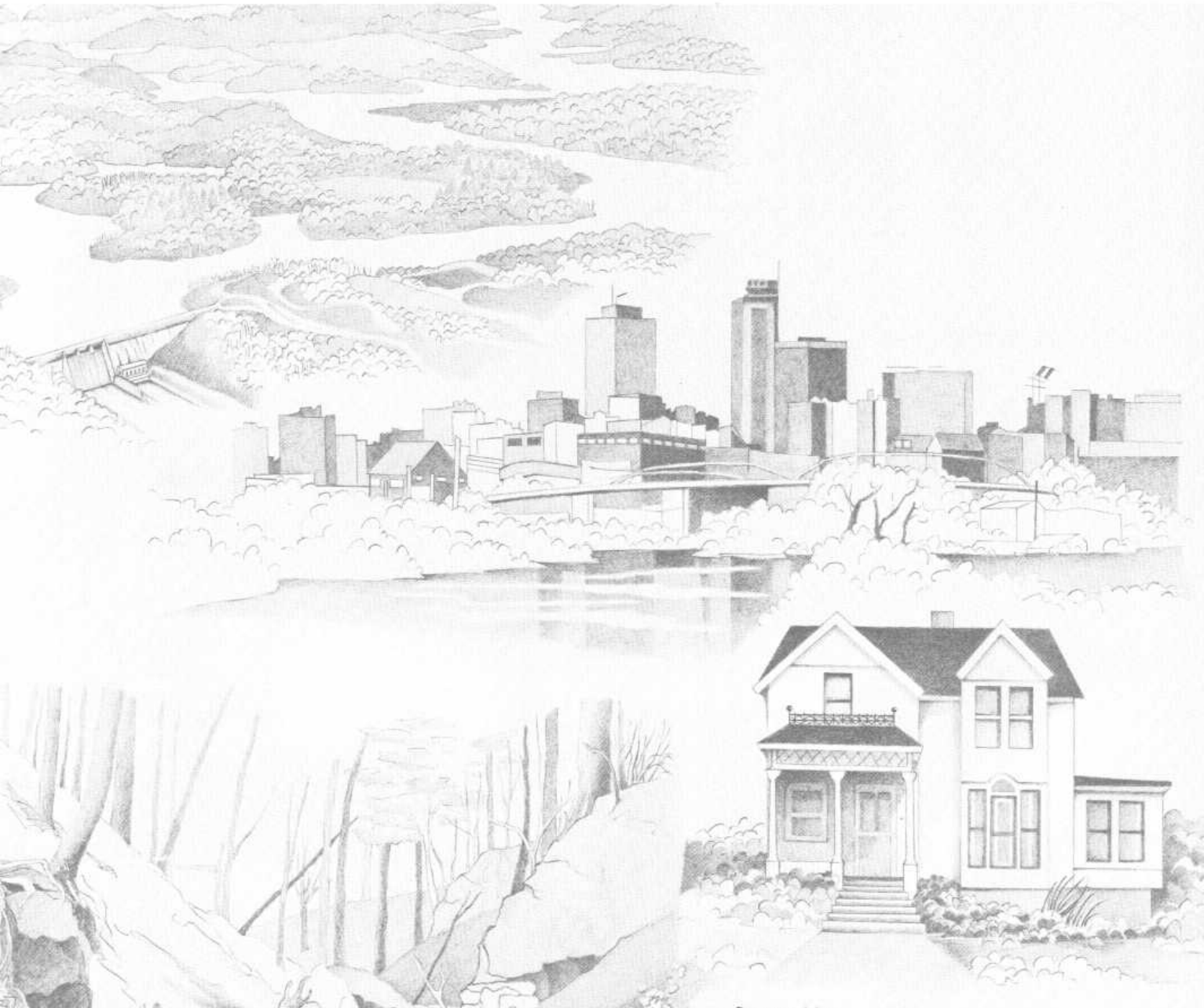


DROUGHT-RELATED IMPACTS ON MUNICIPAL AND MAJOR SELF-SUPPLIED INDUSTRIAL WATER WITHDRAWALS IN TENNESSEE--PART B



Prepared by
U. S. GEOLOGICAL SURVEY

in cooperation with
TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT, Division of Water Management
TENNESSEE VALLEY AUTHORITY, Office of Natural Resources and Economic Development,
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SUMMARY

Study results indicated 463 public water facilities supplied water to about 3,814,000 people or 83 percent of the 1980 population of Tennessee. The service of these companies range from 9 connections and 27 people (Cold Springs WS) to 192,966 connections and 600,000 people (Memphis Light, Gas and Water Division). Total water usage was 566.1 Mgal/d of which 346.8 Mgal/d or 61 percent was from surface-water sources and 219.3 Mgal/d or 39 percent was from ground water. Although, ground water was used statewide, it was the sole source of public supply in the Hatchie River, Memphis Area, and the Obion-Forked Deer River basins; commonly referred to as West Tennessee. Of the 219.3 Mgal/d of ground water used statewide, 164.0 Mgal/d or 75 percent was used in West Tennessee.

While 142 problems were indicated by the public water suppliers, they could be grouped into 18 types as shown in table 53. Four types of problems, turbidity (33), inadequate storage capacity (25), inadequate water supply during droughts (22), and excessive water losses due to leaks in distribution lines (15) account for 95 or 67 percent of the 142 problems. Only 22 or 15 percent of the problems reported were due to an inadequate supply. However, an analysis of the 463 public water systems in the State indicate that 71 could experience water shortages now or in the future. No water shortage problems are expected in West Tennessee since ample ground water is available and no surface water is being used for public supply at this time.

