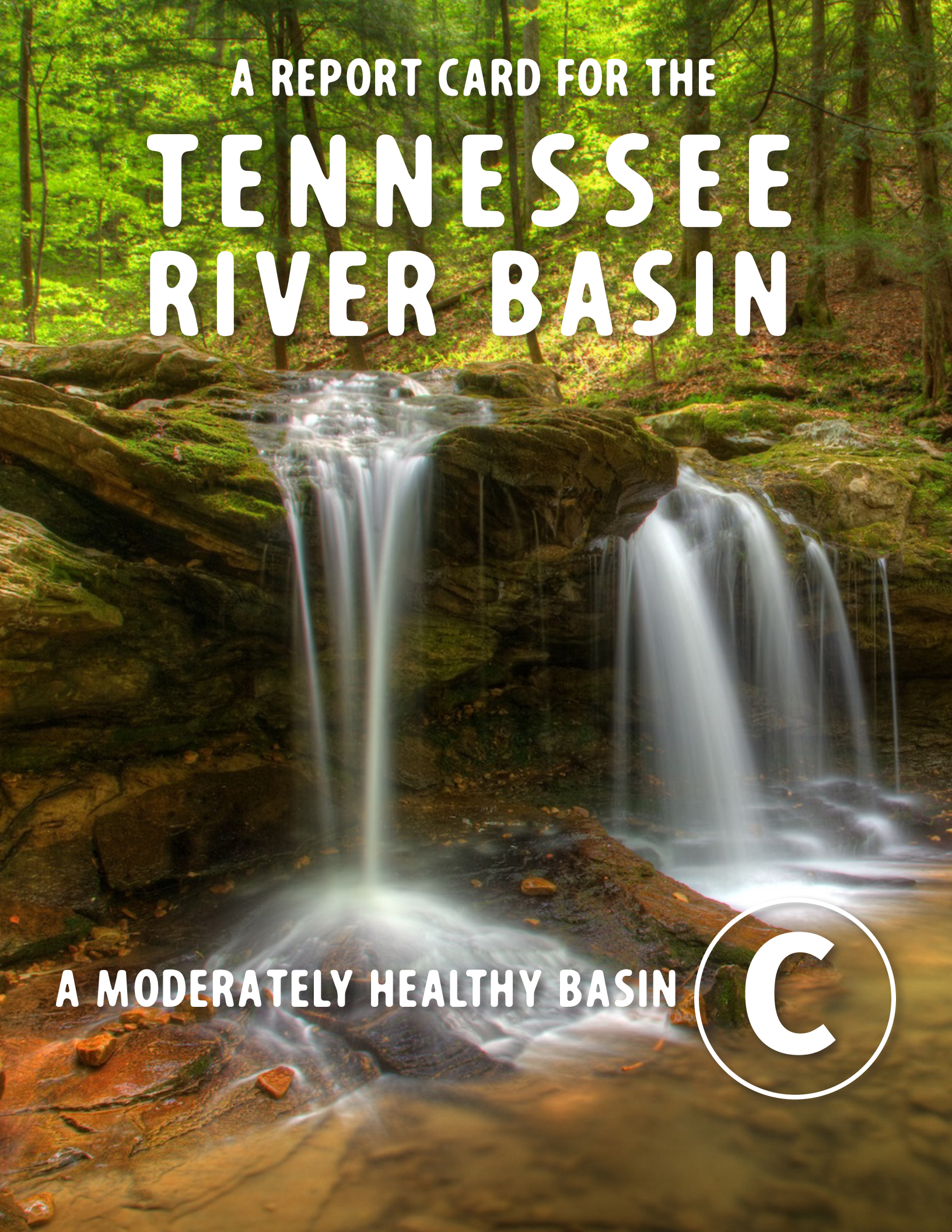
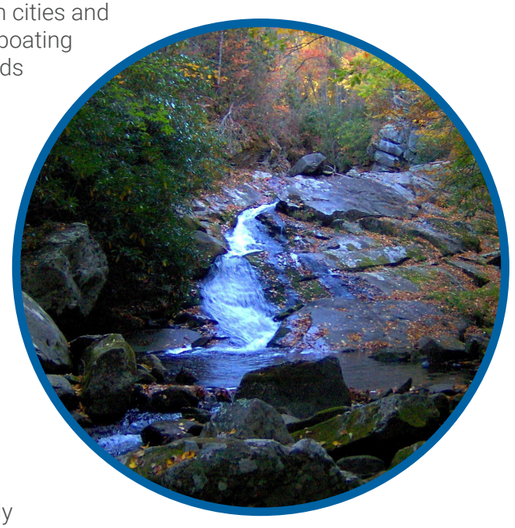

