

# 2017

## Water Quality of Streams in Forsyth County, NC



This report was requested by  
and completed in honor of  
the late Commissioner  
Walter Marshall.

Commissioner Marshall was  
a strong proponent of  
environmental protection  
issues in Forsyth County.



Published by:

Forsyth County Office of Environmental

Assistance and Protection

2/27/2017

## Water Quality of Streams in Forsyth County

### Description of Forsyth County Watersheds

Forsyth County's watershed system impacts both local and downstream communities in three separate river basins; the Yadkin/Pee-Dee River basin, the Roanoke River basin, and the Cape Fear River basin. As shown below in Figure 1, approximately 76% of Forsyth County is in the Yadkin/Pee-Dee River basin. The Roanoke River basin occupies about 21% of the northeastern section of the county. The Cape Fear basin impacts less than 3% of the county on the eastern edge that includes a small part of Kernersville.

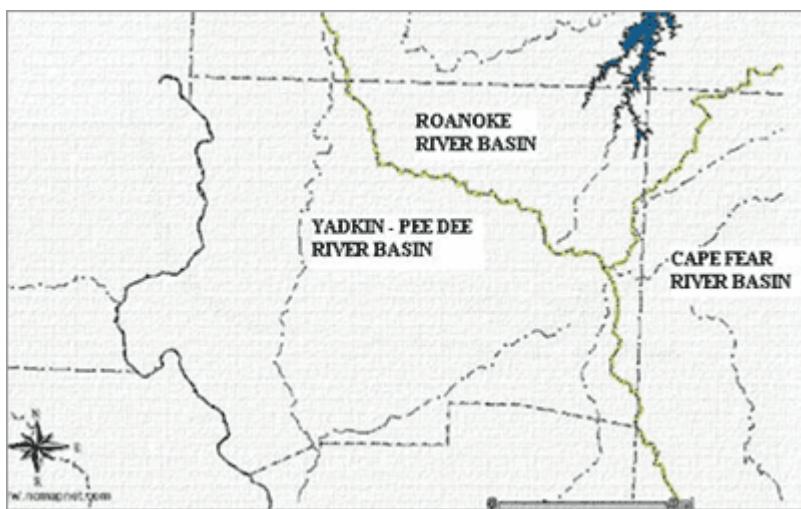
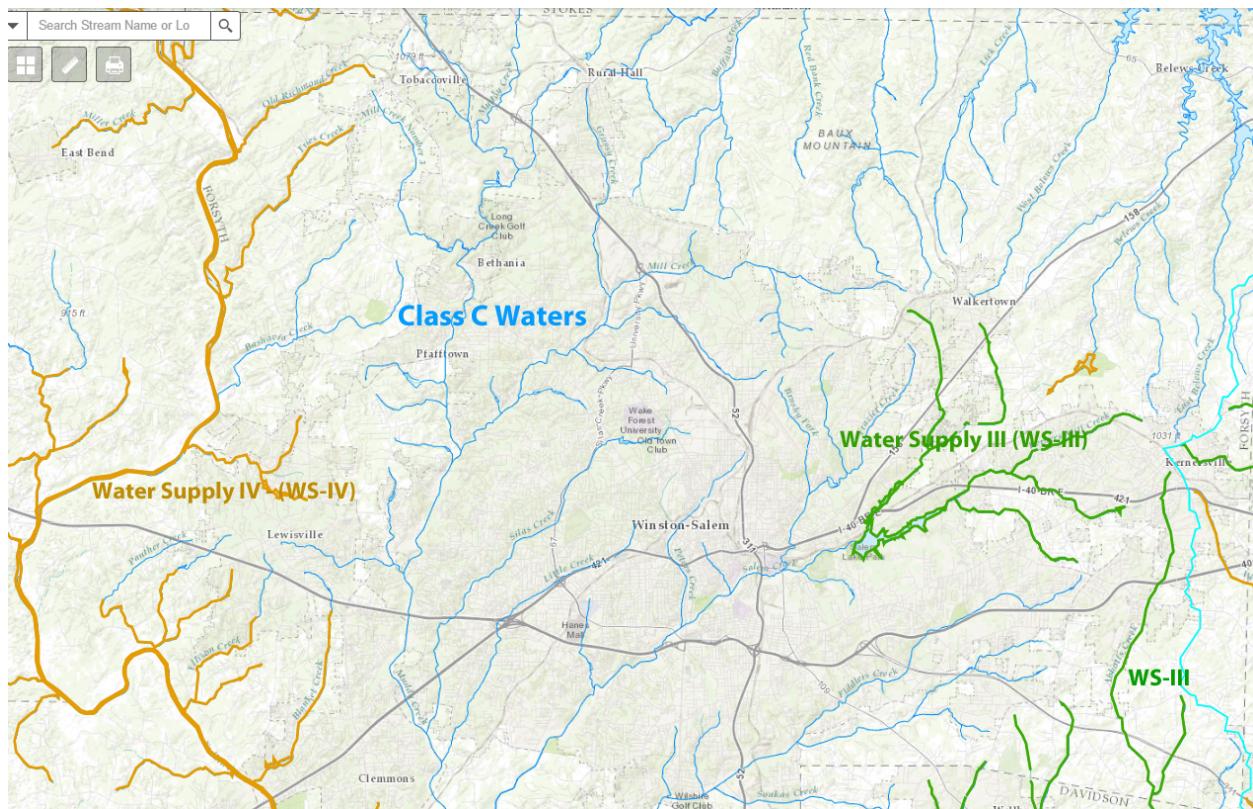


