Chapter 4 -
Water Quality Issues Related to Multiple Watersheds in the Broad River Basin

4.1 Overview

This chapter discusses water quality issues that relate to multiple watersheds within the basin. Habitat degradation, including sedimentation, which results from a variety of activities in the watershed, is the most prevalent water quality problem in the Broad River basin. Other issues related to water quality include fish tissue contamination, population growth and urbanization. There are also a wide variety of concerns related to water quantity and flow management.

4.2 Habitat Degradation

Instream habitat degradation is identified in the use support summary (Appendix III) where there is a notable reduction in habitat diversity or a negative change in habitat. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour. Good instream habitat is necessary for aquatic life to survive and reproduce. Streams that typically show signs of habitat degradation are in watersheds that have a large amount of land-disturbing activities (construction, mining, timber harvest and agricultural activities) or a large percentage of impervious surfaces. A watershed in which most of the riparian vegetation has been removed from streams or channelization has occurred also exhibits instream habitat degradation. Streams that receive a discharge quantity that is much greater than the natural flow in the stream often have degraded habitat as well.

Determining the cause and quantifying amounts of habitat degradation are very difficult in most cases. To assess instream habitat degradation in most streams would require extensive technical and monetary resources and perhaps even more resources to restore the stream. DWQ is working to develop a reliable habitat assessment methodology.

Although DWQ and other agencies are starting to address this issue, local efforts are needed to prevent further instream habitat degradation and to restore streams that have been impaired by activities that cause habitat degradation. As point sources become less of a source of water quality impairment, nonpoint sources that pollute water and cause habitat degradation need to be addressed to further improve water quality in North Carolina's streams and rivers.

4.2.1 Sedimentation

<u>Introduction</u>

Soil erosion, transport and redeposition are among the most essential natural processes occurring in watersheds. However, land-disturbing activities such as the construction of roads and buildings, crop production, livestock grazing and timber harvesting can accelerate erosion rates by causing more soil than usual to be detached and moved by water. If best management practices (BMPs) are not used effectively, accelerated erosion can strip the land of its topsoil, decreasing soil productivity and causing sedimentation in streams and rivers (NCDENR-DLR, 1998).

Sedimentation is the process by which eroded soil is deposited into waters. Sediment that accumulates on the bottom of streams and rivers smothers aquatic insects that fish feed upon and buries fish habitat that is vital to reproduction. Sediment filling rivers and streams decreases their storage volume and increases the frequency of floods (NCDENR-DLR, 1998).

Major Causes of Sedimentation in the Broad River Basin

- Land clearing activities (construction and preparing land for planting and crops)
- Streambank erosion
- Runoff from unpaved rural roads and eroding road grades

Suspended sediment can decrease primary productivity (photosynthesis) by shading sunlight from aquatic plants, affecting the overall productivity of a stream system. Suspended sediment also has several effects on various fish species including avoidance and redistribution, reduced feeding efficiency, and therefore, reduced growth by some species, respiratory impairment, reduced tolerance to diseases and toxicants, and increased physiological stress (Roell, June 1999). Suspended sediment also increases the cost of treating municipal drinking water.

During 2000 basinwide monitoring, DWQ aquatic biologists reported streambank erosion and sedimentation throughout the entire basin that were moderate to severe. Some streams are currently considered biologically impaired due to habitat degradation related in part to these impacts. Even in streams that were not listed as impaired, lower bioclassifications were assigned because of sedimentation; bottom substrate was embedded by silt and/or pools were partially filled with sediment. Unstable and/or undercut (eroding) streambanks were also noted in explanation of lower bioclassifications for the Broad River (NCDENR-DWQ, December 2001).

The Wildlife Resources Commission's *Fisheries Management Direction for the Broad River Basin* also lists sedimentation of the Broad River and tributary streams as one of three major concerns in the basin (NCDENR-WRC, July 1998). Sedimentation was also identified by participants at the public workshop as the major threat to water quality in the Broad River basin.

Land Clearing Activities

Erosion and sedimentation can be controlled during most land-disturbing activities by using appropriate BMPs. In fact, substantial amounts of erosion can be prevented by planning to minimize the (1) amount and (2) time the land is exposed. Land clearing activities that contribute to sedimentation in the Broad River basin include: construction of homes and subdivisions; plowing of soil to plant crops; and road projects.

DWQ's role in sediment control is to work cooperatively with those agencies that administer sediment control programs in order to maximize the effectiveness of the programs and to protect water quality. Where programs are not effective, as evidenced by a violation of instream water quality standards, and where DWQ can identify a source, then appropriate enforcement action can be taken. Generally, this entails requiring the landowner or responsible party to install acceptable BMPs.

As a result of new stormwater rules enacted by EPA in 1999, construction or land development activities that disturb one acre or more are required to obtain a NPDES stormwater permit (refer to page 26 for more information). An erosion and sediment control plan must also be developed for these sites under the state's Sedimentation Pollution Control Act (SPCA) administered by the NC Division of Land Resources. Site disturbances of less than one acre are required to use BMPs, but a plan is not required.

Forestry activities in North Carolina are subject to regulation under the SPCA. However, a forestry operation in the Watauga River basin may be exempt from the permitting requirements if compliance with performance standards outlined in *Forest Practice Guidelines Related to Water Quality* (15NCAC 1I .201-.209) and General Statutes regarding stream obstruction (77-13 and 77-14) are maintained. Extensive information regarding these performance standards and rules as they apply to forestry operations can be found on the NC Division of Forest Resources website at http://www.dfr.state.nc.us/managing/water_qual.htm.

For agricultural activities which are not subject to the SPCA, sediment controls are carried out on a voluntary basis through programs administered by several different agencies (see Appendix VI for further information).

Some Best Management Practices

Agriculture

- Using no till or conservation tillage practices
- Fencing livestock out of streams and rivers
- Leaving natural buffer areas around small streams and rivers

Construction

- Using phased grading/seeding plans
- Limiting time of exposure
- Planting temporary ground cover
- Using sediment basins and traps
- Leaving natural buffer areas around small streams and rivers

Forestry

- Controlling runoff from logging roads
- Replanting vegetation on disturbed areas
- Leaving natural buffer areas around small streams and rivers

New Rules Regarding Sediment Control

The Division of Land Resources (DLR) has the primary responsibility for assuring that erosion is minimized and sedimentation is reduced. In February 1999, the NC Sedimentation Control Commission adopted significant changes for strengthening the Erosion and Sedimentation Control Program. The following rule changes were filed as temporary rules, subject to approval by the Rules Review Commission and the NC General Assembly:

- Allows state and local erosion and sediment control programs to require a preconstruction conference when one is deemed necessary.
- Reduces the number of days allowed for establishment of ground cover from 30 working days to 15 working days and from 120 calendar days to 90 calendar days. (Stabilization must now be complete in 15 working days or 90 calendar days, whichever period is shorter.)
- Provides that no person may initiate a land-disturbing activity until notifying the agency that issued the plan approval of the date the activity will begin.