A REPORT CARD FOR THE
TENNESSEE RIVER BASIN
A MODERATELY HEALTHY BASIN
C

# A UNIQUE/AND VALUED BASIN

## THE TENNESSEE RIVER BASIN IS WILD AND DIVERSE

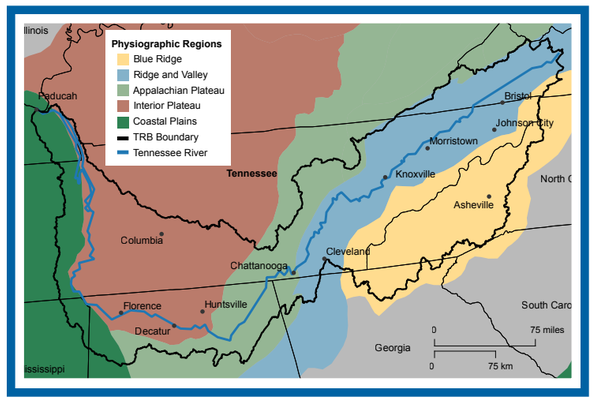
The Tennessee River Basin is home to over 5 million people in cities and small rural communities. Hunting, fishing, hiking, biking, and boating are popular outdoor activities in the amazing recreational lands of the Blue Ridge mountains. Flowing out of the Blue Ridge headwaters are thousands of streams that support some of the most diverse aquatic life in the world. However, the many dams here and throughout the basin restrict the movement of fish and other aquatic organisms, limiting dispersal and threatening population stability. The Tennessee River is one of the most impounded rivers in the world. Activities like boating and fishing on lakes created by dams are a way of life in the basin, garnering millions of dollars in economic activity through tourism. Through the ridge and valley and interior plateau, the river and its network of lakes is an important transportation corridor for shipping goods produced throughout the basin. Dams are also a source of carbon-neutral electricity, which attracts businesses dependent on clean electricity. The rich cultural heritage of Tennessee leads to the state being entirely designated as a National Heritage Area; Civil War sites throughout the state recall and remember the past.



Lynn Camp Prong Falls, Great Smoky Mountains, TN.
*Brian Stansberry.*

## REPORT CARD REGIONS ARE BASED ON GEOLOGY AND BIOLOGY

Tennessee River Basin stakeholders divided the basin into six regions based on the geology and biology of the landscape. The headwaters of the Tennessee River are in the Blue Ridge mountains and Ridge and Valley regions. While the Blue Ridge enjoys considerable land protection and a dense network of forests, the valleys of the Ridge and Valley region are more densely populated, including the cities of Knoxville and Chattanooga, and land is used extensively for grazing. Agricultural activities intensify in the Appalachian and Interior Plateaus, where the topography is more conducive to agriculture. At the most western edge of the Tennessee River Basin is the Coastal Plain, which is a remarkably flat region dominated by cultivated agriculture. The reporting regions of this report card largely follow these physiographic boundaries, although the Appalachian Plateau is divided into a northern and southern region. Each region was evaluated independently, based on relevant data for indicators measuring important stressors, environmental condition, and management activities.




Six physiographic provinces in the Tennessee River Basin are based on physiographic characters of the landscape.

# STRESSORS IN THE BASIN

## A BASIN UNDER THREAT

The Tennessee River Basin faces many stressors that threaten the basin's health. Main stressors to the basin include habitat fragmentation, climate change and its effects on aquatic habitats, pollution, and development in the basin. These major threats are outlined below. Indicators were chosen to reflect these stressors in the report card.

