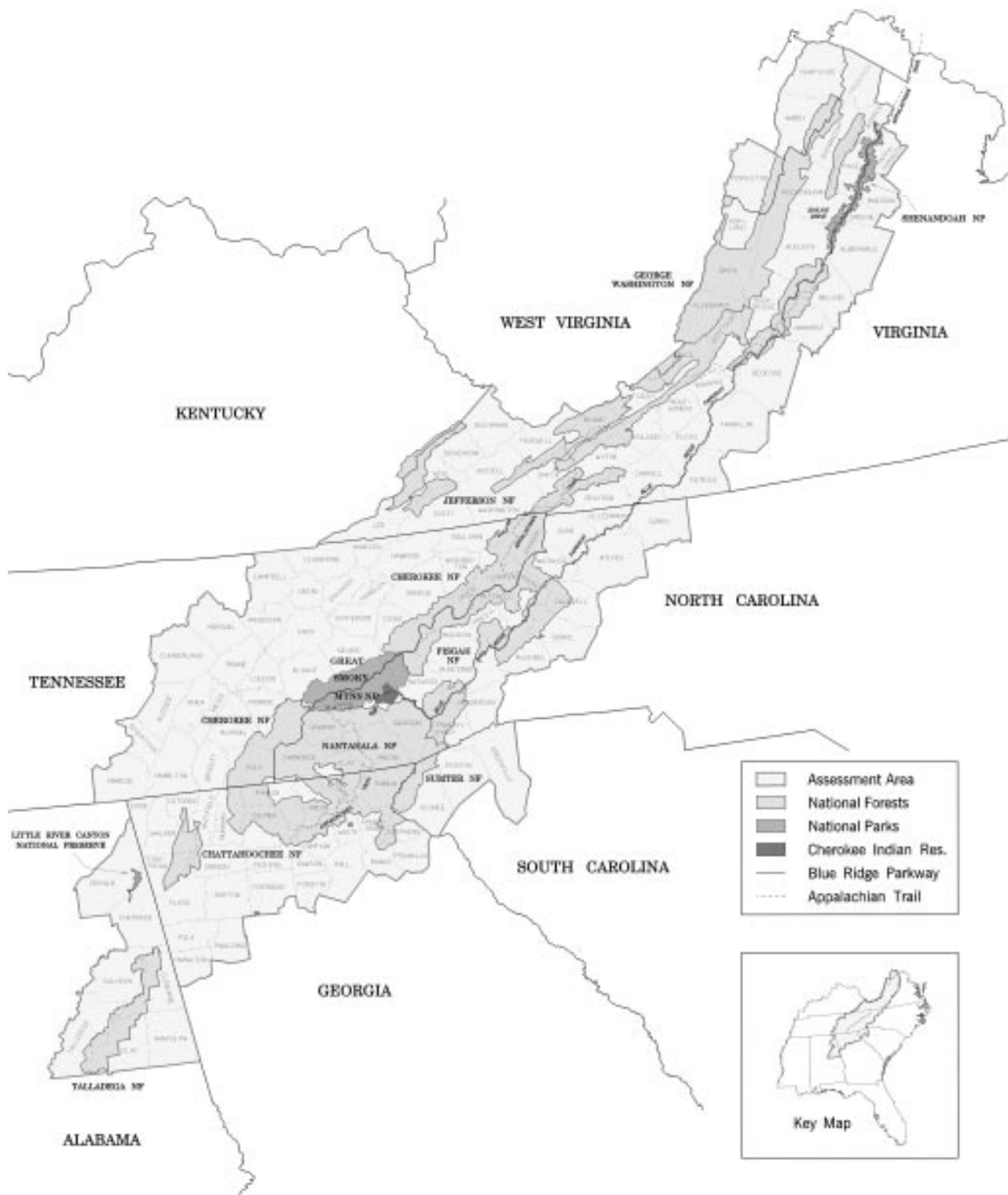


Figure 1

SOUTHERN APPALACHIAN ASSESSMENT AREA



Executive Summary

The Southern Appalachian ecosystem is widely recognized as one of the most diverse in the temperate region. The headwaters of nine major rivers lie within the boundaries of the Southern Appalachians, making it a source of drinking water for much of the Southeast.