- Allows assessment penalties for significant violations upon initial issuance of a Notice of Violation (NOV).

Additionally, during its 1999 session, the NC General Assembly passed House Bill 1098 to strengthen the Sediment Pollution Control Act of 1973 (SPCA). The bill made the following changes to the Act:

- Increases the maximum civil penalty for violating the SPCA from $500 to $5000 per day.
- Provides that a person may be assessed a civil penalty from the date a violation is detected if the deadline stated in the Notice of Violation is not met.
- Provides that approval of an erosion control plan is conditioned on compliance with federal and state water quality laws, regulations and rules.
- Provides that any erosion control plan that involves using ditches for the purpose of de-watering or lowering the water table must be forwarded to the Director of DWQ.
- Amends the General Statutes governing licensing of general contractors to provide that the State Licensing Board for General Contractors shall test applicants' knowledge of requirements of the SPCA and rules adopted pursuant to the Act.
- Removes a cap on the percentage of administrative costs that may be recovered through plan review fees.

For information on North Carolina's Erosion and Sedimentation Control Program or to report erosion and sedimentation problems, visit the new website at http://www.dlr.enr.state.nc.us/ or call the NC Division of Land Resources, Land Quality Section at (919) 733-4574.

4.2.2 Streambank Erosion and Loss of Riparian Vegetation

During 2000 basinwide sampling, DWQ biologists reported degradation of aquatic communities at numerous sites throughout the Broad River basin in association with narrow or nonexistent zones of native riparian vegetation. Riparian vegetation loss was common in rural and residential areas, as well as in urban watersheds (NCDENR-DWQ, December 2001). The Wildlife Resources Commission's *Fisheries Management Direction for the Broad River Basin* also reports that loss of riparian vegetation along the Broad River and its tributaries is of major concern (NCDENR-WRC, July 1998).

Removing trees, shrubs and other vegetation to plant grass or to place rock (also known as riprap) along the bank of a river or stream degrades water quality. Removing riparian vegetation eliminates habitat for aquatic macroinvertebrates that are food for trout and other fish. Rocks lining a bank absorb the sun's heat and warm the water. Some fish require cooler water temperatures as well as the higher levels of dissolved oxygen cooler water provides. Trees, shrubs and other native vegetation cool the water by shading it. Straightening a stream, clearing streambank vegetation, and lining the banks with grass or rock severely impact the habitat that aquatic insects and fish need to survive (WNCT, 1999).

Livestock grazing with unlimited access to the stream channel and banks can cause severe streambank erosion resulting in degraded water quality. Although they often make up a small percentage of grazing areas by surface area, riparian zones (vegetated stream corridors) are particularly attractive to cattle that prefer the cooler environment and lush vegetation found beside rivers and streams. This concentration of livestock can result in increased sedimentation of streams due to "hoof shear", trampling of bank vegetation, and entrenchment of the destabilized stream. Despite livestock's preference for frequent water access, farm veterinarians have reported that cows are healthier when stream access is limited (EPA, 1999).

Preserving the natural streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers in particular provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife (NCDENR-DWQ, February 2002).

4.2.3 Unpaved Rural Roads and Eroding Road Grades

As is typical of settlement in mountainous areas, many roads in the western portion of the Broad River basin follow streams. The roads are often constructed on the streambank with very little (if any) vegetated buffer to filter sediment and other pollutants from surface runoff. Many of the steep road grades are actively eroding because of a lack of stabilization. Road grades of 12 percent or less are desirable. Unpaved roads with grades in excess of 12 percent erode easily and are difficult to maintain (WNCT, 1999). Additionally, when road maintenance activities are conducted, there is often inadequate space for structural BMPs to be installed to control erosion from the land-disturbing activity.

Roads built to accommodate vehicles and equipment used for forestry activities in the Broad River basin also contribute to sediment runoff. These roads are generally unpaved and accelerate erosion unless they are maintained with stable drainage structures and foundations. In the mountainous areas of North Carolina, ordinary forest roads are known to lose as much as 200 tons of soil per acre of roadway during the first year following disturbance (NRCD-DFR, September 1989).

4.2.4 Channelization

Channelization refers to the physical alteration of naturally occurring stream and riverbeds. Typical modifications are described in the text box. Increased flooding, bank erosion and channel instability often occur in downstream areas after channelization has occurred.

Typical Channel Modifications

- Removal of any obstructions, natural or artificial, that inhibit a stream's capacity to convey water (clearing and snagging).
- Widening, deepening or straightening of the channel to maximize conveyance of water.
- Lining the bed or banks with rock or other resistant materials.

Direct or immediate biological effects of channelization include injury and mortality of benthic macroinvertebrates, fish, shellfish/mussels and other wildlife populations, as well as habitat loss. Indirect biological effects include changes in benthic macroinvertebrate, fish and wildlife community structures, favoring species that are more tolerant of or better adapted to the altered habitat (McGarvey, 1996).

Restoration or recovery of channelized streams may occur through processes, both naturally and artificially induced. In general, streams that have not been excessively stressed by the channelization process can be expected to return to their original forms. However, streams that have been extensively altered may establish a new, artificial equilibrium (especially when the channelized streambed has been hardened). In such cases, the stream may enter a vicious cycle of erosion and continuous entrenchment. Once the benefits of a channelization project become outweighed by the costs, both in money and environmental integrity, channel restoration efforts are likely to be taken (McGarvey, 1996).

Channelization of streams within the continental United States is extensive and promises to become even more so as urban development continues. Overall estimates of lost or altered riparian habitats within US streams are as high as 70 percent. Unfortunately, the dynamic nature of stream ecosystems makes it difficult (if not impossible) to quantitatively predict the effects of channelization (McGarvey, 1996). Channelization has occurred historically throughout the Broad River basin and continues to occur in some watersheds, especially in small headwater streams.

4.2.5 Recommendations for Reducing Habitat Degradation

DWQ will continue to work cooperatively with DLR and other agencies that administer sediment control in order to maximize the effectiveness of the programs and to take appropriate enforcement action when necessary to protect or restore water quality. However, more voluntary implementation of BMPs is needed for activities that are not subject to these rules in order to substantially reduce the amount of widespread sedimentation present in the Broad River basin. Public education is needed basinwide to educate landowners about the value of riparian vegetation along small tributaries and the impacts of sedimentation to aquatic life.

It is recommended that the Department of Transportation, as well as county highway departments, take special care when constructing and maintaining (including mowing) roads along streams in the Broad River basin. The lack of riparian vegetation and streambank erosion is well documented and will lead to increased instream habitat degradation if these problems remain unchecked. Vegetation along streams should remain as undisturbed as possible when conducting these construction and maintenance activities, keeping in mind that most of these streams are to be managed in a manner similar to HQWs pursuant to Administrative Code Section: 15A NCAC 2B .0225 e(4).

