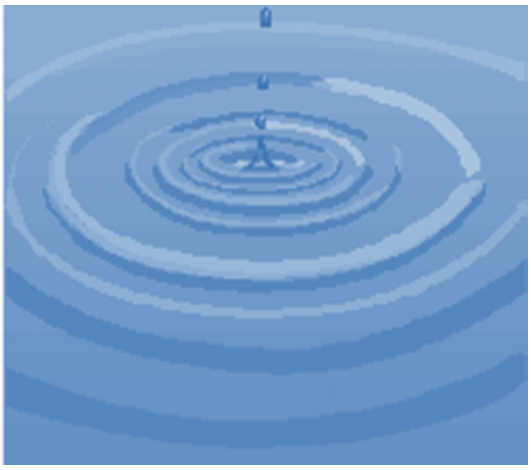
# The North Carolina Wellhead Protection Guidebook

## Developing a Local Wellhead Protection Program




**Developed by:**

**NCSU Water Quality Group**
**Department of Biological and Agricultural Engineering**
**North Carolina Cooperative Extension Service**
**North Carolina State University**

**North Carolina Department of Environment and Natural Resources**
**Division of Environmental Health**
**Public Water Supply Section**



**2003**

# Table of Contents

# Introduction

## What is wellhead protection?

Wellhead protection (WHP) is the process of managing the land area around your well to prevent contamination of your water supply. The State's WHP program is designed for communities that want to protect their drinking water. This program is administered by the Public Water Supply (PWS) Section of the North Carolina Division of Environmental Health. A key feature of this program is that each community develops its own local WHP program, based on local conditions and priorities.

In North Carolina, each community uses state guidelines to develop its own local WHP program, but members of the community decide which specific actions are the most important for protecting their own water supply. Therefore, both public participation and technical guidance from the state are important for developing a good program. Specifics of the local program are detailed in a WHP plan which the community submits to the state for review and approval.

The goal of WHP is to prevent contaminants from entering your public water supply wells. This is accomplished by identifying and managing potential sources of contamination that may impact your drinking water supply. The plan will identify a protection zone around each well called the WHP Area (WHPA). The WHPA is the area surrounding your public water supply well through which contaminants are reasonably likely to move toward and reach your water supply well. The WHP plan should also identify ways for the community to manage activities in the WHPA to minimize the risk that the water supply will be contaminated in the future. Contingency plans are also included so that corrective actions can be taken quickly in case of accidental spills or other emergencies.

This guidebook will lead you through the steps of developing a WHP plan that addresses local needs and also meets state standards.

This guidebook will lead you through the steps of developing a WHP plan that will help you protect your community's drinking water and meets state requirements for approval.

### *Why it is important*

Because many people do not understand where their well water comes from, they often take it for granted. However, well water can become contaminated more easily than many people realize. The well your community currently depends on may not be able to provide an adequate supply of clean drinking water in the future.

The ground water that supplies your community's wells ultimately comes from rain and snow. This water seeps into the ground and moves toward your community's wells. Sometimes, pollutants can also seep into the ground and enter the water. In recent years, there have been many stories in the news about people who became ill because of contaminated water, or whose homes lost their value because of a contaminated private well. Wellhead protection is a preventive program to help maintain the quality of public drinking water supplied by wells. Wellhead protection planning is one way to help ensure that your community has a long-term source of clean water.

Wellhead protection is an investment in the future of your community. Your community can take a proactive step toward reducing the likelihood that your community's wells will become contaminated.

Developing a local WHP program allows your community to put its own decisions into action. Your community can tailor the local WHP program to meet its specific circumstances and goals. The best time to plan the future of your community's water supply is now, before there is a problem.

Wellhead protection is cost effective. A modest investment in a local WHP program can save a community tens to hundreds of thousands of dollars later, by preventing contamination. If your well becomes contaminated, your community may face costs associated with more frequent treatment of the water to meet drinking water standards, cleaning up the ground water, drilling a new well, and providing an alternate source of water to customers. There may also be less direct costs, such as temporary shutdowns in businesses and industry that rely on the water, or outbreaks of waterborne illness.

By developing a local WHP program, your community can put its own decisions into action.

Wellhead protection fosters a positive climate for economic growth. A community with an active WHP program can avoid the adverse economic impacts of a contaminated water supply, which could lead to a loss of jobs or falling real estate values. Both current and future residents and businesses will know that efforts are being made to ensure a safe, adequate water supply well into the future. Other aspects of community planning may also benefit from the knowledge gained through the WHP planning process.

Because of its long-term economic benefit, the state also considers the presence of an approved WHP plan when awarding loans and grants to local governments for water and wastewater improvement projects. When a local WHP program is in place, the state knows its investment is going to a community that is less likely to face the financial impact of a contaminated water supply. Therefore, the current system for determining which communities get water and wastewater improvement loans and grants awards "priority points" to those communities with state-approved WHP plans.

# How to use the guidebook and develop your plan

*"I would say to any town that's small like ours that this is the best thing they can do. Because we had our WHP plan, the extra points put us high enough on the list to get funding for our new sewage treatment plant. Without the points, we wouldn't have been awarded the funds, and our tax base is too small to handle it ourselves. I would advise any small town to do Wellhead Protection."*

This Guidebook has been prepared by the State of North Carolina to help your community develop a local WHP program that satisfies state requirements and meets your community's needs. Each chapter of the book corresponds to a step in preparing your WHP plan. When you have completed these steps, you should have a comprehensive WHP plan that is tailored to your community and is ready to submit to the state for review and approval.

At the end of this introduction, you'll find a checklist to help you track your progress. You should complete the steps in order, because the information from each one is needed for the next. Also, notice that after you first determine the WHPA, you may want to submit it to the state for approval prior to completing the remaining steps. This is for your benefit. If the area needs to be revised, you can correct the boundaries before doing a lot of unnecessary work.

Each chapter has the following format, leading you from the beginning of the step to preparing the related part of your final plan. This includes:

- a description of the step and its purpose;
- information that will help you carry out this step;
- a list of additional resources that may help with this step;
- a checklist of items to be completed and included with your plan as a result of this step; and
- examples of the language that you may use when writing your plan.

In addition, a sample plan has been prepared for the fictional Town of Clearwater. The part of the plan that results from a given step has been included with that step. In some cases, examples are provided for various circumstances that may occur in different municipalities or in different parts of the state, and you can choose any that apply to you. When possible, a form or template has been provided so that you can fill in the information about your community, and then include the completed template in your plan.

The chapters correspond to the main activities that must be carried out to develop a WHP plan and obtain state approval for it. The following paragraphs provide a brief description of those steps.

## Step 1. Forming a Planning Team

The most successful programs include public involvement from the earliest stages. Volunteers also reduce the workload for public works personnel. This chapter gives suggestions for identifying those people who should be included: those who will carry out the plan, those who will be affected by it, and those who will have the most impact on future water quality.

## Step 2. Delineating the Wellhead Protection Area (WHPA)

The first step for the planning team is to identify the land area that will need to be managed to protect your community's water supply. This step involves collecting basic information including yield, depth, pumping period, and source of supply for each well. The water pumped from a well passes through the surface and subsurface land surrounding the well. This area, which may extend up to thousands of feet from the well, is called a Wellhead Protection Area (WHPA). The goal of delineation is to determine this area as accurately as possible. Methods that have been approved by the PWS Section for determining the size and shape of the WHPA are provided.

## Step 3. Potential Contamination Source (PCS) Inventory

Once the WHPAs have been delineated, the next step is to identify and locate all potential contamination sources (PCSs) within these areas. A PCS is any substance or activity which could lead to the contamination of the ground water. There is a broad range of possible sources of contaminants, and they will be different for each community. Examples include such things as industrial or agricultural chemical storage and use, a highway or railroad track where accidents could occur, underground and above-ground petroleum storage tanks, and residential septic tanks. The purpose of the PCS inventory is to understand the nature and magnitude of potential threats to water quality and human health. The inventory must be as thorough and complete as possible.

Once the PCSs contained within the WHPAs are identified, they will be ranked in terms of relative risk to each public water supply well. In this way, the most serious concerns can be given priority, and limited resources can be applied to these first.

This chapter includes lists of PCSs to look for, ranking methods, and detailed instructions concerning the development of a PCS inventory.

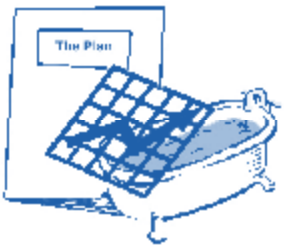
## Step 4. Management of PCSs

Once the area to be protected has been delineated, and the PCSs in it have been identified, the next step is to develop strategies for keeping contamination from entering the water supply. The planning team must decide upon methods for managing any threats that were identified in the PCS inventory. Some PCSs may not be a significant threat and may not require management. Others may not require active management because they are already regulated and monitored under existing federal and/or state programs.

Examples of management strategies for many common PCSs are provided. These include both regulatory strategies (such as zoning or use permits) and non-regulatory strategies (such as education or household hazardous waste collection). The local planning team must decide what methods are appropriate in each WHPA. Public water system suppliers that have no regulatory authority must submit a plan for adequately managing any area they own around their wells.

## Step 5. Contingency Plan

A vital aspect of a WHP plan is a contingency plan. A contingency plan ensures that a community has an alternative water supply if the primary source is contaminated. This chapter guides the planning team through the development of both short-term (less than 48 hours) emergency response plans and alternatives for long-term (when the source is permanently impaired) plans.




## Step 6. Implementing and Updating the WHP Plan

When the plan is submitted, it must include a timeline for putting it into action. Once a wellhead protection program is in place, continued administration of the program is necessary in order for it to be successful. Administration includes the establishment of WHPAs for new wells, periodic well and well site inspection, periodic updating of PCS inventories, and the review and revision of WHP plan management strategies.

## Step 7. Submitting the Plan

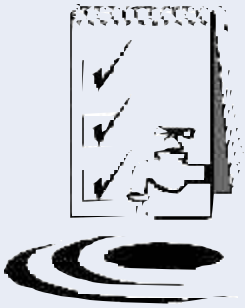
This guide includes instructions for preparation of the plan within each chapter. The finished plan is sent to the PWS Section, as instructed in this chapter. After the PWS Section reviews your WHP plan, it will be returned to you with suggestions for revisions, if needed. When the submitted plan is satisfactory, you will receive a letter of approval.

# References

*Why do Wellhead Protection? Issues and Answers in Protecting Public Drinking Water Supply Systems.* May 1995. EPA 813-K-95-001. Office of Water, U.S. Environmental Protection Agency, Washington, DC.

*Wellhead Protection Programs: Tools for Local Governments.* April 1989. EPA 440/6-89-002. Office of Ground Water Protection, Office of Water, U.S. Environmental Protection Agency. Paper, 50 pages.

# Progress checklist for WHP plan approval



| Check when completed | Step in WHP plan approval process |
|---|---|
| _____ | **1. Form a Planning Team**<br>Identify participants<br>Identify resources<br>Identify goals |
| _____ | **2. Delineate WHPA: Define the area to be protected**<br>*Submit WHPA Delineation to public water supply<br>*Obtain approval of WHPA before proceeding |
| _____ | **3. Conduct Potential Contamination Source Inventory**<br>Collect physical data for each WHPA<br>Develop a preliminary inventory map of each WHPA<br>Conduct a windshield survey<br>Contact landowners<br>Complete inventory map for each WHPA and a questionnaire for each potential contamination source |
| _____ | **4. Develop Management Strategies** |
| _____ | **5. Develop a Contingency Plan** |
| _____ | **6. Prepare timeline for implementing and plans for updating WHP plan**<br>(including provisions for any new wells added to system) |
| _____ | **7. Submit completed plan**<br>Revise and resubmit if necessary<br>Implement and update |

*Recommended

# 1 Step 1: The Planning Team

## Introduction: what this step is about

The first step in developing your Wellhead Protection (WHP) plan is to form a planning team that will guide the project from beginning to end. Later, this same group of people may help put the plan into effect, after it has been approved.

### *Why have a planning team?*

The most successful programs include people representing citizens from across the community, beginning with the earliest stages of planning. Involvement in planning gives participants a sense of ownership in the program. The more people who believe in the program and care about its success, the better the chances are that the plan will be carried out as intended.

In many small communities, the public works department may not have the staff to develop a good WHP plan within a reasonable time frame. A planning team can share the workload, delegating tasks among members according to their skills and access to resources. Team members may also be able to recruit new volunteers and obtain resources for meeting additional needs as they arise.

Many agencies, organizations and individuals are already involved to some degree in water quality protection. Although the primary agency is the Wellhead Protection Program Office of the Public Water Supply (PWS) Section, NC Division of Environmental Health, others may also have information that is important to your community. Inviting representatives from a broad range of these related state and local groups to participate in developing your WHP plan will help to coordinate resources and enhance the success of your program in the long run.