The Southern Appalachian Assessment (SAA) area (fig.1) includes parts of the Appalachian Mountains and Shenandoah Valley extending southward from the Potomac River to northern Georgia and the northeastern corner of Alabama. It includes seven states, 135 counties, and covers approximately 37 million acres. The Southern Appalachians are one of the world's finest remaining ecological regions. Early in the 20th century, the Appalachian landscape and natural resources were being exploited; croplands, pastures, and hillsides were eroding; and timberlands were being cut with little thought for sustaining the resources. National forests and national parks were created to preserve and restore the natural resources in the region. The seven national forests in conjunction with three national parks, the Blue Ridge Parkway, and the Appalachian Trail form the largest contiguous block of public lands east of the Mississippi River.

The SAA, a comprehensive, interagency assessment, began in the summer of 1994 and was completed in May 1996. It was designed to collect and analyze ecological, social, and economic data. The information provided will facilitate an ecosystem-based approach to management of the natural resources on public lands within the assessment area.

Public participation has been, and will continue to be, an important part of the assessment. One of the first actions of the assessment was to conduct a series of town hall meetings at which the public gave suggestions on the major themes and questions to be addressed. These questions, supplemented by additional concerns expressed by land managers and policy makers, form the structure for the assessment.

The Southern Appalachian Assessment

those involved with resource planning for ecosystem management. The four SAA technical reports address terrestrial resources, aquatic resources, air quality, and social/cultural/economic aspects in the Southern Appalachian Mountains. The SAA is a cooperative effort of the U.S. Environmental Protection Agency (EPA); U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior, Fish and Wildlife Service (FWS), Geological Survey (USGS), National Biological Service (NBS), and National Park Service (NPS); U.S. Department of Energy, Oak Ridge National Laboratory; Department of Commerce, Economic Development Administration; Tennessee Valley Authority (TVA); the U.S. Army Corps of Engineers (COE); and the states of Tennessee, Georgia, and North Carolina.

This SAA aquatic technical report compiles existing regionwide information on aquatic resource status and trends, riparian condition, impacts of various land management or human activities, water laws, aquatic resource improvement programs, and water uses. The report discusses the distribution of aquatic species and identifies impacts on aquatic resources and water quality. Some problems include numerous degraded streams (greater than 20 percent of stream miles impacted in 15 basins), eutrophication of lakes (approximately 38 percent), habitat stress such as loss of up to 75 percent of riparian forest in some watersheds, loss of aquatic species, and the impacts of increasing human population and development. The report further identifies cooperative opportunities for citizens, businesses, and government agencies and identifies future data needs for aquatic resources.

Diversity of aquatic species is high, with a rich fauna of fish, molluscs, crayfish, and aquatic insects. Although human activities that impair aquatic habitat have decreased, population growth and concomitant land development have the potential to increase pressure on aquatic resources. The heritage program files

the SAA area. These include 26 endangered mussels and 7 endangered fish. Mussel populations may experience additional declines over the next 30 years in the Tennessee River basin. Impoundments of rivers and degradation of water quality have been implicated in the loss of these mussel species. Approximately 39 percent of the SAA area is in the range for wild trout, consisting of 33,088 miles of potential wild trout streams. The three trout species within the SAA area are vulnerable to stream acidification, which is increasing, particularly in higher-elevation streams.

While the percentage of degraded streams in the study area cannot be estimated accurately with available information, evidence documented in this aquatic resources report provides some estimates.

The states' assessments of designated use for aquatic life, drinking water, recreation, and other uses show that approximately three-quarters of all drainages in the SAA area have at least 6 percent of their streams not fully supporting uses (see section 2.2). Because most states monitoring programs cover only a small fraction of waters, and their monitoring network locations are not chosen to represent all streams in the SAA area, we can consider the range of 6 to 20 percent degraded streams to be an estimate for the larger streams. Second, studies of selected portions of the SAA area, using fish community biological samples of smaller drainages in several basins (see section 2.7), suggest that over 70 percent of locations sampled show moderate or severe fish community degradation. Third, a statistical sample of stream habitat condition overlapping the portions of the study area in Virginia and West Virginia suggests that about 50 percent of stream miles in the area studied show habitat impairment compared to relatively unimpacted reference conditions (see section 3.1).