Figure 1 - River Basins in Forsyth County

Within the larger Yadkin-Pee Dee watershed are three major secondary and tertiary watersheds. The Muddy Creek watershed which encompasses 76% of the area in Forsyth County feeding to the Yadkin River, the Salem Creek watershed, a sub-watershed of Muddy Creek, and Abbotts Creek draining a southern section of Kernersville and areas south. It is these three sub-watersheds along with areas on the western portion of Forsyth County feeding directly into the Yadkin River that are most affected by activities in the Winston-Salem, Clemmons, Rural Hall, Lewisville, and Kernersville municipalities, along with their surrounding developing areas. Kernersville is the major municipality in Forsyth County that also affects water resources in the Cape Fear River basin with Reedy Creek and West Fork Deep River Creek being the 2 main tributaries for that basin. Streams in the NE corner of Forsyth County are in the Roanoke River basin and drain to Belews Lake with Belews Creek being the major tributary draining that area.

### Stream Water Classifications

Stream water classification is a tool used by federal, state, and local agencies to manage and protect surface waters (streams, lakes, rivers, etc.). Classifications are assigned based on the best uses that should be assigned to that water body (swimming, fish and wildlife habitat, drinking water supply, etc.).



**Figure 2 - Classifications**

## Class C

Waters protected for uses such as secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner. A majority of the streams in Forsyth County are Class C (see figure 2)

## Water Supply III (WS-III)

Waters used as sources of water supply for drinking, culinary, or food processing purposes where a more protective WS-I or II classification is not feasible. These waters are also protected for Class C uses. WS-III waters are generally in low to moderately developed watersheds. Salem Lake is a back-up water supply for the area. As Figure 2 shows, the waters draining into Salem Lake are classified as WS-III.

## Water Supply IV (WS-IV)

Waters used as sources of water supply for drinking, culinary, or food processing purposes where a WS-I, II or III classification is not feasible. These waters are also protected for Class C uses. WS-IV waters are generally in moderately to highly developed watersheds or protected areas as shown in Figure 2 along the Yadkin River.