Planning team members can be vital in gaining public support for the WHP effort. They will provide opinions that represent the citizens you serve. They can also help with educational efforts to reach the whole community throughout your WHP planning process.

Many other people in your community have a role to play in water quality protection, too. Some of them should be included on your planning team. It makes sense to include those persons who will be involved in implementing the plan, such as municipal utility employees. Also, those persons who will be affected by the plan, such as local emergency responders, should contribute their perspectives.

*The state requires public participation for the WHP plan to be approved.* This requirement is in the best interest of your community. People who are directly and locally involved can provide the best guidance for the development of the plan. It is important to take advantage of the knowledge and expertise that exist within your community. Also, bringing in representatives from different parts of the community provides the most complete community perspective. It will also be easier to deliver information to the public and get community support when representatives of various groups are already active in the process. This can determine whether the public "buys in" to the plan; whether as many groups as possible accept the plan and its goals; and whether the public cooperates with the plan's management strategies.

## Assistance is available

*One manager of a very small community put it this way: "I would suggest that people contact the Rural Water Association. They're excellent people to work with, and they made a big difference for us." Another added, "Neither could have done this alone: we needed their expertise for some of the technical parts, and they can't do it without the knowledge of the local people."*

This document contains the instructions your planning team needs to prepare a good WHP plan. There is no requirement for an engineer or other consultant to be involved. However, since many communities do not have experience with this kind of project, many have found it helpful to talk with a professional consultant. The North Carolina Rural Water Association (NCRWA) provides consultants at no charge to PWS systems. Rural Water Association consultants are experienced in all aspects of developing and preparing a WHP plan. They can help with activities described in the following chapters that may be unfamiliar, such as determining the area around the well that needs to be protected and searching electronic databases for potential contamination sources. The NCRWA consultant can also recommend management strategies that have been successful for other public water supplies. Your planning team can choose what assistance, if any, you need from NCRWA. The address and telephone number for contacting the NCRWA are in the Resources and References section at the end of this chapter. Private consulting firms also have qualified consultants who can be hired to help develop a WHP plan, but this is usually more expensive. You may wish to contact other public water supplies who already have an approved WHP plan (see the "Resources and References" section), and ask about their experiences with the consultants they used.

# Procedure: what you need to do to complete Step 1 toward your WHP plan

Identify the organization that will provide leadership and be responsible for the plan. This can be the water utility, town planning board, etc. Then, add other community members to the team. You will need to choose one person to lead the team and stay in contact with the consultant and the PWS Section.

## *Forming the planning team*

### Represent all stakeholder groups on your planning team

The word "stakeholder" is used to describe anyone who "has a stake in," or has some interest in, the results of this WHP plan. The membership of your planning team will depend on the number and variety of stakeholder interests in your town. That includes anyone who uses the water for drinking, agriculture, business, or industry. It also includes anyone who plays a role in the operation and administration of the water utility. It is important to identify all stakeholders and include them in planning. If the support of different groups is not obtained in the planning stage, you may meet resistance when you try to implement the recommended strategies. This can result in delays in implementing the plan, as well as loss of confidence in the program.

### How do we identify stakeholders and candidates for the planning team?

*Advice from others' experience that might be considered: "Include your [WHP plan's] worst enemy on your committee. Find the person who is most likely to fight this later, and include them from the start. If you can sell them on it, everyone else will be easy."*

Possible committee members could include representatives of the water utility, local officials, farmers, business representatives, members of service organizations, and interested citizens. Examples of the various groups in your community that could be represented on your team are shown in the figure "Community Roles" on page 4. Remember that these are only suggestions to give you ideas; you are the best source of information about people in your own community.

Some users who have not been directly involved in water quality issues in the past may have a strong interest in the water supply, such as a hospital or food processing plant.

Be sure to recruit opinion leaders from the community. Sometimes these individuals are not in official leadership positions, but they may have a lot of credibility with neighbors and friends. They will help you reach different groups within the community, facilitating their participation or cooperation.

Don't forget to look beyond your service area, too. In some cases, the utility does not have legal authority over the area that needs to be protected. For example, this would be true if the WHPA extends outside the legal boundaries of your municipality. In these cases, invite representatives of the relevant governing bodies to be on the planning team.


Water Supply Providers
- City manager
- County manager
- Water systems manager
- Other public works employees who will be involved in implementing the plan

Local Government
- Planning department or board
- Elected officials
- Emergency response planner
- Fire department
- Budget and/or Finance Office
- Economic Development Office or Commission
- Public Information Officer

Economic Interests
- Developers
- Realtors
- Bankers
- Chamber of Commerce
- Agricultural representatives
- Industry representatives

Expert Advisors
- Water quality expert, such as NCRWA consultant
- Legal counsel
- Health/Environmental Health Department
- State agencies (DEH, DWR)
- Medical representatives

Community Groups
- Residential water users
- Private well and septic system users in the protection area, after it is determined
- Landowner groups
- River Basin associations
- Service organizations
- Civic, ethnic or religious leaders

Other
- Media
- Representatives from neighboring local jurisdictions
- Councils of government
- Small community water supply owners

**Community Roles—people to consider for the planning team.**

*"We didn't get much response from the public when we put out announcements about the Wellhead Protection Plan early on. Then, when we started contacting businesses in the Wellhead Protection Area, they didn't understand what it was about or why we were doing it.*

*At first, they assumed we were telling them they couldn't run their business. There was a lot of defensiveness. Once we talked to them and they understood why we were doing this and what we were really doing, everything was fine. Looking back, it would've been better if we invited some people from the community in at the beginning, so they would know why we were doing this, and they could have told their neighbors."*

## What will planning team members do?

Members of your planning team may serve for the entire planning process; or they may be brought in for a short time, for a specific purpose. When you select planning team members, think in terms of the roles that different organizations and individuals can play. A wide variety of skills can be useful in developing your plan, and then in implementing it later. See "What can planning team members do to help?" on page 5 for examples of activities that team members could carry out. The items listed may also give you ideas about people who would be valuable members of the planning team.

Attachment 1 is an example of a letter that might be used to invite potential planning team members to join.

As you work together, you'll quickly see that this group of stakeholders, the planning team, actually represents a cross section of public opinion. The members will provide direction and insight into the public education and public relations needs in your community.

## What can planning team members do to help?

There are many ways to educate the public and raise the profile of wellhead protection, and many ways that individuals can contribute to the planning process itself. Below are examples of activities that may occur in various stages of the planning process. Not all of them will be appropriate in every community. You may think of others as you clarify your own needs and goals, and others will be determined by the membership of your planning team.

### Information gathering

- Search public records for past ownership and land uses.
- Search computer databases for known contamination incidents.
- Assist with survey for potential contamination sources.
- Interview senior citizens about previous land uses.
- Document current water use, facilities, and sources, including well and pump specifications.
- Document anticipated future water use, facilities, and sources.
- Document current emergency response procedures
- Inventory existing resources for protecting your water supply.
- Contact Cooperative Extension or retail outlets for information about agricultural chemical use.
- Conduct surveys to assess the community's education needs, identified problems, and perceived needs regarding the drinking water supply.

### Resource gathering

- Meet with local business and industry to arrange public/private partnerships, financial assistance, or in-kind contributions such as graphic arts services and printing.
- Recruit volunteers as needed.
- Obtain assistance from groups with common interests, such as a science class at a nearby community college.
- Learn what educational materials are available from your county Cooperative Extension Center and the American Water Works Association, NCRWA, or other organizations with an interest in water quality.
- Order pamphlets from the EPA.
- Obtain support from other municipal departments to coordinate efforts, such as inclusions with monthly bills.

### Education and outreach

- Prepare public service announcements, fliers, fact sheets, doorknob hangers, and other informational materials to reach the public. Prepare wall murals, public bulletin boards, and displays at public libraries (or invite a youth organization to do this).
- Adapt printed materials to target all segments of the community (for example: translating into Spanish, or rewriting for different educational levels).
- Create a web site.
- Provide public speakers who can present a program about WHP and related topics such as underground fuel tanks and septic system maintenance to interested groups.
- Coordinate with town recreation department, Scout troops, 4-H, or schools for art or essay contests, and other educational activities about drinking water protection and conservation.
- Meet with area environmental groups to obtain their support and assistance, and to coordinate efforts.
- Invite the local newspaper to cover planning team meetings. Prepare press releases. Ask the paper to run a series of articles about the source of your drinking water, ways it can be contaminated, and what citizens can do to help.
- Celebrate National Drinking Water Week or Day with a Water Awareness festival. Participate in other local celebrations and festivals, household hazardous waste collection days, or other one-time events that provide an opportunity for publicity.
- Make personal contact, such as one-on-one visits and phone calls.
- Publicly express appreciation for assistance from volunteers and elected officials.

### Administrative tasks

- Schedule and reserve meeting rooms for planning team and public meetings.
- Submit meeting announcements to media and public events calendars.
- Prepare meeting agendas.
- Collect public comments, distribute to team members to provide prompt feedback, and thank senders for their input.
- Prepare regular updates for team members, to keep them informed and motivated.
- Type! A member with computer and word processing skills can prepare your plan for submission to the PWS Section.

# Getting started

Here are some suggestions for your team, based on the experience of others.

## Understand the existing conditions

Before beginning to plan for the future, the planning team should have a clear understanding of the way its water supply system works and the WHP plan process. Even if members consider themselves knowledgeable, bringing everyone to the same starting point can help the team function smoothly later on.

*A comment resulting from the experience of one community:*

*"Focusing on goals that protect the ground water in a voluntary rather than a regulatory manner has been essential."*

It can be helpful if a member of your local water utility explains your system to the members of the planning team who are not familiar with it. Also, the NC Cooperative Extension service has excellent publications on wells and how they work. It can provide a demonstration to your planning team, using a ground-water model that shows where well water comes from. Contact your local county Cooperative Extension Center for more information.

The team also needs to understand the process they are about to begin: preparing the WHP plan and obtaining approval for it. NCRWA consultants will be glad to meet with you and discuss the WHP program. Representatives of the PWS Section can also provide information.

## Set initial goals and priorities

At an early meeting, the team should determine its initial goals, establish time frames, and define clear objectives for measuring progress. Other goals will not be determined until later, when the team has more information about the problems and needs in the WHPA.


The team will need to decide how to evaluate local needs and establish local protection program goals and priorities. Is your goal only to maintain the quality of your water supply, to keep it from degrading over time? Could your goal be to *improve* the quality of your water, thereby reducing treatment costs? While completing the steps that lead to your WHP plan, you will get a better idea of exactly what you want and need to protect, and what local conditions need to be addressed. Any conflicts with existing goals in other community projects can be identified and resolved. Each community is unique. If the committee agrees on an overall philosophy toward the program and specific protection goals early in the process, this will help guide later decisions, priorities, and commitments.

Clear goals help groups understand and make progress toward water quality protection efforts. When these goals are stated clearly in a way that relates to your community, they can help the general public, elected officials, business, the press, and community leaders understand and support your efforts.

Some groups find it helpful to organize their work in terms of visions, goals, and action items. This approach is described in "Organizing goals" on page 7.

**A. Visions** – Broad, general statements of where the group/planning team wants to go and what it will accomplish over a given time span (usually several years).

Visions should be comprehensive enough to capture the thrust of the effort's overall mission. In this case, your overall mission is to prepare your WHP plan and obtain approval for it. However, this is an opportunity for your community to think about what it wants 10 or 20 years down the road. If your community already has a vision of preserving open space, this can affect choices you make regarding land around the well.

**B. Goals** – Less general than visions, goals describe what is needed to achieve your vision, refer to components of the overall effort, and sometimes contain specific measurements or dates.

An example of a goal could be, "Obtain the cooperation of the local media to provide information about WHP and the planning process."

**C. Action Items** – Explain who is going to do what, where, and when. They generally state the way the goals will be carried out and should be quantified if possible.

Action items related to the goal of establishing a relationship with the media could be:

- "Jane Doe will contact the local print media outlets such as newspapers, and Bill Smith will contact television and radio stations, explaining the WHP plan to each of them."
- " The secretary will keep track of any requirements, deadlines, etc., that must be met when submitting articles and announcements."

**Organizing goals. This framework is used by many groups to help organize a large project they are about to undertake. It is provided as an example, and you may find it helps the process go more smoothly. Completed goals provide something a committee can point to that demonstrates its progress to others.**

## Establish a timeframe for the planning process


The time each activity takes will depend on the nature of your water supply system, and the goals your planning team sets. Researching the properties and potential contaminant sources in the WHPA usually takes a long time. Other activities, such as public education, take place throughout the planning process, and continue into the future. It may seem difficult to set deadlines at this point, but a schedule helps people complete tasks in a timely manner and keeps the process moving.

The planning team will need to meet regularly throughout the planning process. As you learn more about your WHPA, the planning team can make more decisions about the plan and set additional goals.