### Forest habitat fragmentation

An important strategy of landscape conservation is to protect a network of densely forested areas, each connected by forest corridors that permit the movement of plants and animals to new and better habitat. Outside of the region's state and national parks and forests, timber production companies have historically owned many of these important core and corridor forests. However, recent trends in land ownership have opened the potential for non-forest land uses. Thus, unprotected core and corridor forests have become a significant stress on the basin, potentially leading to lower quality, fragmented forests in the future.

### Dams, climate change, and aquatic habitat fragmentation

The Tennessee River Basin is one of the most impounded river networks in the world, which poses challenges to aquatic organisms attempting to disperse, find habitat, spawn, and thrive. As the climate warms and precipitation variability becomes more extreme, droughts are becoming more common. Drought, and the associated low stream flow, further reduce aquatic habitat area and connectivity. Drought has also contributed substantially to forest health and the risk of wild fire, notably contributing to the devastating 2017 wildfires in Gatlinburg, TN.

### Land-based sources of pollution to streams and rivers

River and stream pollution can originate from urban land, but sedimentation and nutrients from agricultural lands is the dominant pathway in the basin. Highly erodible soils located in hilly terrain are the biggest source of sediment. While agricultural best management practices such as cover cropping and buffers can reduce runoff and leaching of polluted waters to streams and groundwater, these practices have not been implemented everywhere.

### Development

Cities are the center of economic activity in the Tennessee River basin and are a prominent feature of human society. However, buildings, roads, and parking lots don't let rainwater soak into the ground, thus increasing runoff and sediment delivery to streams and rivers. Impervious surface area as low as 2-3% has been shown to impact sensitive fish species in small watersheds. As our cities have grown, these conditions have become more common.

## WHAT YOU CAN DO TO HELP

Stakeholders identified many threats to the Tennessee River Basin. Below are a few simple actions YOU can take to help conserve threatened ecosystems like the Tennessee River Basin.

- Support land use decisions that keep important forests and waterways connected.
- Support decisions that keep public lands public.
- Reduce energy use and your carbon footprint.
- Pick up your own trash and clean up trash that others have left behind.
- Plant and restore native vegetation that will soak up nutrients and prevent erosion.
- Don't dump household chemicals into streams, gutters, or drains.
- Stay educated on the issues in your river basin – support only development that is healthy for the ecosystem.

# TENNESSEE RIVER BASIN INDICATORS

Indicators for this report card were chosen to measure ecosystem stressors, condition, and management in the Tennessee River Basin. Stressors may have negative effects on ecosystem condition, but these effects can be reduced through management actions. Stressor indicators are intended to measure stresses on ecosystem condition; Ecosystem condition indicators reflect the state of aquatic and terrestrial components of the ecosystem; Management indicators measure efforts to reduce the negative impacts of Stressors on Condition throughout the basin. Detailed information for each indicator, including data sources used, analysis methods, and processes for these decisions are included in an accompanying methods report.

## STRESSORS

**Development** was evaluated from satellite estimates of the area covered by pavement and buildings, and averaged over small watersheds within each region. (US Department of Agriculture)

**Drought** was evaluated by calculating the cumulative number of months exhibiting extreme drought conditions over the past 10 years. (NOAA Palmer Drought Severity Index)

**Wildfire** risk was evaluated using the percent of each watershed threatened by wildland fire. (US Department of Agriculture)

**Forest pests and pathogens** were evaluated using the percent of tree basal area at risk of forest pathogens. (US Department of Agriculture)

**Sedimentation** was evaluated using the Soil Vulnerability Index for runoff. (Natural Resources Conservation Service)

## CONDITION

**Forest connectivity** was evaluated by calculating the area of forest in regional and local core areas under some form of land protection. (Appalachian LCC Natureserve)

**Aquatic connectivity** was evaluated by counting the total stream length without dams or road crossings over streams. (National Hydrography Data and Tiger Roads)

**Aquatic biodiversity** was evaluated based on indices of fish and aquatic insect biological integrity. (Tennessee Valley Authority)

**Aquatic insect richness** was evaluated based on indices of aquatic insect biological integrity. (Tennessee Valley Authority)

## MANAGEMENT

**Agricultural runoff best management practices** were evaluated using rates of farmer implementation of conservation practices to reduce runoff. (Natural Resources Conservation Service)

**Agricultural leaching best management practices** were evaluated using rates of farmer implementation of conservation practices to reduce nutrient leaching. (Natural Resources Conservation Service)

**Protected forests** were evaluated by looking at the percentage of important connecting forest that is currently protected. (US Protected Areas Database, National Land Cover Dataset)

**Protected wetlands** were evaluated by calculating the area of National Wetland Inventory lands under protection. (US Fish and Wildlife Service).