## Water Quality Assessment in Forsyth County

When discussing the water quality of Forsyth County streams, the chronic (long term) indicators of stream quality are the focus for assessing whether a stream is meeting the conditions set forth in its Classification (Class C, WS-III, or WS-IV - the three classifications found in Forsyth County). At times, shorter term pollutant loads are used to indicate longer term issues, especially with respect to fecal coliform

As shown in Figure 3 below, several agencies monitor streams in Forsyth County. The City of Winston-Salem's Stormwater\Erosion Control Division (noted in red) are required to monitor streams under their Phase I Stormwater permit. The State of North Carolina's Division of Water Resources perform intermittent sampling by both their ambient monitoring group (noted in yellow) and their Biological Assessment Branch (noted in blue). Additionally, the Lower Yadkin-Pee Dee River Association (noted in green) assist the State with sampling including biological assessment in our area. The map shows routine sampling sites although additional sites may be sampled by these agencies as resources allow or need requires.

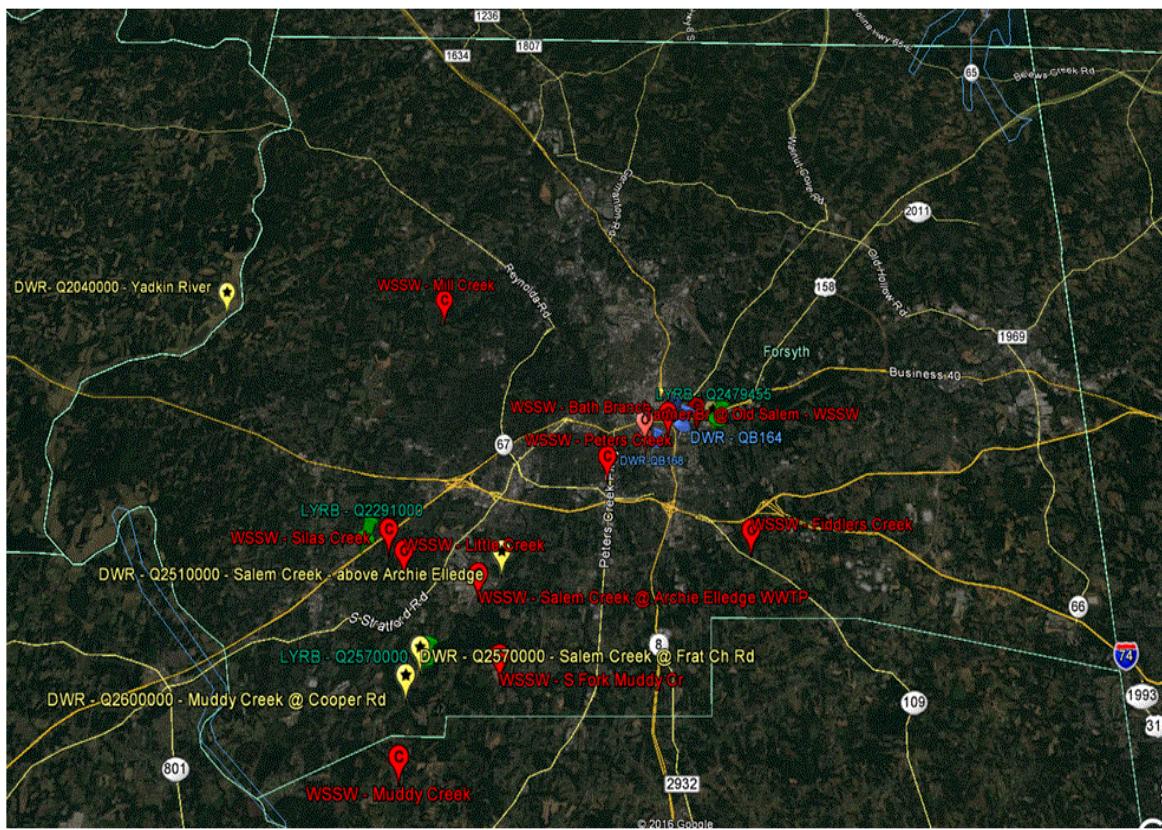


Figure 3 - Routine Stream Sampling Locations

A majority of the sampling locations align closely with major tributaries draining 76% of Forsyth County feed into Muddy Creek and the Yadkin River. As illustrated in Figure 4, the results from the sampling of these various agencies found several areas of concern in Forsyth County Streams.

