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

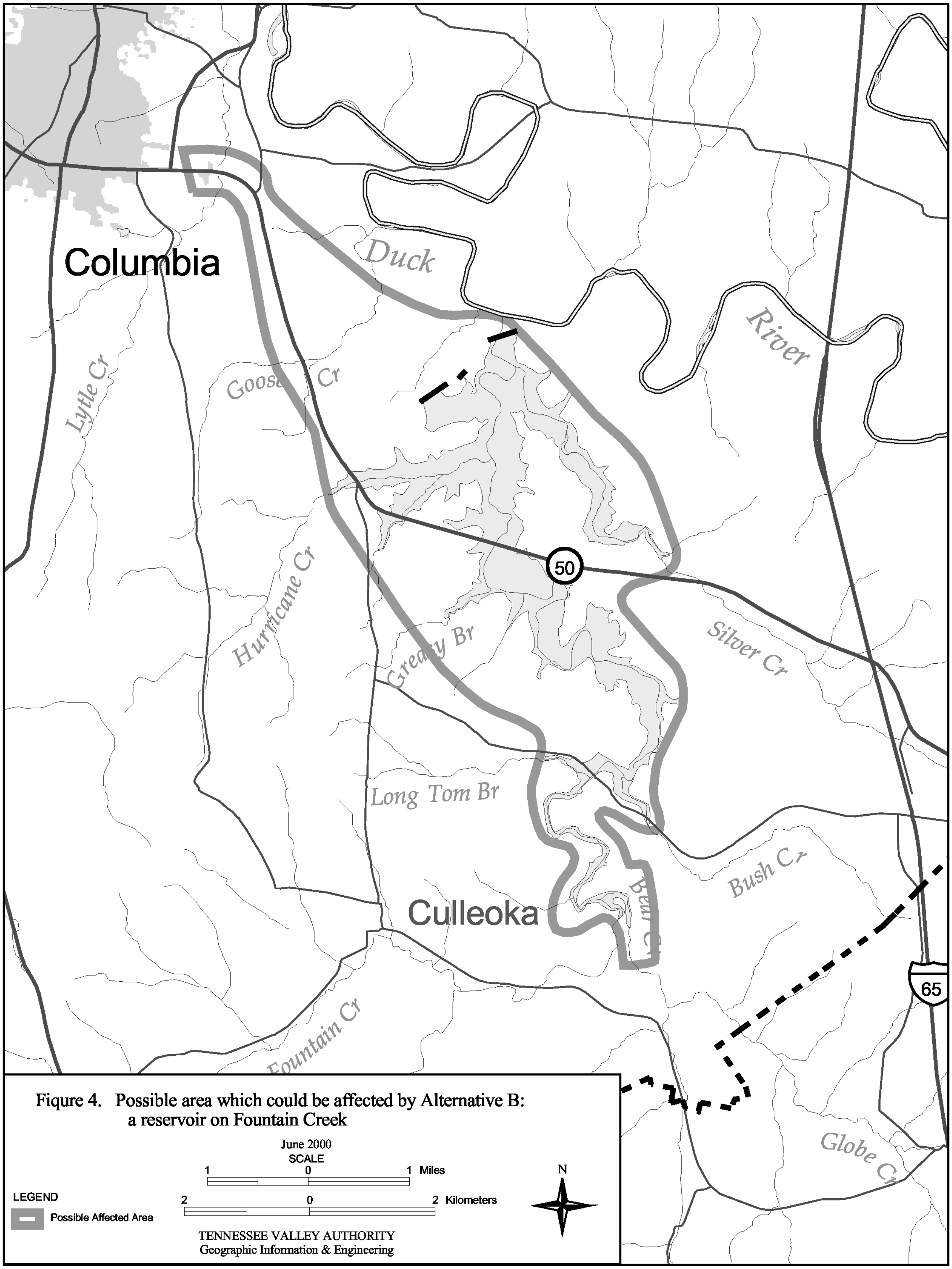

Figure 4. Possible area which could be affected by Alternative B: a reservoir on Fountain Creek