Funding is available for cost sharing with local governments that set up new erosion and sedimentation control programs or conduct their own training workshops. The Sediment Control Commission will provide 40 percent of the cost of starting a new local erosion and sedimentation control program for up to 18 months. Two municipalities or a municipality and county can develop a program together and split the match. The towns of Lake Lure and Chimney Rock and Buncombe County have a locally delegated erosion and sediment control program (refer to Section C for further details). It is recommended that other local governments draft and implement local erosion and sedimentation control programs.

Funding is also available through numerous federal and state programs for farmers to restore and/or protect riparian buffer zones along fields or pastures, develop alternative watering sources for livestock, and fence animals out of streams (refer to page 132). EPA's *Catalog of Federal Funding Sources for Watershed Protection* (Document 841-B-99-003) outlines some of these and other programs aimed at protecting water quality. A copy may be obtained by calling the National Center for Environmental Publications and Information at (800) 490-9198 or by visiting the website at http://www.epa.gov/OWOW/watershed/wacademy/fund.html. Local contacts for various state and local agencies are listed in Appendix VI.

4.3 Fecal Coliform

Fecal coliform bacteria live in the digestive tract of warm-blooded animals (humans as well as other mammals) and are excreted in their waste. Fecal coliform bacteria do not actually pose a danger to people or animals. However, where fecal coliform are present, disease-causing bacteria may also be present and water that is polluted by human or animal waste can harbor other pathogens that may threaten human health.

The presence of disease-causing bacteria tends to affect humans more than aquatic creatures. High levels of fecal coliform bacteria can indicate high levels of sewage or animal wastes which could make water unsafe for human contact (swimming) or the harvesting and consumption of shellfish. Fecal coliform bacteria and other potential pathogens associated with waste from warm-blooded animals are not harmful to fish and aquatic insects. However, high levels of fecal coliform bacteria may indicate contamination that increases the risk of contact with harmful pathogens in surface waters.

Pathogens associated with fecal coliform bacteria can cause diarrhea, dysentery, cholera and typhoid fever in humans. Some pathogens can also cause infection in open wounds.

Under favorable conditions, fecal coliform bacteria can survive in bottom sediments for an extended period (Howell et al., 1996; Sherer et al., 1992; Schillinger and Gannon, 1985). Therefore, concentrations of bacteria measured in the water column can reflect both recent inputs as well as the resuspension of older inputs.

Sources of Fecal Coliform in Surface Waters

- Urban stormwater
- Wild animals and domestic pets
- Improperly designed or managed animal waste facilities
- Livestock with direct access to streams
- Improperly treated discharges of domestic wastewater, including leaking or failing septic systems and straight pipes

Reducing fecal coliform bacteria in wastewater requires a disinfection process, which typically involves the use of chlorine and other disinfectants. Although these materials may kill the fecal coliform bacteria and other pathogenic disease-causing bacteria, they also kill bacteria essential to the proper balance of the aquatic environment, and thereby, endanger the survival of species dependent on those bacteria.

Water quality standards for fecal coliform bacteria are intended to ensure safe use of waters for recreation and shellfish harvesting (refer to Administrative Code Section 15A NCAC 2B .0200). The North Carolina fecal coliform standard for freshwater is 200 colonies/100ml based on the geometric mean of at least five consecutive samples taken during a 30-day period and not to exceed 400 colonies/100ml in more than 20 percent of the samples during the same period. The 200 colonies/100ml standard is intended to ensure that waters are safe enough for water contact through recreation.

The standard for Class SA waters (waters used for shellfishing) is a median or geometric mean fecal coliform Most Probable Number (MPN) not greater than 14 MPN/100ml. In addition, not more than 10 percent of the samples can be in excess of 43 MPN/100ml. Many areas closed to shellfish harvesting have median levels below 14 MPN/100ml, but fail to meet the second criteria due to periodic contamination that occurs after moderate to heavy rainfall events.

The North Carolina Division of Environmental Health (DEH) has subdivided all of the state's coastal waters into shellfish growing areas in which a sanitary survey is conducted every three years. Beginning in the summer of 1997, DEH began assessing fecal coliform levels in coastal recreation waters. These assessments provide a gauge of water quality along the North Carolina coast over the short and long-term.

If a certain area along the coast is found to have potential water quality problems related to stormwater pipes or high levels of indicator bacteria, health officials will post signs recommending that people not swim there or harvest shellfish from the area. The location will be listed on the DEH website at (http://www.deh.enr.state.nc.us/shellfish/), and local media and county health departments will be notified.

The state does not encourage swimming in surface waters since a number of factors which are beyond the control of any state regulatory agency contribute to elevated levels of disease-causing bacteria. To assure that waters are safe for swimming indicates a need to test waters for pathogenic bacteria. Although fecal coliform standards have been used to indicate the microbiological quality of surface waters for swimming and shellfish harvesting for more than 50 years, the value of this indicator is often questioned. Evidence collected during the past several decades suggests that the coliform group may not adequately indicate the presence of pathogenic viruses or parasites in water.

The detection and identification of specific pathogenic bacteria, viruses and parasites such as *Giardia*, *Cryptosporidium* and *Shigella* are expensive, and results are generally difficult to reproduce quantitatively. Also, to ensure the water is safe for swimming would require a whole suite of tests for many organisms, as the presence/absence of one organism would not document the presence/absence of another. This type of testing program is not possible due to resource constraints.

4.4 Urban Runoff

Runoff from built-up (developed) areas carries a wide variety of contaminants to streams including sediment, oil and grease from roads and parking lots, street litter, and pollutants from the atmosphere. Generally, there are also a larger number of point source discharges in these areas. Cumulative impacts from habitat and floodplain alterations, point and nonpoint source pollution can cause severe impairment to streams.

Projected population growth over the next ten years (1998-2018) for the Broad River basin shows a 0-5 percent increase for Gaston County, 5-10 percent increase for Rutherford and

Cleveland counties, a 10-20 percent increase for McDowell and Buncombe counties, a 20-30 percent increase for Polk and Henderson counties, and a greater than 30 percent increase for Lincoln County. As populations expand, so do developed areas. Some local governments in the Broad River basin have prioritized water quality planning; however, proactive planning efforts at the local level are needed across the entire basin in order to assure that development is done in a manner that minimizes impacts to water quality. A lack of good environmental planning was identified by participants at the public workshops as a threat to water quality in the Broad River basin.