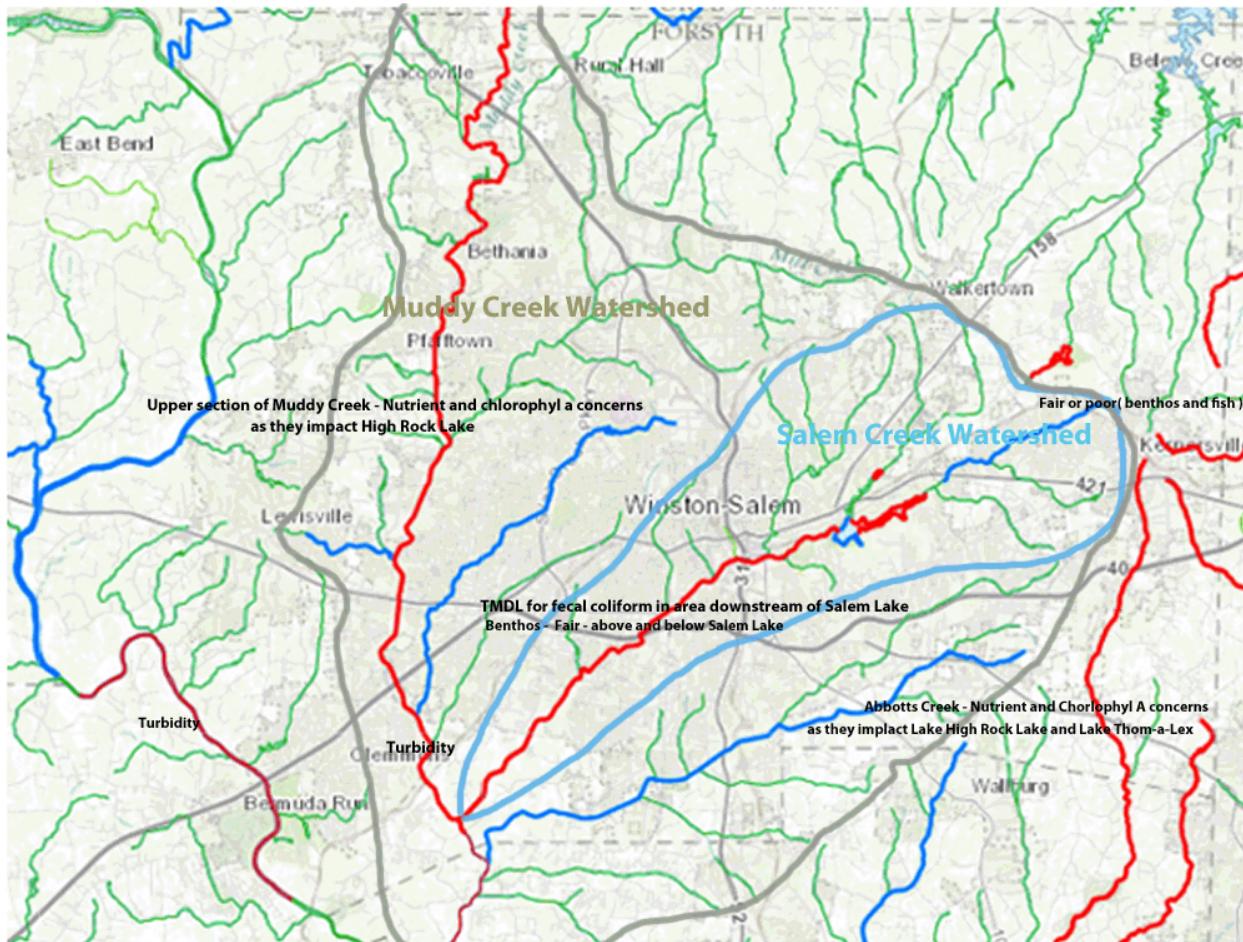


Figure 4 - Stream impairments and concerns

The most localized concerns are Fecal Coliform and Turbidity. More far-reaching pollutants that contribute to problems in downstream reservoirs such as Lake Thom-a-Lex and High Rock Lake include nutrients and chlorophyll a. Salem Creek downstream of Salem Lake, Muddy Creek, and streams draining to the Cape Fear basin are found to be fair or poor with regards to their ability to support pollutant intolerant species of macroinvertebrates and fish.

#### ***Fecal Coliform - Class C section of Salem Creek***

Sampling results from all sampling agencies including routine interval sampling by the W-S Stormwater Division verify a continuing problem with fecal coliform in Salem Creek. Fecal coliform indicates that waste from humans, animals, etc. are present in the stream and is a warning that any other type of microbe associated with human or animal waste may also be

present. Through Winston-Salem's Phase I permit, the City of Winston-Salem is actively finding ways to reduce fecal coliform to the maximum extent practicable through the issuance of a Total Maximum Daily Load (TMDL) plan for the stretch of Salem Creek from the downstream side of Salem Lake to its confluence with Muddy Creek. Since fecal coliform is considered to be an uncontrollable non-point source of pollution, Winston-Salem has activated several programs including: reducing pet waste (ex. poop and scoop outreach program, pet waste ordinance, public education, etc.), finding and reducing sewer overflows (walk the creek, reduce fats\oils\grease in sewer systems, sewer maintenance, etc.), and other activities related to erosion control to catch the first flush of water from a storm event. The most recent activity being the construction of a wet pond to catch the first flush storm event affecting the Piedmont Triad Research Park.

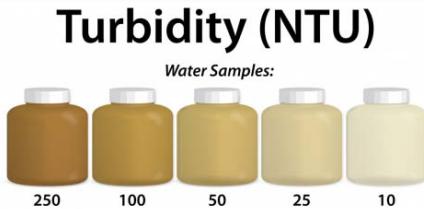
In addition to the City of Winston-Salem's responsibilities, the maintenance of individual residential waste systems is an important factor in the reduction of fecal coliform to the watersheds. Forsyth County's Environmental Health section of the Public Health Department assure these systems are properly sited and maintained.