Table 53.--Summary of problems reported by public water suppliers in Tennessee

| | |
|---|----------|
| Occasional turbidity | 33 |
| Inadequate storage capacity | 25 |
| Inadequate water supply during periods of drought | 22 |
| Excessive water losses due to leaks in distribution lines | 15 |
| Inadequate pump capacity | 8 |
| Excessive concentration of manganese or iron | 7 |
| Clogging of water-supply intake facilities | 6 |
| Occasional taste or odor problems | 4 |
| Occasional periods of water discoloration | 4 |
| Inadequate distribution line size | 4 |
| Occasional flooding problem | 3 |
| Inadequate water pressure at times | 3 |
| Problems with algae | 2 |
| Corrosive raw and treated water | 2 |
| Occasional industrial spills | 2 |
| Inadequate treatment capacity | 1 |
| High chlorine demand | <u>1</u> |
| Total | 142 |

Statewide 129 companies indicated a self-supplied water withdrawal of 0.1 Mgal/d or more. Four of these companies were in the Cumberland River basin, 40 in West Tennessee, and 85 in the Tennessee River basin. The total self-

supplied water used by these companies was 1,106.7 Mgal/d of which 1,006.8 Mgal/d or 91 percent was surface water while 99.9 Mgal/d or 9 percent was ground water. The largest self-supplied water user in the State (454.3 Mgal/d) was Tennessee Eastman Co. at Kingsport.

Thirty water related problems were reported by 23 industries statewide. Four types of problems, turbidity (11), flooding (5), water quality (4), and water shortage during droughts (3) account for 23 or 77 percent of the 30 problems reported. Only three industries experienced water shortages during periods of drought; all are located in the Tennessee River basin.

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APPENDIX I

INVENTORY OF PUBLIC AND LARGE, SELF-SUPPLIED COMMERCIAL
AND INDUSTRIAL WATER USERS IN TENNESSEE

CONTENTS

| | Page |
|--|------|
| Introduction..... | 247 |
| Inventory resource materials..... | 247 |
| Basic inventory assumptions and terminology..... | 248 |
| Index | |
| Public water-supply facilities..... | 253 |
| Index | |
| Self-supplied commercial and industrial water users..... | 263 |

TABLES

| | | | |
|-------|-----|--|-----|
| Table | 1. | Public water-supply facilities, Clinch River basin..... | 267 |
| | 2. | Self-supplied commercial and industrial water users, Clinch River basin..... | 274 |
| | 3. | Public water-supply facilities, Lower Cumberland River basin..... | 275 |
| | 4. | Self-supplied commercial and industrial water users, Lower Cumberland River basin..... | 285 |
| | 5. | Public water-supply facilities, Upper Cumberland River basin..... | 286 |
| | 6. | Self-supplied commercial and industrial water users, Upper Cumberland River basin..... | 293 |
| | 7. | Public water-supply facilities, Duck-Buffalo River basin..... | 294 |
| | 8. | Self-supplied commercial and industrial water users, Duck-Buffalo River basin..... | 302 |
| | 9. | Public water-supply facilities, Elk-Shoal River basin..... | 305 |
| | 10. | Self-supplied commercial and industrial water users, Elk-Shoal River basin..... | 312 |
| | 11. | Public water-supply facilities, French Broad River basin..... | 314 |
| | 12. | Self-supplied commercial and industrial water users, French Broad River basin..... | 318 |
| | 13. | Public water-supply facilities, Hatchie River basin.... | 320 |
| | 14. | Self-supplied commercial and industrial water users, Hatchie River basin..... | 322 |
| | 15. | Public water-supply facilities, Holston River basin.... | 323 |
| | 16. | Self-supplied commercial and industrial water users, Holston River basin..... | 330 |
| | 17. | Public water-supply facilities, Memphis Area basin..... | 332 |
| | 18. | Self-supplied commercial and industrial water users, Memphis Area basin..... | 335 |
| | 19. | Public water-supply facilities, Obion- Forked Deer River basin..... | 338 |
| | 20. | Self-supplied commercial and industrial water users, Obion-Forked Deer River basin..... | 344 |
| | 21. | Public water-supply facilities, Lower Tennessee River basin..... | 346 |

| | Page |
|---|------|
| Table 22. Self-supplied commercial and industrial water users, Lower Tennessee River basin..... | 355 |
| 23. Public water-supply facilities, Upper Tennessee River basin..... | 358 |
| 24. Self-supplied commercial and industrial water users, Upper Tennessee River basin..... | 364 |
| 25. Public water-supply facilities, Tennessee River Western Valley basin..... | 365 |
| 26. Self-supplied commercial and industrial water users, Tennessee River Western Valley basin..... | 369 |

APPENDIX I

INVENTORY OF PUBLIC AND LARGE, SELF-SUPPLIED COMMERCIAL AND INDUSTRIAL WATER USERS IN TENNESSEE

INTRODUCTION

Basic information and data relative to existing or potential water-supply problem areas is presented in the form of tabular inventories of (1) public community water-supply facilities and (2) large, self-supplied commercial and industrial water users whose use exceeds 0.1 Mgal/d. These inventories provide information and data relative to each community or self-supplied user's source of water, average daily water use, source capacity, population served, treatment plant and storage capacities, and water-supply quantity-related problems. Separate inventories are provided for each of the 13 major river basins in Tennessee.

