2018

Tennessee's Roadmap to Securing the Future of Our Water Resources

Surface Water Working Group

Executive Summary

Tennessee's Surface Water Resources

Executive Summary

Among Tennessee's most valuable assets is its wealth of water resources. Tennessee has a diverse mix of surface water categories consisting of more than 60,000 miles of rivers and streams and 570,000 lake and reservoir acres. Tennessee also boasts an estimated 787,000 acres of wetlands that serve as buffer zones along rivers, help filter pollutants from surface runoff, store floodwaters during times of high flows, serve as spawning areas for fish, and provide habitat for specialized plant and wildlife species. In addition to the tangible and intangible benefits of the natural water treatment processes and enhanced habitats, wetland areas serve as outdoor classrooms.

The *TN H_2O* project is the Volunteer State's initial effort to develop a comprehensive guide for stewardship of Tennessee's waters. This effort lays the foundation for future scientific works that are necessary to inform decisions on development and management of our resources and identify water quality pressures at a regional and local level. Through continued development of this plan, Tennessee will be poised to apply appropriate resources at federal, state, and local levels to deploy solutions in a sustainable and timely manner. It is important to first understand the water resources with which Tennessee is so blessed.

Tennessee's two longest rivers, the Tennessee River and the Cumberland River, flow into the Ohio River in Kentucky and join the Mississippi River at Cairo, Illinois. Several large reservoirs are shared with bordering states including Reelfoot Lake (KY) Pickwick Lake (AL and MS), Kentucky Lake (KY), Lake Barkley (KY), Guntersville Lake (AL), South Holston Lake (VA), and Dale Hollow Lake (KY). The Mississippi River also forms a portion of the state's western border with Missouri and Arkansas. The Mississippi, Cumberland, and Tennessee Rivers are suitable for commercial traffic.

Tennessee's five major river basins include the Middle Tennessee River Basin, the Upper Tennessee River Basin, the Lower Tennessee River Basin, the Cumberland River Basin, and the Mississippi River Basin. In addition to these five major basins, the Conasauga River Basin, while largely in Georgia, plays a significant role in southeast Tennessee. Of Tennessee's river basins, all but one, the Conasauga River Basin, located in the southeastern corner of the state, flows to the Mississippi River.

Tennessee River Basins (Upper Tennessee River Basin, Middle Tennessee River Basin, and Lower Tennessee River Basin)

The Tennessee River Basins cover almost 41,000 square miles and is the fifth largest river system in the United States. The watershed includes seven states and comprises three of the five major Basins in Tennessee. The Tennessee River, with a total length of 652 miles, originates in Knoxville at the convergence of the Holston and French Broad rivers. The Tennessee River flows southwestwardly along the Alabama-Mississippi line, and then flows northward across the state into Kentucky. Other tributaries of the Tennessee River are the Clinch, Duck, Elk, Hiwassee, and

Sequatchie rivers. The Tennessee River system is regulated by a series of dams and reservoirs managed by the Tennessee Valley Authority (TVA). TVA operates the Tennessee River System to provide year-round navigation, flood-damage reduction, power generation, improved water quality, water supply, recreation and economic growth.

Cumberland River Basin

The Cumberland River Basin includes 18,000 square miles and 22,500 miles of streams in southeastern Kentucky and central Tennessee. Fourteen major watersheds comprise the Basin that serve 2 ½ million people. Of the 22,500 miles of streams in Kentucky and Tennessee that are a part of this Basin, 3,100 miles are impaired from sediment, bacteria and nutrients. The Cumberland River, with a total length of 687 miles, originates in southeastern Kentucky, flows across central Tennessee, and then turns northward back into Kentucky. Rising in the western Appalachian Mountains of Kentucky, the streams that come together to form the Cumberland River travel through rugged terrain and pristine forests with a high level of water quality. Many of the streams are listed as exceptional waters of the state, including the Big South Fork National River. The principal tributaries of the Cumberland River are the Harpeth, Red, Obey, Caney Fork, and Stones rivers and Yellow Creek.

The Nashville District of the U.S. Army Corps of Engineers (USACE) manages federal water resources projects within Cumberland River Basin for flood risk management, commercial navigation, hydropower production, municipal and industrial water supply, fish and wildlife, water quality, and recreation. The USACE operates and maintains ten multi-purpose projects within the Basin, six of which are located in Tennessee. Nine of the USACE projects have hydropower production facilities. Four of the projects have navigable locks, three of which are located in Tennessee (Cheatham, Old Hickory, and Cordell Hull). These lock and dam projects allow for a navigable waterway from the mouth of the Cumberland River to Celina, Tennessee.