Agricultural animals such as cattle and chickens also may contribute to problems with fecal coliform and good practices must be used to assure animal waste is properly handled and disposed.

Forsyth County residents must also act responsibly to assure their pet waste is disposed of properly. This includes scooping the poop when taking pets for a stroll and disposing of pet waste at home responsibly.

#### ***Turbidity (Muddy Creek - downstream from its confluence with Silas Creek, Yadkin River South of its confluence with Hauser Creek)***

Turbidity is caused by particles suspended or dissolved in water that scatter light. Particulate matter may include sediment, organic or inorganic matter, algae and other microscopic organisms. Some of the problems with turbidity are the impacts it has on aquatic life (gill function, growth rate, resistance to disease, spawning beds, etc.), cost of water treatment for drinking water, and its impact on recreation and tourism.



The North Carolina Division of Water Resources (NCDWR) has developed a Total Maximum Daily Load (TMDL) for Turbidity for applicable sections of Muddy Creek and the Yadkin River. TMDL development is prioritized by NCDWR based on many factors including willing stakeholders, the number of impairments on the water body, its classification, and other priorities as they emerge. For both Muddy Creek and the Yadkin River, approximately 59% reduction has been proposed for the applicable Stormwater permittees (Village of Clemmons, City of Winston-Salem, NCDOT, Town of Lewisville) as well as an average limit of 30 mg/l of suspended solids emitted from point source NPDES permittees (12 or more small Waste Water Treatment Facilities - WWTPs). For Municipal Phase I and Phase II stormwater permits, incremental changes are made to the permits over time as reductions are realized (or not). Reliance on and enforcement of existing sediment and water volume control measures (stormwater catchment

ponds, erosion control, riparian buffers, proper planning initiatives, etc.) are paramount to the long term reduction of turbidity for these and all streams in Forsyth County.