- Clinch River basin
- Lower Cumberland River basin
- Upper Cumberland River basin
- Duck-~~Buffalo~~ River basin
- Elk-Shoal River basin
- French Broad River basin
- Hatchie River basin
- Holston River basin
- Memphis Area basin
- Obion-Forked Deer River basin
- Lower Tennessee River basin
- Upper Tennessee River basin
- Tennessee River Western Valley basin

These river basins were delineated by the Geological Survey and the TDWM in 1982.

INVENTORY RESOURCE MATERIALS

The information and data presented in these inventories were obtained from the TDWM through its ongoing water-use survey efforts during the past 3 years. To insure that all data and information reflected in these survey forms were complete and up-to-date, efforts were made to contact all public and large, self-supplied commercial and industrial water users to review and update the information provided to the TDWM through the survey program. All public water-supply systems and self-supplied commercial and industrial water users who had not submitted a completed water-use survey form since 1979 were contacted by telephone to (1) determine if they were still in operation and utilizing either a self-supplied or municipal water source in the case of industries and commercial users, (2) inform them of the ongoing water-supply problem area study, and (3) request their participation in this study by completing and returning the survey form. Data and information collected

through this followup survey have been incorporated into the inventories. In addition, all updated and followup survey forms were sent to the TDWM for incorporation into the Tennessee water use data system.

In those instances where current data and information for community water-supply facilities were not available through either Tennessee's water-use program or the followup survey, the following resource materials were used in compiling the water-supply-use inventories.

- Tennessee Comprehensive Joint Water and Related Land Resources Planning, Preliminary Baseline (Tennessee Department of Conservation, 1976)
- Computer printout listing community water-supply systems in Tennessee (Tennessee Department of Public Health, 1981)

All of these facilities have been marked by a (+) sign to distinguish them from those facilities for which recent survey data are available.

BASIC INVENTORY ASSUMPTIONS AND TERMINOLOGY

Summarized below to facilitate the user's understanding and utilization of the basic data and information contained in the inventory tables are some notes which (1) provide explanatory information regarding the specific information presented in the tables and (2) delineate the basic assumptions, if any, used in developing the information shown.

Individual public water supplies facilities listed in these inventories are presented alphabetically by county. However, all systems or facilities who purchase all or any part of their average daily water use from another system are listed directly below the system from which the water is purchased. To facilitate the designation of these systems, a single asterisk was used to designate or highlight a system which receives all of its water from surface- and (or) ground-water sources; two asterisks denote a system which purchases part or all of its water from a single-asterisk (primary) system; three asterisks denote a system which purchases part or all of its water from a double-asterisk (secondary) system; while four asterisks denote a system which purchases part or all of its water from a three-asterisk (tertiary) system.

- Water-Supply/User Inventory Acronyms. Basic acronyms used in identifying and describing water-supply facilities and self-supplied users in the inventory tables include the following:
 - Gallons per day - gal/d
 - Gallons per minute - gal/min
 - Million gallons per day - Mgal/d
 - Public Works Department - PWD
 - Standard Industrial Classification - SIC
 - Utility District - UD
 - Water Commission - WC
 - Water Department - WD
 - Water System - WS

- Population Served.--Number of people supplied water by the indicated company. If the number of people was not given on the Water Use Survey Form, the population served was estimated based on the number of connections assuming an average of 3.5 persons per household or was obtained from computer printouts furnished by the Tennessee Department of Health and Environment (formerly the Department of Public Health).
- Number of connections.--Number of active water taps being supplied by the indicated water supplier. NOTE--in some cases, one connection or water tap may serve a number of individual users such as a large apartment complex or resort area.
- Source Capacity.--Source capacity is defined as the best estimate of the capacity of a particular water-supply source over an extended period of time. The longer the period of time, the more reliable the source capacity data are. Source capacity data for public and self-supplied water users served via surface-water resources reflect several different values as described below depending on the location of the water-supply intake facilities in a regulated stream, nonregulated stream, or an impoundment.

Regulated Stream.--A regulated stream is defined as any stream reach which has been impounded by a mainstem or tributary reservoir or is located immediately below one of these reservoirs and is thus affected by existing reservoir operation patterns relative to water releases. Water releases from reservoirs are common for a wide variety of purposes including hydro-power generation, flood control and navigation, vector and aquatic weed control, and compliance with contractual agreements requiring the release of water for specific purposes. Surface-water sources falling into the classification of a regulated stream would include all of the Cumberland River and Tennessee River mainstem, the Tennessee River headwaters area, and parts of many tributary streams such as the Caney Fork, Clinch, Duck, Elk, Hiwassee, Little Tennessee, Obey, Ocoee , and Stones Rivers. For those communities and large, self-supplied water users whose intake facilities are located within a regulated stream, the source capacity was determined by calculating the minimum daily average flow or reservoir release from the controlling upstream reservoir for the available reference period (20 or more years). This value was modified, as appropriate, to reflect inflows (3-day, 20-year recurrence interval low flows) from nonregulated streams entering the regulated stream below the controlling reservoir and the impact of upstream water users on the existing stream flows. Where the controlling reservoir has not been in existence for 20 years, the minimum daily average flow was based on the reservoir's reference period. For each water-supply intake located in a regulated stream, the name of the controlling upstream reservoir is noted in the additional information column. Detailed information describing each basin's major reservoirs relative to reservoir operation patterns, reservoir release agreements, and unique circumstances such as the complete cessation of reservoir releases for one or more days is provided in the hydrology section of each basin's descriptive narrative.

