# Water Shortage Response Planning Handbook

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# 1 INTRODUCTION

North Carolina receives an average of 48 inches of rainfall annually, spread fairly evenly throughout the year. In most years, rainfall is adequate to maintain and replenish our ground and surface water supplies. However, the occurrence of droughts is also a normal part of the weather cycle and should be expected. During droughts, water available from our streams, rivers, and wells can be severely diminished. In addition, water use can increase drastically.

The extent to which communities' drinking water supplies are impacted by drought depends on many factors. Obviously, the more severe and long-lasting the drought is, the greater the impact will be. Also, water systems that are already using a large percentage of their available water supply during a normal year are more likely to experience drinking water shortages during droughts. Responding proactively to a developing water shortage can greatly reduce the risk that a community will face serious drinking water shortages during drought. The North Carolina Drought Monitoring Council webpage (http://drought.ncwater.org/) is a good planning tool for system managers. The page provides information regarding current drought conditions, recommended responses, contacts, education, etc. that can be used to track the drought status in NC and to assist you in making decisions for your community.

Drought is not the only possible cause of a drinking water shortage. Water systems may experience short-term problems with water treatment or distribution. Water line breakage, perhaps due to construction, can suddenly interrupt water service. Water supply contamination or some other water quality problem can also result in a water shortage.

Because water supply systems in North Carolina are so numerous and diverse, response plans need to be designed to reflect specific water system conditions. Therefore, the best place to address planning for responding to water shortages is at the local level. This handbook describes how a multi-level, water shortage response program can be developed and implemented. Such a program can enable a community to respond to water shortages early and minimize the need for extreme measures later on. The vulnerability of a water system to water shortages depends on the system's size, the amount and type of water sources, availability of additional emergency sources, and other system-specific factors. It must be emphasized that a water shortage response program must be tailored to fit local conditions. Local preparedness and timely community action are critical when coping with a water shortage. Local officials must organize their community, monitor local conditions, and take necessary action.

During water shortage conditions, finding additional supplies can be difficult. Planning ahead to maintain adequate supplies and implementing a water shortage response program will provide your community with more protection and will avoid last minute attempts to supplement water supplies.

A Water Shortage Response Plan should be part of an overall water use policy that emphasizes the efficient use of water at all times, not just during drought. Other components of a comprehensive water use policy include:

- **Water Loss Reduction:** Eliminate water leaks and reduce unaccounted-for water.
- **Water Use Guidance:** Provide guidance on appropriate uses of drinking water.
- **Water Efficiency:** Improve water use efficiency through water rate structures, metering, retrofits, drought tolerant landscaping, and reuse.
- **Public Education and Outreach:** Improve the effectiveness of your program by increasing public awareness and education.

This handbook presents a phased response to address a developing water shortage. It describes three levels of increasing water shortage severity, along with guidelines for identifying each level and suggests response measures. The three water shortage response phases are:

- **Voluntary Conservation Phase:** Conditions indicate the potential for water supply shortages, and voluntary conservation should be encouraged.
- **Mandatory Restriction Phase:** Water supplies are visibly or measurably lower than the seasonal norm and are diminishing, and mandatory restriction measures must be imposed. More than one mandatory restriction stage may be desirable.
- **Emergency Response Phase:** The system is experiencing a water shortage, the supply is clearly inadequate, and more stringent restriction measures must be imposed.

# 2 DEVELOPING A LOCAL WATER SHORTAGE RESPONSE PLAN

It is critical to implement a local water shortage response program well before a shortage develops. Elements of the program include defining water use classifications, evaluating vulnerability to water shortages and enacting a Water Shortage Response Plan. The primary goal of your Water Shortage Response Plan is to outline how drinking water will be used when supply cannot meet demand. A Water Shortage Response Plan should be designed to alleviate difficult judgement calls and allow for an orderly transition between response levels. Care should be taken to document exactly what needs to be accomplished in the event of a drought or other water shortage. It is important that public education and public input be integrated into each element of the plan to ensure effectiveness and community support.

## 2.1 OVERVIEW

In order to implement a Water Shortage Response Plan, someone has to have the authority to activate it when necessary. Therefore, it is vital to identify where authority resides ensuring that there is legal authority for local officials to implement a Water Shortage Response Plan and impose conservation and restriction measures as the need arises. Communities lacking clearly defined authority in existing ordinances should consider adding to or amending current ordinances or bylaws to provide for the proper authority.

The Water Shortage Response Plan should provide for the declaration of a water shortage, define different phases of water shortage severity and outline responses to each. Your community plan should specify voluntary conservation and mandatory restriction measures to be imposed at each phase of water shortage severity. Suggested responses for each phase are described in this handbook. In addition, the plan should classify the various uses of drinking water based on the need for water treated to drinking water standards and importance to the local community, especially in terms of the local economy. The handbook suggests dividing drinking water uses into Essential, Socially or Economically Important, and Non-essential.

Different communities are likely to have different priorities for drinking water uses and should develop a Water Shortage Response Plan that addresses local needs. If your plan is to be effective at reducing water use, it must be tailored to your water supply and needs.

## 2.2 DEFINING WATER USE CLASSIFICATIONS

Different water uses are of differing levels of importance to the people of your community. Thus, water use restrictions must be uniquely applied to different classes of drinking water use based on their importance to the community. *Essential* water uses (Class 1) are those necessary for maintenance of public health and safety. *Non-essential* water uses (Class 3) can be restricted or totally banned without significant social or economic impacts. *Socially or Economically Important* water uses (Class 2) are those that fall between Class 1 and Class 3, and it is likely to be the largest class of users. Determining the social and economic importance of various water uses will require input from community members and business representatives. Involving the public in formation of your Water Shortage Response Plan will improve identifying need areas and adherence if the plan has to be implemented.

Your Water Shortage Response Plan should contain a list of water uses and their classifications. A sample list is given below and detailed in Section 3**.** Your list may differ from this example, since priorities may be different for each community. For this reason, public involvement in the classification of water uses is very important.

