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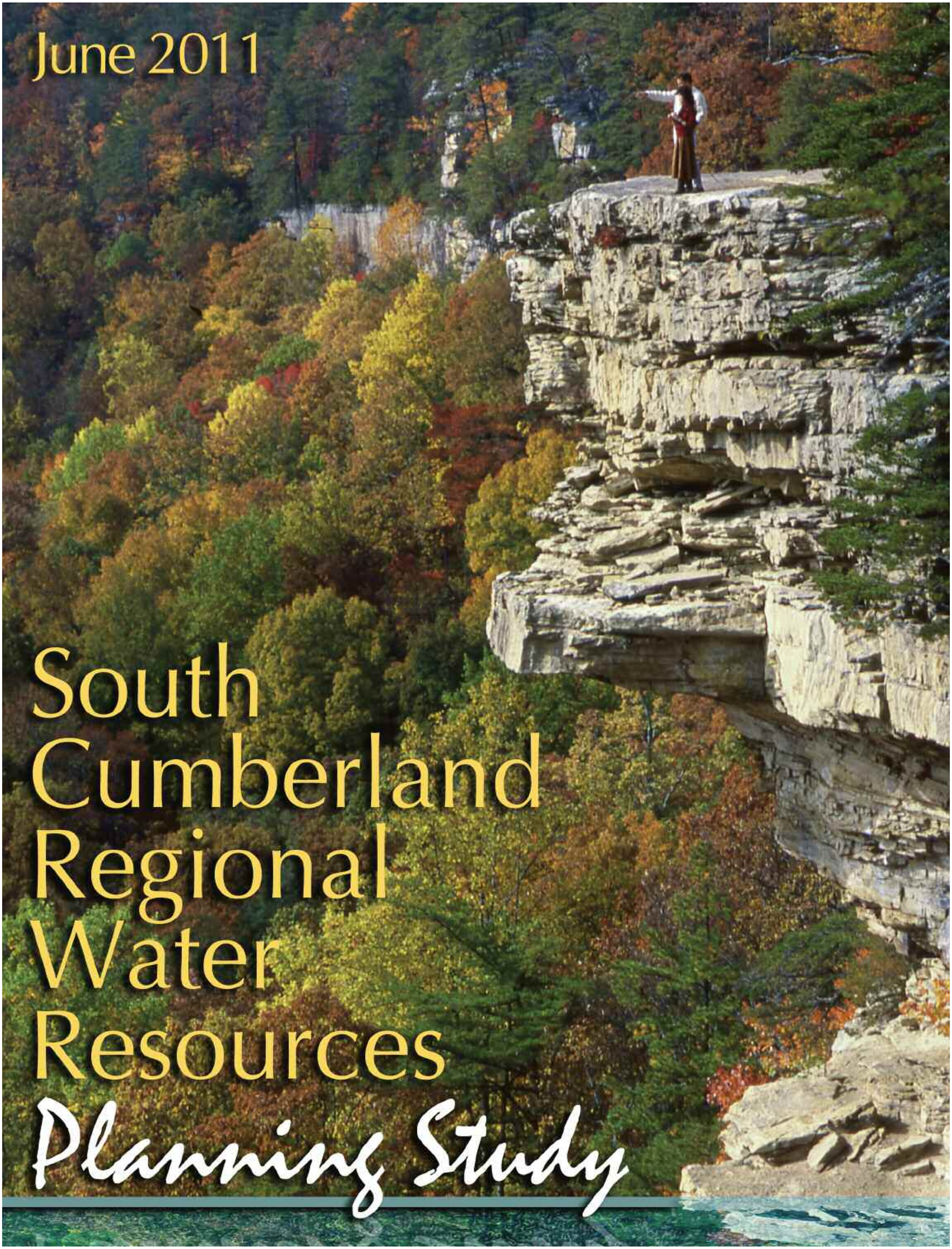

South Cumberland Regional Water Resources *Planning Study*

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Preface

The drought of 2007 and 2008 was one of the most severe on record, and a harsh reminder that while the water supply in this state is abundant, it is not unlimited. Many of Tennessee's 458 community public water systems were confronted by limits of their capacity to provide water to meet the demand. Fortunately, system failures were avoided through the work of a drought emergency task force hosted at the Tennessee Emergency Management Agency and the cooperation among public water systems made possible by their prior investments in interconnecting their systems.

Although only the small, Marion County community of Orme ran completely out of water,[1] the drought elevated the need to update the Tennessee Department of Environment and Conservation's drought management plan, as well as each of our community public water systems' emergency drought response plans, and to develop a model for long-term, regional water resource planning that could be used anywhere in the state. These needs prompted TDEC to form the technical advisory committee authorized by Tennessee's Water Resources Information Act. With the help and advice of the committee, TDEC revised its drought management plan and is now working with community public water systems as they update their drought response plans.

Two study areas were chosen as pilots to support development of a regional water resource planning model: the southern end of the Cumberland Plateau and the northern part of Middle Tennessee. What follows is the first of these two pilots, the South Cumberland Regional Water Resource Planning Study. Water utilities in the South Cumberland study area were hit especially hard by the 2007-2008 drought, but they were able to manage by improving existing interconnections in order to share water sources better. Given the difficulties they encountered during the recent drought, it is not clear that residents of the South Cumberland could weather droughts as severe as the ones that occurred in the first half of the 20th century without additional or improved water supply sources.

The objective of the study was to identify the most cost-effective, sustainable way to meet the water supply needs of the study area through 2030. It is an attempt to align sustainable water sources to current and future uses of water within the region over the next 20 years. Doing that required nearly two years of work to develop the data and information necessary to make a sound and defensible recommendation. The study did not address extending service to areas without public water, nor did it include analysis of wastewater handling capacities or needs.

These pilot studies have made clear the complexity of regional water issues; the need for broad collaboration among local, state, and federal partners; and the need to include with regional water plans the tools needed to make adjustments as circumstances change. Although each of these pilots presented its own, distinct challenges, the same process was successfully applied by the study team. As we look to make water resource planning available to other regions across the state, it will be essential to recognize each region's unique set of issues, but the general principles and technical approaches used in these pilots are suited to the challenges of other regions across the state as well.

[1] The sources could not produce enough water to pressurize the city's water system.

Executive Summary

The Study Area

Situated high on the Cumberland Plateau, the South Cumberland study area comprises most of Grundy County and small sections of Franklin, Marion, and Sequatchie counties. Its geography, ecology, population, land use and development patterns, and utilities are all important factors in assessing current and potential water sources to determine how best to project and meet the area's water supply needs.

The Cumberland Plateau is the highest land area in Tennessee west of the mountains along the North Carolina border. Consequently, it is home to small headwater streams that begin their journey atop the plateau before descending its steep slopes to form larger streams. The study area includes portions of the watersheds of several of these small streams, some of which are already impounded to serve as water sources. Because both the streams and their watersheds are small, meeting water supply needs in the area is challenging.

In fact, it is widely thought that water supply is the most significant limiting factor for growth and development. Grundy County, which includes the bulk of the study area, grew by only 4% from 1980 to 2000, while the state as a whole grew by 24% (from 4.6 million to 5.7 million). Based on estimates from the U.S. Census Bureau, the county's population actually declined through 2010 as the state's population grew to 6.3 million. With so little growth in the area, it is no surprise that there is little planning for growth. There is no long-range planning in Grundy County and only one planning commission (the town of Monteagle's). Yet without a comprehensive plan for growth, it is impossible to coordinate development and ensure that there is sufficient water to serve it.

Grundy County Population 1980 through 2010

	Number of Residents
1980	13,787
1990	13,362
2000	14,332
2010	13,703

Currently, water for domestic and industrial use is produced by four major water systems: Big Creek Utility District, Monteagle Public Works Department, Sewanee Utility District, and Tracy City Water Department. Smaller utilities in the area purchase water from one of these systems. Partly because these utilities serve sparsely populated areas, their water rates are high compared with utilities in most other parts of the state. But because the area's economic activity is relatively limited, its customers' incomes—particularly those in Grundy County—are much lower than in much of the rest of the state. In fact, incomes in Grundy County are generally much lower than in surrounding counties, which elevates concern about the cost of supplying more water to the area. Any new source must be carefully evaluated to ensure that water customers in the area can afford it. With water rates already high, the area's immediate need to reduce the risk posed by drought requires a delicate balance between serving projected needs and potential growth and keeping the financial burden on current residents as low as possible.

Median Household Income (2009)

Tennessee	$41,715
Franklin	$40,432
Grundy	$27,373
Marion	$37,067
Sequatchie	$37,810

In addition, there are environmental concerns that must be considered. Wastewater disposal is generally through septic tanks and field lines; however, many soil types on the plateau are shallow to bedrock and thus not well suited for traditional on-site wastewater-disposal systems. These factors have resulted in fears about water quality in the lower valleys. Loss of forestland, climate changes, construction activity, and increased developmental pressures can affect the plateau environment, its biodiversity, and the natural watersheds. Planning commissions could address these and similar issues through adoption of land use policies.

Meeting the Area's Water Needs

Estimated Reliable Yield of the Study Area's Water Supply Sources	
Utility	Reliable Yield (gallons per day)
Big Creek Utility District	850,000
Monteagle Public Works Department	170,000
Sewanee Utility District	330,000
Tracy City Public Utilities	400,000
Total	1,750,000

All of the public water systems in the study area rely on reservoirs that are barely adequate to support current raw water withdrawals. The amount of water that can be drawn from some of the water supply reservoirs is limited by contract or the depth of the water intakes so that the reliable yield of all sources combined is only 1.75 million gallons per day. This yield falls 350,000 gallons per day short of the current average daily water use of 2.1 million gallons. Analysis indicates that another 106,000 gallons per day will be needed to provide for projected growth in the study area. Consequently, avoiding unacceptable shortages during severe drought or other water supply emergency will require access to more water.

Seldom used emergency sources could meet some of the area's need if contractual use limits were re-negotiated. Using these sources in combination with existing sources would increase the aggregate yield for the region and could postpone the need to develop new water supply sources as could increased conservation and demand management. Although water rates in the study area are relatively high, the utilities are reasonably efficient when it comes to managing their drinking water treatment and distribution systems and have unaccounted for water losses well within state guidelines.[2]

2009 Unaccounted for Water Losses	
Utility	Percent of Finished Water
Big Creek Utility District	24.18%
Monteagle Public Works Department	11.86%
Sewanee Utility District	16.84%
Tracy City Public Utilities	8.99%

[2] In accordance with Tennessee Code Annotated §§ 7-82-702 and 68-221-1009(a), the Utility Management Review Board and the Water and Wastewater Financing Board have set an excessive water loss percentage at 35%. That means that any water system reporting a water loss of 35% or higher (using the current method) in its annual financial statements will be referred to the appropriate board for further action. This determination was made at the joint meeting of the Boards held on October 7, 2010. See http://www.comptroller1.state.tn.us/UMRB/ and http://www.comptroller1.state.tn.us/WWFB/ accessed online 28 March 2011.

Four structural alternatives to supply additional water to the study area were evaluated by the study team:

- raising the existing Big Fiery Gizzard Dam, owned and managed by Tracy City,
- construction of a new dam and reservoir on Big Creek,
- purchase and conversion of Ramsey Lake from private use to water supply, and
- construction of a treated water pipeline from the Tennessee River at South Pittsburg to the plateau.

These alternatives plus regionalization—improving interconnections and operating all of the utilities as one large system—were evaluated against the criteria of sufficiency, cost, implementability, flexibility, raw and finished water quality, environmental benefits and impacts, and other relevant factors. Sufficiency is a threshold criterion. If an alternative does not have sufficient reliable yield to meet projected needs, then it should not be considered further. Regionalization alone could not meet this test. Neither could raising Big Fiery Gizzard Dam without reducing the minimum amount of water currently required to be released through it to maintain adequate downstream flow. Although neither of those alternatives was evaluated further, regionalization should be considered as part of any water supply improvement project because it can be accomplished more quickly and cheaply than structural alternatives, and the improved interconnections involved will help the area weather droughts and deal with whatever other water supply emergencies may occur in the future.

> Reliable yield is not all of the water that could be withdrawn from a lake. It is the amount that should be used in planning to minimize the risk of running out.

The remaining alternatives were evaluated further through a two-tiered process. Tier One, in addition to sufficiency, considered general estimates of cost; implementability, considering the need for permits, public acceptance, property acquisition, and ease of construction; and flexibility, which is a matter of whether the project can be completed in phases with the costs spread over time to make it more affordable while still meeting the region's water supply needs, as well as its drought resistance. Tier Two scrutinized costs more closely and considered the remaining criteria of water quality, potential environmental benefits or impacts, and other relevant factors, which in this case included the uncertainty of the Ramsey Lake purchase and the energy expense of operating the proposed pipeline to South Pittsburg.

Based on these criteria, raising the Big Fiery Gizzard Dam with modification of the release requirement along with a regional system of drought planning and management is the preferred alternative. This option was chosen primarily because its cost is estimated to be roughly one third or less of the other alternatives and it could be implemented most quickly. As noted earlier, meeting needs beyond the 2030 planning horizon or unanticipated growth could require consideration of one or more of the other alternatives or some other option that might arise in the future. This evaluation process should be repeated as conditions change.

Next Steps

Although Monteagle and Tracy City are the main utilities with pressing needs, all of the water utilities in the study area would benefit from improved interconnections and conservation and demand management, all of which is described further in this report. These measures and a coordinated system of drought management will require community outreach and education, as will the rate increases that will likely be necessary to fund the improvements required to implement the preferred alternative.

Work has already begun to determine whether the current release requirement at Big Fiery Gizzard Dam can be modified and still provide sufficient stream flow below the dam to meet environmental requirements. An initial draft of a report developed by the U.S. Army Corps of Engineers on the release requirement is currently being reviewed by staff of the Corps, the Tennessee Department of Environment and Conservation, and the Tennessee Wildlife Resources Agency. If the outcome of the study suggests that a lesser discharge is acceptable, then Tracy City will need to apply for a modified permit.

Additional engineering work will be necessary to determine when, where, and how to upgrade interconnections to increase the region's ability to share water sources, manage drought, and meet future needs. And the dam will need to be fully engineered. The cost of completing this work should be shared by all of the utilities that benefit from it, and that may require rate studies to determine how each utility will pay for that work. Because multiple utilities will be involved, it may also require a joint project management structure. The legal framework for an inter-local agreement to fund and manage the project is already provided by Tennessee state law.

Grant funds may be available to help pay for the project, but another source of funds might be to establish a regional joint financing agreement similar to that employed by the south central Tennessee utilities that are members of the Duck River Agency. That agency has been collecting five cents per 1,000 gallons of water sold for many years and has built up a reserve for infrastructure improvements. Again, because of its small streams and watersheds, maintaining sufficient water supply resources to support stronger economic growth will require cooperation among all of the communities, utilities, and governmental entities in the region. Such a future will require comprehensive and coordinated planning to make the best use of the region's resources.

Chapter 1. Description of the Study Area

1.1 Introduction

Situated high on the Cumberland Plateau, the South Cumberland study area comprises most of Grundy County and small sections of Franklin, Marion, and Sequatchie counties. Water for domestic and industrial use is produced by the area's four major water systems: Big Creek Utility District, Monteagle Public Works Department, Sewanee Utility District, and Tracy City Public Utilities. Several smaller utilities in the study area have no water supply source of their own and provide water to their customers by purchasing finished water from one of the four larger systems. To that extent, the water systems are part of a regional system that is interconnected and shares water sources, though each of the smaller utilities purchases from only one of the larger ones.

The study area's location presents several challenges. All of its water supply sources are impoundments on small headwater streams, which limits the area's potential for growth and its ability to weather severe drought. Several large forested tracts of land have been divided into large residential lots. Extending water to these lots, because they are widely spread, could be expensive in this area of already high water rates. Additionally, growth in this area will increase the wastewater load, which could adversely affect the quality of its small streams whether handled on-site or through centralized systems. These distribution and waste-handling issues are beyond the scope of this report, but should be taken up by area planners.

The purpose of this study is to identify and evaluate alternative methods for meeting raw water withdrawals so that all of the water utilities in the study area may have continued access to sufficient, clean water through 2030. Properly assessing the suitability of potential water supply sources requires a sound understanding of the area's geography, ecology, population, land use and development patterns, and water utilities. This chapter lays that groundwork for the South Cumberland study area.

1.2 The Geography of the Region

Bounded on the west by the Highland Rim and overlooking the Great Valley of East Tennessee to the east, the Cumberland Plateau is part of the Appalachian Plateau that forms the western edge of the Appalachian Highlands, which extend from northern Georgia and Alabama, through Tennessee, all the way through Maine, and into Canada. Slopes in Grundy County, where the bulk of the study area lies, are generally moderate with most of the area ranging in elevation from 1,700 to 1,800 feet, but the plateau's escarpments along the western and northern edges of Grundy County, roughly 800 feet high, are extremely steep and rugged. Elevations generally increase toward the southeast where the county's eastern and southeastern borders with Sequatchie and Marion counties rise to over 2,000 feet. The Tennessee Valley Divide, which separates the drainages of the Cumberland and Tennessee Rivers, runs northward out of Marion County over Ross Mountain (elevation 2,350 feet), southeast of Gruetli-Laager, and in a generally northwesterly direction into Coffee County. About a third of the county is in the Tennessee River drainage area with the remainder drained by tributaries of the Cumberland River.[3] The bounds of the study area are shown in Figure 1-1 below.