4.4.1 Rural Development

More than three-quarters of the land in western North Carolina has a slope in excess of 30 percent. Building site preparation and access are complicated by shallow bedrock, high erosion rates, soils that are subject to sliding, and lack of adequate sites for septic systems. Additionally, road grades of 12 percent or less are desirable. Unpaved roads with grades in excess of 12 percent erode easily and are difficult to maintain (WNCT, 1999). This terrain presents a kind of "no win" situation. Development could occur in the relatively flat stream and river valleys placing pressure on floodplains and riparian zones and displacing agricultural land uses. Alternatively, it could occur on the steep slopes causing acute problems in handling large amounts of erosion and sedimentation during construction and chronic problems with failing septic systems and eroding road grades. Development occurs in both places in different portions of the Broad River basin.

4.4.2 Urbanization

Urbanization often has greater hydrologic effects than any other land use, as native watershed vegetation is replaced with impervious surfaces in the form of paved roads, buildings, parking lots, and residential homes and yards. Urbanization results in increased surface runoff and correspondingly earlier and higher peak flows after storms. Flooding frequency is also increased. These effects are compounded when small streams are channelized (straightened) or piped and storm sewer systems are installed to increase transport of drainage waters downstream. Bank scour from these frequent high flow events tends to enlarge streams and increases suspended sediment. Scouring also destroys the variety of habitat in streams leading to degradation of benthic macroinvertebrate populations and loss of fisheries (EPA, 1999).

In and around municipalities in the Broad River basin, DWQ biological assessments revealed that streams are being impacted by urban stormwater runoff. Most of the impacts are in terms of habitat degradation (see page 54), but runoff from developed and developing areas can also carry toxic pollutants to a stream (NCDENR-DWQ, December 2001).

The presence of intact riparian buffers and/or wetlands in urban areas can lessen these impacts and restoration of these watershed features should be considered where feasible; however, the amount of impervious cover should be limited as much as possible. Wide streets, huge cul-de-sacs, long driveways and sidewalks lining both sides of the street are all features of urban development that create excess impervious cover and consume natural areas.

4.4.3 Stormwater Regulations

DWQ administers a number of programs aimed at controlling stormwater runoff in the Broad River basin. These include: 1) programs for the control of development activities near High Quality Waters (HQW) and Outstanding Resource Waters (ORW) and activities within designated water supply (WS) watersheds; 2) NPDES stormwater permit requirements for industrial activities and municipalities; and 3) NPDES stormwater permit requirements for construction or land development activities on five acres of land or more.

Amendments were made to the Clean Water Act in 1990 (Phase I) and most recently in 1999 (Phase II) pertaining to permit requirements for stormwater discharges associated with storm sewer systems. Part of Phase II required some municipal storm sewer systems serving populations under 100,000, which are located in larger urbanized areas and/or that have a high population density to obtain an NPDES stormwater permit. The municipal permitting requirements are designed to lead to the formation of comprehensive stormwater management programs for municipal areas. Shelby will be considered for inclusion under the Phase II rules because of a population greater than 10,000 and/or a population density greater than 1,000 persons per square mile. DWQ is currently developing criteria that will be used to determine whether this and other municipalities will be required to obtain a NPDES permit. Refer to page 26 for further information.

4.4.4 Recommendations

Proactive planning efforts at the local level are needed to assure that development is done in a manner that minimizes impacts to water quality. These planning efforts must find a balance between water quality protection, natural resource management and economic growth. Growth management requires planning for the needs of future population increases as well as developing and enforcing environmental protection measures. These actions are critical to water quality management and the quality of life for the residents of the basin. These actions should include, but not be limited to:

- preservation of open spaces;
- provisions for controlled growth;
- development and enforcement of buffer ordinances and water supply watershed protection ordinances more stringent than state requirements;
- halt on floodplain development and protection of wetland areas;
- examination of zoning ordinances to ensure that they limit large, unnecessary parking lots; allow for vegetation and soil drainage systems; and build in green spaces in parking lots to limit and absorb runoff; and
- sustainable land use planning that considers long-term effects of development.

Planning Recommendations for Development

- Minimize number and width of residential streets.
- Minimize size of parking areas (angled parking and narrower slots).
- Place sidewalks on only one side of residential streets.
- Vegetate road right-of-ways, parking lot islands and highway dividers to increase infiltration.
- Plant and protect natural buffer zones along streams and tributaries.
- Minimize floodplain development.
- Protect and restore wetland / bog areas.

Public education is needed in the Broad River basin in order for citizens to understand the value of urban planning and stormwater management. Action should be taken by county governments and municipalities to plan for new development in urban and rural areas. For more detailed information regarding recommendations for new development found in the text box, refer to EPA's website at www.epa.gov/owow/watershed/wacademy/acad2000/protection.

4.5 Golf Courses

Participants at the Broad River basin workshops listed golf courses as a potential impact to water quality. In the Broad River basin, there are 11 golf courses (three in Rutherford County, three in Polk County and five in Cleveland County), all of which are located adjacent to lake shorelines and/or streambanks. Without proper site design, construction practices and maintenance, all turf areas can serve as source of sediment, nutrients and other contaminants that can impact water quality. Golf courses, because of their size, location and historical design practices, can cause significant impacts to small streams. In order to insure water quality protection, BMPs should be implemented throughout the life of a golf course from design to construction to daily maintenance (NGF, 2001).

Proper site design works with the landscape. The design should designate environmentally sensitive areas throughout the course and strive to protect them with minimal disturbance. The design can prevent or minimize erosion and stormwater runoff by maintaining natural vegetated riparian areas near streams, wetlands and lake shorelines as much as possible. Good design also minimizes the development of gullies, avoids channelization (straightening) of streams, and prohibits the unnecessary disruption of streambanks and lake shorelines (NCCES, 1995).

During golf course construction, the exposed soils and steep slopes are highly susceptible to erosion and sedimentation. In order to reduce erosion and sedimentation from the site, strategies to effectively control sediment, minimize the loss of topsoil, and protect water resources need to be implemented throughout the construction of the course (CRM, 1996). One most effective BMP to use during construction activities on large sites is to minimize the duration of exposed soils and to establish ground cover as soon as possible after soil disturbance (NCCES, 1995).

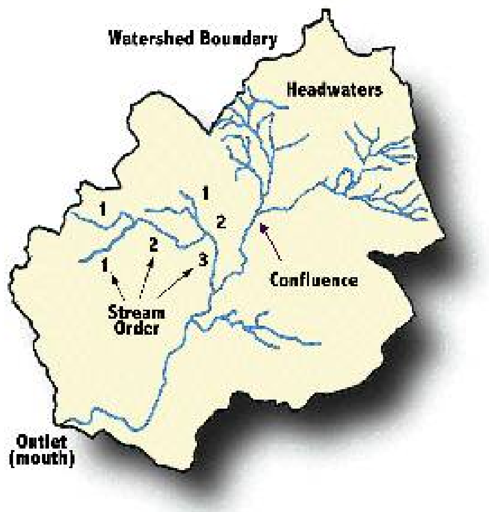
Maintenance of the golf course also has the potential to impact water quality through improper fertilization, mowing and irrigation. Fertilizer applications should be based on a soil test to determine the appropriate timing, level and type of fertilizer necessary for the type of grass on particular areas of the course. Fertilizers should also not be applied on the steep slopes near surface waters or directly to lakes, streams and drainage areas. It is a good practice to maintain a buffer of low-maintenance grasses or natural vegetation between areas of the highly-maintained portions of the golf course and surface waters (NCCES, 1995).