**Sample Water Use Classifications**

- **Class 1:** Essential
- **Class 2:** Socially or Economically Important
- **Class 3:** Non-essential

## 2.3 EVALUATING VULNERABILITY TO WATER SHORTAGES

The goal of water supply planning is to ensure adequate supplies to meet system demands. Balancing demand and supply becomes critical when the issue becomes a declining supply as opposed to increasing demand. Vulnerability to water shortages can be determined by examining available supply and demand for drinking water. A good starting point for a municipal water system is the assessment of current and future water needs and the system's ability to meet those needs provided by its Local Water Supply Plan. Local governments that provide public water service are required to have a Local Water Supply Plan and to update it every 5 years. Other water systems that serve 1000 or more customers are also strongly encouraged to prepare a Local Water Supply Plan. Contact the Division of Water Resources for additional information on local water supply planning.

### 2.3.a Assessing Water Needs

It is important to have a good understanding of the demands being placed on your water system. Your distinctive mix of water customers has a significant impact on the variability of your system's water demands and on your customers' ability to reduce water use during a shortage. For example, systems comprised mainly of residential users can normally reduce water use considerably by restricting outdoor water use, however, systems whose usage is largely industrial may realize only limited reductions by restricting outdoor water use. For systems with a high proportion of industrial water use, it may be necessary to begin residential conservation measures earlier and to have a more aggressive program to target industrial water savings. It is essential to work closely with industrial water customers to develop a realistic approach to water use reductions. Individual industrial facilities will have different limitations on their ability of change water use patterns without jeopardizing production and jobs.

Demands typically increase during hot, dry weather, which is when shortages are most likely to occur. In addition, the service population can increase several-fold for systems serving resort areas with fluctuating seasonal populations, further increasing water demands. Seasonal demands must be considered when evaluating the adequacy of your water supplies during drought conditions. Even if adequate water supplies are available for typical demands, seasonal and peak demands can tax a system's ability to treat and deliver enough water for its customers.

Unaccounted-for water can significantly affect the total demand for water. A well-operated system may have as much as 10-15% unaccounted-for water, representing water losses due to leaks as well as unmetered and inaccurately metered water uses. Some systems, particularly older ones, may have considerably higher unaccounted-for water, which take a notable toll on water systems, especially during a water shortage. At a minimum, unaccounted-for water does not generate revenue and, if due to leaks, requires treating more water than necessary to meet customer demands. Conducting an annual water audit and maintaining an active leak detection and repair program will help reduce unaccounted-for water.

### 2.3.b Assessing Water Supplies

Along with assessing your water supply needs it is essential to identify available water supplies. Recognizing when available water supplies are, or potentially are, insufficient to meet projected demands is critical to responding effectively to a drought or other water shortage situation. Generally speaking, water systems that use more than 80% of their available water supply under normal conditions are more likely to experience water shortages during drought. Those systems should be aggressively managing their water demands and pursuing additional water supplies.

**Wells:** Typically, it takes longer for wells to be affected by drought than it does for surface water supplies. On the other hand, recharge of ground water is relatively slow. Wells are slower to recover from the effects of drought than surface water supplies. Water levels in wells and daily pumping times are the best indicators of diminishing ground water supplies or overuse of existing supplies. Therefore, it is important that water levels and pumping times be monitored routinely during normal conditions and especially during drought conditions to assess the impact on ground water supplies. The NC Division of Water Resources can provide assistance on how to monitor water levels in your wells.

**Streams:** During a period of drought, streamflows will naturally be below normal. However, other factors can also limit the amount of water available for water supply. In some cases, the ability to withdraw water may become impaired during low flows even if sufficient water is still available in the stream because of channel and intake configuration or intake location. Some systems may be subject to withdrawal criteria that require a minimum flow to be maintained below the intake or restricts withdrawal when streamflows

fall below a certain level. Stream users also need to consider other existing and potential upstream and downstream users. For example, upstream withdrawals (for irrigation or other purposes) can reduce the amount of water available, or a downstream wastewater discharge could limit upstream withdrawals because of water quality concerns. Additionally, some streams are regulated by releases from upstream impoundments. While required minimum releases help to augment downstream flows during low-flow conditions, impoundments without required minimum releases can significantly impact downstream flows during drought. Contact the Division of Water Resources for additional information on these stream withdrawal considerations.

A network of over 200 stream gages across North Carolina provides real-time and historic streamflow data. If a stream gage is located near your intake, this provides the best available information for assessing your water supply, especially if the gage has been in operation for many years. The Division of Water Resources or the U.S. Geological Survey can help you determine if gage data are available and assist with streamflow analysis. Gage data may need to be adjusted to account for any withdrawals or discharges between the intake and the gage and for differences in drainage areas.

Comparison of water demands to the streamflow available for water supply will allow system managers to assess their ability to continue meeting current demand levels or whether conservation measures are necessary to reduce demand. System managers can estimate how long streamflows may be adequate to meet demand and when water use restrictions may be needed based on the rate of decline in streamflows at gages throughout the intake drainage area.

If stream gage data are not available, installing a permanent staff gage on a nearby bridge abutment or on the intake structure to measure water levels regularly can develop a relative indicator of low-flow conditions. Recording water levels at the staff gage will help establish the seasonal patterns of streamflow. System managers can assess the severity of low-flow conditions by comparing seasonal water levels to the historical water level data compiled through staff gage monitoring.

**Reservoirs:** Reservoirs store water during periods of high flow to be used later when streamflows might otherwise be inadequate to meet water demands. Assessments of water supply in reservoirs need to be based on the ***useable*** water supply storage, not the total volume of storage. Useable storage can be limited by several factors. Over time, water supply storage is lost to sediment buildup in reservoirs. Storage volume reserved for sediment should not be included when calculating *useable* storage. In addition, the elevation or location of a reservoir's intake may cause water below a certain lake level to be unavailable for water supply. Therefore, storage below the lowest intake should not be considered useable. Keep in mind; raw water quality in the lower levels of a reservoir can be quite different from water near the surface. Variations in raw water quality can result in treatment problems that can limit the volume of drinking water produced from a given volume of raw water and essentially limit useable supply. Each reservoir is different and should be evaluated based on site-specific considerations.

The relationship between reservoir water levels (stage) and the reservoir storage can be graphed and is a convenient reference for monitoring reservoir conditions. A reservoir stage-storage curve showing the water supply storage available at specific lake levels is an important tool for water system managers. By regularly monitoring the lake levels, water system managers can easily determine the remaining useable water supply at any given time by referring to the stage-storage curve.

During drought conditions, it is equally important to monitor both the flow in streams feeding the reservoir and the flow out of the reservoir, particularly if minimum releases are required. Streams feeding the reservoir should be visually checked regularly, especially if no stream gages are located upstream for monitoring. If releases are required from the reservoir, check often to ensure that the proper amount of water is being released. Contact the NC Division of Water Resources for additional information on these topics.

