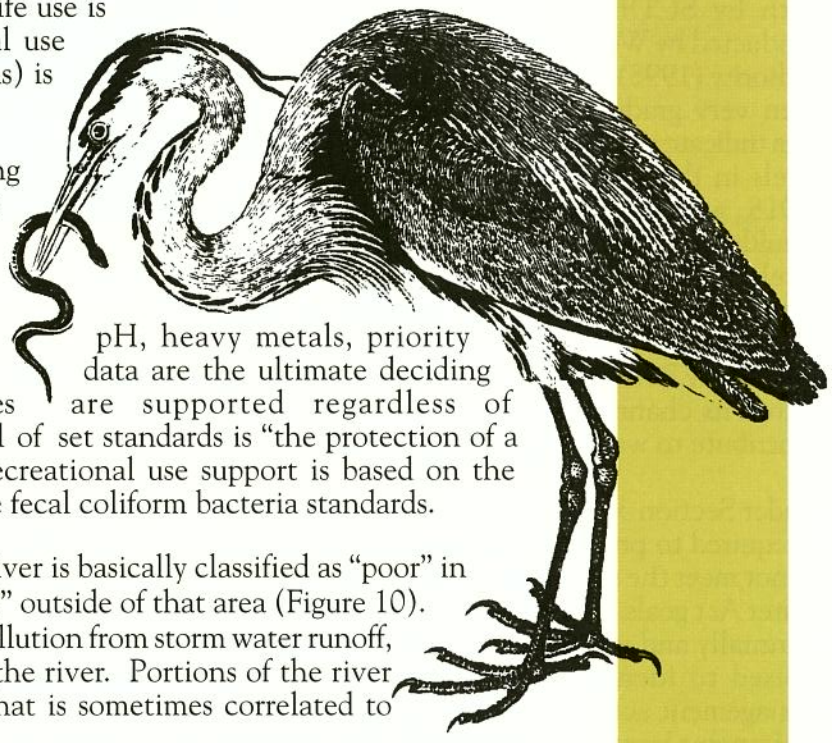
Water Quality

Photograph by Tom Blagden

The two basic sources of impacts to water quality within the Reedy River are point source pollution and nonpoint source (NPS) pollution. Point source pollution originates at a specific source, such as an industrial outfall or pipe. Currently, there are ten permitted point source dischargers within the Reedy River Watershed. Each of these facilities has a National Pollutant Discharge Elimination System (NPDES) permit that delineates the allowed levels for specific contaminants in the discharge from these facilities. All of the permitted facilities are located within the northern portion of the watershed (Figure 6 in the *Resources of the Reedy River* section of this report). Additionally, nonpoint sources also contribute to contaminant loading within the river. NPS contamination is generally introduced to a water body during a storm event and originates from a variety of activities that include agriculture, silviculture, construction, urban storm water runoff and residential wastes. Typical types of NPS contamination are pesticides, fertilizers, fecal coliform bacteria, grease, oil and sediment.

The South Carolina Department of Health and Environmental Control (SCDHEC) prepares a water quality assessment report for all rivers within the state. The most recent water quality assessment report for the Reedy River illustrates the condition of water quality within the Reedy River (SCDHEC, 1998). The Reedy is classified as "freshwaters" (FW). In order to determine how well this classification is being met, the river is investigated to determine whether it supports aquatic life and recreation. SCDHEC regularly collects and analyzes water samples from the Reedy River. There are a total of 18 monitoring sites located on the river. These stations are divided among primary, secondary, and basin monitoring sites and macroinvertebrate monitoring sites (Figure 6 in the *Resources of the Reedy River* section of this report). Four primary stations are located on the mainstem of the river with samples collected from these stations monthly throughout the year. Six secondary stations are located within the watershed. Samples are collected from these stations monthly from May through October, a period critical to aquatic life due to higher water temperatures and lower flows. Two basin stations are located on the mainstem of the river, with samples collected on a monthly basis during a basin's target year. Each basin within the state is targeted for additional sampling once every five years. Finally, six macroinvertebrate sampling stations are located within the watershed. Data collected from these sites is used to determine whether aquatic life use and recreational use are supported at each station. For the Reedy River, aquatic life use is supported at 9 of 16 stations and recreational use (based on fecal coliform bacteria concentrations) is supported at 5 of 13 stations.

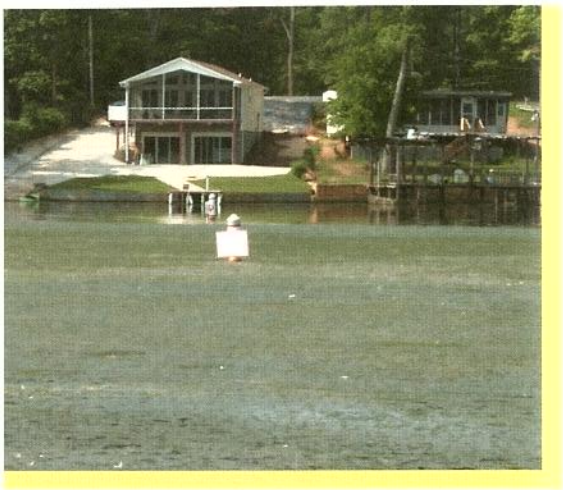


Aquatic life use support is assessed by comparing important water quality characteristics and the concentrations of potentially toxic pollutants with standards set by SCDHEC. Parameters that assist in determining whether aquatic life is supported include dissolved oxygen (DO), pH, heavy metals, priority pollutants, chlorine and ammonia. Biological data are the ultimate deciding factor used to determine whether aquatic life uses are supported regardless of chemical conditions because the ultimate goal of set standards is "the protection of a balanced indigenous aquatic community." Recreational use support is based on the frequency with which water samples exceed the fecal coliform bacteria standards.

In terms of supporting aquatic life, the Reedy River is basically classified as "poor" in the vicinity of the City of Greenville and "good" outside of that area (Figure 10). Metals, which tend to be associated with NPS pollution from storm water runoff, have been discovered in water samples within the river. Portions of the river also show a decreasing trend in pH, a trend that is sometimes correlated to atmospheric emissions.

In terms of recreational use, much of the Reedy River is classified as "poor;" however, the southern-most portion of the river (just above lake Greenwood) is classified as "fair" (Figure 11). Fecal coliform bacteria levels exceed SCDHEC's standards more than 25 percent of the time at all monitoring stations except those in Boyd Mill Pond and the Reedy portion of Lake Greenwood. Therefore, within the watershed, only Boyd Mill Pond and the Reedy portion of Lake Greenwood meet the "swimmable" standards. The frequency with which fecal coliform bacteria levels exceed the standards illustrates a noteworthy trend of an overall increase in fecal coliform bacteria levels within the Reedy River. Currently, the source of this contamination is unknown.

When overall use is considered for the Reedy River, the northern portion of the watershed is classified as "poor" and the southern portion of the river is classified as "fair" (Figure 12).



In recent years, portions of the Reedy River appear to have been adversely affectedby nutrification, which occurs when an excess of plant nutrients is added to the river. In terms of water quality, phosphorus and nitrogen are the nutrients that cause the most concern. Large concentrations of plants can reduce dissolved oxygen and cause fluctuations in pH, resultingin catastrophic fish kills in extreme cases. Although South Carolina currently has no official standards or criteria for nutrients in water, such standards may be included in revised SCDHEC regulations. However, the United States Environmental Protection Agency (USEPA) has issued recommendations for phosphorus concentrations to prevent over-enrichment of water bodies. SCDHEC does include phosphorus standards for applicable NPDES permits.

