and follows it in Section 3.9.

A19. *The draft identifies a variety of alternatives ranging from a traditional impoundment, pipeline options and a dam improvement alternative. A single alternative or combination of options can provide water well into the future. One or more of the alternatives addressed by the EIS may provide a long-term and reliable source of water.* **Justin P. Wilson, Deputy to the Governor,43c**

Response to Comment A19: TVA concurs with this assessment.

A20. *I know the people that has to make these decisions have a hard job. . . . You people that are inside have got to make a decision some way, and I'm for you if you can do something right but, if you can't, let's just don't go too far until we can get something else done.* **Jack Craig, 77d**

A21. *Mr. Craig was so correct in saying they need to definitely count the cost and don't start doing something that the environmentalists are going to come in and discount.* **Sharon Vaughn, 79d**

A22. *Does it say that the downstream water intake, is that a sure thing, can it be done, there's nothing to uphold it, the environmentalists or anything can't step in and say you can't take water out or is this a sure thing or is this just a guess? And then on Normandy, raising of that pool, is that a sure thing, can it be done, or are you going to have trouble raising that pool? And on the Tims Ford pipeline, is that a sure thing, or can they say, well, you don't get any more water. Are we going to the expense to do some of these and not have any assurance or get any water? And on Normandy, if they raise that pool or if it stays like it is, in a push and shove situation when we run out of water, is there any kind of guarantee that we are going to get water out of that dam? There's a lot of unanswered questions and until we know whether they are sure things or not, I don't see how anybody can make a projection on that they want.* **William Derryberry, 73a**

A23. *These four alternatives that you are suggesting were present at the time the other dam was built and, if they were present then, they ought to have been thought about and it should have been checked out and knew you could put water behind Columbia before*

it was ever built. If you are thinking about building a dam on Fountain Creek, we need to know for sure that the thing can be built. No need in building one and then tearing it down. $84M is a lot of tax money thrown away, not to think about the homes and lives of the people that live there. Fish and mussels and everything mean a lot but people's lives and their homes mean nothing to anybody. They need to be taken into consideration. **William Derryberry, 73g**

Response to Comments A20 - A23: Comments noted. The chief purpose of this evaluation has been to help everyone understand the variety of issues that ought to be considered when deciding how to meet the future needs for water in the watershed.

A24. *No preferred alternative was selected by TVA in the DEIS, although TVA has indicated a non-preference for the No Action Alternative (A). While acceptable from a NEPA perspective and understandable in the sense that TVA and its cooperators might want additional public input before selecting a preferred alternative, we note that delaying the identification of TVA's selection until the FEIS stage is late in the NEPA process. At that stage, the public and resource agencies would not be able to comment on the preferred alternative until the FEIS comment period, which may or may not truly influence any modification of the preferred alternative and would reduce the probability of a different alternative being selected if the public so-requested.* **EPA, 51h**

Response to Comment A24: As with the related Land Use EIS, TVA determined that members of the public and the affected agencies would benefit most from a wide-ranging discussion concerning several viable water supply alternatives. Especially when local agencies will have to build and defend the eventual project(s), we believe this approach results in better-informed decisions.

A25. *Given the potential serious impacts on aquatic fauna in several proposed alternatives, TVA is strongly urged to completely disregard Alternative B and D, and consider the possibility of constructing an offshore* [off-stream ?] *reservoir. Page 58 of the DEIS stated that this alternative was "adequately represented by the Fountain Creek Reservoir alternative." However, our proposed alternative represents an entirely different scope than a tributary reservoir. TVA should not consider these alternatives to be the same. Given the number of federally listed aquatic species in the Duck River system, and the relatively common nature of many of the terrestrial plants and animals, it makes much more sense to limit impacts to an offshore site. Impacts with this sort of alternative would likely only affect plant communities in the area. Since TVA has purchased the rights to 3,800 acres of land within the Fountain Creek watershed, surely a parcel of land exists where few sensitive plant or animal communities exist, or where these effects would be minimal. This alternative would preserve the biotic integrity of the aquatic fauna of the Fountain Creek system (182 spp.). Additionally, this alternative could adequately meet water supply needs if the containment reservoir was built to accommodate a large volume of water (ca. 1 billion gallons). Such a reservoir allowed to fill slowly would minimize cubic feet per second (cfs) removal effects if the water withdrawal area were around Duck River Mile 140-200. Furthermore, this alternative could allow construction of the reservoir near the river (within a few miles), therefore eliminating the need for a 10-20 mile pipeline. TVA should strongly consider including this alternative in their potential revisions or attachments to the DEIS.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33v**

Response to Comment A25: In order to meet the projected need for water in 2050, any potential source would have to be able to supply 14 mgd (22 cfs of flow) during all of a July-October drought period (123 days). The total volume of water used during this period would be approximately 1.72 billion gallons (14 mgd x 123 days), which equals 5,285 acre-feet of water. If the depth of the off-stream reservoir averaged seven feet, the usable volume of the reservoir would need to be 755 acres; however, to compensate for evaporative losses (at about three inches per surface acre per summer month) the reservoir would need to include 755 more acre-feet of water (5,285 + 755 = 6,040 acre-feet), or a total of 863 acres (6040 acre-feet/7 feet). At that size, the construction and operation of an off-stream reservoir would involve most of the same problems described for the Fountain Creek reservoir (land acquisition, landowner rights, controlling leakage, nutrient enrichment, long retention time, etc.). In addition, the water stored in the off-stream reservoir probably would be pumped from the Duck River during winter and early spring (the high flow period) when the river would contain large amounts of organic matter and nutrients resulting from non-point source runoff. The quality of the water in an off-stream storage reservoir might be too poor to release back to the Duck River without treatment and might be expensive to treat due to its high organic content and the likely presence of taste- and odor-producing algae. These are some of the factors which led TVA to conclude that an off-stream storage reservoir was not a reasonable and separate water supply alternative which needed to be evaluated in this EIS.

A26. *We strongly support a no-net-loss (similar to our Tennessee Wetland Conservation Strategy and the wetland protection initiative) approach to the management of public lands and our State natural resources. Although TVA outlines some protection of natural resources as part of the description of the proposed Alternatives, these are not specific and do not address long term protection of natural resources, specific sensitive habitat and species throughout the planning corridor.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64c**

A27. *In order to comply with the National Environmental Policy Act, consideration should be given to the comprehensive and cumulative impacts associated with the project actions. Considering the information provided, it is probable that any proposed pipeline development will increase stream crossings, will affect instream aquatic and riparian habitat, and thereby significantly degrading habitat as part of proposed construction implementation. The TVA has not identified restoration nor reclamation actions to lessen any construction-related impacts, e.g., best management practices or bioengineering techniques.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64b**

A28. *The relocation of Highway 50, any secondary roads, power transmission lines, water treatment plants and other related facilities of the presented alternatives, as well as other present, proposed and foreseeable future projects over a 10- to 20-year horizon in the region, should be considered and discussed in the FEIS.* **EPA, 51ai**

A29. *The impacts of the remaining action alternatives (C, D & E) are uncertain since impacts of pipeline routes (C & E) and specifics on treatment plants common to all action alternatives are not disclosed.* **EPA, 51n**

Response to Comments A26 - A29: The general nature of these issues are identified in the appropriate sections of the EIS; however, specific measures to protect them will have to be addressed in the subsequent NEPA and NPDES permit evaluation(s) for whatever projects are proposed to be built.

A30. *Given these considerations, our alternatives "preference" from most preferred to least is as follows: A, Modified E (if feasible), C, E, D and B.* **EPA, 51q**

A31. *If . .* [adoption of the No Action Alternative for the near term] *is unacceptable to local water authorities or if additional agricultural or water-consuming interests can be expected to withdraw significant additional volumes from the Duck River, EPA recommends that the most environmental alternative be implemented by approximately 2025. Voluntary conservation methods should be encouraged and employed regardless of which alternative is selected, with incentives and disincentives should be provided by local authorities for complying customers. Conservation should target those activities that consume water (e.g., lawn watering) as opposed to those that return a large portion of the water to its source (e.g., wastewater).* **EPA, 51j**

A32. *In summary, until a true water need can be demonstrated beyond what existing sources (Normandy flows and wastewater returns) and conservation methods can provide, EPA favors the No Action (A) for the near future. If this is considered unacceptable to local water authorities and implementation of one of the remaining alternatives (B-E) is pursued, we would not prefer implementation of the Fountain Creek Reservoir (B) or raising the pool of the Normandy Reservoir (D) due to their impacts. We also have environmental concerns about the alternatives with long pipelines (C and E) with unclear routes and undisclosed impacts. If the pipeline impacts could be minimized through alignment shifts and the impacts of new water treatment plants common to all action alternatives could also be minimized, we would favor C over E since it has a shorter pipeline than E, and E also involves interbasin transfer. However, we strongly suggest that the feasibility of a modification of E (Modified E) be considered, which returns additional wastewater to the Duck River as opposed to transferring it to the Tims Ford Reservoir.* **EPA, 51aj**

A33. *In summary, considering the Alternatives presented, we find Alternatives C and E least objectionable and these alternatives clearly present minimal environmental impacts when compared to other alternatives presented. We have concerns about the management of shoreline tracts (Alternative D) and decreased stream flows that could result from Alternative C. We suggest that these impacts be further addressed and documented in the Final EIS as well as the methods for avoiding impacts associated with implementing these Alternatives.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64r**

Response to Comments A30 - A33: Comments noted.

A34. *I still have faith in TVA doing the right thing, and I hope that this matter will be settled this time. I hope it will be sooner rather than later and we don't wait until we have a problem to handle it.* **Sharon Vaughn, 79e**

A35. *A review of the work and efforts put into the EIS reminds us that with each of the possible alternatives there remains many unanswered questions. A good foundation of knowledge has been established, but a great deal of work remains. . . . For us, this document is only the first step of a renewal effort to meet the anticipated need for WATER in the Duck River Basin.* **Larry E. Jones, 1b**

A36. *Work on the EIS has reminded all of us that with each of the possible alternatives there are still many unanswered questions. A good foundation of knowledge has been established but a great deal of work remains to be done. Those of us with a direct*

responsibility for water supply feel an increasing urgency to move forward with the process. For us, this document is but the first step of a renewed effort to meet the anticipated need for water in the Duck River Region. **Linda Nannie, Chairman, Duck River Agency, 20c and 71c**

A37. *I was born about 2000 feet south of Fountain Creek. I moved across it about 2000 feet when I was two, three, or four years old, and lived there until I was grown. After I come back out of service, I bought a farm on Fountain Creek and I've seen that stream real low. Everybody else that's been in that area has seen the same thing I have. I'm not smart; I'm not inside on this thing. If I was, it would probably be in worse shape than it is but I think we've got a problem and I think it's the most environmental thing that we are looking at of all the choices that we have.* **Jack Craig, 77a**

Response to Comments A34 - A37: Comments noted.

A38. *The support for <u>any</u> action is mixed and limited. Local trust of TVA has reached bottom. Any plan selected will incur undue opposition even though TVA has stated they would not participate in design or construction. The low attendance at your meeting of 9/28/2000 indicates poor local interest and support. When Columbia actually realizes that they are, or will be, short on their water supply, the deadheads will come alive and the politicians will climb aboard.* **Douglas K. Mitchener, 59b**

A39. *We do need to consider something for the long range. I don't want to say nothing about people in the past but if, in the 60's, we'd had leadership (and I don't mean local leadership; our local leadership wanted the Columbia Dam), but if we had leadership up higher, especially in Washington, who had some backbone to stand up to some environmentalists, we wouldn't be here discussing this today. The option I am looking for is for our children and the next generation not to have to come back to this auditorium or one similar to it where they are going to have to discuss the same thing - what are going to have to do about water. We have our chance now to solve the water for a long range and we need to have the backbone to do it.* **Wayne Romesberg, 72f**

Response to Comments A38 and A39: Comments noted. These comments reflect some of the negative perspectives which will have to be addressed when one or more water supply projects are proposed.

A40. *We recognize that this EIS -- like the TERDA EIS -- is burdened with years (and generations) of expectations, disappointment, and frustration. In this case, it was created by the anticipated completion of the Columbia Dam and its subsequent abandonment. Fortunately, the final EIS can benefit from improvements in conservation science and the science of water (supply and quality) management gained through the intervening decades. It is imperative that decisions in the final EIS also anticipate ethical considerations in preventing and managing present and future social conflicts over natural resources on the Duck.* **Marty Marina, Executive Director, Tennessee Conservation League, 58b**

A41. *As stated in the EIS, people living in the upper Duck watershed "will have to realize that protection of the quantity and quality of the water supply will be critical to their health and local economy," and "will have to work together to make sure each community has enough good quality water to meet their needs." As a member of this watershed community, The Nature Conservancy strongly urges that all residents, organizations, and utility districts assist the Duck River Agency in finding a long-term,*

regional solution that balances environmental concerns and economic development needs. **Leslie Colley, The Nature Conservancy of Tennessee, 44h**

A42. *It is extremely important to the local water systems and the Duck River Agency, which are jointly responsible for the water supply in the region, that this document has established an outline of the environmental issues and concerns that must be considered in the future development of the alternatives and the ultimate selection and completion of project and program solutions without prematurely limiting the alternatives. Over 30 years ago our predecessors anticipated the region's need for water and conceived of the Duck River project. They did not solve the problem indefinitely, but they did create Normandy Reservoir which sustains all of us and the main Duck River environment today. None of the current alternatives will sustain us indefinitely either. This EIS looks out to the year 2050 but there is nothing magical about that year. We owe it to the next generation to preserve alternatives and options that may be needed well beyond our lifetime.* **Linda Nannie, Chairman Duck River Agency, 20b and 71b**

A43. *The Duck River will be unable to supply Columbia's and Maury County's water supply needs by the year 2015. Maury County will have to find additional water supply sources to meet the water supply and water quality control needs of its citizens and industries. Since the halting of construction work on the Columbia Dam in 1983, no significant progress has been made toward meeting the future water needs of the lower Duck River area. An enormous amount of time and financial resources have been expended studying and documenting the obvious issues, needs, and solutions. It is imperative that no more time be lost. TVA, working with local water systems and Duck River Agency, has prepared an Environmental Impact Statement (EIS) on ways to meet projected water supply needs of the area. The draft EIS identifies water needs of the Duck River Basin and evaluates the environmental and socioeconomic impact of possible ways to meet future water needs without pre-selection of one alternative. The information contained in the discussion of general concepts presented can be beneficial to water planners and community leaders as they pursue a timely regional water resource. Obviously, important factors such as costs, consumer rate impacts, and site-specific details can and should be made by local and regional project sponsors.* **John R. Collier, Jr., Chairman, Board of Public Utilities of Columbia, Tennessee, 53a**

A44. *By addressing the environmental and socioeconomic issues of the alternatives early in the project's concept and design phase, we can create an opportunity for a successful project that balances community water resource needs, economics, and environmental impact. On behalf of CPWS water customers in Columbia, Maury County, and parts of southern Williamson County, we urge every responsible agency and community leader involved to show renewed determination and effort to complete the task of securing additional water supplies.* **John R. Collier, Jr., Chairman, Board of Public Utilities of Columbia, Tennessee, 53b**

Response to Comments A40 - A44: Even though they are stated in slightly different ways, all of these comments seem to imply that this EIS represents an opportunity to address the long-term water needs in the upper Duck River area without causing adverse environmental effects. If that happens, the document will have achieved all of its purposes.

B. Other General Topics

B1. *Complete the Columbia Dam; it should never have been stopped!* **Don F. Lee, 6c**

B2. *Dan* [Ferry] *it is not your fault, but people in Murray County still have a sour taste about TVA. I know you had the project dumped in your lap and it's not your fault but there are a lot of people that still have a sour taste about the Columbia Dam fiasco, and that's what it was - a fiasco. It should have never happened, but it did.* **Wayne Romesberg, 72j**

B3. *I know we all feel like that there has been a terrible mistake made and I think we are justified in doing this, us people that lived here. I had to move; my parents had to move, and a pretty good percentage of neighbors in our area had to move from where we were because of this thing and then it didn't work out besides all the tax dollars we put into it. I feel like if our friend Joe L. Evans had lived, the environmentals wouldn't had the problem we've had we would have had in here. I think we would have had a dam in Columbia today and been using it, but that's my opinion. It's not somebody else's, but I think when we lost our politics in Washington is the reason we don't have a dam in Columbia today. I hope, just like Buddy said and Mr. Jacobs, that we don't make this same mistake again.* **Jack Craig, 77c**

B4. *There were five options to accept or discuss, there really should have been six, number six being, the completion of the Columbia dam project. . . . The land is already acquired, the engineering of the dam is already complete and the preliminary work is already done. . . . The project will allow Maury County a growth of many years with water readily available, water sports and recreation would bring both increased populace as well as increased revenue to the county, due to the availability of water sports. . . . The disadvantages are few, one really, the possibility of one lost refuge for a mussel, mind you <u>not the last refuge.</u> No matter how you look at the entire scenario there is no logic for not completing the Columbia project. The benefits are not only to Maury county but all the surrounding counties as well, industry and manufacturing would find a greater attraction to the entire area. Mankind and the continuation of mankind as we know it should and must remain the top priority. There were five options mentioned in the article, none of which will meet the long-term needs of Maury County. The construction of another new dam on Fountain Creek would almost certainly meet the same resistance as the Columbia Project did, plus all the land is not acquired. It's time we looked at the needs of the majority not the desires of the special interest groups and met those needs. It's time to do what's "best for the business" and complete the Columbia Project.* **Jim Hillman, 16**

Response to Comments B1 - B4: TVA understands and appreciates the heart-felt nature of these comments; however as indicated in the Columbia Project Land Use EIS and in Section 1.2 of this EIS, in 1995 TVA determined that the Columbia Dam Project could not be completed as a dam and reservoir on the Duck River. Since then, TVA has been working with a variety of agencies to meet the purposes of that project in other ways. One of those purposes was water supply, which this EIS addresses.

B5. *I was born and raised here in Murray County, been here all my life practically, and I know you all have been through a tremendous amount with all this last 20-25 years. It has affected our county more than anything I've ever seen happen in this county. It's very disturbing to a lot of people to see things like this happen when we're suppose to*

have what I call common sense. We might not have a degree from some college but when you get into things like this, I think you need to use a little common sense. **Ed Jacobs, 76a**

B6. *I was nine years old when my grandparents sold their land to TVA and, of course, nothing came through as far as the dam. There's a lot of the older generation, my generation, that's all we remember is people selling their land and nothing has come of it. A lot of people have lost trust and they really need to keep this in the community versus bringing water from outside. We need to have our trust back and we don't want to be dependent upon anyone else for our resources. We want to be an independent county of everyone else.* **Cindy Short, 81**

Response to Comments B5 and B6: One of the potential benefits of this EIS is to help everyone in the upper Duck River watershed realize that good planning now can make a long-term difference in the availability of water for everyone.

B7. *Retain public land for public use.* ***No*** *new development on public land. Permanently turn over Duck River Dam property to TWRA.* **Nancy L. Penrod, 69b**

Response to Comment B7: Comment noted. Uses of the Columbia Project lands were evaluated in the Land Use EIS.

B8. *I feel that the options presented are viable; however, I believe that the gentlemen from the County Commission that talked about we need to take care of this locally was very correct and that we need to handle our own water issues and not be as dependent on other counties and other areas to provide our water. This is a local issue.* **Sharon Vaughn, 79b**

B9. *Ultimately, the decision to make a proposal to replace the water that would have been provided by the Columbia dam and to offer it for federal and state permits resides with the community. The TVA has acted responsibly and prudently to aid the community to make the necessary decisions. We commend your leadership and offer our assistance for a final resolution.* **Justin P. Wilson, Deputy to the Governor,43l**

B10. *I would like to say this is a local issue and it should be solved by the local people. We don't need environmental groups from California (western states), we don't need environmental organizations in the southeast to help solve our problems, and we definitely don't need another attorney from Murfreesboro to try to solve our problem. We know what happened last time there . .* [words lost on tape] *. . besides him getting rich. I think anyone here tonight needs to speak, state who they are, where they live, and if they represent any organizations.* **Wayne Romesberg, 72a**

Response to Comments B8 - B10: TVA concurs that addressing the future water needs of the Columbia area is a local issue. As stated in the EIS, TVA has prepared this evaluation of the need for water and the comparison of several possible ways to meet the identified need to help local agencies and the public understand the choices that are available.

B11. *Local governments, within the assistance of the Duck River Agency need to set up a commission of affected counties to plan and formulate a set of action steps to address the water supply issue for this region.* **Charles Sanders, 15a**

Response to Comment B11: This is one of several ways decisions could be made with regard to meeting the future water needs of the area.

B12. *Now, if a major wastewater treatment plant and associated infrastructure is built for our State Park and areas around the lake, as a trade off, the issue of water quality on Tims Ford Reservoir can change. Most importantly, we need to change the way we do business around here. Yesterday, we worked on Tims Ford Reservoir planning, today it's the Upper Duck River Basin planning. Wouldn't it be advisable to do comprehensive regional planning? TVA is doing most of this at our expense. It appears we are takers of whatever we are told we can do. Franklin and Moore Counties can only develop small parcels in a small way--yet, our neighbors in Maury, Bedford, Marshall, and Williamson counties get whatever they need at someone else's expense, including our water. I take issue with this approach and request that TVA either leave us alone, or help us help others by giving us some tools to protect our precious resources and thus have them available for all to use not just 50 years from now, but for all time beyond 2050.* **F. Montgomery Adams, Jr., Franklin County Executive, 29f**

Response to Comment B12: While everyone might not think so at any given time, TVA always attempts to act responsibly with regard to the wise use and conservation of the natural resources in the entire Tennessee River watershed. Acting responsibly also does not always mean that TVA can or should assist everyone in doing what they want, just because they want it.