### 2.3.c Triggers

Measures of available supply are referred to as "***triggers***" throughout the handbook. A trigger is a specific indicator of the potential for and severity of a water supply shortage based on accurate assessments of available water supply. Triggers are used to initiate and remove restrictions. They take the pressure off decision-makers and reduce the need for local officials to make "judgment calls" in the heat of a crisis. Triggers also help to alleviate public disagreement over restrictions. If the public understands why and when water use restrictions are put into effect, they will be more likely to cooperate. A well informed public can be your greatest ally in times of water supply shortage. A plan that is

"triggered" by specific water supply assessments is a proactive and logical approach that will garner respect from the general public. Possible triggers include:

- Streamflows
- Reservoir level or storage
- Number of days of supply remaining
- Ground water levels or daily pumping times
- Pressure or water levels in storage tanks
- Peak demand or percent of water treatment capacity

Your choice of triggers will depend on your water supply source and the ability to accurately monitor the various components of your system. You should select triggers that will start restrictions while there is still enough supply to manage. Experience with your system will allow you to fine tune your triggers over time. Possible triggers for each phase of reductions are presented in Section 4.

**2.3.d Triggers and Available Supply**

The primary goal for developing a Water Shortage Response Plan is to establish a procedure for guiding water system and community response to reductions in water supply that limit a system's ability to meet customer demands for drinking water. When supply becomes limited the only way to maintain the balance between supply and demand is to lower demand. Reductions in water usage can be accomplished by first asking and then, if necessary, requiring customers to use less water. Deciding when to request and/or require restrictions on drinking water use are critical components of an effective Water Shortage Response Plan. The Division of Water Resources strongly recommends including members of the community when determining the level of risk for running out of water they are willing to accept and tying requests for reductions to the appropriate measures of available supply.

The public should be included in all phases of planning, including the determination of triggers for your community. Having the community involved in the process for establishing criteria for triggers will expand their understanding of the relationship between drinking water demand and its source. Furthermore, it is beneficial to involve the public in determining the timing for implementing reduction efforts. It will build support and improve the likelihood that water use reduction efforts will be effective. Participants in the process will become valuable resources in public education campaigns and explaining the validity of the Water Shortage Response Plan to other customers in the community. By using a consistent measurement system of available supply as the triggers for reductions, you will be enable to keep customers constantly informed of conditions. In this way, your customers will be prepared for a voluntary request for reduction and potential mandatory restrictions. An educated and informed public enables officials and system managers to focus on bringing demand inline with supply rather than justifying a decision to ask for water use reductions.

Each community will have to determine the appropriate triggers based on their available water sources, distribution system characteristics and customer profile. This handbook presents a sequence of staged increases in restrictions on drinking water that are related to the amount of water available to a system versus the risk of running out of water at each level of supply. The goal is to increase customer awareness when a potential for shortage is anticipated and incrementally increase restrictions as needed.

# 3 WATER USE CLASSES

Section 2.2 briefly discussed the need for water use classifications. This section contains examples of the types of water uses within different sectors of the community and how they are fit into one of the following classes: Essential, Socially and Economically Important, and Non-essential. Of course, your classification system will be dependent on your community's customer profile.

## 3.1 CLASS 1: ESSENTIAL

**3.1.a Domestic Use:**

- Water necessary to sustain human life and the lives of domestic pets, and to maintain minimum standards of hygiene and sanitation

**3.1.b Health Care Facilities:**

- Patient care and rehabilitation, including swimming pools used for patient care and rehabilitation

**3.1.c Public Use:**

- Firefighting, including testing and drills by the fire department if performed in the interest of public safety and if approved by the municipal governing body
- Flushing of Sewers and Hydrants as needed to ensure public health and safety and if approved by the municipal governing body

### 3.2 CLASS 2: SOCIALLY or ECONOMICALLY IMPORTANT

**3.2.a Domestic Use: All Domestic Uses Other Than Those Included in Classes 1 and 3**

- Home water use including kitchen, bathroom and laundry use
- Minimal watering of vegetable gardens
- Watering of trees where necessary to preserve them

**3.2.b Commercial, Agricultural, Industrial and Institutional Uses**

- Outdoor commercial watering (public or private) using conservation measures
- Irrigation for commercial vegetable gardens and fruit orchards or the maintenance of livestock
- Watering by commercial nurseries at a minimum level necessary to maintain stock
- Water use by arboretums and public gardens of national, State, or regional significance where necessary to preserve specimens
- Use of fresh water at a minimum rate necessary to establish vegetation following earth-moving, where such vegetation is required by law or regulation
- Watering of golf course greens
- Filling and Operation of Swimming Pools:
  - Residential pools which serve more than 25 dwelling units
  - Pools used by health care facilities for patient care and rehabilitation
  - Municipal pools
- Commercial car and truck washes
- Commercial Laundromats
- Restaurants and clubs
- Air Conditioning:
  - Refilling for start up at the beginning of the cooling season
  - Make-up of water during the cooling season
  - Refilling specifically approved for by health officials and the municipal governing body, where the system has been drained for health protection or repair purposes
- Schools, Churches, Motels/Hotels and Similar Commercial Establishments

### 3.3 CLASS 3: NON-ESSENTIAL

**3.3.a Ornamental Purposes:**

- Fountains, reflecting pools, and artificial waterfalls

**3.3.b Outdoor Non-Commercial Watering (public or private):**

- Gardens, lawns, parks, golf courses (except greens), playing fields and other recreational areas
- Filling and operation of recreational swimming pools which serve fewer than 25 dwellings
- Non-commercial washing of motor vehicles
- Serving water in restaurants, clubs, or eating places except by specific request
- Air Conditioning: refill cooling towers after draining except as specified in Class 1

## 4 RESPONDING TO A WATER SHORTAGE

If conditions indicate the potential for a water shortage, water system managers and local officials should begin planning to take the following actions as needed.

1. Review your Water Shortage Response Plan. Have circumstances changed significantly since it was adopted.
2. Locate and correct leaks.
3. Explore possibilities for supplementing the water supply. In most cases, finding additional sources should be viewed as a long-range response. In order to avoid last minute attempts to supplement local supply, water officials should consider establishing purchase or exchange agreements with neighboring utilities on a permanent basis. If agreements are feasible, they should be put in place before a shortage occurs.
4. Evaluate if you can discourage unnecessary use by changing the water rate structure.
5. Direct the community to conserve drinking water according to the severity of the shortage, as per your Water Shortage Response Plan.
6. Begin monitoring water supply conditions and the effectiveness of conservation measures. Continue this monitoring throughout the water shortage.