Nonregulated Stream.--Source capacity data for communities and large, self-supplied water users whose intake facilities are located in a nonregulated, that is, a free-flowing, unimpounded stream, reflect the 3-day, 20-year recurrence interval low flow.

Impoundments.--Source capacity data for communities and large, self-supplied water users whose intake facilities are located on the Cumberland River or Tennessee River mainstem tributary within the normal minimum pool of a mainstem reservoir, within the normal minimum pool of a tributary reservoir, or within a small city impoundment or lake such as Howard H. Baker Lake, Cove Lake, Holiday Hills Lake, and so forth, are presented in the additional information column as indicated by the words "See additional information." This column provides information regarding the impoundment's estimated total storage at normal minimum pool and the relative adequacy or inadequacy of this storage to meet the community or self-supplied user's water demands for 90 days or more. While these water-supply systems generally have access to vast quantities of water in comparison to their average daily use, the actual amount of water available without modification of the water-supply intake facilities will be determined by the difference in elevation between the intake facility and the impoundment surface.

It should be noted that source capacity data shown for surface-water supplies, particularly in the case of supplies served from regulated streams, presents a conservative, but realistic picture of long-term streamflow (water supply) availability.

Source capacity data for communities and self-supplied water users served via ground-water resources reflect measured or estimated "dependable" long-term well and spring yields for ground-water sources. These data were acquired primarily from existing Federal (Sun and others, 1963) and State (DeBuchananne and Richardson, 1956) ground-water publications, TVA records from previous contacts with water systems, and contacts with individual water-supply systems personnel such as the plant manager or city engineer.

- Plant Design Capacity.--This represents the capacity of the facility's treatment plant. N/A means "not applicable" and indicates a public, community water-supply facility which receives its water from another community water-supply facility which has its own water treatment plant or from a ground-water source which requires no treatment other than chlorination.
- Average Water Use.--Average water-use data shown in million gallons per day (Mgal/d) reflect the average daily amount of water withdrawn or purchased from the indicated supply source. When the system is the source of supply to other districts or systems, the average water use of all of the systems is included with the water use of the primary system.
- Gross Per Capita Water Use.--Gross per capita water use includes all water use for domestic, commercial, and industrial purposes as well as that used by the community or lost in the system. Domestic water use includes water use for drinking, culinary, washing, and sanitary purposes as well as lawn and garden watering, car washing, and so forth. Average daily domestic water use in 1975 equaled 118 gallons per capita day - 87 gallons inside the home and 31 gallons outside (U.S. Water Resources Council, December, 1978). Gross per capita water use does not include water sold to communities or in areas supplied via public water-supply systems.
- Average Consumptive Water Use.--Consumptive water use refers to that part of the total water withdrawn for municipal, commercial, and industrial purposes

which is not returned to a surface- or ground-water source. A dash indicates that consumptive water use is negligible or very minimal in nature.

- Additional Information.--Essentially, this column includes basic data and information relative to existing water supply, quantity-related problems; storage capacity for treated and untreated water; and a numerical rating as outlined below which categorizes each facility and self-supplied user according to selected categories denoting each facility or user's source of water; existence or lack of impoundment facilities; base streamflow; and ground-water availability.

Category 1 - Surface-water source located in a regulated stream with adequate base streamflow (minimum daily average flow) to meet the indicated average daily water use.

Category 2 - Surface-water source located in a regulated stream with inadequate base streamflow (minimum daily average flow) to meet the indicated average daily water use.

Category 3 - Surface-water source located in a nonregulated stream with adequate base streamflow (3-day, 20-year recurrence interval low flow) to meet the indicated average daily water use.

Category 4 - Surface-water source located in a nonregulated stream with inadequate base streamflow (3-day, 20-year recurrence interval low flow) to meet the demand for water withdrawal.

Category 5 - Surface-water source with adequate impoundment facilities to meet the 90-day water withdrawal under base streamflow conditions.

Category 6 - Surface-water source with inadequate impoundment facilities to meet the 90-day demand for water withdrawal under base streamflow conditions.

Category 7 - Ground-water source of known capacity, based on pumping tests or reliable estimates, which is adequate to meet the indicated average use.

Category 8 - Ground-water source of known capacity, based on pumping tests or reliable estimates, which is inadequate to meet the indicated average use.

Category 9 - Ground-water source of unknown capacity.

For those facilities and users served via a mix of surface- and ground- water resources, each individual source was evaluated and categorized to reflect pertinent information about the source and its relative ability to meet its share of the facility or user's daily demand for water withdrawal. This column also includes other information, where available, to (1) describe more explicitly the area being served, (2) note significant increases or decreases in total water use, and (3) highlight specific activities being implemented to improve or expand the facility or user's system. In the inventory table for self-supplied commercial and industrial water users, this column also identifies the product being produced.

It should be noted that communities and self-supplied users categorized as having adequate supplies to meet the indicated average daily water use may still experience, and often do report as shown in the additional information, periodic water-supply shortages during drought periods.