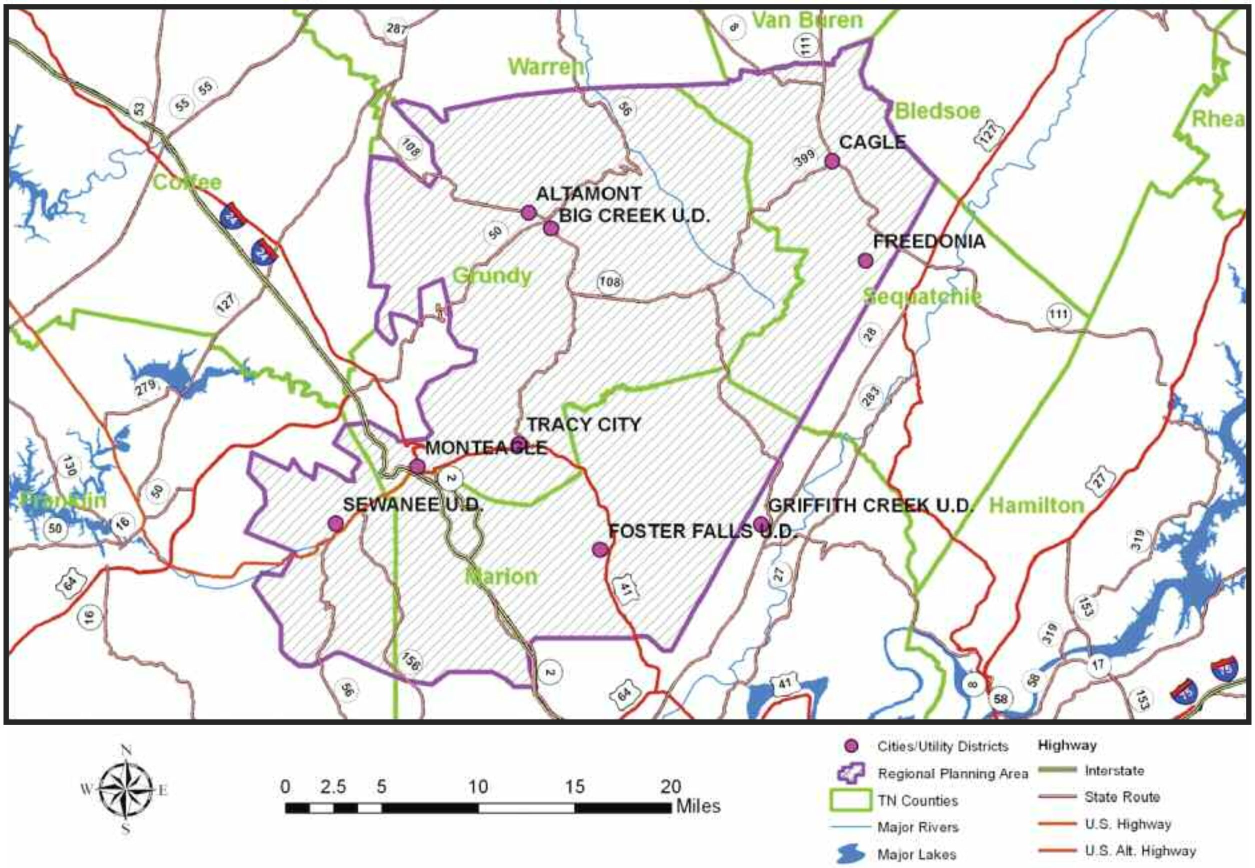

Figure 1-1. The South Cumberland Study Area and Its Utilities

Average annual rainfall varies from 50 to 55 inches, about five inches more than is typical across Tennessee to the west of the plateau.[4] Although rainfall over the area is relatively high, the topography of the plateau contributes to its water supply problems. The study area is dissected by several small watersheds at the source end of their streams. The streams atop the plateau are "first order" streams with no other streams feeding into them, tributaries of the rivers for which the watersheds are named. The impoundments on them are likewise small because of their small drainage areas. Their dams must be managed to ensure sufficient releases of water to maintain adequate flows in the streams below them.

Streams in the Upper Elk River watershed flow to the west and southwest. Headwaters of the Collins River flow to the northwest, while tributaries to the Sequatchie River flow to the southeast. Another watershed drains south to the Tennessee River at Guntersville Reservoir. (See Figure 1-2.)

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[3] Tennessee Division of Geology, Department of Environment and Conservation. (2009) Bulletin 86: Tennessee Topography.

[4] Office of the State Climatologist at the University of Tennessee, Climate of Tennessee, accessed online at http://climate.tennessee.edu/Climate%20of%20TN.pdf, 8 March 2011.

Southern Plateau Regional Planning Study

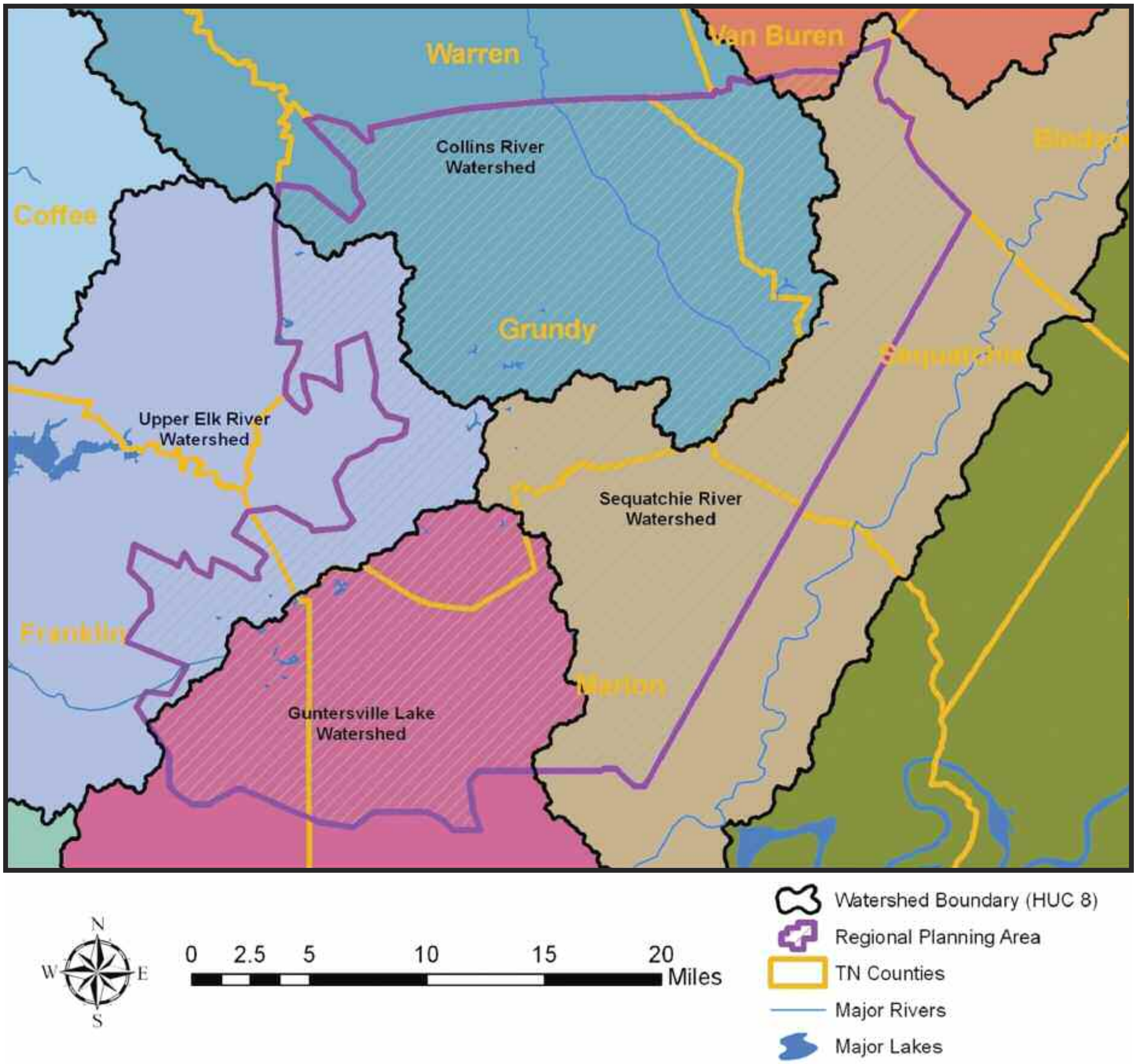

Figure 1-2. Watersheds of the South Cumberland Study Area

1.3 The Ecology of the Region

Because of its geology, climate, elevation, and soils, the Southern Cumberland Plateau is one of the most intact and biologically diverse natural landscapes remaining in the eastern United States with many diverse plant, animal, and natural communities. With a wide range of geology, forests, and stream habitats, it is home to a number of rare or endangered mammals, birds, mollusks, reptiles, fish, crustaceans, amphibians, insects, and flowering and non-flowering plants.[5] The area also contains the highest concentration of caves and the largest number of cave invertebrate species in the world.[6]

The Southern Cumberland's abundant natural resources are managed and protected through the efforts of private landowners and managers, non-profit organizations, and local, state, and federal government agencies. Some of the finest Tennessee state parks and natural areas are found here. In the heart of the area is the South Cumberland State Recreation Area, which includes Savage Gulf Natural Area, Fiery Gizzard Natural Area, Foster Falls, and Grundy Lakes. These state lands contain outstanding natural features and provide abundant recreational opportunities.

The watersheds that begin in the Southern Cumberlands, in general, are characterized by streams with good water quality, valuable recreational uses, important ecological values, and outstanding scenery. These characteristics led to the designation of several streams as Exceptional Tennessee Waters, which must be considered when assessing new water supply sources.

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[5] Tennessee Department of Environment and Conservation, Division of Natural Areas, Tennessee Rare Animals List, accessed online at http://tn.gov/environment/na/pdf/animal_list.pdf, 27 April 2011. See also Tennessee Department of Environment and Conservation, Division of Natural Areas, Tennessee Rare Plant List, accessed online at http://tn.gov/environment/na/pdf/plant_list.pdf, 27 April 2011.

[6] Tennessee Wildlife Resources Agency, Tennessee's Comprehensive Wildlife Conservation Strategy, accessed online at http://www.wildlifeactionplan.org/pdfs/action_plans/tn_action_plan.pdf, 27 April 2011.

1.4 The Population of the Region

The broader region within which the South Cumberland study area lies has experienced little population growth in recent years. As shown in Table 1-1, Grundy County, which comprises the bulk of the study area, increased by only 4% (545 people) from 1980 to 2000 and is estimated to have decreased by 629 individuals through 2010. The populations of the three remaining counties, which also contain small parts of the study area, have grown more rapidly, but little of that growth has occurred in the study area.

**Table 1-1. Population of Cities and Counties in the Study Area
Select Years 1980 through 2010**

	Year				Growth Rate
	1980	1990	2000	2010	1980-2010
Tennessee	4,591,120	4,877,203	5,689,276	6,346,105	38.2%
Grundy County	13,787	13,362	14,332	13,703	-0.6%
As a Percent of the State Total	0.30%	0.27%	0.25%	0.22%	
Altamont	679	742	1,136	1,045	53.9%
Beersheba Springs	643	591	553	477	-25.8%
Coalmont	625	813	948	841	34.6%
Gruetli-Laager	*	1,810	1,867	1,813	n/a
Monteagle (part)	667	750	804	715	7.2%
Palmer	1,027	769	726	672	-34.6%
Tracy City	1,444	1,595	1,679	1,481	2.6%
Unincorporated	8,702	6,292	6,619	6,659	-23.5%
Franklin County**	31,983	34,923	39,270	41,052	28.4%
As a Percent of the State Total	0.70%	0.72%	0.69%	0.65%	
Monteagle (part)	n/a	n/a	6	48	n/a
Sewanee***	2,298	2,016	2,361	2,311	0.6%
Unincorporated	19,526	20,334	23,827	24,190	23.9%
Marion County**	24,416	24,683	27,776	28,237	15.6%
As a Percent of the State Total	0.53%	0.51%	0.49%	0.44%	
Monteagle (part)	446	442	428	429	-3.8%
Unincorporated	15,532	13,246	15,414	15,913	2.5%
Sequatchie County**	8,605	8,863	11,370	14,112	64.0%
As a Percent of the State Total	0.19%	0.18%	0.20%	0.22%	
Unincorporated	4,924	5,117	7,197	8,091	64.3%
Total for Cities in Multiple Counties					
Monteagle	1,113	1,192	1,238	1,192	7.1%

Source: U.S. Bureau of the Census.
* Gruetli-Laager was not an incorporated municipality when the 1980 Census was taken.

** Most of the populations of Franklin, Marion, and Sequatchie counties lie outside the study area.

*** Sewanee is not an incorporated municipality; however, the Census shows a population for it as a part of the Census County Division.

1.5 The Land Use and Development Patterns of the Region

As shown in Figure 1-3, the study area is largely timberlands interspersed with other land uses. Public and semi-public lands, which consist of mostly undeveloped state park land holdings, comprise around 6% of the area, and residential uses make up only 5% of the area. When coupled with the agricultural and vacant lands, the undeveloped area covers more than 85% of the area. Only 8% of the total area can be classified as developed.

The town of Monteagle has the most non-residential development. It also has experienced a recent increase in the number of residential developments, including summer homes, which can have a dramatic, seasonal effect on the demand for water. The population and the demand for services, including police and fire protection,

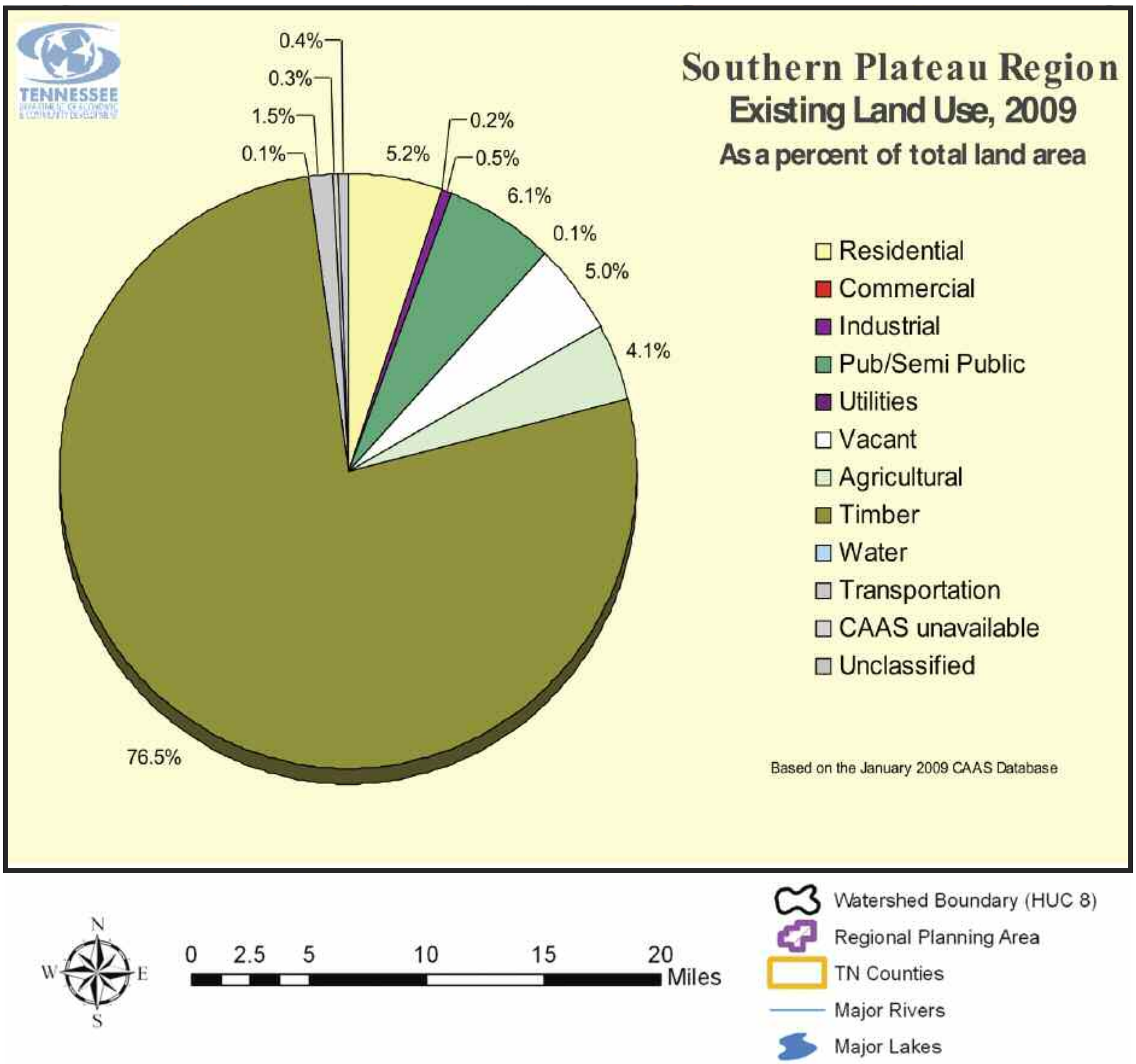

Figure 1-3. Existing Land Uses in the South Cumberland Study Area

Source: Tennessee Department of Economic and Community Development, Office of Local Planning Assistance, 2009.

street maintenance, health services, and water supply, will increase as these new developments are built out. If the homes there are mainly second homes, which are typically occupied in late spring, summer, and early fall when rainfall is least plentiful and raw water withdrawals are at their peak, they will further stress the water supply and complicate treatment plant management. Demand for water will fluctuate more over the course of the year with peaks that are much higher than amounts needed during the off season. Water treatment plants will have to have sufficient capacity to meet peak raw water withdrawals, and a larger portion than normal of that capacity will go unused for a substantial portion of the year.

The town of Gruetli-Laager is the largest municipality. It is predominantly residential, but development is scattered along State Route 108. Tracy City is also largely residential but has a small commercial area at the intersection of U.S. Highway 41 and State Route 56. A new commercial location has been developed in the town of Coalmont at the intersection of State Routes 56 and 108. The presence of two interchanges at Interstate 24 has also spurred the development of commercial service facilities along U.S. Highway 41. (See Figure 1-1 for the location of these highways.)

The Sewanee area includes a university, residential areas, and a small commercial village. All other municipalities have small, local, commercial facilities that provide services to residents. Some residential and industrial development has also occurred in Sequatchie County.

Few local governments in the study area have planning commissions, and only Sewanee[7] engages in long-range planning. Monteagle has the only planning commission in Grundy County. Because its planning commission is deemed municipal-regional,[8] its authority to regulate subdivisions extends beyond the town limits. Both Franklin and Marion counties have active planning commissions and regulate subdivisions, but only Franklin County has adopted countywide zoning, which applies to Sewanee as well. (See Table 1-2.)

Table 1-2. Status of Planning in the South Cumberland Study Area, 2010

County/City	Planning Commission	Long-Range Plan	Subdivision Regulations	Zoning
Grundy Co.	No	No	No	No
Altamont	No	No	No	No
Beersheba Springs	No	No	No	No
Coalmont	No	No	No	No
Gruetli-Laager	No	No	No	No
Monteagle	Yes	No	Yes	Yes
Palmer	No	No	No	No
Tracy City	No	No	No	No
Franklin Co.	Yes	No	Yes	Yes
Sewanee[7]	Yes			
Marion Co.	Yes	No	Yes	No
Sequatchie Co.	No	No	No	No

Source: Tennessee Department of Economic and Community Development, Office of Local Planning Assistance.

[7] Sewanee is not an incorporated municipality, but it has a strategic plan for the Sewanee Domain.

[8] This extraterritorial authority is granted by the Local Government Planning Advisory Committee in the Tennessee Department of Economic and Community Development.

Traditionally, local planning departments and commissions are concerned mainly with the arrangement of the land uses across the community and regulating new development. While long-range plans sometimes do (and always should) examine the ability of water and wastewater treatment plants to meet future raw water needs, the adequacy of the supply source is rarely considered. Yet the importance of planning for future water supplies cannot be overstated. In the absence of local government planning, all responsibility for planning for future water supplies falls to the utilities that provide the water, and there is no formal coordination between the providers and the governments. While all utilities have that responsibility even with government planning, the lack of government involvement means that development is not linked to an essential planning process.

1.6 The Utilities of the Region

There are four major water utilities in the study area. Three smaller water utilities purchase finished water from the major utilities and are dependent on them for the water they distribute in their service areas. All four of the major utilities have developed their own raw water sources and have the capacity to meet drinking water quality standards. Over time and through experience managing periods of drought, the four systems have developed significant interconnections for sharing water resources.[9]

- Big Creek Utility District of Grundy County was incorporated under Tennessee law in 1959. Its water supply service area lies in Grundy County, north of Tracy City. In addition to supplying water to unincorporated areas of Grundy County, the district supplies Altamont, Beersheba Springs, Coalmont, Gruetli-Laager, and Palmer. As of February 28, 2010, the district had approximately 3,075 customers.[10] The northern portions of the service area lie within the Cumberland River drainage basin while the southern service area lies in the Tennessee River Basin. Big Creek also sells finished water to the Cagle-Fredonia and Griffith Creek utility districts, which do not have their own water treatment plants.[11]

- Monteagle Public Works Department operates both a water supply system and a sewer system. In 2009, the waterworks had 1,209 customers. The sewer system had 273 customers.[12] The service area for Monteagle waterworks extends beyond the town limits into Marion County and lies entirely within the Tennessee River drainage basin.