B13. *While unrelated to the environmental impact issue, the financing of a future water supply is a major consideration. The 5¢ per thousand gallons TVA has collected from the Columbia area should be forfeited since they failed to complete their contract as scheduled when appropriations by Congress were approved.* **Douglas K. Mitchener, 59h**

B14. *Although it is not a specific part of this analysis, we commended TVA for meeting another state criteria to resolve its obligations for water. The setting aside of locally derived trust funds for regional water supply projects represents sound judgment and necessary fairness. These funds can play a significant role in the funding of an alternative addressed in the EIS.* **Justin P. Wilson, Deputy to the Governor,43k**

B15. *The 5¢ per thousand should continue to be collected from all users of Duck River water. Revenue collected from Shelbyville and upstream would be used for the maintenance of the Normandy Lake and river system water quality down to the Lewisburg intake. Revenue from Columbia, Lewisburg and Spring Hill (if they build their own water intake) would be added to funds already collected. Thus an account for future construction of the Williamsport Water intake would be established, funds would be controlled (and audited) by a representative(s) of each contributing system.* **Douglas K. Mitchener, 59i**

Response to Comments B13 - 15: As indicated in the Land Use EIS, the 5¢ per thousand gallons surcharge was collected by the Duck River Agency, not TVA, and placed in a trust fund to meet the local financial contribution to completion of Normandy and Columbia reservoirs, components of the Duck River Project. Subject to certain conditions, TVA has agreed to transfer the money in the trust fund to help respond to the water supply needs in the Columbia area. Future collection and use of this type of surcharge should be determined by people in the affected area.

B16. *We in Tennessee deserve better and demand more judicious treatment of our life-giving rivers. There is far more value to a river than simply its supply of water for human consumption. It seems that TVA should have learned this lesson from its loss of prestige due to the highly unpopular Tellico Dam, which destroyed one of the most beautiful rivers in the Nation, and from its experience in the abandoned Columbia Dam fiasco.* **Floyd and Linda Ayers, 32d**

Response to Comment B16: TVA agrees that the waters of the Tennessee Valley have many beneficial uses. Domestic water supply, recreation, and fish and aquatic life uses are all very important. One of the purposes of this EIS is to examine the potential impacts of each of the four action alternatives on existing and potential uses of the streams and reservoirs.

B17. *Let me say a few words about the Duck River Development Agency. You have changed your name so many times; you have changed your mission statement. I don't even think you recognize yourself when you look in the mirror. I don't. What have you done for Maury County. Name one thing. I don't think you can. Maury County has contributed over half of that nickel on a thousand gallons. What have you done for Maury County? Went to Hickman County and built them a water park or something like that for about $45K. You didn't even do that for Maury County. Why Maury County would even give you our support is beyond me. The Duck River Development Agency was created for one reason, maybe two. They gave one man a job for the rest of his life that nobody else could hold as long as he was alive, and you have been sopping up that nickel on a thousand gallons since 1972 and you still are. Thirty five years down the road, have you accomplished anything? Do you think in another 35 years you will have accomplished anything? You haven't done a thing, not a thing. Mr. Murdock, I told you once, I will tell you again. You got a lousy job. You're going to try to straighten up something somebody has made so crooked, bless your heart. Go back to Florida.* **Carolyn Derryberry, 74b**

Response to comment B17: Comment noted. TVA and DRDA recognize the strong feelings some have about the Columbia Reservoir Project and the agencies involved in it.

B18. *The only thing we are guaranteed by the Duck River Development Agency is that we pay a nickel on the thousand gallon but, in the DRA's legal response to TVA contractual audit March 26, 1998, page 54, the nickel per thousand gallon has not paid for water taken from the reservoir but from the Duck River. Again, it is not payment for water, it is a payment for a promise but undelivered - a two-dam reservoir project. That was stated in that audit. In the contract between TVA and the Upper Duck River Development Agency dated July 1, 1971, page 13-14, in the contract between the Upper Duck River Development Agency and the five public water utilities, including the City of Columbia, page 3 and 4, it first states they guarantee so many million gallons to all of them, and on the next page it says neither the TVA nor Agency guarantees the availability of the foregoing amounts of water. The only thing that was guaranteed was that nickel on the thousand gallon and these contracts. Everybody in Maury County and Marshall and all of them need to ask for these contracts and read them. You'd be surprised what you learn.* **William Derryberry, 73f**

Response to Comment B18: Comments noted.

B19. *Now I have a ruling on a U.S. Supreme Court case. Some ranchers in northern California and southern Oregon asked the EPA for water from reservoirs in that area* [but] *they turned them down, so they carried it to the United States Supreme Court. The ruling was in favor of the ranchers and against the environmentalists. This ruling is number 95813 Supreme Court of the United States Argued November 13, 1996, Decided March of 1997. I wish you would get a copy of that, look at it, and see if we file a lawsuit to get rid of the Pearly Mussel. . . . . We need to send the EPA a lawsuit about the Pearly Mussel or any other thing in the way and get the Corps of Engineers to build a dam for us or help get us one built because it looks like TVA don't want to at all.* **Glenn Stevenson, 78d**

Response to Comment B19: Comment noted.

C. Water Needs

C1. *A variety of unresolved issues and unmet obligations remained after the closure of the Columbia Dam project. First and foremost of these is the need to resolve the long-term water supply needs of the Upper Duck River Basin. In* ***Governor Don Sundquist's view, clean and dependable water for the Columbia region is as fundamental to the economic growth of the region as is dependable, low-cost electricity. This is the State's overriding concern.*** **Justin P. Wilson, Deputy to the Governor,43a**

Response to Comment C1: TVA agrees that clean, dependable water supplies are needed in the upper Duck River region. Each of the action alternatives discussed in the EIS is capable of meeting the projected water supply need through the year 2035 or 2050. The residents of the area can be confident that their long-term water needs would be met by one or more of these alternatives.

C2. *The solution to the projected problem(s) in the Duck River watershed should be solved in the Duck River watershed. Only as a last resort should the other watersheds adjacent to it be asked to share their dwindling resources. This is not a selfish comment, but a matter of possible future survival. The mighty Colorado River was once thought inexhaustible. There have been so many diversions for so many reasons, that it is only a small part of what it once was. We can't let that happen here.* **Jerry C. Lashlee, 26f**

Response to Comment C2: Comment noted.

C3. *Now air is our number one most valuable thing and water is next, second. We can't do without either one of them too long, so for the benefit of the future, TVA paid me for a 100 acres just above the dam not too far. I'd rather see it covered with water than to give it back to me or sell it back to me. Water is going to be a problem all over the world at a certain time. Atlanta is hunting water; Dallas is hunting water; . . . we don't know what year it is coming. It may be two years or twenty years but it's coming.* **Glenn Stevenson, 78e**

Response to Comment C3: Comment noted. TVA, in cooperation with local water systems, has been able to estimate when additional water would be needed in the Duck River at Columbia. As indicated in Section 2.8, during drought conditions between the years 2015 and 2025, the water demand at Columbia would exceed the amount of water available in the Duck River.

C4. *One of the biggest concerns that we have in Marshall County is water. When we apply for community development block grants, one of the criteria for getting the grant is to test the wells of the potential customers. In almost all cases these reports come back with a positive contamination report. It is in the best interest of Marshall County to find a new source of water other than the Duck River.* **Terry Wallace, Marshall County Executive, 65c**

Response to Comment C4: Microbial contamination of groundwater is very common in many parts of the upper Duck River watershed. The shallow soil underlain by limestone rock provides many opportunities for contamination from animal and human waste to percolate down into the groundwater. This also is the reason why public water systems with effective water treatment capabilities are so important to the region. Section 2.8 indicates that the future water demand in the Marshall County Water Service Area can be met by the Duck River.

C5. *More emphasis must be placed on future water needs throughout the basin. Normandy Reservoir is already not meeting the stated objectives. The release from the dam is already curtailed each year through the winter to allow the reservoir to be filled by the limited rainfall that occurs in the basin. Even at this reduced release, the reservoir has not reached full pool by the target date in some years. Fortunately, timely summer rainfall events have allowed the reservoir to be filled to full pool or higher. To date, the area has just plain been lucky.* **Randal J. Braker, 70a**

Response to Comment C5: TVA agrees that more emphasis is needed on water issues in the upper Duck River watershed. TVA also believes that Normandy Reservoir has met, and is continuing to meet, its project objectives. When Normandy reservoir was planned, TVA recognized that the recreation pool elevation of between 870 feet to 875 feet could be maintained only 90 percent of the time. TVA implemented water conservation operation measures during the drought of 1980-1981 and during the drought of 1987-1988 to keep the reservoir pool elevation as near normal as possible while meeting the intent of the downstream water quality and water supply minimum flow objectives. These operations to conserve water have been continued to date to benefit the water supply of the Duck River Utility Commission. TVA has effectively used the water from summer rainfall events to help maintain lake levels as high as practical during recent dry summer months.

C6. [I]*f you use A, B, or C or whatever down here, Lewisburg and Shelbyville hasn't got any guarantee that they're going to have sufficient water in the future. If you put the pipeline in, Shelbyville gets the benefit of the water; Lewisburg gets the benefit of the water; we get the benefit of the water. It comes downstream and our cost and environmental impact on the pipeline is negligible . . . as it has already been told here tonight. So I don't really see why it is really such a complicated matter to solve our water problems, and we are talking about 2050, that's 50 years off. So I believe the figure on that was $13M and I'm sure a fellow could run a 30-inch pipeline for $13M and put a couple of pumping stations on it. You're amount of people to operate it and see after it and whatnot.* **Ed Jacobs, 76c**

Response to Comment C6: Comment noted.

C7. *It is clear to the DRA Board of Directors and to the managers of the regions water systems, who serve on our Technical Advisory Committee and work each day to remove the pollutants from our drinking water, that we are not separable from our environment. If we are to continue to enjoy the quality of life that is Middle Tennessee, we must take steps to ensure that there is abundant clean water for all elements of the environment. With each day that we delay, additional stress is placed on the environment and solutions become more costly.* **Linda Nannie, Chairman, Duck River Agency, 20d and 71d**

Response to Comment C7: TVA appreciates the efforts of the water supply systems in the upper Duck River watershed to produce safe drinking water. The purpose of the EIS is to help guide future coordinated efforts of these systems to ensure that there will be safe, dependable water supplies for the region's growing population and economy.

C8. *This situation was calculated years ago by the TVA when the Columbia Dam was proposed and mostly built. Now that the dam project has been canceled, the chickens have come home to roost. Water, plentiful and clean, is the most compelling issue we will all face in our lifetime. We have watched as the Upper Duck River Basin has*

evolved into a major growth area complete with all the problems that come from lack of sufficient planning and unbridled growth. **F. Montgomery Adams, Jr., Franklin County Executive, 29a**

Response to Comment C8: Comment noted.

C9. *Although there seems to be a perceived need by some of the locals (pg. 10) for additional water supplies in the watershed, the actual need seems unjustified at this time for the Bedford and Marshall County service area through 2050, based on the needs analysis in the DEIS. However, for the Maury and southern Williamson County service area, water supply is expected to become a growing issue after 2015. The DEIS indicates (pg. 31) that by 2025 the unmet need would be 6 cfs (4 mgd), by 2035 it would be 14 cfs (9 mgd), and by 2050 it would be 22 cfs (14 mgd) beyond the 40 cfs available from the Normandy Reservoir. However, page 35 notes that "[t]hese amounts of water would be needed only during extended drought conditions, when demand was at its maximum and nearly all of the flow in the river was supplied by the minimum discharge from Normandy Dam."* **EPA, 51d**

Response to Comment C9: The purpose of the Water Supply Needs Analysis was to help local water systems and residents identify where and when additional water would be needed and how much would be required.

C10. *EPA is not convinced that a water supply alternative is needed at this time for the area of concern, particularly the Bedford and Marshall County service areas. In regard to Maury and southern Williamson County, we believe the determined unmet need during droughts starting in 2015 through 2025 (4 mgd or 6 cfs) could and should be met through water conservation. The 2035 unmet need (9 mgd or 14 cfs) could arguably also be met through conservation. The unmet need for 2050 (14 mgd or 22 cfs), however, is approximately 50% above the 40 cfs baseline Normandy flows, and therefore would likely require additional water supply. However, that need is many years away and would only apply during drought situations. As such, based on the DEIS, EPA believes the need for additional water supply is unfounded for the Bedford and Marshall Counties and can be met by conservation methods for some time (through approximately 2025 or 2035) for the Maury and southern Williamson Counties during droughts. At this time, therefore, EPA favors the No Action Alternative (A) for the near term. We recognize, however, the value of early planning for future needs in order to determine an adequate and environmental approach to additional source water.* **EPA, 51l**

Response to Comment C10: Section 2.8 of the EIS indicates that the estimated future water demand of the Bedford County and Marshall County Water Service Areas can be met by the Duck River and no action would be required to address water needs through 2050 in those water service areas. The estimated future water demand of the Maury/southern Williamson County Water Service Area would begin to exceed the amount of water available in the Duck River after the year 2015. Throughout the United States, water conservation efforts have been documented to accomplish about a 10 percent savings in average daily water use. If the Maury/southern Williamson County Water Service Area would implement a water conservation program and accomplish a 10 percent reduction in total water demand, the result could be a water savings of 3 mgd (4.6 cfs) in 2025, 3.5 mgd (5.5 cfs) in 2035, and 4.0 mgd (6.2 cfs) in 2050. These savings, while significant, would only partially offset the need for additional water. The additional water that would still need to be met by would be 1.4 cfs in 2025, 8.5 cfs in 2035, and 15.8 cfs in 2050.

Water conservation in the Bedford County and Marshall County Water Service Areas also could increase the amount of water available in the Duck River at Columbia and, if effective, could further delay the need for additional water sources. A 10 percent reduction in water use in Bedford and Marshall counties could defer the need for additional water in the Maury/southern Williamson County Water Service area until after the year 2025 and, if the conservation measures continued to reduce the demand by 10 percent, the additional water that would be needed in the Columbia area could be reduced to 5.5 cfs in 2035 and 12.3 cfs in the year 2050. Considering how long it takes to design, engineer, permit, and construct most possible water supply solutions (especially reservoirs), this examination of water supply needs and alternatives is both timely and appropriate.

C11. *Shelbyville is predicted to exceed the water supply allocation for Bedford County from Normandy Reservoir soon after 2050. Will the area be stopped from withdrawing water or will the Lewisburg area be forced to make due with a lower flow in the river?. Raising the height of the dam at Normandy Reservoir is clearly the best choice because it solves these existing problems with the releases from the dam and also solves the shortages at Columbia.* **Randal J. Braker, 70b**

C12. *The Alternative D, raising Normandy, this may be semi-acceptable but it is definitely better for the upper reaches of the Duck River than for the lower regions like Marshall, Murray, Hickman, Humphreys, that in the long run probably will not help solve us as well as they just said. We still* [would] *have to do water conservation in 2035, so basically that means our children will have to be back in 2035 to try to find another answer that we didn't solve.* **Wayne Romesberg, 72d**

Response to Comments G11 and C12: The purpose of this EIS is to evaluate ways of meeting the need for water in the upper Duck River basin through 2050. This evaluation used state-of-the-art projections about future population growth in the area that were provided by the U.S. Geological Survey. Local and regional planners will have to recognize when population growth and the demand for water begin to vary from these projections and start planning to meet the revised future needs. By 2035, it is quite likely that assumptions made in this EIS concerning the ways water is used and its value will have changed sufficiently to warrant renewed interest in long-term planning for water needs in the area.

C13. *To the people here, consider the source. In 1965, we had the same people* [TVA] *telling us we were fast approaching a water shortage. In 1965, there was a little biddy blue book in Murray County library published by TVA that said by the year 2000, Murray County would be using 40 million gallons a day. We don't come anywhere near that. They were wrong then, what's to say you are right now?* **Carolyn Derryberry, 74a**

Response to Comment C13: In 1965, Maury County had several industries which used large amounts of water to wash and process phosphate ore. Those industries have since ceased operations in the area, considerably lowering the industrial water demand. Even though population has increased substantially, industrial water use in the Columbia area has declined from about 29 mgd in 1965 to about 4mgd in 2000.

C14. *We are concerned that future use projections were based upon the assumption that "no new large water-consuming industries would locate in any of the water service areas in the upper Duck River basin." We feel that the leadership of the cities and*

countries of the area should have the opportunity to be involved in the adoption of any such assumption as its use might, unintentionally, place a "water cap" on economic growth in the region. The I-65 corridor is an area in heavy demand for industrial development. While extremely heavy water users (5-10 MGD+) would probably not consider the area due to its basic scarcity of water and lack of large receiving streams, a few new industrial users in the 1-2 MGD range could be vital to the area's future economy. More importantly, existing water using industries may be negatively impacted in their future decisions regarding expanding in place or having to relocate. **Wilton Burnett, Jr., Special Projects, Department of Economic and Community Development, 63a**

Response to Comment C14: As indicated in Section 2.5, the future demand for water in the upper Duck River watershed used in this EIS was determined by the U.S. Geological Survey in conjunction with the DRDA. The specific set of projections used as worst case conditions in the EIS include additional industrial growth in the Maury/southern Williamson County Water Service Area beyond the steady growth projected to occur in the Marshall and Bedford County water service areas. This liberal growth projection for the Maury/southern Williamson County Water Service Area would accommodate a good deal of additional industrial water use but does not, and cannot, account for any specific, large, self-served, water-using industries which might decide to locate in the watershed at some time in the future. As indicated in the comment, however, extremely heavy water users would probably not consider locating or expanding in this area due to its basic scarcity of water and lack of streams capable of assimilating large volumes of wastewater.

C15. *The draft EIS addresses anticipated water demand without considering the impacts of low flow scenarios - similar to those presently being experienced - on maintaining river function. TVA's experience this summer in managing the water supply for Chattanooga and northeast Tennessee speaks to what happens when God does not provide enough rain to create adequate runoff.* **Marty Marina, Executive Director, Tennessee Conservation League, 58d**

Response to Comment C15: The analysis of water available in the Duck River for water supply withdrawal is based on severe drought conditions such as occurred in 1953 when a U.S. Geological Survey team observed that there was no flow entering the Duck River from tributary streams between Shelbyville and Columbia. Under such a scenario, the only flow in the river would be that supplied by releases from Normandy Dam, wastewater return flow, and drought flow from Fountain Creek. Sections 2.6 and 2.7 describe these conditions. The dry summer months experienced in the Duck River during 1999 and 2000 were not as severe as the drought conditions used in the Water Needs Analysis and evaluated in the EIS.

C16. *It's unfortunate Columbia and the Duck River watershed are outgrowing their natural resources. However that is their problem. Rather than rob Peter to pay Paul, Peter should adjust his lifestyle to fit his resources. If the Duck River cannot supply sufficient water needs in the years to come, then growth and expansion should be minimized rather than maximized. Also, the overflow from Davidson County is fast filling Williamson County. By 2050, all of Williamson County will need much more water to meet those growth needs and you will be looking for ways to provide that increase. If you're drawing from Tims Ford, you'll want to draw even more. Once the cycle is started, bureaucrats find it easy to make the cycle even larger.* **Jerry C. Lashlee, 26b**

C17. *Quoting the EIS "The primary focus of the EIS is the future water supply needs in the Columbia area .... and .... form the basis for completing the remainder of this evaluation". This primary focus does not take into account the water supply needs in the Franklin County area. One might describe this view as "tunnel vision".(Page 11)* **Mark H. Dudley, 24c**

C18. *We're growing in the Elk River watershed also. Our needs are also increasing. Have those been addressed and the increase been included into your equation? I saw nothing in your brief that would lead me to think so. In fact, there was nothing in there that made any kind of mention to the effects on the Elk River watershed, either present or future.* **Jerry C. Lashlee, 26e**

C19. *There is an even greater reason for TVA not to consider Alternative E. The water in the Tennessee Valley belongs to the citizens of the Valley, not to TVA. By moving water from one area to another, TVA is assuming they have ownership of the water. If the citizens in this (Winchester) area objected, and this action was contested in court, I do not believe it would be judged legal.* **Eugene J. Sanders, 39b**

C20. *Steal the water from the Cumberland River; blast the rock away and put in an enormous pipeline to serve the burgeoning South Nashville Metro Population! Tell the COE to cooperate!* **Don F. Lee, 6d**

Response to Comments C16 - C20: The future water needs of the Elk River watershed are as important to TVA as those in the upper Duck River watershed. Local water districts and local governments, with the assistance of various state agencies will decide which water supply alternative(s) should be pursued in the future. The Tims Ford Pipeline alternative would likely be viewed as unreasonable if the water transfer would constrain economic growth in, or otherwise adversely affect residents of, the Elk River area. In anticipation of residential and industrial growth, TVA included large amounts of water for municipal and industrial water supply use in Tims Ford Reservoir. Based on the estimated population growth in Franklin and Moore counties, a surface water withdrawal of about 10 mgd could reasonably be expected by the year 2050. At the normal summer pool elevation of 888 feet, the reservoir holds 535,000 acre-feet of water and the estimated future water need of 10 mgd is small in comparison to the volume available. There would be enough water in Tims Ford reservoir to meet growing water needs in Franklin and Moore counties as well as supply water to the Duck River without impacting existing uses of the reservoir.