Public Water-Supply Facilities

INDEX

| | Page |
|--|------|
| Adams-Cedar Hill Utility District..... | 279 |
| Adamsville Water System..... | 368 |
| Alamo Water Department..... | 338 |
| Alcoa Water System..... | 358 |
| Alexandria Water System..... | 290 |
| Algood Water Department..... | 288 |
| Allardt Water System..... | 287 |
| Alpha-Talbott Utility District..... | 324 |
| Anderson County Utility Board..... | 267 |
| Andersonville Utility District..... | 268 |
| Ardmore Water System..... | 307 |
| Arlington Water Department..... | 332 |
| Arthur-Shawnee Utility District..... | 269 |
| Ashland City Water Department..... | 275 |
| Athens Utilities Board..... | 351 |
| Atoka Water Department..... | 334 |
| Atwood Water Department..... | 338 |
| | |
| Bangham Utility District..... | 288 |
| Bartlett-Ellendale Water Department..... | 333 |
| Baxter Water Department..... | 288 |
| Bean Station Utility District..... | 324 |
| Bedford County Utility District..... | 294 |
| Beech Bluff Utility District..... | 342 |
| Bell Buckle Water System..... | 295 |
| Bells Public Utility District..... | 338 |
| Belvidere Rural Utility District..... | 305 |
| Benton Water System..... | 352 |
| Bethel Springs Water Department..... | 321 |
| Big Creek Utility District (Hawkins County)..... | 325 |
| Big Creek Utility District (Grundy County)..... | 347 |
| Big Sandy Water System..... | 365 |
| Bloomington Utility District..... | 327 |
| Blountville Utility District..... | 328 |
| Blue Springs Utility District..... | 323 |
| Bluff City Water System..... | 328 |
| Bolivar Water Department..... | 320 |
| Bon Aqua-Lyles Utility District..... | 297 |
| Bon de Croft Utility District..... | 292 |
| Bradford Water Department..... | 340 |
| Brentwood Water Company..... | 276 |
| Brighton Water Department..... | 321 |
| Bristol Water System..... | 328 |
| Bristol-Bluff City Utility District..... | 328 |
| Brownlow Water System..... | 326 |
| Brownsville Utility Department..... | 320 |
| Bruceton Water System..... | 365 |

| | Page |
|---|------|
| Brushy Mountain Prison Water System..... | 272 |
| Buffalo River Utility District..... | 301 |
| Bulls Gap Utility District..... | 325 |
| Byrdstown Water Department..... | 288 |
| Calderwood Village Water System..... | 358 |
| Camden Water Department..... | 365 |
| Camelot Water System..... | 325 |
| Carderview Utility District..... | 326 |
| Carthage Water Department..... | 289 |
| Caryville-Jacksboro Utility District..... | 269 |
| Castalian Springs-Bethpage Utility District..... | 282 |
| Catoosa Utility District..... | 271 |
| Cedar Grove Utility District..... | 338 |
| Celina Water System..... | 286 |
| Center Grove-Winchester Springs Utility District..... | 306 |
| Centertown Utility District..... | 291 |
| Centerville Water System..... | 297 |
| Chalet Village North Utility District..... | 316 |
| Chapel Hill Water System..... | 299 |
| Charleston-Calhoun Utility District..... | 347 |
| Cherokee Mills Utility District..... | 352 |
| Chinquapin Grove Utility District..... | 329 |
| Chuckey Utility District..... | 314 |
| Claiborne County Utility District..... | 270 |
| Clarksburg Utility District..... | 365 |
| Clarksville Water Department..... | 279 |
| Cleveland Utilities Board..... | 346 |
| Clifton Water Department..... | 368 |
| Clinton Utilities Board..... | 268 |
| Cold Springs Water System..... | 327 |
| College Grove Utility District..... | 283 |
| Collierville Water Department..... | 333 |
| Collinwood Water Department..... | 368 |
| Columbia Water Department..... | 299 |
| Consolidated Utility District of Rutherford County..... | 281 |
| Cookeville Boat Dock Road Utility District..... | 289 |
| Cookeville Water Department..... | 288 |
| Copper Basin Board of Public Utilities..... | 352 |
| Copperhill Water System..... | 352 |
| Cordell Hull Utility District..... | 290 |
| Cornersville Water System..... | 299 |
| County Wide Utility District (Crockett County)..... | 339 |
| Covington Water Department..... | 321 |
| Cowan Water System..... | 305 |
| Crab Orchard Utility District..... | 271 |
| Crockett Mills Utility District..... | 339 |
| Cross Anchor Utility District..... | 314 |
| Crossville Water System..... | 270 |
| Cumberland Gap Water Services..... | 270 |
| Cumberland Heights Utility District..... | 279 |
| Cumberland Utility District (Roane County)..... | 273 |