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

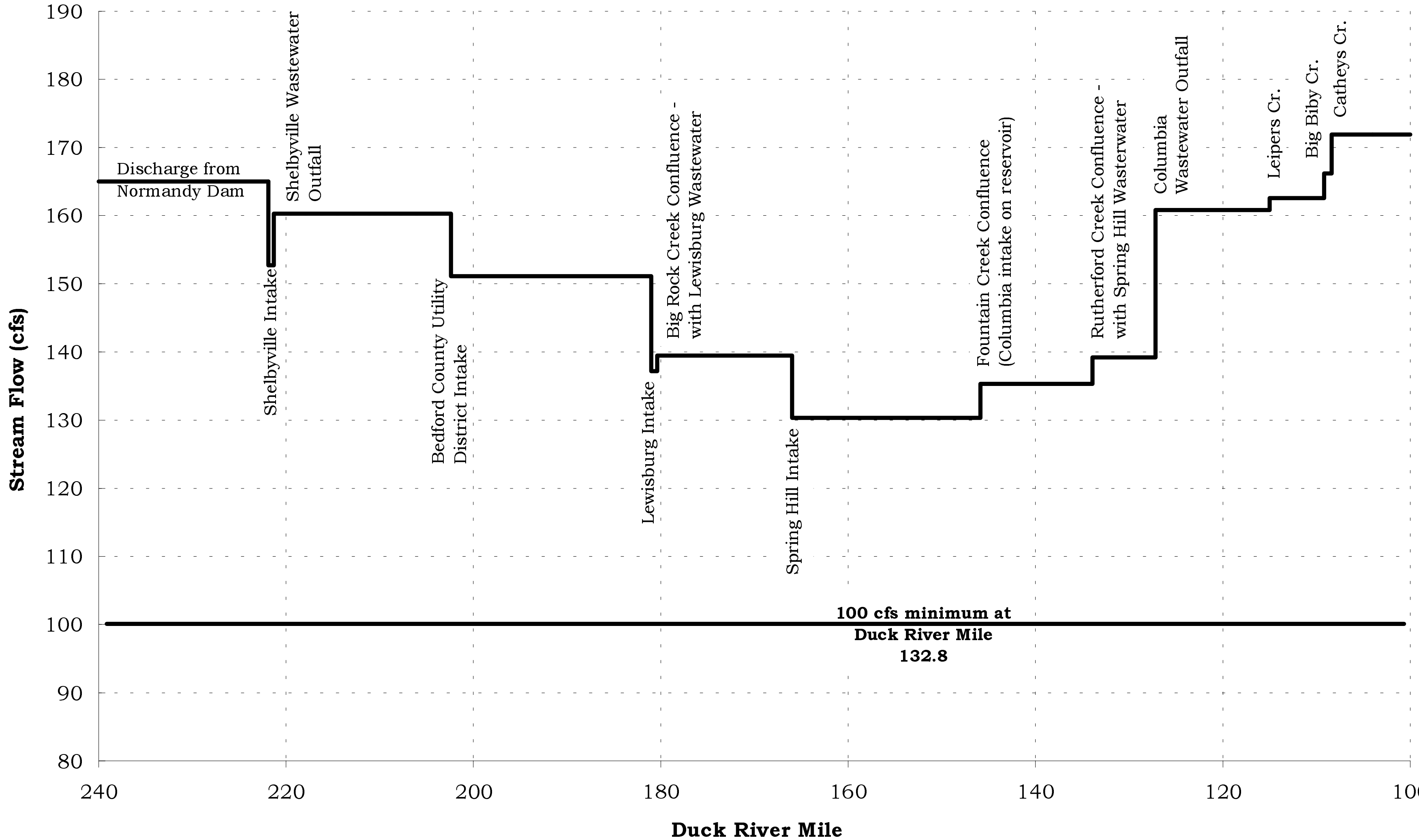

Figure 5. The potential effects of Fountain Creek Reservoir water supply source (Alternative B) on flows in the Duck River during possible drought conditions in 2050.