# *Begin Public Awareness, Education, and Outreach*

Public education and involvement are key to a successful WHP program and are important from the beginning of the planning process through implementation of the final plan.

### Why are public education and involvement so important?

First, ground water is hidden underground, people can't see it, and, for the most part, they don't understand it. When people learn about ground water, they are then able to understand and become concerned about it. As they become more aware of it, they often care more about it.

Second, many myths and mysteries are associated with ground water. Misinformation can lead policy makers to bad decisions.

Third, ground water is frequently taken for granted. It is commonly thought that ground water is always pure and safe. Few people understand the connection between ground water and the land. It takes some time to shift the public's perception toward a more accurate view of ground water. Until this happens, people don't realize the ways they can change their actions to help protect the water.

### Important messages for the public


Important Message for the Public About Ground Water

One very important educational message is that ground water is a relatively inexpensive source of supply *if it is clean*. If ground water can be used for drinking water, this is much less expensive than developing and producing a surface water supply. Treatment and distribution are also typically less costly for a ground water source than for a surface water supply. However, once ground water has become contaminated, it is an extremely expensive resource to clean up (see Resources and References section). Clean up, if possible, can cost millions of dollars. There is also the cost of providing an alternate water supply, even if only for a short time. Protection is much less expensive than remediation. That is a very simple message, but it is often overlooked.

Another very important educational message is explaining how the public can help to keep its drinking water clean. People are often glad to cooperate when they understand where their drinking water comes from, and how their activities can affect it. People are more likely to support your efforts if they understand what you are trying to do and its benefit to their lives.

### Communication goes both ways

Begin building your support early, by carrying the message to all parts of the community through the members of your planning team. This allows you to get feedback during the plan development process, when it is easier to make changes.

## *Monitor progress*

Include in your goals and timetable opportunities to evaluate your progress. Take stock of the different activities involved in the planning process and be sure they are all moving forward.

Let the community know about your accomplishments!

# Resources and References

- PWS Section, Division of Environmental Health, North Carolina Department of Environment and Natural Resources:

  Gale Johnson
  Public Water Supply Section
  Wellhead Protection Program
  1634 Mail Service Center
  Raleigh, North Carolina 27699-1634
  (919) 715-2853
- NC PWS Section website, including link to list of public water supplies with approved plans:
  http://www.deh.enr.state.nc.us/pws/
- North Carolina Rural Water Association (NCRWA)
  (336) 731-6963
- North Carolina Cooperative Extension Service
  Contact your local county Extension center, listed in the telephone directory, or go to http://www.ces.ncsu.edu/ and choose "County Centers" to find yours.
- The EPA has many publications describing different ways that citizens can become involved in ground-water protection. Some of these publications describe citizen activities in other communities.
- The documents below can be ordered through the National Center for Environmental Publications:

  U.S. EPA/NSCEP
  P.O. Box 42419
  Cincinnati, Ohio 45242-0419
  Phone: 800-490-9198
  http://www.epa.gov.ncepihom/

  If the document is also available on the internet, the address is provided with its description.

*Protecting Local Ground-Water Supplies through Wellhead Protection.* May 1991. EPA 570/09/91/007. Office of Water, U.S. Environmental Protection Agency. Paper, 18 pages.

## Case studies from other communities

*Case Studies in Wellhead Protection: Ten Examples of Innovative Wellhead Protection Programs*. 1992. EPA 813-R-92-002. Office of Ground Water and Drinking Water, Office of Water, U.S. Environmental Protection Agency. Paper, 38 pages. Online at http://www.epa.gov/ogwdw/Pubs/02ground.html

Top 10 Watershed Lessons Learned, EPA840-F-97-001: what works and does not based on past experience. Although these experiences were collected during community surface watershed management efforts, much of this can be applied to WHP as well; online at http://www.epa.gov/owow/lessons/EPA information for educators and children; online at http://www.epa.gov/safewater/kids/

## Attachments

At the end of this chapter, you will find attachments to help you prepare your plan document.

Remember, the attachments that are labeled "Example" are only here to give you ideas.

- **Attachment 1: Example of an invitation letter**
  You do not need to use an invitation letter when you create your Planning Team. However, if you do want to invite people in writing (for example, to create a permanent record documenting your actions), you are welcome to use any or all of the language shown in the example.
- **Attachment 2: Example of a partial plan, showing the portions of the plan that result from this step**
  The Example Plan shows you the kind of information that you are expected to include in the plan that you submit for approval. Your final plan will be different from the fictional Town of Clearwater plan that is provided as an example. Your planning team will be composed of the community representatives you choose, and may have more or fewer members than the team shown in the example. You will have your own goals and needs, and you will use the most effective ways to reach the public in your community. Therefore, you are not expected to use all of the exact wording that is shown in the Example. On the other hand, if any of the specific language in the Example also applies to your community, then feel free to use that language in your plan.

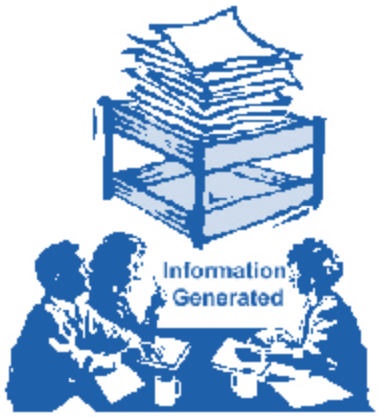
Attachments labeled "Template" are pages that are to be filled in and included with the plan you submit. These pages are also available as Microsoft Word files.

- **Attachment 3: Template for cover sheet**
- **Attachment 4: Template for planning team list**

# Products that should result from Step 1, to be included with the final plan:

When you have finished this step, you should be able to complete the following items:

1. Fill in the following attached templates. These will be part of the plan that you submit to the PWS Section for approval.
   - Cover sheet (Attachment 3), identifying your public water supply and the contact person for the WHP plan
   - Planning team roster (Attachment 4), listing the individuals and the positions they will serve on the team
2. Begin preparing the plan document. It must contain the following information:
   - Statement of initial goals and tactics for achieving them
   - Statement identifying the persons, job position, or group (for example, the Town of Clearwater Board of Commissioners) responsible for implementing the WHP plan
   - Schedule for preparing plan (dates can be filled in prior to submission)
   - Schedule of planning team meetings (dates can be filled in prior to submission)
   - Actions taken or planned for involving the public



# Attachment 1: Sample Planning Team Invitation

Dear :

The Town is forming a planning committee to prepare our local wellhead protection (WHP) program plan. You have been identified as someone who has an interest in protecting our water supply. We invite you to be a member of our planning team.

We depend on our public water supply system to provide clear, clean drinking water when we turn on the tap. Our community's water supply comes from wells, and many of us have taken for granted that well water is safe. However, in recent years many communities have experienced contamination of the ground water that supplies their well. The State of North Carolina has a *voluntary* local WHP program. The goal of wellhead protection is to prevent contaminants from entering public water supply (PWS) wells by managing the land that supplies water to the wells.

We will be developing our own local WHP program according to local needs using guidelines provided by the state. Members of our community will determine the specific activities that will most effectively protect our own water supply. For this reason, public participation will be just as important to the project as technical assistance.

This is an excellent opportunity for us to protect our public drinking water supply, for our children and for the future of Clearwater.

There is an additional benefit to the taxpayers of Clearwater. The state grant and loan system uses a point system for setting priorities to decide which local governments receive funding for water and wastewater improvement projects. After our local WHP program is approved by the State of North Carolina PWS Section, the Town will be eligible for additional priority points should it apply for state grants and loans in the future.

Meetings will be held throughout the next several months. If you are not interested, but know of another individual who might be, please forward their name to us.

Please return the enclosed form at your earliest convenience. If you have any questions, please contact the town hall at...

**Town of Clearwater**
1 Main Street
Clearwater, NC

***Attachment 1, Page 2 (continued)***

Please indicate your level of interest in the local WHP program planning process by checking the appropriate box(es) below:

- ☐ I am interested in serving on a WHP planning committee.
- ☐ If requested, I will attend the first planning committee meeting on [DATE].
- ☐ I am not interested in serving on an advisory committee, but would like to remain on the mailing list to receive information pertaining to the local WHP program planning process, such as announcements of public meetings and proposed plans.
- ☐ Please remove my name from the mailing list.

Please provide the following information:

Name: _____

Organization Affiliation/Representation: _____

Address: _____

_____

Phone Number: _____

Fax Number: _____

E-Mail Address: _____

Please submit this form by [DATE]

## Attachment 2. Example of Step 1 of a WHP Plan

# WELLHEAD PROTECTION PLAN

# TOWN OF CLEARWATER

# in WAKE COUNTY

PWS ID #99-99-999

Prepared: June 1, 2000
Revised: September 1, 2000

Contact: John J. Doe, Public Works Director
101 Commercial St.
Clearwater, NC, 27999

Phone: 919-555-7000
Fax: 919-555-7010

## Introduction

After discussions with the North Carolina Rural Water Association (NCRWA), the Town of Clearwater decided to proceed with the development of a local Wellhead Protection (WHP) program by developing a WHP plan. The NCRWA Consultant has agreed to provide technical assistance throughout each of the seven steps of the plan. The Town of Clearwater is embracing this voluntary program because of the benefits to its citizens, both now and into the future.

## Planning Team

Municipal employees whose positions are relevant to the WHP plan and its preparation have been assigned to the planning team or have volunteered to serve on it. Invitation letters were sent to ten other members of the community who were believed to have an interest in water quality or whose contribution to the planning process was desired. Three people who responded were added to the team.

The following persons were selected to serve on the local WHP program planning team for the Town of Clearwater:

| **Name** | **Position or group being represented** |
|---|---|
| John J. Doe | Town Manager |
| (name) | Water Plant Superintendent |
| (name) | Water Plant Operator |
| (name) | Special Projects Coordinator |
| (name) | Mayor |
| (name) | Town Alderman |
| (name) | Fire & Rescue Chief |
| (name) | Bi-county health department Environmental Health Sanitarian |
| (name) | Chamber of Commerce |
| (name) | Interfaith Housing Council |
| (name) | Blue River Council of Governments |
| (name) | Local well driller |
| NCRWA Consultant's Name | NCRWA |

## Responsibilities for the WHP Plan

The Clearwater Board of Aldermen will be responsible for preparing, implementing, and updating the WHP plan. John J. Doe, Public Works Director, is chair of the planning team and will be responsible for communications with the PWS Section. [Alternate language: The Consultant will prepare the document presented to the PWS Section]

## Needs and Goals

Long-term goals and visions established by the WHP planning team include:

- Safe drinking water for Clearwater
- Adequate supply of water
- Thorough survey of potential contamination sources
- Public education, directed toward various segments of the population
- Approval of the completed WHP plan by the PWS Section of North Carolina's Department of Environment and Natural Resources (NCDENR)
- Review and update the WHP plan on a regular basis after approval by the PWS Section

Problems and needs identified by the WHP planning team include:

- Lack of information about a contingency plan
- Lack of management strategies for potential sources of contamination
- New well for current and future demands
- Upgrade of filters at water plant
- Improvements to existing above ground water tanks
- Improvements to distribution lines and replacement of smallest lines
- Expansion of distribution system to areas requesting city water
- Lack of information about existing contamination threats

Additional actions needed to carry out the planning process were identified and assigned to planning team members. These include identifying volunteer groups to help in later stages of the plan, obtaining in-kind donations from a local print shop for educational materials, and reserving rooms for planning team and public meetings. Details can be found in the minutes of the planning team meetings, which are on file at the Clearwater Town Hall.

[Name], the Town of Clearwater Special Projects Coordinator, prepared a press release which was delivered to the Clearwater Tribune (published August 11, 2000), the local radio station, and the three television stations that serve the area. [Name], the Agricultural Extension Agent, met with school administrators to discuss ways that ground-water education could be incorporated into lessons during this time. [Name] prepared a pamphlet, based on similar EPA materials, that explained wellhead protection, its value to Clearwater residents, and ways that all citizens can help. Audience members at the community presentations received copies of these pamphlets. Citizens were informed that the public would be given opportunities for input to the final plan, and were invited to submit written comments and reactions for consideration at the initial planning meeting.

## Time Frame

The planning team agreed that there would be opportunities for public input at the following stages of the planning process:

- Shortly after the first planning team meeting, to explain wellhead protection and encourage public involvement.
- After the completion of the contaminant survey, to discuss risks and priorities.
- When the first draft of management strategies is prepared, to obtain public feedback and support.

The first and third opportunities for input were in the format of a series of presentations at club and other local group functions. The format for the second was a single public meeting.

Planning team meetings were held to discuss each step of the process as it occurred, with additional meetings scheduled as needed. The dates were {fill in when known}.