#### ***Nutrients and Chlorophyll A - Yadkin River, Abbotts Creek***

Nutrient related water pollution (Nitrogen and Phosphorous) has created water quality problems in High Rock Lake and Lake Thom-a-Lex. Both pollutants can travel hundreds of miles in streams. Therefore, all streams and rivers leading to these two lakes are targets for reduction of nutrients and Chlorophyll A (increased by high levels of nutrients and an indicator of algae biomass). Excessive amounts of nutrients cause problems including low oxygen levels, fish kills, and algal blooms. These types of conditions shorten the life of ponds and lakes or incur huge expenses when dredging and other means become necessary to revive them.

Education outreach to citizens, commercial (landscapers, golf courses, etc.), and agricultural enterprises for proper application of fertilizers and protection of nearby streams through vegetative buffers are important steps in reducing nutrients in streams.

#### ***Biological Assessment of Streams - Benthic Macroinvertebrates - Salem Creek downstream from Salem Lake, Reedy Creek, W Fork Deep River Creek***

Small and medium sized streams are probably the most crucial areas for providing natural and long term water quality benefits to the larger water bodies (rivers and lakes) that they feed. Sub-watersheds provide the benefit of aeration due to larger portions of their waters exposure to air and biological benefits as small organisms (macroinvertebrates) and fish living in an oxygen rich environment feed on organic wastes in the water. Biological assessment of a stream's health is the most profound indication of a stream's health and ability to provide mechanisms for improving water quality. An abundance of research has been done in this area and the biological community has been catalogued according to the ability of specific macroinvertebrates and fish populations to live within polluted waters. Tolerant species of fish and macroinvertebrates are capable of living in more polluted streams and those more vulnerable to pollution are classified as intolerant.



In the areas where this assessment has been performed (Salem Creek downstream of Salem Lake, Reedy Creek, Muddy Creek (fish populations)) conditions have been deemed fair to poor meaning that the streams evaluated provide living conditions that do not favor fish or macroinvertebrates sensitive (intolerant) to pollution (including sedimentation affecting habitat). Subsequently, these streams are less capable of enhancing water quality before they reach the deeper waters, such as rivers and lakes. Unfortunately, poor and fair conditions are fairly

common in highly urbanized and developing areas throughout the State. In fact, it could be inferred that other streams within the County exist with these fair or poor conditions. On the positive side, routine sampling for pollutants does not indicate that high pollutant loads are the cause of these fair or poor conditions. These conditions are most likely due to poor habitat for the more tolerant species of fish and macroinvertebrates impacted by stream reformation causing excess stream bank erosion and other erosive events occurring during storm flows.

#### ***Acute pollution events (spills, leaks, etc)***

Unfortunately, acute pollution events do occur in Forsyth County streams. These are unexpected but potentially damaging spills or leaks that are able to cause loss of fish or biota in a short period of time. Given the state of the streams in an urbanized area, loss of fish and biota can take many months or even years to recover depending on the extent and toxicity of the spill.



The largest number of leaks are sanitary sewer overflows due to blockages and/or the infiltration of water into the system during a very severe storm event. To limit these events, the City of Winston-Salem actively inspect their sewer lines by walking the sewer lines as well as the creeks in their proximity. They also have a fat, oil, and grease reduction program to help prevent clogged sewer lines. For more about the City's plan to reduce sewer problems and other problems related to fecal coliform, please read their revised TMDL by [clicking here](#), or if you are reading in paper form, type in the following to your browser address bar:  
<http://www.cityofws.org/Portals/0/pdf/stormwater/TMDLupdate.pdf>.