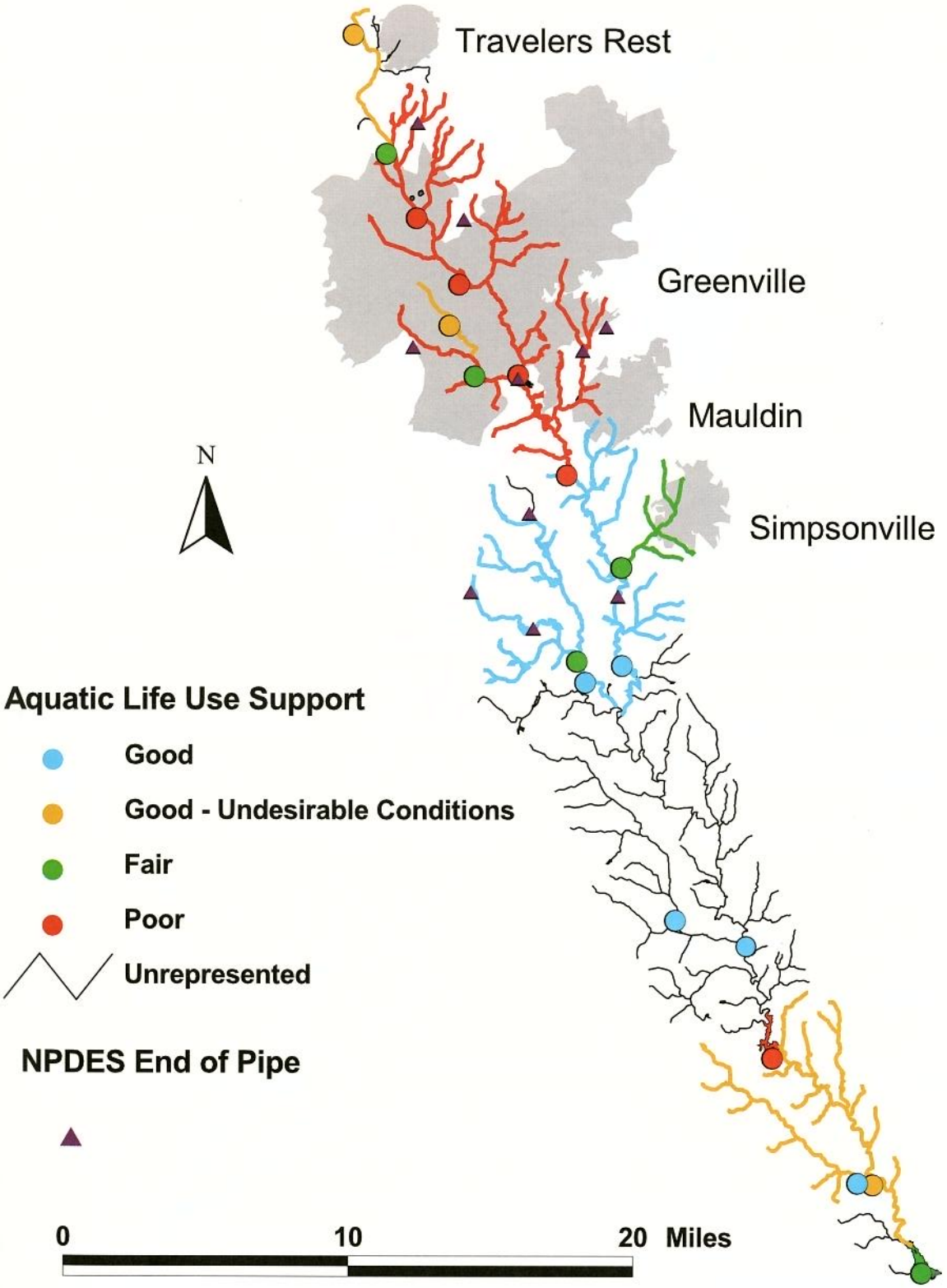
Lake Greenwood has recently been plagued by algal blooms that cover the water surface. These blooms result from excess nutrification

After phosphorus detergent was banned in 1992, statistically significant reductions in phosphorus occurred in much of the Reedy River. This trend of reduction in phosphorus has been discovered both by SCDHEC (1998) and in a study conducted by Western Carolina Regional Sewer authority (1998). However, these decreases have been very gradual. Additionally, monitoring data indicate a significant increase in phosphorus levels in the Reedy River at sampling station S-018, which is located south of the City of Mauldin and Lake Conestee. High phosphorus levels continue to be observed at the next two monitoring stations on the Reedy River, above Boyd Mill Pond.

The Reedy River is also adversely affected by a great deal of litter within its channel and along its banks. Some of this litter may contribute to water quality degradation.

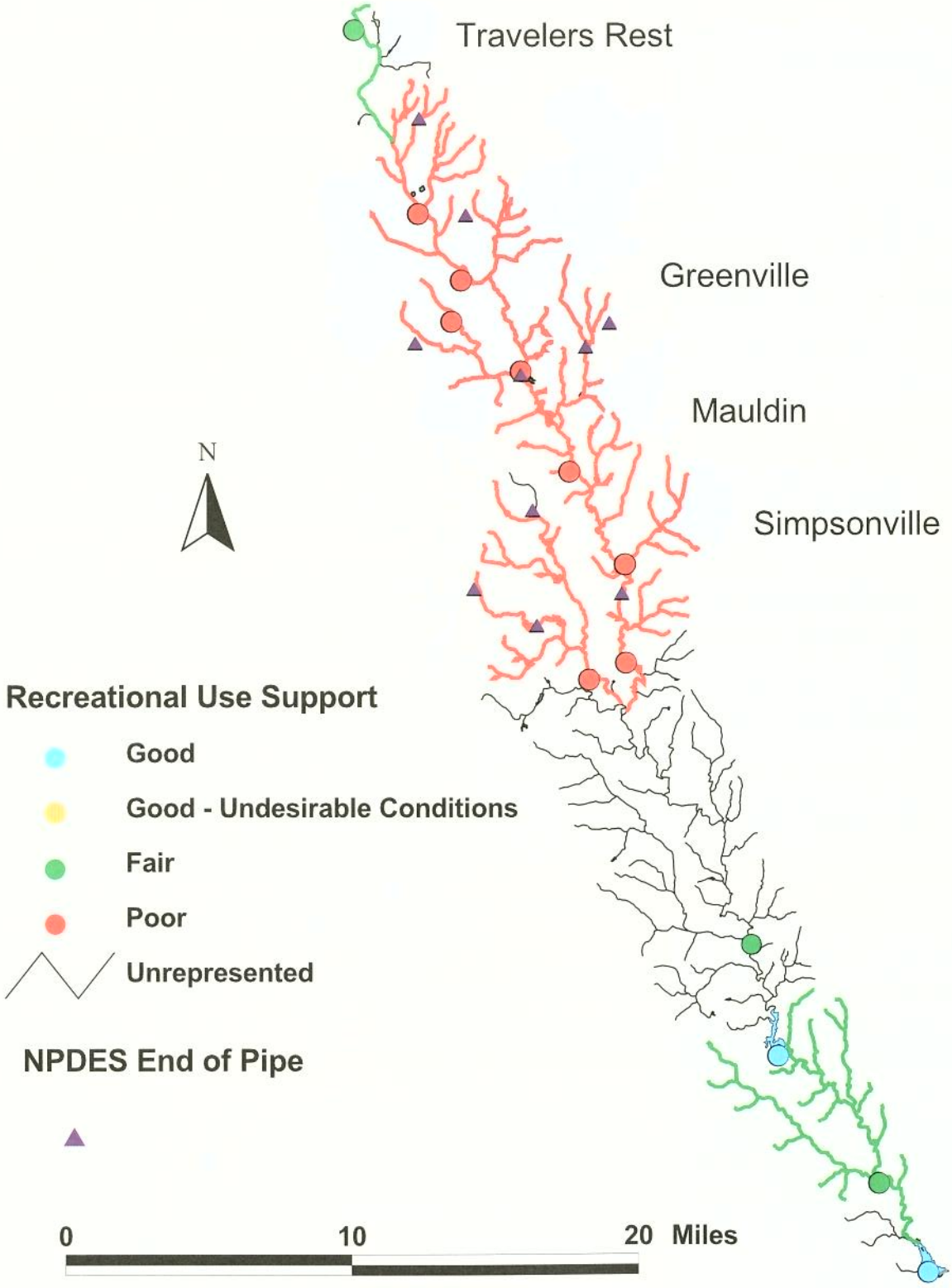
Under Section 303(d) of the Federal Clean Water Act, each state is required to provide a comprehensive inventory of waters that do not meet the state water quality standards or the Federal Clean Water Act goals. The list generated from this inventory is prepared biennially and is referred to as the "303(d) list." The 303(d) list is used to identify those waterbodies that need additional management actions. Water bodies are included on the 303(d) list by point locations (identified by the sampling station number); however, the impairment most likely extends for some distance upstream and/or downstream from the point location listed.