Monitoring supply and demand provides critical information for making timely and appropriate responses to water shortages. At a minimum, the community should evaluate remaining water supplies at current usage and at different levels of reduced use. Once established, monitoring should be continued on a year-round basis to keep officials aware of changing patterns of water use in the community. Publishing available supply and demand data as part of a public education campaign will keep customers updated on changing conditions.

This handbook describes three phases of water shortage response based on the severity of the shortage with the goal of bringing demand for drinking water in line with available supply. The following conservation measures and related activities are suggested for each response phase.

**Voluntary Conservation Phase**

- Inform the public about the potential problem
- Issue water shortage advisory
- Set conservation goals and prepare for decreasing supply
- Request voluntary conservation from all water users

**Mandatory Restriction Phase**

- Inform the public about the problem
- Issue water shortage alert
- Set increased conservation goals
- Ban or restrict all Class 3 (non-essential) uses
- Restrict Class 2 (socially and economically important) uses
- Request voluntary conservation for all other water uses
- Monitor compliance with the ban on use and enforce when necessary
- Increase restrictions as necessary

**Emergency Response Phase**

- Issue water shortage emergency declaration
- Set increased conservation goals
- Ban all Class 3 (non-essential) water uses
- Ban or restrict Class 2 (socially and economically important) water uses
- Request additional conservation from Class 1 (essential) users as may be possible
- Monitor all drought activities, especially compliance with the bans and enforcement
- Enact advanced restriction pricing with fines for overuse.
- Keep the public informed about the increased water shortage severity

Suggested triggers for when to enact the various phases of your water shortage response are

given in the following sections. These recommendations may need to be adjusted based on your specific water supply situation and your experience with your water shortage response program. As a rule of thumb, least essential water uses should be restricted or banned first. The following table outlines recommended response levels for each classification of water use.

**Recommended Responses to Water Use Classes at Different Phases**

| | Voluntary Phase | Mandatory Phase | Emergency Phase |
|---|---|---|---|
| **Class 1: Essential** | Voluntary Conservation | Voluntary Conservation | Additional Conservation as possible |
| **Class 2: Socially or Economically Important** | Voluntary Conservation | Voluntary Conservation / Mandatory Restrictions | Mandatory Restrictions |
| **Class 3: Non-Essential** | Voluntary Conservation | Mandatory Restrictions | Mandatory Restrictions |

## 4.1 VOLUNTARY CONSERVATION PHASE

### 4.1.a When to Institute Voluntary Conservation

The Voluntary Conservation Phase may be a part of a year-round public education program and emphasized during peak summer usage. Do not have more than one voluntary stage. People will either conserve voluntarily or they will not. You can further publicize this voluntary stage when you want to try to increase conservation, but there is no guarantee that you will get it. If not already in place, voluntary conservation should be placed in effect when conditions indicate the potential for water supply shortages. Below are examples on how to relate your supply situation to triggers for a voluntary conservation phase.

**Wells:** A potential shortage for ground water systems is suspected when well water levels begin to drop below normal seasonal levels or when daily pumping times begin to exceed 12 hours to meet demand and maintain water system storage. You may consider requesting voluntary reductions when pumping water levels reach some specified percentage (maybe 40%) of the normal difference between pumping levels and pump depth. For example, if during the periods of peak use there is normally 20 feet of water above the pump intake during pumping consider requesting voluntary conservation when the pumping level reaches 8 feet above the pump intake. Ground water system managers should check and record water levels in their wells weekly and monitor the number of hours each well is pumped daily.

**Streams:** A potential shortage is suspected when extended dry conditions result in persistently low flows in your area. For water systems with run-of-river intakes, voluntary conservation is probably appropriate if streamflows are consistently below seasonal norms and continued dry conditions are forecasted. Streamflows and demands should be assessed at least weekly.

**Reservoirs:** A potential shortage exists when reservoir levels are below normal seasonal levels. Consider requesting voluntary conservation when less than 80 percent of the useable water supply storage remains. For some systems in may be more useful to trigger requests for reductions to the number of days of supply remaining. Water supply storage and demands should be assessed at least weekly.

### 4.1.b What to Do in the Voluntary Conservation Phase

Use this time to increase your public education on water conservation; do not wait until mandatory restrictions are in place. This is the time to give customers the opportunity to voluntarily reduce water use and prepare them for what they may have to do if the water supply situation worsens. If there is not an on-going program start an educational campaign to show how individuals can conserve water. Remind your customers that if voluntary conservation is effective, more severe measures could be delayed or avoided.

In most circumstances, voluntary measures can be expected to reduce water use by only 5 to 10 percent, and is achieved primarily through changes in outdoor water usage. Actual water use should be

closely monitored to determine whether or not the needed reductions are meeting your goals. If not, the need for voluntary conservation should be more strongly emphasized or mandatory restrictions should be imposed.

## 4.2 MANDATORY RESTRICTION PHASE

### 4.2.a When to Declare Mandatory Restrictions

A Mandatory Restriction declaration should be placed in effect when supplies are significantly lower than the seasonal norm and drought conditions are expected to persist. You may want to consider having two stages of mandatory restrictions to provide more flexibility and an additional step in the sequence of increasing restrictions prior to having to implement emergency restrictions. The goal is to bring demand for drinking water in line with available supply to avoid having to move to a higher degree of restrictions. The following explains how to relate your water supply situation to the Mandatory Restriction phase.

**Wells:** Ground water systems should imposed mandatory water use restrictions when water levels in wells drop notably below normal seasonal levels or if daily pumping times consistently exceed 12 hours to meet demand and maintain water system storage. Consider a smaller percentage (maybe 30%) of the difference between pumping water levels and pump depth as a trigger for mandatory restrictions. Ground water systems should continue to check water levels in their wells weekly and monitor the number of hours each well is pumped daily.

**Streams:** Water systems with run-of-river supplies should impose mandatory water use restrictions when demands exceed 50 percent of the estimated streamflow above their intake that is <u>available</u> for water supply. Streamflows and demands should be assessed at least twice weekly.