The appropriate level of irrigation for a golf course is vital to the health of the grasses and the preservation of water quality. Under-watering may harm the grasses while over-watering increases the potential for leaching fertilizers and nutrients from the soil and increasing runoff. A properly designed irrigation system will apply a uniform level of water at the desired rate and time. The amount and frequency of watering should be based on the type of grass and soil and weather conditions (NCCES, 1995).

Golfers can also play a role in protecting water quality on the golf course. Players should respect designated environmentally sensitive areas within the course and recognize that golf courses are managed areas that complement the natural environment. Golfers should also support and encourage maintenance practices that protect and enhance the environment and encourage the development of environmental conservation plans for the course. In addition, golfers can choose to patronize courses that are designed, constructed and maintained with protection of natural resources in mind (CRM, 1996).

4.6 Protecting Headwaters

Many streams in a given river basin are only small trickles of water that emerge from the ground. A larger stream is formed at the confluence of these trickles. This constant merging eventually forms a large stream or river. Most monitoring of fresh surface waters evaluates these larger streams. The many miles of small trickles, collectively known as headwaters, are not directly monitored and in many instances are not even indicated on maps. However, degradation of headwater streams can (and does) impact the larger stream or river.



In smaller headwater streams, fish communities are not well developed and benthic macroinvertebrates dominate aquatic life. Benthic macroinvertebrates are often thought of as "fish food" and, in mid-sized streams and rivers, they are critical to a healthy fish community. However, these insects, both in larval and adult stages, are also food for small mammals, such as river otter and raccoons, birds and amphibians (Erman, 1996). Benthic macroinvertebrates in headwater streams also perform the important function of breaking down coarse organic matter, such as leaves and twigs, and releasing fine organic matter. In larger rivers, where coarse organic matter is not as abundant, this fine organic matter is a primary food source for benthic macroinvertebrates and other organisms in the system (CALFED, 1999). When the benthic macroinvertebrate community is changed or extinguished in an area, even temporarily, it can have repercussions in many parts of both the terrestrial and aquatic food web.

Headwaters also provide a source of insects for repopulating downstream waters where benthic macroinvertebrate communities have been eliminated due to human alterations and pollution. Adult insects have short life spans and generally live in the riparian areas surrounding the streams from which they emerge (Erman, 1996). Because there is little upstream or stream-to-stream migration of benthic macroinvertebrates, once headwater populations are eliminated, there is little hope for restoring a functioning aquatic community.

Recommendations

Because of the small size of headwater streams, they are often overlooked during land use activities that impact water quality. All landowners can participate in the protection of headwaters by keeping small tributaries in mind when making land use management decisions on the areas they control. This includes activities such as retaining vegetated stream buffers, minimizing stream channel alterations, and excluding cattle from streams. Local rural and urban planning initiatives should also consider impacts to headwater streams when land is being developed.

All streams in the North Carolina portion of this basin are the headwaters of the Broad River. For a more detailed description of watershed hydrology, refer to EPA's Watershed Academy website at http://www.epa.gov/OWOW/watershed/wacademy/acad2000/watershedmgt/principle1.html.

4.7 Instream Mining Operations

Construction sand and gravel were produced by an estimated 4,000 companies from 6,100 operations in 50 states in 2000. Overall production increased 5.4 percent in that year. It is estimated that production will increase again by 2.6 percent in 2001. Uses include concrete aggregates, road base, covering and stabilization, construction fill, concrete products (such as bricks, blocks and pipes), plaster, snow and ice control, railroad ballast, roofing granules and filtration. The most important commercial sources of sand and gravel nationwide have been river floodplains, river channels and glacial deposits (USGS, 2001). Mining of sand and gravel occurs in two major forms: instream mining and land mining, which includes floodplain excavations that often involve a connecting outlet to a stream (Meador and Layher, November 1998).

The composition of the streambed and banks is an important facet of stream character, influencing channel form and hydraulics, erosion rates, sediment supply and other parameters. Channel bed and bank materials determine the extent of sediment transport and provide the means of dissipating energy in a stream or river. For a stream to be stable it must be able to consistently transport its sediment load, both in size and type, associated with local deposition and scour. Channel instability occurs when the scouring process leads to degradation (deepening or lowering channel elevation) or excess sediment results in aggradation (filling or raising channel elevation) (Rosgen, 1996).

In addition to physical stream changes, sedimentation and increased turbidity also can accrue from mining activities, wash water discharge, and storm runoff from active or abandoned mining sites. Other effects may include higher stream temperatures and reduced dissolved oxygen, lowering of the water table, and decreased wet periods in riparian wetlands. Expansion of a mine site or mining at a new site is often preceded by riparian forest clearing, which can affect instream habitat and contribute to bank instability (Meador and Layher, November 1998).

The Division of Land Resources' (DLR) Mining Program "provide(s) for the mining of mineral resources while ensuring the usefulness, productivity and scenic value of all lands and waters" in North Carolina. DLR issues permits for two types of instream mining which are described in the text box: sand dipping and sand dredging. Typically, instream mining permits for sand dipping operations are issued for five years, and sand dredging operations are permitted for ten years. In the Broad River basin, there are five permitted sand dredging operations and six permitted sand dipping operations.

Two Types of Instream Mining Permits

Sand Dipping – Removes sand from the river bottom through the use of a dragline (a crane with a bucket) that sits on the riverbank. There is potential for large amounts of vegetation to be removed from the riverbank with this type of mining operation.

Sand Dredging – Hydraulically removes sand from the river bottom through the use of a floating dredge and a suction pump.

Processing typically includes screening and grading sand in wash water (usually stream water), and discharging the wash water into settling pits before releasing it back into the stream (Meador and Layher, November 1998).

Recommendations

DWQ will work with DLR to evaluate and reduce turbidity from permitted instream mining operations in the Broad River. As permits are renewed, monitoring upstream and downstream of mining operations and instream BMPs (such as those used by the NC Department of Transportation during bridge construction) could be required. In addition, DWQ will notify local agencies of water quality concerns regarding these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding.