**The following two pages are Attachments 3 and 4, the Cover Page and Planning Team Roster.**

# WELLHEAD PROTECTION PLAN

# FOR

_____

**PWS** name

in _____ County

PWS ID #_____

Date prepared_____
[Add Date revised, if necessary_____]

Contact Name: _____
Position: _____
Phone: _____
Fax: _____

Mailing Address: _____
Street or PO box

_____, North Carolina _____
City Zip

# Planning Team Members

| Name | Representing | Address | Email |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# 2 Step 2: Delineating the Wellhead Protection Area

## Introduction: what this step is about

This step involves making an inventory of all Public Water Supply (PWS) wells included under the plan and gathering basic information about each well. The most important part of this step is to **identify the area that must be managed to reduce the likelihood of contamination of your well** — the Wellhead Protection Area (WHPA). Simply stated, the WHPA is the part of the landscape — above or below ground — that contributes water that will eventually reach the pumping well. If a contaminant reaches ground water within the well system's contribution area, the contaminant can move with the ground water into the well. If the contributing area for the well is identified and management strategies set in place to manage certain activities, the possibility that the well might become contaminated can be significantly reduced. This is the area where your wellhead protection (WHP) plan will apply.

WHPA delineation identifies the land area that must be managed to reduce the likelihood of contamination of your well.

In the first part of this step, you will compile basic data for each well in your water system.

By the end of this step, you will have a sound, defensible idea of what land area needs to be managed to protect the quality of your water supply and a map showing each well location with a WHPA delineated around each well or group of wells.

### *Ground-water primer*

Ground water is water moving through the cracks and pore spaces in underground rock formations called *aquifers*. Aquifers are ground-water reservoirs that store and transmit water. It is the discharge from aquifers that keep rivers flowing long after the rain has stopped. Aquifers may be divided into two categories, unconfined and confined. An unconfined aquifer is one in which water only partially fills the aquifer. The upper surface of the zone of saturation, known as the water table, is free to rise and fall. The surficial aquifer is the unconfined aquifer that immediately underlies the land surface. A confined aquifer is completely filled with water and is overlain by a low permeability confining layer which restricts the movement of water into and out of the aquifer.

Under natural conditions, aquifers are filled or *recharged* by precipitation falling on the land surface and percolating downward to the ground water. Water leaves or *discharges* from the aquifer in areas such as springs, streams, or rivers. Ground water moves continuously from areas of natural recharge to areas of natural discharge. However, unlike rivers, ground-water movement is very slow, typically from less than an inch to just a few feet each day. The rate of movement of ground water depends, in part, on the effective permeability of the aquifer

material, which in turn depends on its porosity – the size and connectedness of the cracks and pore channels in the aquifer material.

Wells are simply holes drilled into an aquifer through which water may be removed. Pumping water from a well causes the water level in the well to fall below the water level in the surrounding aquifer. This causes water in the aquifer to flow toward and into the well to replace the water being pumped out. For an unconfined aquifer, the land area surrounding a well in which precipitation infiltrates to the ground water and eventually flows to the pumping well is known as the *contributing area* for the well. Within the contributing area, any contaminant released to the environment that reaches the ground water can reasonably be expected to move toward and possibly reach the well. Therefore, in situations where the surficial, unconfined aquifer is used for water supply, the WHPA should at least encompass the contributing area around your well. This would include wells located in the Piedmont and Mountain areas of the State and wells withdrawing water from the surficial aquifers of the Coastal Plain area.

The size of the contributing area for a well is controlled by the rate at which water is pumped from the well and the rate at which the aquifer receives recharge. For example, if an aquifer in a particular area had an average recharge rate of 500,000 gallons per day per square mile, a well pumping one million gallons per day would have a contributing area of two square miles. If this same aquifer had an average recharge rate of 100,000 gallons per day per square mile, then, the size of the contributing area for a well pumping one million gallons per day would be 10 square miles. That is, for a given pumping rate, the smaller the average recharge rate for the aquifer, the larger the contributing area has to be to supply the water.

The average recharge rate to the confined aquifers of the coastal plain are, in general, small in comparison to the average recharge rate to the surficial, unconfined aquifers. WHPAs for wells withdrawing water from these aquifers could potentially be unmanageably large if based on the size of the contributing area. Also, because the contributing area for a confined aquifer may be located many miles from the well, accurate determination and management of WHPAs bases on contributing areas present numerous technical and jurisdictional difficulties. As a result, WHPAs for wells withdrawing water from confined coastal plain aquifers are often based on a time of travel calculation. A time of travel calculation uses the rate of ground-water movement to estimate how long water or a contaminant will take to reach a well from a point within the aquifer. This approach has been adopted in many states for defining WHPAs for confined aquifers. In North Carolina, the WHPA for wells withdrawing water from certain confined aquifers encompasses the area surrounding the well for which the time of travel from the outer edge of the area to the well is 10 years. A ten-year period was selected to provide time to assess the potential impact of any ground-water contamination discovered within the WHPA and for developing appropriate remediation and ground-water protection strategies for the water supply. A WHPA based on a longer time of travel may provide a greater degree of protection to the well and allow more advance warning to respond to a contamination incident within the WHPA, but it will also expand the area to manage under your WHP Plan.

# Procedure: what you need to do to complete Step 2 toward your WHP plan

## Gather information

**Know your well system**
Collect information on your well and its aquifer as a basis for WHPA delineation

Before you begin the actual delineation of the WHPA for a PWS well, you should obtain as much information as possible about the well. This information should be collected for all wells that compose your water system. Knowledge about your water system will help in the methods and calculations used to define a WHPA.

At a minimum, the information you compile should include:

1. Well owner/system name;
2. Well name/number;
3. Well location;
4. Date drilled;
5. Town or community served by well;
6. Source of supply (aquifer);
7. Well depth;
8. Well diameter;
9. Casing depth;
10. Top and bottom of screened or open hole section(s);
11. Pumping rate in gallons per minute;
12. Pumping period in minutes per day;
13. Well yield as determined from a 24-hour drawdown test (North Carolina Administrative Code 15A NCAC 18C.0402); and
14. Copy of 24-hour drawdown test.

This information may be recorded on the well-site evaluation form shown in Attachment 2. Most of the information you need should be readily available. Well construction records and well yield tests are required for all public water supply wells. Information on well depth, casing depth, well diameter, screen or open hole sections, and yield can be obtained from well construction records available from the NC DENR–Division of Water Quality–Groundwater Section or the well contractor that drilled the well.

## Delineate the WHPA

You must use an acceptable method to delineate the WHPA. Methods accepted in North Carolina include:

- Calculated fixed radius
- Variable shape
- Ground-water velocity
- Aquifer source–volume

Methods for WHPA delineation accepted in North Carolina include:

- Calculated fixed radius
- Variable shape
- Ground-water velocity
- Aquifer source–volume

Other methods of WHPA delineation such as computer modeling or hydrogeologic mapping may be used if they can be shown to more accurately define the contributing area for the well. However, such methods require site-specific data and considerable technical expertise and are therefore more expensive to apply.

The first two methods listed above are suitable for delineating WHPAs for wells withdrawing water from unconfined aquifers. This includes all wells in the Piedmont and Mountains and wells withdrawing water from the surficial aquifer in the Coastal Plain. The last two methods listed above are suitable for wells withdrawing water from confined coastal plain aquifers (highly confined and certain semi-confined aquifers). Other more sophisticated delineation methods may be used to more accurately define the area contributing water to the well system, if data and expertise are available. The state will review and accept delineations based on such methods if the state concludes that the input data and results are of acceptable quality.

**Calculated Fixed Radius.** This method is the simplest of all acceptable methods for WHPA delineation. The method results in a WHPA that is a circle with the well at the center, and is applicable to all wells withdrawing from unconfined aquifers in the Coastal Plain and for all wells in the Piedmont and Mountain regions. The only information needed to apply this method is the **maximum permitted daily withdrawal** for the well and the **recharge rate** of the aquifer.

To calculate the area of the proposed WHPA, first calculate the contributing area by simply dividing maximum permitted daily withdrawal by recharge rate:

$$A = \frac{Q}{W} \qquad (1)$$

where:
A = contributing area, square miles
Q = maximum permitted daily withdrawal, gallons per day
W = average recharge rate, gallons per day per square mile

To account for directional differences in certain aquifer parameters, the contributing area calculated by equation 1 is doubled to define the WHPA. The radius around the well for the WHPA is obtained by:

$$r = 4213\sqrt{\frac{Q}{W}} \qquad (2)$$

where:
r = radius from well of WHPA, feet
Q = maximum permitted daily withdrawal, gallons per day
W = average recharge rate, gallons per day per square mile
4213 = factor for converting area in square miles to radius in feet; includes doubling of the contributing area

The maximum permitted daily withdrawal is determined from information on well yield and an assumed daily period of well operation (in minutes per day). The well yield is the maximum sustained pumping rate possible for the well and

is determined from a 24-hour pumping test required by state regulations for all PWS wells. The well yield (in gallons per minute) is multiplied by 720 (the number of minutes in 12 hours) to determine the maximum permitted daily withdrawal. A value of 720 is used because state regulations require that public supply wells provide the system's average daily demand in 12 hours pumping time. If the actual pumping time exceeds 12 hours, then the actual pumping period in minutes per day should be used in the calculation.

Information on average recharge rates will be derived from published information. Average recharge rates in North Carolina range from 150,000 to 600,000 gallons per day per square mile. Average recharge rates across the state are shown in the figure in Attachment 3 and are available from the North Carolina Public Water Supply Section.

### Example of Fixed Radius Calculation

Well yield from a Piedmont well is 30 gallons per minute. Assuming a 12-hour pumping day, maximum permitted daily withdrawal (Q) is 21,600 gallons. Recharge rate is estimated to be 300,000 gallons per day per square mile. Using equation 1, the contributing area would be 0.072 square miles, or about 46 acres:

$$A=\frac{Q}{W} \qquad A=\frac{21{,}600}{300{,}000}$$

$A$ = 0.072 sq. miles = 46 acres

Using equation 2, which accounts for doubling the contributing area, the radius of the WHPA would be 1,130 feet or ~0.21 miles:

$$r=4213\sqrt{\frac{Q}{W}} = 4213\sqrt{\frac{21{,}600}{300{,}000}}$$

$$r=4213x0.2683 = \textbf{1,130 feet}$$

Once the radius (r) is calculated, the resulting WHPA can be drawn on a map as a circle with the well in the center.

**Variable shape.** This method is more complicated than the calculated fixed radius method, but it can improve accuracy of the delineation substantially if the required information exists. Therefore, this method is preferred over the calculated fixed radius method by the State of North Carolina. The **size** of the contributing area is determined as before, but the **shape** of the area is determined from properties of the aquifer and the direction of ground-water flow in the area.

Size. As in the calculated fixed radius method, the contributing area is calculated from equation 1:

$$A=\frac{Q}{W}$$

where:
A = contributing area in square miles
Q = maximum permitted daily withdrawal in gallons per day
W = recharge rate in gallons per day per square mile

Unlike the calculated fixed radius method, the contributing area calculated with the equation above is not doubled to set the size of the WHPA.

Shape. After determining the size of the contributing area, the next step is to determine its shape and position relative to the pumping well. This is a much more complex problem because it may involve consideration of the direction of ground-water movement and the hydraulic gradient in the vicinity of the well, hydraulic boundaries, and directional transmissivity.

1. **Direction of ground-water movement and the hydraulic gradient.** For a well withdrawing from an unconfined aquifer that is not affected by either hydraulic boundaries or directional transmissivity, the shape of the contributing area is controlled primarily by the hydraulic gradient. The hydraulic gradient, or slope of the ground-water table in unconfined aquifers, can be determined from water level maps or from field measurements of water levels in different water wells. Where the water table is nearly flat, as near the water-table divide in broad interstream areas of low relief, it can be assumed that the contributing area and the associated WHPA will have a circular shape. Where hydraulic gradients are moderate, contributing areas are elliptical in shape and oriented in the direction of ground-water movement: the steeper the gradient, the more elongated the ellipse. In the absence of specific water-level data, it is generally assumed that the direction of ground-water movement past a well under natural, non-pumping conditions is parallel to the slope of the land surface.
2. **Directional differences in water-transmitting capacity, or directional transmissivity.** Under the simplifying assumptions employed in the Wellhead Protection Program, this factor applies only to the Piedmont and Mountains. The ground-water system in the Piedmont and Mountain area consists of a surficial layer of unconsolidated granular material referred to as regolith overlying consolidated bedrock. Ground water in the Piedmont and Mountains occurs both in the pore spaces between the rock particles comprising the regolith and in a network of interconnected fractures in the bedrock. As a result, the transmissivity is generally not the same in all directions but tends to be largest in the direction parallel to the dominant fracture set in the bedrock. These directional differences in transmissivity result in elliptical-shaped contributing areas around pumping wells. Where the transmissivity is twice as large in the direction of the dominant fracture set as at right angles to it, the contributing area will be an ellipse twice as long in the direction of the dominant set as at right angles to it. In some areas of the Piedmont and Mountains the transmissivity of the bedrock parallel to the dominant fracture set may be five or more times that at right angles to it which will result in a contributing-area ellipse with a length five or more times its width. However, for purposes of the Wellhead Protection Program, a 2:1 ratio of transmissivity is assumed in the absences of site-specific transmissivity data. This assumption results in an elliptical contributing area twice as long as it is wide.