**Reservoirs:** Water systems with water supply reservoirs should impose mandatory water use restrictions when less than 60% of the useable water supply storage is remaining. If your plan contains two stages of Mandatory Restrictions, the second stage should begin at 50% of useable storage remaining. Water supply storage and demands should be assessed at least twice weekly.

### 4.2.b What to Do in the Mandatory Restriction Phase

During a Mandatory Restriction Phase, mandatory measures should be chosen and implemented by relying first on the least restrictive and least costly measures. Restrictions on specific outdoor uses (such as lawn watering and car washing) usually constitute the most effective initial mandatory measures. However, in order to ensure compliance, customers must fully understand that the restrictions will be enforced. A penalty for violating water use bans or restrictions must be equitably applied and should be graduated for repeat offenders. Enforcement actions may include written warnings, monetary fines, or discontinuation of water service. Educational efforts to encourage water conservation will need to be intensified during the Mandatory Restriction phase. The community should be made aware of impending restrictions and the consequences for noncompliance.

Mandatory measures can reduce system use from 10 to 25 percent, depending on the time of year and how your plan limits water use. Continue monitoring water use to determine the effectiveness of imposed mandatory water restrictions and whether or not more stringent measures are necessary.

### 4.2.c 1st Stage Mandatory Restrictions.

**If this stage is effective, further restrictions may not need to be enacted.** To be most effective this stage should limit or ban everything that is truly not needed. This is where the planning stage pays off, because you should know what is important to your customers and what are the best management practices for certain water uses. By now, your customers should have been educated about conservation during the voluntary stage. This is a mandatory stage, which means it is required. You will need to enforce it. If it is not enforced, it will simply serve to cause strife in your community. Those that follow the rules will be upset if you do not take action against those that violate ordinances. The first stage of mandatory restrictions should affect all customer classes to some degree, but have limited economic

impacts.

**Examples of restrictions**:

- NO outdoor non-vegetative use (residential carwashing, sidewalk washdown, etc.)
- Limit lawn watering to once or twice a week. This is where your best management practices will become important. (Refer to Section 7.1.c) Again, public education is the key. Explain to your customers why it is better to irrigate turfgrass once or twice a week. Explain the possibility of further restrictions later in the growing season and how this current watering schedule will help prepare their lawn for drought and also increase its overall health.

**4.2.d 2nd Stage Mandatory Restrictions**.

**This stage should be severe & simple.** You are now at a stage where you need to conserve water in an attempt to prevent a water shortage emergency. It is best to avoid an emergency phase at all costs. Your public education campaign should have been preparing your customers for this possibility. In addition, the previous restrictions should have been preparing them and their lawns as well. You should work one-on-one with large non-residential water users to encourage and identify water use reduction areas.

**Examples of restrictions**:

- NO outdoor non-vegetative use (residential carwashing, sidewalk washdown, etc.)
- NO lawn watering
- Handheld & drip irrigation only (except for maintenance of nursery stock). This will allow customers to water their vegetable gardens and their important plants. It also allows them to make use of their drip irrigation. This is a benefit to those that have installed drip irrigation and an enticement to others to install it in the future. Again, educate the public about best management practices.
- Specify mandatory reduction targets for non-residential users.

## 4.3 EMERGENCY RESPONSE PHASE

### 4.3.a When to Enact Emergency Restrictions

Emergency measures are required when a water utility is experiencing an extreme water shortage. This section explains how to relate your supply situation to the Emergency Phase.

**Wells:** As pumping water levels approach the level of the pump or if pumping cannot meet restricted water demands, a Water Shortage Emergency should be declared. Pumping water levels as low as the pump intake level should be avoided. Therefore, consider initiating emergency phase restrictions when pumping leaves only 10-20% of the normal difference between pumping water levels and the pump depth. Ground water systems should check water levels in their wells daily and reduce pumping times to allow water levels to recover to above-pump levels.

**Streams:** Water systems with run-of-river supplies should declare a Water Shortage Emergency when demands exceed 75 percent of the estimated streamflow above your intake that is <u>available</u> for water supply. Streamflows and demands should be assessed daily.

**Reservoirs:** Water systems with water supply reservoirs should declare a Water Shortage Emergency when less than 40% of the useable water supply storage is remaining or if deteriorating water quality limits drinking water production below current demands. Water supply storage and demands should be assessed daily.

### 4.3.b What to Do in an Emergency Phase

During an Emergency Phase, more stringent restriction measures are needed. Ban all non-essential uses of drinking water. When water supply shortages reach this level of severity it becomes crucial to as much as possible restrict the use of drinking water to those uses that require water treated to drinking water quality. Emergency pricing measures and additional mandatory restrictions could be used

to significantly reduce drinking water usage. Instituting a significant price increase for water use above the amount required to meet domestic needs can target non-essential uses of drinking water. Consider instituting emergency rates in addition to the conservation rate pricing that should be in affect at all times. Types of pricing practices that should be used include both excessive use penalties and discounts for meeting reduction targets. At this level of water shortage, you will likely have to impose mandatory restrictions on essential water uses. Work closely with essential water users to set realistic goals for reductions while providing public health protection. At this level of severity, it is time to think about how water can be rationed if conditions continue to worsen. Determine the minimum amounts of drinking water needed by various essential uses. Consider the question of who will be shut off last if it becomes impossible to meet minimal essential needs.

Specific criteria for determining the fixed amounts of water above or below which economic penalties or rewards will be imposed must be clearly defined and extremely well publicized. The amount of water allotted to users without penalties can be determined in one of several ways.

- A **flat percentage** requires all customers to reduce water use by the same percentage of their normal use, which tends to penalize those who are already using water conservatively.
- A **variable percentage** requires higher-volume water customers to reduce their use by a greater percentage than lower-volume water customers, which reduces the impact on conservative users and targets more wasteful users.
- Setting **maximum allowable usage** requires customers to limit use to a specified amount.

Flat percentage and maximum allowable allotments are easier to administer. Maximum usage limits are more equitable if applied per person instead of per household. However, it is more difficult.

### 4.4 RETURN TO NORMAL WATER SUPPY CONDITIONS

When water shortage conditions have abated and the water supply situation is returning to normal, water conservation measures employed during the Voluntary Conservation, Mandatory Restriction, and Emergency phases can be decreased in reverse order of implementation. Permanent measures directed toward long-term monitoring and conservation should be implemented or continued. The community will be in a better position to prevent future shortages and respond early to future water shortage conditions.