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

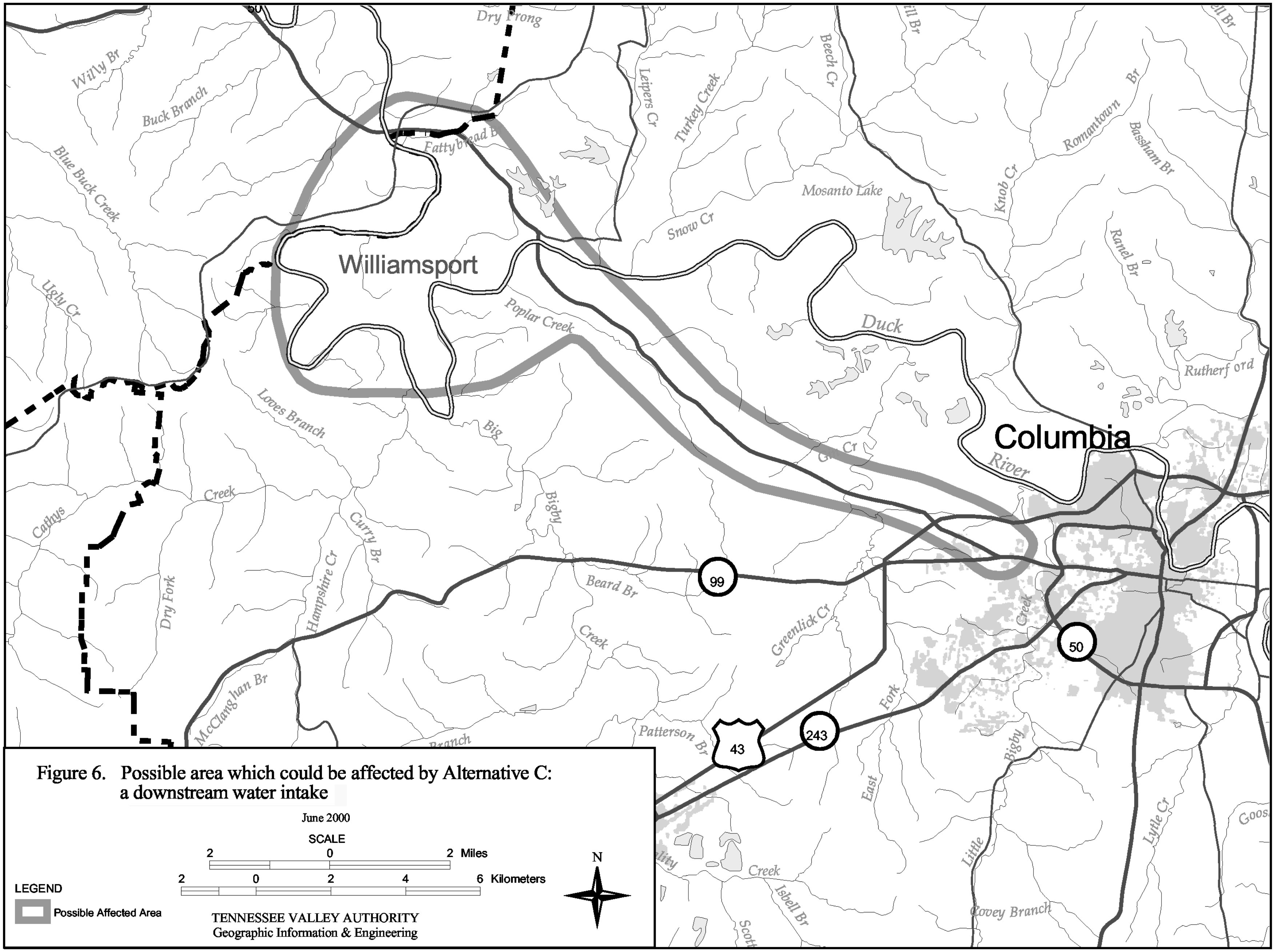

Figure 6. Possible area which could be affected by Alternative C: a downstream water intake