- Sewanee Utility District lies entirely within the Tennessee River drainage basin, is incorporated under Tennessee law, and is located in Franklin and Marion counties. The district operates a water system with 1,329 customer billings and a sewer system with 678 customer billings. Approximately one-third of the district's water and sewer revenue is received from one customer, the University of the South.[13]

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[9] Water Resources Regional Planning Pilot Study for the Southern Cumberland Plateau, Phase I, prepared by the U.S. Army Corps of Engineers District, Nashville Corps of Engineers, in conjunction with the Tennessee Department of Environment and Conservation. March 2009.

[10] The number of customers is not the population served. Rather it is based on metered water sales, including households, which may have any number of residents.

[11] Big Creek Utility District 2010 Audited Financial Statements and Other Financial Information.

[12] 2009 Town of Monteagle Annual Financial Report.

[13] 2008 Sewanee Utility District Financial Statement.

- Tracy City Public Utilities operates a water supply system that serves 1,472 customers and a sewer system that accommodates 52 customers.[14] The water supply service area of Tracy City extends beyond the town limits into Marion and Grundy counties. The town's water supply service area is bounded on the west by Monteagle's service area and on the north by Big Creek Utility District and lies entirely within the Tennessee River drainage basin. Tracy City sells finished water to the Foster Falls Utility District, which does not have its own water treatment plant.

1.6.1 Water Supply Sources

Table 1-3 lists the water supply sources and estimated total and usable storage capacities for the four major utilities in the South Cumberland study area. Usable storage is the amount of storage in a reservoir between the normal pool elevation and the lowest water supply intake unless restricted by contractual agreement. Contractual agreements limit utilities to a maximum number of feet off the top of the reservoir as indicated.

TABLE 1-3. South Cumberland Plateau Public Water Supply Sources[15]

Utility	Source	Total Storage Capacity (million gallons)	Usable Storage Capacity (million gallons)
Big Creek Utility District	Ranger Creek Reservoir	300	271
Monteagle Public Works Department	Laurel Lake—Primary	91.2	61
	Lake Louisa—Emergency	213	14*
Sewanee Utility District	Lake O'Donnell—Primary	62	58
	Lake Jackson—Secondary	107	71
	Lake Dimmick (Day Lake)—Emergency	218	54*
Tracy City Public Utilities	Big Fiery Gizzard Reservoir	200	198

* Limited by contract to the top two feet of the reservoir.

[14] 2009 Town of Tracy City Annual Financial Report.

[15] Water Resources Regional Planning Pilot Study for the Southern Cumberland Plateau, Phase I, prepared by the U.S. Army Corps of Engineers District, Nashville Corps of Engineers, in conjunction with the Tennessee Department of Environment and Conservation. March 2009.

1.6.2 Water Rates

The South Cumberland Plateau is an area of relatively high water rates and relatively low household incomes. Consequently, finding low-cost solutions to meeting water raw water needs in the area is paramount. According to a recent survey of water prices in Tennessee,[16] Monteagle's September 2009 price of $43.60 for 5,000 gallons inside the town limits was greater than prices charged by 92% of the 252 water systems participating in the statewide survey. Tracy City's price of $37.76 for 5,000 gallons inside its town limits was greater than 84% of the 252 water systems in the survey. Sewanee's price of $39.78 for 5,000 gallons was greater than 86% of the systems in the survey. Big Creek's price of $30.13 for 5,000 gallons, the lowest in the study area, was greater than 68% of the water systems responding to the survey. This statewide survey of water prices did not include rates charged to customers outside the city or town limits. Those rates are typically higher than rates charged to city or town residents.Based on data from 2009, median household incomes are relatively low in the South Cumberland study area. Incomes are especially low in Grundy County—more than $14,000 per year lower than the statewide median and $10,000 or more per year lower than the surrounding counties in the study area. Only three Tennessee counties have lower median household incomes than Grundy. See Appendix A for analysis of the affordability of water prices in the South Cumberland study area.[17]

Median Household Income (2009)	
Tennessee	$41,715
Franklin	$40,432
Grundy	$27,373
Marion	$37,067
Sequatchie	$37,810

[16] Allen & Hoshall. 2009. Tennessee Water and Sewer Rate Survey. Memphis, TN.

[17] See Appendix A, Table 6, and related text.

Chapter 2. Assessment of Utilities and Current Sources

2.1 Introduction

Residents of the South Cumberland study area rely on both groundwater and surface water. Self-supplied users—those who are not served by a public water utility—rely mainly on groundwater. All of the public water systems in the study area purchase water or obtain it from reservoirs.

The four major water suppliers rely on seven reservoirs—five that are regularly used for water supply and two that are used in emergencies. Because they lie on the top of a plateau, the reservoirs are generally small, have small drainage areas, and are very dependent on rainfall for filling. As a result, drought is one of the biggest risks to the region's water supplies.

During the 2007 drought, some of the South Cumberland water systems suffered severe shortages, highlighting the need to look comprehensively at the area's current water sources, its capacity, and demand. The U.S. Army Corps of Engineers, Nashville District (the Corps), and the Tennessee Department of Environment and Conservation (TDEC) collected information on the quality and capacity of existing water supply sources.

The **firm yield** of a water supply source is the most that could be taken from it in the worst drought on record.

The **reliable yield** of a water supply source is used for planning purposes to account for uncertainty and minimize the risk of running out of water in the future.

Firm Yield. A firm yield was calculated for each reservoir in the study area. The firm yield of a reservoir is typically defined as the maximum amount of water that could have been delivered every day during the worst drought in recorded history, or the "historical drought of record" leaving no reserve storage. It is the most water that could be had during the worst drought. The firm yield estimates presented in this chapter are based on simulated rainfall and runoff from the watershed and the corresponding reservoir response, given its usable storage capacity.[18,19]

[18] As noted in Chapter 1, usable storage is the amount of water available given the depth of the water supply intakes and any contract limitations.

[19] Two models were used to develop the reservoir yield estimates: The Hydrologic Modeling System developed by the Corps' Hydrologic Engineering Center (see http://www.hec.usace.army.mil/software/hec-hms/ for more information) and the Operational Analysis and Simulation of Integrated Systems (OASIS) model developed by Hydrologics, Inc. (see http://www.hydrologics.net/water_system_evaluation.html for more information).

Reliable Yield. In addition to the firm yield for the individual reservoirs, the reliable yield for each utility system as a whole was determined. The reliable yield was defined as the maximum amount of water that could have been delivered every day during the worst drought in recorded history while preserving 20% of the usable storage in a reservoir or system of reservoirs. It is the largest amount of water you should plan on being able to withdraw in order to minimize the risk of running out. The concept of reliable yield accounts for uncertainty in the accuracy of data sources and models, assumptions about climate variability, and potential water quality and treatability issues that may develop during extreme drought. It also reduces the risk that a system would completely deplete its resources in the event of a drought more severe than the worst drought on record.

Because usable storage is only one of several factors that go into calculating yield, a 20% reserve does not translate directly into a 20% difference in yield. A different reserve percentage could be used in calculating reliable yield depending on the level of certainty about the accuracy of data and the effects of climate variability, as well as the risk tolerance of the water system and community. For systems with multiple sources, the reliable yield was based on existing operating guidelines and criteria.

For systems with multiple sources, the sum of the yield (firm or reliable) of individual sources will usually be less than the yield of the same sources operated as a system in which all sources can be used and their differing emptying and refilling times accounted for. Changing how emergency sources are used, including restructuring contractual limits on withdrawals, would increase flexibility. Operating existing sources as a regional system could increase overall yield beyond the sum of the individual source yields for the lakes in the study area.

Firm yield represents the upper bound of water availability, but reliable yield is the best target for planning growth and development. If water supply systems could be managed with perfect knowledge of how long droughts would last and operated with perfect efficiency each day, then firm yield could be used for planning. But that's not a dependable assumption. When we're in the midst of a drought, we don't know how much longer it will last or how much worse it could become, and we can't make plans based on when we'll get rain. So for this study, the team used reliable yield as the basis for determining the capacity of existing and alternative water supply sources.

2.2 Utilities and Current Sources[20]

Drinking water is provided by utilities, so utilities and their sources must be the focus of any effort to identify unmet needs and alternative ways to meet them. The first step in determining the need for new water supply sources is assessing the capacity of existing sources, utility by utility. The combination of the sources for the study area would provide a firm yield total of approximately 3.0 million gallons per day if all contracts and drawdown limits were respected. The combined reliable yield of the sources for the study area would be 1.75 million gallons per day.

[20] Information about the public water utilities in the study area in this chapter is derived primarily from a series of reports prepared by GKY Associates in cooperation with the U.S. Army Corps of Engineers District, Nashville Corps of Engineers, and Tetra Tech Inc.:

- Water Resources Regional Planning Pilot Study for the Southern Cumberland Plateau, Phase II, Critical Drought Evaluation. (September 2009)
- Water Resources Regional Planning Pilot Study for the Southern Cumberland Plateau, Phase II, Existing Sources Firm Yield Analysis. (April 2010)
- Water Resources Regional Planning Pilot Study for the Southern Cumberland Plateau, Phase II, Water Conservation Summary. (August 2010)
- Water Resources Regional Planning Pilot Study for the Southern Cumberland Plateau, Phase II, Alternative Sources Yield Analysis. (November 2010)

Additional information about the utilities unaccounted for water volumes and percentages is found in Appendix B.

Utility	Firm Yield (gallons per day)	Reliable Yield (gallons per day)
Big Creek Utility District	1,093,000	850,000
Monteagle Public Works Department	473,000	170,000
Sewanee Utility District	791,000	330,000
Tracy City Public Utilities	630,000	400,000
Total for All Utilities	2,982,000	1,750,000

Table 2-1. Estimated Yield of the Study Area's Water Supply Sources

The emergency sources evaluated have been used little in the past, but they could add considerable flexibility in the future if contractual use limits were re-negotiated. Combining these emergency sources with existing sources might allow a greater overall yield for the region. Moreover, while the utilities in the study area have adopted a number of conservation and demand management strategies, additional measures could be adopted to maximize the yield of existing sources and postpone development of new ones. These strategies are particularly important for the South Cumberland study area, which already has relatively high water rates and relatively low household incomes.

2.3 Big Creek Utility District—Ranger Creek Reservoir

Big Creek Utility District serves Grundy County north of Tracy City including Altamont, Beersheba Springs, Coalmont, Gruetli-Laager, and Palmer. Its sole water supply source is Ranger Creek Reservoir, located just north of Coalmont about five miles south of Altamont in the Collins River Watershed. A 2010 TDEC on-site sanitary survey lists Big Creek Utility District as an approved water system, meeting all treatment technique and monitoring standards for safe drinking water. Ranger Creek Reservoir's watershed has an area of 1,471 acres with land uses that include timber, low-density residential development, and the Grundy County High School.

The utility estimates the lake's storage capacity at 300 million gallons at its normal elevation of 1,826 feet, but TDEC's Safe Dams program estimates its capacity at 271 million gallons. The more conservative estimate of 271 million gallons was used for the yield analysis. The reservoir has an average inflow of approximately 3.3 million gallons per day. The 18-month drought that began in May 1930 and peaked in December 1931 produced the largest deficit of any drought on record, including the 2007-2008 drought, when modeled against this inflow. The reservoir's firm and reliable yields, based on its average usable storage capacity, its inflow, and the 1930-31 drought, were calculated as 1.1 million and 850,000 gallons per day, respectively.

Big Creek Utility District has several strategies in place to conserve water and manage demand. All customer accounts are metered, and its distribution system is highly looped, so less flushing is required than in more branched systems with dead-end lines. However, leak detection efforts are limited to monitoring plant production, water tank levels, and meter readings. And billings are based on an inclining block rate schedule, which imposes higher rates as water use increases to discourage waste. Big Creek's unaccounted for water percentage is around 24%, which is the highest of the four major utilities in the study area, but still below the state standard of 35% for unacceptable losses.

2.4 Monteagle Public Works Department

Monteagle has two surface water sources: Laurel Lake and Lake Louisa. Laurel Lake is the primary source; Lake Louisa was added as an emergency water supply source after the 2007 drought. The critical drought response measures in Monteagle's drought management plan, which include drawing water from Lake Louisa, are triggered when Laurel Lake drops five feet below normal pool. Lake Louisa has not been thoroughly studied as a water supply source but has sufficient storage to provide water during drought emergencies. The reliable yield for the two sources combined when operated as a system according to Monteagle's plan was calculated at 170,000 gallons per day.

Monteagle's water meets all safe drinking water standards and was deemed approved based on a 2010 on-site sanitary survey. The town has no significant active conservation or demand management strategies in place outside of its drought management plan, but it does meter all accounts and has a block rate pricing schedule that could be modified to discourage unnecessary use. Monteagle's unaccounted for water percentage is around 12%, the second lowest in the study area and well below the state standard of 35% for excessive water losses.

2.4.1 Laurel Lake

Laurel Lake is in the Tennessee River's Guntersville Reservoir Watershed (see Figure 1-2 in Chapter 1). Its watershed covers 1,117 acres and is roughly rectangular with the lake emptying to the south. The lake has a surface area of 40 acres at normal pool. A one-half mile section of a tributary to the lake has been identified by TDEC as impaired because of the failure of the town's wastewater collection system and leaks from waste storage tanks.

According to Tennessee's Safe Dams Program, Laurel Lake holds 91.2 million gallons at normal pool. Based on the elevation of the lowest intake used for water supply, 20 feet below the current normal pool, Laurel Lake has a storage volume of 30.1 million gallons that is not available for water supply, which leaves a usable storage capacity of 61 million gallons for yield calculations. The lake's firm yield was calculated at 363,000 thousand gallons per day. The average inflow is 2.5 million gallons per day, and the critical drought lasted from May to December 1944. If the entire storage volume in the lake were available for water supply, a yield of 493,000 gallons per day might be achievable.

2.4.2 Lake Louisa

The Lake Louisa watershed is 705 acres and is largely forested with some low density residential development. Additional development is proposed, which could affect the quality of this source. The average inflow for Lake Louisa is 1.6 million gallons per day. Its total storage at normal pool is 213 million gallons according to records from Tennessee's Safe Dams Program. By contract, Monteagle can use only the top two feet of the lake (as measured from the normal pool elevation) for water supply in emergencies, which reduces its usable storage to 14 million gallons. If operated under the conditions of the contract, the lake's firm yield would be 110,000 gallons per day. If the entire 213 million gallon volume of the lake were available for water supply, it could support a firm yield of 650,000 gallons per day.

2.5 Sewanee Utility District

Sewanee has three surface water sources: Lake O'Donnell, Lake Jackson, and Lake Dimmick. Sewanee's reservoirs are operated as a system with Lake O'Donnell as the primary source. Lake Jackson is a secondary source that is pumped to Lake O'Donnell as necessary. Lake Dimmick is an emergency source. Sewanee's water quality is generally very good and the water system meets safe drinking water standards.[21] The reliable yield for the system as a whole was calculated at 330,000 gallons per day.

Sewanee Utility District has accounted for all but 17% of the finished water produced in its 2010 fiscal year. Managers there say leakage is low mainly because most of the pipes in its distribution system are less than 30 years old and are replaced on a regular schedule and because of a targeted meter replacement program. System managers are also looking into direct or indirect reuse of treated wastewater.

Sewanee encourages conservation by charging a dollar per thousand gallons more for irrigation than for domestic use, by imposing higher rates for residential use over 8,000 gallons per month, and through materials and information placed on its website. Sewanee's philosophy is that economic incentives are the best route to conservation, and its drought management strategies include surcharges.

2.5.1 Lake O'Donnell

Lake O'Donnell, Sewanee's primary source, is the smallest reservoir in the system with a surface area of 21 acres. It has a relatively small drainage area of 196.4 acres, which with the exception of the Franklin County Airport, is predominately forested. TDEC's Safe Dams staff classifies Lake O'Donnell's dam as high hazard because of potential downstream impacts if the dam were to fail–this classification does not in any way reflect the current condition of the dam. At its maximum pool elevation of 1,910 feet, the lake can hold 62 million gallons of water; however, the maximum desirable drawdown of 18 feet as operated by the utility (the lake is 28 feet deep) limits usable storage to 58 million gallons. Modeling Lake O'Donnell produced an estimated average inflow of 370,000 gallons per day and a firm yield of 172,000 gallons per day.

2.5.2 Lake Jackson

Lake Jackson's 471-acre drainage area is primarily forested, but it has some low-density development in the northern portion of the watershed. This 23.7-acre lake has a maximum pool elevation of 1,850 feet and is 60 feet deep. Water is drawn off near the bottom of the lake and pumped into Lake O'Donnell. Sewanee's engineers computed the lake's total storage at 107 million gallons at its normal pool elevation of 1,852 feet. According to the engineers, Lake Jackson can be drawn down completely, but it has a maximum desirable drawdown of 14 feet as operated by the utility, which limits its usable storage to 71 million gallons. Yields were calculated for both storage estimates, and either could be considered the firm yield depending on the rules for operating the lake. The overall firm yield for 107 million gallons of storage was estimated at 391,000 gallons per day. Taking into account the reduced storage at the preferred drawdown level, the firm yield was 326,000 gallons per day.

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[21] An on-site sanitary survey was conducted within the past year, and the water system was provisionally approved. The provisional approval was associated with a Director's Order that was issued in June for failure to maintain an on-going cross connection program, failure to collect bacteriological samples after line repairs, failure to report the highest turbidity obtained during a 4-hour period, and failure to submit plans and specifications prior to construction. The system is now in compliance.

2.5.3 Lake Dimmick

The third water source used by Sewanee Utility District is Lake Dimmick (also referred to as Day Lake), a large recreation lake owned by the University of the South and used by Sewanee as an emergency source. It has the largest surface area of any lake in the study area. By contract, Sewanee is allowed to use only the top two feet of Lake Dimmick as an emergency water supply. Much of Lake Dimmick's 1,277-acre watershed is currently undeveloped and is part of the University of the South's Domain (as the campus and surrounding area are known).[22]

Elevations and storage values based on Sewanee's engineering surveys and on the Safe Dams Program's estimates differ significantly. The Safe Dams estimate is the more credible of the two when compared with the hydraulic characteristics (i.e., surface area, storage, and hydraulic height) of other lakes in the study area. The difference between the two estimates is not of great importance as only the top two feet of Lake Dimmick, which contain 54 million gallons of storage, can be used for water supply. The firm yield calculated at the contractual limit is 293,000 gallons per day.

2.6 Tracy City Public Utilities—Big Fiery Gizzard Reservoir

Tracy City has only one water supply source: Big Fiery Gizzard Reservoir. The reservoir has a watershed size of approximately 1,511 acres. There are three inlets: the first at 9.7 feet, the second at 19.7 feet, and the third at 25.7 feet (all below normal pool elevation). Lower levels have water quality issues as a result of stratification. TDEC's permit for this reservoir requires that it release a minimum of 1.0 cubic foot per second (646,000 gallons per day) to protect classified uses downstream.