# THE TENNESSEE RIVER BASIN IS IN MODERATE CONDITION

## OVERALL BASIN HEALTH BY REGION

STRESSORS CONDITION MANAGEMENT

Stressor, condition and management indicators all averaged a grade of a C overall for the Tennessee River Basin. Overall basin health was determined to be a C.

## HEALTH OF THE SIX REGIONS IN THE BASIN

### BASIN HEALTH SCALE

Very good A B C D F Very poor

100% 80 60 40 20 0

Moderate

### RIDGE AND VALLEY

### NORTH APPALACHIAN PLATEAU

### INTERIOR PLATEAU

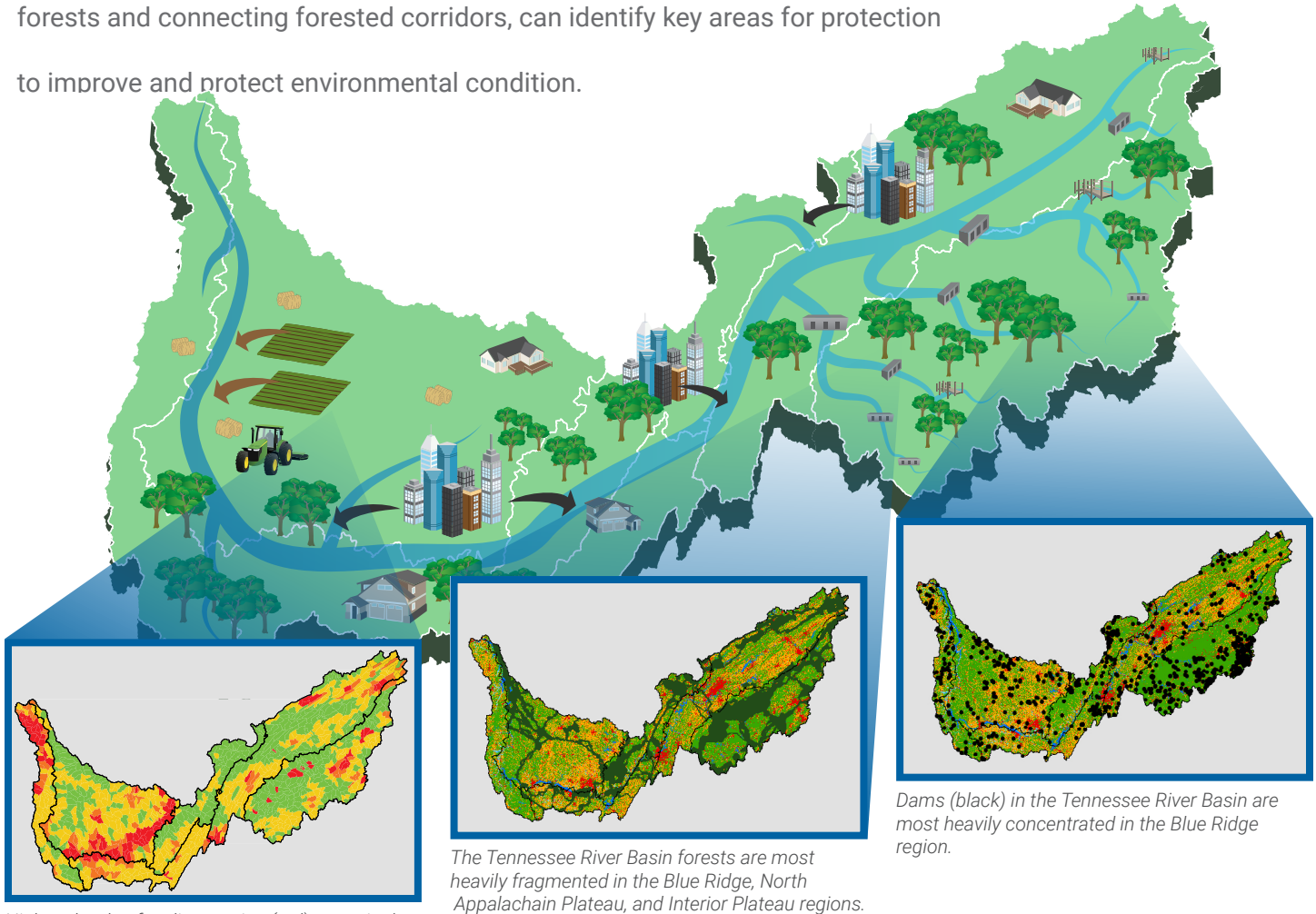
### COASTAL PLAIN

### SOUTH APPALACHIAN PLATEAU

### BLUE RIDGE

# A FRAGMENTED BASIN

Urban areas, agriculture, transportation, and dams provide important societal benefits. However, they can also have environmental consequences. Dams provide hydroelectric power, and the reservoirs they create have many recreational opportunities. But dams reduce fish movement within the river network. Cities, towns, and transportation infrastructure are important components of a healthy society, but further degrade aquatic connectivity through the placement of streams into culverts and stormwater systems. Impervious surfaces associated with development lead to greater and more intense runoff during storms. Storms also carry sediment from agricultural lands, with some soils being more at risk than others. Forest lands that have been altered for urban and agricultural use, can cause forests to become fragmented and disconnected. Landscape conservation design that identifies and protects local and regional core forests and connecting forested corridors, can identify key areas for protection to improve and protect environmental condition.



*Highest levels of sedimentation (red) occur in the Interior Plateau and Coastal Plains regions of the Tennessee River Basin.*

*The Tennessee River Basin forests are most heavily fragmented in the Blue Ridge, North Appalachain Plateau, and Interior Plateau regions.*

*Dams (black) in the Tennessee River Basin are most heavily concentrated in the Blue Ridge region.*

# REPORT CARDS FOR YOUR FUTURE

## HOW YOU CAN USE THIS REPORT CARD TO INFLUENCE FUTURE IMPROVEMENTS IN TENNESSEE RIVER BASIN HEALTH

This report card provides a snapshot assessment of ecosystem stressors, condition, and protection in the Tennessee River Basin. Depending on your profession, you might use this report card to help improve the basin in a variety of ways.