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

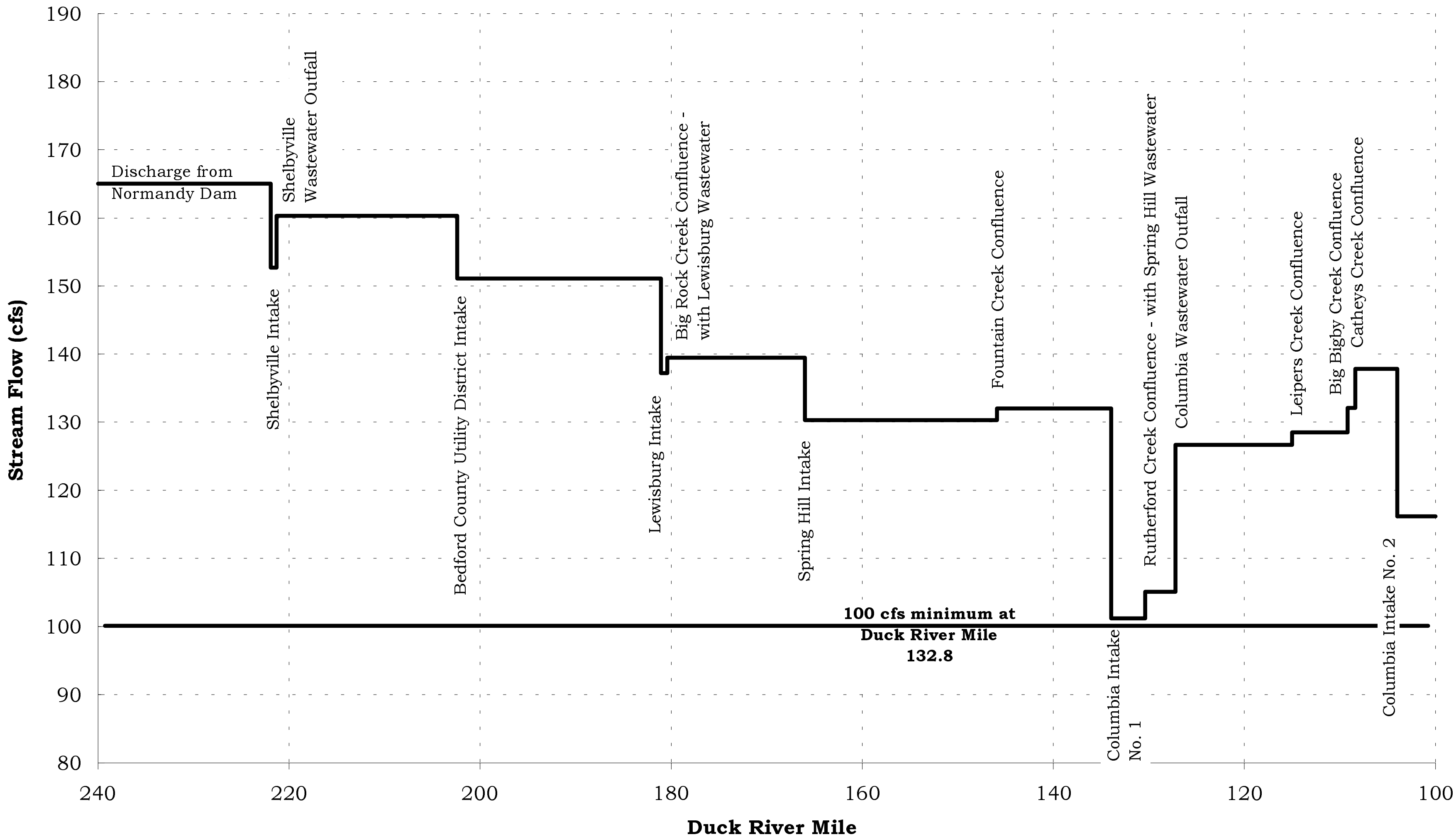

Figure 7. The potential effects of a downstream water supply source (Alternative C) on flows in the Duck River during possible drought conditions in 2050.