Mississippi River Basin

The Mississippi River Basin forms the western boundary of the state and drains about 8,907 square miles. The watershed moves east to west to the Mississippi River. The Forked Deer and Wolf rivers are among those flowing into the Mississippi River, which forms the western border with Missouri and Arkansas.[1]It has a humid-continental climate with an annual average precipitation in the watershed from 1980-2010 is about is approximately 52 inches. The annual average temperature is approximately 58 degrees Fahrenheit. In the eastern headwaters, the rolling topography contains several north-south bands of sand and clay formations. The local streams have a moderately high gradient over generally sandy substrates. The low drainable porosity of the fragipan soils can produce very “flashy” hydrologic responses in regions where they occur. Water use in the lower Mississippi River Basin relies primarily on groundwater sources due to the abundance of water of excellent quality.

Conasauga River Basin

The Conasauga River begins high in the Blue Ridge Mountains in northwest Georgia and descends rapidly north into southeastern Tennessee. The river then flows west for several miles before returning to Georgia for the remainder of its 90-mile length. The Conasauga River watershed includes almost 500,000 acres of land and nearly 125,000 people. It encompasses 727 square miles; about 127 square miles are in Tennessee and the remaining area is in Georgia. Water quality is excellent within the national forests, providing a home to more than 90 species of fish. Some pools within the river have inventory lists of greater than 40 fish species. As the river leaves the forest and enters the Ridge and Valley region, the water quality quickly declines due to less than favorable land use practices. The river, along with its surrounding lands, is also one of the most popular recreation areas in the region, providing opportunities for thousands of annual visitors to fish, swim, kayak, canoe, snorkel, climb, hike, and camp.

Surface Water Uses

Tennessee's surface waters provide a number of uses. According to the Tennessee Annotated Code, Chapter 0400-40-04, the use classifications for Tennessee's surface waters are: Domestic Water Supply, Industrial Water Supply, Fish and Aquatic Life, Trout Stream, Naturally Reproducing Trout Stream, Recreation, Livestock Watering and Wildlife, and Irrigation. The statute also identifies a combination of uses for each named or unnamed surface waters. These standard uses of water may require that the water be taken from their current location.

Surface Water Withdrawals for All Uses

Water withdrawals are identified as thermoelectric, industrial, public supply, and irrigation (agriculture-crops, golf course). While these withdrawals from surface waters occur primarily in Tennessee, withdrawals do occur in neighboring states of Alabama, Kentucky, Georgia, North Carolina, and Mississippi.

Surface water withdrawals for all sectors in Tennessee in 2010 totaled about 7,230 million gallons per day. In 2015, Tennessee utilized 5,990 million gallons per day that were withdrawn from Tennessee's surface waters for various uses (public supply, self-supplied domestic water; livestock, irrigation, thermoelectric power, self-supplied industrial, mining, and aquaculture). Water use from 2010 to 2015 declined for public-supply, self-supplied industry, thermoelectric power, and irrigation for crops.

Surface Water Withdrawal for Public Supply

Water sources for Tennessee's public drinking water supplies vary considerably across the state. The predominant source of drinking water for West Tennessee is ground water, whereas in Middle Tennessee it is surface water. East Tennessee relies on both ground water and surface water, with the ground water sources frequently being springs.[i]

Withdrawals for public-water supply in Tennessee for 2010 totaled about 890 million gallons per day (MGD) with about 321 MGD from groundwater sources and 569 MGD from surface water sources. The total state population in 2010 was about 6.35 million people.

Projected Future State

Projections of Surface Water Withdrawal in Tennessee 2020 – 2040ii

The water-use projections for 2020, 2030, and 2040, show a steady increase in water needs for off-stream use in Tennessee. The water-use projections are primarily driven by assumptions on the growth in population in Tennessee and conservative increases in irrigation. The projected water use from surface waters for 2020, 2030, and 2040 are 7,238 million gallons per day, 7,315 million gallons per day, and 7,388 million gallons per day, respectfully.

Projections of Surface Water Withdrawal for Public Supply

Population projections for Tennessee are; 2020 – 6.95 million people; 2030 – 7.52 million people; 2040 – 8.34 million people. Water withdrawals by public-water systems show similar increases; 2020 – 629 million gallons per day; 2030 – 684.7 million gallons per day; 2040 – 757.7 million gallons per day.

The future condition and availability of Tennessee's surface water resources is directly tied to the land and water management decisions and investments made today. As population and public demand for Tennessee surface waters increases, there will be increased need to consider effective ways to maximize watershed protection, conservation and restoration.