3. **Hydraulic boundaries formed by streams or topographic divides.** Hydraulic boundaries refers to physical features that limit the extent of contributing areas. In the Piedmont and Mountains these are most commonly ridgelines and perennial streams, lakes, and reservoirs. Ridgelines commonly coincide with divides in the water table which, in hydraulic terms, are no-flow boundaries. Thus, in the Piedmont and Mountains, drawdowns produced by most pumping wells do not extend past adjoining ridgelines. Where contributing areas drawn around wells cross ridgelines, it may be necessary to move the boundary of the contributing area inward to the ridgelines. Whether it is necessary to move the boundary inward to the ridgeline depends on how far the boundary extends past the ridgeline. If it extends a maximum of a hundred or so feet beyond the ridgeline, no change in the boundary need be made because the water-table divide can be offset short distances. Where the contributing area boundary is moved inward to a ridgeline will result in a decrease in the size of the WHPA. To compensate for this reduction, it may be necessary to extend the WHPA boundaries up and down the valley, parallel to the ridgelines, to encompass the size calculated for the contributing area. Whether this extension is necessary depends on whether the contributing area intersects a perennial stream or other surface-water body. Water moving through ground-water systems ultimately discharges to streams or other surface-water bodies. Where drawdowns caused by pumping wells reach these streams or surface-water bodies, ground-water discharge may be reduced or stopped. Additionally, surface water may be induced to flow into the source aquifer. Where induced infiltration of surface water occurs, it results in a reduction in the size of the contributing area making it unnecessary to compensate for the decrease in the size along ridgelines by extending the contributing area, and therefore the WHPA, up and down the stream valley.

   In the Coastal Plain, topographic divides (“ridgelines”) between streams rarely, if ever, limit the extent of contributing areas. Therefore, the only hydraulic boundaries of any importance in the Coastal Plain are those formed by large perennial streams in direct hydraulic contact with the source aquifer. This condition is most likely to affect only the unconfined surficial aquifers and the semi-confined aquifers, where they are in direct contact with major streams.

Two basic WHPA shapes can result using this method. One of the shapes is an ellipse, the other is a combination of a semicircle and a rectangle. The decision to use one or the other is based upon the amount of information that is available and the specific hydrogeologic conditions. However, it is important to note that regardless of how WHPAs are drawn, due consideration should be given to hydraulic boundaries (i.e., surface-water bodies and ridgelines) that may modify the shape of the contributing area.

For Piedmont and Mountain locations, the shape of the elliptical area (a) is derived from the common assumption of a 2:1 ratio in directional transmissivity. This results in an ellipse that is twice as long in one direction as the other (see Figure 1a).

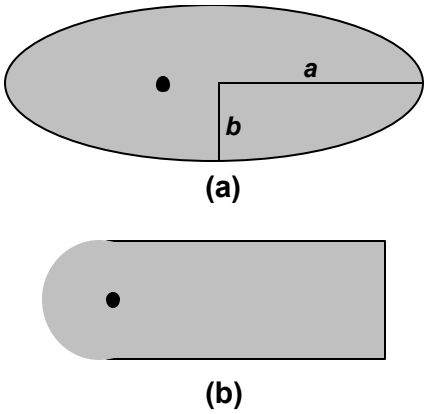



**Figure 1. Basic shapes of wellhead protection areas derived from the simplified variable shape method: (a) ellipse and (b) semicircle and rectangle. Small solid circle represents pumping well.**

Using this assumption, the equations for determining the lengths a, and b in Figure 1 are:

$$a = 4213\sqrt{\frac{Q}{W}} \qquad (3)$$

and

$$b = a/2 \qquad (4)$$

where Q and W are the same as in Equation 1 and *a* and *b* are in feet.

### Example of Variable Shape Calculations

Yield from a Mountain well is 50 gallons per minute. Ratio of directional differences in transmissivity is 2:1. WHPA assumed to be elliptical with 2:1 axial ratio. Assuming a 12-hour pumping day, average pumping rate (Q) is 36,000 gallons per day. Recharge rate (W) is estimated to be 400,000 gallons per day per square mile. Using equations 3 and 4, the long axis (*a*) of an elliptical WHPA would be 1,264 feet; the short axis (*b*) would be 632 feet:

$$a = 4213\sqrt{\frac{36{,}000}{400{,}000}} = \textbf{1,264 feet}$$

$b = a/2 =$ **632 feet**

The next step is to place the ellipse in the proper position with respect to the well. Two things need to be considered when doing this; the orientation of the ellipse or rotation (direction of the long axis *"a"*) and how much the ellipse is shifted (how much closer the well is to one end of the ellipse than the other end. See Figure 1(a).

The ellipse will be oriented or rotated such that the long axis "a" is along the direction of the dominant fractures in the rock. Water flows more easily

toward the well in this direction (transmissivity is greater). Since water moves more easily along this path, it will get to the well more quickly than water coming from other directions.

Direction of the dominant fractures can sometimes be obtained from geologic maps. A trained geologist may also be able to determine fracture directions from field observations.

The position of the well within the elliptical-shaped contributing area depends on the pumping rate of the well, the regional hydraulic gradient, and its position with respect to the water-table divide and recharging streams. If this information is known, several analytical techniques are available to calculate the distance from the pumping well to the downgradient edge of the contributing area.

If specific hydrogeologic information is available, the shape of the WHPA might look like Figure 1(b). A series of calculations are done to delineate the area. More than one attempt may be required to insure that the area matches the area calculated for the size of the contributing area as calculated in Equation 1.

For further information on application of the variable shape method, contact the North Carolina Rural Water Association, or consult the North Carolina Wellhead Protection Guidebook (NCDENR, 1995).

**Special method for confined aquifers.** In highly confined and certain areas of semi-confined aquifers, using rate of recharge ("W" in Equation 1) may result in calculating an unmanageably large WHPA. In such cases, two modified approaches to delineating the WHPA may be used.

Special methods may be used to estimate WHPAs in confined aquifers

Ground-water velocity. Many states base their WHPAs on ground-water *time of travel.* North Carolina uses a period of ten years, a period believed to be appropriate to provide an adequate time frame for assessing the impacts of any ground-water contamination discovered within the WHPA and for developing a remediation strategy.

For the ground-water velocity method, if hydraulic conductivity and hydraulic gradient are known, the ground-water velocity can be calculated and used to define the boundary of the area around the well within which the time of travel to the well is ten years. The equation used to calculate ground-water velocity is:

$$v = \frac{K}{n} x \frac{dh}{dl} \qquad (5)$$

where: v = velocity, feet per day
K = hydraulic conductivity, feet per day
n = porosity, dimensionless
dh/dl = the hydraulic gradient in foot vertical per foot horizontal

Of these factors, only porosity can be estimated with acceptable accuracy; other values must be derived from site-specific data.

**Example of Ground-water Velocity Calculation**

The following values have been measured in a confined aquifer in the Coastal Plain:

hydraulic conductivity (K) = 0.0003 feet per second = 26 feet per day
porosity (n) = 0.2
hydraulic gradient (dh/dl) = 5 feet in 1600 feet

Using equation 2.4:

$$v = \frac{K}{n} x \frac{dh}{dl} = \frac{26}{0.2} x \frac{5}{1600} = 130 \; x \; 0.0031 = 0.41 \text{ feet/day}$$

At a velocity of 0.41 feet/day, a circle defining a 10-year time of travel has a radius of:

0.41 feet/day *x* 365.25 days/year *x* 10 years = **1498 feet**

Aquifer source–volume method. The lack of specific data on hydraulic conductivity or hydraulic gradient will preclude determination of ground-water velocity for most WHPAs. In that case, it will be necessary to use a method that estimates the volume of aquifer from which water withdrawals are made. This is called the aquifer source-volume method. The volume of an aquifer that supplies withdrawals for a specified period of time can be estimated by the following equation:

$$V_P = Q\left(\frac{gal}{\min}\right) \times t_d\left(\frac{\min}{day}\right) \times \left(\frac{ft^3}{7.48\ gal}\right) \times \left(\frac{365.25\ days}{year}\right) \times \frac{P\ (years)}{n} \quad (6)$$

where:
$V_p$ = the volume of aquifer in cubic feet that supplies water for time P
Q = well yield in gallons per minute
$t_d$ = the daily pumping period in minutes per day
P= the period of withdrawals in years
n= estimated porosity, dimensionless

The well yield **Q** is the maximum sustained pumping rate possible for the well as determined from a 24-hour drawdown test; if well yield information is not available, the maximum capacity of the pump installed may be substituted. The daily pumping period $\mathbf{t_d}$ is usually 720 (minutes in 12 hours); if the actual pumping period exceeds 12 hours, then actual period in minutes should be used.

If standard values of $\mathbf{t_d}$ of 720 minutes per day, **P** of 10 years, and a general estimate of n (porosity) are used in Equation 6, the equation reduces (rounded) to:

$$V_{10} = 1{,}800{,}000 \text{ x } Q \quad (7)$$

Where
$V_{10}$ = the volume of aquifer in cubic feet that supplies ten years of water withdrawals

For simplicity, it is assumed that the volume calculated in Equation 7 is contained in a cylinder centered on the well. To estimate the radius of the cylinder (and therefore the radius of the WHPA around the well) it is necessary to determine or estimate the thickness of the part of the aquifer that supplies water to the well. Thickness may be known or is approximated by the length of the screened portion(s) of the well. Then, the radius can be calculated as:

$$r = \sqrt{\frac{V_{10}}{pb}} \qquad (8)$$

Where:
r = radius in feet
$V_{10}$ = volume of aquifer in cubic feet that supplies 10 years of withdrawals
$\pi$ = 3.1416
b = the aquifer thickness or length of well screen in feet

Because actual aquifer thickness may be underestimated by well screen length alone, it may be preferable to use the recommended guidelines in Table 1.

## Example of Aquifer Source-Volume Estimation

A well drilled into a semi-confined Coastal Plain aquifer is screened for 50 feet and has a yield of 250 gallons per minute. To estimate the ten-year aquifer source volume using equation (7):

$V_{10}$ = 1,800,000 *x* Q = 1,800,000 *x* 250 = **450,000,000 cubic feet**

Assuming an aquifer thickness equivalent to the screen length, the radius of the WHPA calculated using equation (8):

$$r = \sqrt{\frac{V_{10}}{pb}} = \sqrt{\frac{450{,}000{,}000}{3.1416x50}} = \sqrt{2{,}864{,}789} = \textbf{1,693 feet}$$

Alternatively, using values in Table 1, the radius is estimated to be **2,000 feet**

## Table 1. Recommended radii of WHPAs for wells withdrawing from semi-confined and highly confined aquifers.

| Well Yield Q[1] (gpm) | Maximum Permitted Withdrawal ($Q_{MPW}$[2]) (gallons) | Aquifer Thickness[3] (ft) | Radius of WHPA (ft) (rounded) |
|---|---|---|---|
| 50 | 36,000 | 25 | 1,000 |
| 100 | 72,000 | 50 | 1,000 |
| 200 | 144,000 | 50 | 1,500 |
| 500 | 360,000 | 75 | 2,000 |
| 1000 | 720,000 | 75 | 3,000 |
| 2000 | 1,440,000 | 100 | 3,500 |

[1] Maximum sustained well yield or maximum capacity of the pump, in gallons per minute. Read as "up to" the indicated value; e.g., for a well yield of 150 gpm, use line representing 200 gpm.
[2] Maximum Permitted Withdrawal ($Q_{mpw}$) based on 12 hours per day of pump operation.
[3] Aquifer thickness is a value assumed on the basis of the pumping rate.

**Other Methods.** More sophisticated methods of delineation can provide a more precise delineation of your WHPA, but typically require a high level of expertise, specific data on your aquifer, or both.