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

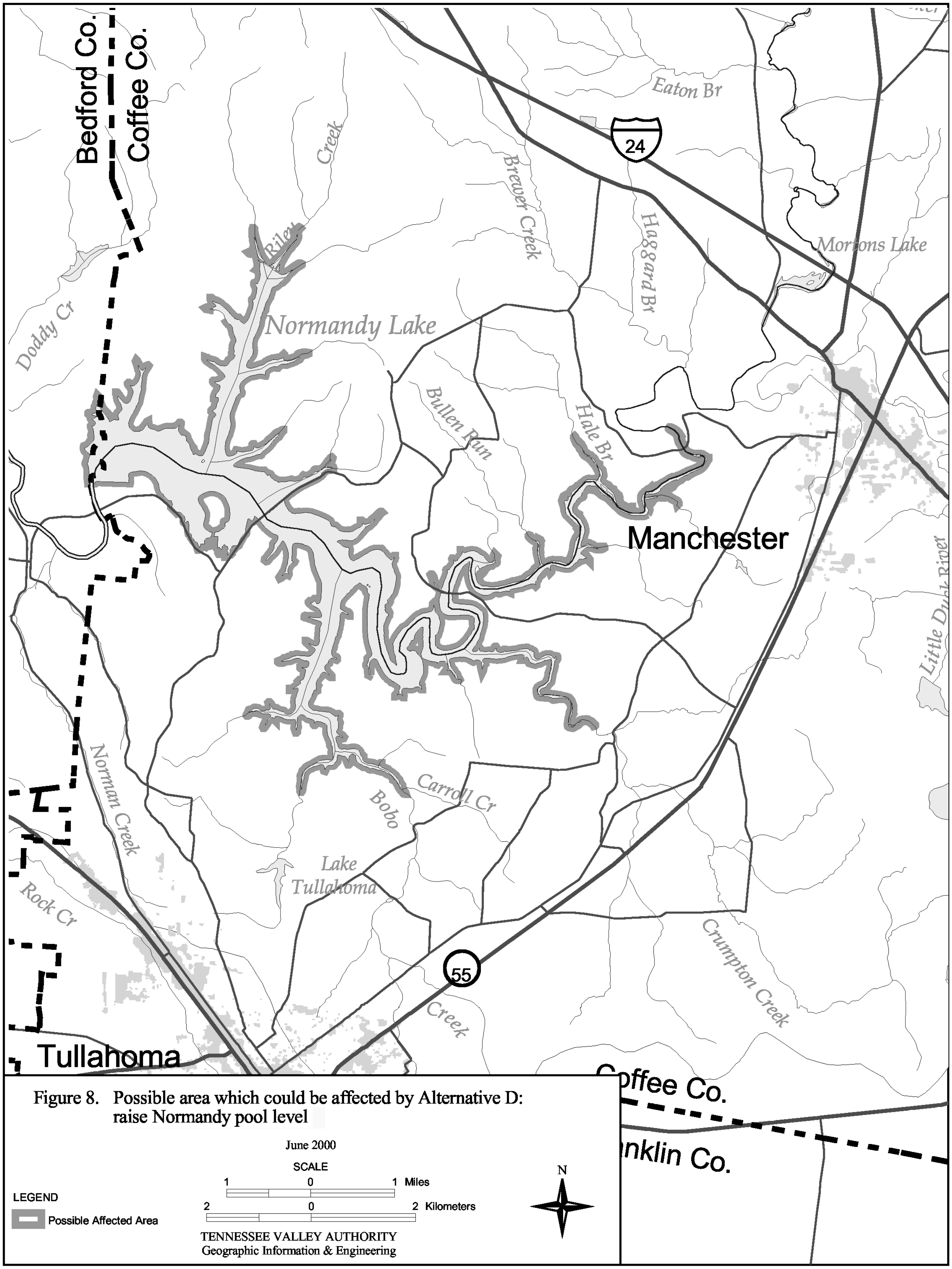

Figure 8. Possible area which could be affected by Alternative D: raise Normandy pool level

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-

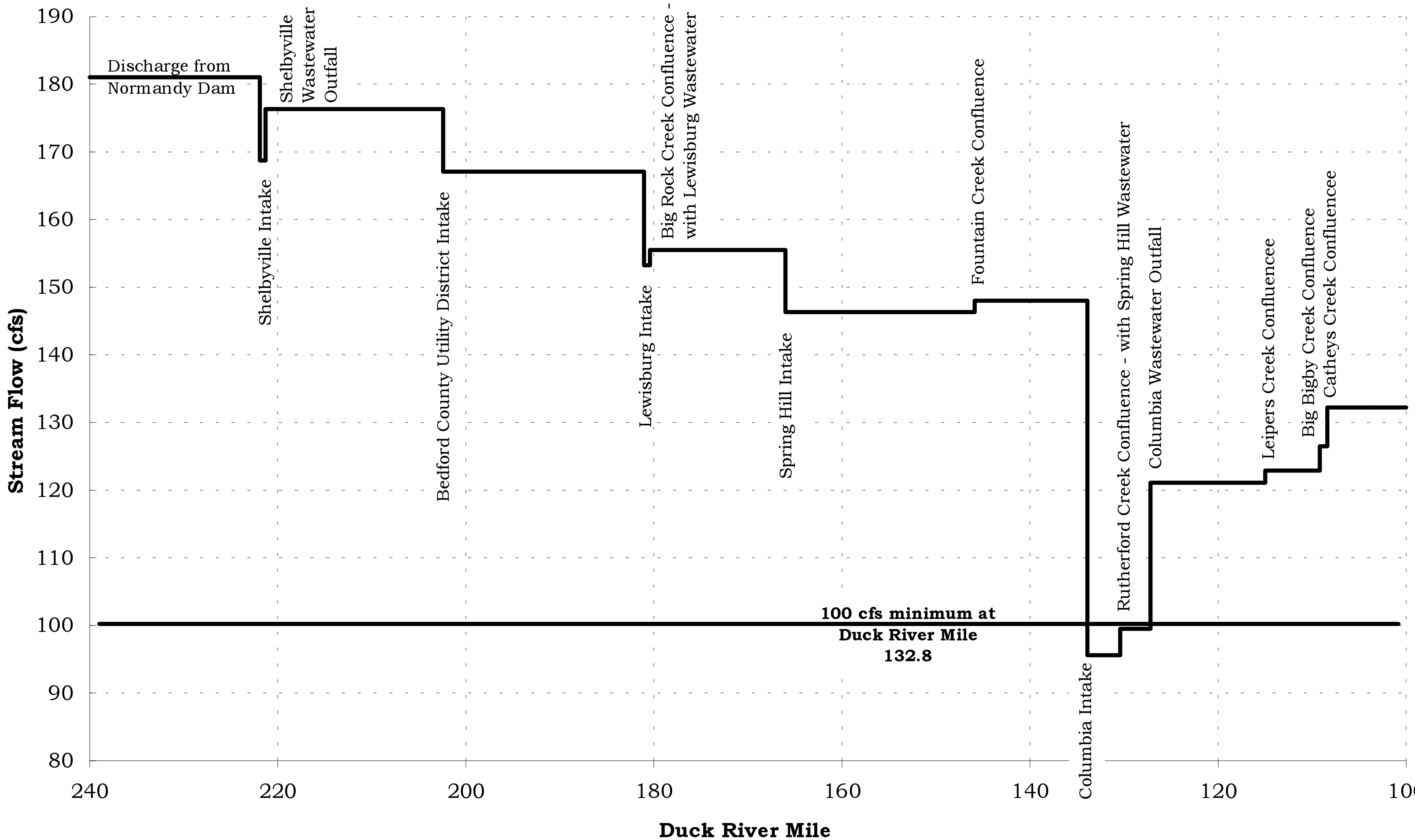

Figure 9. The potential effects of raising the Normandy pool level (Alternative D) on flows in the Duck River during possible drought conditions in 2050.