| | Page |
|--|------|
| Cumberland Utility District (Davidson County)..... | 275 |
| Cunningham Utility District..... | 279 |
| | |
| Daisy-Soddy Falling Water Utility District..... | 348 |
| Dandridge Water Department..... | 314 |
| Dayton Water System..... | 353 |
| Decatur Water System..... | 352 |
| Decaturville Utility District..... | 366 |
| Decherd Water Works..... | 305 |
| DeKalb Utility District..... | 286 |
| Delano Water System..... | 352 |
| Dewhite Utility District..... | 292 |
| Dickson Water Department..... | 296 |
| Dixie Lee Utility District..... | 360 |
| Doe Valley Water System..... | 327 |
| Double Springs Utility District..... | 289 |
| Dover Water Department..... | 281 |
| Dowelltown-Liberty Utility District..... | 286 |
| Dresden Water Department..... | 343 |
| Dry Valley Utility District..... | 289 |
| Duck River Utility Commission..... | 295 |
| Dunlap Water System..... | 354 |
| Dyer Water Department..... | 340 |
| Dyersburg Suburban Cons Utility District..... | 339 |
| Dyersburg Water Department..... | 339 |
| | |
| Eagleville Water Department..... | 280 |
| East Dyersburg Utility District..... | 339 |
| East Knox Utility District..... | 327 |
| East Montgomery Utility District..... | 279 |
| Eastside Utility District..... | 350 |
| Eastview Utility District..... | 321 |
| Elbridge Utility District..... | 342 |
| Elizabethton Water Department..... | 323 |
| Englewood Water System..... | 351 |
| English Mountain Water System..... | 315 |
| Erin Water Department..... | 278 |
| Erwin Utility District..... | 317 |
| Estill Springs Water Department..... | 305 |
| Ethridge Utility District..... | 309 |
| Etowah Water Department..... | 351 |
| Evensville Utility District..... | 353 |
| | |
| Fairfield Glade Water System..... | 271 |
| Fairview Utility District..... | 307 |
| Fairview Water System..... | 276 |
| Fall Creek Falls Utility District..... | 290 |
| Fall River Road Utility District..... | 309 |
| Falling Water Utility District..... | 289 |
| Falls Branch Utility District..... | 329 |
| Fayetteville Water System..... | 309 |
| Fentress County Utility District..... | 287 |

| | Page |
|--|------|
| First Utility District of Anderson County..... | 267 |
| First Utility District of Carter County..... | 323 |
| First Utility District of Hardin County..... | 366 |
| First Utility District of Hawkins County..... | 325 |
| First Utility District of Knox County..... | 359 |
| First Utility District of Tipton County..... | 321 |
| FL & G Co-op..... | 289 |
| Flat Creek Water Co-op..... | 295 |
| Flatwoods Utility District..... | 309 |
| Forks of the River Industrial Park Water System..... | 315 |
| Fort Pillow State Prison..... | 320 |
| Franklin Water Department..... | 283 |
| Free Hill Utility District..... | 286 |
| Friendship Water Company..... | 339 |
| Friendsville Water System..... | 358 |
| | |
| Gainesboro Water Department..... | 287 |
| Gallatin Water Department..... | 281 |
| Gallaway Water Department..... | 332 |
| Gates Water Department..... | 342 |
| Gatlinburg Water System..... | 316 |
| Germantown Water Department..... | 333 |
| Gibson County Municipal Water District..... | 340 |
| Gibson Water Department..... | 340 |
| Gladeville Utility District..... | 283 |
| Gleason Water Department..... | 343 |
| Glen Hills Utility District..... | 314 |
| Grand Junction Water Department..... | 332 |
| Graysville Water System..... | 353 |
| Greenbrier Water System..... | 280 |
| Greeneville Water Commission..... | 314 |
| Greenfield Water Department..... | 343 |
| Griffith Creek Utility District..... | 348 |
| | |
| HB & TS Utility District..... | 300 |
| Halls Water Department..... | 342 |
| Hallsdale-Powell Utility District..... | 272 |
| Hampton Utility District..... | 323 |
| Hank Johnson Subdivision Water System..... | 323 |
| Harbin Hills Community Water System..... | 327 |
| Harpeth Utility District..... | 277 |
| Harpeth Valley Utility District..... | 276 |
| Harriman Utility District..... | 273 |
| Hartsville Water Department..... | 282 |
| Henderson Water Department..... | 338 |
| Hendersonville Utility District..... | 282 |
| Henning Water Department..... | 321 |
| Henry County Water Company..... | 367 |
| Henry Water System..... | 341 |
| Highway 11-W Utility District..... | 328 |
| Hillsville Utility District..... | 296 |
| Hiwassee Utilities Commission..... | 346 |

| | Page |
|---|------|
| Hiwassee Water Corporation..... | 351 |
| Hixson Utility District..... | 350 |
| Hohenwald Water System..... | 298 |
| Hollow Rock Water System..... | 365 |
| Holston Utility District..... | 328 |
| Hornbeak Utility District..... | 342 |
| Hornsby Utility District..... | 320 |
| Humboldt Water Department..... | 340 |
| Huntington Water Department..... | 338 |
| Huntland Water System..... | 305 |
| Huntsville Utility District..... | 289 |
| | |
| Intermont Utility District..... | 328 |
| Iron City Utility District..... | 308 |
| Irving College Utility District..... | 291 |
| | |
| Jackson Utility Division..... | 342 |
| Jamestown Water Department..... | 287 |
| Jasper Water System..... | 350 |
| Jefferson City Water System..... | 326 |
| Jellico Water Department..... | 286 |
| Johnson City Public Water Department..... | 329 |
| Jonesboro Utility District..... | 317 |
| | |
| Kelso Water System..... | 310 |
| Kenton Water Department..... | 342 |
| Kingsport Water System..... | 329 |
| Kingston Water System..... | 362 |
| Kirkwood Utility District..... | 279 |
| Knox-Chapman Utility District..... | 315 |
| Knoxville Utilities Board..... | 359 |
| | |
| La Follette Water Department..... | 268 |
| La Grange Water Department..... | 332 |
| La Vergne Water System..... | 276 |
| Lafayette Water System..... | 278 |
| Laguardo Utility District..... | 283 |
| Lake City Water System..... | 267 |
| Lakeland Development Corporation..... | 333 |
| Lakeland Utility District..... | 315 |
| Lakemont Utility District..... | 325 |
| Lakeview Utility District..... | 326 |
| Lakewood Water Department..... | 277 |
| Lantana Utility District..... | 271 |
| Lauderdale County Water System..... | 321 |
| Lawrenceburg Water System..... | 309 |
| Lebanon Water Department..... | 283 |
| Lee County Water Authority..... | 270 |
| Lenoir City Utility Board..... | 360 |
| Leoma Utility District..... | 309 |
| Lewisburg Water System..... | 298 |
| Lexington Water System..... | 366 |