- **Analytical methods** involve the use of equations to delineate the boundaries of the WHPA. Specific hydrogeologic input data are required to satisfy the equations; these data can include hydraulic conductivity, transmissivity, hydraulic gradient, and thickness of the saturated zone. Once this information has been obtained, the equations can be used to define features of the WHPA such as the distance to the downgradient divide and the appropriate zone of contribution. The upgradient boundaries can be based on time of travel. This method can be relatively inexpensive, although costs can be high if site-specific hydrogeologic data are not readily available and must be obtained for the delineation.
- **Hydrogeologic mapping** uses geological, geophysical, and dye tracing methods to map flow boundaries and time of travel. To determine the actual flow boundaries, geological studies of the aquifer are undertaken to identify permeability characteristics, areal extent, and aquifer thickness. This method can be used to delineate WHPAs in areas of complex or rapid ground-water flow such as karst aquifers. Application of these delineation techniques requires considerable technical expertise and professional judgement and may become very expensive if field investigations are necessary. It is inappropriate to try to extrapolate data from other areas to your own using this method; it must be site-specific.
- **Numerical models** use computer modeling techniques to simulate the three-dimensional boundaries of an aquifer. The numerical approach uses a grid to simulate the aquifer, with data on water table elevation, hydraulic conductivity, and aquifer thickness input for each point on the grid. Computer models have the advantage of being able to model highly complex aquifers quickly and to simulate the response of the system to proposed management options, such as the operation of a new well. Because a high level of expertise and an extensive data base are required for application, numerical models are potentially the most expensive method of delineation of contributing areas.

Note that the PWS Section will only accept delineations based on these methods if enough good information is available to reliably apply them.

Sophisticated techniques for WHPA delineation may be more precise but also require special expertise and data and have a higher cost.

**What about multiple wells?** Most PWS systems contain more than one well located relatively close to each other. In many cases, WHPAs delineated for individual wells may overlap. If the overlap is relatively small, you can simply draw your WHPA boundary along the widest boundary created by the overlap. However, to provide for the greatest degree of protection and to promote administrative feasibility, you may need to take a different approach. It is probably not desirable, for example, to leave a “hole” inside your WHPA simply because a small area is not covered by the intersection of several WHPAs centered on individual wells.

One approach is to treat a group of clustered wells as a single well with a pumping rate equal to the total of all the wells. If the wells are arranged in a line, the WHPA may be an ellipse that contains an area equal to the combined WHPAs for all the wells. If wells are grouped in a cluster, you can calculate a WHPA radius for the total of all well yields centered on an imaginary point at the center of the cluster. You may wish to seek expert assistance or consult additional

resources in complicated situations (see References and Resources section). It is also a good idea to submit a draft WHPA delineation to the PWS Section for review and approval prior to completing the remaining steps of the WHP Plan.

**Which method is right for you?** The region the WHPA is in may determine which delineation method is appropriate. Your planning team must evaluate what is technically and economically feasible and technically acceptable. Before making a decision on a delineation method, ask these questions:

- Is the aquifer confined or unconfined?
- Do geologic maps exist for the area?
- Does pump test information exist?
- Is regional ground-water flow direction known?
- Is regional or local hydraulic gradient known?
- Is technical assistance available from the N.C. Rural Water Association or elsewhere?
- Are resources available to retain a consulting hydrogeologist or other professional assistance?

It is usually advisable to consult with staff from the PWS Section or the N.C. Rural Water Association before making a firm commitment on a delineation method. More detailed information on delineation of WHPAs is available in print (Heath, 1991; NCDENR, 1995; Heath and Johnson, 2001; USEPA, 1993).

**Pros and Cons of Different Delineation Methods**

| Method | Advantages | Disadvantages |
|---|---|---|
| Calculated Fixed Radius | Easy to do, inexpensive<br>Generally conservative<br>Limited data requirements | Not very accurate<br>May not be appropriate with confined aquifer |
| Variable Shape | Can be more accurate than calculated fixed radius<br>Low cost if data available<br>Still relatively simple | Requires more information than calculated fixed radius |
| Ground-water Velocity | Applicable in confined and semi-confined aquifers<br>Estimates realistic WHPA<br>Low cost if data available | Requires site-specific data |
| Aquifer Source-Volume | Applicable in confined and semi-confined aquifers<br>Estimates realistic WHPA<br>Low cost if data available | Requires some site-specific data<br>Uncertainty in estimation of actual aquifer thickness |
| Analytical Methods | Widely used<br>Less arbitrary and more accurate than simpler methods | Requires field data<br>Moderate cost<br>Probably requires professional help |
| Hydrogeological Mapping | Can be used in karst aquifers, other complex situations<br>Can be accurate if good data exist | Data must be site-specific<br>Requires technical expertise<br>May be expensive if field investigations required |
| Numerical Flow Modeling | Can be highly accurate | Requires extensive field data<br>Requires technical expertise<br>Can be very expensive |

## Involving the public

Keep your community informed – make sure citizens know what the WHPA is and that its delineation is not an arbitrary or political decision.

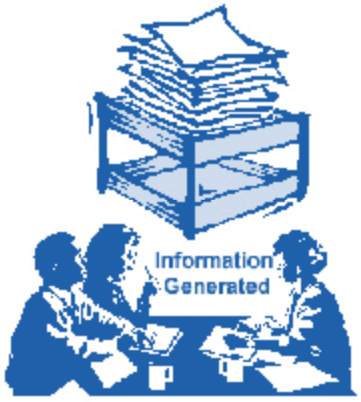
The process of delineating your WHPA is primarily a technical task, best accomplished by the Planning Team with support from appropriate consultants or technical personnel. In this process, it is crucial to gather all pertinent technical information. Thus, it is important to include not only the core group highlighted in Step 1 but also any city and county staff with a technical background in ground water. Your team can also tap the expertise available in local universities, and state agencies. Depending on the delineation method used, it may be necessary to hire a consultant to help complete this task. If so, try to bring in people who could help select an appropriate consultant.

Although general public input may not help the delineation process, it is essential that members of the community understand what the WHPA is and that its delineation is not an arbitrary or political decision. Therefore, it is advisable to inform the public on the process and results of the WHPA delineation effort before proceeding to the next step.

# Products that should result from Step 2, to be included in the final plan

When you have completed this step, you should have the following information to include with the final plan you submit to PWS:

1. **Well site evaluation forms for each water supply well** (See Attachment 2).
2. **Maps with WHPA delineations**; either paper copies or in GIS format. The delineation should include full documentation of the method chosen to delineate the area and all data and calculations associated with the result. An example delineation is shown in Attachment 4.



# Resources and References

NCDENR. 1995. The North Carolina Wellhead Protection Guidebook. Edited by L.S. Smutko, L.E. Danielson, and G.D. Jennings. North Carolina Department of Environment, Health and Natural Resources Division of Environmental Management Groundwater Section Raleigh, NC.

NCDENR. 1999. North Carolina's Source Water Assessment Program Plan. North Carolina Department of Environment & Natural Resources, Division of Environmental Health, PWS Section.

Heath, R.C. and M.G. Johnson. 2000. Proposed Revisions to the North Carolina Wellhead Protection Program.

USEPA. 1993. Wellhead Protection: A Guide for Small Communities. U.S. EPA EPA/625/R-93-002, Office of Water, Washington, D.C.

There are resources available to help you delineate your WHPA. The North Carolina Rural Water Association has staff dedicated to assisting communities in delineating WHPAs. The NCRWA is on the web at: http://www.ncrwa.com/ and may be contacted at (336) 731-6963.

Another source of help is the PWS Section of the North Carolina Division of Environmental Health. They will review your draft wellhead protection plan (see Step 7) and can assist you in the process of developing a plan. PWS has central and regional offices. This information may be found on the web at: http://www.deh.enr.state.nc.us/pws/. The central office phone numbers is: 919-733-2321 Regional offices are listed by county at: http://www.deh.enr.state.nc.us/pws/counties.htm

## Attachments:

Beginning with the next page, you will find attachments that are provided to make it easier for you to prepare your plan document.

Remember, the attachments that are labeled "Example" are only for you to give you ideas.

- **Attachment 1: Glossary of ground-water terms with figures**
- **Attachment 2: Well site evaluation form**
- **Attachment 3: Ground-water recharge rate map for North Carolina**
- **Attachment 4: Example of a partial plan, showing the portions of the plan that result from this step.** The example plan shows you the kind of information that you are expected to include in the plan that you submit for approval. Your final plan will be different than the fictional Town of Clearwater plan that is provided as an example.

# Attachment 1: Glossary of Ground-water Terms with Figures

The following terms are often used when discussing ground water and planning for wellhead protection. Many of the terms are illustrated in the accompanying diagrams.

***Aquifer*** – an underground, water-bearing geologic formation that will yield water in a usable quantity to a well or spring.

***Capture zone*** – the area within an aquifer that drains to and is captured by a pumping well. Also known as the zone of contribution (ZOC) or contributing area.

***Cone of depression*** – the depression of the ground-water level around a pumping well caused by the withdrawal of water. Also known as the zone of influence (ZOI) or radius of influence.

***Confined aquifer*** – an aquifer saturated with water and bounded above and below by materials having a lower hydraulic conductivity than the aquifer itself.

***Contaminant plume*** – an elongated and mobile band of a pollutant moving in association with ground water through soil or an aquifer.

***Distance*** – a radius measured outward from the pumping well. Distance is the most basic, and often least accurate, criterion used in delineating a WHPA.

***Drawdown*** – the lowering of the water table surrounding a well during pumping. Drawdown is greatest at the well and decreases with distance from the well.

***Ground-water divide*** – a ridge in the water table from which ground water moves away in right angles in both directions; analogous to a surface watershed divide.

***Hydraulic conductivity*** – the capacity of an aquifer material to transmit water; expressed as the volume of water that will move in a unit time through a unit area at a hydraulic gradient of unity (1.0).

***Hydraulic gradient*** – the slope of the water table along the direction of flow; the change in water level per unit distance, e.g., ft/ft.

***Permeability*** – The ability of a porous medium to transmit water; permeability depends on porosity

***Porosity*** – the volume of openings in soil or rock, expressed as the ratio of the total volume of openings to the total unit volume of soil or rock.

***Pumping test*** – A test performed by pumping a well for a period of time and observing the water level to determine characteristics of the aquifer.

***Recharge rate –*** The volume of water on average that reaches the aquifer from a surface source such as rain. Expressed here in gallons per day per square mile.

***Saturated zone*** – the zone (below the land surface) in which all interconnected openings are filled with water.

***Specific yield*** – the amount of water that will drain from a water-bearing material under the influence of gravity.

***Time of travel*** – the amount of time it takes for water to reach a well from a certain distance.

***Transmissivity*** – the capacity of an aquifer to transmit water; equal to the hydraulic conductivity times the aquifer thickness

***Unconfined aquifer*** – an aquifer that contains both an unsaturated and a saturated zone, i.e., an aquifer not full of water

***Water table*** – the top of the saturated zone in an unconfined aquifer; the level in the saturated zone at which the water is under a pressure equal to atmospheric pressure