The water transfer to the Duck River from Tims Ford Reservoir would not be needed every year or for longer than 3 or 4 consecutive months at a time. In most years, the Duck River has enough water to meet even the projected future needs within the watershed. To evaluate potential impacts of a water transfer, TVA analyzed what would have happened during the severe drought of 1987-1988 if a pipeline had been withdrawing 22 cfs from Tims Ford Reservoir from June to October. The analysis showed that the withdrawal would have lowered the reservoir pool elevation by 8 inches in 1987 and 7 inches in 1988 during the recreation period. If Alternative E was to be considered for implementation, additional analysis would be performed to better document the potential impacts on the recreation pool level, as well as effects of increased water withdrawals by public water supply systems.

C21. *I believe business and residential water rates in the Duck River watershed should be increased to allow demand to match their local supply without "raiding" the Elk River's watershed. I do not want to sacrifice the Elk River merely to allow cheaper water rates in other areas.* **Ken McGarry, 13b**

Response to Comment C21: A review of existing water rates would be one of the first logical steps in implementing a water conservation program. One of the first adjustments that a water system could make would be to revise water rate structures to encourage conservation instead of water use. TVA believes it would be beneficial for all water systems to implement water conservation programs.

C22. *The document fails to discuss water conservation as an alternative or supplement to the action or no action alternatives. Efficient use of existing supplies can save money, obviate the need for additional water storage capacity, and prolong the use of existing supplies during shortages. Successful implementation of water conservation measures depends on regulatory action by state and local governments and management decisions by the local utility. Typical measures are codes and ordinances that mandate water conservation through the use of plumbing fixtures, use of reclaimed water, installation of meters, leak detection programs, rate structure changes, and public education programs. As previously indicated, voluntary conservation methods should be encouraged and employed regardless of the alternative selected, with incentives and disincentives provided by local authorities for complying customers. Conservation should target those activities that consume water (e.g., lawn watering) as opposed to those that return a large portion of the water to its source (e.g., wastewater).* **EPA, 51r**

Response to Comment C22: TVA agrees that water systems in the upper Duck River watershed should implement water conservation programs regardless of the outcome of this EIS. The typical conservation measures identified in this comment have proven to be effective in reducing water use. Specific components of water conservation programs implemented in the upper Duck River watershed could be tailored to the size and capability of each individual water supply system. The discussion of water conservation in Section 3.8 has been expanded to include this concept.

D. Alternative A - No Action

D1. *The most sensible and logical course is to use alternative "A" or take no action.* **Douglas K. Mitchener, 59a**

D2. *I believe the "no action", Alternative A is the correct course of action. The bunch of morons that stopped the Columbia Dam must reap what they sowed. If the dam could not be constructed because changes to the river threatened "the rich flora and fauna of the Duck River", then other changes to the river and local environment cannot be allowed, either. Sorry, Charlie.* **John Albright, 2**

D3. *Alternative A, the alternative of doing nothing, to me that is not an answer, so we should not even consider that.* **Wayne Romesberg, 72b**

D4. *Based on our evaluation of the Draft EIS, we agree that Alternative A (no action) is untenable given the projected population growth of this region.* **Leslie Colley, The Nature Conservancy of Tennessee, 44b**

D5. *Using the present resources is an untenable solution because the system is presently functioning near its limits.* **Marty Marina, Executive Director, Tennessee Conservation League, 58f**

D6. *One of the things that I know we do not need to do is to do nothing. One of the things that most concerns me, not only as a resident of Murray County but also as a businessman in Marshall County, is the ability to have water to use for not only drinking but for fire protection and all the many associated needs of water.* **Randy Short, 80a**

Response to Comments D1 - D6: Comments noted.

D7. *According to your introductory or cover letter accompanying this Draft EIS, the purpose of the Study was to identify "potential ways to meet the projected water supply needs..." Based on this statement, a "do nothing" alternative does not meet this basic criterion and is therefore academic.* **Frank M. Tamberrino. President, Maury Alliance, 66a**

Response to Comment D7: Consideration of the No Action Alternative is a required part of a NEPA review. In this EIS, the function of the No Action Alternative is to indicate what would happen in the area if nothing was done to address the projected future water needs. Routinely, the No Action Alternative establishes a baseline for evaluating the effects of the action alternatives.

E. Alternative B - Fountain Creek Reservoir

E1. *Build Dam on Fountain Creek.* **Joe P. Due, 49**

E2. *In favor of Fountain Creek Reservoir.* **Doug Wooten, 36**

E3. *In favor of Fountain Creek Reservoir for fishing.* **Steve Sacchinelli, 37**

E4. *I would choose the fountain creek option if I were to choose.* **Kent Curtis, 4a**

E5. *After reviewing all of the alternatives that were discussed at the public hearing in Columbia, it is my opinion that the Fountain Creek impoundment would be the best alternative for Marshall County.* **Terry Wallace, Marshall County Executive, 65a**

Response to Comments E1 - E5: Comments noted.

E6. *Fountain Creek Dam, I feel, would be helpful in our water supply. I believe the people of Maury County would support the Fountain Creek Dam. We need the water supply. I hope the damage to our land would be minimal* [c]*ompared to what has already been damaged by the Big dam project.* **Debbie J. Grissom, 68**

E7. *So the solution I see is B, the Fountain Creek Dam. Granted, it is more expensive but sometimes you do have to bite the bullet to solve a problem and this is the bullet. . . . . But in the long haul, I do feel like Alternative B, the Fountain Creek, is our best alternative for us, our children. and generations to come.* **Wayne Romesberg, 72g**

E8. *In looking at all the alternatives to having enough water for the area of Murray, Marshall, Bedford Counties and also Williamson County, I feel the best solution would be a reservoir in the Fountain Creek area. It's going to provide more water than all the other three alternatives combined. . . . . Let's build a reservoir; let's get it over with; and let's get on with the future.* **Randy Short, 80b**

E9. *The only long-term quality answer for Maury County is the reservoir on Fountain Creek. The money will come from local money and benefit the people of Southern Middle Tennessee. This resolves a problem that many people have realized existed for a long time - need for quality water supply. Its time has come. Dam up Fountain Creek.* **W. Roger Witherow, 11**

E10. *This department recommends a serious consideration of the Fountain Creek alternative, Alternative B, because it presents the greatest buffer or excess water availability for future use. Alternative B projects to give a 39-40 CFS excess over the 100 CFS baseline needed in the Duck River while C and E project to give excesses of only 10 and 2 CFS respectively and D will go below the baseline need. These figures are based upon the "no new heavy water users" projection.* **Wilton Burnett, Jr., Special Projects, Department of Economic and Community Development, 63b**

Response to Comments E6 - E10: Comments noted. Alternative B does have the potential to provide the most water to the Columbia area.

E11. *I think that the Fountain Creek impoundment would enhance the region of Marshall and Maury County by providing this two-county region with a source of water for drinking as well as recreation. The impoundment could also be used as an emergency*

source of water. A plan could be worked out for a water treatment plant to be built that could serve Marshall, Maury, and southern Williamson County with a water supply that could possibly connect a water grid system to help get water to parts of the counties that do not have a public water supply. **Terry Wallace, Marshall County Executive, 65b**

E12. *I am strongly in favor of the development of Fountain Creek Reservoir for several reasons. Firstly, it encourages economic enhancement in a positive and non-toxic (industrial) growth. Secondly, it would become a central recreational magnet for Colombians and surrounding counties to enjoy in every season. Lastly, it is an ample and manageable water supply that's not shipped in via pipeline from Normandy or Tims Ford. It would also demand that our ancient H_{20} treatment facility be upgraded to accommodate the lake. This alone, is a gain. Though I am aware that the estimated cost is higher for the lake project, the benefits our community would receive, far outweigh the cost of completion. We deserve to have this lake project completed after enduring all the burdens from the entangled Duck River Dam project.* **Marian J. Haynes, 48**

E13. *Certainly the Fountain Creek Reservoir would benefit all of lower Middle Tennessee in more ways than just water supply. Doesn't this community deserve this kind of economic and recreational stimulation after suffering the twenty-five year debacle of the Columbia Dam? With substantial resources and infrastructure already committed to support this proposal, let us move ahead with the commitment to finish this reservoir project. No other alternative redresses the travesty which has been the earmark of this project heretofore.* **Lewis P. Haynes, 40**

Response to Comments E11 - E13: Alternative B could supply a large quantity of water; however as indicated in Sections 5.4 and 5.11, protection of that water supply source probably would involve restrictions on recreational and other use of the reservoir.

E14. *The Fountain Creek Reservoir is the most practical solution to Maury County's and southern Williamson County's fifty year water needs, and does not disturb Duck River downstream. Alternative "B" Fountain Creek Reservoir appears to be the only solution Maury County can consider concerning the economical growth. Water is the first thing a prospective employer asks about. Depending on a pipe line supply or over-worked (90 miles away) Normandy Reservoir would bring the growth of our county to a halt: if not now, in ten to fifteen years. Maury and Williamson counties, along with the other partner along the path of the Duck River, cannot let the need for water impede our growth.* **Ralph G. Maddux, 23a**

Response to Comment E14: Each of the action alternatives could meet the projected water needs of the Columbia area through 2035 or 2050.

E15. [T]*he Board of Directors of the Maury Alliance, a public-private partnership for economic development in Maury County,* [has passed a resolution] *which clearly states our support for the Fountain Creek alternative. This alternative provides a long-term solution to the current and projected water needs of this area, much as the original dam was supposed to.* [T]*he Maury Alliance Board of Directors believes that: a) The recognized time for projected water demand to exceed existing water supply in the Columbia region is the year 2015 and that action to address the issue well before that time should begin now, b) The Fountain Creek Reservoir alternative can supply the*

largest amount of water of the proposed alternative, in fact almost the same volume as the other alternatives combined, and c) The Fountain Creek alternative is the best, most logical solution to an imminent water supply issue, best approximates the earlier and original conceptual solution to address the long-term water needs of the greater Columbia area and appears to be cost-effective from the preliminary analysis. **Frank M. Tamberrino, President, Maury Alliance, 47a**

Response to Comment E15: Comments and recommendations noted.

E16. *I am opposed to Alternative B (Fountain Creek Reservoir) on the basis of cost and habitat destruction.* **Dennis D. Horn,10b**

E17. *I oppose the environmentally damaging alternatives B&D.* **Louise Gnenflo, 25a**

E18. *I wish it known that I am strongly opposed to Alternatives B, D, and E.* **Robert F. Shanks, 34b**

E19. *TCWP strongly opposes the two alternatives, B and D, that are identified as having "substantially more potential for adverse environmental effects" and that would alter substantial areas through inundation and associated damages.*

- *Alternative B, construction of a 3,600-acre reservoir on Fountain Creek, would consume at least 3,600 acres (800 to be acquired plus 2,800 already in public ownership). It would also be by far the costliest alternative, estimated at $50 million.*

Liane B. Russell, for the Tennessee Citizens for Wilderness Planning Board of Directors, 30b

Response to Comments E16 - E19: Comments noted.

E20. *I was raised on Fountain Creek in my early years and the water there, when it gets dry, won't support a dam. Now this last summer on each Sunday, . . . after church I go over and check the water as it goes into Duck River and Fountain Creek would go through a 4-inch pipe at natural flow. There was no pressure at it's lowest stage before the first rain came.* **Glenn Stevenson, 78a**

Response to Comment E20: Available information indicates that a reservoir in the Fountain Creek watershed similar to that evaluated under Alternative B would receive enough rainfall during even a drought period to meet the projected needs of the Columbia area through 2050.

E21. [T]*here are concerns with the Fountain Creek Proposal . . . . Water quality issues are the main concern with the Fountain Creek Reservoir proposal. The Division is concerned that the iron and manganese levels and aquatic growth will cause a water quality issue for the customers of the Columbia Water System.* **W. David Draughon, Jr., Division of Water Supply, TDEC, 62c**

E22. *Impoundment of Fountain Creek would create a relatively small, shallow, nutrient rich reservoir. As a public water supply, such a reservoir may experience significant taste and odor problems. Fountain Creek Reservoir would provide ideal habitat for aquatic plants, algae, and phytoplankton. Seasonal oxygen depletion at depth would result in the build up of dissolved minerals including iron and manganese. In addition to loss of the relatively diverse community of fish and aquatic life currently supported by Fountain Creek, an impoundment may result in seriously degraded tailwater*

discharges. Oxygen depletion, elevated dissolved minerals, hydrogen sulfide, and significant fluctuations in flow, could contribute to water quality and habitat degradation in the tailwaters and the Duck River. When combined with anticipated loss of wetlands, Alternative B has potential for serious negative environmental consequences. **Abrey McKinney, Environmental Services Division, TWRA, 61a**

E23. *Page 147 indicates that the Fountain Creek watershed that would contain the reservoir proposed under Alternative B "...contains relatively high levels of nitrogen and phosphorus from natural sources as well as non-point sources." This page further states that "[t]hese levels of nutrients would be quite likely to support excessive algal growth in the upper layers of the reservoir." Page 149 similarly states that "...construction and use of the Fountain Creek water supply reservoir would create a relatively small, nutrient-rich reservoir which probably would have to be carefully monitored and the watershed strictly managed to protect the quality of the source water." Accordingly, EPA is concerned that the Fountain Creek Reservoir proposed under B could become eutrophic and not comply with the Clean Water Act.* **EPA, 51s**

Response to Comments E21 - E23: The information available to TVA indicates that each of these water quality effects could occur. If Alternative B was implemented, each of these issues would have to be addressed to protect the water supply source and downstream uses of the Duck River.

E24. *Of the four presented action alternatives (B-E), EPA does not environmentally favor the construction of Fountain Creek Reservoir. This is due to the projected substantial loss of forested wetlands and uplands, potential ground-water effects due to local karstic geology, the potential for shoreline development and its associated impacts on water quality, the expectation for a small nutrient-rich reservoir with a slow flushing rate which may result in noncompliance with water quality standards associated with eutrophication, the potential for aquatic ecology effects downstream of the proposed dam due to reduced flows, the need to acquire an additional 800 acres of land, the uncertainty of the undocumented impacts of the new water treatment plant and associated five-mile long pipeline, and the existence of two nearby reservoirs (Normandy and Tims Ford) which might be utilized.* **EPA, 51k**

E25. *Of the four action alternatives, the Fountain Creek Reservoir (Action Alternative B) is the least favorable. This alternative will result in the greatest costs, both environmental and economic. The Draft EIS projects a net loss of 140 species, a loss of 200 acres of wetlands which would probably result in mitigation costs, a considerable expense for dam construction and the maintenance of long-term water quality in this reservoir, and the greatest negative impact on prime farmland and community noise. The projected benefit of additional water volume of 74cfs is contingent upon the function and capacity of this reservoir in an area that is characterized by karst geology and seldom has surface water in even mild drought conditions. While addressing the projected water needs for Maury and southern Williamson counties, the Fountain Creek reservoir may provide no benefit to residents of Marshall and Bedford counties.* **Leslie Colley, The Nature Conservancy of Tennessee, 44c**

Response to Comments E24 - E25: These comments summarize many of the potential adverse effects which could be associated with Alternative B. By way of clarification, the available information indicates that the stream-dwelling species which would be displaced by the reservoir also occur in many other streams in the adjacent part of the Duck River watershed.

E26. *I also object to damming Fountain Creek (Alternative B). Please consider the environmental impact and the cost effectiveness of the proposed alternatives. Short Springs and the Fountain Creek water shed deserve protection for future generations and most importantly, the diverse life present there.* **Kevin C. Fitch, 54b**

Response to Comment E26: Each action alternative would have both benefits and adverse effects. The challenge in projects such as this is to maximize as many of the benefits as possible while avoiding or minimizing the potential adverse effects.

E27. *Building Fountain Creek Reservoir is an expensive alternative, reminiscent of choices made in the '60s and '70s. TVA and its stakeholders will do well to learn from previous experience and save itself and the taxpayer's dollars by choosing another scenario. This area of Fountain Creek is not suited to a reservoir because of the shallow water depth. As noted in the draft EIS, the Fountain Creek Reservoir will be a shallow, nutrient rich reservoir. By definition, we believe it will provide a poor water supply and poor aquatic habitat. It also has a potential for creating more public expectation and suffering the same sociological conflicts over resources presently experienced on TVA's Nickajack, Chickamauga and Guntersville reservoirs. These were unintended consequences in those areas. Neither TVA, the state, or county governments can afford the cost of managing the natural resource conflicts and it would be inexcusable to knowingly create them. Further, building the reservoir will cause biological loss and maintaining it under low dissolved oxygen and low flow circumstances will likely to continue this trend.* **Marty Marina, Executive Director, Tennessee Conservation League, 58g**

E28. *I feel that the Fountain Creek option should be given the lowest priority ranking of the five options. The capital cost (given the actual water demand) is excessive. The project is essentially "overkill", and the amount of environmental/ social destruction is therefore unwarranted. The operational costs will also be exorbitant, given the regional attitude to develop every water body as a luxury golf course development. The best the locals could hope for would be a Radnor Lake scenario.* **Richard E. Lockwood, 31b**

E29. *The Fountain Creek Dam Alternative is fraught with both opportunity and limitations. This alternative appears to provide an adequate water supply. The Columbia Dam land use EIS, associated deed restrictions and agency agreements provide for environmental mitigation. Other permit issues must be resolved before project approval. Moreover, reservoir's shallow nature creates challenges for water quality. In no event, however, should the Fountain Creek Dam alternative be abandoned until provisions have been made for an adequate water supply through 2050.* **Justin P. Wilson, Deputy to the Governor,43d**

Response to Comments E27 - E29: These comments highlight the serious, long-term considerations which will have to be carefully evaluated before a decision is made concerning this alternative. All of the potential adverse effects would have to be resolved or substantially overshadowed by the expected benefits before this alternative should be built.

E30. *The land currently reserved for alternative "B" (Fountain Creek) should be retained in that status for the foreseeable future. TWRA would be allowed to operate the land area with a ban on any permanent structures. This would remain a possible impoundment area.* **Douglas K. Mitchener, 59g**

E31. *All land presently owned by TVA/ State of Tennessee shall be managed by TWRA. None should be sold to the public or be allowed to be squandered by our local govts* [governments ?]. *This 12,600 acres will be a jewel of this area if left whole and not systematically sold or developed. Our local govts and agencies cannot handle owning any of this land. They will turn it into trailer parks. The people that gave it up and our next generation deserve better.* **Mike D. Penrod, 67b**

Response to Comments E30 - E31: At present, the federal land in the Fountain Creek watershed is proposed to be transferred to the State of Tennessee with restrictions on its use that were described under the preferred alternative in the 1999 Land Use EIS. Those restrictions would exclude many kinds of activities on the land and maintain the possibility of building a water supply reservoir in the Fountain Creek watershed until 2050 or when a decision was made not to build such a reservoir.

E32. [W]*e recognize that the Fountain Creek Reservoir would apparently become part of the TVA system and would therefore be managed by TVA, which has demonstrated significant expertise and success in reservoir management.* **EPA, 51l**

Response to Comment E32: Information presented in Section 1.3 and 3.2 indicates that TVA is not proposing to design or construct any of these alternatives. While any reservoir built in the Fountain Creek basin would be within the Tennessee River watershed, TVA is not planning to manage such a project.

E33. *The Fountain Creek proposal is costly, of high environmental and landowner impact, and has risk of failure for the same reasons Columbia Reservoir Project failed.* **John M. Procter, Elk/Duck River Chapter, Trout Unlimited, 60b**

Response to Comment E33: The EIS identifies all of the known issues which would need to be evaluated before a decision is made to construct any additional water supply project(s). Both the EIS and many of the comments on that document highlight issues about a possible reservoir which would have to be addressed before such a project should be built.

E34. *Before you get too excited about any one of these alternatives, take a good look at the people who are going to have to give up their homes and their farms. We've done it once, it didn't work. Fool me once, shame on you; fool me twice, shame on me. And he who would ignore history is doomed to repeat it. Please dear God, let there be a wise head in this crowd. Don't do it again.* **Carolyn Derryberry, 74c**

E35. *There needs to be somebody to check this out to see if the environmentalists are going to let you build* [a dam] *before you go out there and start taking land like you did before. They got the cart before the horse the last time and they went out there and started taking land and then they found out they couldn't complete it. The blame was laid on Congress. They said Congress gave them the money and told them to do it and that's the reason it was done. The three Judges we stood before in Cincinnati told our lawyers that we needed to take this to Congress and it's their job to straighten it up and that's where it's at today, in Congress.* **William Derryberry, 73c**

Response to Comments E34 - E35: All of the important issues associated with building and operating this reservoir should be resolved before any action is taken to move people off of their land. TVA and the other cooperating agencies are very much aware of the anguish many people in the Columbia area feel about the loss of their land for a reservoir project that was never built.

E36. *Very little has been said about the recreational advantages this project offers. Our city and county elected officials have made the county a recreation center and are attempting to do more at the present time with the land that has been purchased by TVA. The people are paying 5 cents per 1000 gallons of water used. The Fountain Creek Reservoir is a part of the Columbia Dam project. So lets finish a part of the Columbia Dam Project.* **Ralph G. Maddux, 23b**

E37. [T]*he average depth* [of a Fountain Creek Reservoir] *would only be 19 feet. I don't know about you but I see a few sportsmen out here, 19 feet would be some pretty good fishing, especially for some Crappie and Brim and that's what I enjoy fishing for. We didn't talk about the recreational uses. There will be recreational uses for Fountain Creek.* **Wayne Romesberg, 72h**

Response to Comments E36 - E37: As described in the Land Use EIS, the recreation benefits that were part of the Columbia Dam Project are now proposed to be met in the future uses of the land along the Duck River. As described in Section 3.4, the purpose of Alternative B would be water supply. Also as described in Sections 5.4 and 5.11, recreational and other uses of the reservoir probably would have to be substantially restricted to protect the quality of that water supply.