| | Page |
|--|------|
| Lincoln County Board of Public Utilities..... | 310 |
| Lincoln Memorial University Water System..... | 270 |
| Linden Water Department..... | 300 |
| Livingston Water Department..... | 287 |
| Lobelville Water Department..... | 301 |
| Long Island Utility District..... | 329 |
| Loretto Water System..... | 309 |
| Loudon Utility District..... | 361 |
| Lower Collins Utility District..... | 291 |
| Luttrell - Blaine - Corryton Utility District..... | 324 |
| Lynchburg Water System..... | 311 |
| Lynnville Utility District..... | 307 |
| | |
| Madison Surburban Utility District..... | 276 |
| Madisonville Water Department..... | 362 |
| Mallory Valley Utility District..... | 283 |
| Manchester Water Department..... | 296 |
| Marshall County Board of Public Utilities..... | 299 |
| Martel Utility District..... | 360 |
| Martin Water Department..... | 343 |
| Maryville Water System..... | 359 |
| Mason Water Department..... | 333 |
| Maury City Water Department..... | 339 |
| Maury County Water System..... | 300 |
| Maynardville Water System..... | 273 |
| McEwen Water Department..... | 297 |
| McKenzie Water Department..... | 338 |
| McLemoresville Water Department..... | 338 |
| McMinnville Water Department..... | 291 |
| Medina Water Department..... | 340 |
| Memphis Light, Gas and Water Division..... | 333 |
| Mercer Utility District..... | 321 |
| Michie Water Department..... | 368 |
| Middleton Water Department..... | 320 |
| Midtown Utility District..... | 363 |
| Milan Department of Public Utilities..... | 340 |
| Milcrofton Utility District..... | 283 |
| Mill Creek Heights Utility District..... | 280 |
| Millington Water Department..... | 333 |
| Minor Hill Utility District..... | 307 |
| Monteagle Water System..... | 308 |
| Monterey Water Department..... | 289 |
| Mooresburg Utility District..... | 325 |
| Morristown Water System..... | 324 |
| Moscow Water Department..... | 332 |
| Mosheim Utility District..... | 314 |
| Mount Pleasant Water System..... | 299 |
| Mountain City Water System..... | 327 |
| Mowbray Mountain Utility District..... | 348 |
| Mulberry Utility District..... | 310 |
| Munford Water Department..... | 333 |
| Murfreesboro Water Department..... | 280 |

| | Page |
|---|------|
| Nashville Water Department..... | 276 |
| New Canton Utility District..... | 325 |
| New Johnsonville Water System..... | 367 |
| New Market Utility District..... | 326 |
| New Prospect Utility District..... | 309 |
| Newbern Water Department..... | 339 |
| Newport Water System..... | 314 |
| Niota Water System..... | 347 |
| Nolensville Utility District..... | 283 |
| Normandy Road Co-op Utility District..... | 295 |
| Norris Water System..... | 268 |
| North Anderson County Utility District..... | 267 |
| North Bradley Utility District..... | 347 |
| North Elizabethton Water Cooperative..... | 323 |
| North Greene Utility District..... | 314 |
| North Montgomery County Utility District..... | 279 |
| North Overton Utility District..... | 287 |
| North Stewart Water Company..... | 279 |
| North Warren Utility District..... | 291 |
| Northeast Knoxville Utility District..... | 327 |
| Northeast Lawrence Utility District..... | 309 |
| Northwest Clay County Utility District..... | 278 |
| Northwest Dyersburg Utility District..... | 339 |
| Northwest Henry County Utility District..... | 367 |
| | |
| Oak Ridge Water System..... | 268 |
| Oakland Water Department..... | 332 |
| Obion Water Department..... | 342 |
| Ocoee Utility District..... | 347 |
| O'Conner Utility District..... | 292 |
| Old Gainesboro Road Utility District..... | 289 |
| Old Hickory Utility District..... | 277 |
| Oliver Springs Water System..... | 268 |
| Oneida Water & Sewer Commission..... | 289 |
| Orlinda Water System..... | 280 |
| Orme Water System..... | 310 |
| | |
| Paris Board of Public Utilities..... | 367 |
| Parsons Water System..... | 365 |
| Perryville Utility District..... | 366 |
| Persia Utility District..... | 326 |
| Petersburg Water System..... | 310 |
| Pigeon Forge Water System..... | 316 |
| Pikeville Water System..... | 346 |
| Piney Utility District..... | 361 |
| Pinson Utility District..... | 342 |
| Plateau Utility District..... | 272 |
| Pleasant Hill Utility District..... | 292 |
| Pleasant View Utility District..... | 275 |
| Poplar Grove Utility District..... | 334 |
| Portland Water System..... | 282 |
| Proctor City Utility District..... | 341 |