Several sources, including Tennessee's Safe Dams Program and Tracy City, estimate total storage at approximately 200 million gallons. According to data provided by Tracy City, 1.9 million gallons of storage are below its lowest intake, so the usable storage for calculating yield is approximately 198 million gallons. Based on that amount and the reservoir's average inflow of 3.6 million gallons per day, its firm yield is 630,000 gallons per day and its reliable yield is 400,000 gallons per day. As operated, the outlet structure at the dam does not discharge a constant 1.0 cubic foot of water per second. It is instead dependent on the pool elevation of the reservoir. At normal pool, the release is approximately 1.0 cubic foot per second. As the pool level drops, the release declines. If the reservoir fell low enough, the release would be zero.

Tracy City Public Utilities has no specific strategies in place to manage demand and conserve its water source, but has kept its unaccounted for water at a very low 9% despite having only a passive leak detection program that relies mainly on monitoring meter readings. Its distribution system is considerably looped, which should reduce line flushing, but managers still find that they have to release significant quantities of water to keep disinfection byproducts within allowable levels. While this water is accounted for, it nevertheless is lost from the system. Reducing the need to flush would save water and money. Changes in the treatment strategy employed by the water system might prove helpful. For instance, disinfection byproducts are the result of organic compounds in the raw water coming into contact with the chlorine disinfectant. An effective strategy to reduce disinfection byproducts is to reduce organics and turbidity as much as possible before disinfection.

[22] http://about.sewanee.edu/. Accessed on 1 February 2011.

Chapter 3. Projected Water Withdrawals and Unmet Needs

3.1 Introduction

Understanding and anticipating current and future water needs is essential to effective water supply planning. Water supply systems that are too small can limit economic development. Systems that are too large can be costly and wasteful. These issues loom particularly large in the South Cumberland study area because water prices are already relatively high and household incomes, particularly in Grundy County are relatively low. Even if grants can be acquired for infrastructure improvements, the customers of the utilities will have to pay the cost of operating and maintaining them. If water use doesn't grow fast enough to generate sufficient revenue to pay these costs at current rates, the rates may have to be raised, which means existing customers will be paying for growth.

Future water supply needs can be projected based on current raw water withdrawals and population growth rates. Current water withdrawals for the study area were derived from two sources: monthly operation reports and water system surveys submitted by the utilities to the Department of Environment and Conservation. Population projections for the study were based on the work of the University of Tennessee's Center for Business and Economic Research (CBER). CBER is the State Data Center for the U.S. Census Bureau and routinely projects population growth for counties and cities.[23] Their most recent projections are available through 2030, which matches the study team's 20-year planning horizon. Like all projections, these include some amount of uncertainty. Actual population counts for every city and county are made only once every ten years; in between, populations are estimated. When these projections were made, the latest estimates did not include the effects of the recent economic downturn, which introduced more uncertainty. Utility managers and planners in the study area will want to review them, customize them to their service areas, and update them as time goes by and conditions change. They will want to be especially mindful of the possibility that growth will be higher or lower than these projections suggest.

3.2 Population Projections

The South Cumberland study area includes most of Grundy County and small sections of three others: Franklin, Marion, and Sequatchie. Population projections for the service areas of the utilities in the study are not available; consequently, projections for the utilities had to be based on those for the counties in which they lie.[24] Grundy and Marion counties have experienced little to no growth over the past decade and are expected

[23] For more information about the population projections, see Population Projections for the State of Tennessee: 2010-2030, a joint publication of the Center for Business and Economic Research and the Tennessee Advisory Commission on Intergovernmental Relations released in June 2009 and published online at http://www.state.tn.us/tacir/population.html.

[24] It is likely that projections for the parts of the study area that lie in Sequatchie County are overstated because growth in that county has been mainly in areas closer to Chattanooga, but the study team had no other data on which to base them. The population of that part of the study area is relatively small; the effect on demand projections should likewise be small.

to continue to grow slowly through 2030. From 2000 to 2010, Franklin County's population grew 4.5%; it is expected to grow 17.0% from 2010 through 2030. Sequatchie is the fastest growing county in the study area, growing 24.1% between 2000 and 2010 and expected to grow another 37.9% from 2010 through 2030, but only a very small part of the county is included in the study area. (See Table 1-1 in Chapter 1 and Table 3-1 below.)

Table 3-1. Projected Population in the South Cumberland Study Area

Year	Actual 2010	Projected 2020	Projected 2030	Growth Rate 2010-2030
Tennessee	6,346,105	6,860,231	7,397,302	16.6%
Grundy	13,703	14,272	14,403	5.1%
As a Percent of the State Total	0.22%	0.21%	0.19%	
Altamont	1,045	1,152	1,190	13.9%
Beersheba Springs	477	518	506	6.1%
Coalmont	841	984	1,011	20.2%
Gruetli-Laager	1,813	1,912	1,964	8.3%
Monteagle (part)	715	707	679	-5.0%
Palmer	672	661	636	-5.4%
Tracy City	1,481	1,590	1,577	6.5%
Unincorporated	6,659	6,748	6,840	2.7%
Franklin	41,052	45,531	48,035	17.0%
As a Percent of the State Total	0.65%	0.66%	0.65%	
Monteagle (part)	48	48	56	16.7%
Unincorporated	24,190	27,540	28,927	19.6%
Marion	28,237	27,504	27,518	-2.5%
As a Percent of the State Total	0.44%	0.40%	0.37%	
Monteagle (part)	429	365	352	-17.9%
Unincorporated	15,913	15,809	15,801	-0.7%
Sequatchie	14,112	17,243	19,454	37.9%
As a Percent of the State Total	0.22%	0.25%	0.26%	
Unincorporated	8,091	10,888	12,237	51.2%
Total for Cities in Multiple Counties				
Monteagle	1,192	1,120	1,087	-8.8%

Source: U.S. Bureau of Census, 2010 Decennial Census.

3.3 Current and Projected Water Withdrawals

The utilities' monthly operation reports were used to tabulate each water system's the gross raw water withdrawals, amount of water sold or purchased, and net amount of water used internally. The water system surveys provided information about the amount of total finished water distributed, including water sold to other water-supply systems. The surveys also included the number of accounts and the amount of water billed to residential, commercial, and industrial customers, and the amount used for purposes such as firefighting, line flushing, maintenance, and other public uses or losses. Estimates of the study area's raw water needs developed by combining this water use with the population projections for each utility indicate that water withdrawals in the study area will increase from the current (2010) amount of 2.1 million gallons per day in 2.2 million gallons per day by 2030. This projected 5.1% increase, totaling 106,000 gallons per day, by category, includes

- finished water sold to residential customers of 61,000 gallons per day (58% of the total increase);
- finished water sold to commercial and industrial customers of 25,000 gallons per day (24% of the total increase); and
- treatment and non-revenue water of 20,000 gallons per day (18% of the total increase).

Table 3-2 provides more detailed projections of raw water withdrawals for the individual utilities in the study area. See Appendix C for further explanation of how they were developed.

Table 3-2. Projected Raw Water Withdrawals by Public Water Systems in the South Cumberland Study Area, Actual 2005 and Projected 2010, 2020, and 2030

				Projected					
		Actual 2005		2010		2020		2030	
Utility	Water Supply source	Population Served*	Raw Water Withdrawals (gallons per day)	Population Served*	Raw Water Withdrawals (gallons per day)	Population Served*	Raw Water Withdrawals (gallons per day)	Population Served*	Raw Water Withdrawals (gallons per day)
Sewanee Utility District	Lake O'Donnell	4,708	290,000	4,849	300,000	5,286	330,000	5,576	350,000
Monteagle Public Works Department	Laurel Creek Lake	3,157	430,000	3,163	430,000	3,138	430,000	3,166	430,000
Tracy City Public Utilities	Big Fiery Gizzard Reservoir	4,222	470,000	4,231	470,000	4,194	470,000	4,227	470,000
Big Creek Utility District	Ranger Creek Reservoir	10,762	870,000	10,942	880,000	11,343	910,000	11,725	940,000
Study Area Totals		22,849	2,060,000	23,186	2,090,000	23,961	2,140,000	24,695	2,190,000

* Estimated based on customer accounts and average household size.

3.4 Projected Unmet Water Supply Needs

Comparing the projected raw water withdrawals to the reliable yield of existing sources (from Chapter 2) produces an estimate of the potential unmet need in the region that takes risk into account. This can be done at a regional level to determine the potential for meeting the study area's needs by sharing water supply sources. Figure 3-1 compares projected raw water needs for the entire study area with the aggregated firm yields of the seven reservoirs and the reliable yields of the four systems and with their combined water treatment capacity.

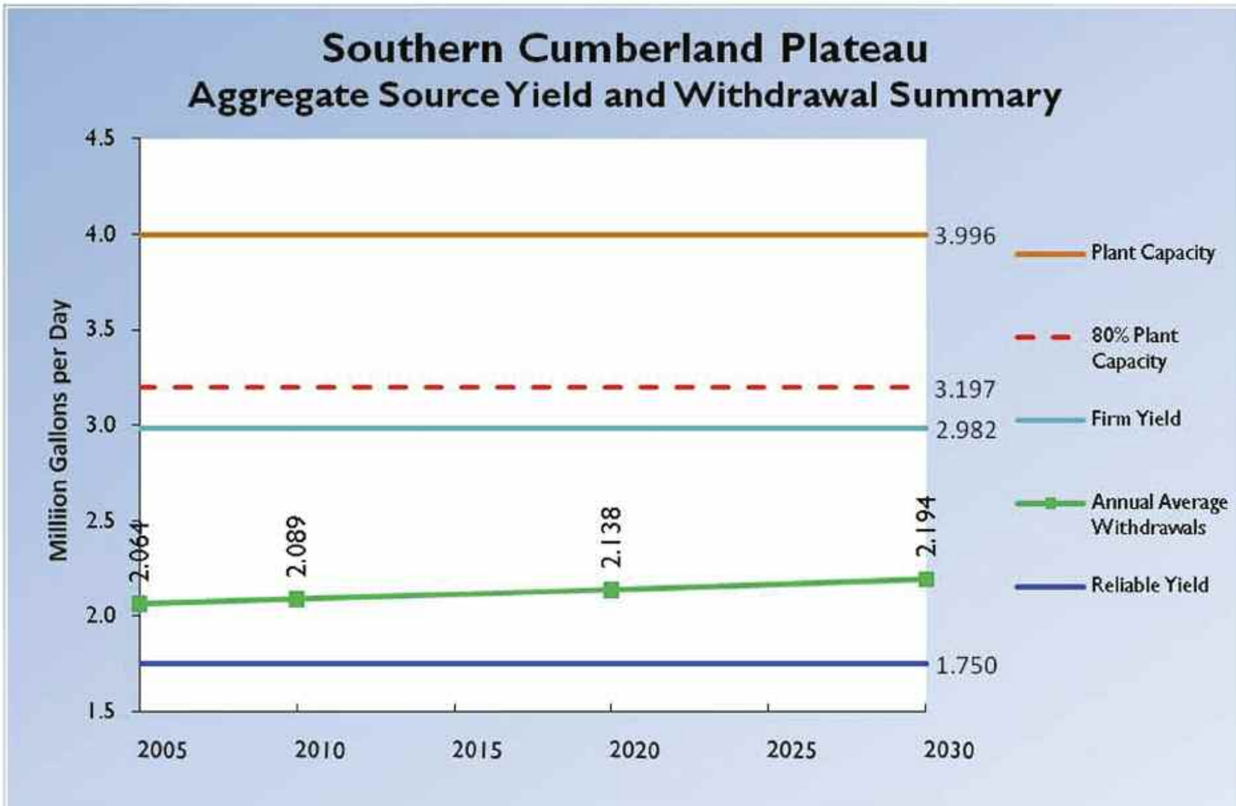

Figure 3-1. Aggregate Source Yields and Withdrawals for the South Cumberland Study Area

As Figure 3-1 shows, the projected raw water withdrawals for the region are considerably less than the aggregate firm yield of the existing water sources through the planning horizon, and the region as a whole has sufficient treatment capacity to handle its projected withdrawals. But firm yield does not take into account the uncertainty of these projections and the possibility that a worse drought than any past drought will occur. The reliable yield of the region's sources, which does account for these factors by building in a 20% reserve, already falls nearly 340,000 gallons per day short of current withdrawals and more than 440,000 gallons per day below the withdrawals projected for 2030. Based on the level of risk chosen by the study team, the region needs additional raw water sources to ensure that it can meet even current needs should a severe drought occur.

Because of their generally small watersheds and dependence on rainfall for filling, the seven small reservoirs in the study area individually provide limited yield and are particularly vulnerable to drought. Maintaining and improving the ability to share sources among utilities is paramount to each utility's ability to meet its raw water withdrawal needs. The following sections explore the ability of each utility to reliably meet its projected needs without sharing sources, but source sharing should be considered an effective strategy to reduce risk and maximize the availability of water across the region.

3.4.1 Sewanee Utility District

As noted in Chapter 2, the firm yield currently available from Sewanee's three sources totals approximately 791,000 gallons per day, and the reliable yield for the system as a whole is approximately 330,000 gallons per day. Figure 3-2 compares the projected raw water withdrawals for Sewanee with the aggregated firm yield from all three sources and the system's reliable yield, as well as its existing water treatment capacity.

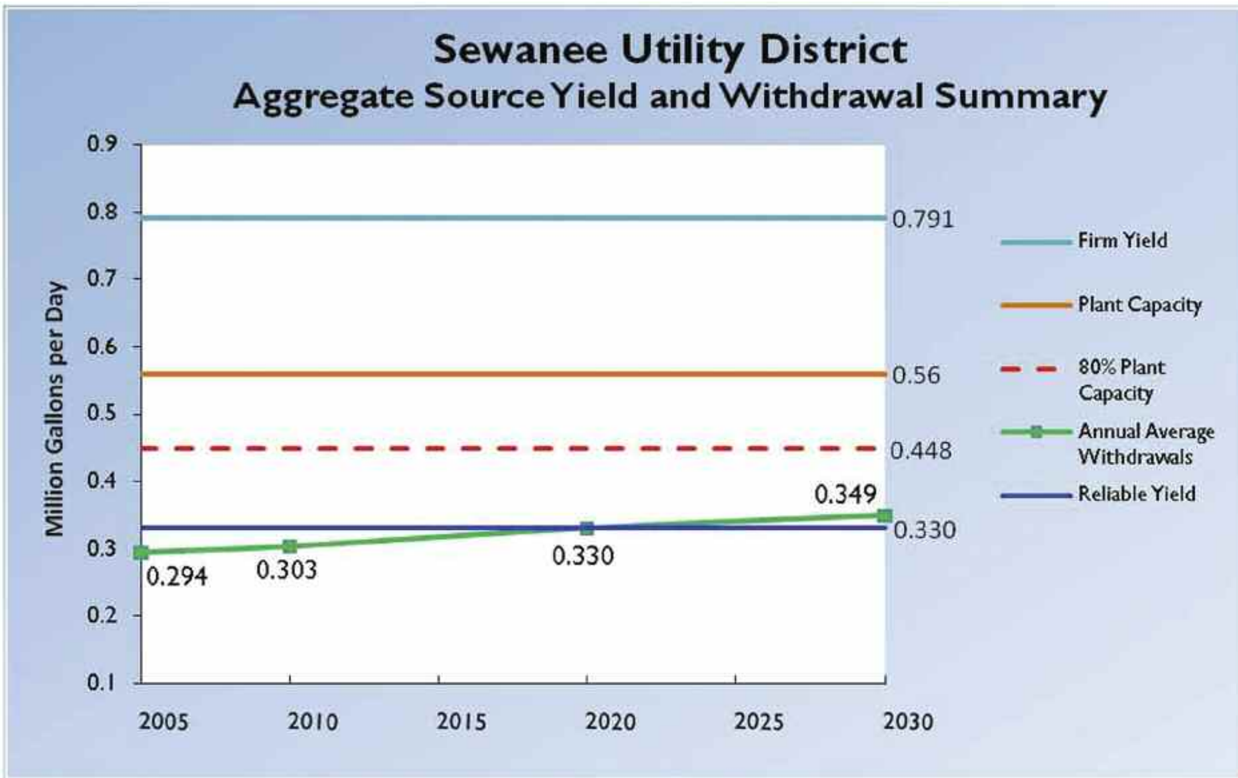

Figure 3-2. Sewanee Utility District Aggregate Yield and Withdrawal Summary

The estimated aggregate firm yield of Sewanee's sources is approximately 442,000 gallons per day greater than the withdrawals projected through the planning horizon. Existing treatment capacity is sufficient even for 2030. But the estimated reliable yield of the system as a whole, which takes uncertainty and risk into account, is approximately 19,000 gallons per day less than its projected withdrawals, so in the latter part of the planning period, it appears that Sewanee could have trouble in a severe drought. As noted in Chapter 2, however, Sewanee's emergency source—Lake Dimmick, the recreation lake owned by the University of the South—has capacity that is limited by contract. If more water could be made available from Lake Dimmick in emergencies, the risk of running out in a drought would be lessened.

3.4.2 Monteagle Public Works Department

The aggregate estimated firm yield of Monteagle's two sources, as presently configured with Laurel Lake as its primary source and Lake Louisa as an emergency source, is approximately 468,000 gallons per day. The overall system's estimated reliable yield is 170,000 gallons per day. Figure 3-3 compares Monteagle's projected raw water withdrawals with the estimated total firm and reliable yields and with the utility's existing water treatment capacity.