Figure 10: Aquatic Life Use Support 1993-1997



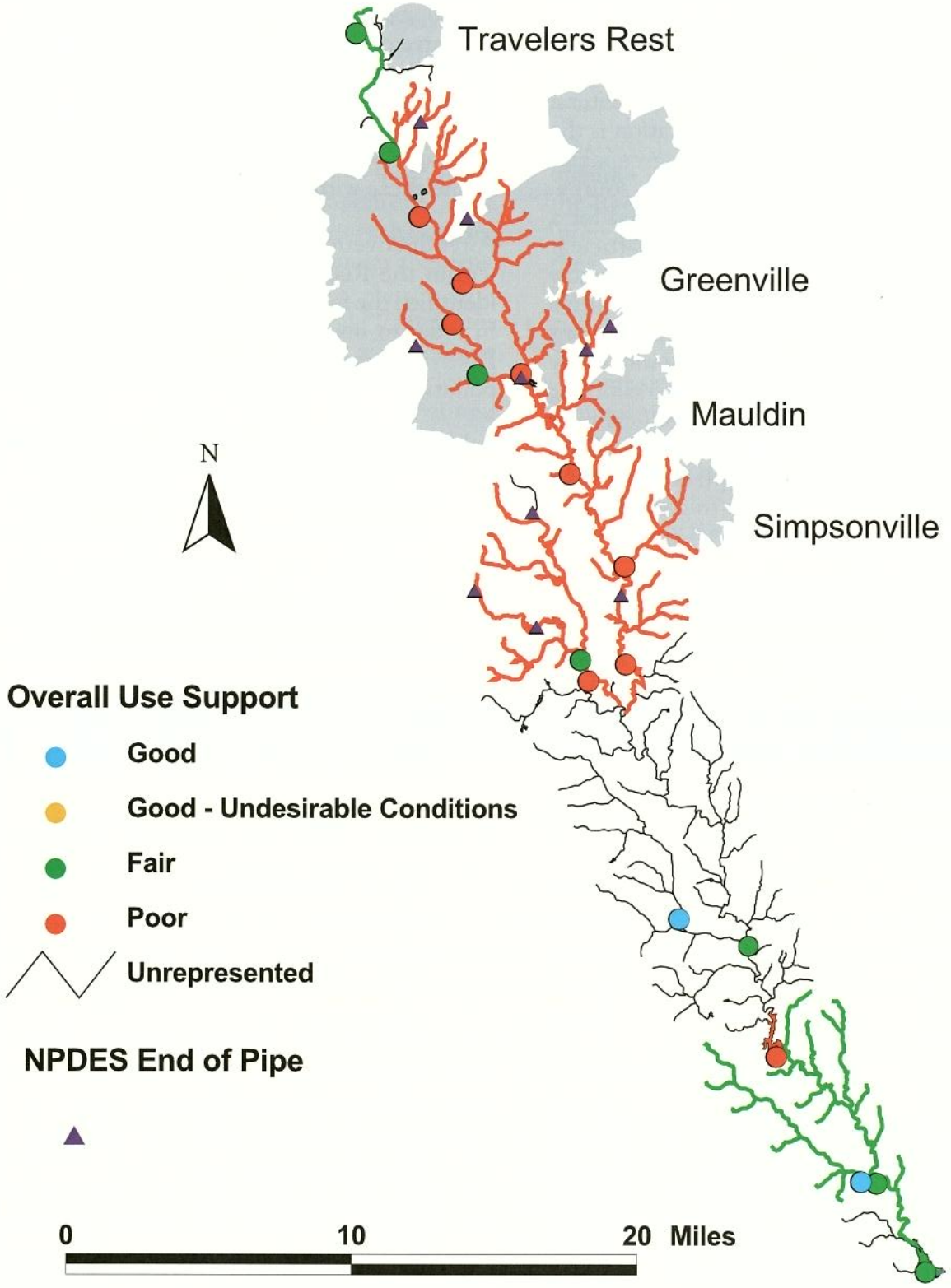
Prepared by the South Carolina Department of Health and Environmental Control, Bureau of Water, for the Reedy River Task Force

Figure 11: Recreational Use Support 1993-1997



Prepared by the South Carolina Department of Health and Environmental Control, Bureau of Water, for the Reedy River Task Force

Figure 12: Overall Use Support 1993-1997



Prepared by the South Carolina Department of Health and Environmental Control, Bureau of Water, for the Reedy River Task Force

SCDHEC must develop a Total Maximum Daily Load (TMDL) for each specific contaminant exceeded within a specific waterbody identified on the 303(d) list. A TMDL represents the maximum pollutant load allowed for a specific waterbody so that water quality standards can be maintained. Further, a TMDL is made up of two main components, a load allocation and a waste allocation. A load allocation is the portion of the receiving water's loading capacity attributed to existing or future NPS contamination or to natural background sources. The waste load allocation is the portion of the receiving water's loading capacity allocated to an existing or future point source. Although TMDLs were historically developed for a particular portion of a watershed or for a particular point source, broad watershed-based TMDLs are now being developed to address the combined cumulative impacts of all sources. For example, if concentrations of fecal coliform bacteria have resulted in a waterbody being placed on the 303(d) list at one or two sampling locations, a TMDL will be developed specifically for fecal coliform bacteria for the entire waterbody. Each point source within that waterbody will be allocated a specific waste load that it is allowed to contribute to the waterbody through its effluent.

There are nine monitoring stations within the Reedy River Watershed that are on the Section 303(d) list for 2000 (Table 4). Each station listed on the 303(d) is identified by its monitoring site number (refer to Figure 6 in the *Resources of the Reedy River* section of this report for the location of these stations). Additionally, the county in which the station is located, the impaired use (recreational or aquatic life supporting), the cause for listing and its priority for development of a TMDL are also presented in Table 4. Three of the stations on the 303(d) list within the Reedy River Watershed are listed for more than one cause. Priorities for development of TMDLs are identified numerically as "1," "2," or "3." Those stations with a priority of "1" will have TMDLs developed before those with a priority of "3."

After discovering the existing condition and impacts within the Reedy River Watershed, the committee identified the following issues that should be addressed in order to improve water quality within the Reedy River while arresting degradation of the river due to pollution, storm water flow and sediment input:

- Collection and consolidation of information
- Public education
- Identification of river flow regime
- Identification of potential for catastrophic releases
- Reduction in contaminant loading/development of TMDLs
- Elimination of trash

Table 4: Reedy River Monitoring Stations on 303(d) List for 2000

Station Number	County	Impaired Use	Cause	Priority
S-013	Greenville	Recreation	Fecal Coliform Bacteria	2
S-013	Greenville	Aquatic Life	Chromium	3
S-013	Greenville	Aquatic Life	Copper	3
S-018	Greenville	Recreation	Fecal Coliform Bacteria	1
S-018	Greenville	Aquatic Life	Chromium	2
S-018	Greenville	Aquatic Life	Zinc	2
S-021	Laurens	Recreation	Fecal Coliform Bacteria	2
S-070	Laurens	Recreation	Fecal Coliform Bacteria	3
S-072	Greenville	Recreation	Fecal Coliform Bacteria	1
S-073	Greenville	Recreation	Fecal Coliform Bacteria	3
S-319	Greenville	Recreation	Fecal Coliform Bacteria	1
S-319	Greenville	Aquatic Life	Zinc	1
S-178	Greenville	Aquatic Life	Macroinvertebrates	3
S-868	Greenville	Aquatic Life	Macroinvertebrates	3

Methodology

Improving water quality was identified as a key issue in the management and restoration of the Reedy River. The Water Quality Issue Committee was chaired by Bob Harley of Bowater Inc. and included fifteen other members representing state agencies, environmental groups, landowners, universities and industries. The committee met on a regular basis from August 1999 through July 2000. Several concerns of this committee overlapped with those of the Storm Water and Aquatic Health and Riparian Zone Management Issue Committees. Therefore, joint meetings of these three issue committees were held to discuss similar concerns.

The mission of the Water Quality Issue Committee was to determine how best to improve water quality within the Reedy River while arresting degradation of the river due to pollution, storm water flow and sediment input. The committee began by researching the existing impacts to and the current condition of water quality within the Reedy River. In order to conduct this research, the committee reviewed available water quality monitoring data from SCDHEC, flow data from the United States Geological Survey (USGS), land use maps of the watershed and other data and information from a variety of sources. Further, the committee used the experience of its members and other knowledgeable people to determine impacts.

Information Collection Consolidation

As the committee researched the current condition of water quality, the members realized that existing data, collected by a variety of entities, was stored in several different locations and was not easily accessible. Additionally, more data may need to be collected to adequately characterize water quality in the river. SCDHEC has collected water quality information for the parameters they use to classify waters of this state. However, there is very little information concerning sedimentation rates within the river. Also, monitoring stations within the watershed are limited in number. USGS has flow data from three stations within the river that can assist in determining how contamination is transported within the system. Because the detrimental effects of both flow and water chemistry can be additive, it would also be beneficial to be able to correlate this data to better determine the potential impact to water quality.