E38. *The cost, I'm not sure about the dollar figures I've seen tonight because I don't know if we are talking about today's dollars or tomorrow's dollars. If it's tomorrow's dollars, I would say you are way out of line.* **Randy Short, 80c**

E39. [T]*he . . . approximate $50M cost* [of a Fountain Creek Reservoir], *it was also put in that could be plus or minus 30%. Well that means if we watch our construction cost, this dam could be completed for as little as $35M if we pinch pennies. If we don't pinch pennies, it could $65M. I also noticed when we talked about the pipelines, we never did say if that was going to be plus or minus 30%, Being that it was not said, I am going to assume that it wasn't so when we are looking at possibly a $35M versus some of these $11M and $18M alternatives, hey we are in the neighborhood.* **Wayne Romesberg, 72i**

Response to Comments E38 - E39: The "order of magnitude" cost estimates included in the EIS have a wide accuracy range ($\pm$ 30 percent) and were presented only to help compare the alternatives. The present (Year 2000) cost estimates would be refined considerably as details of the project(s) were identified.

E40. [I]*f we do decide to go with Alternative B, what we need to do is make a solid commitment behind it, no bailing out from pressures of any group. I don't know if TVA will even have anything to do with it, but if they do, I would like to make sure that TVA does fight for Fountain Creek like they did fight for Tellico years ago because when they fought for Tellico, they won all the way to the Supreme Court.* **Wayne Romesberg, 72k**

Response to Comment E40: Federal and state agencies can evaluate future water needs on a regional scale, identify conceptual options, and conduct generic evaluations of those options. Meeting the day-to-day water needs of the Columbia area will require the leadership and cooperation of local agencies and officials. TVA itself is not planning to build or operate a reservoir on Fountain Creek.

E41. *I think that the Fountain Creek Dam would probably do a lot to settle a lot of emotions and a lot of the defeated attitudes around here, that finally somebody has a chance to do something right in this county if they can follow through.* **Sharon Vaughn, 79c**

Response to Comment E41: TVA also is very much aware that the Duck River Project has been "underway" for over 30 years and that most of the "activity" has been conflict between one group and another. Completing the last part of this project (identifying ways to meet the water needs) will allow everyone to close out this part of our history and focus on new opportunities.

E42. [T]*he Maury Alliance Board of Directors recommends that: a) work begin on the planning and financing of the Fountain Creek alternative in order to meet the timetable necessary to avert any potential water shortage issues, and b) TVA and the State of Tennessee support local and regional agencies in their pursuit of their collectively agreed upon best alternatives to water supply and wastewater disposal that benefit the community, its residents, and the quality of life in middle Tennessee.* **Frank M. Tamberrino, President, Maury Alliance, 47b**

Response to Comment E42: TVA has prepared this EIS to help everyone in the upper Duck River basin understand the alternatives that are available to meet future water needs and the potential effects those alternatives could have on the area. Now, local water supply agencies have to consider all of the available information, develop detailed plans for likely alternatives, and gain public support for those projects.

F. Alternative C - Downstream Water Intake

F1. *Please opt for the river mile 100 intake alternative.* **P. F. Clemens, 22**

F2. *I have looked over the alternatives proposed, the one outlining a downstream intake for Columbia appears to be the least damaging and also the least expensive.* **Jeff Stewart, 52b**

F3. *Of the four alternatives presented, "Alternative C Downstream water Intake", provides the most water in cubic feet per second for the least cost and has the least potential for adverse environmental effects.* **Marjorie S. Collier, President, Friends of Short Springs, 27e**

F4. *After studying the Draft EIS, Executive Summary, of the Future Water Supply Needs in the Upper Duck River Basin, and consulting respected knowledgeable individuals concerning the potential impact of the alternative proposals to address such needs, I have concluded that Alternative C would be in the best long run interests of area residents. Please, then, show that I favor Alternative C.* **Robert F. Shanks, 34a**

F5. *As a lifelong resident and owner of river bottoms and banks along the Duck River below Normandy Dam, I would like to ask support from TVA for Alternative C (Downstream Water Intake) in what would seem to be the most practical and least objectionable answer to providing more water for Columbia and other downstream communities.* **Polly Dement Oettinger, 41a**

F6. *Of the options listed for assuming a water supply for Maury/ Williamson counties in the Upper Duck River Basin, I believe the Duck River Interface Conduit at mile 100 plan is the one to implement and I cast my vote in its favor. We need to use and conserve our water reservoir carefully and I appreciate TVA's efforts to do so.* **Henry Lewis, 21**

F7. *Of all the solutions offered, it appears that the only logical path is the "Duck River Intake Conduit" at river mile 100. This would provide the longest supply for the best price and would avoid doing harm to the Short Springs State Natural Area. The State Natural Area was declared after many years of work and study. It is a place of natural beauty to be preserved as the town and county continue to grow.* **Angela B. Arnold, 19**

F8. *Of the five alternatives presented to supply the water needs of the Upper Duck River Basin, Alternative C (Downstream Water Intake) is the preferred alternative. This alternative is the most cost effective. In terms of cost per cubic foot of water supplied, Alternative C is the lowest cost by over a factor of two! Alternative C will also provide the required water needed through the year 2050. . . . . Alternative C is the only alternative that meets the water needs at a reasonable cost and is not detrimental to the environment.* **Dennis D. Horn, 10a**

F9. *After an open discussion, we unanimously agreed that the Downstream Water Intake is the least objectionable proposal . . . . for the benefit of the Elk and Duck River tailwaters. Additionally it is the least disturbing for communities in the Duck River basin outside the need area of Columbia. The EIS was very thorough, and although it lacks in specific detail regarding issues important to preserving cold water fisheries, there is plenty of information to conclude this best option. Second lowest cost, least*

environmental impact, proximity to need (Columbia), shortest pipeline, sufficient cfs increase to satisfy 2050 projections, all clearly support this option. There is little water need downstream of Columbia, so it seems most just for Columbia to draw water closer to home and without impacting a larger population outside this need area upstream. **John M. Procter, Elk/Duck River Chapter, Trout Unlimited, 60a**

Response to Comments F1 - F9: Comments noted. Present information concerning the effects of each alternative are discussed in Chapter 5 and are summarized in Section 3.9.

F10. *I support one of the pipeline alternative (C&E) with C probably being superior to E.* **Louise Gnenflo, 25b**

F11. *Alternatives C and E, respectively, will provide the most cost effective results, will provide longer-term results, and are the least destructive to the environment.* **Kevin C. Fitch, 54c**

F12. *There are two alternatives, C and E, that would cause less land disturbance and have far less potential for adverse environmental effects. Of these, Alternative C supplies more water, requires a shorter pipeline, and is less costly than Alternative E (Tims Ford pipeline). For these reasons Tennessee Citizens for Wilderness Planning prefers Alternative [C]. If, however, other environmental considerations (e.g., significant habitat) should make Alternative E preferable, it would be acceptable to us.* **Liane B. Russell, for the Tennessee Citizens for Wilderness Planning Board of Directors, 30d**

F13. *Action Alternatives C and E (the Downstream Water Intake and the Tims Ford Pipeline, respectively) present solutions that The Nature Conservancy believes are more positive and balanced. Both of these alternatives have lower projected environmental impacts than Alternatives B and D and are an order of magnitude less expensive than the Fountain Creek reservoir. An intake below Columbia at Duck River Mile 104 would meet projected needs for Maury and southern Williamson counties but does not address potential water needs in Marshall and Bedford counties, particularly if population growth in these counties exceeds projections. . . . . Concerns that surround Alternatives C and E include construction of the pipeline, placement of the discharge point, increased erosion and turbidity, alteration of water temperature, and transfer of species. However, these concerns would ultimately be addressed during the design and implementation process.* **Leslie Colley, The Nature Conservancy of Tennessee, 44f**

F14. *This letter is in opposition to all the alternatives proposed in your Draft Environmental Impact Statement on the Future Water Supply Needs in the Upper Duck River Basin. We regard the proposed alternatives as a highly undesirable course of action for several reasons.* [Comments are provided in several subject areas] *However, if any of the proposed alternatives must be chosen, we support Alternative C: Downstream Water Intake.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33a**

Response to Comments F10 - F14: Comments noted.

F15. *Additional consideration of low-flow impacts from implementation of Alternative C, the pipeline to downstream reaches of the Duck River, should be further evaluated and discussed. All impacts should be weighed and assessed to contrast each alternative fully.* **Justin P. Wilson, Deputy to the Governor,43h**

F16. *It is difficult to assess the impact of this alternative without having solid information on future cumulative withdrawal demands on the Duck River, including direct industrial and agricultural use. As the percentage of Duck River low flow comprised of treated wastewater increases, there is a corresponding increase in the vulnerability of Duck River fish and aquatic life to pollution episodes. The potential adverse impacts of this alternative during periods of extended low flow should be further explored.* **Abrey McKinney, Environmental Services Division, TWRA, 61b**

F17. *Taking water from downstream of the Columbia discharge needs more information before it can be a viable choice. This EIS does not consider construction or low-flow impacts to ground water, surface water, aquatic life, terrestrial life, or endangered species. Further it does not address consequences to the supply or biological life from continuously recycling water so close to the outflow pipe. What will be the attendant cost of wastewater and freshwater treatment or biological loss?* **Marty Marina, Executive Director, Tennessee Conservation League, 58h**

Response to Comments F15 - F17: The information presented in Section 3.9 summarizes and compares what is known about the potential effects of each alternative on the environment. As indicated there and in the more detailed discussions presented in Chapter 5, the present concept of this alternative would not reduce the flow downstream from the new intake below 100 cfs or substantially degrade the quality of aquatic habitat conditions in that area, but would offset or augment the flow and habitat conditions in the river downstream from the present Columbia water intake. As with each of the other alternatives, the likely effects of Alternative C would have to be confirmed and updated as the specific details of the project(s) were developed.

F18. [T]*here are concerns with . . . pumping water from below Columbia back to the water treatment plant. If water is to be pumped from below Columbia back to the plant, it is suggested that the discharge be into the Duck River below the intake. This would provide the additional water to meet the low flow conditions established for the Duck River while allowing Columbia to withdraw more water from the Duck at the current intake location. The Division is not receptive to the idea of using this returned water in the intake.* **W. David Draughon, Jr., Division of Water Supply, TDEC, 62d**

Response to Comment F18: This suggestion is a subject which local agencies may want to consider if they choose to pursue some form of Alternative C. As indicated in Sections 3.10 and 5.4, the existing treatment plant in Columbia does not have the capacity to treat all of the water that is projected to be needed starting some time after 2015. If additional space for expansion of the water treatment plant becomes available in Columbia, local interests might consider withdrawing all of the needed water through the existing intake and, when necessary, augmenting the flow in the river using water withdrawn some distance downstream. Alternative approaches already mentioned in the description of Alternative C in Section 3.5 include treating water from a downstream intake closer to the source or closer to customers living in that part of the service area. As indicated in Section 5.4, the water in the Duck River near River Mile 100 presently meets all applicable water quality criteria and is classified for domestic water supply use. Especially if all appropriate source water protection measures were followed, TVA sees no reason why a municipal water supply intake could not be located in that part of the river.

F19. *Alternative C is Cathy's Creek Pumping Station. I don't believe this is an acceptable alternative because I don't know about you all but I don't think the idea of drinking my own sewer water is acceptable. I understand the people in California have been doing that for years and we see some of the problems they have.* **Wayne Romesberg, 72c**

Response to Comment F19: Water is a finite resource that we all use, treat, and recycle on a daily basis. In fact, some water used in Columbia has passed through both the Shelbyville and Lewisburg wastewater treatment plants before it was withdrawn from the river. Standard treatment methods are adequate to ensure that this common practice poses no risks to human health.

F20. *I don't know whether the thing that Mr. Jacobs just talked about* [Tims Ford Pipeline] *is the best or not. I feel like you start at the head of a stream when you want to get some water and I feel like we're going to do just like he said, leave Marshall County and Bedford County out if we go down below Columbia and start pumping water back up here. We let it get by us, maybe we just need to stop it somewhere.* **Jack Craig, 77b**

Response to Comment F20: Comment noted.

F21. *Alternative "C" could be implemented at a later date and put into service in approximately 30 months.* **Douglas K. Mitchener, 59f**

Response to Comment F21: TVA has not attempted to estimate the construction time associated with any of the action alternatives. The length of the construction period would depend on the size and type of any new water treatment plant and the lengths of any new supply lines and/or new distribution lines which would be included in the project. Pipelines can be built in just a few months; other facilities often take substantially longer.

G. Alternative D - Raise Normandy Pool Level

G1. *The Division believes the Normandy Dam proposal will help ensure the needs of the area until 2050 and is not opposed to this alternative.* **W. David Draughon, Jr., Division of Water Supply, TDEC, 62b**

G2. *The League has investigated the choices and believes raising Normandy Dam to be the optimal choice. . . . . As usual, we look forward to supporting TVA in creating a well-balanced solution to this issue.* **Marty Marina, Executive Director, Tennessee Conservation League, 58a**

G3. *Raising the Normandy pool level has a moderate cost and the best chance of answering short and mid-term supply, with minimal biological or sociological impacts. While there will be some short-term loss, this alternative seems to accommodate management of the State Natural Area for its intended purpose and other habitat concerns at the reservoir. It will also improve present habitat conditions on the Duck.* **Marty Marina, Executive Director, Tennessee Conservation League, 58i**

Response to Comments G1 - G3: Comments noted.

G4. *I feel that the highest priority ranking should be given to the Raise Normandy Dam option, but with serious reconsideration of a water conservation method in the Columbia area* [including the use of cisterns]. **Richard E. Lockwood, 31c**

Response to Comment G4: The use of cisterns could be one way of conserving water in the Columbia area under this or any of the other alternatives.

G5. *As far as the Normandy Dam, that would be fine to raise it as high as you could go but that is going to be hard to do with those people up there.* **Glenn Stevenson, 78c**

G6. [I]*f you raise the dam up at Normandy five feet, you are going to cover up some more land; you're going to dislocate some more people; you're going to have all kind of problems.* **Ed Jacobs, 76d**

Response to Comments G5 and G6: As indicated in Section 5.10, all of the land which would be affected by raising the Normandy pool five feet is already owned by the federal government; no private land would be required to complete that project as it is presently defined.

G7. *We recommend the Final EIS attempt to more fully predict the impact Alternative D would have on water quality in both the reservoir and Normandy tailwaters. Of particular interest is the quality of water available for tailwater release and as provided to TWRA's Normandy Fish Hatchery. This alternative may well improve the quality and quantity of tailwater releases, providing a significant environmental benefit to the Duck River while resolving the water supply issue.* **Abrey McKinney, Environmental Services Division, TWRA, 61c**

Response to Comment G7: Section 5.4 presents the results of a careful evaluation of the possible effects of this conceptual alternative on both the water quality in Normandy Reservoir and in the Duck River downstream from Normandy Dam. If this project was proposed to be built, these results would be confirmed or refined during an evaluation using the detailed construction and operational plans that would have been developed.

G8. *The Friends of Short Springs . . . . are strongly opposed to Alternative D, "Raising Normandy Pool Level 5 Feet"* **Marjorie S. Collier, President, Friends of Short Springs, 27a**

G9. *Action Alternative D (raising the pool level of Normandy Lake) would not meet projected needs beyond 2035 and is second only to impounding Fountain Creek in potential negative environmental impacts.* **Leslie Colley, The Nature Conservancy of Tennessee, 44d**

G10. *I oppose the environmentally damaging alternatives B&D.* **Louise Gnenflo, 25c**

G11. *Cities upstream from Columbia are not interested in Columbia's future and will oppose alternatives "D" and "E".* **Douglas K. Mitchener, 59c**

G12. *I also wish it known that I am strongly opposed to Alternatives B, D, and E.* **Robert F. Shanks, 34c**

Response to Comments G8 - G12: Comments noted.

G13. *I certainly do think it is advisable to do this planning and be concerned about future water demands but I think we need to take into account the affect on the environment and economics of the situation and make the make* [?] *choice. Clearly, Normandy pool level raising should be ruled out.* **Marjorie Collier, 75b**

G14. *I am opposed to Alternative D (Raise Normandy Lake Level) on the basis of cost and habitat destruction. . . . I am opposed to Alternative [D] (Raise Normandy Lake Level) because that would be detrimental to the Short Springs State Natural Area. This alternative will not satisfy the water needs through the year 2050. Alternative D is not the most cost effective option.* **Dennis D. Horn, 10c**

G15. *This correspondence is to register my opposition to the proposed alternative to "Raise the pool level on Normandy Reservoir." If implemented, this action would destroy the richest and most environmentally valuable part of the Short Springs State Natural Area lying downstream of Machine Falls and along Bobo Creek. This is more environmentally damaging than other available alternatives and provides only a short term solution to Columbia's water needs.* **J. P. Christopher, 42**

G16. *I am writing regarding the possibility of flooding of the Short Spring Natural area to provide water for Columbia, Tennessee or another area. The lower portion is a beautiful area for wild flowers, some of which are native to that area only. Much work has been done to make this area accessible to groups to hike and enjoy one of God's many gifts. I would like to go on record in strong opposition to raising Normandy Dam (Alternative D). It would be complete destruction of a natural area which violates the Act of 1971, Natural Areas Preservation.* **Agnes Miller Smedley, 46**

G17. *I am writing to urge TVA not to raise the Normandy Lake level five feet for the purposes of providing additional water to the Columbia, TN area (Alternative D). . . . . Please consider the environmental impact and the cost effectiveness of the proposed alternatives. Short Springs and the Fountain Creek watershed deserve protection for future generations and, most importantly, the diverse life present there.* **Kevin C. Fitch, 54a**

G18. *My understanding is that if the Normandy dam is raised, Short Springs will be* [?] *about five feet. Short Springs consists of two small ravines, and raising the water level five feet will flood the bottom land where most of the wildflowers are. It will flood out the trails that lead to Machine Falls and wander along Bobo creek. Because of the steepness of the slopes, new trails above the waterline will be impractical. Most of the spring water in the area appears just prior to the two main creeks entering Normandy lake. Raising the lake will effectively submerge a couple of large springs on Bobo creek and will reduce the 'dean' spring water exposure from Machine Falls to just a few feet. In addition, all of the flotsam and jetsam associated with lake coves will inundate the Short Springs area and greatly affect its beauty.* **Jeff Stewart, 52a**

G19. *TCWP strongly opposes the two alternatives, B and D, that are identified as having "substantially more potential for adverse environmental effects" and that would alter substantial areas through inundation and associated damages.*

- *Alternative D, raising the height of Normandy Dam, and the pool level of Normandy Reservoir, by 5 feet, would, (a) have disastrous effects on prime wildflower habitat in the 420-acre Short Springs State Natural Area NE of Tullahoma, and (b) flood a 60-acre TVA Small Wild Area adjacent to the Natural Area. Further, this is the only Alternative that fails to meet the water-supply objective. Thus, the additional water volume supplied by Alternative D is only 16 cfs (instead of the 22 cfs minimum objective), and the water needs would be met only through the year 2035 (instead of through 2050).*

Liane B. Russell, for the Tennessee Citizens for Wilderness Planning Board of Directors, 30c

G20. *I'm Marjorie Collier; I'm from Tullahoma; I'm President of Friends of Short Springs, which is a support group for Short Springs state natural area, which is located in the city limits of Tullahoma in Coffee County and lies adjacent and part of it's along the Normandy impoundment. We object very strongly to the option of raising the Normandy pool level five feet. Our objections are fourfold:*

- *it is environmentally destructive of a state natural area. It would come up over the lower part of the natural area where two creeks come together below a beautiful waterfall and has an outstanding group of wildflowers in that area. It's very rich. The state of Tennessee designated the area as a designated state natural area under the Natural Area Preservations Act and, at that time,*
- *it would be illegal, frankly, to come up and inundate, raise that level five feet onto that natural area. Not only environmentally destructive but really illegal to do that to a designated natural area. TVA set aside 60 acres along the Normandy impoundment as a small wild area and, when the state made it a designated state natural area, that 60 acres became part of it.*
- *it's not the most economical alternative. The cost of getting water downstream from Columbia is half the cost of the Normandy alternative and the downstream alternative is also much less environmentally damaging than the Normandy alternative.*
- *The fourth objection we have is that the Normandy alternative would not meet projected future demands beyond the year 2035 and the other three will meet the projected future demand up to year 2050 or even later than 2050.*

Marjorie Collier, 75a

G21. *Under Alternative D, the suggested maximum pool of Normandy Lake would be raised from 875 feet to 880 feet. Alternative D would flood portions of Short Springs*

Designated State Natural Area along Bobo Creek at contours below 880 feet during the normal maximum pool elevation of the reservoir. The bottom-land habitat receives seasonal inundation. By raising the lake level there would be prolonged periods of occasional inundation as well as longer periods of more permanent flooding of the habitat. We would expect this habitat and associated biological diversity to change community type and floristic composition along with the associated forest habitat. The forest type is a high quality mesic area with rich displays of spring wildflowers along Normandy Lake between the 875 and 880-foot contours. These areas could be impacted by inundation under Alternative D and could significantly impact the natural area through the destruction of the flora and fauna depending upon the timing and duration of inundation. This impact is cited in table 7 on page 63; however, it is not mentioned in the impacts described under Alternative D pages 48 - 56. The environmental impact of flooding the bottomland riparian forest could be a violation of Natural Resources Areas Rules, {TCA Section, 0400-2-8-.08 Intrusions, 0400-2-8-.22 Water Level Control} and may require additional Departmental permits for wetland impacts. **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 641**

Response to Comments G13 - G21: Comments noted. The potential significant adverse effects of this alternative on part of the Short Springs Natural Area are presented in Section 5.11 and are summarized in Section 3.9. If the pool level of Normandy Reservoir was to be raised, appropriate measures should be included in the project to avoid or mitigate those adverse effects on this Natural Area.