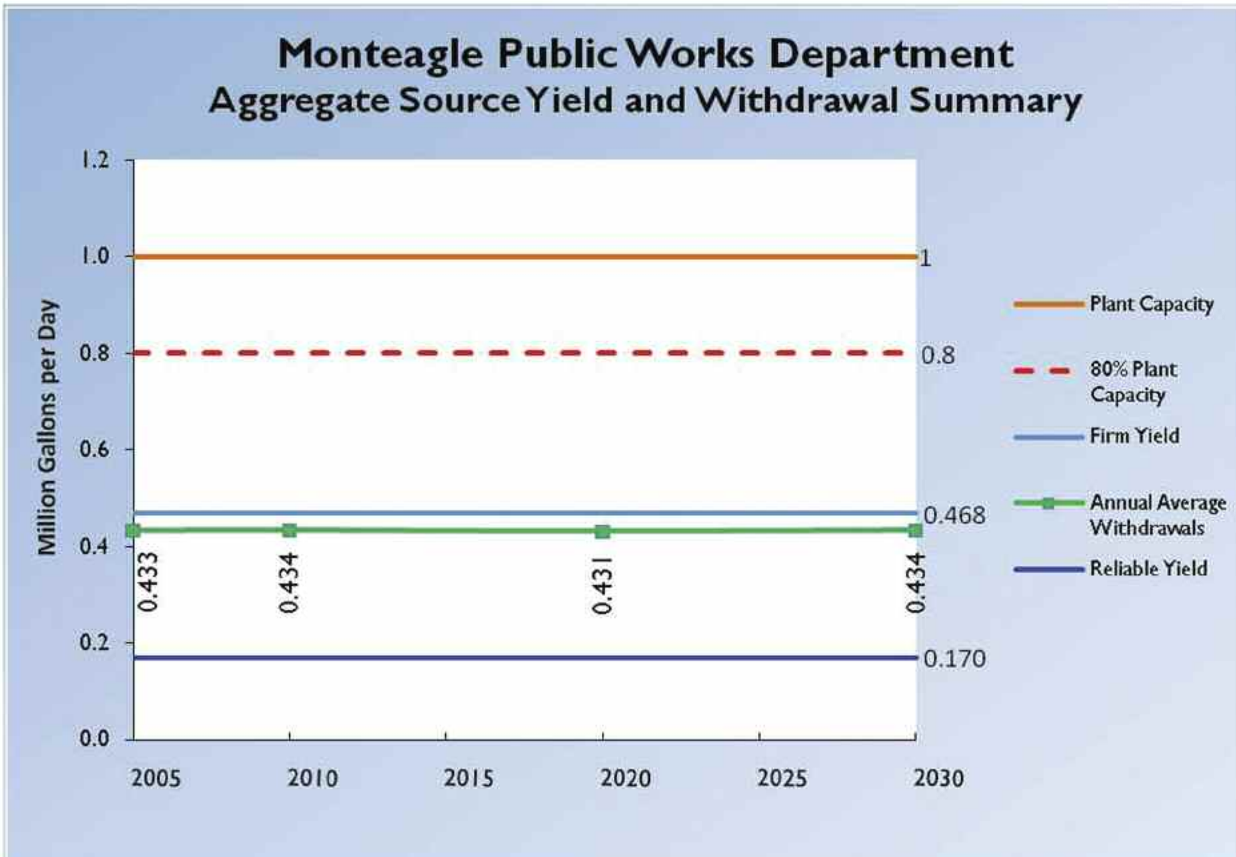

Figure 3-3. Monteagle Public Works Department Yield and Withdrawal Summary

As indicated by the chart, Monteagle has sufficient water treatment capacity to meet its raw water withdrawal needs through the planning horizon but its projected withdrawals are only 34,000 gallons per day below its combined sources' firm yield. Taking uncertainty and risk into account, the system's estimated aggregate reliable yield of 170,000 gallons per day is approximately 264,000 gallons per day less than its current withdrawals. Consequently, the risk that Monteagle would not be able to meet its raw water needs during a reoccurrence of the critical historical drought is considerable. Developing additional raw water sources for the region is particularly important to Monteagle, especially considering the difficulty it faced in meeting water supply demands during the recent drought. As with Sewanee and Lake Dimmick, this risk could be at least partially mitigated if the contract limiting Monteagle to the top two feet of Lake Louisa were modified.

3.4.3 Tracy City Public Utilities

Big Fiery Gizzard Reservoir is Tracy City's only water source. Its current Aquatic Resource Alteration Permit (ARAP) for the dam requires a minimum constant release of 1.0 cubic foot per second (646,000 gallons per day). In reality, the quantity of water released through the dam depends on the reservoir level. At normal pool, the release is approximately 1.0 cubic foot per second, but as the pool level drops, the release declines. If the reservoir fell low enough, the release would be zero.

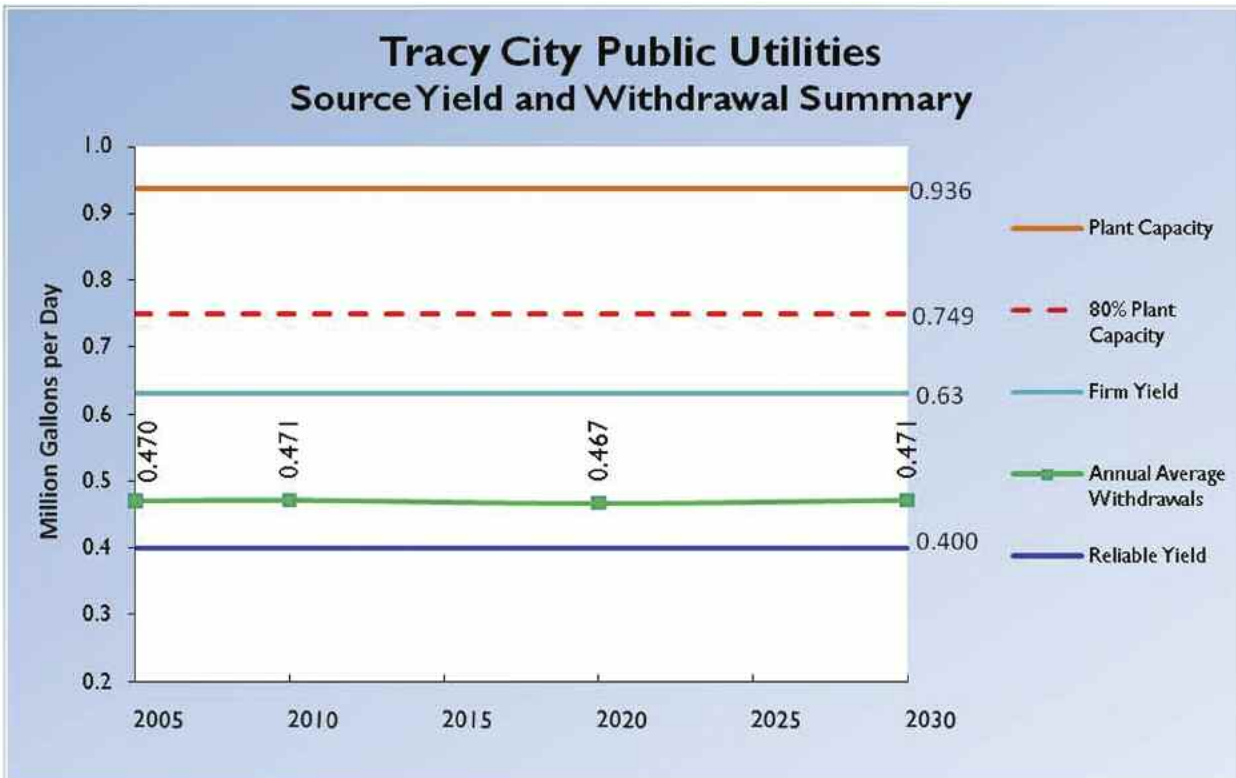

Figure 3-4. Tracy City Public Works Source Yield and Withdrawal Summary

Figure 3-4 compares the projected raw water withdrawals for Tracy City, which includes water needed by Foster Falls Utility, with the estimated firm and reliable yields of Big Fiery Gizzard Reservoir and with Tracy City's existing water treatment capacity. The estimate of firm yield from Big Fiery Gizzard Reservoir from Chapter 2 is approximately 630,000 gallons per day, and the estimated reliable yield is 400,000 gallons per day. Although Tracy City has sufficient treatment capacity, regardless of how the yield is modeled, it is less than their current and projected withdrawals of around 470,000 gallons per day. Consequently, as with Monteagle, the development of additional raw water sources for the region will be particularly important for Tracy City.

3.4.4 Big Creek Utility District

Figure 3-5 compares the projected raw water withdrawals for Big Creek Utility District, which includes water needed by Griffith Creek and Cagle-Fredonia utility districts, with Ranger Creek Reservoir's estimated firm and reliable yields and Big Creek's water treatment capacity.

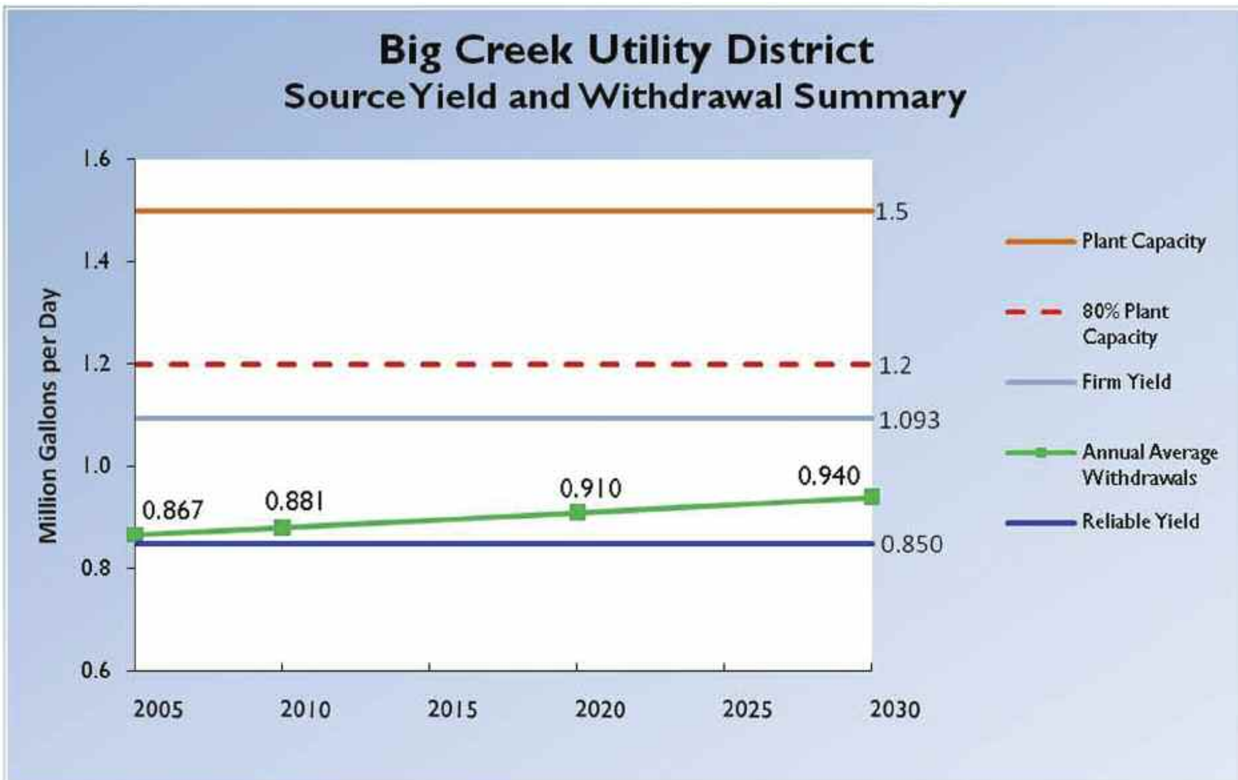

Figure 3-5. Big Creek Utility District Source Yield and Withdrawal Summary

At 940,000 gallons per day in 2030, Big Creek's projected withdrawals are well below its treatment capacity, but the reliable yield of its reservoir, estimated at 850,000 gallons per day, is already less than current raw water withdrawals, and the gap could grow to 90,000 gallons per day by 2030. During a reoccurrence of a drought comparable to the worst on record for the area, Big Creek, like Sewanee, could have difficulty meeting its raw water needs based on the conservative assumptions adopted by the study team to minimize risk and the effects of uncertainty about such things as climate variability and projections of growth.

Chapter 4. Identification of Potential Sources and Means of Meeting Projected Needs

4.1 Introduction

The 2007-2008 drought raised serious concerns about the ability of the water supply systems of the South Cumberland study area to meet increasing customer need. While raw water withdrawals for the region as a whole are expected to grow only slightly through 2030, Monteagle's withdrawals are already within 35,000 gallons per day of its firm yield and well above its reliable yield based on the planning standard adopted by the study team. Tracy City is currently withdrawing more than both its firm and reliable yields. As raw water needs continue to increase in these areas, existing resources do not provide an acceptable margin of safety.

A list of potential alternatives to meet the region's needs was developed with the assistance of stakeholders in the study area through a series of meetings with local government officials, utility managers, and the public. The alternatives fell into four categories:

- conservation and demand management,
- regionalization or water sharing among utilities,
- improvement of existing sources, and
- development of new sources.

The study team reviewed these alternatives in depth to determine which one or combination would be most likely to meet future needs in the most sustainable way at the least possible cost. The remainder of this chapter gives an overview of the alternatives.[25] Other alternatives may become evident in the future, and changing circumstances may require consideration of them. The process developed by the study team and described in this report should be followed to determine their potential to meet the region's needs in a sustainable, cost-effective manner.

Four structural alternatives have been under consideration by the utilities in the study area and proposed to the study team:

- Building a new water supply reservoir on Big Creek
- Raising the existing Big Fiery Gizzard Reservoir dam

[25] For more information about the alternatives, see Water Resources Regional Planning Pilot Study for Southern Cumberland Plateau, Tennessee, Phase III—Water Supply Alternatives Assessment, prepared by GKY & Associates and Tetra Tech Inc. in cooperation with the U.S. Army Corps of Engineers, Nashville District (November 2010). Cost estimates in that report were based in large part on the following sources:

- Application for Aquatic Resource Alteration Permit to Enlarge the Dam and Reservoir Pool of Big Fiery Gizzard Creek Reservoir, submitted by Tracy City Public Utilities to the Tennessee Department of Environment and Conservation and prepared by Nolen Engineering Group, 2008.
- Preliminary Engineering Report on Southern Cumberland Plateau Permanent Water Source for Grundy County, Tennessee: Appalachian Regional Commission Application, prepared by James C. Hailey and Company, Consulting Engineers, Nashville, Tennessee for Grundy County, Tennessee, 2008.

- Purchasing the existing Ramsey Lake for conversion to a water supply reservoir
- Building a pipeline from the Tennessee River in South Pittsburg to the Southern Cumberland Plateau

The estimated cost of these alternatives is summarized in Table 4-1. Table 4-2 shows which utilities each alternative has been proposed to serve. The check mark indicates which utility would have the largest role in operation of the alternative source. Secondary service determination is approximated based on connectivity and source water availability of the alternative sources.

Table 4-1. Summary of Estimated Costs for Structural Water Supply Source Alternatives

Alternative	Estimated Cost* (in millions)
Modification of Big Fiery Gizzard Dam and Reservoir	$ 3.5
Construction of Big Creek Reservoir	$ 26.4
Purchase and Modification of Ramsey Lake	$ 9.6
Construction of South Pittsburg Pipeline	$ 83.7

* Estimated costs include construction and both operational and maintenance costs over the estimated 50-year life cycle of the projects at their 2010 present value based on an interest rate of 4.375%.

Table 4-2. Utility Served by Each Structural Water Supply Alternative

Alternative	Utility			
	Big Creek Utility District	Monteagle Department of Public Utilities	Sewanee Utility District	Tracy City Public Utilities
Proposed Big Creek Reservoir	✓	O	O	O
Big Fiery Gizzard Alteration	O	O	---	✓
Ramsey Lake Purchase/Alteration	✓	O	---	O
Proposed South Pittsburg Pipeline	O	✓	O	O

NOTE: ✓= Primary Service, O = Secondary Service.

Figure 4-1 shows the location of the proposed alternatives, as well as the locations of all existing water sources in the study area. Watersheds of potential new sources are green, and existing source watersheds are beige. New source lakes are dark blue, and existing sources are light blue. Big Fiery Gizzard Reservoir is an existing source, and its lake will change but not its watershed. A portion of the proposed South Pittsburg Pipeline is delineated in blue.

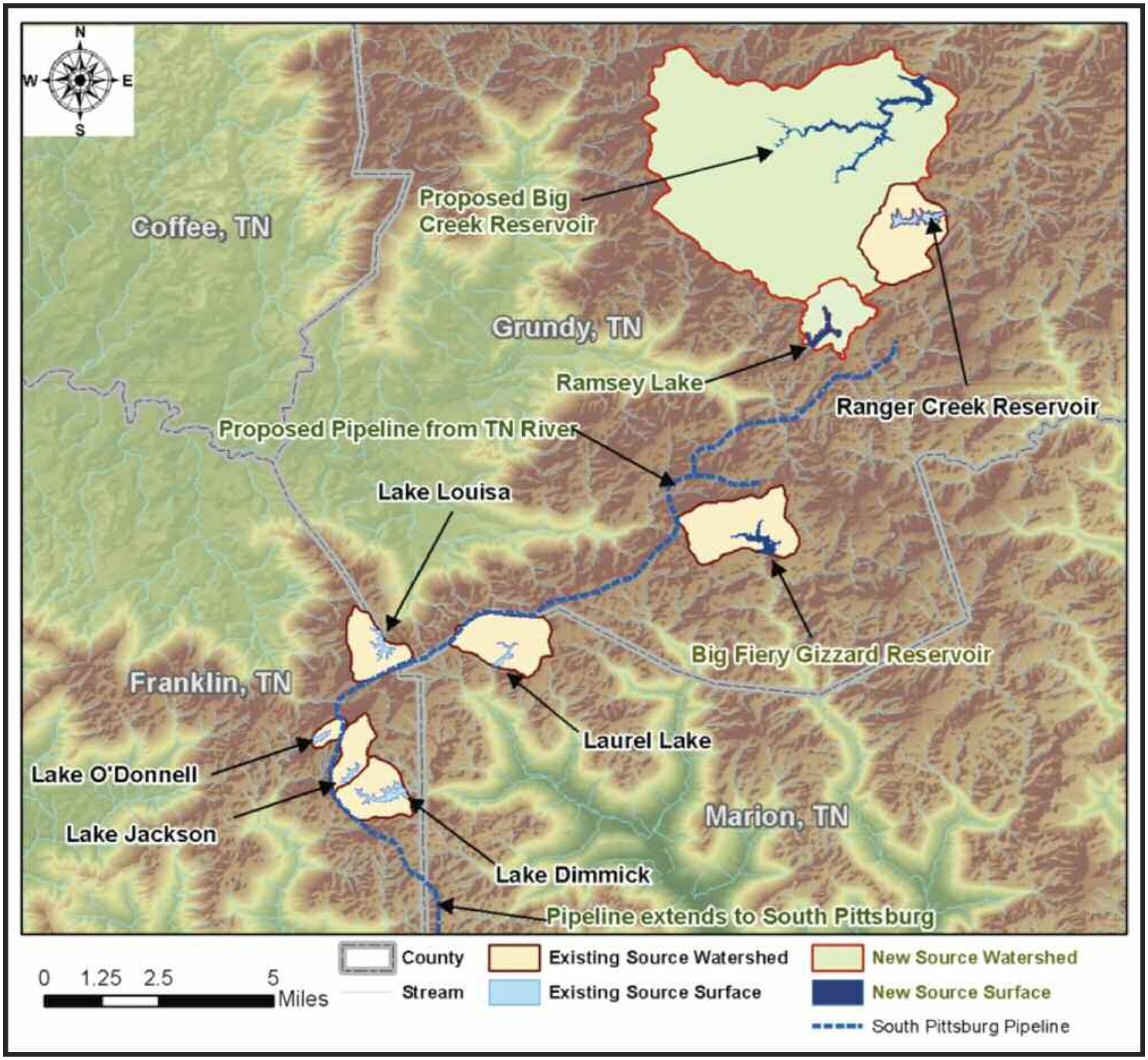

Figure 4-1. Existing and Proposed Southern Cumberland Plateau Water Supply Sources

4.2 Water Conservation and Demand Management

Conserving water and managing, even restricting, its use are the main strategies that sustained utilities in the South Cumberland study area through the drought of 2007 and 2008. They are common strategies in times of drought, and they are becoming more commonplace in times of normal rainfall because they can reduce costs—both for utilities and for customers—and postpone the need to invest in expensive, new water supply sources. For some utilities, the most effective way to reduce pressure on existing water supply sources is reducing the amount of water lost through leaks and flushing. Utilities that adopt strategies to reduce leaks and flushing save both water and money by reducing the amount of raw water that must be treated but can't be billed. As noted in Chapter 2, some of the utilities in the South Cumberland study area have such programs in place, but others could benefit from adopting them as well.