Once data is consolidated, it will be easier to investigate the overall water quality of the river. In the event that additional data is necessary, it can be collected. The data collected and consolidated can then be used to develop a comprehensive water quality model that could serve as a foundation for water quality management throughout the basin.

Public Education

Currently, both governmental and private organizations are working to educate the people within the Reedy River Watershed about the importance of protecting water quality and the river around which they make their homes. Governmental agencies with public outreach programs of this nature include SCDHEC, SCDNR, Natural Resource Conservation Service (NRCS), South Carolina Forestry Commission, South Carolina Department of Parks, Recreation and Tourism and the Soil and Water Conservation Districts for Greenville, Laurens and Greenwood Counties. Two local organizations that do a great deal of outreach in the watershed are Friends of the Reedy River (FoRR) and Upstate Forever.

Flow Regime

During their investigation, committee members attempted to determine whether the flow regime of the Reedy River had changed drastically within the last century due to changes in land use. It is well documented that flows within the river can change drastically during a storm event, resulting in very large peak flows. However, the committee was unable to determine whether base flow in the watershed has been altered due to increased development in the northern portion of the watershed. To assist in reducing water quality impacts, the flow regime within the river, ways to moderate peak flows, and ways to increase base flow should be investigated.

Catastrophic Releases

The 1996 diesel fuel spill in the Reedy River is an example of a catastrophic release. Such releases are generally accidental; however, these accidents can often be prevented. Currently, a list of all sources that may potentially result in a catastrophic release is not available. To better protect the river from such an event, it would be beneficial to identify all areas that have the potential to release contamination to the

river. Once identified, mitigation plans could be developed to reduce impacts in the event that a release were to occur in the future.

Contaminant Loading

Contaminants that enter the river can originate from a variety of sources. Those contaminants from point sources are generally well characterized through programs within SCDHEC. However, contaminants that are not monitored by SCDHEC and contaminants that originate from nonpoint sources are not characterized as thoroughly. It is important that all sources and types of contamination affecting the Reedy River be identified. Once this information is available, water quality management programs can be better implemented. This information can also be very beneficial during development of TMDLs for the Reedy River Watershed.

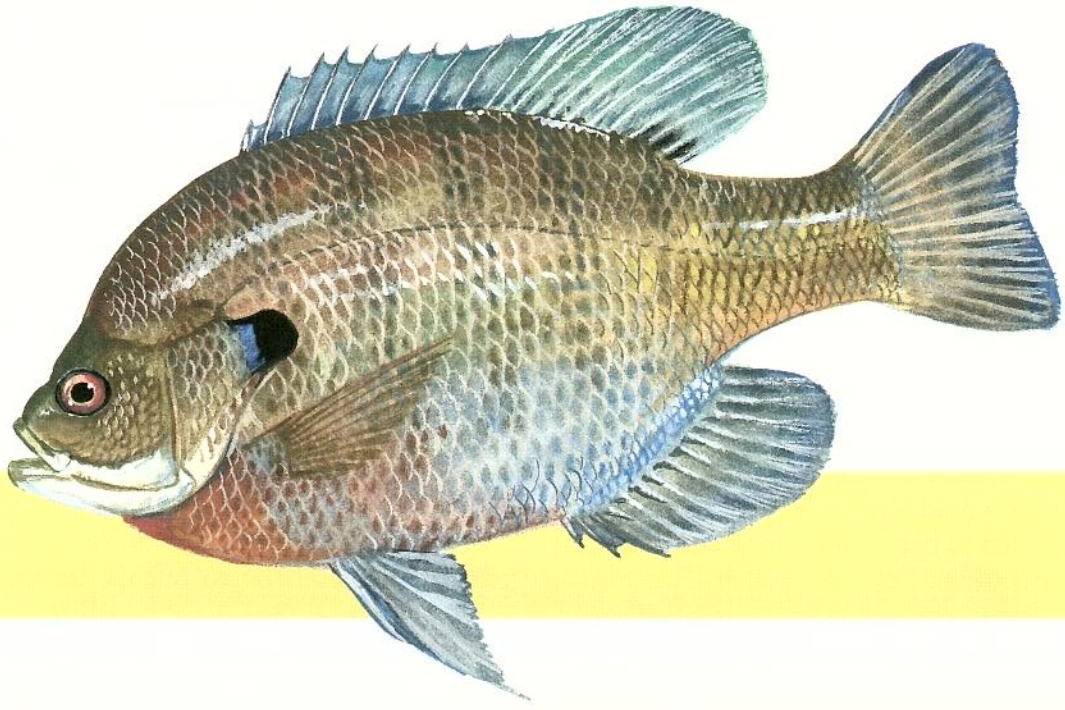
Trash Elimination

The beauty of the Reedy River is frequently marred by the amount of trash in the river and lining its banks. Although several groups are currently involved in organizing river cleanup days, more needs to be done to remove the existing trash and to reduce/eliminate the potential for future trash in the river.

Recommendations

After reviewing the issues that affect water quality, the issue committee developed and submitted the following recommendations to the Reedy River Task Force. All were subsequently approved for inclusion in this plan.

1. Build and maintain a comprehensive water quality model, including data for water chemistry, flow, sediment loading and aquatic habitats for the Reedy River basin that will serve as a foundation for water quality management throughout the basin. As part of development of the model, the following should be accomplished:
   a. Develop an easily accessible comprehensive database of all on-going studies and existing data addressing water quality issues.
   b. Identify water quality data gaps and develop solutions to address these gaps, including volunteer and cooperative monitoring programs.
2. Accelerate a nonpoint source educational program similar to the one currently in place in the Neuse River Basin, North Carolina.
3. Improve the flow regime of the Reedy River by increasing base flow and moderating peak flows.
4. Identify risks and mitigation strategies to prevent impairment to Reedy River water quality from catastrophic releases.
5. Reduce nutrient and contaminant loading into the Reedy River from both point and nonpoint sources. Cooperate with SCDHEC in the development and implementation of TMDLs within the Reedy River basin.
6. Develop an accelerated program to reduce and eliminate trash in and along the Reedy through an aggressive educational campaign and a program of coordinated cleanups utilizing supervised work forces during suitable conditions and times of year. Enforce existing litter laws.