## 5 CONSERVATION MEASURES

### 5.1 INDOOR USE

#### 5.1.a Conservation Measures During Voluntary and Mandatory Conservation Phases

- Use dishwashers only when they are full.
- Wash only full loads of laundry. Adjust water level if possible.
- Turn off faucets while brushing teeth, shaving, etc. to save about 5 gallons per day.
- Reduce water used per flush by installing toilet tank displacement inserts. A plastic jug may often be used as an alternative. DO NOT USE BRICKS - They disintegrate when soaked and the resulting grit hinders closing of the flap valve, causing leakage.
- Do not use the toilet as a trash can (flushing down tissues, etc.).
- Keep a bottle of water in the refrigerator, so as not to run the tap to get cold water.
- Find and fix leaks in faucets and water-using appliances. Faucets can usually be fixed cheaply and quickly by replacing washers.
- Adapt plumbing with flow-restricting or other water-saving devices. These are usually inexpensive and easy to install.
- Learn to read your water meter so you can judge how much water you use and the difference conservation makes.
- Take shorter showers and shallow baths to save about 25 gallons.

- Do not use a garbage disposal.

**5.1.b Conservation Measures During Emergency Restriction Phase (In addition to measures listed above)**

- Turn off shower while soaping up.
- Use disposable eating utensils.

**5.2 OUTDOOR USE**

**5.2.a Conservation Measures During Normal Conditions and Voluntary Conservation Phase**

**Lawns**

- Water before 10:00 a.m. to prevent evaporation during the hottest part of the day. Morning is better than evening, when the dampness encourages growth of fungus.
- Water only when lawn shows signs of wilt. Grass that springs back when stepped on does not need water.
- Water thoroughly (long enough to soak roots) not frequently (a light sprinkling evaporates quickly and encourages shallow root systems).
- Water slowly to avoid runoff.
- Do not let the sprinkler run any longer than necessary. In an hour, 600 gallons can be wasted.
- Allow a maximum of one inch of water per week on your lawn.
- Use automatic shutoff nozzles on hoses to avoid waste when watering flowers and shrubs.
- Aerate lawns by punching holes 6 inches apart. This allows water to reach roots rather than run off.
- Position sprinklers to water the lawn, not the pavement.
- Avoid watering on windy days when the wind not only blows water off target, but also causes excess evaporation.
- Keep sprinkler heads clean to prevent uneven watering.
- Adjust hose to simulate a gentle rain. Sprinklers that produce a fine mist waste water through evaporation.
- Install automatic shut off devices on automatic sprinkler systems.
- Know how to turn off an automatic irrigation system in case of rain.
- Use an alarm clock or stove timer to remind you to shut off sprinklers that do not have timers.

**Vegetables and Flower Gardens**

- Water deeply, slowly, and weekly. Most vegetables require moisture to a depth of 6 to 8 inches.
- Keep soil loose so water can penetrate easily.
- Keep weeds out to reduce competition for water.
- Put the water where you want it and avoid evaporation by using soil-soakers or slow-running hoses, not sprinklers.

**Trees and Shrubs**

- Water deeply with a soil-soaker or drip-irrigation.
- Water only when needed. Check the depth of soil dryness by digging with a trowel.
- Mulch to reduce evaporation. A 2" - 3" layer of wood chips, pine needles, grass clippings, or straw keeps the soil cool in summer.
- Dig troughs around plants to catch and retain water.
- Water trees growing in full sun more often than those in shade.
- Do not use sprinklers. Apply water directly at the base of trees.
- Do not fertilize during the summer. Fertilizing increases a plant's need for water.
- Postpone planting until fall or spring when there is generally less demand for water.
- Determine the amount of water being used outdoors by comparing water bills for summer and winter.

### 5.2.b Conservation Measures During Mandatory Restriction Phase (In addition to measures listed above)

- Vegetable gardens and food trees should be given a minimal amounts of water on an individual need basis only.
- Do not water lawns and inedible plants.
- Do not use sprinklers.
- Do not allow children to play with hose or sprinklers.
- Limit car washing.
- Be ready to catch rainfall. Place containers under drain sprouts.
- Use leftover household water if available.
- Consider delaying seeding or sodding new lawns.

### 5.3 HEALTH CARE FACILITY USE

- Reduce laundry usage or services by changing bed linens, etc. only when necessary to preserve the health of patients or residents.
- Use disposable food service items.

### 5.4 INDUSTRIAL USE

For equipment connected directly to waterlines, such as processing machines, steam-using machines, washing machines, water-cooled air conditioners, and furnaces.

- Ensure that valves and solenoids that control water flows are shut off completely when the water-using cycle is not engaged.
- Adjust water-using equipment to minimize the amount of water required to achieve its stated purpose.
- Shorten rinse cycles for laundry machines as much as possible; use lower water levels whenever possible.
- Install toilet tank displacement inserts; place flow restrictors in showerheads and faucets; close down automatic flushes overnight.
- Install automatic flushing valves to use as little water as possible or to cycle at longer intervals.
- Enact a Water Conservation Education Program for your employees, students, patients, customers, etc. Educate them on how to conserve. They will be more apt to incorporate conservation both at work and home if they know you are also making amends.
- Check meters frequently to determine consumptive patterns.
- Review usage patterns to determine where other savings can be made.

## 6 PUBLIC EDUCATION

A comprehensive public education program is essential to developing a good Water Shortage Response Plan and implementing an effective conservation program. Reductions in water demand depend on user cooperation and will be more successful if the public is informed about why conservation is necessary, the severity of the shortage, expected response levels, and how they can achieve them. In other words, provide as much information as possible and be specific about how you expect the public to cooperate.

Water utility managers, community officials and civic group leaders should develop a public information campaign that will immediately notify the public about the extent of any water shortage situation. Use local newspapers, radio, and television to inform everyone in the community of the need to conserve water. Any change in the shortage situation or the conservation program should be presented through the same media outlets initially used.

## 6.1 WORKING WITH THE MEDIA

When distributing public information, provide concise, accurate, and current information. If you give out incorrect or misleading information, the public will lose faith in future announcements, which could indicate worsening conditions and require an even greater degree of cooperation.

When preparing press releases, use "plain" language. Remember that the general public will not understand a lot of technical language. Check with your local newspaper for their deadline. If you want to include photographs of local water supplies, ask what format is needed.