Other effective strategies for reducing the pressure on existing water supply sources and reducing current costs include

- metering all water use, even use that isn't billed, to support leak detection efforts and minimize the amount of water that can't be accounted for;
- pricing water to promote conservation, for example by adopting an inclining block rate schedule and higher rates for landscape irrigation;
- installing landscaping that requires less water with less turf, more mulch, and timed or moisture-sensing irrigation systems;
- replacing old fixtures and appliances that require more water than newer models; and
- reusing or recycling water, using treated wastewater for irrigation, groundwater recharge, etc.

> Of the many options available for conserving water, leak detection is a logical first step. If a utility does what it can to conserve water, customers will tend to be more cooperative in other water conservation programs, many of which hinge on individual efforts.
>
> *Leak Detection and Water Loss Control*
> National Drinking Water Clearinghouse

Some of the South Cumberland utilities have adopted one or more of these strategies, for example, Sewanee imposes higher rates for irrigation and is looking into reuse strategies, and Big Creek has adopted an inclining block rate schedule for domestic water use. Both Big Creek and Tracy City have highly looped distribution systems, which typically require much less flushing than systems with more dead-end lines. All of the utilities could benefit from further conservation and demand management. Options such as those listed here are described further and resources for more information about them are included in Appendix D.

4.3 Regionalization

As noted in Chapter 3, maintaining and improving their ability to share water supply sources is paramount to each utility's ability to meet demand through a drought or as the area grows. Regionalization can extend limited supplies to meet projected withdrawal needs routinely as well as during emergencies. In 2007, Big Creek and Sewanee had surpluses of water during the drought, while Tracy City and Monteagle suffered major shortages. Monteagle mitigated impacts, in part, by purchasing finished water through connections to Sewanee and Tracy City. Formal contracts currently exist between Tracy City and Big Creek and between Tracy City and Monteagle. Although the combined reliable yield of the region's existing water supply sources is less than both current and projected raw water withdrawals for 2030, further regionalization is always an option worth pursuing to maximize the use of existing sources and reduce the risk of any one utility running out of water in a localized emergency. The utilities in the region have already taken a major step in this direction by adopting a regional drought management plan.

4.4 Existing Source Improvement—Modification of Big Fiery Gizzard Dam and Reservoir

Tracy City applied for an Aquatic Resource Alteration Permit in 2008 to raise Big Fiery Gizzard Dam and increase the reservoir's storage capacity. Figure 4-2 below shows the existing reservoir, dam, and intake-riser structure extending from the center of the dam into the normal pool.

Description of the Alternative. The proposed modification involves raising the dam and normal reservoir pool by seven feet. Crushed rock fill, excavated from near the existing emergency spillway, would be placed on the downstream face of the dam to raise it. The storage capacity of the reservoir would increase by approximately 168 million gallons. Its surface area would expand by roughly 37 acres. Its shoreline would gain about 4,000 feet.

Figure 4-2. Aerial photo of Big Fiery Gizzard Reservoir

Design of the Alternative. The proposed alteration should not change the existing hazard classifications of the dam.

Potential Costs. As noted in Table 4-1, the estimated cost of this alternative is $3.5 million.

4.5 New Source Development

Three alternatives were considered for new source development: building a new dam and reservoir on Big Creek, purchasing Ramsey Lake, and building a finished water pipeline up the eastern side of the plateau from South Pittsburg.

4.5.1 Construction of Big Creek Reservoir

Because the watersheds on top of the plateau are relatively small and development is scattered, it was once believed that there were no longer any suitable locations on the plateau for a new reservoir with any significant storage volume. Upon a further review, a location to the east of Altamont, along Big Creek, was identified as suitable for a reservoir of considerable size. Although preliminary designs have not been developed for the reservoir, consultants working for the study team were able to develop preliminary design details from a number of sources.

Description of the Alternative. This alternative involves construction of an earthen embankment roughly 1,100 feet upstream of the State Route 56 Bridge over Big Creek. It would impound approximately 1,575 million gallons at normal pool elevation and inundate a surface area of roughly 306 acres. Figure 4-3 shows the drainage area (green line), normal pool, and nearby water treatment plant.

Design of the Alternative. The proposed dam would have a concrete main spillway, an earthen auxiliary spillway, a hydraulic height of 60 feet, and a structural height of 80 feet. The reservoir's volume at normal pool elevation (1,800 feet) is approximately 1.4 billion gallons. The top of the dam would be 25 feet wide and accessed from Old Route 56. The dam would most likely be classified in the Hazard Potential Category 1 because of the potential downstream impacts from a failure. Figure 4-4 shows the proposed Big Creek Reservoir with a potential route for a pipeline to the Big Creek Utility District water treatment plant or Ranger Creek Reservoir.

Potential Costs. The total investment cost for this alternative is estimated at $20 million.

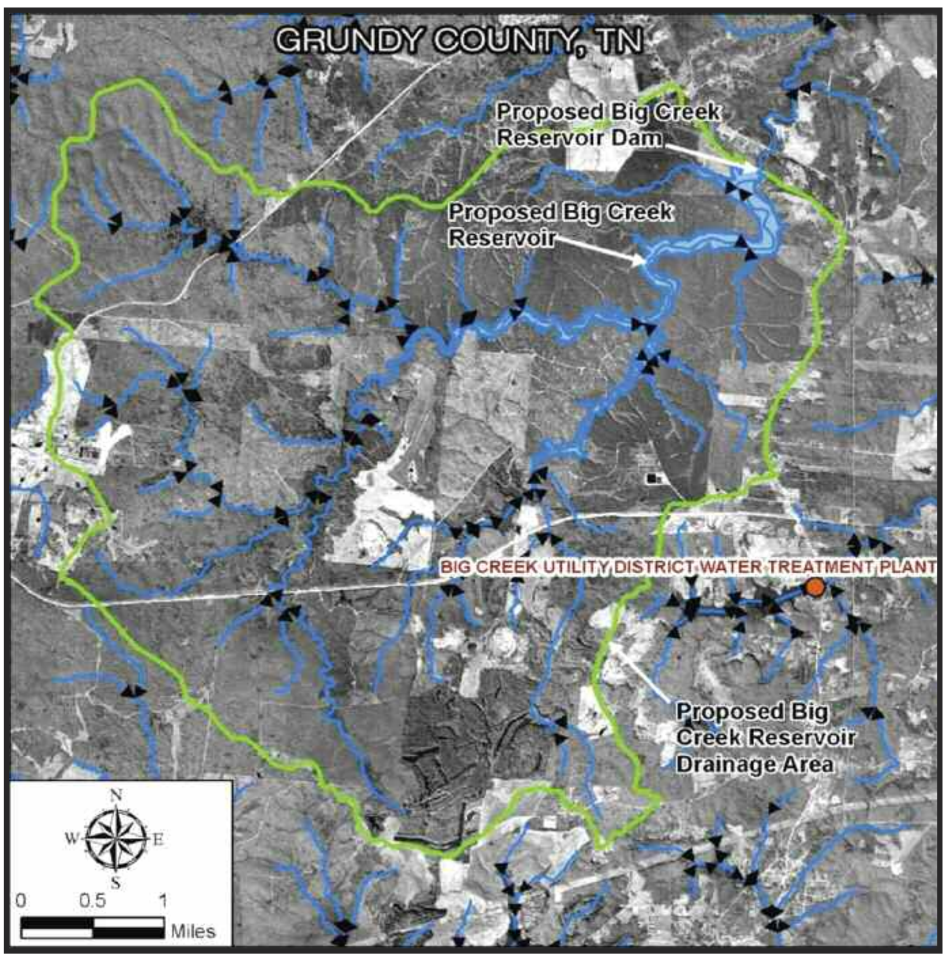

Figure 4-3. Proposed Big Creek Reservoir drainage area map

4.5.2 Purchase and Modification of Ramsey Lake

James C. Hailey and Company investigated this water supply alternative on behalf of Big Creek Utility District. This alternative involves purchasing Ramsey Lake, an existing privately owned recreational body, and converting it to a water supply source. Ramsey Lake comprises two hydraulically connected pools. At normal pool, the lake has a storage volume of about 185 million gallons and a surface area of about 66 acres. Figure 4-5 on the next page shows Ramsey Lake's normal surface area and its watershed boundary (green line).

Description of the Alternative. This alternative includes installation of a floating dock intake and a raw water pipeline with a pump to transfer water to Ranger Creek Reservoir, about 3 miles away. The existing dam has a 560-foot embankment with a 21-foot structural height, 16-foot hydraulic height, and a top elevation of 1,879.5 feet. A combined principal/emergency earthen spillway maintains the normal pool elevation at 1,874.2 feet and routes the flow exiting the lake through a natural channel to a confluence with the original stream channel of Corn Branch. A roadway embankment separates the north and south ends of the lake. It has an estimated storage volume of 185 million gallons. Using the lake for water supply would change its Safe Dams classification to Hazard Potential Category 1 because three residences and one country road downstream of the dam could be flooded if the dam broke. Upgrades to the dam, including modification of the existing spillway to increase its safety and potentially the addition of a low flow outlet, would be necessary.

Potential Costs. Total investment costs consist of the total present value of construction costs and operational costs. A constant delivery of 1.0 million gallons per day was assumed for the electricity cost estimate. Operational costs for the water intake at Ramsey Lake include annual inspection, incidental repair, and annual pumping power requirements. Pipe replacement costs were assumed at 10- and 25-year intervals. As shown in Table 4-1, the total present value of the cost to buy the reservoir and convert it to a water supply, including the present value of the operational costs, is about $9.6 million. This estimate does not include safety upgrades for the spillway.

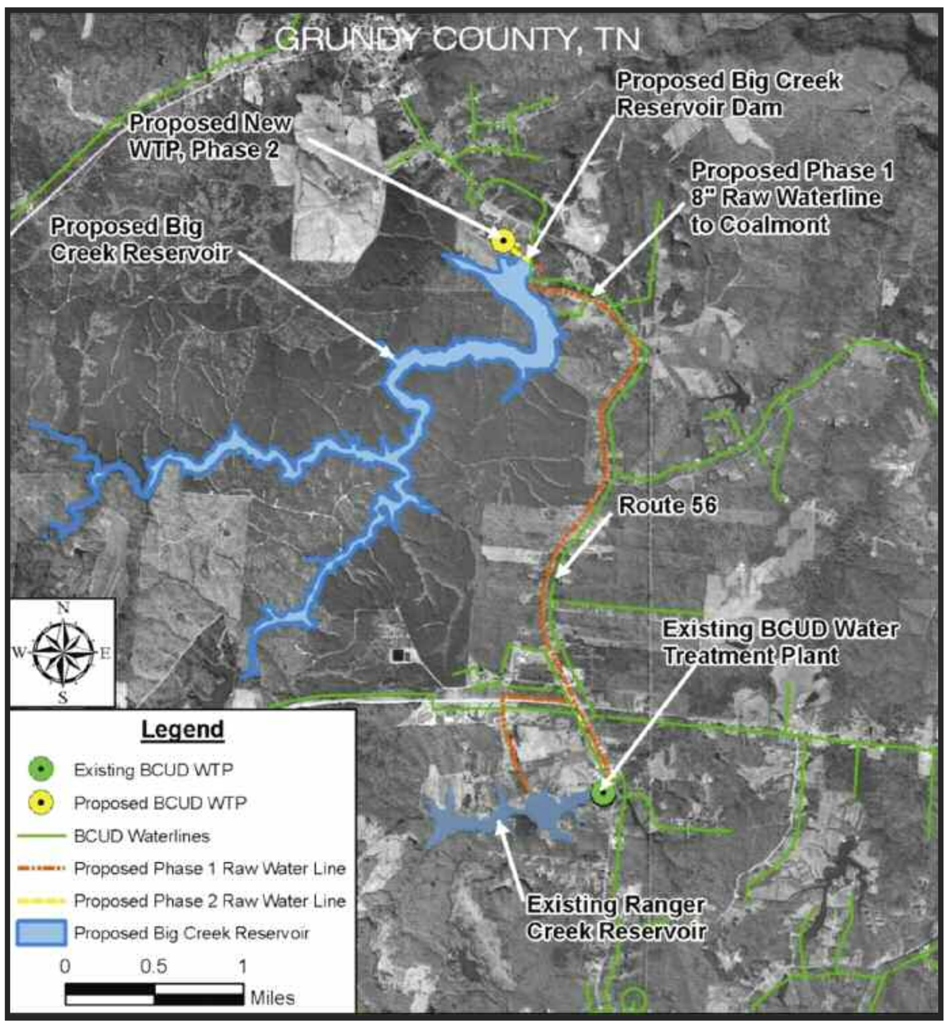

Figure 4-4. Proposed Big Creek Reservoir, Transmission Main, and Water Treatment Plant

4.5.3 Construction of a South Pittsburg Pipeline

Originally proposed by Grundy County in 2008, this alternative involves building a 40-mile-long pipeline to deliver treated water from South Pittsburg to the study area. The water would be withdrawn from the Tennessee River and treated at South Pittsburg's water treatment plant.

Description of the Alternative. Construction would occur in three phases and include new pipelines, storage tanks, and pumps. Phase 1 proposes building a pipeline from the end of South Pittsburg's distribution system to Monteagle, constructing a new water storage tank, building a new booster pump station, and upgrading the existing South Pittsburg pumps to provide 600,000 gallons of water per day of treated water. Phase 2 would increase the pipeline's pumping capacity to 3.0 million gallons per day. Phase 3 would extend a network of smaller pipelines across the plateau from Monteagle to Big Creek Utility District and Tracy City. Figure 4-6 shows an overview of the proposed water transmission pipeline route.

Potential Costs. The operational costs for the South Pittsburg Pipeline are based on available information and a preliminary design of the pipeline. The following table summarizes costs for the South Pittsburg Pipeline from the 2008 study, updated to August 2010 price levels, for each of the three phases.

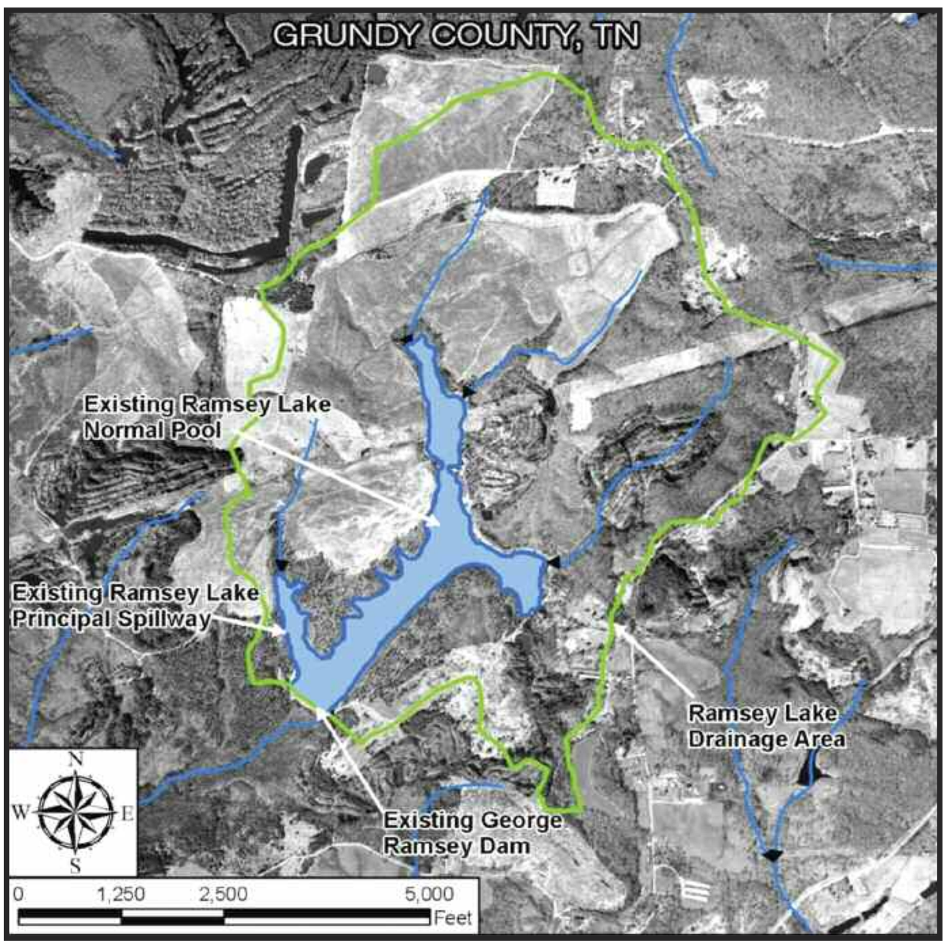

Figure 4-5. Ramsey Lake Drainage Area Map

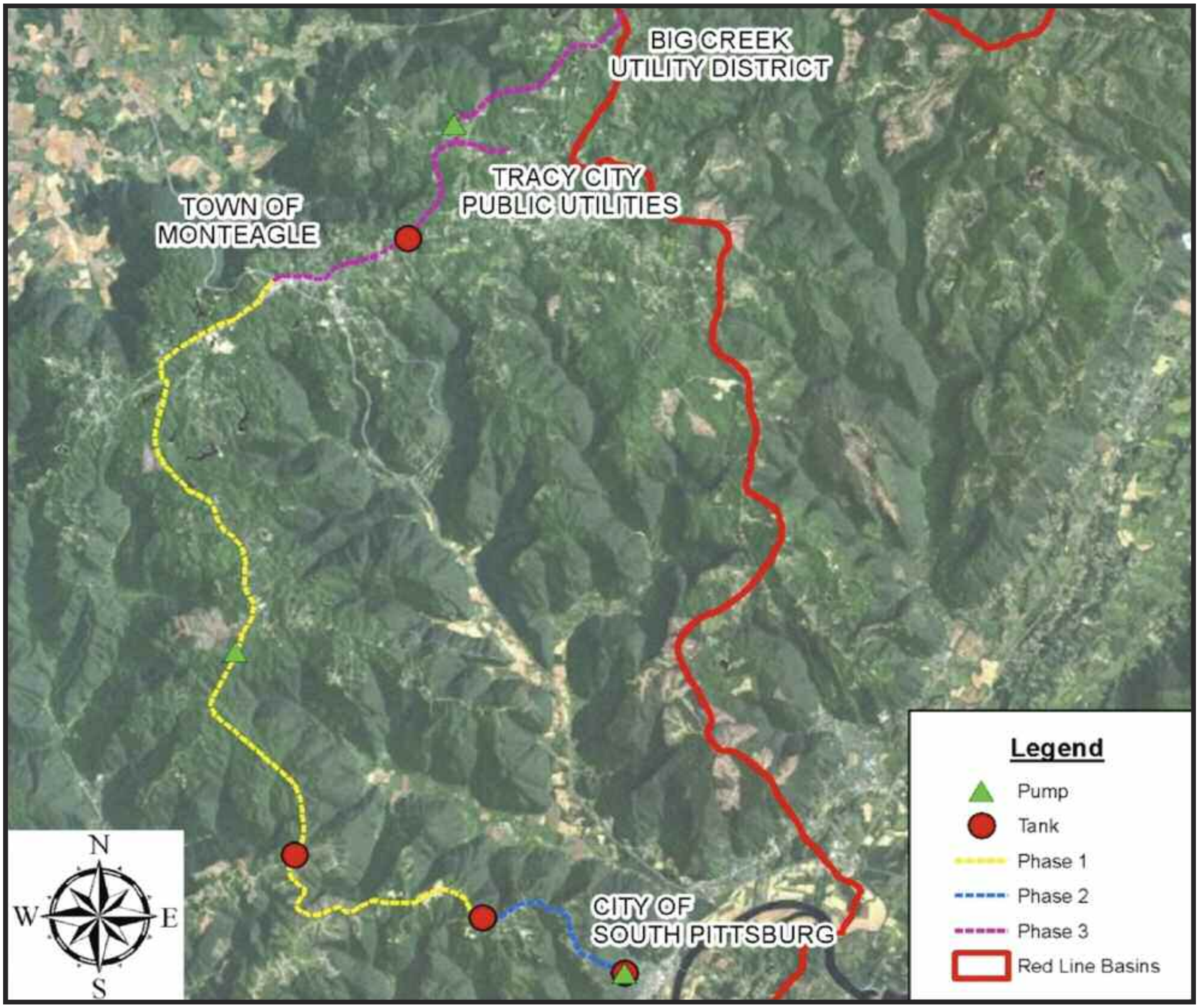

Figure 4-6. South Pittsburg Pipeline Alternative Proposed Route and Phases

Table 4-3. Estimated Cost of South Pittsburg Pipeline by Phase of Construction

Pipeline Phase		Construction Cost* (in millions)	Operational Cost (in millions)	Total Cost (in millions)
Phase 1	600,000 gallons per day Transmission Line to Monteagle	$ 11.5	$ 13.6	$ 25.1
Phase 2	Upgrade to 3 million gallons per day to Monteagle	3.7	44.2	47.9
Phase 3	Extend to 3 million gallons per day to Tracy City and Big Creek	10.3	0.4	10.7
All Phases		$ 25.5	$ 58.2	$ 83.7

* Includes engineering design, site surveys, and miscellaneous other expenses associated with construction.