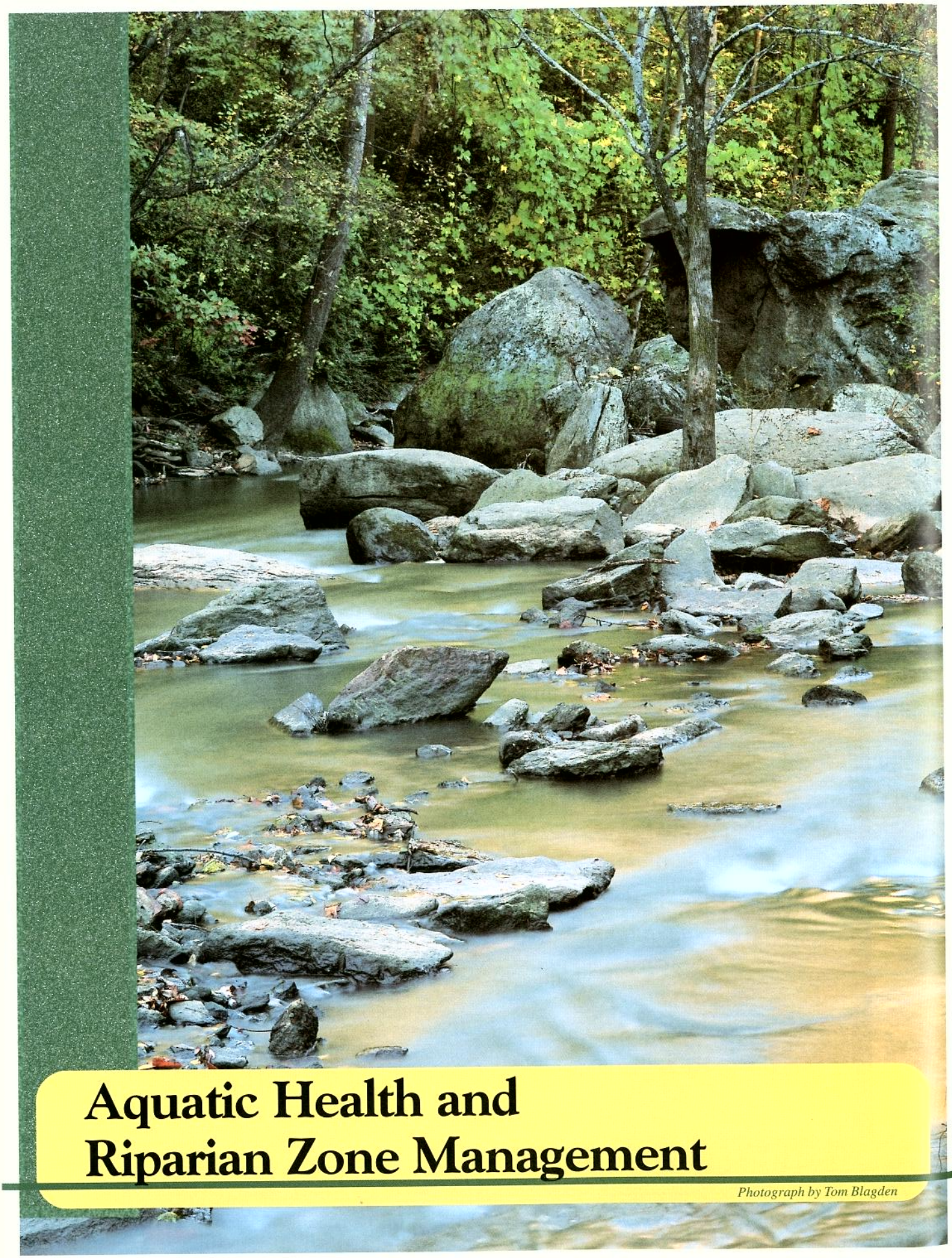


I have crossed, canoed and waded in many rivers. I have seen the powerful, the famous, the fast and the revered. But these rivers that have elicited awe and joy and sometimes a rush of fear have never cut a course through my heart like the Reedy.

This worn out farm that borders the Reedy has been in my family for generations. Sentimentality about the land and river would probably have been met with derision by my grandfather and great-uncles who remembered the intense labor and mind-numbing drudgery of farming. My parents too had a practical and unsentimental attitude about the farm and the river that defined one border. In the 1950s the river was ugly and polluted and stunk. Yet that was when I fell in love with the Reedy. It happened when I was in the bottom field with my father as he talked with men who were operating a sawmill. It was as if a portal to the past opened and I saw the river and surrounding land as it was before the white man came.

Almost half a century later, due to the tragic diesel spill that occurred in 1996, the Reedy River gained public attention. For months, I attended Reedy River Task Force meetings and listened as people spoke with knowledge and authority about the negative impact man has had on the river. And I listened as proposals were made to reverse the damage or to profit in some way. Through the many hours of discussion, I gained a broader perspective of the Reedy and insight into the complexities of a river that is both urban and rural. But the most important thing I learned was that others care about the river, too. With the help of others, my husband and I envision our old farm as a haven for wildlife, protected in perpetuity from development. We envision access areas to the river so that others can experience the joy of canoeing the Reedy and discovering its rapids. We cannot stop the spread of development but we can preserve a natural space along the Reedy River. Decades from now, this spot of green will remain.

Freda Alverson
Reedy River Landowner



Aquatic Health and Riparian Zone Management

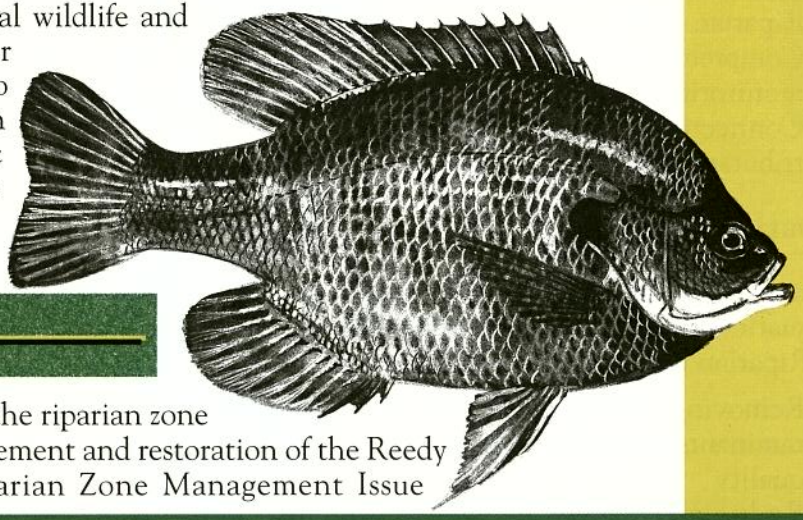
Photograph by Tom Blagden

The current condition of and impacts to aquatic health and riparian zones vary in different portions of the watershed. Many factors affect aquatic and riparian zone health including storm water runoff, point and nonpoint source discharges, trash and dams.

In northern Greenville County, storm water has adversely affected both aquatic health and the condition of the riparian zone. Increased storm water runoff has increased the magnitude of peak flows within the Reedy River. These flows scour the streambed, resulting in loss of aquatic habitat, bank erosion and increased sediment loading in the river. Increased sedimentation results in further loss of aquatic habitat and can also result in injury to or loss of aquatic life when fine sediments adhere to gills of aquatic organisms and respiration is impaired. Sediment trapped behind impoundments increases channel downcutting and bank erosion downstream of the dam, resulting in degradation of in-stream and riparian habitats. Decreasing water quality, through increased nonpoint source contaminants, continued point source discharges and increased nutrient loading within the river, has further degraded aquatic health. The amount of trash in the river can also impact water quality. The riparian zone has been cleared and developed throughout much of the northern portion of the river. Once altered in this fashion, the riparian zone is no longer effective in trapping sediments or absorbing pollutants from storm water runoff, nor can it support terrestrial wildlife. Further, when stream shading is lost in degraded riparian zones, water temperatures increase; this temperature increase can result in habitat losses for fish and other aquatic species. Dams within the watershed act as barriers to movements of fish and other aquatic life. When barriers are present in a stream channel, the ability of aquatic organisms to recolonize impacted areas, such as those affected during the 1996 diesel fuel spill, is reduced or eliminated.

In southern Greenville County and Laurens County, storm water flows to the Reedy are not as drastic as those in the northern section of the river; however, some impacts from sedimentation are evident. High flows originating upstream have resulted in down-cutting (a reduction in streambed elevation) which results in steep cutbanks. As in the northern section of the river, water quality has decreased due to nonpoint source contaminants, increased fecal coliform bacteria levels, increased nutrient loading, and trash in the river. Although there are no point source discharges in this portion of the river, flows from upstream continue to adversely affect this area of the Reedy. Further, aquatic life has still not fully recovered from the 1996 diesel fuel spill. The riparian zone in the southern portion of the river is more intact than in the river's northern section; however, the impacts described above will occur in the event the existing riparian zone is destroyed. Dams in the southern section of the river also act as barriers to aquatic life.

The health of both aquatic and terrestrial wildlife and plant communities within the Reedy River Watershed is not fully understood due to the lack of comprehensive population studies. However, existing data for aquatic macroinvertebrate and fish communities indicate that the aquatic health of the Reedy River is impacted.



Methodology

Protecting aquatic health and managing the riparian zone were identified as key issues in the management and restoration of the Reedy River. The Aquatic Health and Riparian Zone Management Issue

Committee was chaired by Dr. Robert Hudson of Presbyterian College and included ten other members representing state agencies, environmental groups, landowners and industry. The committee met on a regular basis from August 1999 through February 2000. Several concerns of this committee overlapped with those of the Storm Water and Water Quality Issue Committees. Therefore, joint meetings of these three issue committees were held to discuss similar concerns.

The mission of this committee was to determine how best to protect and restore aquatic health within the Reedy River as well as appropriate protection of existing riparian zones and restoration of denuded riparian zones within the watershed. The committee began by researching the existing impacts to and the current condition of aquatic health and riparian zones. In order to conduct this research, the committee reviewed 1994 aerial photographs, land use maps, buffer overlays on land use maps and maps of critical habitats. The committee also utilized current scientific literature and the experience of committee members and other knowledgeable people.