***Zone of influence (ZOI) –*** See *cone of depression*.

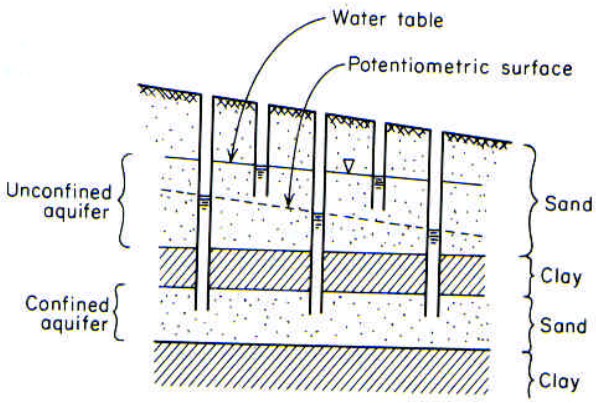



**Figure A-1 . Illustration of terms (from Freeze and Cherry, *Groundwater*)**

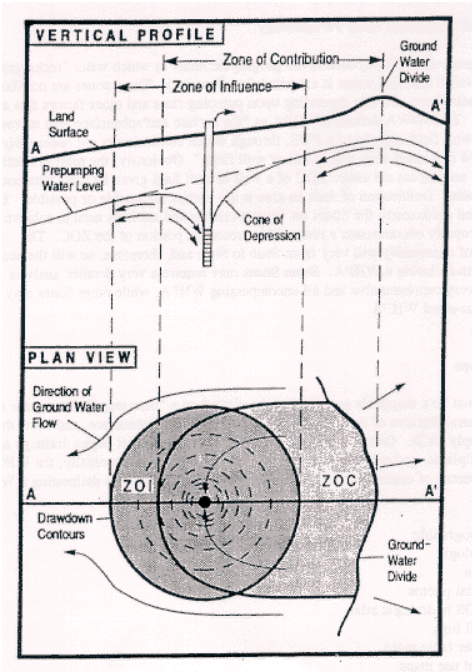



**Figure A-2 Illustration of Capture Zone and Zone of Influence**

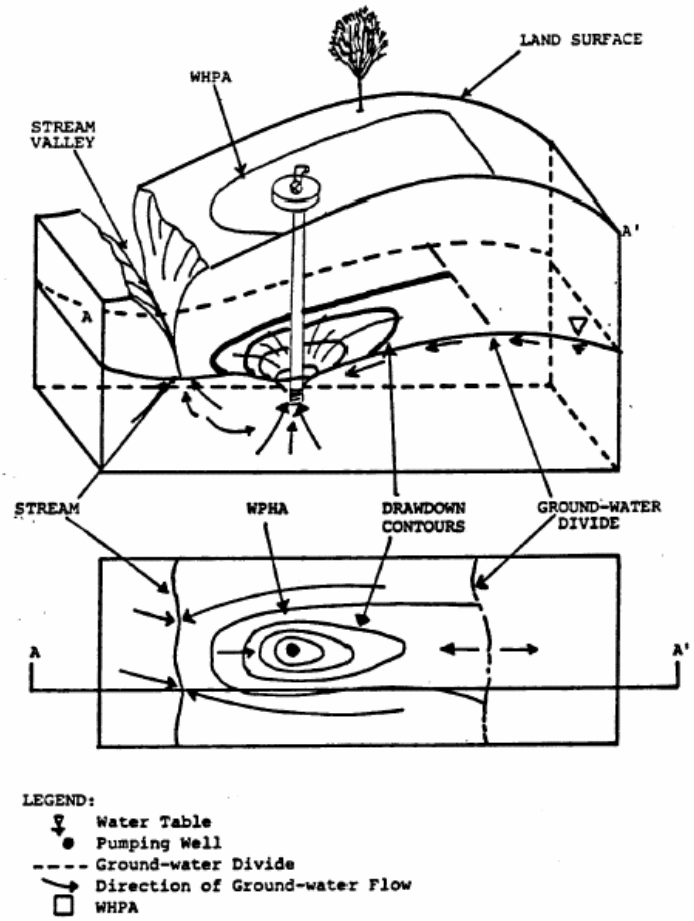



**Figure A-3 WHPA delineation using groundwater divides and streams**

# Attachment 2: Well Site Evaluation Form

General Information

*1) Well owner/system name_____ 2) Date drilled _____

*3) Well location (St./Rd. & Town)_____

*4) Water supplied to_____

5) Source aquifer (if known)_____

6) Well depth _____ft.

7) Diameter _____in.

8) Depth cased _____ft.

9) Open hole/screen from _____ to _____ft.

Information from the Well Acceptance Test

10) Date: _____ 11) Length: _____hours

12) Pumping Rate _____ gpm 13) Depth to Static Water Level:_____ft.

14) Pumping Level _____ ft. 15) Drawdown _____ ft.

Well Operation

*16) Pumping rate _____ gpm *17) Pump Period _____min/day

Well Location

*18) Latitude: _____ *19) Longitude: _____

*20) A1:24,000 scale 7.5 minute topographic map showing the well location must also be submitted.

Other information as available:

_____

_____

_____

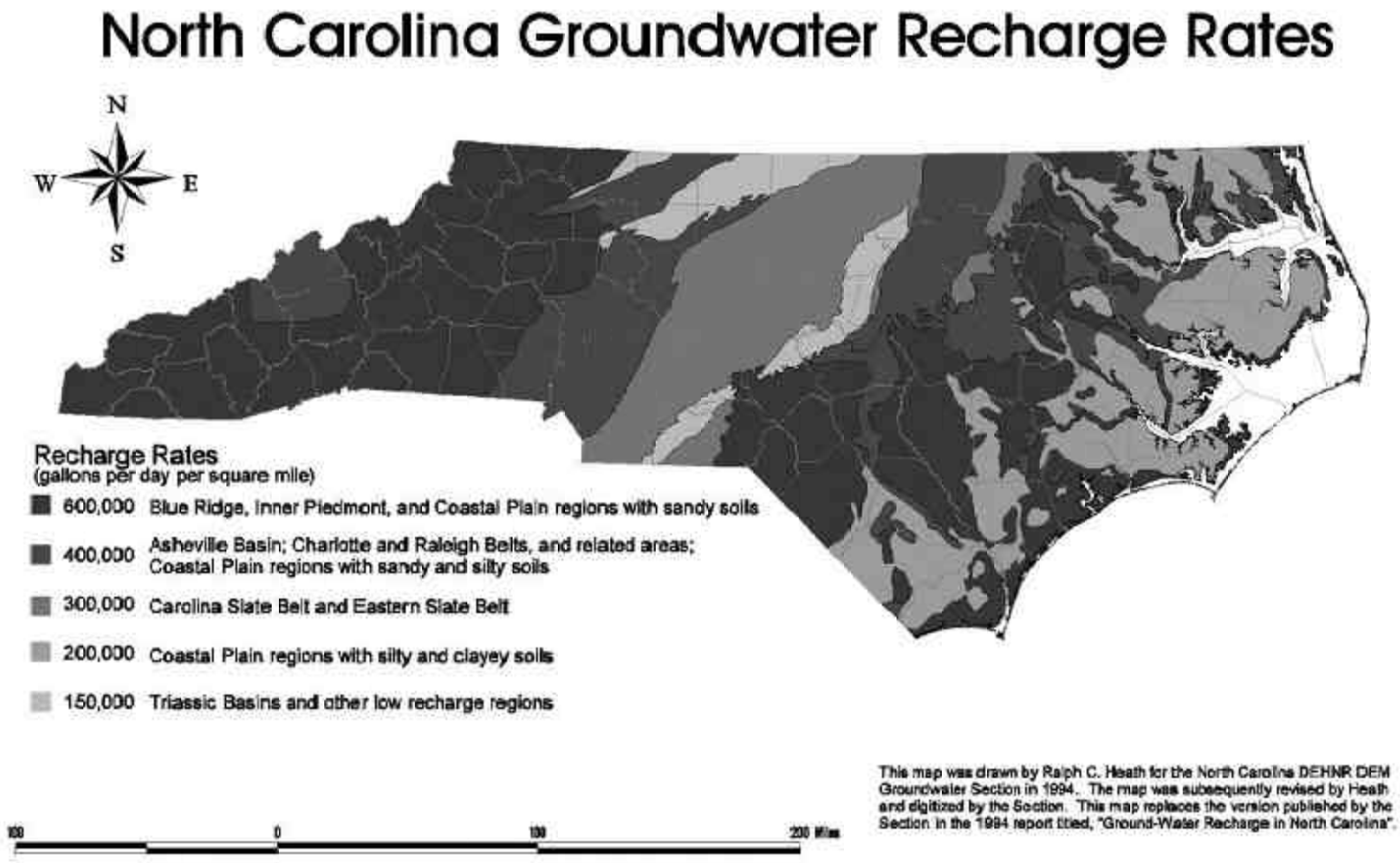
_____

_____

*Minimum data required for Wellhead Protection Area delineation.
Additional information will improve the accuracy of the delineation.

Prepared by _____ Date _____ Checked _____

# Attachment 3: Figure showing estimated average recharge rates in North Carolina



# Attachment 4: Example of a partial plan, showing the portions of the plan that result from this step

The Town of Clearwater lies in the central portion of Burns County, approximately 16 miles northwest of Springfield. The Clearwater Water System serves a population of 4,700 people via 2,315 connections and uses three wells to supply its population with water. These wells lie in the Black Creek geological formation consisting of mostly lignitic sand and clay in the Coastal Plain physiographic province of North Carolina. Their water comes from the Black Creek Aquifer that is unconfined in this area and has an estimated average recharge rate of 200,000 gallons per day (gpd) per square mile ($mi^2$).

Well # 1 is located in a residential area in the southern portion of the town. A well site evaluation form for Well #1 is shown in Figure 1. Well # 2 is located in a rural area south of town and Well # 3 is located in a rural area northeast of town. The topography surrounding the wells is generally flat.

Information about each of the wells was collected by the WHP Planning Team. The well locations are shown on the map in Figure 2. The location of these wells and their maximum production rates, as determined from well acceptance test data, are shown below.

| WELL # | LOCATION | DEPTH (FT) | SCREENED FROM (FT) | LATITUDE | LONGITUDE |
|---|---|---|---|---|---|
| 1 | 311 Gordon St. | 280 | 147 – 276 | 35° 11.381’ | 78° 03.780’ |
| 2 | 1458 SW Church Rd. | 295 | 258 – 290 | 35° 10.934’ | 78° 01.140’ |
| 3 | County Road 1A | 294 | 155 – 289 | 35° 13.020’ | 78° 03.780’ |

The Calculated Fixed Radius method was used to delineate the WHPA. This method is accepted by the NCDENR/PWS Section.

| Well # | Maximum pumping rate | Minutes pumped per day | Max. permitted daily withdraw (gal/day) | Recharge rate (gal/day/$mi^2$) | Well contributing area ($mi^2$) | WHPA ($mi^2$) | WHPA Radius (ft) |
|---|---|---|---|---|---|---|---|
| 1 | 800 | 720 | 576,000 | 200,000 | 2.88 | 5.76 | 7,149 |
| 2 | 600 | 720 | 432,000 | 200,000 | 2.16 | 4.32 | 6,192 |
| 3 | 900 | 720 | 648,000 | 200,000 | 3.24 | 6.48 | 7,583 |

When areas were delineated around each of the wells individually, the areas for wells #1 and #2 overlapped, while the area around well #3 did not overlap either of the other areas. The Planning Team decided that designating a single WHPA using combined pumping rates for all three wells would encompass too large an area and would include land not within the contributing area for any well. Instead, the Planning Team has designated two WHPAs, as shown in Figure 2:

**WHPA 1** an oval (dashed line) that includes the calculated fixed radius WHPAs around wells #1 and #2, having an area equal to the combined areas of the WHPAs calculated for wells #1 and #2; and

**WHPA 2** a circle around well #3 with a radius of 7,583 feet.

# WELL SITE EVALUATION FORM

General Information

*1) Well owner/system name Clearwater Water System 2) Date drilled August 14, 1972

*3) Well location (St./Rd. & Town) 311 Gordon Street, Clearwater

*4) Water supplied to Clearwater

5) Source aquifer (if known) Black Creek Aquifer

6) Well depth 280 ft.

7) Diameter 6 in.

8) Depth cased 280 ft.

9) Open hole/screen from 147 to 276 ft.

Information from the Well Acceptance Test

10) Date: August 21, 1972 11) Length: 24 hours

12) Pumping Rate 800 gpm 13) Depth to Static Water Level: 120 ft.

14) Pumping Level 190 ft. 15) Drawdown 70 ft.

Well Operation

*16) Pumping rate 800 gpm *17) Pump Period 720 min/day

Well Location

*18) Latitude: 35° 11.381″ *19) Longitude: 78° 03.780″

*20) A1:24,000 scale 7.5 minute topographic map showing the well location must also be submitted.

Other information as available:

Well # 1 is located in a mixed residential area, less than 1 mile north of Well #2

Prepared by Carl Morgan Date January 18, 2002 Checked H.S.

**Figure 1. Well Site Evaluation Form for Well #1**

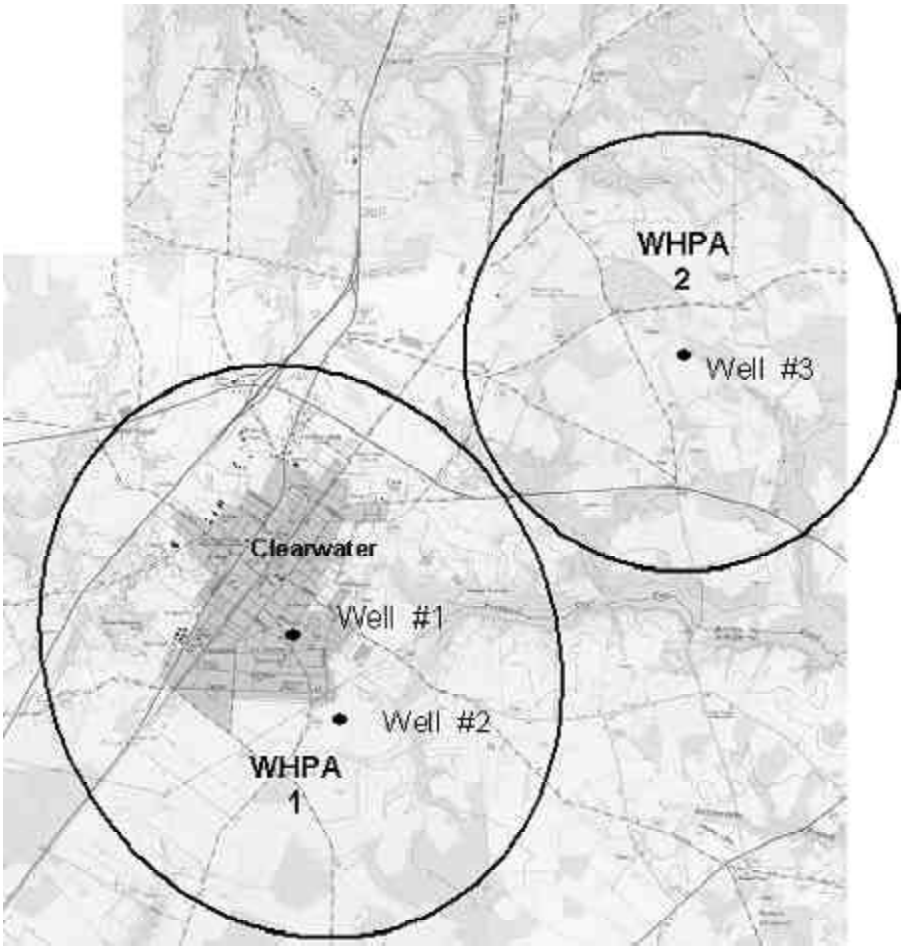



**Figure 2. WHPAs for Town of Clearwater**

# 3 Step 3: Conducting a Potential Contaminant Source Inventory

## Introduction: what this step is about

In this step, you will identify and evaluate the substances and activities in your WHPA that threaten your water supply.