Chapter 5. Evaluation and Selection of Alternatives

5.1 Introduction

Selecting the best alternative requires thorough study and a fair comparison. Each alternative must be measured against the same criteria. The study team adopted the criteria used in the Duck River Agency's regional water supply study, which involved extensive input from all of the stakeholders and the public, with one modification as indicated below:

- **Sufficiency**—the ability of the source to support the study area's projected need for an additional 440,000 gallons per day
- **Cost**
- **Implementability**—the presence or absence of known obstacles or challenges
- **Flexibility**—capacity for phased implementation, drought resistance, and adaptability to changed conditions
- **Raw and Finished Water Quality**
- **Environmental Benefits and Impacts**
- **Other Relevant Factors**—a broader criterion than recreation, which was used in the Duck River study

This chapter describes the study team's two-tiered analysis of the alternatives presented in Chapter 4. Except as otherwise indicated, information used in the analyses presented here is found in the sources listed at the beginning of Chapter 4.

5.2 Tier 1 Criteria and Evaluation

The Tier 1 evaluation of alternatives was qualitative and included the first four factors listed above: sufficiency, cost, implementability, and flexibility. Alternatives that failed to meet the sufficiency criterion were eliminated immediately; the rest were carried all the way through Tier 1. Alternatives that appeared relatively equal based on the Tier 1 evaluation were subjected to the Tier 2 evaluation.

5.2.1 Tier 1: Sufficiency

Sufficiency is a threshold criterion that compares yield to raw water needs. If the reliable yield of an alternative is insufficient to supply the projected raw water withdrawal needs of the study area, then there is no need to evaluate it further. A number of variations of the alternatives presented in Chapter 4 were modeled to determine whether they could meet current and projected withdrawal needs through the 2030 planning horizon. Each alternative was modeled for its effects on all utilities in the study area simultaneously. The following standards were applied and had to be met for every utility or the alternative was rejected:

- a 20% reserve of usable storage remains in each reservoir in the system for all years of the historical rainfall/drought record and
- no drought plan is triggered more often than once every 7 to 8 years.[26]

Regionalization alone could not meet either sufficiency standard but was included as an option in modeling the other alternatives. Raising Big Fiery Gizzard Dam failed to meet either standard, but modeling showed that it could pass the sufficiency test if the current minimum release requirement were reduced. Other alternatives that passed the sufficiency test were purchasing and modifying Ramsey Lake and building the proposed Big Creek Reservoir. The combination of Ramsey Lake and raising Big Fiery Gizzard Dam was also modeled to determine whether it would be sufficient without reducing the minimum release requirement. It passed both tests and was carried forward as an option to consider if the release requirement cannot be reduced. Sufficiency was not modeled for the South Pittsburg pipeline because it could be engineered and built to provide any water supply capacity desired.

5.2.2 Tier 1: Cost

The Tier 1 evaluation of costs is a qualitative assessment of the estimates for each of the alternatives presented in Chapter 4. Table 5-1 below recaps the cost estimates from Chapter 4 and shows the combined cost of Ramsey Lake and Big Fiery Gizzard Dam.

Raising Big Fiery Gizzard Dam is the least expensive alternative, but the minimum release requirement must be modified to meet the sufficiency standards. The South Pittsburg pipeline is by far the most expensive alternative.

Table 5-1. Summary of Estimated Costs for Water Supply Source Alternatives that Meet the Sufficiency Requirement

Alternative	Estimated Cost* (in millions)
Raising Big Fiery Gizzard Dam and modifying the minimum release requirement	$ 3.5
Purchasing and modifying Ramsey Lake	$ 9.6
Raising Big Fiery Gizzard Dam plus purchasing and modifying Ramsey Lake	$ 13.1
Building Big Creek Reservoir	$ 26.4
Building a Pipeline to South Pittsburg	$ 83.7

* Includes both construction costs and operational costs over a 50-year life cycle. Net present values of costs were based on an interest rate of 4.375%.

[26] The primary modeling tool used to evaluate water supply sufficiency is the OASIS model used to determine reliable yield (see Chapter 2). Details of the analysis, methodology, and results are described further in Appendix E.

5.2.3 Tier 1: Implementability

The implementability of an alternative is a measure of the relative ease with which it can be accomplished in time to meet projected needs. This criterion considers whether regulatory permitting (including environmental considerations), public acceptance, property acquisition, or constructability issues could stymie or delay implementation of the alternative.

Permitting is a large part of implementability. Tennessee dams are regulated by the Safe Dams Section of TDEC's Division of Water Supply, which is responsible for certifying, inspecting, and approving dams, and by TDEC's Division of Water Pollution Control, which is responsible for protecting surface waters. The following permits or documents may be required for any of the alternatives:

- Aquatic Resource Alteration Permit (ARAP) or Section 401 Water Quality Certification for stream alteration from the Division of Water Pollution Control (TDEC)
- Section 404 Permit from the U.S. Army Corps of Engineers
- Section 26-A Permit may be required from the Tennessee Valley Authority
- Safe Dams Certificate from the Division of Water Supply (TDEC)
- Stormwater Discharge Permit for the construction site from the Division of Water Pollution Control (TDEC)
- Inter-basin Transfer Permit from the Division of Water Pollution Control (TDEC)

Raising Big Fiery Gizzard Dam and Modifying the Required Minimum Release. Implementability concerns stem mainly from potential downstream effects that will require a more definitive evaluation of existing conditions to determine whether the current release requirement can be changed. Tracy City has already obtained an Aquatic Resource Alteration Permit (ARAP) to raise the dam, but it retains the current minimum release requirement of 1.0 cubic foot per second, which was set without a detailed study of the potential impacts to the Exceptional Tennessee Water downstream where Big Fiery Gizzard Creek flows into the Grundy Forest State Natural Area. Preliminary information indicates that the modification would not harm aquatic resources, but making that determination will require further evaluation. Releases from the existing outlet as currently operated depend on the elevation of the lake—the higher the lake the more water is released from the outlet.

Other implementability concerns relate to the additional area that would be inundated by raising the dam. About 37 acres would be affected, the majority of which (19.6 acres) is public land. The remainder is a mix of residential, timber, vacant, and road or right-of-way land uses. Two structures, a private residence and a storage shed, would be affected. The larger lake would affect approximately 200 feet of Brown Road and 310 feet of Orchard Drive, which includes a 6-inch water pipe that belongs to Tracy City.

Purchasing and Modifying Ramsey Lake. This alternative raises several implementability concerns related to the permits that may be required and to the challenges posed by purchasing an existing private lake and modifying the dam to meet safety standards for water supply lakes. First, the permits: Big Creek Utility District applied for an ARAP in 2008 for the preliminary design. The application states that, to mitigate environmental impacts, withdrawals would occur only when Ramsey Lake is overflowing. Ramsey Lake itself is considered a wetland and could be impacted during times of significant withdrawal and drawdown. Ranger Creek Reservoir, Big Creek Utility District's existing water source, would be affected by the downstream discharge of water, and reduced downstream discharges could reduce water quality in Corn Branch and other receiving waters. If an ARAP were issued, it would likely impose a downstream flow requirement.

Construction of a pipeline to the existing water treatment plant could require additional permits. The pipeline crosses two streams—one a minor tributary of Ramsey Lake; the other Ranger Creek, upstream of Ranger Creek Reservoir. These streams could be affected by pipeline construction, and a construction permit may be required for the temporary impact. Properly constructed, the pipeline should have virtually no long-term impact on these streams. However, it would cross the boundary between the Tennessee Western Valley River Basin and the Upper Cumberland River Basin and so may require an inter-basin transfer permit.

Although the size of the lake and the height of its dam would remain the same, the embankment and spillway would have to be modified to meet Safe Dams' requirements for water supply dams, which do not apply to private lakes. The proposed intake structure would need a permanent valve pit and would affect a small area of vacant land. The approximately 15,100-foot-long pipeline would cross 14 parcels of land with varied uses, including six residential parcels, and four roads, most notably crossing Lockhart Town Drive at two locations.

Raising Big Fiery Gizzard Dam and Purchasing Ramsey Lake. The implementability concerns for this alternative are a combination of those discussed for the individual alternatives except that it does not require a change in the minimum release requirement for Big Fiery Gizzard Reservoir.

Building Big Creek Reservoir. This alternative raises similar concerns: environmental considerations for permitting, inundated areas and potential downstream impacts. The proposed lake would cover about 305 acres at its normal pool elevation of 1,800 feet and would inundate about 45,457 feet of Big Creek. The portion of Big Creek within the boundaries of Savage Gulf and South Cumberland State Park, about 1.5 miles downstream of the proposed dam, is an Exceptional Tennessee Water. Thus, the potential downstream impacts of the Big Creek Dam must be studied in detail to develop potential minimum flow requirements. No permit has been applied for, and whether the alternative could meet the sufficiency standards outlined in Section 5.2.1 if some minimum flow requirement were imposed on it is not known.

Other implementability concerns relate to the area that would be covered by the lake and the potential effect on Eagle Lake upstream of the proposed dam site. The area that would be inundated is mostly rural with a mix of wooded and farm land uses and about 16 acres of vacant residential land. Two unnamed bridges, about 200 feet of Old Highway 56, and 500 feet of unnamed farm road would be inundated or affected. About 200 feet of a Big Creek Utility District 6-inch waterline would also be inundated. Eagle Lake, southwest of the dam, could be affected; at normal pool, the proposed reservoir extends nearly to the Eagle Lake dam, and large storms could cause Big Creek Reservoir to reach the dam's downstream face. This potential impact requires further investigation. Two residential structures downstream of the auxiliary spillway would be affected by dam construction. Property impacts would increase for the maximum proposed pool inundation (1,820 feet), which is 20 feet higher than the normal pool.

Building the South Pittsburg Pipeline. Implementability issues for this alternative relate mainly to permitting. The proposed pipeline would bring finished water up several hundred feet from South Pittsburg to the utilities in the study area. South Pittsburg's current withdrawal from the Tennessee River would increase by up to 3.0 million gallons per day. The river's flow at South Pittsburg is largely regulated by the outflow from Nickajack Reservoir. Nickajack is a Tennessee Valley Authority (TVA) lake with multiple purposes, including flood control, power generation, recreation, and water supply. A separate study may be needed to assess the impacts of withdrawal on the Tennessee River and the operation of the TVA reservoirs.

An inter-basin transfer permit may be required. The majority of the proposed pipeline would lie within the Tennessee Western Valley River Basin, but there are a number of end-use points, including customers and wastewater treatment facilities, that are not in the Tennessee Western Valley River Basin.

Construction of the pipeline would disturb over 60 acres of land. The new lines would run along State Route 156 for most of the distance between South Pittsburg and Monteagle. Sections of the route run through Franklin Marion State Forest. Construction would require heavy trucks and machinery on the local roads. Some land would likely be purchased for the pipeline, storage tanks, and pumping stations.

5.2.4 Flexibility

The flexibility of an alternative is a matter of whether it can be implemented in phases, with costs spread over time, while still reliably meeting projected regional water supply needs. This criterion also considers an alternative's resistance to drought

Raising Big Fiery Gizzard Dam and Modifying the Release Schedule. This alternative would be constructed in a single phase. It is fairly resistant to drought.

Purchasing and Modifying Ramsey Lake. Conversion of Ramsey Lake from private use to water supply would likewise be a single-phase project. It would be highly resistant to drought and could serve the region well beyond the planning horizon.

Raising Big Fiery Gizzard Dam and Purchasing Ramsey Lake. Combining the proposed Big Fiery Gizzard Dam project with the conversion of Ramsey Lake to water supply creates an alternative that could be completed in two phases. It would reliably meet the projected regional water supply needs.

Building Big Creek Reservoir. This new reservoir would also be built in a single phase. As proposed, the reservoir would more than meet projected needs and thus would be highly resistant to drought.

Building the South Pittsburg Pipeline. The proposed pipeline would be completed in three phases, allowing costs to be spread over time. With its connection to the Tennessee River, this alternative would be highly resistant to drought and allow for expansion beyond the current projected need.

5.2.5 Tier 1 Evaluation Summary

As Table 5-2 below indicates, neither regionalization nor raising Big Fiery Gizzard Dam without reducing the required minimum release could provide sufficient capacity and so were eliminated from further study. However, as noted previously, regionalization is recommended as a means to extend supplies to meet projected needs. Big Creek Reservoir was eliminated because of its relatively high cost ($26.4 million), its potential downstream impacts on the Exceptional Tennessee Water in the Savage Gulf portion of South Cumberland State Park, and its lack of flexibility (it cannot be constructed in phases). The combination of the Big Fiery Gizzard Dam and Ramsey Lake alternatives was also eliminated because it performed only marginally better than Ramsey Lake alone and was significantly more expensive.

Table 5-2. Tier 1 Evaluation Summary

Alternative	Sufficiency	Cost	Implementability	Flexibility
Regionalization	-	*	*	*
Raising Big Fiery Gizzard Dam	-	*	*	*
Raising Big Fiery Gizzard Dam w/modified minimum release	+	$	+/-	-
Purchasing and modifying Ramsey Lake	+	$$	-	-
Raising Big Fiery Gizzard Dam plus purchasing and modifying Ramsey Lake	+	$$$	+/-	+
Building Big Creek Reservoir	++	$$$$	- -	-
Building finished water pipeline to South Pittsburg**	++	$$$$	+/-	+/-

* These alternatives failed to meet the sufficiency standards and were eliminated from further evaluation.
** Includes all three phases of the pipeline.

Based on the Tier 1 evaluation, three alternatives warranted Tier 2 evaluation:

- raising Big Fiery Gizzard Dam and modifying its release schedule,
- purchasing and modifying Ramsey Lake, and
- building phase one of the pipeline to South Pittsburg.

The entire pipeline project would not have to be built at one time. As noted in Chapter 4, Phase one alone could provide 600,000 gallons per day, which is more than the 440,000 gallons needed. It would meet the sufficiency criteria for the 2030 planning horizon at only a fraction of the cost of the entire project as proposed.

5.3 Tier 2 Criteria and Evaluation

Tier 2 criteria included examination of the storage remaining in a critical drought—an extension of the sufficiency analysis; refinement of costs; and consideration of the quality of the raw and finished water for the alternative, any potential environmental benefits and impacts, and any other factors relevant to a decision. Other factors included whether an alternative could serve multiple purposes, such as releases from a dam that could improve the stability of downstream resources or the recreational attractiveness of the area; whether an alternative allows for economic growth or provides for the study area beyond the planning horizon; and whether the alternative makes financial sense for the utilities and their customers. The study team also considered any updates or additional details obtained on the Tier 1 criteria.

Table 5-3 summarizes the evaluation. It is important to note that this study did not have the resources to completely answer many of the Tier 2 questions; however, enough information was available to eliminate some alternatives and recommend others for more detailed study.

Table 5-3. Tier 2 Evaluation Summary

Alternative	Storage Remaining* (million gallons)	Cost (millions)	Water Quality	Environmental Benefits or Impacts	Other Factors
Raising Big Fiery Gizzard Dam w/Modified Release Schedule	5.4	$3.5	No Change	Release study required	Study could increase existing release requirements
Purchasing and Modifying Ramsey Lake	70.4	$9.6 to $15**	Additional treatment may be needed	Release study required	Dam safety classification will change
Building Phase I South Pittsburg Finished Water Pipeline	n/a***	$25.1	Long transmission could cause problems	None identified	High energy use/operational costs would increase costs to consumers more than other alternatives

* Above 20% reserve storage.

** Includes a range of potential raw water pipeline routing options, real estate costs, and costs to improve the spillway.

*** Not a storage project; relies on Tennessee River and, therefore, highly drought resistant.

5.3.1 Storage Remaining During Critical Drought

Storage remaining in Table 5-3 refers to the volume of water left in a reservoir above the 20% reserve required to pass the sufficiency test. This criterion applies only to reservoirs and was not modeled for the pipeline alternative. Storage remaining above the 20% reserve would provide flexibility for the region beyond the 2030 planning horizon adopted for this study. Each reservoir alternative was modeled as a regional scenario in which the source was shared through interconnections to serve all of the utilities in the study area.

The amounts shown in column one of Table 5-3 for the two reservoir alternatives are based on the most severe drought on record in the study area compared with water use needs projected for 2030 from Chapter 3. The modified Big Fiery Gizzard Dam alternative would provide additional supply to Tracy City while also meeting Monteagle's needs when its supplies are not sufficient to meet customers' needs. Approximately 5 million gallons of additional storage in the lake remained in this scenario. With the Ramsey Lake alternative, Tracy City and Monteagle would purchase water from the lake via Big Creek Utility District. Additional storage remaining in Big Creek's system after meeting regional needs in this scenario would be approximately 70 million gallons.

5.3.2 Cost

Cost is a particular concern in the South Cumberland study area because, as noted in Chapter 1, water prices are already high in this area of low household incomes. All project information available to the study team was conceptual, so cost estimates considered would change if further engineering work were done. And estimates of certain types of costs, including potential real estate costs, were not available. Even so, the cost estimates that were currently available are consistent with the conceptual design stage of project development.

The least expensive project evaluated in Tier 2 is raising Big Fiery Gizzard Dam. The cost to purchase Ramsey Lake and convert it to a water supply is not well defined. Unknown costs include the purchase price of the lake and the cost of modifying the dam to meet state safety standards and minimum release requirements. The range of costs presented in Table 5-3 is based on the initial asking price for the real estate, the cost of the structural modifications required, a pipeline to Ranger Creek Reservoir, and the present value of operating costs for the 50-year life of the project. Phase one of the South Pittsburg pipeline is the most expensive. Costs from a 2008 feasibility study were updated to 2010 prices, and operational costs, which account for more than half the cost presented in Table 5-3, were estimated and added.