4.8 Color Reduction Strategy

The 1998 basinwide plan recommended that color be addressed in the Broad River basin, especially in the Second Broad River watershed. In the Broad River basin, there are ten facilities that discharge color into surface waters: Spindale WWTP (Second Broad River), Forest City WWTP (Second Broad River), Cone Mills (Second Broad River), Dan River, Inc. (Broad River), Tryon WWTP, Grover WWTP, Shelby WWTP, Grover Industries, Kings Mountain WWTP and Cleveland Mills. Grover Industries and Cleveland Mills have suspended operations, but still retain their NPDES permits. Of the remaining dischargers, all except for Cone Mills and Dan River, Inc. are municipal wastewater treatment plants that receive the color as part of pretreatment permits.

According to state regulations, colored effluent is allowed in "only such amounts as will not render the waters injurious to public health, secondary recreation, or to aquatic life and wildlife or adversely affect the palatability of fish, aesthetic quality or impair the waters for any designated uses." This color standard is a narrative standard based on aesthetics. The standard for color is not a numeric standard. The advantage of a narrative standard is that it is flexible. The disadvantages are that is it subjective and difficult to enforce. The state has considered developing a numeric standard, but there are many challenges in doing so. Some of these challenges include knowing what the appropriate analytical approach is; what the appropriate numeric standard is; and if a different standard should be used for different regions in the state to reflect variations in background water color. In addition, the practical application of this regulation must take into account the various ways in which color is perceived. No narrative definition of color impairment can be specified by a simple set of criteria because color is perceived differently by individuals under varying environmental conditions.

It should be noted that to date, there are no data to show that the colored effluent is posing any human health threat or is the only source of impact on the aquatic life in the river. Color is usually not a toxicological problem. However, under certain conditions it can limit light penetration that may be essential for the growth and existence of instream organisms. All dischargers with color waste are required to conduct toxicity testing on the effluent to assure the discharge will not adversely impact the organisms in the receiving stream. All of the color discharge facilities conducting toxicity testing were in compliance with permit limits over the review period for this basin plan (8/1998-9/2000).

As a first step toward making progress in reducing color in the Broad River basin, NCDENR hosted a color reduction conference in Charlotte in 1998. Over 140 people from across the state were in attendance. Most attendees represented textile mills, municipalities and consulting firms. The main purposes of the conference were to emphasize the state's interest in reducing instream color and to encourage facilities to reduce color.

In addition, several facilities in the basin have taken voluntary steps to reduce color in their effluent. In 1995, Cone Mills installed a color reduction procedure that uses flocculation, coagulation and filtration. The system is effective at removing 50-60 percent of the color associated with package dyes and 80-90 percent of the color associated with indigo dyes. As of 2002, Cone Mills is able to run the physical color reduction system but is not adding a polymer due to problems with identifying a polymer that does not cause toxicity problems. The Town of Forest City receives the color through a pretreatment permit with National Textiles. The town has experimented with several color reduction techniques, but none have proven very effective and have had similar problems as Cone Mills in identifying a polymer that does not cause toxicity problems.

Recommendations

DWQ, in response to comments at the public workshops and to complaints, has brought the need to reduce color in effluent to the forefront. Progress is being made to address this need with the following actions.

DWQ still believes that the most effective and equitable means of addressing color is to rely on the narrative aesthetic standard and complaints. DWQ will concentrate on a color reduction strategy to reduce color in the Broad River basin to the point that complaints are infrequent. Some of the specific actions DWQ will take to address the issue of color are to:

- Request that Cone Mills and Dan River, Inc. monitor color in their effluent and upstream and downstream of the discharge monthly beginning in January 2002.
- Request that the Spindale WWTP, the Forest City WWTP and the Tryon WWTP modify their pretreatment permits to require pretreatment facilities to measure influent and effluent color monthly and that the WWTP plants modify their Long-Term Monitoring Plan and measure monthly both influent and effluent color beginning in January 2002.

- Conduct site visits of each of the ten color dischargers in the summer of 2002 to document the presence of a color plume and the distance downstream the color plume persists. At this time, a meeting with the facility operators will be requested. The meeting is intended to review the history of color and let the dischargers know that they will be required to reduce their color input unless they can demonstrate that they are not a significant source of color. The meeting is intended to also discuss plans for determining the amount of color reduction necessary to protect the aesthetic water quality standard.
- Based on the results of the monitoring and field studies, establish a final reduction goal for facilities that continue to have significant color discharges. Permit limits would be developed, as needed, for the next permit cycle (2004-2007) based on the final reduction goals.
- DWQ is also committed to work with the Office of Waste Reduction to identify possible color source reduction methods.

4.9 Cleveland County Schools' NPDES Permits

On June 8, 1999, DWQ issued a Special Order of Consent (SOC) to provide relaxation of the permits limits of eight NPDES dischargers owned and operated by the Cleveland County School District in subbasins 03-08-04 and 03-08-05: Crest Middle School (0.02 MGD to Beaverdam Creek); Crest High School (0.02 MGD to an unnamed tributary to Beaverdam Creek); Burns Middle School (0.02 MGD to an unnamed tributary to Maple Creek); Burns High School (0.02 MGD to an unnamed tributary to Maple Creek); Casar Elementary (0.007 MGD to an unnamed tributary to Crooked Run Creek); Township #3 (0.008 MGD to Boween River); Washington Elementary School (0.005 MGD to an unnamed tributary to White Oak Creek); and Falston School (0.008 MGD to Long Branch). The original penalty paid to NCDENR by the Cleveland County School District was $21,899.00. The order was later amended and included an additional penalty of $9,007.00.

In agreement with the SOC, all of the dischargers except for Casar Elementary have had their discharge eliminated by connecting to either the City of Cherryville WWTP or the City of Shelby WWTP. Crest Middle School, Crest High School, Burns Middle School, Burns High School, Falston School and Township #3 have tied into the City of Shelby WWTP, and Washington Elementary School has tied into the City of Cherryville WWTP.

Currently, Casar Elementary School is still discharging effluent into an unnamed tributary to Crooked Run Creek. However, in agreement with the SOC, the Casar Elementary School WWTP was upgraded and the facility is operating within its permit's limits.

4.10 On-Site Wastewater Treatment

In the Broad River basin, there are other types of wastewater treatment besides WWTPs with NPDES permits. Wastewater from many homes and commercial businesses, such as campgrounds and convenience stores, is treated by septic systems. Septic systems can be a safe and effective method for treating wastewater if they are sized, sited and maintained properly. However, if the tank or drainfield are improperly placed, constructed or maintained, nearby wells and surface waters may become contaminated causing potential risks to human health.

Section .1961(a) of the Laws and Rules for Sewage Treatment and Disposal Systems requires that the person owning or controlling the property upon which a septic system is sited be responsible for that system's operation and maintenance. Many homeowners are unaware of this legal responsibility, as well as the steps that must be taken to assure proper operation. Often owners do not realize they have an on-site wastewater treatment system until they experience problems. At this point, serious damage may have already occurred.