G22. *Raising Normandy Dam has additional benefits independent of the water needs identified in this study.* **Justin P. Wilson, Deputy to the Governor,43f**

Response to Comment G22: The focus of this EIS is on meeting future water supply needs. If Alternative D was proposed to be built, the detailed plans for and evaluation of that project should include all of the benefits and potential adverse effects which could occur. Local planners probably would appreciate input from state agencies on the possible benefits of this project, as well as state agency perspectives on its possible adverse effects.

G23. [Under Alternative D,] *An increase in shoreline erosion associated with additional access to Federal lands, encouraged by the proposed raising of water levels, could result directly in an increase in water pollution (especially sedimentation). The Draft EIS does not provide documentation for adequate protection of natural resources that could result in net losses of the State's biological and natural resources as well as increases in shoreline erosion. Perhaps TVA could suggest shoreline management strategies that would be implemented to protect natural resources and biodiversity if this alternative were selected.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64o**

G24. [T]*he proposed Alternative D could increase shoreline erosion, decrease water quality, reduce aquatic habitat, manipulate and significantly reduce forested and riparian habitat, and reduce contiguous forested tracts (communities) simply as a result of prolonged inundation by sustained higher lake levels. We suggest that TVA fully document these losses and compare them to anticipated habitat improvements associated with increasing the lake shoreline area by raising the lake levels. Managed shorelines, with increased efforts toward restoring habitat (particularly by erosion control through bioengineering techniques), are paramount to long term water quality improvements and protection of the State's rare, threatened or endangered species. By*

utilizing specific reservoir-wide management strategies throughout Normandy Lake, TVA could demonstrate habitat improvements associated by raising the lake levels with increasing the lake shoreline area. Additional documentation is needed to outline steps that will be taken by TVA to protect the current recreational uses and diverse habitat along the shoreline. **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64p**

Response to Comments G23 and G24: If this alternative is proposed to be built, the detailed evaluation of possible effects on the environment would need to include a wide variety of subject areas, probably including all of the issues mentioned in these comments. As indicated in Section 3.6, all of the work on this project would be conducted using appropriate methods to minimize construction impacts and to comply with pertinent NPDES permits. Operation of the enlarged project probably would include measures to maximize recreational and other benefits around the reservoir and to avoid or minimize adverse effects to natural resources in the area.

H. Alternative E - Tims Ford Pipeline

H1. *I support one of the pipeline alternative (C&E) with C probably being superior to E.* **Louise Gnenflo, 25d**

H2. *Based on information provided by the EIS, the Tennessee Department of Environment and Conservation's Division of Water Supply states that the Tim's Ford pipeline alternative provides the highest quantity and quality water. This alternative may also provide benefits to other communities along its route who face increasing water needs.* **Justin P. Wilson, Deputy to the Governor,43e**

H3. *After careful review of the alternatives discussed, the Division of Water Supply is of the opinion that the Tims Ford alternative is the best alternative for meeting the water supply needs of the Columbia area. Tims Ford Lake has the best water quality of any of the alternatives presented. It also has the quantity available to supply the 2050 demand in Columbia. An added benefit is that it could be designed to help with any underestimation of water demand in the Shelbyville/Lewisburg area. This is an alternative that adds additional water to this area.* **W. David Draughon, Jr., Division of Water Supply, TDEC, 62a**

H4. *As you have already heard, each plan has been discussed here, each one has pretty well been opposed, and the pros and cons on it. I won't try to get into arguing about which one and why you might have some complications, but the simplest thing that I see and, actually, I proposed it when we had out meeting here before about the pipeline. If you've ever been on Tims Ford, it's a big lake. It's got a lot of water and no doubt that water is not being used. They aren't letting it out and the reason I proposed the pipeline is real simple. As they have already told here tonight, you can run the pipeline down the road, and it will only have to be used two or three months out of the year. If you don't need it, you don't have to use it.* [It is] *one of the cheapest forms of answering our problems. . . . . With a pipeline, you're not bothering anybody. You're guaranteed you got the water - you know you got it. There's not any problem with it. So to me, I'd like to say that the pipeline is the simplest, the best, and the most economical to operate, . . . and it's got the best future for it too without creating any problems.* **Ed Jacobs, 76b**

Response to Comments H1 - H4: Comments noted.

H5. *Action Alternatives C and E (the Downstream Water Intake and the Tims Ford Pipeline, respectively) present solutions that The Nature Conservancy believes are more positive and balanced. Both of these alternatives have lower projected environmental impacts than Alternatives B and D and are an order of magnitude less expensive than the Fountain Creek reservoir. . . . Alternative E, the Tims Ford pipeline, also has a lesser degree of environmental impacts, while still meeting projected needs through 2050. In fact, this pipeline would increase flow across a wider region, maximizing benefits to the most residents and to aquatic life. Concerns that surround Alternatives C and E include construction of the pipeline, placement of the discharge point, increased erosion and turbidity, alteration of water temperature, and transfer of species. However, these concerns would ultimately be addressed during the design and implementation process.* **Leslie Colley, The Nature Conservancy of Tennessee, 44g**

Response to Comment H5: As noted in this comment and in the EIS, if this alternative was proposed to be built the detailed planning and subsequent evaluation would include an more-detailed evaluation of potential adverse effects on the environment.

H6. *I wish it known that I am strongly opposed to Alternatives B, D, and E.* **Robert F. Shanks, 34d**

H7. *I have read the proposals for supplying water to Columbia via accessing water from Tims Ford Lake (Alternative E) and as a long term home owner on the lake. I oppose this measure, as do my neighbors in the Highland Ridge subdivision of Estill Springs.* **Tom Willingham, 17**

H8. *[I have] lived on Big and Little Duck. [I am] opposed to proposed Tim's Ford water line and think it is a disgrace that so much money has been spent on Columbia.* **J. D. Spencer, 14**

H9. *TVA has done much to improve the quality of life in the Southeast for which we are grateful. Alternative E, the proposal to divert Elk River water for the benefit of the few in a small area, would serve to diminish our overall quality of life. It might be one of the least expensive of the four proposals, but it is not one of the two best. It is the worst.* **Floyd and Linda Ayers, 32e**

Response to Comments H6 - H9: Comments noted.

H10. *The report is deficient in that it does not address effects on Tims Ford Reservoir should that option be elected; how much drawdown, etc.* **Jerry C. Lashlee, 26a**

H11. *Of the proposed plans, I would like to register my objection to Plan E, which will spoil the pristine setting and environment of Tim's Ford lake which the former controlling agency TERDA and TVA has worked so hard to ensure over the years. It is not worth sacrificing this area to support growth in Columbia, TN.* **Lane and Tom Willingham, 18**

H12. *I am appalled at TVA's consideration of pumping water out of Tims Ford Reservoir to satisfy the Duck River Basin water supply demand. Tims Ford does not have enough water coming in now to properly flush the system and alleviate the poor dissolved oxygen problem. The water quality in this lake is continually deteriorating; your proposal would only aggravate this problem.* **Don F. Lee, 6a**

H13. *I do not like the idea of pumping water out of Tims Ford lake for Columbia, TN. It would greatly damage the ecology of our water. I certainly do not like this water being replaced with Tullahoma sewer water. We have a beautiful lake and we should not do anything that would hurt the quality of water we now have. It's bad enough having the city of Winchester empty their sewer water into the lake.* **Kay & Ron Hall, 50**

H14. *As a property owner at Tims Ford lake, I should like to strongly urge that pumping water out of Tims Ford NOT be allowed for diversion into the Duck River. This would cause the water level in Tims Ford to drop and would impair the lake for recreational use. The water level is already too low at times. As a taxpayer, there are cheaper alternatives which would take care of Columbia's water needs. For instance, 8 million for the proposed Normandy elevation vs. 13 million for the proposed Tims Ford*

pumping project. We have been blessed with a wonderful asset in Tims Ford Lake. Let us not succumb to the temptation to imperil this treasure. **David L. Hudson, 38**

H15. *We [Tims Ford Council] are objecting to "Alternate E" of the proposed water-supply alternatives for the Duck River Basin. Any additional draw on the waters of Tims Ford will have a tremendous adverse effect on the attractiveness and recreational usability of this lake. This would be especially noticeable during hot, dry summers like we have had the past two years when TVA has used Tims Ford for power generation and downstream flow. As a consequence, lake levels have lowered considerably before the end of summer usage periods. Tims Ford Lake is of immense economic benefit to Franklin County and all of southern Middle Tennessee. We want to see this lake continue to be a valuable asset to the region and be maintained for the enjoyment of property owners and recreational users of the lake.* **Tims Ford Council, 3**

Response to Comments H10 - H15: Existing information, presented in Section 5.4, indicates that, even in a severe drought, use of this pipeline would draw Tims Ford Reservoir down just 7 or 8 inches more than would occur if this project were not in place. This additional reduction in the pool level would not be noticeable to most people and would not adversely affect the use of the reservoir. If this alternative was proposed to be built, the planning for this project would include a up-to-date, more-detailed evaluation of the potential effects on water levels in Tims Ford Reservoir.

H16. *As a landowner whose property borders on the Elk River in western Lincoln County, Tennessee, I am against ANY plan that involves transferring water resources out of the Elk River watershed. I believe such a plan would negatively affect low-water flows on the Elk River, seriously impacting the use of the river for irrigation and recreation.* **Ken McGarry, 13a**

H17. [As a] *Property owner on Tims Ford,* [I am] *concerned about water quality and failure to maintain minimum flow below dam.* [My impression is that] *flows for October are in the range of 64 to 75 rather than 80 cfs. Odor and clarity also are problems during low flow periods.* [I am concerned that] *Piping water* [to the Duck River] *will drop lake levels, impact dock owners, and affect fishing quality.* [I think the actual] *cost of building pipeline will be higher that what has been projected by the time it's planned and constructed.* **Bill Balsley, 45**

Response to Comments H16 and H17: The preliminary planning that has been done concerning this alternatives is based on the assumption that no changes would be made in the quantity or quality of the releases from Tims Ford Dam. If this alternative was proposed to be built, a more-detailed evaluation of this potential effect on water releases into the Elk River would be conducted using specific information about the details of the project.

H18. *Building a pipeline from the Tims Ford Reservoir to the Duck River will unnaturally favor a county outside the Tims Ford Reservoir and handicap counties within the reservoir as they struggle to meet their existing and current demands for clean and plentiful water. There will also be negative impacts to flora and fauna as the pipeline is constructed and maintained over the years.* **Marty Marina, Executive Director, Tennessee Conservation League, 58j**

H19. *It was with great disbelief & disgust that I learned of TVA's plan to build a pipeline to transfer water from Tims Ford Lake to the Duck River. This does not seem to be a solution but a contrivance to allow unlimited, unregulated & poorly planned development in the Duck River Basin. . . .TVA has been instrumental in advancing the southwest to a position of prominence and TVA should have the integrity to say enough is enough and discard this alternative.* **Robert N. Reed, 28a**

H20. *I disagree with the Alternative E, "Tims Ford Pipeline" because it is effectively "robbing Peter to pay Paul". Removing a portion of a valuable water resource from a viable and fast growing area could be very detrimental to the economic future of the Franklin County area. In conclusion, it would be an example of poor planning, in my view, to remove precious water resources from the Franklin County area without thorough considerations of the long term effects on this area.* **Mark H. Dudley, 24i**

H21. *Tims Ford pipeline would generate revenue, from the sale of water, for the repayment of debt obligations of concerns outside of the region, the Duck River Development Agency. (Page 4) These debt obligations were part of the original agreement covering* ***local participation*** *in the overall project. Again, "robbing Peter to pay Paul".* **Mark H. Dudley, 24b**

Response to Comments H18 - H21: This alternative would use water stored in Tims Ford Reservoir to meet drought-related needs in the Columbia area part of the Duck River basin. Water that would occasionally be used this way would, otherwise, be passed on down the Elk River. As indicated in Section 5.4 and 3.9, Tims Ford Reservoir is not expected to be adversely affected by this alternative; however if this project was proposed to be built, additional more-detailed analyses would be conducted to confirm or revise this conclusion. It should be noted that TVA is not proposing to build this project; rather, TVA and the cooperating agencies have simply identified it as one of several reasonable ways to meet the future water supply needs of the Columbia area.

H22. *How can you take water out of Elk River and* [away from] *the people in Athens, I don't believe they would like that.* **Glenn Stevenson, 78b**

H23. *Alternative E also proposed interbasin transfer of water from Tims Ford Reservoir to Duck Creek, with which there also could be some associated environmental issues.* **EPA, 51o**

H24. *Tims Ford and the Elk River are for the people Southern Middle Tennessee or, at least, in that watershed. There are several large towns already drawing on those water resources. Periods of drought are also felt here in the form of decreased summer pool level and minimum flow into the river; i.e., low level and brackish river water conditions. This will only be felt more should water be drawn off for the Duck River people.* **Jerry C. Lashlee, 26c**

H25. *TVA's proposal to steal water from Elk River and divert it to Duck River for the sake of real estate development in the Maury and Williamson County area is obscene. It demonstrates TVA's disrespect for our natural environment and for the people who inhabit the Elk River Valley. How can you glibly state that it would have only "short-term and minor effects" on Elk River when you are proposing to permanently reduce the flow of this river? How much Elk River water will be needed to support growth in the Duck River area during the following fifty years? The following one and two hundred years? This proposal totally ignores the needs of future generations in the Elk River Valley.* **Floyd and Linda Ayers, 32a**

H26. *I am strongly opposed to Alternative E, taking water from Tims Ford reservoir to supply the upper Duck river basin. I think this would establish a bad precedent, and lead to a situation such as exists at the present out west with the Colorado river. The growth potential for the Tims Ford area is very great, e.g., Nissan's plans to hire a thousand new employees at Decherd, which will bring at least five thousand new people to the area. In a few years, we may need the water worse than Franklin and Columbia.* **Eugene J. Sanders, 39a**

H27. *The pumping station from Tims Ford, I don't believe that's good. I do not like the idea of taking water from one river valley and pumping it to another river valley. It sets a precedent. What could happen in the future there, if someone wants to come into the Duck River valley, take water out of the Duck River valley, say pump it into the Harpeth River valley, or maybe even go back to the Elk. That's entirely possible. If we take this action, then we are setting a precedent. I don't believe this is good.* **Wayne Romesberg, 72e**

Response to Comments H22 - H27: As described in Section 3.7, this pipeline would be used only during drought conditions to meet critical needs in the Maury/southern Williamson County Water Service Area (excluding Franklin and other distant parts of Williamson County). The present concept of this project would not alter the discharge from Tims Ford Dam or reduce the pool level in Tims Ford Reservoir more than 7 or 8 inches, even during drought conditions. If this project was proposed to be built, detailed plans for the pipeline and its operation would have to be developed, details of the project would have to be evaluated further for environmental effects, and the public would have an opportunity to comment on the project and its potential effects. All of the issues identified in these comments should be evaluated and addressed during that process.

H28. *Cities upstream from Columbia are not interested in Columbia's future and will oppose alternatives "D" and "E".* **Douglas K. Mitchener, 59d**

Response to Comment H28: As indicated in many of the comments presented in Sections G and H of this Appendix, people have a variety of views about both of these alternatives, in addition to each of the others. Some of those views include reasons related to interests quite different from providing water to the Columbia area.

H29. *Why not use 36" pipeline from Tim's Ford instead of 30". Cost difference is negligible and this could allow for more water to meet needs further into the future.* **Mike D. Penrod, 67a**

H30. *The pipeline length could be reduced by 50% if the north end terminated on a Flat Creek tributary having maximum natural flow equal to the pipelines capacity. The benefits of having more and better water at the Shelbyville intake may not be worth the extra cost of 10 more miles of pipeline. this would provide only an occasional benefit during drought conditions for Shelbyville. I would prefer to see Flat Creek never run dry.* **Fred H. Horn, 5**

Response to Comments H29 and H30: The present concept of this alternative includes features designed to meet the projected need for water through 2050. While a variety of other features could be included in this project, each of them also could add potential adverse effects at one or both ends of the pipe, wherever the pipeline might start or end. All components of the full project should be evaluated in detail before this, or any other, water supply project is proposed to be built.

H31. *I am not opposed to Alternative E (Tims Ford Pipeline), but that option is more expensive, both in actual cost and in cost per cubic foot of water supplied, than Alternative C.* **Dennis D. Horn,10d**

Response to Comment H31: The present order of magnitude cost estimate indicates this is likely to be true. If the decision about which alternative should be built comes down to cost, the present construction estimates would have to be refined and operational costs would have to be determined before that cost comparison is completed.

I. Climate, Geology, and Soils

I1. *EPA is concerned over the apparent lack of geotechnical studies in the document to determine the suitability of the site soils to hold water relative to the reservoir alternative (B). Local soils should ideally be relatively impermeable in order to retain desired water levels without creating zones of saturated soils adjacent to the project. Leakage and erosion of the proposed earthen dam are also a concern. The FEIS should contain estimates of impacts of water loss through the permeable parent soil materials that will make up the basin of the proposed reservoir.* **EPA, 51z**

Response to Comment I1: A foundation feasibility study for a possible reservoir in the Fountain Creek watershed was performed by the U.S. Army Corps of Engineers in 1997. This study provided information used in the description of Alternative B presented in Section 3.4 and various parts of the evaluation of potential effects discussed in Chapter 5. The feasibility study, though limited in scope, concluded that it would be geologically feasible to construct a reservoir at the location and to the elevation described in the EIS. The report on the feasibility study also indicated that the limestone terrain would be highly susceptible to leakage, the karst drainage system would require treatment, and a grouting program would be needed to reduce the potential for leakage. The report also pointed out the need for additional evaluations of the underlying geology before proceeding with detailed design and specifications of the possible reservoir project.

J. Ground Water

J1. *The project area is generally karstic and as such has sinkholes and other natural conduits to the water table. Construction of a reservoir in these areas could promote contamination of ground water if the reservoir water quality and sediment quality becomes degraded and migrate into the water table. The DEIS mentions (pg. 142) the potential for grouting the bottom of the reservoir area during construction to prevent such interconnection. Special engineering methods would be needed in these karstic areas, particularly those involving excavation, low elevations, caves, and similar geologic features. The greatest potential for ground water impacts among the alternatives appears to be the construction of the reservoir.* **EPA, 51u**

Response to Comment: J1: TVA agrees that construction of a reservoir in this karst area could promote contamination of the ground water if water in the reservoir became degraded and migrated into the water table. This was acknowledged in Section 5.3 of the EIS, accompanied by the suggestion that grouting may be required to prevent intrusion into the ground water. If this alternative was selected, geologic surveys would need to be conducted to determine the extent of potential surface/subsurface connections. Based on those surveys, measures to prevent extensive surface water intrusion (such as grouting or sealing) would be determined through special engineering studies as part of the detailed planning for that project.

J2. *Adoption of Alternative C entails the development of a 13-mile pipeline and the subsequent construction of its downstream Duck River booster station. The sinkholes and caves at this venue often form delicate conduits or natural water pipes. There are concerns that, during construction, the sinkholes and caves may be impacted. Such impacts during construction might involve irreversible collapsing of the fragile karst topography, quite possibly increasing the likelihood of ground water contamination.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33b**

Response to Comment J2: The installation of pipelines in karst terrain is routinely done for water, natural gas, and various petroleum products. As indicated in Section 5.3, a variety of avoidance and engineering techniques are available for mitigating impacts to the subsurface environment during the installation of a pipeline. It is true that karstic geology may contain sinkholes, fissures, and caves; however, those areas are still rock strata and, as such, are normally very stable and solid. Should this alternative be selected, specific measures to mitigate subsurface impacts would be addressed in the subsequent engineering evaluations and the evaluation of possible environmental effects.

J3. *What effect on the ground water resources in the Elk River Watershed as a whole would result from the reduction in the capacity of the Tims Ford Reservoir to recharge groundwater supplies.* **Mark H. Dudley, 24g**

Response to Comment J3: There would be no measurable effect on the groundwater resources in the Elk River watershed. The only time Tims Ford reservoir would have water removed to the Duck River would be during a drought year. During such a time, the elevation of the reservoir could be reduced by 7-8 inches, which is well within the normal operating range of Tims Ford Reservoir and would not have any effect on ground water.

K. Surface Water

K1. [I]*t is unclear what criteria TDEC uses to determine that one stream segment is suitable for an industrial water supply designated use, and not for a municipal water supply designated use.* **EPA, 51ab**

Response to Comment K1: Many of the use classifications in effect today were assigned to streams several years ago when Tennessee initially adopted water quality standards. At that time, a stream reach was classified for water supply use if it was being used for water supply or if a sufficient volume of water was available to support that use. In recent years, TDEC has been diligent to classify all streams for fish and aquatic life and recreation uses in accordance with the Clean Water Act. TDEC has not gone back and added the industrial and domestic water supply use classifications to all stream reaches not currently classified for those uses; however, they would likely respond to a local request to have a use added. TDEC probably would use its EPA-approved water quality criteria for Domestic Water Supply and Industrial Water Supply when determining the suitability of a specific stream reach.

K2. *We note from page 82 that: "The domestic water supply use classification is excluded in these areas because the State of Tennessee (TDEC) considers stream reaches immediately downstream from municipal wastewater discharges to be unsuitable for domestic water supply withdrawal." The state's criteria and scientific basis for this decision is unclear. How does TDEC determine where such an exclusion zone should no longer exist? Although not a TVA decision, we would appreciate some discussion on this matter in the FEIS.* **EPA, 51aa**

Response to Comment K2: As a matter of policy, TDEC no longer considers the first five miles of stream reach downstream from a wastewater discharge to be unsuitable for domestic water supply use. If TDEC were to allow a domestic water supply intake to be sited in a specific reach of the Duck River not presently classified for domestic water supply, the reach would be reclassified to protect that use. Reference to the previous policy in Section 4.4 has been deleted.