Most instances of spills or leaks (or illegal dumping of a substance) rely on citizens to report information to the local agencies. It is important to get someone to the scene as soon as possible to evaluate the spill and determine if it is ongoing. If so, it can be traced to its source and stopped as soon as possible to limit the extent of the damage.

## **Summary Discussion of Water Quality in Forsyth County Streams**

The streams in Forsyth County are typical of streams in highly urbanized and developing areas. Other than local fecal coliform issues in Salem Creek below Salem Lake and turbidity issues in the lower portion of Muddy Creek, other pollutant levels that are routinely sampled by the W-S Stormwater Division and the State of North Carolina remain below State regulatory standards. Impairments noted for nutrients and chlorophyll A are concerns that are far reaching with regards to downstream reservoirs, and even estuaries, due to the distance that nutrients can travel. At this time, waters draining into Salem Lake are not classified as impaired due to nutrients. However, nutrients in Salem Creek are additive to the concerns of Muddy Creek. Local effects may include increases in eutrophic conditions in area ponds.

It is important to protect the fish and benthic community (macroinvertebrates and other organisms living at the bottom of a water body) in local streams in order to reduce pollution, including organic waste, and provide long term benefits with regards to water treatment costs and the stream's aesthetic qualities. Vegetative buffers along streams provide a filtering effect that reduces nutrients, sediment, and other pollutants from entering streams during storm events. As development occurs the addition of water volumes that change the dynamics of a stream system must be considered in stormwater control designs.



It is not uncommon to see streams that once flowed continuously become intermittent streams that only flow during rain events. Therefore, reducing impermeable surfaces where practical will help to maintain ground water tables that feed streams at their point of origin. Proper sizing, design, and maintenance of erosion control management practices continues to be a balance between environmental impacts and economic impact to developers. Developers have a responsibility to the community to assure their stormwater control measures are properly maintained and operated.

Instances of leaks or spills can affect not only turbidity but create concerns about toxicity

impacting aquatic life and the safety of surface waters. When a chemical or other type of spill occurs, rapid identification of the source of the problem and stopping the activity as soon as possible is important. The City of Winston-Salem's Stormwater\Erosion Control Division has an active program (including regulatory) to respond to surface water pollution events or failures of erosion control systems. If high values are found for any pollutant in their routine monitoring, City Stormwater staff are alerted and initiate an investigation to find the source of the problem. The Town of Kernersville and the Village of Clemmons also have staff assigned to respond to stream pollution in their municipalities. Additionally, the Forsyth County Office of Environmental Assistance and Protection (FCEAP), under a Memorandum of Agreement (MOA) with the State of North Carolina's Division of Water Resources (DWR), provide local response to help stop non-erosion pollution events as they are occurring. If regulatory action is needed, NC DWR is nearby to provide guidance and continue the investigation to its conclusion. FCEAP also responds to complaints in the Town of Rural Hall to assist them with their illicit discharge investigations required in Rural Hall's Phase 2 Stormwater Permit. In the case of a hazardous material spill or spills occurring after business hours, the City\County Fire Department along with Forsyth County's Emergency Management Service should be the first responders and have the skills and equipment to reduce hazards to the area land and streams.

Finally, it should be cautioned that even a Class C stream deemed to be "good" only means that it is suitable for *"secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner."* In general, streams should not be considered potable for humans or pets and caution should always be taken due to the possibility of undiscovered illicit discharges or pollutants not found in normal sampling routines.

## RESOURCES

[North Carolina Watershed Protection Program](#)

[NC DEQ - Classifications](#)

[City of Winston-Salem - NPDES Stormwater Program - TMDL Implementation Plan](#)

Special thanks to staff at the City of Winston-Salem Stormwater\Erosion Control Division for providing sampling information, site locations, and a knowledge-based discussion.

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