Because these estimates are inadequate to represent the entire SAA area, a comprehensive statistical sample of streams in the SAA study area is necessary to determine the extent of degraded streams with known confidence. In the future we can expect an overall improvement in water quality. However, impacts associated with industrial and rural development are likely to continue until watershed management and planning are implemented across the

Water quality laws and regulations have been effective in controlling most point sources of pollution. In addition, widespread application of Best Management Practices (BMPs) to nonpoint sources of pollution has proven effective in protecting and maintaining water quality.

Finally, this aquatic resources assessment outlines information and data gaps which should be filled to allow evaluation of changes in aquatic conditions over time and to permit more reliable evaluation of the effectiveness of water quality protection programs. Such data gaps provide excellent opportunities for joint research and monitoring activities by federal and state agencies and other organizations. In order to document improvement in aquatic resources, techniques for using sensitive biological, physical habitat, and chemical indicators must be developed and collaboratively applied. (Intergovernmental Task Force on Monitoring Water Quality 1994)

Questions and Key Findings

The aquatic technical report addresses five questions raised during public outreach of the proposed SAA. Government agency scientists from various levels, forest planners, and concerned citizens identified the five questions as necessary to the understanding of the unique Southern Appalachian ecosystem being studied. Following is a brief summation of the key findings associated with each question.

Question 1 (Chapter 2):

What is known about the current status and apparent trends in water quality, aquatic habitat, and aquatic species within the Southern Appalachian study area?

The Southern Appalachian Mountain region, blessed with abundant rainfall and a vast network of streams, provides water supplies for foothill communities and major cities of the Eastern and southeastern United States. Information pertaining to these waterbodies is essential to understanding and managing our vital resources.

- High annual precipitation is typical for the SAA area which includes stations

- Water is a significant part of the SAA area landscape. The mean density of stream and river channels is 12 feet per acre and would be greater if all small mountain streams could be measured.
- The SAA area contains more than 556,000 acres of flooded river and lake surface, about 1.5 percent of the total SAA area.

Evaluation of the condition of rivers and tributaries is based upon the waterbodies' ability to support designated uses – fishing, swimming, aquatic life, and drinking water. State water quality monitoring data serve as the basis for this evaluation.

- There is general agreement that water quality has improved significantly since the adoption of the Clean Water Act in 1972. In addition, in some areas, population growth and resulting landscape alterations have caused some degradation in water quality.
- Most watersheds (representing 75 percent of the river miles in the SAA) have over 80 percent of their river miles rated as partially or fully supporting their designated uses as prescribed in the Clean Water Act.
- The trophic status of lakes in the SAA area varies widely. Overall, for lakes greater than 500 acres assessed by the states, 38 percent were listed as eutrophic, 46 percent mesotrophic, and 16 percent oligotrophic.
- The Tennessee River and Alabama River basin areas include most of the significantly impacted watersheds. See Chapter 5 for a discussion of pollutant sources and their impacts on water quality.
- The Chesapeake Bay drainage area, primarily in Virginia, has the highest percentage of waterbodies meeting water quality standards for the protection of aquatic life in the study area.
- The occurrence of fecal coliform bacteria above the states' standards for human contact is evident throughout the SAA area and is probably due to wildlife, livestock operations, and municipal discharges.

impaired water quality.

In the Southern Appalachians, geologic bedrock and the associated buffering capacity of soils to neutralize acid is used to identify watersheds that are sensitive to acid deposition.

- Within the SAA area, 54 percent of stream miles have high sensitivity to acid deposition, 18 percent have medium sensitivity, and 27 percent have low sensitivity.
- Published scientific evidence indicates that some streams in the area have become increasingly acidic in recent years.
- Projections of future conditions suggest that additional streams could become more acidic in the decades to come.
- The northern part of the assessment area is more vulnerable because of climate and proximity to sources of acid deposition.
- Headwater mountain streams in rugged terrain are typically most sensitive to acid deposition.