K3. [S]*ediments and disinfection-by-products (THMs) have been a significant issue for the public water supply system currently using the Duck River as its source water. The source, effects and control of THMs should be discussed in the FEIS.* **EPA, 51t**

Response to Comment K3: The suggested discussion has been added to Section 4.4.

K4. [S]*ediments and disinfection-by-products (THMs) have been a significant issue for the public water supply system currently using the Duck River as its source water. THM precursors include algae and high Total Organic Carbon (TOC) levels, which are in turn related to elevated nutrients. We strongly recommend a TVA commitment for source water protection as part of the preferred alternative in the FEIS. We believe such protection should be part and parcel of any potential approval of a water supply project.* **EPA, 51ac**

Response to Comment K4: Information presented in Section 5.4 identifies the need to protect the additional water supply source. TVA agrees that management of potential sources of contamination through source water protection efforts is a critical need in the upper Duck River watershed. TDEC has an EPA-approved Source Water Assessment Program and assessments for individual water systems

are presently underway. Regardless of which water supply alternative is pursued, the state program would be the appropriate avenue for ensuring that source water protection is implemented.

K5. *The draft EIS does not address cumulative impacts of projected development on water quality or the water supply needed to clean the anticipated Total Maximum Daily Load (TMDL) created by development. Failures to address this issue can be found among the many streams listed on the Tennessee Department of Environment and Conservation's 303D list.* **Marty Marina, Executive Director, Tennessee Conservation League, 58e**

Response to Comment K5: State and local governments, which regulate public and private wastewater systems, are responsible for ensuring that growth and development do not aggravate existing water quality conditions or adversely affect water quality and stream uses.

K6. *Additionally, we were concerned that increased water surface on the lake increases the evaporation rate, offsetting the benefit. No analysis of this offset was presented. Was it studied?* **John M. Procter, Elk/Duck River Chapter, Trout Unlimited, 60d**

Response to Comment K6: The slope of the shoreline surrounding Normandy Reservoir is very steep, so raising the normal summer pool elevation by five feet would increase the surface area by just 230 acres (from 3230 acres to 3460 acres - see Section 3.6), about a seven percent increase. Because evaporative loss is related to the amount of surface area, no more than a seven percent increase would be expected in the volume of water lost to evaporation.

K7. *At the time Normandy Lake was on the planning board, it was pointed out that due to the small flow of the Duck River an amount equal to the actual flow would evaporate each day from the lake. Thus there was not much gain as far as water supply is concerned. Now here we are, with the need for water increasing. If Franklin and Moore County have been limited in the amount of development in the name of water quality, then it is time to put the brakes on development in the Upper Duck River Basin.* **F. Montgomery Adams, Jr., Franklin County Executive, 29e**

Response to Comment K7: Evaporative losses would be greatest in hot dry months such as July, August, and September. In August, when evaporative losses in the Duck River watershed would be highest and the volume of water flowing into Normandy Reservoir would be lowest, the volume of water entering the reservoir would still exceed the evaporative loss by 25 percent.

K8. *To help further assess the potential success or problems associated with the reservoir alternative, we suggest that water quality monitoring data for the nearby Normandy Reservoir (which by now has aged or equilibrated as a reservoir) be provided in the FEIS for comparison, to the extent the two reservoirs are similar. We have also enclosed an EPA Region 4 checklist (EPA Section 404 Reservoir Review) prepared by our wetlands section that should provide additional guidance in assessing potential reservoir projects.* **EPA, 51m**

Response to Comment K8: Water quality conditions in Normandy Reservoir are discussed extensively in Section 4.4, especially with respect to low dissolved oxygen concentrations, high concentrations of iron and manganese, and high chlorophyll-a concentrations. Section 4.4 summarizes findings from many years of water quality analysis on Normandy Reservoir and uses that information, in part, as the basis for

the predictions of water quality conditions expected in a reservoir on Fountain Creek. Section 5.4 also summarizes the undesirable water quality conditions identified on Normandy Reservoir that would be expected to occur in a Fountain Creek reservoir and predicts conditions even more severe at Fountain Creek due to the slower flushing rate. The most recent data report on Normandy Reservoir has been added in the list of references (Section 6.3).

K9. *The modification of introducing cold, oxygen-depleted, bottom water into the system will possibly further deplete the dissolved oxygen -- possibly disrupting the complex thermal stratification layers in the water. Such a disruption could also interfere with nutrient cycling -- a necessity for all life in aquatic systems. Accurate impact assessments dealing with such intricately complex cycles and oxygen depletion effects (often exponential) in Alternative B should be approached with caution.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33g**

Response to Comment K9: These are important issues that can and should be dealt with in the detailed design of the outlet structure for a Fountain Creek reservoir if that alternative is pursued. The outlet probably would be designed to ensure that releases from the dam would contain at least 5 mg/l of dissolved oxygen. Water released from the reservoir also probably would not be allowed to adversely affect aquatic life or other beneficial uses in the reach of Fountain Creek immediately downstream from the dam or in the adjacent reach of the Duck River.

K10. *Additionally, many bivalent metal ions tend to dissolve out of solution and into the soils over time. However, a lowered pH and depleted dissolved oxygen will cause many metals (calcium, manganese, etc.) to dissolve back into the water. This alone can have a hazardous effect upon humans via primary ingestion, secondary, ingestion or prolonged contact.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33h**

K11. *The extraction of soils necessary for construction would subject the nearby waters to high amounts of dissolved metals, petroleum and organic acids that have been long since trapped within the soils. This contamination could effectively lower the pH, possibly affecting nearby ground water tables. In addition, increased amounts of freshly killed plant matter and the introduction of carbon rich humus into the heterogeneous waters may cause many species of heterotrophic bacteria to bloom. Collectively, potential effects of lowering the dissolved oxygen content in the reservoir as well as increasing the chance for an outbreak of dangerous bacteria such as Cryptosporidium sp., E coli and other fecal coliform merits further rejection of Alternative B.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33f**

Response to Comments K10 and K11: Dissolved metals such as iron and manganese would be expected to be present in the deeper water of a Fountain Creek reservoir when dissolved oxygen concentrations were very low. Concentrations of iron and manganese would be regulated under the secondary standards of the Safe Drinking Water Act because they would affect the aesthetic quality of drinking water but not human health. Dissolved oxygen depletion in the deeper water of a Fountain Creek reservoir would likely be more severe during the first 2-5 years after impoundment than in later years due to the decay of vegetation left in the reservoir and the breakdown of oxygen-demanding material present in the inundated soil. Effective control of non-point sources in the Fountain Creek watershed would be essential to prevent potentially harmful bacteria from entering the water supply reservoir.

K12. *The Fountain Creek reservoir does not appear to be a viable alternative in light of the estimated cost and potential for eutrophication caused by the nutrient rich Fountain Creek basin. Both TVA and the Tennessee Department of Agriculture have identified many nonpoint source water pollution issues throughout the watershed. These water pollution issues could have long-term impacts on the biodiversity of the area, particularly aquatic species. Correction of these problems is not a documented cost nor included in the discussion of impacts of this proposed alternative.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64d**

Response to Comment K12: Available information suggests that the Fountain Creek watershed has significant non-point sources which should be corrected regardless of which alternative is selected. Non-point contamination sources would be a continuing threat to a water supply intake directly in the reservoir or one located downstream of the mouth of Fountain Creek. The cost of a watershed-wide non-point source pollution management program was not included in the order of magnitude cost estimate for the Fountain Creek reservoir alternative. Fountain Creek is listed on the TDEC Section 303(d) list which means that in the future non-point pollution sources will have to be corrected to restore use of the stream. If the Fountain Creek reservoir alternative was selected for implementation by local governments before the non-point source management program is in place, then an accelerated correction program probably would be needed. In addition, the non-point source pollution management program required to correct current use impacts to the free flowing Fountain Creek would not be as extensive or as costly as the program needed to protect a water supply reservoir.

K13. *The letter dated April 6, 1979, from D. L. Muland, then the Director of Division of Water Quality Control, to Mr. John L. Ferguson, then TVA Project Manager, stated that Columbia Reservoir would have limited water quality related to the summertime eutrophic conditions that future water user in the Columbia area have not been made aware of. Well, I didn't know anything about it until about three years ago when we ran across this information.* **William Derryberry, 73d**

K14. *We've already spent $84M on a dam and then had it tore down and not a drop of water put behind it. The reason they tore it down is the same reason they can't be none put behind a Fountain Creek Dam. In a letter dated June 6, 1979, from Steve Anderson of the Tennessee Department of Public Health to the Commissioner of Health, Eugene W. Bowwinkle, MD, states that the Columbia Reservoir would have severe water quality problems, would not be another high quality Tennessee lake, and the Tennessee public health recommended that certification of Columbia Dam be denied. The Columbia Reservoir would degrade the water quality of the Duck River. Now if the Columbia Dam would degrade the water of Duck River, what would Fountain Creek do? In this book right here on page 20 of the EIS, it states that in 1953, there was no streams running into the river from Normandy to Columbia, so at that time Fountain Creek was not even running. That was in 1953 and between there and 1960 I know there were two or more years that the water was not running because I lived on the creek and I went down there many a time and played in the mudholes and there was no water running, so what kind of quality of water are we going to have?* **William Derryberry, 73b**

Response to Comments K13 and K14: The water quality impacts of the four alternatives are fully described in the EIS, including water quality conditions expected in a reservoir on Fountain Creek. Water quality conditions in a Fountain Creek reservoir would be similar to the conditions predicted to occur in the

Columbia Reservoir, had it been completed. TDEC would likely require the water released from a reservoir on Fountain Creek to meet all pertinent water quality standards of the state of Tennessee, which would prevent any adverse impacts on water quality in the Duck River.

K15. *From a water-quality point of view, we believe Alternative C will have the Least Minimal Impact on water quality from both the natural reservoir and the reservoir construction area is minimal and does not run the risk of contaminating water from exposed soil runoff or wiping out entire communities of organisms. The amount of water transferred is sufficiently small enough, greatly reducing the risk of affecting nutrient cycling and thermal stratification or the lowered dissolved oxygen levels within certain population parameters.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33d**

Response to Comment K15: Comment noted.

K16. *Alternative D is projected to meet Columbia area water needs only through year 2035 while the other alternatives are projected to meet water needs up to or later than year 2050.* **Marjorie S. Collier, President, Friends of Short Springs, 27d**

Response to Comment K16: If Alternative D was pursued, water supply systems in the Maury/southern Williamson County Water Service Area would need to implement water conservation measures or adopt other means of meeting the anticipated water needs beyond the year 2035. A 10 percent conservation savings is a reasonable expectation since, throughout the United States, water utilities routinely accomplish at least this percentage of reduction in water use through conservation programs.

K17. *Allowing Alternative E [would] reduce valuable water supplies in the Elk River Watershed to allow more development in the Duck River Watershed, a watershed area whose capacity is limited is an example of poor planning. One, this encourages further development to occur in an area that is outgrowing the already limited resource of its watershed supplies. Secondly, [this] discourages development in the Elk River Watershed by reducing the impoundment's supplies and reducing groundwater recharge.* **Mark H. Dudley, 24a**

K18. *Recharging one river with another is not really solving the problem, for it creates other problems. A typical dry period in the Upper Duck River Basin is a typical dry period in our watershed, also. Water quality here is not very good now and during dry periods is less so. Dropping Tims Ford Reservoir by 7-9 inches in a dry period is not wise and would lead to further water quality problems here. As Franklin County grows, and you know we are, our water needs will grow too.* **F. Montgomery Adams, Jr., Franklin County Executive, 29c**

K19. *This study does not comment on potential effects downstream from Tims Ford Dam during periods of drought which might result from the reduced water supply in Tims Ford Reservoir.* **Mark H. Dudley, 24f**

K20. *We also want to bring to the committee's attention that promised minimum flows of 75 cfs have not been maintained in recent weeks and months on the Elk River below Tims Ford. This effect, coupled with the adverse effect of the new water cress operation, has many trout anglers who normally fish the Elk now preferring to fish the Duck. It has been a dry Fall season. I do not know if we are in drought conditions, but it sure*

does not seem we have had our 10 inches of rainfall to not be in one. Surely, everyone recognizes a drought in Columbia likely means a drought for the Elk River basin as well. It seems illogical to steal water from Tims when minimum flows already cannot be met. **John M. Procter, Elk/Duck River Chapter, Trout Unlimited, 60e**

Response to Comments K17 - K20: Tims Ford Reservoir holds 4.5 times more water in storage than Normandy Reservoir (approximately 535,000 acre-feet in Tims Ford compared to 117,000 acre-feet in Normandy). In 1995, the water systems in Franklin and Moore counties used 2.1 mgd of surface water and 1.7 mgd of groundwater from wells and springs, for a total water demand in both counties of 3.8 mgd. That level of water use would be equivalent to 12 acre-feet per day if all of the water was withdrawn from Tims Ford Reservoir. With steady or even additional growth in Franklin and Moore counties, there would be enough water in Tims Ford Reservoir to meet future water supply demands in the Elk River area while helping to meet the needs of adjacent water service area. The estimated lowering of Tims Ford reservoir pool elevation by 7 to 8 inches in drought years would have no measurable effect on water quality. TVA's ability to maintain an instantaneous minimum flow of 80 cubic feet per second downstream from Tims Ford Dam to support downstream uses also would not be affected by the operation of a pipeline similar to the one described under Alternative E.

K21. *I suggest that all water taken out of Normandy re-enter the Duck River watershed.* **Nancy L. Penrod, 69a**

K22. *One solution that might be considered would be to have City of Tullahoma, who draws its water from Normandy Lake, to deposit its treated wastewater into the Duck River instead of depositing into Tims Ford Lake as it now does.* **Robert N. Reed, 28c**

K23. *One possibility would be to discharge back to the Duck River all treated water originally drawn from it. This would include Tullahoma, among others.* **F. Montgomery Adams, Jr., Franklin County Executive, 29d**

K24. *If you need to increase the flow of Duck River, we have a proposal for you. Currently, the City of Tullahoma draws its municipal water from Normandy Reservoir on Duck River, but dumps its treated wastewater into Tims Ford Reservoir on Elk River. It would be far less costly to return the City of Tullahoma's wastewater to Duck River than to construct a twenty mile pipeline from Tims Ford Lake to Shelbyville. This would return both rivers to a more natural flow volume and would improve the water quality in Tims Ford Lake. If the resulting increase in water flow in Duck River should be insufficient to meet future demand in the Maury/southern Williamson County Water Service Area, then that demand is unreasonable and should be lowered by placing limits on development in that area.* **Floyd and Linda Ayers, 32b**

K25. *We recommend that a modification of Alternative E (which we name here as Modified E) be considered to the extent that it might be feasible. Modified E relates to the Tullahoma Wastewater Treatment Plant (Tullahoma) discussed on pages 152-153. Tullahoma purchases water from the Duck River Utility Commission which withdraws from the Normandy Reservoir. Tullahoma then discharges its treated wastewater into Rock Creek which is a tributary of the Elk River, which is connected to and drains into the Tims Ford Reservoir. As such, water is being removed from the Duck River system and discharged into Tims Ford and, with Alternative E, Tims Ford water is being withdrawn and discharged into the Duck River. We suggest that the potential for Tullahoma returning its Duck River water to Duck River as Modified E be explored.*

This would avoid interbasin transfer and the Tims Ford 20-mile pipeline (albeit, the logistics and volumes of Modified E are unclear and the need for a pipeline of uncertain Tullahoma to the Duck River exists). **EPA, 51p**

Response to Comments K21 - K25: TVA does not consider the discharge of this wastewater into the Duck River to be a viable alternative to meet future water needs of the Columbia area. The present volume of the Tullahoma wastewater discharge is about 3.0 mgd and, even with growth over the next 50 years, the volume of water available from this wastewater discharge would not be sufficient to meet the 14 mgd water supply shortfall which is projected to occur in the Maury/southern Williamson County Water Service Area by 2050. Furthermore, relocating the discharge to the Duck River downstream from Normandy Dam would require the construction of a 12- to 15-mile long pipeline and a pumping station to transport the wastewater from the Tullahoma treatment plant. Also, the cost of constructing a pipeline through the urban area of Tullahoma would be substantial.

K26. *My calculations indicate that just by retrofitting the present 17,500+ residences (based on the population numbers listed for the Columbia/Spring Hill/Thompson Station service area) with cisterns of 0.75gal/sq.ft. of house, the equivalent of 3+ mgd (at 50 inches of rain per year) would be captured. This is roughly 50% of residential use, which is probably used primarily for landscape irrigation anyway. Furthermore, there is no reason why cisterns could not be incorporated into commercial and industrial applications. Each system could be installed for less than $0.50 per gallon of capacity. This is expensive compared to the other options, but this option would provide multiple secondary benefits. Furthermore, as growth continues the installation of cisterns could be incorporated into local building codes, with costs added to new homes and businesses (possibly with incentives like In Lieu of a portion of Impact fees).* **Richard E. Lockwood, 31d**

Response to Comment K26: Studies suggest that about 32 percent of the total water used by an average household is used outdoors. If this is true and if every household used a cistern for outdoor use, by 2050, the potential water savings in the Columbia area would be about 4 mgd. The estimated additional water supply needed in the Maury/southern Williamson County Water Service Area in 2050 is 14 mgd. Therefore, the 4 mgd estimated to be saved by household cisterns would not, by itself, be enough to meet the future needs of the area. The concept of cisterns falls into the category of water conservation measures individual homeowners on a public water system could implement to save water. Other water saving measures which have been adopted by homeowners include retrofitting inside plumbing fixtures with water saving faucets, shower heads, and toilets. General public acceptance of cisterns would probably be low due to the construction cost, siting considerations for each residence, construction inconvenience, operation and maintenance difficulties, and potential liability. Most citizens probably would rather pay to have water supplied to them through pipes than deal with a household cistern system.

L. Aquatic Life

L1. *We were told it was snail darters and everything else and mussels but that couldn't be so because they turned lose those otters and they've eaten nearly every one of those mussels. There are mussel shells everywhere over there.* **William Derryberry, 73e**

Response to Comment L1: Recent surveys of mussel resources indicate that a wide variety of species and large number of individuals still occur in suitable habitat along the length of the Duck River. River otters apparently do eat some mussels; however, they also apparently reduce the number of muskrats, which would lower the number of mussels that muskrats would eat.

L2. *Alternative B will have the greatest effects on the quality of surface and ground water. The large area necessary for construction will have adverse effects on a complex array of aquatic ecosystems. For example, by destroying undetermined species within the large non-surveyed areas, we cannot be certain of the impacts that one or perhaps three or four species disappearance would have on the system as a whole.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33e**

Response to Comment L2: Comment noted. Available information suggests that the aquatic species present in this potential project area are relatively widespread and common in the Duck River watershed. If future studies indicate that endangered or other rare species occur in either the surface or ground water which could be affected by this project, that information would be considered during the evaluation of potential environmental effects of building the project.

L3. *All minimum flows downstream of the proposed dam for Alternative B should be consistent with the U.S. Fish and Wildlife (FWS) and EPA guidelines that include minimum flow rates and variable flows consistent with sustainability requirements for fish and other aquatic inhabitants.* **EPA, 51ad**

L4. *There appear to be few impacts on the aquatic fauna associated with the adoption of Alternative C. Of the alternatives suggested by TVA, Alternatives C and E appear to be the most reasonable alternatives concerning aquatic life. Due to the relatively low amount of water that is being withdrawn from the proposed site in Alternative C, few negative effects would be likely. Sedimentation from construction could present localized problems in terms of disturbing habitats of benthic and lithophilic species, especially certain percid and cyprind fishes which utilize these habitats for spawning (12 darter species and 16 shiner/chub species).* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33i**

L5. *Additionally, there is concern that the project* [Alternative C] *may pose some localized threats to the mollusk fauna, as they, too, are sensitive to sedimentation from construction activities. Fortunately, the mollusk fauna at the potential withdrawal site (RM 104) does not contain some of the more sensitive mussel species (Epioblasma sp., Lemiox sp.). However, little or no survey data concerning the gastropod fauna from this reach is available. Given the presence of an endemic gastropod in the Duck River system (*Lithasia genticulata*), and the rich species diversity present in the Duck, it is incumbent on TVA to conduct a gastropod inventory in this proposed withdrawal area. TVA needs to be aware of what aquatic fauna is to be reasonably affected by a withdrawal station.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33j**

L6. *The proposed Alternative C would construct a water supply intake at a point downstream from Columbia in the Duck River and downstream from Cathy's Creek. The Draft EIS outlines suggested short-term impacts to ground water, surface water, aquatic life, terrestrial life, endangered species, etc. The document fails to identify the probable impacts of the proposed construction and water withdrawal. Although the document discusses the withdrawal of approximately a fifth of the maximum flow, the document does not acknowledge the potential impacts to reduced flow as seen during the most recent drought and low flow conditions (summer flow gauge records for 1998-2000).* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64k**

L7. *Alternative E proposes to transfer water from Tims Ford reservoir to a downstream site through a 20-mile pipeline and booster pumping station to the lower Duck River. The transfer of large volumes of water between watersheds (inter-basin) could result in artificial range extensions for aquatic species or increase the likelihood that exotic species could invade these watersheds e.g., zebra mussels. The Draft EIS does not consider these potential impacts. The long-term impact by minor but continued drawdowns is not fully addressed considering the reduction of water from Tims Ford reservoir as part of this proposal. The Draft EIS does not consider aquatic biodiversity impacts in the reservoir resultant from sustained water withdrawals during drought conditions.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64q**

Response to Comments L3 - L7: Section 5.5 addresses many of the possible effects on aquatic life which could occur if one or more of the action alternatives was adopted. As noted in that section, Alternative C would involve the withdrawal of up to 31 cfs near River Mile 100, which would reduce the minimum flow from approximately 147 cfs to approximately 116 cfs, a 21 percent reduction. This amount of flow reduction is not likely to have a substantial change in aquatic habitats or aquatic life in that part of the river. These and the other possible effects of the action alternatives would have to be reviewed or reevaluated and, perhaps, other issues would have to be addressed as part of the subsequent evaluation of whatever version of each alternative might be proposed to be built. As a point of clarification, the potential withdrawal associated with Alternative C would be approximately one-fifth of the minimum flow downstream from Catheys Creek.