After discovering the existing condition of and impacts to the riparian zone and aquatic habitats within the Reedy River Watershed, the committee developed the following goal:

> ***Improve riparian and aquatic habitat in the ReedyRiver Watershed so that all waters "fully support" a balanced and indigenous population of flora and fauna as measured by acceptable biological protocols.***

Using this goal, the committee identified the following issues that should be addressed for protection and restoration of aquatic health and protection of existing riparian zones and restoration of altered riparian zones:

- Riparian buffers
- Comprehensive biological inventories/ monitoring
- Connectivity between the Reedy River, its tributaries and its floodplain

Riparian Buffers

Without an intact riparian buffer zone, the health of both aquatic and terrestrial organisms will begin to suffer. Riparian buffers benefit watersheds by:

- Removing sediment, nutrients and other contaminants from runoff, thereby improving water quality
- Reducing erosion of the streambank by reducing surface water flow velocity
- Stabilizing the streambank
- Providing habitat for aquatic wildlife through increased large woody debris in the stream channel
- Providing habitat for terrestrial wildlife
- Providing an energy source for the aquatic system through increased vegetative and wood debris
- Enhancing aesthetics
- Promoting recreational uses within the watershed such as picnicking, hiking and canoeing
- Preserving the integrity of historical and cultural sites
- Providing flood zone management by setting development back from the immediate banks of the stream

Extensive research has been conducted to determine what types of riparian buffers will protect rivers and their associated biota. The width and type of cover used for the buffer will determine its ability to trap sediment and other contaminants before they get into the stream, as well as the ability of the buffer to provide appropriate habitat for both aquatic and terrestrial life. Existing data demonstrate that buffers less than 100 feet in width can be effective in removing some sediment and improving some aspects of water quality, but may not protect overall aquatic health (Wenger, 1999). For example, buffers of 100 feet or greater are desired to adequately protect streams from the impacts associated with increases in nutrients such as phosphorus and nitrogen. A conceptual drawing of an appropriate buffer for the Reedy River is illustrated in Figure 13. Figure 14 and Table 5 illustrate the amount of land that would be required within Greenville and Laurens Counties to implement a buffer of 100 feet in the Reedy River Watershed. To more clearly illustrate the amount and type of land that would be required for a 100-foot riparian buffer, this information was determined for each of the 13 subwatersheds of the Reedy River. Figures delineating land use and acreages are presented in Appendix C.

Although all riparian buffers will offer some benefit to terrestrial wildlife, research has determined that maximum benefit to these organisms will be realized with buffers of greater than 300 feet (Wenger, 1999). This wider buffer is necessary to provide terrestrial wildlife with habitat for breeding, appropriate feeding grounds and migratory corridors.

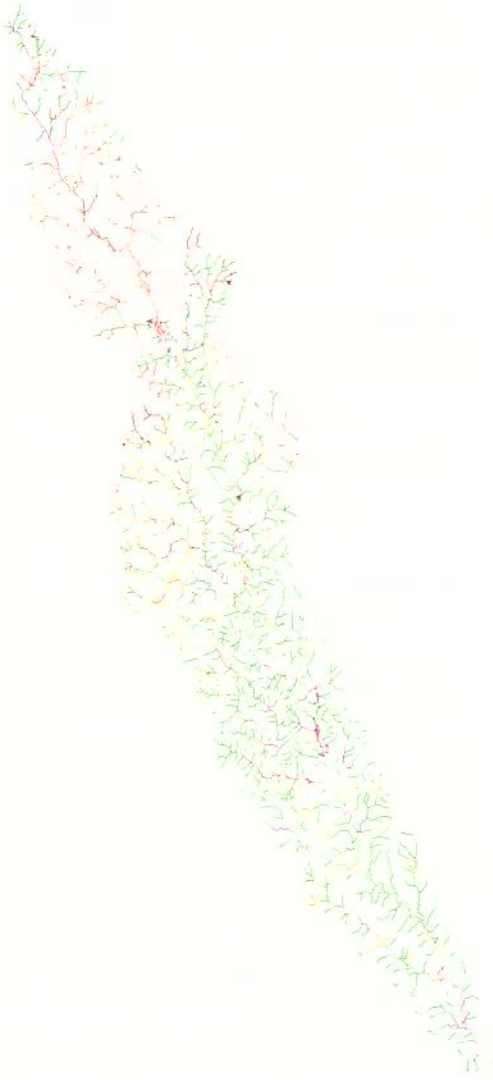
The vegetated cover present within the riparian zone is also important when determining the type of protection the buffer will allow. Grass strips have been

Figure 13: Conceptual Illustration of a Riparian Buffer

Figure 14: National Wetlands Inventory (NWI) Land Use/Land Cover 100' Buffer

Acreages of Land Cover / Land Use within 100' Hydrology Buffer

Description	Acres	Percent LU/LC
Agriculture	1647.31	9.35
Barren Land	29.99	0.17
Forest - Deciduous	2189.35	12.43
Forest - Evergreen	4886.42	27.75
Forest - Mixed	3349.02	19.02
Forested Wetland	1185.70	6.73
Marsh	105.40	0.60
Other Urban	542.19	3.08
Shrub/Scrub Wetland	205.54	1.17
Urban - Commercial/Industrial	764.87	4.34



100' Hydrology Buffer
Land Use / Land Cover *
Water
Marsh
Forested Wetland
Shrub/Scub Wetland
Residential
Commercial / Industrial
Other Urban
Agriculture
Forest - Deciduous
Forest - Evergreen
Forest - Mixed
Barren Land

2 0 2 4 6 8 Miles

* Source: U.S. Fish and Wildlife Service / National Wetland Inventory (1994)

Table 5: Land Area Affected by 100' Buffer Recommendation

Land Use Description	Acres Within the100' Buffer	% of Watershed Area	% of Total Greenville County Area	% of Total Laurens CountyArea
Agriculture	1,647.31	0.98	0.32	0.36
Barren Land	29.99	0.02	0.01	0.01
Forest - Deciduous	2,189.35	1.30	0.43	0.47
Forest - Evergreen	4,886.42	2.90	0.96	1.06
Forest - Mixed	3,349.02	1.99	0.66	0.72
Forested Wetland	1,185.70	0.70	0.23	0.26
Marsh	105.40	0.06	0.02	0.02
* Other Urban	542.19	0.32	0.11	0.12
Shrub/Scrub Wetland	205.54	0.12	0.04	0.04
* Urban - Commercial/Industrial	764.87	0.45	0.15	0.17
* Urban - Residential	2,705.10	1.61	0.53	0.58
TOTALS	17,610.89	10.45	3.46	3.81
Totals Minus Grandfathered Uses	1,598.73	8.27	2.74	3.02

* Uses typically grandfathered (would not be required to install 100' buffers)

Note: Acreage figures for this table were taken from the National Wetlands Inventory map. For the purpose of this table, total acreage within the Reedy River Watershed is 168,217 acres. This figure is different than the one used as the accepted acreage for the watershed.

shown to be effective in sediment and nutrient removal from runoff; however, forested buffers of native vegetation are necessary to protect the health of aquatic organisms (Wenger, 1999). Stream shading and debris/energy input from these forested areas are critical for survival of some aquatic species.

In developing a recommendation for riparian buffer zones within the Reedy River Watershed, the committee acknowledged that it is not feasible to create 100-foot buffers in some portions of the watershed, such as those areas that are currently developed. However, because storm water runoff and nonpoint source contamination enters the river from these areas, urban/developed portions of the watershed should consider retrofitting development with devices that would act like buffers. These devices include rain gardens, bio-retention basins and storm water collection systems.

Biological Monitoring/Inventories

Although it is generally accepted that both terrestrial and aquatic plant and animal communities are degraded within the Reedy River Watershed, comprehensive data illustrating this phenomenon are not available for most of the watershed. Studies within the Reedy watershed have generally been conducted in response to specific problems, such as the 1996 diesel fuel spill or the degrading water quality in the river. Without knowledge of existing plants and animals in the watershed, it will not be possible to adequately guide restoration of the system. Additionally, collection of physico-chemical parameters in conjunction with biological monitoring/inventories of aquatic communities is important. The types of organisms (both plant and animal) present within a stream are often dependent upon specific physico-chemical parameters. Understanding the chemistry and physical conditions of the river will assist in understanding the types of biological communities within the river and the impacts to those communities.

Four rare, threatened, and/or endangered plant species are known to be located within the upper portion of the Reedy River Watershed. The four plants are:

- Piedmont ragwort *(Senecio millefolium)*
- White goldenrod *(Solidago bicolor)*
- Bunched arrowhead *(Sagittaria fascicula)*
- Sweet pinesap *(Monotropsis odorata)*

General locations of these communities are illustrated in Figure 15. Comprehensive population studies have not been conducted for all plants and animals within the watershed and it is impossible to be certain that these are the only four special status species in the vicinity of the Reedy River. In order to ensure that all special status species are protected, it is necessary to determine which exist in the watershed so that restoration efforts can be conducted most effectively.