The SAA area serves as habitat for a number of threatened, endangered, and special concern species. Threatened and endangered species have been officially listed by the FWS under the Endangered Species Act. Special concern species have limited distribution and have not been legally listed, but are recognized by the Nature Conservancy and others as globally rare.

- The heritage program lists include 190 aquatic and semiaquatic TE&SC species in the SAA area; of these, 62 are fish and 57 are mollusks.
- The state heritage program lists include 34 endangered, 10 threatened, 4 proposed endangered, and 63 former category 2 aquatic and semiaquatic species as determined by the FWS.
- Of the 34 endangered species on the state heritage program lists, 26 are mollusks and 7 are fish.
- The 10 counties with the greatest number of aquatic TE&SC species are in three areas: the Clinch and Powell River drainages of Virginia and Tennessee; the

overall pattern largely reflects patterns for fish and mollusks.

The status of trout and associated habitat in the Southern Appalachians is a major concern with many people who fish for trout. Trout are often viewed as indicators of high water quality.

- Of the 37.4 million acres in the SAA area, 14.6 million acres are in the range of wild trout. Trout also live in some areas of the Southeast that are outside the SAA area.
- Of the total 33,088 miles of potential wild trout streams in the SAA area, 7 percent are in West Virginia, 39 percent are in Virginia, 10 percent are in Tennessee, 32 percent are in North Carolina, 2 percent are in South Carolina, 10 percent are in Georgia, and none are in Alabama.
- Of the total 33,088 miles of potential wild trout streams in the SAA area, 7,975 miles are in areas under Forest Service ownership and 1,634 miles are under National Park Service ownership.
- An additional 1,337 miles of stocked trout streams are found outside the wild trout boundary. An unknown portion of the streams within the wild trout range are stocked.
- Approximately 59 percent of wild trout streams are in areas that are highly vulnerable to acidification and 27 percent are in areas that are moderately vulnerable to acidification. Most of the highly vulnerable areas are in the northern parts of the SAA area, where brook trout are more common than rainbow and brown trout.
- Most Virginia and West Virginia wild trout streams are in counties that have reported hemlock wooly adelgid infestation.
- Twenty-six reservoirs greater than about 1 square mile in the SAA contain trout: 15 are stocked with trout, primarily rainbow trout; 8 contain incidental wild trout from past stockings or tributary streams; and trout may occur in 3 additional reservoirs.

High diversity of aquatic species in the Southern Appalachian Mountain region is a

risk are designated by the states as “threatened and endangered,” “special concern, sensitive,” or “rare,” but are not listed by the FWS.

- Out of a total of 260 other aquatic species at risk in the SAA area, there are 97 fish, 25 mussels, 1 snail, 2 crayfish, 111 insects, 17 salamanders, and 7 turtles.
- Approximately 70 percent of the selected fish are at the edge of their range in one or more SAA states.
- Fish that are categorized as TE&SC species or as other aquatic species at risk (table 2.6.1) comprise about 45 percent of the total number of fish species in the SAA area.
- Mussels that are categorized as TE&SC or as other aquatic species at risk comprise about 50 percent of the total mussels found in the SAA area.

Assessment of the condition of fish communities can provide an integrated picture of the ecological integrity of the assemblages of fish species.

- Detrimental impacts on fish community integrity are evident from fish community samples conducted by state and federal agencies covering selected subsets of the SAA area.
- Of 300 subjectively selected sites in both the Ridge and Valley and Blue Ridge ecological regions, about 69 percent of streams sampled show moderate to severe degradation of habitat. A statistical sample or a much larger and more widely distributed selection of sites would be needed to completely describe fish community condition.

A monitoring program on the George Washington National Forest serves as a case study on aquatic macroinvertebrate species. This approach has potential use for the Southern Appalachian Mountain region.

- Based on this case study, about 60 percent of the streams sampled on the George Washington National Forest with low EPT scores were acidified.

Question 2 (Chapter 3):

What management factors are important in maintaining aquatic habitat and water quality? What is the extent of riparian area and composition?

Habitat condition is one of the main factors influencing the ecological integrity of aquatic resources.