Areas of Concern

Tennessee has experienced drought. The normal annual precipitation, on average is between 50-60 inches, is not only distributed spatially across the state but also temporally throughout the year. The time of year when portions of the state are most susceptible to drought conditions is during the months of August, September, and October[iii]. However, in winter and early spring, with the frequent migratory storms bringing high intensity rains, both widespread flooding and local flash floods can occur. During the summer, the heavy thunderstorm rainfalls frequently result in local flash flooding. While flood producing rainfalls are rare in the fall, a decadent tropical system on occasion can cause serious flooding. The numerous dams along the Tennessee and Cumberland Rivers not only serve to reduce flood damage, but have facilitated water transportation, provided abundant low cost hydroelectric power, and created extensive recreation areas.

Water quality is impacted by both point and nonpoint source pollution. According to the 2014 305(b) Report nearly half of the stream miles and virtually all the large reservoirs have been monitored and assessed within Tennessee. As the assessments are an ongoing process, waters without current data (typically within the last five years) are generally identified as not assessed unless previously identified as impaired[iv]. Approximately 50 percent of assessed streams and rivers and 68 percent of assessed reservoir acres are fully supporting of assigned designated uses[v]. The remainder of assessed waterbodies exhibit impairment to some degree and therefore, not supporting of all designated uses. Tennessee has 3,167 waterbodies that are defined as *Exceptional Waters* and 7 that are defined as *Outstanding National Resource Waters.* Regionally- important Tennessee waters, that constitute an outstanding national resource due to their unique recreational or ecological significance, are Outstanding National Resource Waters.

Water quality degradation, loss of habitat, changes to stream and river flows, invasive species, and changes to precipitation and temperature patterns remain the major challenges to freshwater systems nationwide as well as in Tennessee. Much is known about the causes and sources of these natural resource declines, and in past decades innovations in a wide variety of cross-disciplinary practices such green infrastructure for stormwater, improvements in water quality treatment practices, use of agricultural best management practices, reservoir release improvement technologies, and research have presented opportunities to protect and restore our natural resources, even in the face of the growing demands placed on them.

Water is a public resource and all citizens are entitled to healthy, clean and abundant water. Intertwined with this entitlement are vital fundamental responsibilities, to understand the impacts of our individual and collective actions on all the water resource values provides, and to participate in stewardship that protect and restore the resource value. Facing challenges to their health and sustainability, our surface water resources dictate continued efforts demonstrating the commitment to proactive, collaborative and science-based management, protection, and restoration.

Recommendations

A variety of targeted recommendations were generated by the Surface Water Working Group during the integrated discussions with working group members and learnings from other working group participants. These include addressing actions that encourage systemic improvements to processes that can protect and better manage Tennessee's water resources. Such as, a desired improvement to facilitate and elevate the significance of resource decision-making at all levels and in all sectors (e.g., permitting, grant-making, strategic planning, and other areas) to protect and restore our unique and diverse surface water resources. Others recommendations pertain to the key issue areas related to regulation, administration and management of our water resources, as well as the inextricable link between water availability and healthy waters for sustainable economic growth and development.

Moving forward, an over-arching objective for protecting and restoring the foundational natural processes of our watersheds is critical to sustaining the health and abundance of Tennessee's water resources with the collaborative investments and adaptive management approaches, in both public and private sector decision-making, will be critical to ensuring the sustainability of our water resources and the protection of abundant quality water for Tennesseans into the future.

Recommendation: Protect the foundational natural processes critical to sustaining the health and abundance of Tennessee's water. To accomplish this, our leaders must prevent the weakening of water laws and rules pertaining to water health and abundance. Continue close communication with Tennessee's congressional delegation on matters involving water resource management, clean water programs, and funding.

Recommendation: Establish an approach for adaptive management of river flows and minimum flows that utilizes best available science and optimally protects ecological health and recreational

uses of Tennessee rivers and streams long-term, and acknowledges that climate-related temperature and precipitation changes will exacerbate flow-related stressors.

Recommendation: Aggressively promote and communicate water conservation best practices and behaviors which support and help produce healthy and abundant Tennessee waters.
Develop and execute meaningful efforts to support existing education and outreach efforts of watershed associations, Adopt-A-Stream programs, community festivals and celebrations, and the like, that encourage water resources stewardship. Engage private landowners and citizens in water conservation/watershed protection opportunities, and incentive programs through the development of concise and helpful information resources and delivery systems.

Recommendation: Place water health and abundance considerations as a first step when considering recruitment of industry, and the permitting and decision-making processes. Examples include programs such as Rural Development, 3-Star and other state and federal incentive grant processes.
Educate policy makers/managers about the value of Tennessee's water-based natural resources; as well as, availability.
Encourage local governments to hire staff that can incorporate a conservation perspective into their work and decision making.