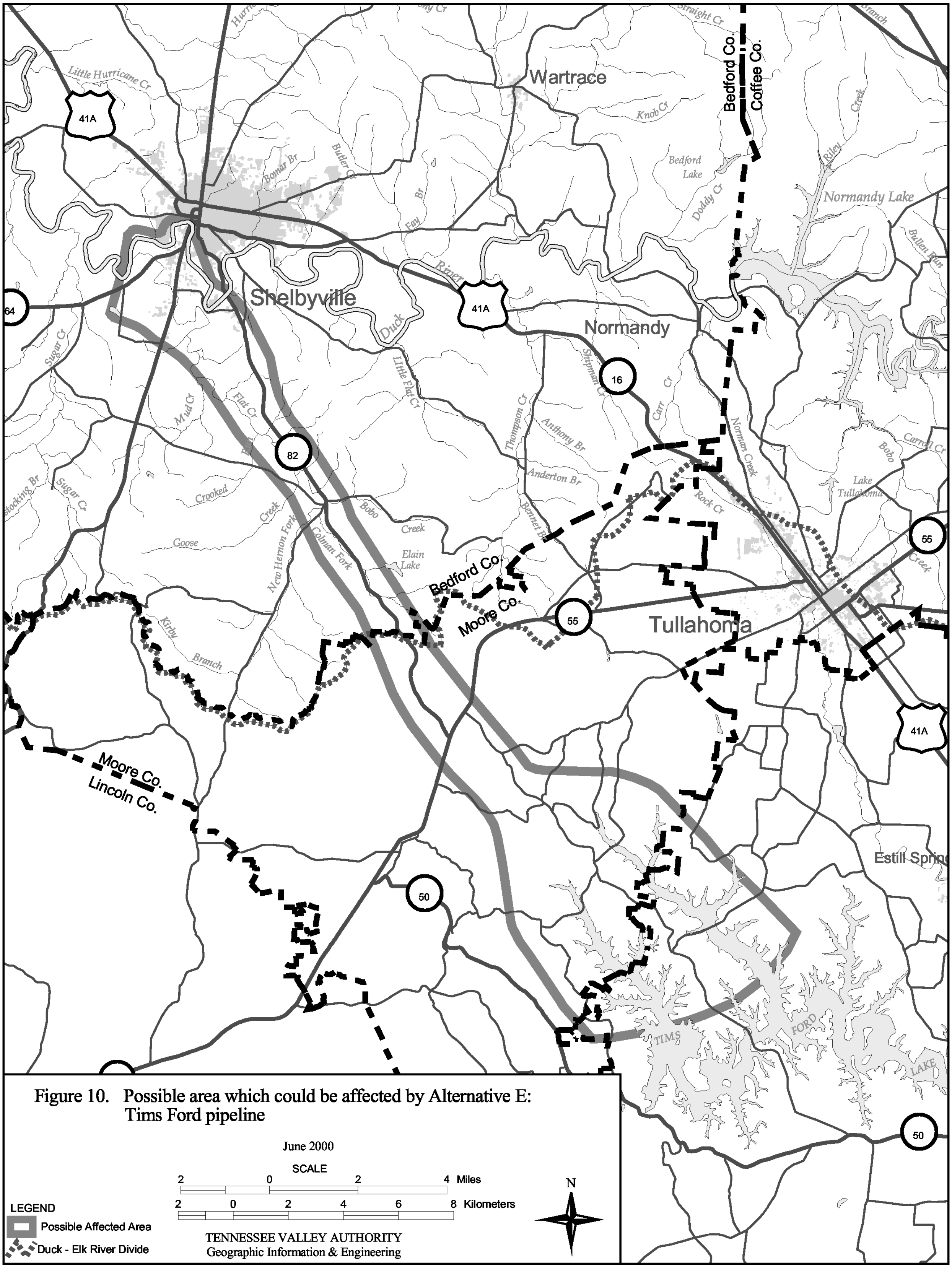

Figure 10. Possible area which could be affected by Alternative E: Tims Ford pipeline

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.