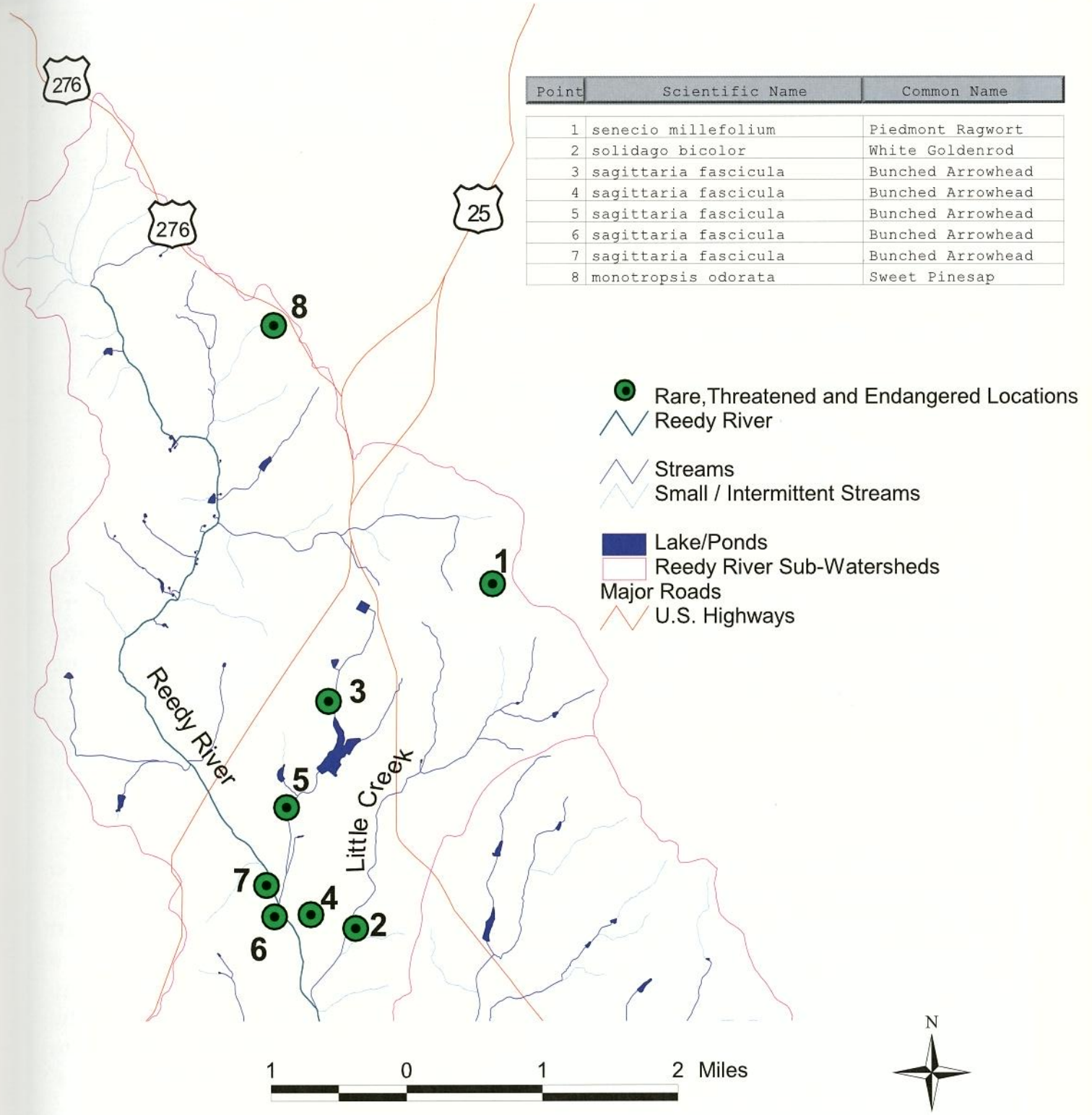
River Connectivity

Several dams currently exist within the Reedy River Watershed. Dams and their resulting impoundments are constructed for various reasons including water storage for water supplies (municipal, industrial agricultural), power generation, flood control, recreation and aesthetic values. Impoundments can also provide important habitat for a wide variety of aquatic, terrestrial and avian species. The utilization of impoundments by waterfowl and wading birds is well documented. Properly constructed and managed impoundments can maximize production of certain fish species and provide recreational fishery benefits.

Impoundments can also negatively impact natural resources, especially streams and those organisms dependent on stream habitats. The physical presence of dams often blocks the movement of aquatic organisms, such as fish, insects, mollusks and other species. Stream fish communities can be significantly impacted and sometimes displaced by impoundment construction. Impoundments also block the downstream transport of energy and nutrients, which normally move from headwater tributaries to larger streams. Dams result in warmer stream water temperatures in the summer and colder stream water temperatures during the winter due to broad, shallow

Asiatic clams in the Reedy River

Figure 15: Rare, Threatened, and Endangered Species



Point	Scientific Name	Common Name
1	senecio millefolium	Piedmont Ragwort
2	solidago bicolor	White Goldenrod
3	sagittaria fascicula	Bunched Arrowhead
4	sagittaria fascicula	Bunched Arrowhead
5	sagittaria fascicula	Bunched Arrowhead
6	sagittaria fascicula	Bunched Arrowhead
7	sagittaria fascicula	Bunched Arrowhead
8	monotropsis odorata	Sweet Pinesap

Greenville's Reedy River - How far we have come in 30 years.....

The 30th anniversary of Earth Day this year gave reason to reflect on how Greenville has changed over those 30 years. Like most towns, Greenville in 1970 was blissfully unaware of its impacts to the environment. Still dependent on the ways of a dated textile industry, environmental quality was far from the focus of community leaders.

The first Earth Day in 1970 brought an epiphany of awareness of our abuse of the environment to millions of Americans. For many communities, to include Greenville, the wake-up call took several more years to have effect.

The Greenville Piedmont warned in August 1980:

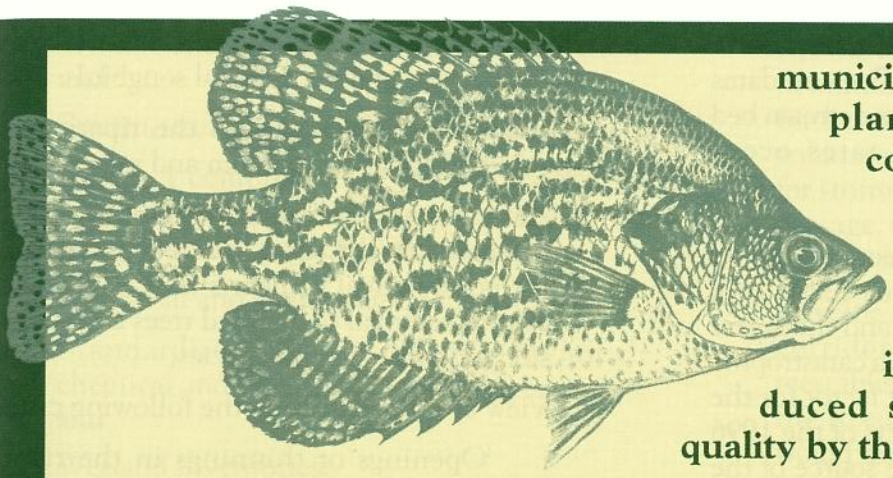
"Don't drink the water. Don't swim in the water. Don't fish in the water. Don't even look at the water. You won't like what you see. It's the Reedy River."

The warning was literal, and Greenvillians heeded it. The Reedy was indeed nasty.

Industrial polluters upstream of Greenville dumped one-and-a-half million gallons of dye-laden wastewater per day to the tiny Reedy at that time. The results were extreme discoloration, sudsing, and putrid odors, all abundantly evident along the river in Greenville, and downstream into Laurens County. The prevailing attitude toward pollution control during that era was basically, 'it's alright to put it in the river because no one cares.' And few did. Still, industrial practices of the 1970's were an enormous improvement over those of the late 1800's, when wastes from Greenville's bleacheries, slaughterhouses, tanneries, and foundries were all dumped directly into the Reedy along with sanitary wastes.