5.3.3 Water Quality

The quality of the treated water of each alternative was also considered. Modifying Big Fiery Gizzard Dam and Reservoir would have little effect on existing drinking water quality and require no specific change in water treatment practices.

The water chemistry of Ramsey Lake is different from some of the other water sources in the region, partly because of historic mining in the watershed upstream of the lake. Specific effects would need to be studied in more detail. Water quality analysis completed for Big Creek Utility District's ARAP application documented high levels of manganese and other metals from former mining activities in the Ramsey Lake watershed.[27] Drawing Ramsey Lake down could concentrate pollutants in a smaller volume of water so that differences in chemistry between the water supplies could cause taste changes and potentially lower potable water quality.

[27] See Appendix F, Water Supply Lake Study—South Cumberland, Tennessee Department of Environment and Conservation, Division of Water Pollution Control.

The effects on water quality of mixing the existing Ranger Creek Reservoir raw water with Ramsey Lake raw water are unknown and would vary with pumping frequency throughout the year, requiring the treatment plant to alter its processes periodically.

Phase one of the South Pittsburg pipeline could raise water quality issues because it involves moving a large volume of treated water from South Pittsburg to Monteagle, a distance of roughly 26 miles through a 16-inch pipe. Disinfection byproducts increase as residence time in pipelines increases. This effect could be mitigated by additional flushing, but flushing removes treated water from the water supply and so can be costly. In addition, the effect of mixing the water from the Tennessee River with water from the Plateau is not known. Differences in chemistry between the water supplies could cause taste problems and potential areas of lower potable water quality. The utility districts on the Plateau could have to alter their treatment processes periodically to deal with the differences.

5.3.4 Environmental Benefits or Impacts

Because raising Big Fiery Gizzard Dam cannot provide sufficient water unless the downstream release requirement in the current ARAP is reduced, a detailed study is needed to define downstream needs and potential impacts. Any change would need to be agreed upon. Conversion of Ramsey Lake to water supply would also require a study of potential downstream impacts and a determination of downstream release requirements. Currently, there is no controlled release structure at Ramsey Lake; all releases are through overtopping of the spillway. The addition of a mechanism to control releases is likely to have positive effects downstream. Phase one of the pipeline alternative would have limited direct impacts on either the Tennessee River or the pipeline construction pathway. It would, however, be less environmentally sustainable than other alternatives because of its high energy requirements. A significant amount of energy would be needed to pump the water up to the plateau. In addition, because treated water would be pumped a long distance, there is a greater potential for water loss and development of disinfection byproducts.

5.3.5 Other Relevant Factors

All of the Tier 2 alternatives would meet the region's water supply needs beyond the 2030 planning horizon. Raising Big Fiery Gizzard Dam is the least costly alternative and would make the most financial sense for the utilities and their customers if the current release requirement can be reduced. Because operational costs cannot be financed or funded with grants and so must be passed along to utility customers, they are a major concern. The average annual operational costs have an estimated present value of $436,000 for the 50-year life of the project, the lowest of the three alternatives evaluated in Tier 2.

The Ramsey Lake alternative is the second most expensive alternative. The present value of its average annual operating costs is estimated at $667,000. An important consideration with this alternative is that the purchasing utility would be assuming liability for a dam that it did not design and build. The upgrades required to meet state safety standards would make the dam safer and reduce the risk to those living or camping downstream of the dam.

Phase one of the pipeline is the most expensive alternative. The present value of its average annual operating costs is estimated at approximately $13.6 million. This includes the costs to operate and maintain the pumps, to rehabilitate one pump at year 10, and replace one pump at year 25, as well as the present value of energy costs. It does not include the cost to purchase water from South Pittsburg or any potential increase in energy rates. Even if the pipeline were funded entirely with grants, the operational costs alone could make it unaffordable for customers in the study area.

5.4 Selection of Preferred Alternative

The alternative selected by the study team is raising Big Fiery Gizzard Dam and reducing its downstream release requirement. This alternative would provide enough water for the planning horizon of 2030, it is the least expensive by a significant margin, and it could be accomplished relatively quickly, which is an important factor given that there is not enough supply in the region to meet today's reliability requirements.

There is, however, one major unknown—downstream release requirements. Raising the dam could meet Tracy City's need through 2030, but unless the current permitted downstream release can be reduced, the reservoir will not provide enough water to serve the region reliably through the planning horizon. The additional study required to determine an acceptable minimum release is underway. A draft report has been prepared and is under review by staff of the Corps, TDEC, and the Tennessee Wildlife Resources Agency.

Although neither conservation nor regionalization alone can meet the water supply needs of the study area through the planning period, the study team recommends pursuing both of these relatively low-cost strategies to make the best use of existing and new water supply sources and improve the region's drought resistance.

Chapter 6. Next Steps

6.1 Introduction

This chapter lays out the steps required to implement the preferred alternative for the twenty-year planning horizon. Making it happen and making it affordable will require no small amount of cooperation and coordination. The water suppliers and many other agencies will be involved, as will the entire community, which in the end, must bear the cost of meeting the region's water supply needs. Accomplishing all of this will require considerable planning. These next steps are offered as a starting point for that process. They will need to be evaluated by the community and adapted to their circumstances. To succeed, they will require the active participation of all communities and utilities in the region.

Based on the study team's water supply withdrawal projections, all of the water suppliers in the study area will need additional raw water before 2030 to ensure sufficient reliable capacity to meet customers' needs. In the meantime, the region could benefit by increasing its efforts to make the most efficient use of its current water resources. Increased conservation and demand management will maximize the water supply from both current and future sources. The study team strongly urges all utilities in the study area to work together to implement these strategies. The study team commends area utilities' adoption of a regional drought management plan and recommends continued efforts to work together as a region to optimize use of their water supply sources through interconnectivity and sharing.

6.2 Water Conservation and Demand Management

Conservation and demand management are essential to making the best use of current and future water supply sources. All of the utilities in the study area can extend their current water sources by reducing leaks and flushing. They can improve their financial condition by reducing unbilled water and by improving energy efficiency. As part of this study, an energy audit was provided to Big Creek Utility District. The method and results are described in Appendix G. Other area utilities should review the report for ideas to improve their own energy efficiency. As noted in Chapter 2, all area utilities' unaccounted for water percentages are within the 35% limit adopted by the Utility Management Review Board and the Water and Wastewater Financing Board, but that limit is likely to be reduced in the future as utilities across the state improve their efficiency.[28]

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[28] The American Water Works Association (AWWA) recommends a shift in focus away from unaccounted for water to non-revenue water (for their assessment of the issues, see http://www.awwa.org/Resources/WaterLossControl.cfm?ItemNumber=47866) and has developed a recommended water audit method that includes a set of performance indicators for non-revenue water and water losses (see http://www.awwa.org/Resources/WaterLossControl.cfm?ItemNumber=48055). The state's two water utility regulatory boards have adopted the AWWA's water loss methodology for use in financial statements received after January 1, 2013.

Strategies for conserving water and managing demand include

- adopting active leak prevention, detection, and repair programs;
- metering unbilled water to better account for and manage all types of water usage;
- informing and educating the public about conservation;
- pricing water to encourage conservation;
- providing incentives for retrofitting and replacing old fixtures and appliances; and
- adopting water efficiency codes and ordinances.

These and other options presented in Chapter 4 are described more fully in Appendix D. Many of these strategies can be implemented without inconveniencing customers or the systems themselves. Adopting any of them, however, necessarily involves learning new ways of doing business. The potential to keep water bills low by postponing structural investments makes them worth the effort.

6.3 Commitment to a Regional Approach

This regional water supply planning pilot has been a collaborative effort from the start. Managers of the study area's major utilities and their state and local elected leaders, as well as members of local communities, were fully engaged in early study findings about water needs and in formulating reasonable alternatives. Although they were not required to commit to a single, regional solution, there are compelling reasons to justify development of a shared water storage project at Big Fiery Gizzard Reservoir and much to be gained from further collaboration. Recognizing this, and following the Tennessee Department of Environment and Conservation's Guidance for Developing Community Water System Drought Management Plans,[29] area utilities have already formulated a regional drought management plan, which was adopted in April 2010.

To benefit more routinely from regional collaboration, area utilities need a formal inter-utility communication and coordination plan for sharing water supply sources. To assist them in developing and evaluating water-sharing scenarios, Tennessee Technological University (TTU) will provide access to the hydrologic model (OASIS) used to develop the preferred alternative. TTU will offer training and help utilities update the analysis presented in this report.

The utilities will also need a formal agreement to guide development and operation of a shared water supply project. One option is found in Tennessee's Interlocal Cooperation Act,[30] which enables local government units, including utility districts, to cooperate to provide services and facilities. The Act sets out a legal framework for inter-local agreements and requires that it include certain types of provisions (e.g., an organizational structure and a financing mechanism). The Act leaves the details of these provisions to the parties, for instance, they may establish a separate legal entity or provide for an administrator or joint board to manage the project.

Arriving at an agreement to jointly support a shared water supply project will require extensive communication among the parties and a strong commitment to a successful resolution. Before executing a formal agreement, the interested parties should draft a memorandum of agreement that, when signed by the appropriate local officials, will identify the steps to be taken to create the agreement and demonstrate the commitment to follow through with a regional project. The University of North Carolina's Environmental Finance Center has published a useful guide, Crafting Inter-local Water Agreements, that covers topics to consider in preparing inter-local agreements.[31]

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[29] Found online at http://tn.gov/environment/dws/pdf/droughtmgtplan_guidance.pdf.

[30] Tennessee Code Annotated, Title 12, Chapter 9.

[31] Found online at http://www.efc.unc.edu/publications/2009/water_partnership_tips.pdf.

6.4 Release Study and Permitting

The success of the preferred alternative, raising Big Fiery Gizzard Dam, depends on approval to reduce the minimum release required by the permit issued in June 2009 to raise the dam. Preliminary modeling indicates that the raised reservoir cannot support the water supply needs projected for 2030 if the current release requirement is met. Modifying the minimum release requires a technical review, currently underway, to determine the in-stream, environmental flow requirements downstream of the dam. A draft report is currently under review by staff of the Corps, TDEC, and the Tennessee Wildlife Resources Agency. If the outcome indicates that a lesser discharge is acceptable, Tracy City will have to apply to modify the existing permit to authorize the release supported by the study. If the outcome indicates that the currently permitted release of one cubic foot per second, or a greater release, is necessary to protect downstream resources, the purchase and modification of Ramsey Lake will become the preferred alternative.

6.5 Preliminary Engineering and Refined Cost Estimates

(This section assumes that the necessary permits are approved to implement the preferred alternative.)

6.5.1 Interconnections

Although regional system interconnection upgrades cannot, by themselves, meet future water needs, they will be required for a shared, water-storage project. And they will be needed to support regional drought management regardless of whether any joint structural project is pursued. If the preferred alternative is implemented, the primary focus of initial interconnection engineering should be improved links between the Tracy City and Monteagle water systems. The capacities of other regional interconnections should be engineered as appropriate to support the needs of Big Creek and Sewanee utility districts.

6.5.2 Modification of Big Fiery Gizzard Dam and Reservoir

The cost estimate for raising Big Fiery Gizzard Dam includes a 25% contingency. This relatively high contingency was used because some key engineering data was not available. Dam site soils and foundation information require soil borings. A topographic survey, bathymetry (water depth studies), and other background data are also needed. The costs of further engineering work should be shared among the utilities participating in the water supply sharing agreement developed to support the project.

6.6 Project Financing

Several jurisdictions in Tennessee have succeeded in jointly financing water supply projects. Perhaps the best example is the Duck River Agency. The agency finances projects to benefit multiple utilities across several counties with a region-wide 5 cents per 1,000-gallon surcharge on water bills collected by the seven participating utilities. Regional water authorities have been created in other areas of the state to manage water supply needs more broadly; however, that may not be desired or necessary in the study area.

While this study indicates that Monteagle and Tracy City will be the immediate project beneficiaries, the results of the reliable yield and capacity analyses strongly suggest that all four of the major water systems, and quite possibly the three utilities that buy finished water from Big Creek Utility District and

Tracy City, will need the proposed regional, shared-storage project. Some parties will benefit more than others from raising the dam, so all of the utilities involved will need to agree on an equitable system of water bill surcharges based on the benefits each receives. Regardless of how it is managed, as a joint project, it should be accounted for and audited separately from the individual utilities.

There are a number of possible funding sources for the preferred project. Many are listed in Finding Money for Municipal Water, Wastewater and Solid Waste Projects in Tennessee,[32] a publication of the University of Tennessee's Municipal Technical Advisory Service (MTAS). TDEC will work with the region, the Southeast Tennessee Development District, and other study partners to identify funding options for the preferred alternative.

6.7 Rate Studies

If the recommended alternative is implemented, water customers should expect to pay a significant portion of costs. Whether the expected costs are financed on a pay-as-you-go basis or by borrowing, customers will likely see some changes in their bills. Parties to the agreement to develop and operate the new shared source will need rate structures that ensure their customers pay only their fair share of the costs of expanding the region's water supply. Guidance for studying revenue needs and adopting rate increases can be found in MTAS' How Any City Can Conduct a Utility Rate Study and Successfully Increase Rates.[33] Guidance for choosing among various rate structures can be found in Meeting Water Utility Revenue Requirements: Financing and Ratemaking Alternatives, a publication of the National Regulatory Research Institute.[34] Appendix A includes basic information from both of these guides.

6.8 Long-range Planning

As noted in Chapter 1, Sewanee is the only community in the study area that engages in long-range planning. Franklin and Marion counties, which contain only small parts of the study area, have active planning commissions, but Grundy County, where the bulk of the study area lies, does not. Yet planning is essential to coordinate government services with development and guide it to ensure the best possible outcomes for local residents. Planning programs can be tailored to fit the particular needs of any community, taking into account local culture and traditions. All of the governments in the study area should explore the establishment of local planning programs and how they can use them to assist with water supply planning.

One essential element in planning for new developments is ensuring that utilities are available to support them. Planning commissions should require letters of availability from the appropriate utility before approving new developments to assure buyers that adequate utilities will be available when a lot is purchased for building purposes. Such a requirement is typically implemented through adoption of subdivision regulations by the local planning commission. Those cities and counties that enforce a zoning ordinance may also require a letter of availability as a part of a request for a rezoning amendment. These mechanisms ensure that land-use and water supply planners work together to support the needs of their communities.

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[32] Found online at http://www.mtas.utk.edu/KnowledgeBase.nsf/0/c3678095c966a2c5852576c4004c831f/$FILE/Finding%20Money%202010%20bw.pdf.

[33] Found online at http://www.mtas.utk.edu/KnowledgeBase.nsf/0/9c55533bf2c336ac85257412004ce8ee/$FILE/How%20Any%20City%20Can%20Conduct%20a%20Utility%20Rate%20Study%20bw.pdf.

[34] Found online at http://nrri.org/pubs/water/93-13.pdf.

Communities on the plateau understand better than most in Tennessee the importance of water quality and water supply, and in that respect, planners elsewhere are just now beginning to catch up with them. The interrelationship of water resources and land use is one of the hottest topics in growth planning today.[35] The primary focus of this regional water supply planning pilot has been on quantity, but quality is equally important and becomes more of a factor as development occurs. Because water supply sources on the plateau are so limited and the streams there support environments that attract significant tourism, protecting the quality of those sources and streams is of critical importance. Land development's effects on the water resources can be reduced with low-impact development, which can promote the natural movement of water in a watershed and restore water supplies.[36] A planning commission and an active planning program can affect these issues through regulations.

6.9 Communication and Community Engagement

State law requires water utilities to operate on an enterprise basis. Consequently, water customers must pay for all debt service and operational costs. While grants may help with construction costs, the remaining costs of a regional shared-storage project will eventually affect customers' monthly bills. They will need to understand the process that led to those changes and the benefits of a more secure water supply, one that is less susceptible to drought. A robust, multi-faceted public involvement program to inform water customers is needed.

Residents in unserved households need help understanding the factors that a utility must consider when determining whether to extend water supply lines. They need to be informed of the implications for themselves and for the entire service area, both up-front and operational costs, including the line flushing required to ensure that the quality of the water they receive is the same as customers in more densely populated areas.

The utilities in the region also can work together to educate their customers about the conservation and demand management practices recommended here. Conserving water and even reusing it can help reduce overall water withdrawals, saving both water and money. These laudable conservation efforts require the understanding and acceptance of the community. If requested, TDEC will work with the parties to a regional agreement to develop an effective community engagement plan to make these practices possible.

Community engagement, however, is not a one-way street. Utilities also benefit from their customers' suggestions and comments about proposed changes. Customers may have valuable ideas about demand management, conservation methods, the availability of water conserving appliances, or incentives to reduce consumption. Engaging with the community is essential to successful demand and drought management.

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[35] Arnold, Craig Anthony, ed. 2005. Wet Growth: Should Water Law Control Land Use? Washington, DC: Environmental Law Institute.

[36] U.S. Environmental Protection Agency, Low Impact Development, accessed online at http://www.epa.gov/owow/NPS/lid, 25 April 2011.

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Appendices

If viewing in electronic format, click on the Appendix label, e.g. Appendix A, to open and view all materials in that Appendix.

Material for the appendices listed above can be found in the electronic version of the Planning Study posted to the TDEC website at: www.tn.gov/environment/regionalplanning

Water Resources Technical Advisory Committee

The Water Resources Technical Advisory Committee was authorized in the Tennessee Water Resources Information Act of 2002. Members of this committee serve as an advisory group to the Tennessee Department of Environment and Conservation by making recommendations on water resources issues in response to requests from the department. The committee will assess each issue in some detail to provide insight from diverse perspectives with the objective of helping to refine and improve water management policies or options for the department.

2002 Tennessee Water Resources Information Act

Tennessee Code Annotated, Section 69-7-309. Technical advisory committee. The commissioner shall appoint a technical advisory committee, the number of members to be determined by the commissioner, that shall advise the commissioner on the status of the state's water resources and future planning efforts. The technical advisory committee shall be composed of representatives of federal, state, and local agencies and of appropriate private organizations, including not for profit organizations. No member of this committee is entitled to a salary for duties performed as a member of the committee. No member is entitled to reimbursement for travel and other necessary expenses incurred in the performance of official duties.

Member	Agency Represented
Bob Freudenthal	Tennessee Association of Utility Districts
Scott Davis	The Nature Conservancy of Tennessee
W. Scott Gain	U.S. Geological Survey
Dennis George	Center for the Management, Utilization and Protection of Water Resources (Tennessee Technological University)
Dan Hawk	Tennessee Department of Economic and Community Development
Michael Hughes	Watauga River Regional Water Authority
Elmo Lunn	Former Director of the Water Authority of Dickson County and the Former Director of the TDEC Water Management Division
John McClurkan	Tennessee Department of Agriculture
David McKinney	Tennessee Wildlife Resources Agency
Doug Murphy	Tennessee Duck River Development Agency
Lynnisse Roehrich-Patrick	Tennessee Advisory Commission on Intergovernmental Relations
Bob Sneed	U.S. Army Corps of Engineers, Nashville District
Gary Springston	Tennessee Valley Authority
Brian Sutherland	U.S. Department of Agriculture Rural Development
Brian Waldron	University of Memphis Ground Water Institute