4.10.1 Reasons for Septic System Failure

Septic systems fail for a variety of reasons. Most of the time the failure is related to improper operation (use) and maintenance. Owners are often unaware of the necessity of pumping their tanks on a regular basis. Tanks need to be pumped every three to eight years depending on the size of the tank, the daily flow of waste and the amount of solids in the waste. It is important that owners prevent unnecessary solids such as grease, food, cigarette butts, sanitary products, disposable diapers and kitty litter from entering the septic tank system. Neglecting to do so will cause pipes to clog, tanks to fill up quickly, and can lead to premature drainfield failure.

Hydraulic overload is a significant cause of system failure. This may result from excessive water use or leaking plumbing fixtures in the home. It can also result from increasing the wasteload that a particular system was designed to handle. Failure to use low flow toilets, showerheads or other water-saving devices will contribute to overload. Leaking tanks, groundwater, stormwater, gutters and poor landscaping also hydraulically overloads systems. Drainfields must have time to rest between doses of effluent, or the life of the drainfield may be shortened significantly.

Chemicals, pesticides, paint products, cleaners, etc. dumped into a tank can kill the bacteria in a system. Bacteria in the septic tank and the drainfield are an essential part of a properly functioning system. Bacteria in the tank help reduce solids; bacteria in the drainfield treat the effluent before it reaches ground or surface waters.

Proper maintenance of the drainfield is also necessary to prevent system failure. Suitable vegetative covers must be maintained to prevent erosion and divert stormwater from the field. Appropriate vegetation helps disperse water and removes nutrients from the wastewater. Poor landscaping over the septic system can contribute thousands of additional gallons. Trees and shrubs must be located far enough away so their roots do not interfere with the systems pipes. Lastly, owners must assure drainfields remain free from vehicle traffic, impervious surfaces, construction or other activities that can compress the soil and damage trenches, pipes and, ultimately, effluent dispersion.

Improper maintenance is not the sole cause of system malfunction and failure. Septic tank systems that are installed incorrectly or are defective from the outset will fail. North Carolina does not require the certification of installers. Without suitable training, installers may be unaware of the fact that trenches should not be dug during rainy periods or care must be taken to avoid compacting the drainfield. They may not have the expertise necessary to recognize defects in the system components such as precast concrete tanks or poor gravel quality. Any one of these situations can lead to system failure and unnecessary owner expense.

Finally, problems have arisen when maintenance is required on underground utilities. Workers installing various underground utilities have damaged drainfields, as well as system components. Little or no effort is made by these underground utility contractors to locate the system and report the damage once it occurs.

More information about the installation and maintenance of septic tanks can be obtained from the NCDENR, Division of Environmental Health, On-site Wastewater Section website at http://www.deh.enr.state.nc.us/oww/ or by contacting your county's Cooperative Extension Service Center. See Appendix VI for contact information for Cooperative Extension Service Centers in the Broad River basin.

4.10.2 Straight Piping

Sometimes pollutants associated with on-site wastewater disposal are also discharged directly to surface waters through straight pipes. Straight pipes are direct pipe connections between the septic system and surface waters, thus, bypassing the drainfield. In some cases, straight pipes pipe wastewater directly from the home or business into a stream, bypassing any type of treatment. Not only is straight piping illegal, the discharge of untreated sewage can be extremely harmful to humans and the aquatic environment. In all cases, straight pipes should be eliminated.

The Wastewater Discharge Elimination (WaDE) program, within the Division of Environmental Health, is helping to identify and remove straight pipes in western North Carolina. This program uses door to door surveys to locate straight pipes and failing septic systems and then offers low interest loans or grants to homeowners who wish to eliminate the straight pipe by installing a septic system. The program also offers low interest loans and grants to repair malfunctioning septic systems. However, no such program is in place in the Broad River basin. County health departments should request funding from the Clean Water Management Trust Fund and Section 319 Program to develop a straight pipe elimination program for the Broad River basin. More information about the Clean Water Management Trust Fund can be found on page 128, and information about the Section 319 Program can be found on page 126.

4.10.3 On-Site System Inspections and Permitting in the Broad River Basin

Local health departments report activities related to on-site wastewater treatment monthly to the NCDENR Division of Environmental Health, On-site Wastewater Section. Table A-31 presents a portion of activities reported for 2001 in three counties within the Broad River basin.

Table A-31 County Monthly On-Site Activity Reports to the NCDENR, Division of Environmental Health in 2001 for Three Counties in the Broad River Basin

	Rutherford	**Polk**	**Cleveland**
Site visits conducted	2,102	814	5,936
Operation permits issued for a new system	561	227	599
Operation permits issued for an expanding system	8	1	18
Operation permits issued for repairs to a system	90	39	112
Total operation permits issued	**659**	**267**	**729**
Notices of Violation Issued	18	2	37

4.10.4 Recommendations

On-site wastewater treatment systems should be located at least 100 feet from your well and allow access for maintenance and repair. Know the location, age, size and condition of your system. Although the maintenance schedule may vary according to the size of tank and number of uses, solids from a septic tank should be pumped every three to five years. Additives for septic systems to "clean, repair or rejuvenate, etc." have limited benefit and do not replace proper maintenance.

Keep the soil over the drainfield covered with grass or plants to prevent erosion. Avoid planting trees or deep-rooted shrubs—roots can clog systems. Do not drive on or compact the soil above drainfields. Flush only toilet paper and human wastes in toilets. Fix leaky pipes and dripping faucets and avoid excessive water use; it will overload the system.

Do not use toilet cleaners that hang in toilet tank. Keep bleach, solvents or other harmful chemicals out of drains and toilets. All of these products can destroy beneficial bacteria that help cleanse the sewage. They can also contaminate groundwater. Keep grease and oil (and their residues) out of the drain, and do not use or limit the use of a garbage disposal in your sink.

For more specific maintenance information, see *Improving Septic Systems*, published by North Carolina Home*A*Syst online at http://ces.soil.ncsu.edu/soilscience/publications/farmassist/homeassist/Septic/ or the *Septic System Owner's Guide* from the North Carolina Cooperative Extension at http://ces.soil.ncsu.edu/soilscience/publications/Soilfacts/AG-439-22/. You may also call (919) 513-3152 to request a copy (Publication No. AG-439-13).

For information on maintenance, innovative systems and current rules, see the NCDENR-Division of Environmental Health, Onsite Wastewater Section website at http://www/deh.enr.state.nc.us/owow/ or call (919) 733-2895. You may also call 1-800-9SEWAGE for technical assistance, to order a copy of the On-Site Wastewater Management Guidance Manual, or to report straight pipes and septic system failures.