L8. *Support for cool water fishery in Duck and Elk, a put and take fishery, and an increase in water releases. Reduced flows on the Elk results in poor water quality.* **Michael Finks, 35**

Response to Comment L8: Comment noted.

L9. [Alternative E] *would mean less water going downstream and therefore less water in Tims Ford Tailwaters thereby causing problems for the trout fishery enjoyed by numerous people from far and wide.* **Don F. Lee, 6b**

Response to Comment L9: If Alternative E was built essentially as proposed in Section 3.7, existing information and preliminary studies suggest there would be no change in the quantity or quality of the discharge from Tims Ford Dam and, therefore, no effect on the trout fishery downstream from that dam.

L10. *What is most concerning to our Chapter are the proposals to Raise Normandy Pool Level or add a Tims Ford Pipeline. Raising Lake Normandy is a disturbing project far from Columbia and individuals who likely don't appreciate this existing water source provision for their community. For a tailwater fisherman, a deeper reservoir at first sounds exciting. I regularly fish the Colorado River at Lees Ferry, Arizona, below Glen Canyon Dam. This 725 ft. high dam provides 48 degree water year round, even in the heat of summer! This river supports an incredible blue ribbon rainbow trout fishery. But I agree with the EIS - you have to realize that a larger operating minimum flow will expend the cool layer of lake water faster.* **John M. Procter, Elk/Duck River Chapter, Trout Unlimited, 60c**

Response to Comment L10: Once any of the alternatives was proposed to be built, detailed planning would have to be done, including specifically how the project would be operated. After that, the careful evaluation of potential environmental effects would have to include a review or reevaluation of the discussion presented in Section 5.5 concerning the possible impacts on aquatic life in each stream reach which would be affected.

M. Wetlands

M1. *As previously stated in the DE1S, the implementation of Alternative C would have short-term minor effects on some known wetlands. The minor effects are further defined as probable minimal construction effects in the DEIS. The severity of the minor short-term effects is apparently dependent on the proper siting, design, and construction of the contiguous facilities. Long-term effects and net loss or total displacement assessments for those wetlands are not adequately addressed in the DEIS. . . . . The wetlands in peril need proper denotations as either forested and scrub-shrub type or emergent type wetlands.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33k**

M2. *The greatest wetland losses are associated with B (reservoir) and D (raising Normandy pool). B would result in the loss of some 225 acres of forested wetlands as well as the loss of the reach of Fountain Creek that would be inundated. It is unclear if perhaps other non-forested wetlands may also be lost within the 2,200 acres to be inundated for the reservoir (the FEIS should therefore total all the estimated jurisdictional wetlands that would be inundated by the reservoir). It should be noted that EPA considers both vegetated wetlands and creek water as wetlands, and water inundation of the reservoir wetlands and creek water is considered the same as filling wetlands with soil.* **EPA, 51v**

M3. *The 225 acres of wetlands were not precisely determined in the field but were estimated by aerial false-color infra-red photography. A jurisdictional determination of these wetland habitats needs to be made pursuant to Section 404/U.S. Army Corps of Engineer regulations. Following this determination, an avoidance or mitigation strategy should be provided. The mitigation strategies (pg. 163) indicated in the DEIS were general in nature and should be refined to indicate a more specific mitigation plan. Although not required, a draft mitigation plan should be included in the FEIS as well as a commitment to provide wetland compensation to the satisfaction of the resource agencies.* **EPA, 51w**

M4. *Implementation of Alternative D, which would raise the elevation of Normandy Reservoir by five feet, would result in the inundation of riparian vegetation including "...several forested wetlands that now occur at the upstream ends of some reservoir embayments" (pg. 164) as well as herbaceous fringe wetlands along the current Normandy shoreline. It is unclear what wetland losses or conversions may be associated with the pipeline alternatives C and E. The FEIS should be more specific as to the kind, quality and function of the wetlands that would be lost for each alternative.* **EPA, 51x**

M5. *Consistent with 404 (b)(l) guidelines, the loss of wetlands associated with B and D would need to be considered in the alternatives analysis, especially since other practicable alternatives with less wetland impacts exist.* **EPA, 51y**

Response to Comments M1 - M5: As stated in Section 1.1, the analysis presented in this EIS has been conducted at a general (programmatic) level. With respect to wetlands, this level of analysis allows an initial assessment of wetland impacts, using existing data about wetland resources in the likely project areas. Specific, detailed assessments of the type, extent, and function of jurisdictional wetlands would be completed in the subsequent evaluation(s) of whatever projects are proposed to be built. Those evaluations would be consistent with state and federal

wetland protection regulations, and would include detailed mitigation strategies developed to offset the specific wetland losses associated with each project. Long-term effects and net loss of wetlands associated with the project(s) would be assessed in detail as part of the subsequent evaluation and environmental review. The wetland types associated with each alternative are described in Section 4.6.

N. Floodplains

N1. *Since the purpose of this project is to supply water, the pipeline and the intake will have to be constructed in the flood plain because there is no other feasible alternative. This will cause some disruption to the areas around the construction of the pipeline, but if the disturbed areas are reverted back to their natural state there should not be any long-term effects. The route chosen for the pipeline would take it across numerous streams. It is at these points that it will be crucial for the construction of the pipeline to follow best management practices to minimize the impacts of the crossings. The pipelines will also have to be constructed in a way to make them able to withstand flood like conditions and to comply with the National Flood Insurance Act. Alternative C would* [a]*ffect only small areas during construction, but without any major impacts. . . . . The effects upon the soils and the flood plain will be negligible.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33m**

Response to Comment N1: Comments noted. Because the pipeline would be underground, there should be no long-term problems with flooding impacts.

P. Terrestrial Life

P1. *Given the length of the proposed pipeline (13 miles), certain species could be affected either by directly disturbing habitat or through disturbance of foraging ability, nesting, etc. . . . . Most importantly to consider are habitat fragmentation effects associated with a pipeline right-of-way. This would have the potential to destroy underground nests/burrows of terrestrial species and potentially impact a species metapopulation. TVA should address potential impact areas for whatever terrestrial species are located there, and provide some attempt to relocate species that most likely affected by pipeline construction. Additionally, TVA should investigate the possibility of co-locating the proposed pipeline in existing right-of-ways.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33n**

Response to Comment P1: TVA appreciates the concern related to the placement of the proposed pipelines and their potential effects on wildlife resources. The intent of the EIS is to outline the different options that are available for meeting future water needs in the upper Duck River basin and not to delineate or evaluate specific utility routes for each alternative. Evaluating the specific potential effects of an alternative proposed to be built would occur once each project was described in detail. Impacts to terrestrial resources would be better determined through additional, project-specific environmental reviews. Any populations of rare organisms and their habitats which could be affected by the project would be addressed as provided by appropriate State or federal laws.

Q. Endangered Species

Q1. *Attention to sensitive species (such as the Indiana Gray Bat) should be considered.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33r**

Q2. *Furthermore, a vascular and non-vascular inventory for endangered or threatened species is appropriate, if not imperative.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33l**

Q3. *As a part of our review of the subject Draft EIS, please be advised that we have reviewed our Departmental data bases and find recorded State and/or Federally listed species, within a one mile radius of the proposed Tennessee Valley Authority (TVA) project boundaries and within a one mile radius of the proposed managed lands (project alternatives). These species have very specific or rare habitat. Our records also indicate additional species occurrence records, sensitive ecological sites, and management areas, within an approximate four mile radius of the proposed project site(s). Your agency is aware of these records and we suggest that these records be further evaluated in cooperation with your Heritage Program in Norris, TN.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64a**

Response to Comments Q1 - Q3: The information presented in this EIS includes up-to-date knowledge about the status of endangered and threatened species in the areas which could be affected by the water supply alternatives. If and when one or more of these alternatives are designed and proposed to be built, the information about protected species would have to be reviewed and up-dated to cover whatever changes would have occurred in the status and known distribution of the protected species.

Q4. *Environmentalist will import some rare nonnative mussel or plant to the alternative "B" area and cause problems.* **Douglas K. Mitchener, 59e**

Q5. *I find it hard to believe that the area where the Columbia dam was being built is the only place that Snail Darters live. Even if it is, I don't think this is a valid reason to not complete something that is so valuable to human life. The people that caused this probably never had to haul water for their livestock or home. Just the way I feel.* **Kent Curtis, 4b**

Q6. *Given the fact that endangered mussels caused the Columbia Dam to be discontinued, TVA should ensure that no such endangered species or other unresolvable "show-stoppers" exist in the nearby Fountain Creek watershed if the reservoir alternative (B) is pursued.* **EPA, 51af**

Response to Comments Q4 - Q6: Whenever one or more additional water supply projects are proposed to be built in the area around Columbia (or elsewhere), federal law probably would require that the project be evaluated for possible adverse effects to any species then listed as endangered or threatened. At present, and as described in Section 5.9, none of the action alternatives is known to include activities which would have direct adverse effects on federal endangered or threatened species.

Q7. Schwalbea americana *and* Xyris tennesseensis *found in Coffee and Lewis Counties respectively are both considered not potentially affected or likely to occur in any of the*

alternative project areas. These assumptions are based on an 1879 site record and an eight-mile separation from a proposed alternative project area. The issue here does not concern itself with tangible distances and uncommonly intermittent records, or even distributions amongst physiographic provinces of protected plants near probable affected areas. But simply how can statements in the DEIS be made concerning the potential or likelihood of at least sixty-eight protected species occurring in alternative areas without a complete baseline vascular plant inventories. **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33q**

Q8. *The Water stitchwort (*Arenaria fontinalis*) is a Tennessee threatened and obligate wetland plant (OBL). The Water stitchwort occurs in seepages and other wet areas along creeks. The OBL plant would not survive prolonged inundation. The Duck river bladderpod (*Lesquerella densipila*) is a Tennessee threatened and globally rare plant, which also occurs in the area of a proposed reservoir on Fountain Creek. Field surveys conducted in the spring of this year by the Division of Natural Heritage staff have documented serious declines in populations of this plant in the majority of its range. Several bottomland areas adjoining Silver Creek continue to support populations of this plant. These populations would be inundated under the Draft EIS, Alternative B.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64g**

Q9. *A change in water flow rates (downstream) or significant water withdrawals from the* [Normandy] *reservoir could affect two rare plants that occur in the Duck River. These are Water stitchwort (*Arenaria fontinalis*) a Tennessee threatened and obligate wetland plant, and Limestone blue star (*Amsonia tabernaemontana *var.* gattingeri*), a Tennessee special concern listed species and a facultative wetland plant. Comparing these two rare species, the Water stitchwort is more dependent on water (an obligate wetland plant) and would be sensitive to changes in hydrology (reduced seepage and flow rates). Occurrences of both species are found in the Duck River watershed, both above and below the confluence of Fountain Creek. It is unclear how the rare plant populations in the Duck River would be affected under the different alternatives, however the increased minimum flow under Alternative D could be beneficial to these rare species.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64n**

Q10. *It is important to note that the Division of Natural Heritage staff did not survey the area south of State Route 50 on Fountain Creek in the spring of this year for the Duck River bladderpod. This area could also support populations of the protected plant species (potentially inundated by the proposed Fountain Creek reservoir).* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64h**

Q11. *Considering endangered or otherwise protected vascular plant species of Tennessee, the DEIS methodology of determining the potential for a protected species to occur in any of the Upper Duck River Basin alternative project areas is unacceptable. Furthermore, simply stating the likelihood of a protected species occurring in an affected area as either 'yes' or 'no' is also unacceptable. For example,* Helianthus eggertii *occurs in nine (not eight) Tennessee counties (Chester et al., 1997). This composite, as noted in the DEIS, occurs approximately twelve miles SW of Columbia in Maury County. As stated in the DEIS,* H. eggertii *is not known to occur in the Central Basin Physiographic Province of Tennessee. However, significant portions of Maury, Bedford, and Davidson Counties each with a site record of the composite subsequently occur in the Central Basin Physiographic Province (Chester), including the station at*

Maury County. This alone establishes that the protected plant is not associated exclusively with the Highland Rim Provinces (East and West). Six counties in the Eastern and Western Highland Rim Provinces support H. eggertii *(Chester), not including the station at Coffee County as stated in the DEIS. Three of the nine known and documented Tennessee stations of the composite are supported in the Central Basin Province contradictory to statements issued in the DEIS.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33o**

Q12. *Considering that three of the populations [of* Helianthus eggertii*] occur in the Highland Rim Province and, more importantly three in the Central Basin Province, should not a complete vascular plant inventory be conducted before any alternative is implemented? Although surveys were conducted on Columbia Project Lands, their methodologies are poorly if at all delineated in the DEIS - merely stated as extensive surveys were conducted. Did the surveys intend to find only* H. eggertii *or all the state's listed and federal species? How is an extensive survey defined? Complete vascular inventories should entail a systematic collection within all affected areas, not merely probable habitats. Sampling should run through two growing seasons depending on the area and number of habitats and documentation of specimens (voucher specimens if applicable for protected species or even pictures) and their respective locations should all be obtainable by the public. Furthermore, extensive surveys are not tantamount to baseline inventories. Surely, a single voucher specimen for every vascular plant encountered was collected and identified in the Columbia Project Lands area. If not, how can the species probability or likelihood of occurrence be stated with any confidence?* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33p**

Q13. [T]*his alternative* [B] *would inundate known populations of a number of rare plant species and could impact several registered State Natural Areas. The Glade cress (*Leavenworthia exigua *var.* exigua*), Tennessee milk-vetch (*Astragalus tennesseensis*), and Limestone fame-flower (*Talinum calcaricum*) are Tennessee special concern plants, which occur in the area of proposed inundation by a reservoir on Fountain Creek. These limestone cedar glade plants, that are globally rare and the plant communities (habitat), would be destroyed by inundation.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64f**

Q14. *A population of the Tennessee and Federally listed (endangered) Leafy prairie-clover (*Dalea foliosa*) occurs between 620 feet and 630 feet elevation in the Moore Lane Glade Registered State Natural Area. This area is outside of the Fountain Creek watershed, but would require protection from inundation (629-foot elevation) by the two proposed extension (saddle) dam structures west of the proposed Fountain Creek reservoir.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64i**

Response to Comment Q7 - 14: As indicated in Sections 1.1 and 3.9, the EIS evaluates the relative potential for environmental impacts associated with each of the five alternatives. A detailed review of potential environmental effects would have to be conducted if one or more of the action alternatives were proposed to be built. In addition, as stated in Section 1.8 with regard to the Endangered Species Act, "The evaluations also would have to focus on the species protected at the federal and state level at that time and comply with the laws and regulations then in existence." Project-specific field investigations would be conducted at that time, and any potential impacts identified at that time would be assessed. As indicated in Section 5.9 and documented in Appendix E, the U.S. Fish and Wildlife Service has

concurred with this approach to addressing any potential impacts on federal endangered species.

Q15. *The information presented indicates that the Moore Lane Glade Registered State Natural Area (west of State Route 50) will be directly affected by the proposed location of the dam and construction area. A raised water table resulting from the impoundment could effect stream flow throughout the proposed project area. Due to the karst features of the area, a small, unnamed tributary to the Duck River (within the Natural Area) could have increased flow from ground water inflow. It is not clear how this change in hydrology would affect the Leafy prairie clover populations, which occur within the Natural Area.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64j**

Response to Comment Q15: Based on information provided by the Tennessee Division of Natural Heritage since the publication of the draft EIS, *H. eggertii* is presently known from 12 counties in Tennessee. This change has been made in Section 4.9 in the final EIS. Although portions of some of these counties occur in the Central Basin physiographic province, a review of the specific localities of each *H. eggertii* population confirms that no populations are known from sites actually located within the Central Basin.

Q16. [T]*here are a number of Tennessee endangered, threatened and special concern plants which occur on lands above the 900 foot contour, around Normandy Lake at sites known as Rutledge Falls, Copperas Branch, and Short Springs Designated State Natural Area. The Division of Natural Heritage has no records of Tennessee endangered, threatened or special concern plants below the 900-foot contour of Normandy Lake.* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64m**

Response to Comment Q16: Comment noted. As stated in Sections 5.9, TVA is not aware of any protected species records from the area around Normandy Reservoir which could be adversely affected by raising the pool level. That conclusion would be reviewed and, if necessary, revised if some form of Alternative D was proposed to be built.

Q17. *Although not documented in the Draft EIS, there are numerous rare, threatened or endangered aquatic species records at the mouth of Fountain Creek and immediately downstream in the Duck River. Assuming suitable habitat exists within Fountain Creek, these species could be present in the watershed e.g., Coppercheek Darter (*Etheostoma aquali*) and Slabside Pearlymussel (*Lexingtonia dolabelloides*).* **Andrew N. Barrass, Environmental Review Coordinator, Division of Natural Heritage, 64e**

Response to Comment Q17: Information presented in the EIS includes the results of recent fish and mussel surveys in the Duck River and in the Fountain Creek watershed (see especially Appendix B). The survey results indicate that the coppercheek darter does occur in Fountain Creek; however, very few native mussels were encountered there. The coppercheek darter is a threatened species in Tennessee but is not, at present, listed as either endangered or threatened by the U.S. Fish and Wildlife Service. TVA believes the available information is sufficient to address the present status of any potential effects of building a Fountain Creek reservoir on protected aquatic species. That information probably would need to be up-dated if and when a reservoir was proposed to be built in that area.

R. Land Use

R1. *Alternative C would only have short-term adverse effects on land use, primarily because the location and construction of the pipeline, intake, and booster station can be adjusted so as to minimize their effects on prime farmland and other uses of the land in the area. Due to its minimum requirements for land (estimated to be 2 acres plus 130 acres of easement for the pipeline), this alternative is preferred over Alternative B which would require the disturbance of 3,600 acres of land.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33s**

R2. *The soils that are present in the Duck River area range from well to moderately well drained silty/loamy soils to highly acidic and low nutrient content soils. The silty/loamy soils are productive for a variety of different crops and considered prime farmland. Grazing cattle frequently use such soils. The economic cost of changing the land use of these few productive agricultural areas merits further investigations before implementing Alternative C.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33c**

Response to Comments R1 and R2: Comments noted. Under the present concepts, Alternative C would involve the permanent use of about two acres of land (to be occupied by the intake structure and the booster station). All other land along the route of the pipeline would be affected only during the construction period, after which the owner could decide how to use it. If these concepts carry forward into actual plans for this project (if it is to be built), Alternative C would not have any long-term impact on land use in the project area.

R3. *The fluctuation that occurs now from the necessary winter/summer pool flows have caused continuous loss of trees which are being undercut by the changing currents along the banks. In an effort to hold as much of the dirt along the banks as possible, we have planted trees along some of the most stressed areas. We would certainly like to see them grow and aid in the protection from erosion that more and higher water levels would make impossible.* **Polly Dement Oettinger, 41b**

Response to Comment R3: The changes in flow patterns which would occur under any of the action alternatives would take place only during drought conditions. None of the alternatives would have any effect on the conditions described in this comment.

R4. *The disposition, ownership, and management of the environs surrounding the reservoir proposal (B) are a major shortcoming of the DEIS. As other reservoir projects in the nation have experienced, control of nutrients in the reservoirs and lakes in the southern U.S. are a continuing challenge. Shallow, warm water bodies enriched with nutrients from farmland and agricultural runoff and natural sources quickly become colonized with mats of aquatic plants and algae. To control nutrient enrichment and eutrophication, the drainage basin containing the reservoir will likely require management measures and land use controls including but not limited to: creation of buffer zones in perennial and intermittent streams in the watershed; timber cutting and agricultural use restrictions in buffer zones; lot size and housing density restrictions; policies on septic tank placement and maintenance, and other strategies to prevent pollutants and nutrients from entering the proposed reservoir. If Alternative B is selected by TVA as its preferred alternative, the FEIS should provide at least a draft basin management plan that includes TVA policies and procedures on shoreline*

management, water quality, monitoring, aquatic weed control, fisheries, etc. as they relate to the proposed Fountain Creek Reservoir. As an example of reservoir management techniques that may be useful in addition to TVA's management EISs such as the recent Shoreline Management EIS, we have enclosed the watershed management rules that the State of North Carolina required for the Lake Randleman watershed (Randleman Watershed Management Rules) in 1998. **EPA, 51ae**

Response to Comment R4: TVA concurs with the basic points made in this comment; however, TVA is not planning to make the decision to construct one or more of these alternatives and TVA probably would not select any additional purpose(s) to be included in one or more of these water supply projects. The EIS identifies that the source of additional water for the Columbia area would have to be protected from contamination and nutrient enrichment. Insuring that appropriate land and water use decisions are made can best be accomplished by the project sponsor(s) and the regulatory agencies.