- Studies of subsets of the SAA area indicate a number of streams show signs of habitat degradation.
- Qualitative visual habitat assessments of 235 sites in the Holston and Hiwassee drainages show 15 percent of the sites sampled were severely impaired, 62 percent slightly to moderately impaired, and 23 percent not impaired.
- Qualitative visual habitat assessments of 178 statistically selected sites in the Mid-Atlantic Highlands Assessment (MAHA) study area (this includes the SAA study area in Virginia and West Virginia and also some areas outside the SAA) estimates that 50 percent of stream miles have impaired physical habitat.
- Approximately 37 percent of stream miles in the Blue Ridge ecological regions of the MAHA area and 60 percent of stream miles in the Ridge and Valley ecological region of the MAHA are impaired due to habitat factors.

Natural and human activities have the potential to significantly influence water quality and aquatic ecological integrity. Much of the landscape in the Southern Appalachians has been changed by human activity.

- Land cover classes aggregated by watershed, and thought to strongly influence water resource integrity, are distributed in the study area as follows: forest – 71 percent, pasture/herbaceous – 22 percent, cropland – 3 percent, and developed/barren – 4 percent.
- Intensive human influence on landscapes in the study area ranges from 0 percent to 75 percent. Intensive human uses include the developed/barren, cropland, and pasture/herbaceous classes. Note:

little or no human use.

- Those land cover classes which influence aquatic resources have distinct patterns in different ecological regions. For example, agricultural lands are predominant in the Ridge and Valley, while forests dominate the Blue Ridge.
- Federal holdings, including National Forest System land and National Park Service lands, have a lower fraction of land cover classes evidencing significant human influence than the rest of the study area.

Instream habitats for aquatic life are dependent on natural bank and riparian zone vegetation. Riparian areas serve as a food source for aquatic species and provide numerous important ecological functions.

- Aggregated land cover classes for the riparian zone of the entire SAA area are distributed as follows: forest – 70 percent, pasture/herbaceous – 22 percent, cropland – 3 percent, developed/barren – 4 percent, and wetlands – 1 percent.
- Federal holdings, including National Forest System and National Park Service land, have 90 percent forest cover in the riparian zone.
- Forest cover in the riparian zones of the study area ranges from less than 25 percent to 100 percent.
- The distribution of land cover classes in the riparian zone shows distinct patterns in different ecological regions. For example, forest cover in the riparian zone is generally much less in the Ridge and Valley than in the Blue Ridge.

Question 3 (Chapter 4):

What laws, policies and programs for the protection of water quality, streams, wetlands, and riparian areas are in place, and how do they affect aquatic resources, other resources, and human uses within the SAA?

- A number of federally funded programs exist to protect, restore, or improve the

agencies, including the USDA Forest Service, Natural Resource Conservation Service, NPS, Farm Services Agency, EPA, TVA, and COE. The programs provide for cost-share technical assistance to private landowners for erosion control, the purchase of easements on private wetlands, restoration, and assistance to private landowners for riparian management.

- The last 8 years have been a turning point in water resource legislation and pollution control. Programs have been specifically designed to deal with such problems as nonpoint source pollution, toxics, and other point sources. Programs also place emphasis on some of our national treasures such as the Chesapeake Bay and Great Lakes. The water pollution regulatory program as administered by EPA has been largely successful in reducing point sources of pollution. Many of our streams and lakes have gradually recovered from years of abuse and now support abundant life for swimming and recreation. The design and implementation of BMPs have demonstrated that technology can effectively reduce nonpoint source pollution.

Question 4 (Chapter 5):

What are the current and potential effects on aquatic resources from various activities?

- Two-thirds of the reported water quality impacts are due to nonpoint sources, such as agricultural runoff, stormwater discharges, and landfill and mining leachate.
- Soil disturbance due to agriculture and its potential for generating soil erosion that might reach the aquatic system declined from 1982 to 1992. While 23 counties reduced potential soil erosion by more than 50 percent over that 10 years, another 8 counties showed an increase of more than 50 percent.
- Impacts on the hydrology of aquatic resources are greatest for land uses and

increase with the proportion of watershed disturbed.