4.11 Water Quality Impacts from Dams

By altering the flow of water in a river or stream, dams have the ability to change the chemical, physical and biological processes of the river downstream. Dams block the free-flowing rivers and reduce the flow of nutrients and sediments, including heavy gravel and cobble, and organic matter that are important to the health of the stream and its biological communities. The river downstream of the dam becomes deprived of its sediment load and, depending on the type of river, can begin to generate its own sediment by eroding its banks and channel, undermining bridges and other riverbank structures. This bank erosion and channel entrenchment can extend for up to 50 miles below the dam. The reduction of gravel, cobble and organic matter inputs also reduces the habitat and food source of many fish and macroinvertebrates (IRN, 2000).

The operation of the dam itself can also lead to accelerated erosion in downstream segments as it alters the timing of flows. Instead of providing a constant flow, some dams cause a withholding and then releasing of water which causes the downstream stretches to alternate between no water and powerful surges. This drastic fluctuation in flow can erode soil and vegetation, flood lands and change the natural seasonal flow variations that trigger natural growth and reproduction cycles in many plants, fish and benthic macroinvertebrates (IRN, 2000).

Dams are also barriers to downstream drift. When benthic macroinvertebrates in a particular section of stream are severely impacted by storm events or toxic conditions, the primary method by which the community is reestablished (recolonization) is by natural drift of benthic macroinvertebrates from upstream areas. In pond or lake environments, flow is greatly reduced and many benthic macroinvertebrates sink to the bottom where habitat conditions are not suitable for survival. Additionally, water is warmer in these larger bodies of water and predators (primarily fish) have the advantage. Dams can also represent a barrier to fish movement in a stream or river (NCDENR-DWQ-WARP, February 2002).

Water temperature and dissolved oxygen (DO) levels are significantly different when rivers are impounded. By slowing water flow, most dams increase the temperature of the water flowing over the dam. Others decrease water temperature by releasing cooled water from the bottom of the reservoir. Fish and other species, especially native trout populations, are extremely sensitive to these temperature irregularities which can change the structure of the communities from native and rare species to less desirable species more tolerant of fluctuating water temperatures. Dissolved oxygen is also decreased in the waters held by the dam and when released can have severe impacts, including death, on the fish, benthic macroinvertebrates and vegetation downstream (IRN, 2000).

In the Broad River basin, two stream segments have been impacted due to the regulated flow from the upstream dams: the Broad River from the Lake Lure dam to the US 64/74 crossing and Buffalo Creek from the dam at Kings Mountain Reservoir to the US 74 crossing.

Recommendations

Situations exist in which it is economically and environmentally feasible to remove dams, restoring free movement of water, sediment, nutrients and aquatic life throughout the river system. However, this recommendation is usually costly, difficult and impractical. Another effective solution involves relocating streams to flow around dams. This solution is particularly valid when populations of aquatic life are thriving upstream of the impoundment, and there are concerns about releasing excess sediment and other pollutants within the existing reservoir (from behind the dam).

Requirement of minimum flow releases and management of dam operations to provide more consistent flow is a solution for streams and rivers that are primarily affected by flow-related problems. Flow management does not usually solve problems with recolonization of benthic macroinvertebrates, but can substantially improve conditions for existing populations below dams. Additionally, there are a variety of engineering solutions to improve temperature and dissolved oxygen both within the reservoir and below the dam.

Due to the impacts of dams on aquatic communities, the construction of most instream impoundments, particular in headwater streams, should be prohibited. The Department of Environment and Natural Resources should reexamine its policy related to instream impoundments that are less than 15 feet in height or impounding less than ten-acre feet of water.

4.12 Priority Issues for the Next Five Years

Clean water is crucial to the health, economic and ecological well-being of the state. Tourism, water supplies, recreation and a high quality of life for residents are dependent on the water resources within any given river basin. Water quality problems are varied and complex. Inevitably, water quality impairment is due to human activities within the watershed. Solving these problems and protecting the surface water quality of the basin in the face of continued growth and development will be a major challenge. Looking to the future, water quality in this basin will depend on the manner in which growth and development occur.

The long-range mission of basinwide management is to provide a means of addressing the complex problem of planning for increased development and economic growth while protecting and/or restoring the quality and intended uses of the Broad River basin's surface waters. In striving towards its mission, DWQ's highest priority near-term goals are to:

- identify and restore impaired waters in the basin;
- identify and protect high value resource waters and biological communities of special importance; and
- protect unimpaired waters while allowing for reasonable economic growth.

4.12.1 Strategies for Restoring and Protecting Impaired Waters

Impaired waters are those waters identified in Section A, Chapter 3 impaired based on DWQ assessments of monitoring data. These waters are summarized by subbasin in Table A-29 (page 53) and indicated on subbasin maps in Section B. The impaired waters are also discussed individually in the subbasin chapters in Section B.

These waters are impaired, at least in part, due to nonpoint sources (NPS) of pollution. The tasks of identifying nonpoint sources of pollution and developing management strategies for these impaired waters are very resource intensive. Accomplishing these tasks is overwhelming, given the current limited resources of DWQ, other agencies (e.g., Division of Land Resources, Division of Soil and Water Conservation, Cooperative Extension Service, etc.) and local governments. Therefore, only limited progress towards restoring NPS impaired waters can be expected during this five-year cycle unless substantial resources are put toward solving NPS problems.

DWQ plans to further evaluate the impaired waters in the Broad River basin in conjunction with other NPS agencies and develop management strategies for a portion of these impaired waters for the next Broad River Basinwide Water Quality Plan, in accordance with the requirements of Section 303(d) (see below).

4.12.2 Addressing Waters on the State's Section 303(d) List

For the next several years, addressing water quality impairment in waters that are on the state's 303(d) list will be a priority. The waters in the Broad River basin that are on this list are presented in the individual subbasin descriptions in Section B. For information on listing requirements and approaches, refer to Appendix IV.

Section 303(d) of the federal Clean Water Act requires states to develop a 303(d) list of waters not meeting water quality standards or which have impaired uses. States are also required to develop Total Maximum Daily Loads (TMDLs) or management strategies for 303(d) listed waters to address impairment. In the last few years, the TMDL program has received a great deal of attention as the result of a number of lawsuits filed across the country against EPA. These lawsuits argue that TMDLs have not adequately been developed for specific impaired waters. As a result of these lawsuits, EPA issued a guidance memorandum in August 1997 that called for states to develop schedules for developing TMDLs for all waters on the 303(d) list. The schedules for TMDL development, according to this EPA memo, are to span 8-13 years.

There are approximately 2,387 impaired stream miles on the 2000 303(d) list in NC. The rigorous and demanding task of developing TMDLs for each of these waters during an 8 to 13-year time frame will require the focus of much of the water quality program's resources. Therefore, it will be a priority for North Carolina's water quality programs over the next several years to develop TMDLs for 303(d) listed waters.