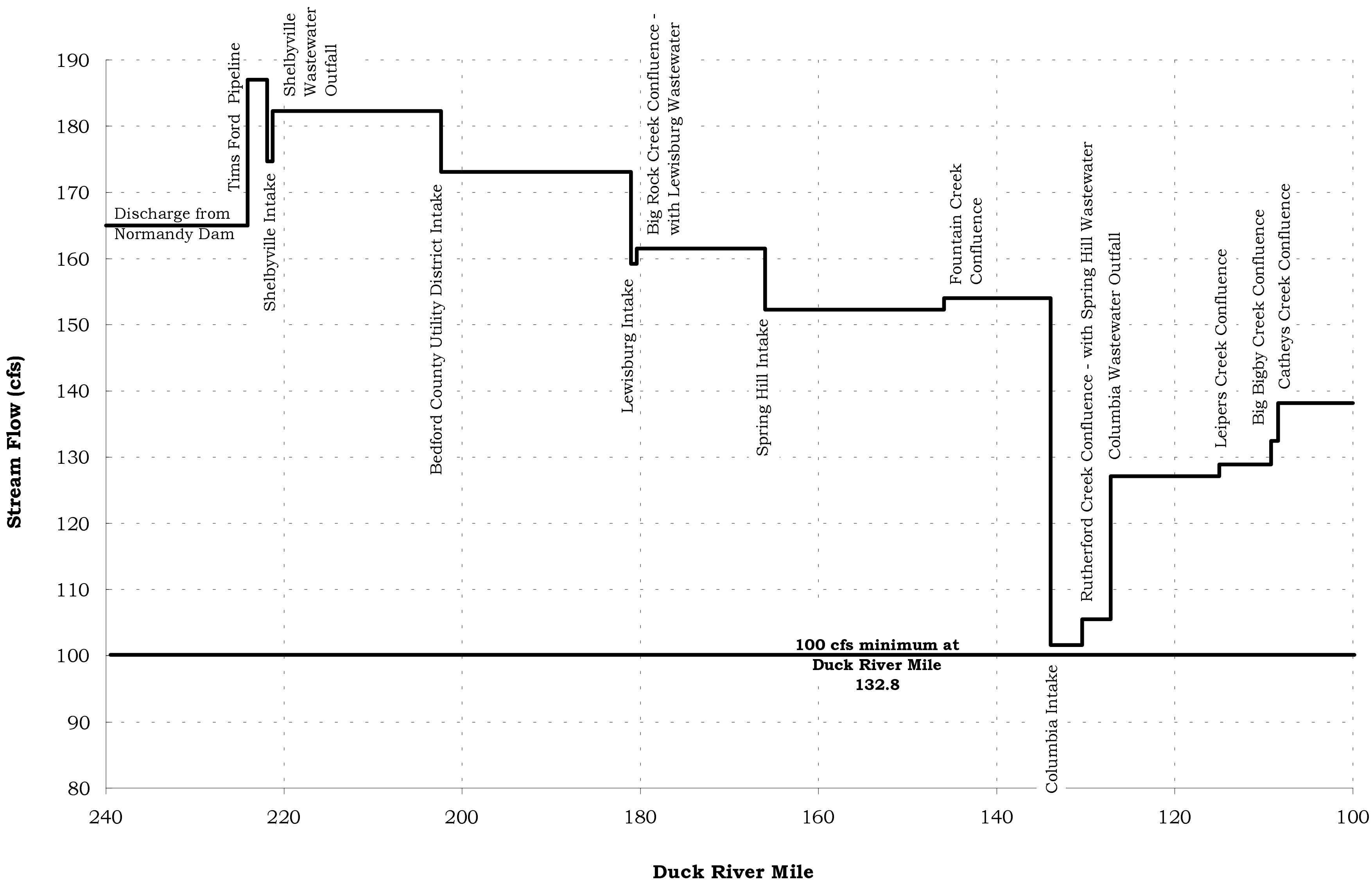

Figure 11. The potential effects of a pipeline from Tims Ford Reservoir (Alternative E) on flows in the Duck River during possible drought conditions in 2050.