| | Page |
|---|------|
| Prospect-McDonald Utility District..... | 347 |
| Pulaski Water System..... | 307 |
| Puryear Water System..... | 367 |
| | |
| Quebeck-Walling Utility District..... | 292 |
| | |
| Rayon City Water Company..... | 277 |
| Red Boiling Springs Water System..... | 278 |
| Reelfoot Lake State Park..... | 341 |
| Reelfoot Utility District..... | 341 |
| Reelfoot Water Authority..... | 343 |
| Riceville Utility District..... | 352 |
| Ridgely Water Department..... | 341 |
| Ripley Water Department..... | 321 |
| River Road Utility District..... | 275 |
| Roan Mountain Water Company..... | 323 |
| Rockwood Water System..... | 363 |
| Rogersville Water System..... | 325 |
| Rossville Water System..... | 332 |
| Russellville-Whitesburg Utility District..... | 324 |
| Rutherford Water Department..... | 341 |
| Rutledge Water Works..... | 324 |
| | |
| Sale Creek Utility District..... | 349 |
| Saltillo Utility District..... | 366 |
| Samburg Utility District..... | 343 |
| Sardis Water System..... | 367 |
| Saulsbury Utility District..... | 332 |
| Savannah Public Utilities Department..... | 366 |
| Savannah Valley Utility District..... | 349 |
| Selmer Water Department..... | 321 |
| Sequatchie Water Works..... | 350 |
| Sevierville Water System..... | 316 |
| Sewanee Utility Department..... | 305 |
| Shady Grove Utility District..... | 326 |
| Shelbyville Water Department..... | 294 |
| Siam Utility District..... | 323 |
| Signal Mountain Water System..... | 350 |
| Smith Utility District..... | 290 |
| Smithville Water System..... | 286 |
| Smyrna Water Department..... | 281 |
| Sneedville Utility District..... | 271 |
| Somerville Water Department..... | 332 |
| South Blount County Utility District..... | 358 |
| South Bristol-Weaver Pike Utility District..... | 328 |
| South Cheatham Utility District..... | 275 |
| South Elizabethton Utility District..... | 323 |
| South Fulton Water Department..... | 343 |
| South Giles Utility District..... | 308 |
| South Paris Water Co-op..... | 367 |
| South Pittsburg Water System..... | 310 |
| Sparta Water System..... | 292 |

| | Page |
|--|------|
| Spencer Utility District..... | 290 |
| Spring City Water System..... | 362 |
| Spring Creek Utility District (Madison)..... | 342 |
| Spring Creek Utility District (Hardeman)..... | 320 |
| Spring Hill Water Department..... | 300 |
| Springfield Water System..... | 280 |
| St. Joseph Water System..... | 309 |
| Stanton Water Department..... | 320 |
| Striggersville Utility District..... | 326 |
| Summertown Water System..... | 298 |
| Surgoinsville Utility District..... | 326 |
| Swan Pond Utility District..... | 273 |
| Sweetwater Board of Public Utilities..... | 361 |
| Sylvia-Tennessee City-Pond Utility District..... | 297 |
| | |
| Taft Youth Center Water Department..... | 290 |
| Tarpley Shop Utility District..... | 307 |
| Tellico Area Services System..... | 361 |
| Tellico Plains Water System..... | 362 |
| Temple Hill Utility District..... | 317 |
| Tenn-American Water Company..... | 349 |
| Tennessee Ridge Water System..... | 278 |
| Timberlake Utility District..... | 310 |
| Tiptonville Water Department..... | 341 |
| Toone Water Department..... | 320 |
| Tracy City Water System..... | 308 |
| Trenton Water Department..... | 341 |
| Trezevant Water Department..... | 338 |
| Tri-Cities/Sullivan Utility District..... | 328 |
| Trimble Water Department..... | 339 |
| Troy Water Department..... | 343 |
| Tuckaleechee Utility District..... | 358 |
| Tullahoma Water Deparment..... | 296 |
| Turnbull Utility District..... | 277 |
| Turney Center Water System..... | 297 |
| Twenty Five Utility District..... | 290 |
| | |
| Unicoi Utility District..... | 317 |
| Union City Water Department..... | 343 |
| Union Fork-Bakewell Utility District..... | 349 |
| | |
| Vanleer Water System..... | 278 |
| Viola Utility District..... | 291 |
| | |
| Waldens Ridge Utility District..... | 350 |
| Walland Water System..... | 359 |
| Wartrace Water System..... | 295 |
| Watertown Water System..... | 284 |
| Waverly Water System..... | 297 |
| Waynesboro Water System..... | 301 |
| Webb Creek Utility District..... | 317 |
| West Knox Utility District..... | 360 |

| | Page |
|---|------|
| West Overton Utility District..... | 288 |
| West Piney Utility District..... | 297 |
| Westpoint Utility District..... | 309 |
| West State Utility District..... | 340 |
| West Tennessee Water Company..... | 367 |
| West Valley Utility District..... | 351 |
| West Warren County Utility District..... | 291 |
| West Wilson Utility District..... | 284 |
| Western Mental Health Institute..... | 320 |
| Westmoreland Water System..... | 282 |
| White Bluff Utility District..... | 277 |
| White House Utility District..... | 280 |
| White Pine Water Department..... | 315 |
| Whiteville Water System..... | 320 |
| Whitwell Water System..... | 350 |
| Wilson County Water & Wastewater Authority..... | 283 |
| Winchester Utility District..... | 306 |
| Witt Utility District..... | 325 |
| Wolf Branch Utility District..... | 273 |
| Woodbury Water System..... | 275 |
| Woodlawn Utility District..... | 279 |