Visit local radio stations and ask to meet with the general manager who will probably already be aware of the situation. Stress the importance of the station's role in alerting the public. Suggest that they interview local officials and feature special water shortage reports.

If there is a television station close to your community, they will want to be advised about your local water shortage conditions. Have a story and visual images in mind when you contact them. For instance, the water level in your supply has dropped or your community has made significant progress in water conservation. Invite them to interview local officials.

Regardless of the media outlet, have your facts and figures prepared before you contact them. Provide charts and graphs if possible, and emphasis that their cooperation is very important to the success of your community's education program about the water shortage. Refer to Appendix A for a sample statement to the press.

## 6.2 PROMOTING WATER CONSERVATION PRACTICES

An effective public education program should lead to conservation practices becoming a community project, with all citizens working toward protecting their common water supply. Section 5 contains an extensive list of water conservation practices. These practices should be highly publicized. If you think of other conservation measures specific to your area, add them to your list. If the conservation practices are successfully working, be sure to distribute **positive** press releases and let your community know that they are making a difference.

If the conservation practices are failing to reduce water usage, publicize them more often and explore different methods for distributing the information. Call a town meeting. Ask for suggestions and solicit volunteers to make signs to be placed in local business windows requesting people to conserve water. Include conservation measures on signs. Ask local newspapers to do a series of articles on water issues. These can be very useful educational tools, even when your community is not experiencing a water shortage. If schools are in session, ask teachers to alert children of the need to conserve water. Ask all civic organizations to include the water shortage situation on their program agendas and to stress conservation measures. Work with neighboring communities and exchange ideas and strategies that have worked. All available local resources should be involved in the public information/education program.

Some water conservation practices involve the adjustment of individual behavior patterns, while others simply involve the installation of low-cost water saving devices that automatically reduce the amount of water used on a daily basis. They can be used with minimum disruption to the daily routine, which means they do not require habits to be changed.

## 6.3 COMMUNITY SUPPORT / STAKEHOLDERS GROUP

Public involvement is crucial in water shortage response planning in order to determine the level of risk members of your community are comfortable with when facing emergency water shortage situations. Obtaining community support through a stakeholders' group composed of local government, civic, business interests and members of the public is one option. First, broad involvement in the development of a Water Shortage Response Plan will insure greater public support for its implementation. Second, public education is the key to water conservation and stakeholders will be key to your public education strategy. Potential stakeholder group members include:

- Businesses (especially large water users)
- Industries (both self-supplied and those which purchase from municipal supplies)

- Chamber of Commerce
- Conservation Groups
- Churches
- Professional Groups
- Schools and Civil Groups
- Media Representatives (TV, radio and newspapers)
- Local Health Department Officials
- City Administration
- Local Elected Officials
- Soil and Water Conservation Districts
- Fire Department
- Water System Managers and Operators

Stakeholder groups can help provide information for determining water use classes and water restrictions. Ideally, members will promote appropriate community responses, especially among their own constituents. They can make public appearances and distribute literature and audio-visual materials when available. Finally, if restrictions are necessary, the stakeholders provide a working support base. Members can assist in program implementation, such as organizing volunteers to help install water saving devices or monitor compliance with mandatory restrictions. Moreover, they should serve as a consensus-building group so local decisions have general community support.

# 7 THE WATER SHORTAGE RESPONSE PLAN

A Water Shortage Response Plan should be designed to alleviate difficult judgement calls and allow for an orderly transition between response levels. It describes the classification of drinking water uses, the various phases of use reductions and when restrictions will go into effect. Great care should be taken to get into writing exactly what needs to be done in the event of a drought or other water shortage. Documentation should remain open to revisions. Each community should tailor its plan to local conditions. An adopted Water Shortage Response Plan allows water suppliers and their customers to respond early to avoid the necessity for extreme measures.

## 7.1 KEYS TO A GOOD WATER SHORTAGE RESPONSE PLAN

A Water Shortage Response Plan can be useful regardless of the cause of a water shortage. Drought is the most common need for a plan, but not the only one. With a plan already in place, it can be enacted quickly whenever water shortage occurs.

Treatment and distribution problems, such as line breaks, pressure drops, etc. can cause a supplier to require its customers to restrict water use for a short period of time. Raw water quality problems, for example, can at times reduce the output of the water treatment plant. Your Water Shortage Response Plan can be used in this instance to reduce the amount of water needing treatment. Natural disasters, such as floods, can render a water supplier unable to meet the demand of its customers. If a Water Shortage Response Plan and a public education program are in place, the public can be readily informed and respond appropriately.

There are four specific keys (**Public Involvement, Triggers, Best Management Practices, and Public Education**) to ensuring that your Water Shortage Response Plan is as effective as possible. Each point is described in detail below along with a few typical problems associated with developing a water shortage response plan.

### 7.1.a Public Involvement in Drafting a Plan

The Water Shortage Response Plan will directly affect the public, so it is imperative to know what is important to them. Advertise your intentions for developing a Water Shortage Response Plan. Use water bill inserts or the media to get the word out. Seek public input from each of the water use sectors that will be affected by water use restrictions. Communication will help you understand what types of responses you can expect when the plan is enacted as well as provide assistance developing realistic

restrictions. Section 4 discusses public involvement in more detail.

### 7.1.b Triggers

It is important to trigger water shortage response activities using a measure of water supply that accurately reflects current supply conditions. Each system will have to develop appropriate triggers based on supply options and system characteristics. Section 4 discusses possible triggers for the phased reductions described in this handbook.

### 7.1.c Best Management Practices

The relationship between water use restrictions and Best Management Practices is an aspect of water shortage planning that is often overlooked. Yet, it is very important as far as public involvement and the media are concerned. Your Water Shortage Response Plan should not contradict best management practices.

For example, lawns should be watered at all times in a manner that encourages deep root growth. In other words, a lawn should not be watered too often, since frequent watering encourages shallow root growth. A shallow rooted lawn will not survive a prolonged drought, but a healthy lawn with deep roots is able to withstand a drought by going dormant. During dormancy, a healthy lawn only needs water every three weeks. When the weather brings rain, the lawn will be able to resume normal growth. Best Management Practices should be tied into your plan regarding lawn watering. Once outdoor water use is restricted or banned, it would be better for lawns had they been watered only once or twice a week instead of every other day prior to the drought. Your public education campaign will need to come into play here. Again, a well-informed public can be your greatest asset in times of water supply shortage.