The consciousness brought by that first Earth Day resulted in the most comprehensive environmental legislation in our nation's history, including the federal Clean Water Act of 1972. For those inclined to believe that government regulation is a 'bad' thing, the effectiveness of the Clean Water Act provides a powerful lesson. Where there had been no economic incentive for polluters to clean up their acts, this law was successful in inducing significant changes. The Clean Water Act provided enforcement agencies with the tools they needed to eliminate many of the worst pollution sources and to measurably improve others.

Under this framework, the pollution faucet upstream of Greenville was finally cut off in 1983. Water quality improved immediately. The environmental awakening of this era also resulted in federally funded upgrades to hundreds of



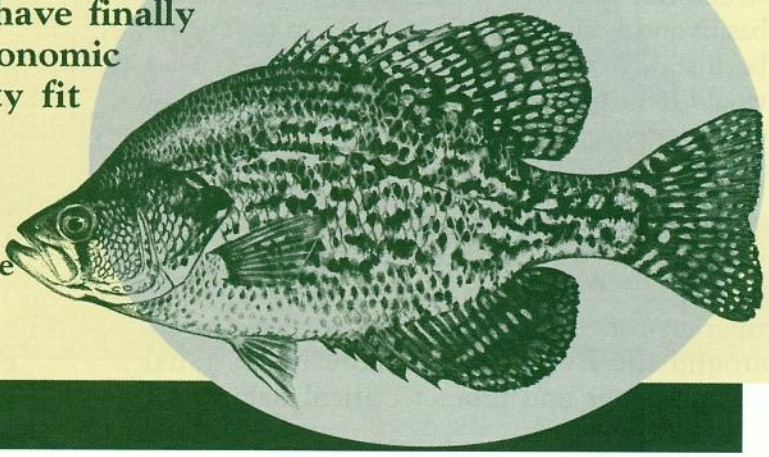
municipal wastewater treatment plants throughout the country, including a major overhaul of Greenville's treatment facility on the Reedy at Mauldin Road. Those facility improvements also produced strikingly better water quality by the late 1980's.

The environmental movement born around Earth Day in 1970 has been instrumental in the impressive turn-around in the health of the Reedy. In contrast to its image 30 years ago, the Reedy is now increasingly perceived as an exceptional resource worth preserving and restoring. We've already demonstrated our newfound stewardship of the Reedy with huge investments along the river, for example the Peace Center and Reedy River Falls Park. It is nothing short of remarkable that now we have investment groups competitively scrambling for the chance to build exciting new projects focused on the Reedy's 'waterfront'. As evidenced by this incredible resurrection, we've clearly recognized that the condition of our 'hometown river' is a core indicator of our 'quality of life.'

Although we've enjoyed significant environmental progress over the last 30 years, we must remain vigilant. Our streams, including the Reedy, are still threatened by uncoordinated growth that overwhelms our treatment plants faster than we can expand them. An even greater threat is the non-point pollution and runoff that increase alarmingly as we convert forests and farms to subdivisions and shopping malls.

We are fortunately blessed with a healthier environment, and a healthier business climate than we had 30 years ago. Now we face the challenge of maintaining that delicate balance between a thriving economy, and the quality of our environment. As reflected in our renewed pride in the Reedy, and our recognition of its value as a natural attraction to commerce and development, perhaps we have finally come to the wisdom that economic and environmental vitality fit hand-in-hand.

Dave Hargett
Friends of the Reedy River
(Reprinted from Greenville Journal, April, 20, 2000)



impoundments that increase exposure of water to the hot summer sun and winter's cold air. Because dams block the transport of sediments, increased stream bed cutting and stream bank erosion rates occur downstream of impoundments.

Dams can segment a river or disconnect it from its tributaries. The more connectivity that exists in a stream system, the healthier the stream and the better chance the resource has to rebound from a catastrophic event. This proved to be an important factor for the recovery of the Reedy River from impacts of the 1996 diesel spill. Tributary streams were the source of the new organisms that recolonized the Reedy after the spill with sampling stations near tributaries the first to show recovery. If dams had blocked these tributaries, recovery would have been slowed.

Recommendations

After reviewing the issues that affect aquatic health and the riparian zone, the issue committee developed and submitted the following recommendations to the Reedy River Task Force. All were subsequently approved for inclusion in this plan.

1. Where riparian buffers are feasible, establish and protect an undisturbed riparian buffer comprised of native trees, shrubs and undergrowth on both sides of perennial streams, intermittent streams and wetlands within the Reedy River Watershed. Areas considered "feasible" for protection are those where extensive development does not currently exist immediately adjacent to water bodies. At least 100 feet of riparian buffer should be preserved or established for the protection of aquatic health and to provide some riparian habitat.

   In areas where a 100 foot buffer does not exist or is not possible, establish as wide a buffer as feasible. In addition, the use of retention structures, such as rain gardens, bio-retention basins and storm water collection systems, should be installed to reduce impacts of run-off that would have been eliminated through the use of wider buffers.

   For individuals and entities that would like to ivoluntarily protect the value of the riparian zone itself, at least 300 feet of riparian buffer should be preserved. Protecting a larger portion of the riparian zone would better protect aesthetics around the river, provide more recreational opportunities and protect critical habitat for riparian dependent mammals, such as otters, mink, beavers and neotropical songbirds.

   Allowable activities within the riparian zone should be kept at a minimum and may include:

   a. Activities necessary to maintain the health and integrity of the area. Such activities may include removal of debris after severe storm events, removal of diseased trees and suppression of invasive plant species;

   b. View corridors utilizing the following criteria:

      i. Openings or thinnings in the riparian buffer to allow for a view of particular features or scenes should be established by selectively thinning underbrush, shrubs and low-hanging limbs. Cutting and felling trees should be avoided when attempting to create views. Such view corridors should extend no more than 75 feet or 1/3 of the lot width, whichever is less.

      ii. The exterior design and height of buildings and other structures may be designed to be compatible with and unobtrusive to the scenic, natural and cultural qualities of the corridor.

      iii. All signs should be designed to be unobtrusive and blend with the surroundings. Commercial signs should be prohibited and procedures for the removal of existing signage should be provided.

      iv. Restore the scenic quality of overused and abused areas in the corridor by landscaping and revegetating eroded and abused areas, planting additional wooded buffers in areas where the buffer is thin, and by controlling access and specific uses that are causing degradation.

   c. Docks, boat launches, public/private water supply intake structures, facilities for natural water quality treatment and purification, public/private wastewater outfall structures and similar structures which by their nature need to be located within the riparian zone;

   d. Pedestrian and/or vehicle access ways leading to docks, fishing piers and boat ramps providing that only permeable or semi-permeable material is used;

   e. Crossing by transportation facilities and utility lines;

f. Wildlife and fisheries management activities; and

g. Stream, streambank and vegetation restoration.

2. Establish a comprehensive water quality and biological assessment program for the Reedy River and its tributaries to include the following:

   a. Terrestrial and aquatic biotic inventories;

   b. Standardized aquatic physico-chemical, chemical and biological monitoring programs; and

   c. Wetland inventories.

3. The data collected through this program should be used to establish baseline conditions and determine whether the condition of aquatic and riparian communities is improving or degrading. In the event data indicate conditions are degrading, the data should also be used to guide development of restoration programs. The data collected should be readily available to the public through various media, including a website.

4. Identify and assess the value and necessity of current dams in the Reedy River Watershed. Where feasible, remove dams that separate the Reedy River from its tributaries or dams that segment the river itself in an environmentally responsible manner withconcern for release of sediments. Removal of appropriate dams would restore connectivity of the river system and aquatic organism populations. Additionally, avoid or minimize construction of new dams that would further segment the river or separate it from its tributaries. Consider construction of dry dams for storm water detention that allow unimpeded passage of aquatic organisms, sediments and organic matter.

5. Develop and implement a comprehensive stream corridor rehabilitation plan that will help reestablish the natural structure and function of the Reedy River's habitats and ecosystem. This would include:

   a. A watershed-scale assessment of stream rehabilitation that addresses needs such as storm water management, stream bank stabilization, pool and riffle development, channel narrowing, stream and riparian habitat enhancement, etc.;

   b. A strategic implementation plan that fully accounts for downstream and upstream effects of each restoration project;

   c. Use of bioengineering techniques to the maximum extent possible to better maintain/ restore the river's aesthetics;

   d. A monitoring program to assess restoration efforts; and

   e. Alternatives for restoration projects that have failed to meet their objectives.