- In the majority of counties in the SAA area, less than 30 percent of the land base is devoted to agriculture. Those counties with more land in agriculture do not necessarily have greater estimated erosion potential, but often do have greater estimated nitrogen loading from fertilizer and animal manure.
- Population in the SAA area increased 19 percent from 1970 to 1980. Growth increased 7 percent more in the next 10 years. Development of housing, service facilities, and roads to serve the growing population generally increases impacts on water quality.
- Nearly 40 percent of the watersheds in the SAA have 6 percent of their stream length near and are potentially impacted by graveled or paved lower class roads. In a few counties, as much as 20 percent of their stream length is near roads.
- A total of 890 potential pollution-source sites are listed under the Comprehensive Environmental Resource Conservation Liability Act (CERCLA) within the SAA. There are 22 sites on the National Priorities List (NPL) Superfund sites, and 84 are either abandoned or closed landfills.
- At the time of this assessment, there were 170 sanitary landfills active in the SAA area that were not on the CERCLA list.
- In the state Water Quality Reports to Congress (required under CWA 305[b]), SAA states indicate that mining impacts on water quality occur predominantly in the Tennessee River basin and southwestern Virginia.
- Mining, urban/suburban development, and dams have had the largest effect on hydrology in the SAA region.
- Forest comprises the primary land cover of the region. Unlike agriculture, forestry activities that disturb soil are dispersed in both space and time. Thus, forestry has a low potential impact on aquatic resources.

- About 3,000 point sources currently discharge treated wastewater into surface waters within the Southern Appalachian region. About 7 percent of these NPDES permit sources are considered major facilities, based on volume of discharge and pollutant loading.
- The majority of permitted point sources with discharges greater than 1 million gallons per day (132 of 222) are municipal treatment facilities. Municipals constitute 40 percent of all permitted discharges.
- Urban areas are a large source of biological oxygen demand (BOD). Waters with estimated high BOD loading are often responsible for stream conditions inadequate for designated uses.
- The three industries with the largest number of point discharges are mining, textiles, and chemicals. Of those industries, 4 mining, 19 textile, and 21 chemical sites are rated as major facilities.
- According to Section 304(1) of the Clean Water Act, lists submitted by the states to EPA, 30 National Pollutant Discharge Eliminate System (NPDES) permit facilities have discharged significant levels of toxic chemicals into SAA waters.
- A total of 17 fish consumption advisories have been issued in the SAA area, with each state having at least one of these advisories. Eleven of the warnings are for Polychlorinated Biphenyl (PCB) contamination, one is due to PCB/chlordane contamination, three are due to mercury contamination, and two are due to dioxin contamination. Of the 17 advisories, 10 are located on 4 rivers and a lake that cross state lines.
- In 1990, approximately two-thirds of the water use within the study area was industrial, with the remainder divided between commercial, domestic, and agricultural.
- Overall, water usage in the domestic, industrial, and agricultural categories decreased 20 percent between 1985 and 1990, primarily due to a 27 percent decline in industrial use. Agricultural and domestic use also decreased, whereas commercial use increased.

Water uses on National Forest System land are predominately for domestic household, irrigation, recreation, municipalities, and the maintenance of fish and wildlife.

- Water usage on national forest system lands ranges from 1,700 gallons per day in Alabama to 1,315,000 gallons per day in Virginia. The Chattahoochee National Forest uses approximately 81,000 gallons per day, and the National Forests in North Carolina use 172,000 gallons per day. Tennessee national forests use 360,000 gallons per day. Only three counties in South Carolina are included in the assessment and no water rights were recorded for this area. The national forests in South Carolina do maintain rights for 39 sites within 4 watersheds within the area.
- Of the 1,315,000 gallons per day of usage in Virginia, 1,126,000 are drawn from the Holston River. Industrial withdrawals from the Holston River for Sullivan County, TN, and Scott and Washington, VA, are the highest within the SAA area.
- Water withdrawn from the Holston River in Virginia for fish and wildlife (614,000 gallons per day) represents the largest use on National Forest System land within the SAA boundary.
- Water usage on national forest land is minuscule in comparison to county usage.

Question 5 (Chapter 6):

What are the status and apparent trends in water usage and supplies within the SAA, including water rights and uses on national forest system land?