R5. *Surely the history of overdevelopment in some of the Western states without adequate water sources should play in mind when forming water and land use strategies for this area. The Tennessee Department of Environment and conservation has taken the initiative to limit development along the shores of Tims Ford Lake; not soon enough, but a step in the right direction. Other watersheds should do the same.* **Robert N. Reed, 28b**

R6. *Pumping Tims Ford Reservoir water to discharge into the Duck River, although an engineering possibility, is contrary to what the TVA envisioned and documented in the Tims Ford Reservoir Land Management and Disposition Plan and EIS. The number one consideration with the Tims Ford Reservoir plan, and what amounts to severely restricted development of the 6000 public acres in Franklin and Moore counties surrounding the reservoir, is land conservation in the name of water quality. Just as when water quantity issues were correctly foreseen for one purpose of the Columbia Dam, water quality issues are at the forefront of Tims Ford Reservoir Land Management Plan and EIS. If, in the name of water quality, we are not allowed to put large areas of tax producing real estate on the market and develop them in the name of expanding our tax base and are, then, compelled to sign on to a project that will degrade further the quality of Tims Ford Reservoir water; I strongly take issue. We would be in effect rewarding unbridled growth in one area of the state by limiting growth in another. At the same time, our area would suffer without direct or indirect benefit.* **F. Montgomery Adams, Jr., Franklin County Executive, 29b**

Response to Comments R5 and R6: Comments noted. Under the recent amendments to the Clean Water Act, the protection of water quality probably would essentially dictate land use decisions in both the Duck and Elk River watersheds, regardless of whether a pipeline connection is constructed or not. The long-term quality and optimum use of these river systems and reservoirs would depend on the ways land use decisions are made all across each watershed.

R7. *While TVA may still claim ownership of 60 acres at Short Springs along the present Normandy Reservoir, this land was designated a TVA Small Wild Area and has subsequently been made a part of the Designated Short Springs State Natural Area under the Natural Areas Preservation Act of 1971. The purpose of the act is to protect areas possessing scenic, scientific, including biological, geological and/or recreational values which are in prospect and peril of being destroyed. Short Springs Natural Area*

is a Class I - Scenic/Recreational Area under T.C.A. 11-14-108 (b)(1)(O). **Marjorie S. Collier, President, Friends of Short Springs, 27c**

Response to Comment R7: Comment noted.

S. Visual, Recreation, & Natural Areas

S1. *Alternative C would have only a minimum impact upon the recreational use of the Duck River - and for only a brief period of time. Only a very small (< 1 acre) would be required for the intake structure. Also, neither the presence nor operation of the underground pipeline would negatively impact the recreational use of this river.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33t**

Response to Comment S1: Comment noted.

S2. [T]*he potential for mitigation measures to protect Short Springs Natural Area should be documented in the EIS.* **Justin P. Wilson, Deputy to the Governor, 43i**

Response to Comment S2: As indicated in Sections 5.11 and 3.9, raising the pool level on Normandy Reservoir as described under Alternative D would have adverse effects on a small part of Short Springs State Natural Area where substantial wildflower populations occur. If that alternative was proposed to be built, detailed plans for the project would be prepared and an appropriate environmental evaluation would be conducted. At that time, project-specific issues, including avoidance and/or mitigation measures in the natural area, would be addressed based on the detailed plans for the project.

S3. *We feel that any negative impact to Short Springs State Natural Area, which has been designated as biologically significant by the State of Tennessee for nearly 20 years, sets an unacceptable precedent.* **Leslie Colley, The Nature Conservancy of Tennessee, 44e**

S4. *I have always been impressed with the willingness of TVA, the state of Tennessee, and the city of Tullahoma to join together to protect the truly unique environs containing Short Springs. It dismays me to think that all of that hard work could disintegrate so quickly. Please consider carefully the legacy that will be left.* **Jeff Stewart, 52c**

S5. *Raising the Normandy Pool Level would be detrimental to Short Springs State Natural Area by inundating lower portions, particularly the area where Bobo Creek and Machine Branch join and where a rich profusion of wildflowers occurs. A portion of the Natural Area extends along Bobo Creek as far down as Carroll Creek and this would also be detrimentally affected.* **Marjorie S. Collier, President, Friends of Short Springs, 27b**

S6. *I wish to urge TVA to not recommend Alternative D in the final Environmental Impact Statement. Short Springs is one of the most beautiful natural wildflower areas around. This small area contains many, many specimen of flowers and is enjoyed by all ages. I love to take my grandchildren there, they love it. Please do not ruin this special place. Surely one of the other alternatives would work as well without destroying the natural beauty of Short Springs.* **Mrs. Herschel McDonald, 57**

S7. *I have just received the very discouraging and disappointing news that your company (TVA) is considering the expansion of services in this particular area of the State (Short Springs). To me it is ludicrous to even think of increasing the services of Normandy Dam; which would entail the destruction (perhaps extinction) of a considerable amount of plant and animal life in some of the most beautiful natural area's of this portion of*

our state. I am also surprised such corporations as TVA would challenge (violate) existing legislation as the preservation law of 1971. I therefore, am vehemently opposed to such action and will do all in my power to convince others to do and feel likewise. **A. E. Smedley, 56**

Response to Comment S3 - S7: TVA recognizes the unique suite of natural features which exist along the reservoir shoreline in the Short Springs State Natural Area and shares the agency and public commitment to this site. If the decision is made to raise the pool level on Normandy Reservoir, TVA would actively participate in determining the potential effects on Short Springs and assist in minimizing or mitigating losses to the site which could not be avoided.

S8. *Currently, residents near the area of the proposed* [Tims Ford] *intake, "regular" boaters and fishermen, and transient boaters and fishermen enjoy a quiet zone, free from industrial type noise....like the continuous hum of high speed electric pumps. This would change dramatically in this area, noting that sound carries well over water, particularly on a quiet night.* **Mark H. Dudley, 24h**

Response to Comment S8: If Alternative E was proposed to be built, appropriate measures would be taken to minimize noise levels associated with the intake structure. As indicated in Section 5.10, these measures could include using low-noise equipment, and locating and designing the intake to minimize noise production. Properly located, designed, and constructed, this alternative would have insignificant effects on local noise levels.

T. Cultural Resources

T1. *When compared with Alternative E (requiring a 20-mile-long pipeline), and Alternative B (requiring the disturbance of 3,600 acres), Alternative C would only disturb a small amount of land. Therefore, assuming that the potential cultural resources are evenly distributed, the Alternative C would have the least impact on any existing cultural resources. In addition, after the site/route is reviewed by the Tennessee State Historic Preservation Office, the pipeline construction could be adjusted to minimize further disturbance to cultural resources under this alternative.* **Environmental Science Graduate Students, University of Tennessee at Chattanooga, 33u**

Response to Comment T1: Comment noted. Assuming a maximum corridor width of 50 feet for pipeline construction, Alternative C would affect approximately 130 acres of land and Alternative E would affect approximately 200 acres. Enlargement of Normandy Reservoir under Alternative D would affect 230 acres and the construction of a reservoir in the Fountain Creek watershed as described under Alternative B would affect approximately 3,650 acres.

T2. *Considering available information, we find, after applying the Criteria of Adverse Effect codified at 36 CFR Part 800, that the project as currently proposed will ADVERSELY AFFECT PROPERTIES THAT ARE ELIGIBLE FOR LISTING IN THE NATIONAL REGISTER OF HISTORIC PLACES. Therefore, this office has an objection to the implementation of this project. You should now, through TVA, inform the Advisory Council on Historic Preservation of this adverse effect determination and begin immediate consultation with our office. Please enclose a copy of this determination in your notification to the Council as delineated at 36 CFR Part 800. Until you have received a final comment on this project from this office and the Council, you have not completed the Section 106 review process.* **Herbert L. Harper, Tennessee State Historic Preservation Office, 12**

Response to Comment T2: These comments were made by the Tennessee State Historic Preservation Officer (SHPO) in a letter dated September 14, 2000. The SHPO provided amended comments by letter dated October 19, 2000 (see Appendix E) indicating that this undertaking is limited to the drafting of a programmatic EIS for future project implementation and, as such, will not affect any properties listed or eligible for listing on the National Register of Historic Places. Appropriate review of the detailed plans for any alternative proposed to be built would be conducted as a part of the subsequent evaluation of potential environmental effects.

U. Socioeconomics

U1. *We do not accept the premise in the Draft EIS that there will be no growth in "new large, water consuming industries." The Tennessee Department of Economic and Community Development believes that industrial growth will be critical to the future growth of the region.* **Justin P. Wilson, Deputy to the Governor,43g**

U2. *While the DEIS indicates that the Fountain Creek alternative will be the most expensive and may have the greatest environmental impact, it could be penny wise and pound foolish to try to cut it so close with the economic future of the area. Past investments in community infrastructure developments have made possible industrial locations and expansions which simply would not have occurred without such investments. These locations and expansions have been vital to the region's economy and have more than repaid the investments made. The same will be true in the future. Further, our expanding environmental capabilities and regulatory protections ensure more than ever that such growth can occur with minimal, if any, negative impact upon our environment.* **Wilton Burnett, Jr., Special Projects, Department of Economic and Community Development, 63c**

U3. *The DEIS analyses assume that no new water-consuming industries were to site in the watershed and increase the water demands. In addition, it is somewhat unclear if agricultural needs were adequately included. Page 24 of the DEIS states that "[t]he amount of water withdrawn for agricultural irrigation is not known, but given the intensive agricultural land use in the three county area, significant amounts could be drawn during an extended drought." Similarly, page 25 states that the USGS, in their 1996 needs evaluation estimates, "...did not include any water for new, self-supplied industries or major expansions of agricultural water use in any of the three water service areas." The FEIS should further discuss agricultural needs and the potential for agricultural expansion and additional water-consuming industries siting in the area.* **EPA, 51e**

Response to Comments U1 - U3: As indicated in Section 2.5, the projections used in the EIS allow for increases in industrial water use in excess of recent growth in the area. They do not, however, include provision for new, large, self-served, water-using industries such as chemical plants, paper mills, or major agricultural expansions. While those types of industries are not likely to locate in the area, if such a facility did locate in the watershed, it would require revision of the water needs projections. It should also be noted that many industries now employ processes that use considerably less water than in the past. A good example is the Saturn plant at Spring Hill, which uses only about one-fifth the water a comparable older automobile manufacturing plant would use (see sidebar on page 19 of the 1998 *Water Supply Needs Analysis for Bedford, Marshall, Maury, and Southern Williamson Counties Tennessee*).

U4. *The draft EIS is geared to providing enough water for Columbia to grow at the present rate for the next 50 years. We believe the present rate was not anticipated when the dam was originally projected and cannot be sustained for so long a period. Further, planning for it (or failing to recognize this) will eventually negatively impact Colombians' quality of life and the economic viability of other counties in the watershed. Atlanta could serve as a poster child for unbridled development.* **Marty Marina, Executive Director, Tennessee Conservation League, 58c**

U5. *Take a look at the current water problems in Los Angeles, California, and Phoenix, Arizona, caused by over-development for the available water supply. We should be learning from their greed centered errors, rather than emulating them. Tennessee is blessed with abundant fresh water. Why concentrate too much development in an area with insufficient water to sustain it? Once this pattern is established, it feeds upon itself and becomes irreversible.* **Floyd and Linda Ayers, 32c**

Response to Comments U4 - U5: Based on present trends and conditions, the existing water supply in the Maury/southern Williamson County Water Service Area is expected to be adequate until during drought conditions some time after 2015. If the demand continues to increase as projected, a decision will be necessary regarding whether to augment the supply and, if so, how to do it. A decision to not increase the supply and thereby restrict population and economic activity to a level that could continue to be supported by the existing supply is the No Action Alternatives.

U6. *I also want to know if anybody has considered the impact of Highway or In-State 840 upon this area and what it is going to do in the areas of Marshall, Murray, and Williamson Counties. Continued growth in Marshall County was too low on that screen; I can tell you today it will more than double, it will more than triple in size simply because of the location of factories and industrial base we have in Marshall County. Murray County will soon see a major growth in industry as it is already doing due to the Saturn Plant at Spring Hill. Satellite factories will continue to come in; that means more people, that means more need for water, and we don't have it.* **Randy Short, 80d**

Response to Comment U6: When it is completed, Highway 840 is expected to have significant impacts on the northern end of Maury County and on southern Williamson County. These effects have been included in the projections of local economic growth. The impact of this new highway on Franklin County is less clear; however, the population projection for Franklin County recognizes and builds on the recent growth in the county.

U7. *The Related Documents identified in the EIS (Page 12) listed only the Draft EIS on the use of land surrounding Tims Ford Reservoir. Again, a myopic view without proper consideration of other effects on the area, does not take other important factors into account. Socioeconomic impacts listed in the EIS do not address any potential impacts to the Franklin County area, other than construction and related activities.* **Mark H. Dudley, 24e**

U8. *The Franklin County area is in a "growth spurt". New major highways have been created, old highways are being widened, our industrial base has seen multi-national industrial companies relocating to this area, most notably Nissan's Decherd facility, and the numbers of residential and commercial Building Permits have increased by about 80% over the numbers just six years ago. It is a distinct possibility, given that Nissan located in this area, new roads have been created, our central location, our recreational resources, that other large, water consuming industries may locate in Franklin County in the near term. This EIS, in my opinion, does not see beyond the boundaries of the study area, particularly at the future adverse socioeconomic impact of reducing precious water supplies to the Elk River Watershed.* **Mark H. Dudley, 24d**

Response to Comments U7 - U8: This programmatic EIS focuses on the water needs of the three water service areas in the upper Duck River watershed However, because of the concern expressed and the potential impact of one of the alternatives on Franklin County in the Elk River watershed, we have looked at the water needs situation in that county. Tims Ford Reservoir holds 4.5 times more water in storage than Normandy Reservoir (approximately 535,000 acre-feet in Tims Ford compared to 117,000 acre-feet in Normandy). In 1995, the water systems in Franklin and Moore counties used 2.1 mgd of surface water and 1.7 mgd of groundwater from wells and springs, for a total water demand in both counties of 3.8 mgd. That level of water use would be equivalent to 12 acre-feet per day if all of the water was withdrawn from Tims Ford Reservoir. With steady or even additional growth in Franklin and Moore counties, there would be enough water in Tims Ford Reservoir to meet future water supply demands in the Elk River area while helping to meet the needs of adjacent water service area.

V. Environmental Justice

V1. *We note that the Environmental Justice Executive Order (EO 12898) was not listed on pages 16-17 under Other Review and Permit Processes. The FEIS should list it and, more importantly, consider potential E*[nvironmental] *J*[ustice] *impacts relative to the alternatives.* **EPA, 51ag**

V2. *Page 137 discusses demographics of the project area. It appears that minority and low-income percentages are similar among project counties and lower than the state average. One exception is the Bethesda Division of Williamson County for low-income groups, which is noticeable greater (12.6%) than that of the total county (5.8%). This should be considered during infrastructure construction of the alternative. However, since the overall effect of the project would be to increase water supply in these counties, this may or may not be a great E*[nvironmental] *J*[ustice] *concern.* **EPA, 51ah**

Response to Comments V1 - V2: TVA is not subject to this Executive Order; however, TVA typically addresses environmental justice issues in the EIS documents we prepare. Accordingly, the Environmental Justice Executive Order (EO 12898) has been added to Section 1.8 in the final EIS. While potential disproportionate impacts have been considered in this study, detailed analyses cannot be conducted until more information about the location of structures and any proposed pipeline routes becomes available. This would be done as a part of the subsequent environmental review of any action alternative proposed to be constructed, depending on the extent of federal agency participation in the project. However, at this time and based on the data shown in Tables 23 and 24, we do not anticipate disproportionate impacts on any segment of the population. The discussion in Section 5.14 will be changed in the FEIS to clarify this.

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Adams, F. Montgomery, Jr., Franklin County Executive
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Albright, John, Log No. 2; Comment D2.
Arnold, Angela B., Log No. 19; Comment F7.
Ayers, Floyd and Linda, Log No. 32; Comments B16, H9, H25, K24, and U5.

Balsley, Bill, Log No. 45; Comment H17.
Barrass, Andrew N., Environmental Review Coordinator, Division of Natural Heritage,
Log No. 64; Comments A26, A27, A33, G21, G23, G24, K12, L6, L7, Q3, Q8, Q9, Q10, Q13, Q14, Q15, Q16, and Q17.
Braker, Randal J., Log No. 70; Comments C5 and C11.
Burnett, Wilton, Jr., Special Projects, Department of Economic and Community Development, Log No. 63; Comments C14, E10, and U2.

Christopher, J. P., Log No. 42; Comment G15.
Clemens, P. F., Log No. 22; Comment F1.
Colley, Leslie, The Nature Conservancy of Tennessee,
Log No. 44; Comments A7, A41, D4, E25, F13, G9, H5, and S3.
Collier, John R., Jr., Chairman, Board of Public Utilities of Columbia, Tennessee,
Log No. 53; Comments A1, A43, and A44.
Collier, Marjorie, Log No. 75; Comments G13 and G20.
Collier, Marjorie S., President, Friends of Short Springs,
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Draughon, W. David, Jr., Division of Water Supply, TDEC,
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Dudley, Mark H.,
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Environmental Science Graduate Students, University of Tennessee at Chattanooga,
Log No. 33; Comments A25, F14, J2, K9, K10, K11, K15, L2, L4, L5, M1, N1, P1, Q1, Q2, Q7, Q11, Q12, R1, R2, S1, and T1.

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Harper, Herbert L., Tennessee State Historic Preservation Office,
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Hillman, Jim, Log No. 16; Comment B4.
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Jones, Larry E., Log No. 1; Comments A9 and A35.

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McGarry, Ken, Log No. 13; Comments C21 and H16.
McKinney, Abrey, Environmental Services Division, TWRA,
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Mitchener, Douglas K.,
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Nannie, Linda, Chairman Duck River Agency,
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Procter, John M., Elk/Duck River Chapter, Trout Unlimited,
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Tamberrino, Frank M., President, Maury Alliance, Log No. 47; Comments E15 and E42.
Tamberrino. Frank M., President, Maury Alliance,
Log No. 66; Comments A2, A6, and D7.
Tims Ford Council, Log No. 3; Comment H15.

Vaughn, Sharon, Log No. 79; Comments A5, A21, A34, B8, and E41.

Wallace, Terry, Marshall County Executive, Log No. 65; Comments C4, E5, and E11.
Willingham, Land and Tom, Log No. 18; Comment H11.
Willingham, , Tom, Log No. 17; Comment H7.
Wilson, Justin P., Deputy to the Governor,
Log No. 43; Comments A10, A18, A19, B9, C1, E29, F15, G22, H2, S2, and U1.
Witherow, W, Roger, Log No. 11; Comment E9.
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APPENDIX E

Results of Endangered Species and National Historic Preservation Act Consultations

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

December 20, 2000

Mr. Jon M. Loney
Manager, NEPA Administration
Environmental Policy and Planning
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37902-1499

Dear Mr. Loney:

I have reviewed the draft Environmental Impact Statement (DEIS) on Future Water Supply Needs in the Upper Duck River Basin, as requested in your September 19, 2000, letter transmitting this document. The DEIS is well written and the likely impacts of each of the alternatives studied are clearly presented.

Because the water supply need for the area would not have to be addressed until some time after the year 2015, I support the decision to present the DEIS to the public without identifying a preferred alternative. And, since no federal agency or other entity has specific plans for, or has proposed to construct, any of the possible projects described in this DEIS; and since the document includes language indicating that detailed, site-specific endangered and threatened species studies would have to be conducted if any of the alternatives were proposed to be built, and that further evaluation of possible impacts would be needed at that time, I concur with your conclusion that this water supply analysis would not have any effect on federal endangered and threatened species.

Thank you for the opportunity to comment. If you have questions, please call me at 931/528-6481, ext. 212.

Sincerely,

Lee A. Barclay, Ph.D.
Field Supervisor

TENNESSEE HISTORICAL COMMISSION
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
2941 LEBANON ROAD
NASHVILLE, TN 37243-0442
(615) 532-1550

October 19, 2000

Mr. J. Bennett Graham
Tennessee Valley Authority
Cultural Resources
NRB 2C
17 Ridgeway Road, Box 920
Norris, Tennessee 37828-0920

RE: TVA, UPPER DUCK RIVER BASIN WATER NEEDS/EIS, UNINCORPORATED, MULTI COUNTY

Dear Mr. Graham:

The Tennessee State Historic Preservation Office has reviewed the above-referenced undertaking received on Friday, October 13, 2000 for compliance by the participating federal agency or applicant for federal assistance with Section 106 of the National Historic Preservation Act. The Procedures for implementing Section 106 of the Act are codified at 36 CFR 800 (64 FR 27044, May 18, 1999).

The undertaking considered for this review is limited to the drafting of the Programmatic Environmental Impact Statement (EIS) for future project implementation. Upon selection, the chosen alternative from the EIS must undergo independent Section 106 review.

Therefore, after considering the documentation submitted, it is our opinion that there are no National Register of Historic Places listed or eligible properties affected by this undertaking. This determination is made either because of the location, scope and/or nature of the undertaking, and/or because of the size of the area of potential effect; or because no listed or eligible properties exist in the area of potential effect; or because the undertaking will not alter any characteristics of an identified eligible or listed property that qualify the property for listing in the National Register or alter such property's location, setting or use. Therefore, this office has no objections to your proceeding with the project.

If you are applying for federal funds, license or permit, you should submit this letter as evidence of compliance with Section 106 to the appropriate federal agency, which, in turn, should contact this office as required by 36 CFR 800. If you represent a federal agency, you should submit a formal determination of eligibility and effect to this office for comment. You may direct questions or comments to Jennifer M. Bartlett (615) 741-1588, ext. 17. This office appreciates your cooperation.

Sincerely,

Herbert L. Harper
Executive Director and
Deputy State Historic
Preservation Officer

HLH/jmb