**Resource manager:** The report card communicates the current condition of the system, and can be used to direct future funding to particular locations and resources that received low grades. Future updates to the report card can be used to assess progress toward goals.

**Scientists:** Continued scientific investment is needed in the development of new indicators that can be inexpensively measured and monitored over time. Resources that are valued by the community but are absent from the report card provide direction to future monitoring and data synthesis activities.

**Residents:** How did your watershed grade? For example, were you surprised to find ecosystem condition in your area received a poor grade? Residents can use the report card to highlight threats to their environmental values and urge their communities to take action towards reversing negative trends.

**Citizen scientists:** Many volunteer citizens help promote scientific advances and leverage environmental monitoring measurements and observations. Web resources and watershed organizations can help volunteers (young and old) to make measurements of air and water quality, biological diversity, and changes over time.

*Dave Herasimtschuk, Freshwaters Illustrated.*

## ACKNOWLEDGMENTS

This preliminary report card was produced and released in November 2017 by the Appalachian Landscape Cooperative and the University of Maryland Center for Environmental Science Integration & Application Network to provide an initial assessment of the conditions in the Tennessee River Basin. Subsequent report cards will build on this to refine the indicators and assessments prepared in this initial effort.

This report card is accompanied by a detailed methods document and report that describes the data sources, analysis methods and process for developing this report card. It also outlines the process required to complete the final report card. Special thanks to the Tennessee River Basin Network for their contributions to the Report Card.

Front cover photo: Debord Falls, Wartburg, TN. Frank Kehren.

Tennessee River Basin Network

Appalachian Landscape Conservation Cooperative

University of Maryland Center for Environmental Science