Recommendation: Drought management is essential in Tennessee. As identified in 2017 Report, it is recommended that legislature should work with TDEC to fund the implementation plans for regional water supply guidelines and process documents, as well as the "Statewide Analysis of Hydrologic and Water System Information Proposal" created by the governor's Water Resources Technical Advisory Committee. (TDEC, DWR, 2017) Detailed drought management plans are needed for each of the smaller watersheds and sub-basins within the basin. It is important to develop water budgets for Tennessee's major basins to forecast water needs and availability with reasonable scientific accuracy. Define the purpose and objectives based on basin-specific needs. It may be advantageous to include the flexibility of Statewide Hydrologic Basin- Level Planning to include county-level usages and availabilities.

Recommendation: Define the standard methodology to be utilized to ensure data collection, modeling, etc. is uniform and universally consistent. It is recommended that a model selection process be established to understand specific needs of each basin and the ability to view impact to surrounding areas as well as entire system. Planning efforts need to define objectives, basin or watershed level priorities, and performance measures, such as minimum base flow requirements, to understand effectiveness of plan(s).

Recommendation: It is recommended that a centralized data repository be evaluated and implemented that is broadly accessible to availability of data is a necessity in order to make informed decisions at all levels.
Public water suppliers are continuing to collect data and report them by submitting paper copies to TDEC. Help should be provided to these water providers so they can report their raw water data

electronically which will result in timely analyses of public water supply data, reduce the cost of data transmission, and ease the burden of data storage. Furthermore, TDEC would benefit from having additional technical assistance with building the system to streamline data submittal to EPA.

Recommendation: It is recommended that a more structured, collaborated, approach is used at the local, state and federal levels with respect to focusing data collection efforts and data collection standards to capitalize on limited resources.

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[i] Approximately 2/3 of the community public water systems using ground water in Middle and East Tennessee have had at least one source determined to be under the direct influence of surface water. This means that these sources of groundwater are located close enough to a source of surface water to receive direct surface water recharge and are thus considered at risk from surface water contaminants and pathogens. Each year, all public water suppliers are required to review their well head or source water protection area for any changes that may have occurred. These are reported to the state in three-year intervals for community systems and every year for non-community systems. (TDEC, DWR, 2017)

[ii] The water-use projections prepared for the TN-H2O process currently only include the water withdrawals for public-water systems in Tennessee. The water withdrawals by the public-water systems are dependent on the population and the reported data are reported monthly providing a dataset that can be evaluated with a QA/QC process. Self-supplied industrial water withdrawals are also reported to TDEC Division of Water Resources, but the projection of industrial water-use is complicated by changes in economic conditions, changes in manufacturing processes, and other factors that make accurate water-use projections difficult. Water-uses for other sectors are also complicated by changes in economic conditions and the estimates of water use rely on indirect methods, such as irrigated acres for crop

irrigation. The water-withdrawal data by county and source for 2010 (Robinson, 2018) were used as the base year for the water use projections. The 2010 population data from the U.S. Census Bureau were used as the base population for the projections. The rate of population change for 2020, 2030, and 2040, relative to 2010, was calculated based on the population projections for those years. Water-use projections for public-water supply, domestic self-supplied, and golf course irrigation were projected based on projected population growth. Water use projections for the other sectors are based on trends, coordination with other agencies, or set at constant rates

[iii] Average yearly rainfall over the Tennessee River watershed is approximately 51 inches. Subsequent average runoff of 22 inches per year usually provides enough water to meet the off-stream water use demands on the Tennessee River system according to TVA. However, periodic droughts may severely limit the ability of the system to meet all of its competing demands, particularly in unregulated portions (streams or rivers without dams) of the Tennessee River system.

[iv] The primary causes of stream and river impairment are pathogens (specifically, Escherichia coli), excess sediment, habitat alterations, organic enrichment (resulting in dissolved oxygen issues), and nutrients originating from livestock and crop production land uses, channelization, urban stormwater run-off, municipal sewer system overflows and point source discharges, and land clearance for construction (TDEC 2018a). For lakes and reservoirs, several pollutants lead the list of causes including dioxins, mercury, metals, pesticides and polychlorinated biphenyls (PCBs) along with other issues in common with rivers and streams including flow alterations, nutrients and organic enrichment, sediment. Water temperature change is an additional cause of impairment in some reservoir systems. Legacy pollutants, like chemicals that are often used and/or produced by industry and that remain in the environment long after they are first introduced, and other long-standing historical sources cause the largest percentage of impairment issues in reservoirs followed by atmospheric deposition, industrial, agricultural and construction related habitat alterations (TDEC 2018a).

[v] According to the Tennessee Annotated Code, Chapter 0400-40-04, the use classifications for surface waters establishes seven classified uses for surface waters: Domestic Water Supply, Industrial Water Supply, Fish and Aquatic Life, Trout Stream, Naturally Reproducing Trout Stream, Recreation, Livestock Watering and Wildlife, and Irrigation. It also identifies a combination of uses for each named or unnamed surface waters. These standard uses of water may require that the water be taken from their current location.