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

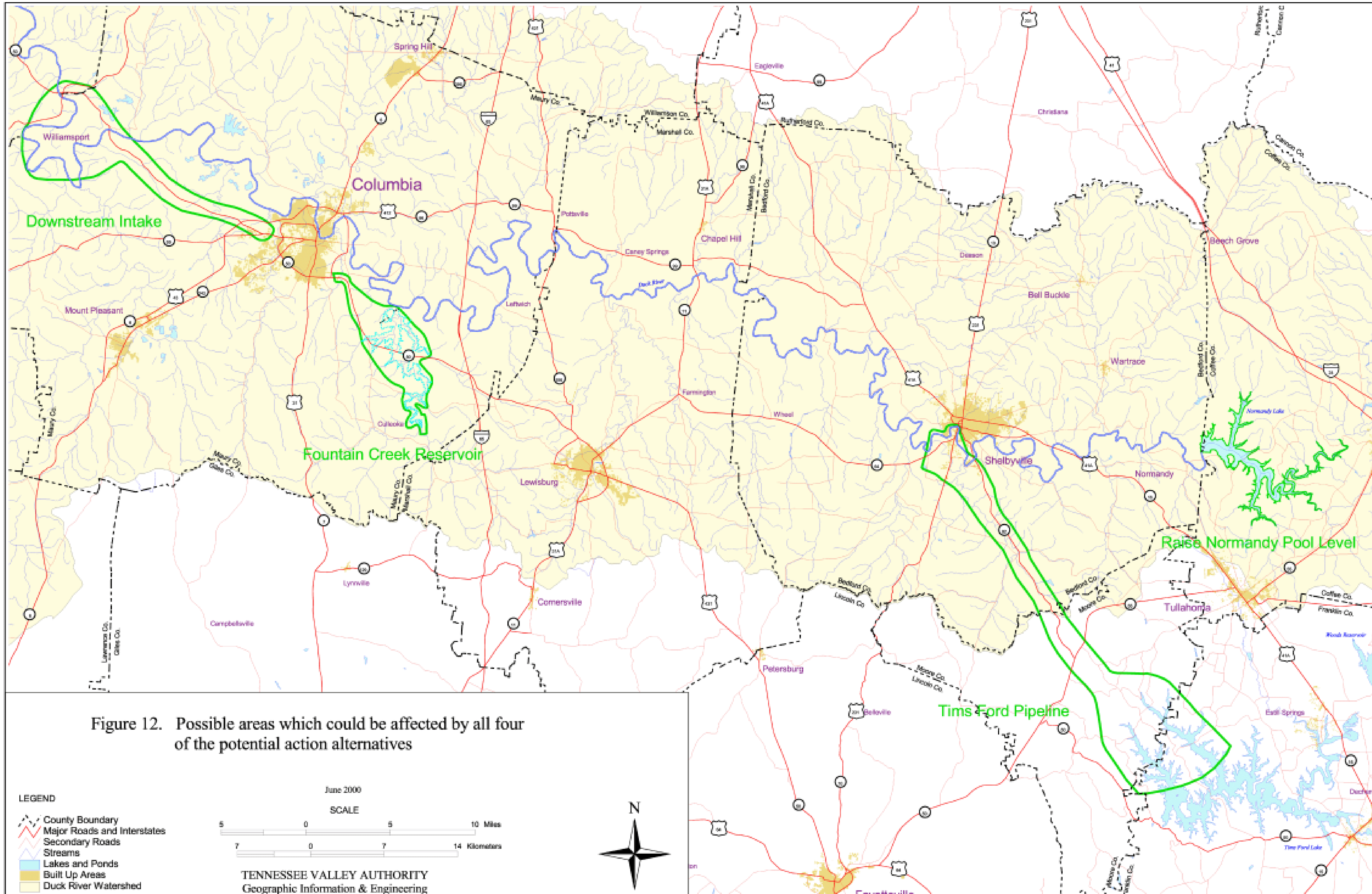

Figure 12. Possible areas which could be affected by all four of the potential action alternatives

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: 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 that 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 two purposes of this document have been met by gathering and evaluating information. These parts of the document have resulted in conclusions but do not require that any decisions be made. The third purpose has been met by conducting a programmatic review of alternative ways of meeting the future water needs in the Columbia area. None of the identified alternatives have yet been proposed to be implemented; however some time around 2015, DRDA and/or the local water systems will determine which, if any of the identified alternatives should be pursued. TVA is not proposing to design or construct any of these facilities.

Based on present knowledge, TVA concludes that Alternative C (Downstream Water Intake) is preferable. As indicated in Section 3.9, construction and operation of a downstream water intake would affect the smallest project area and would meet identified water supply needs in a timely fashion for the least construction cost. In TVA's view, Alternative C is the environmentally preferable alternative because virtually all the facilities could be adjusted to avoid or minimize potential adverse environmental effects.

The local utilities and agencies in the upper Duck River watershed and other interested parties will be the ones to actually decide which alternative way(s) should be pursued to meet their future water needs. Those local agencies and the publics they serve must decide how they want to meet their future water needs and how they will operate those systems. As a regional water resource agency, TVA can assist in evaluating available alternatives and will encourage cooperation among all communities that are dependent on common water resources.