Another example involves the use of drip irrigation. Drip irrigation is one of the most efficient forms of landscape irrigation we have. Drip irrigation should not be restricted until all other efforts have been made at restricting outdoor water use. Customers that have installed drip irrigation know its benefits and efficiency. Restricting the use of drip irrigation as soon as lawn irrigation is restricted, simply because it is a form of automatic irrigation, is contrary to irrigation best management practices and does not encourage customers to invest in efficiency improvements.

Your county Cooperative Extension Service and Soil and Water Conservation Districts can be a valuable resource of information on landscape water use. Involve them when designing your plan for a more efficient use of your water supply. The media, when addressing issues about landscaping and water use during a drought or water shortage, often contacts them. Therefore, their knowledge on the subject will greatly influence the public. If your Water Shortage Response Plan is consistent with best management practices for water use, it will be easier for the public to follow. The Division of Water Resources website (www.ncwater.org) also contains information on landscape water use and many relevant links.

### 7.1.d Public Education Program

Public education is a vital component of your water use policy and water shortage response program. It is essential to make your plan/program as effective as possible. Your public education program should provide meaningful and easy to understand information, beginning with the water bill. Public water suppliers are currently required to submit a Consumer Confidence Report. Therefore, a public education program should already be in place. An important aspect of the public education program is how the specifics of your Water Shortage Response Plan are going to be conveyed to the public. The quicker this can be achieved, the more efficient your shortage response program will be.

Some water systems in North Carolina have instituted year-round water use policies that raise customers' awareness of the need to use drinking water efficiently. Some measures currently being applied are:

- Seasonal Landscape Water Use Restrictions (during peak use months)
- Year-Round Landscape Water Use Restrictions (permanent)
- Automatic Shutoff Requirements for Irrigation Systems (rain gauges/ moisture meters)
- Ban the Irrigation of Impervious Surfaces (forces regular oversight and maintenance)
- Requiring Re-Use Water for Irrigation (where available)

## 7.2 TYPICAL PROBLEMS ENCOUNTERED WITH WATER SHORTAGE RESPONSE PLANS

A Water Shortage Response Plan can have inherent problems that cause it to not work as well as possible. These problems can often be avoided through proper planning.

**Water Shortage Response Plan Problem Areas:**

- **A lack of specific triggers,** or unsuitable triggers to activate the various levels of response. Refer to Sections 2 and 4 for discussions on possible triggers.
- **Plans that are difficult to understand by the public**. The public will not usually read the Water Shortage Response Plan, but the conservation and restriction measures must be easily understood. Even with a great public education program in place, restrictions need to be straightforward for effectiveness. Another aspect of being understandable is proper wording. Restrictions are restrictions - don't try to soften their authority.
- **Inequalities between restrictions on residential and commercial/industrial customers** can cause confusion and resentment among your customers. Do your best to think through how all your different customers can be equitably incorporated into your water shortage response program. Public relations and education will play a vital role in clarifying everybody's responsibility.
- **Water Shortage Response Plans are only as good as their enforcement.** You must give a considerable amount of thought to the warnings and penalties your plan will impose on those who violate water use restrictions. Will you publish the names of offenders in the local paper, increase their water rates, charge a one-time fee for each offense, or require them to donate time for public education? These are only a sampling of enforcement options, be creative in identifying appropriate deterrents for your community.

# APPENDIX A: SAMPLE PRESS RELEASE

DATE:_____CONTACT:_____TELEPHONE:_____

(Community Name) — Due to the abnormally dry weather conditions and the likelihood of continued dry weather, (water system) is asking its customers to conserve water.

[Insert description of situation, such as rainfall compared to normal, lake levels compared to normal, streamflows compared to normal, monthly outlook, etc.]

Voluntary conservation is needed now to ensure water is available for critical uses and to prevent the need for mandatory restrictions. By using voluntary water conservation practices in the home and garden, consumers can cut water use by as much as 10 percent with very little difficulty or inconvenience.

If you have questions or suggestions, please contact:

**Water-Saving Tips**

**Kitchen**
- Eliminate leaks. A dripping faucet can waste 3,600 gallons a year.
- Install faucet aerators.
- Keep a pitcher of cold water in the fridge instead of running water until it is cold.
- Do not leave the water running while rinsing dishes.
- Only use the dishwasher with full loads, and use the “water-saver” setting, if available.

**Bathroom**
- Don’t leave the water running while shaving or brushing teeth.
- Install a water-filled plastic jug or a “toilet tank bag” in your toilet tank to reduce the water used per flush. Do not use a brick, which may crumble and prevent the flapper from closing properly.
- Check for leaks by dropping a small amount of food coloring in the toilet tank. If color appears in the bowl, you have a leak.
- Take shorter showers.
- Install water-saving showerheads.

**Outdoors**
- Water in the morning or evening, not in the heat of the day, to prevent evaporation.
- Avoid watering on windy days.
- Water slowly & thoroughly to promote deep roots and healthy plants.
- Water close to the roots of plants so that there’s little waste and evaporation.
- Add compost and other organic matter to your soil to improve its water-holding capacity.
- Choose plants that don't require a lot of water.
- Mulch all plant beds to reduce evaporation, weeds, and soil temperature.
- Limit car washing. Use a bucket and a hose with spray attachment.
- Use a broom instead of a hose to clean driveways and sidewalks.

## APPENDIX B: SOURCES OF ASSISTANCE

| Agency | Telephone | Assistance |
|---|---|---|
| NCDENR<br>Division of Water Resources<br>www.ncwater.org | 919-733-4064 | Monitoring and Assessment<br>Raw water supply<br>Leak detection<br>Water audits |
| NCDENR Regional Offices - (see map)<br>Division of Environmental Health<br>Division of Water Quality<br>Asheville<br>Mooresville<br>Winston-Salem<br>Raleigh<br>Fayetteville<br>Wilmington<br>Washington | <br><br><br>828-251-6208<br>704-663-1699<br>336-771-4600<br>919-571-4700<br>910-486-1541<br>910-395-3900<br>252-946-6481 | <br><br>Water treatment<br>Raw water supply<br>Health hazards<br>Water quality |
| NC Div of Emergency Management | 919-733-3867<br>1-800-858-0368 (24 hr) | Emergency needs |
| NC Rural Water Association | 336-731-6963 | Leak detection<br>Water audits |
| US Geological Survey | 919-571-4000 | Monitoring and Assessment |

### NC DENR REGIONAL OFFICES