The next step in developing your Wellhead Protection (WHP) plan is to conduct a potential contaminant source inventory. A ***Potential Contaminant Source*** (PCS) is any substance or activity that could adversely affect the quality of your drinking water supply. The PCS inventory is a complete listing, including mapped locations, of past and present land use activities within the wellhead protection area (WHPA) that threaten ground-water quality. Your goal is to protect your drinking water supply by protecting the land area surrounding the well because this is the area that can transmit water directly to your well. The purpose of this step is to inventory the existing and potential sources of ground-water contamination within the WHPA or areas you identified and delineated in Step 2. Each well will have its own WHPA which may or may not overlap with the other WHPAs associated with other wells. To protect this area, you must first learn what the specific actual and potential threats are. In this step, you will identify and evaluate all of the various substances and activities within the WHPA that are potential threats to ground-water quality.

Preventing drinking water contamination through wellhead protection is less costly than cleaning up a polluted water source.

Once drinking water is polluted, there are few easy fixes. Cleaning up contamination or providing alternative water sources to affected residents can be difficult and costly. If cleanup is even possible, it can cost hundreds of thousands or even millions of dollars. Many communities must abandon the use of a contaminated aquifer when faced with contamination of their ground-water supplies. The community must then either find other water supplies, drill new wells away from the contaminated area of the aquifer or, if feasible, drill new wells into a different aquifer. According to the United States Environmental Protection Agency, prevention of contamination through wellhead protection is 27 times less costly than cleaning up a contaminated water source.

Considering the importance of ground water as source of drinking water for so many communities, and the cost and difficulty of either cleaning it up after it has become polluted or providing new water sources, common sense tells us that the best action is to prevent contamination in the first place.

After documenting every PCS that could threaten your water supply, these actual or potential sources must be ranked according to the risk they present for each public water supply (PWS) well. This ranking will ensure that the most vulnerable wells and the greatest threats are addressed first when you make specific decisions about protecting your water supply.

The most common source of ground-water contamination in North Carolina is leaking underground storage tanks; accidental spills are the second most common problem. Some common PCSs that may threaten ground-water quality are listed in Table 1.

# Procedure: what you need to do to complete Step 3 toward your WHP plan

Examples of Potential Contaminant Sources

- Underground storage tanks
- Accidental spills
- Failing septic systems and drainfields
- Improperly abandoned wells
- Use and spillage of fertilizers and pesticides
- Hazardous materials at businesses
- Animal feedlots
- Landfills
- Land disposal of wastes
- Underground pipelines and sewers

Completing a PCS inventory is a process that cannot be completed in a single step. General information will lead to a search for specific details, and new questions may come up that need further investigation and verification. You will have to use a combination of methods to locate and identify all PCSs located within the delineated WHPA. Many contaminants are associated with particular land uses, so you will need to collect agricultural, commercial, industrial, residential, and other types of data that can help locate and identify land use activities associated with potential contaminants. Because soil and ground-water contamination can be very long-lasting, it is critical to identify not just current conditions but also historical land uses, old waste disposal sites, and past uses of chemicals that might be hazardous to drinking water. Businesses that closed long-ago may have left underground storage tanks or other buried chemicals that are still a potential threat to your water supply.

Some background for the PCS inventory process is contained in North Carolina's 1999 "Source Water Assessment Program Plan" (SWAP), a program that calls for assessment of all PWS wells and surface water intakes. In addition, consultants such as those available from the NC Rural Water Association, have experience in searching electronic databases and completing the PCS data sheets.

## Collect physical information for each WHPA

The Nine Most Common Contaminants of Ground Water in North Carolina

1. Benzene
2. Chloroform
3. Tri- and Tetrachloroethlylene
4. Polychlorinated Biphenyls (PCBs)
5. Methylene chloride
6. Toluene
7. Pesticides
8. Nitrates
9. Heavy metals

You should complete a *Potential Contamination Source Data Sheet* (Attachment 1) for each PCS you identify. Some of the information needed to complete the sheet will be available from the databases and records that you search. Contact with an owner may be required to complete other details, either by on-site visit, telephone interview, or mail survey. Include a description of the PCS, its location, the volume of material involved, and any permit references, as indicated on the form. Also, if any existing contamination incidents are identified within the WHPA, include a description of the current status for each in your WHP plan.

If you are uncertain about the potential pollutants being used, a list of contaminants typically associated with common source activities is provided in Table 1. This table contains PCS categories that will be later used with the "PCS Identity Code" form found in Attachment 2. Each PCS will be associated with a PCS Identity Code. A much more exhaustive list of PCSs and their possible contaminants can be found in (USEPA, 1993, Table 4-4) and (Wyoming DEQ, 1997). Refer to the References and Resources section at the end of this chapter for these references if more information is desired.

## Search existing information

Electronic Databases: Federal government agencies and the State of North Carolina maintain records relevant to ground-water contamination in electronic form that can be searched using a computer. A list of such sources is given in the "Resources and References" section. Information on contamination incidents, such as a PIRF (Pollution Incident Reporting Form), must be included in the WHP plan.

**Table 1. Potential Contaminant Sources and Associated Contaminants**

| SOURCE | HEALTH, ENVIRONMENTAL, OR AESTHETIC CONTAMINANT |
|---|---|
| Abandoned wells | Surface runoff; effluents from barnyards, feedlots, septic tanks, or cesspools; gasoline; used motor oil; road salt |
| Above ground storage tank | Heating oil; diesel fuel; gasoline; other petroleum products; other commercially used chemicals |
| Agricultural facilities | Pesticides; fertilizers; gasoline and motor oils from chemical applicators |
| Airport | Jet fuels; deicers; diesel fuel; chlorinated solvents; automotive wastes; heating oil; building wastes |
| Animal feedlot/ waste storage | Livestock sewage wastes; nitrates; phosphates; chloride; chemical sprays and dips for controlling insect, bacterial, viral, and fungal pests on livestock; coliform and noncoliform bacteria; viruses |
| Asphalt plants | Petroleum derivatives |
| Auto repair[1] | Waste oils; solvents; acids; paints; automotive wastes; miscellaneous cutting oils |
| Body shop/salvage[1] | Any wastes from businesses and households; oils |
| Cemetery | Leachate; lawn and garden maintenance chemicals |
| Chemical production | Hazardous chemical products in inventories |
| Chemical mixing storage | Acids/alkalis, solvents, organic chemicals |
| DOT stations | Road salt (sodium and calcium chloride); road salt anticaking additives (ferric ferrocyanide, sodium ferrocyanide); road salt anticorrosives (phosphate and chromate); oil and grease, fuel tanks; repair shop wastes; |
| Drainage canals | Pesticides; fertilizers; bacteria |
| Dumps | Leachate; organic and inorganic chemical contaminants; wastes from households and businesses; nitrates; oils; metals |
| Electroplaters/ metal finishers[1] | Boric, hydrochloric, hydrofluoric, and sulfuric acids; sodium and potassium hydroxide; chromic acid; sodium and hydrogen cyanide; metallic salts |
| Fertilizer/pesticide mixing and storage | Pesticide and fertilizer residues |
| Fertilizer/pesticide production | Acids, mine tailings, chemical by-products |
| Funeral homes | Formaldehyde; wetting agents; fumigants; solvents |
| Gas stations | Oils; solvents; miscellaneous wastes |
| Golf courses | Fertilizers; herbicides; pesticides for controlling mosquitoes, ticks, ants, gypsy moths, and other pests |
| Holding pond/lagoon | Sewage wastewater; nitrates; other liquid wastes; microbiological contaminants |
| Injection wells | Highly toxic wastes; hazardous and nonhazardous industrial wastes; oil-field brines |
| Laboratories | X-ray developers and fixers; infectious wastes; radiological wastes; biological wastes; disinfectants; asbestos; beryllium; solvents; infectious materials; drugs; disinfectants (quaternary ammonia, hexachlorophene, peroxides, chlornexade; bleach); miscellaneous chemicals |
| Laundromat/dry cleaners[1] | Solvents (perchloroethylene, petroleum solvents, Freon); spotting chemicals (trichloroethane, methylchloroform, ammonia, peroxides, hydrochloric acid, rust removers, amyl acetate) |

**Table 1. Potential Contaminant Sources and Associated Contaminants (Continued)**

| SOURCE | HEALTH, ENVIRONMENTAL, OR AESTHETIC CONTAMINANT |
|---|---|
| Lift stations | Municipal wastewater; sludge; treatment chemicals |
| Machine shops | Solvents; metals; miscellaneous organics; sludges; oily metal shavings; lubricant and cutting oils; degreasers (TCE); metal marking fluids; mold-release agents |
| Major highways | Herbicides in highway rights-of-way; road salt (sodium and calcium chloride); road salt anticaking additives (ferric ferrocyanide, sodium ferrocyanide); road salt anticorrosives (phosphate and chromate); automotive wastes |
| Major railroads | Diesel fuel, oil, transported chemicals |
| Military bases | Fuel, Oil, Grease, Pesticides, hazardous chemicals |
| Mining | Acid drainage; metals; dissolved solids; radioactive ores other hazardous and nonhazardous wastes |
| Nurseries | Herbicides, insecticides, fungicides, and other pesticides |
| Oil wells | Metals; acids; minerals; sulfides; other sulfides; other hazardous and nonhazardous chemicals |
| Oil/gas pipeline | Corrosive fluids; hydrocarbons; other hazardous and nonhazardous materials and wastes |
| Other wells | Storm water runoff; spilled liquids; used oil; antifreeze; gasoline; other petroleum products; road salt; pesticides; and a wide variety of other substances |
| Photo processor | Cyanides; biosludges; silver sludges; miscellaneous sludges |
| Power lines | PCBs from transformers and capacitors; oils; solvents; sludges; acid solution; metal plating solutions (chromium, nickel, cadmium); herbicides from utility rights-of-way |
| Printer | Solvents; inks; dyes; oils; miscellaneous organics; photographic chemicals |
| Refineries | Hydrocarbons; oil-field brines (highly mineralized salt solutions) |
| Refinishing[1] | Paints; solvents; degreasing and solvent recovery sludges |
| Septic systems | Septage; coliform and noncoliform bacteria; viruses; nitrates; heavy metals; synthetic detergents; cooking and motor oils; bleach; pesticides; paints; paint thinner; photographic chemicals; swimming pool chemicals; septic tank/cesspool cleaner chemicals; elevated levels of chloride, sulfate, calcium, magnesium, potassium, and phosphate |
| Sewage plants | Sewage wastewater; nitrates; other liquid wastes; microbiological contaminants |
| Spray fields | Organic matter; nitrate; inorganic salts; heavy metals; coliform and noncoliform bacteria; viruses; nitrates; sludge; nonhazardous wastes |
| Substation | PCBs, oils |
| Underground storage tanks | Heating oil; diesel fuel; gasoline; other petroleum products; other commercially used chemicals |
| Waste piles | Organic and inorganic chemicals; metals; oils; wastes from households and businesses |
| Wood preserving[1] | Wood preservatives; creosote |

[1] Listed by EPA as a light industry with high potential to contaminate ground water (USEPA, 1990)

**Some Sources of Existing Information on PCSs**

Superfund sites **(CERCLIS):** *USEPA; DENR Division of Waste Management (DWM), Superfund Section*

Point source discharges **(NPDES):** *DENR Division of Water Quality (DWQ), Water Quality Section*

Ground-water contamination sites **(PIRF)**: *DENR DWQ, Groundwater Section*

Abandoned dump sites: *DENR DWM, Solid Waste Section*

Hazardous waste management facilities: *DENR Division of Solid Waste Management, Hazardous Waste Section*

Underground storage tanks: *DENR, DWM, Underground Storage Tank Section*

Pesticide Applications: *NCDA, Food and Drug Division, Pesticide Division*

Land Application of Waste: *DENR DWQ, Water Quality Section*

Feedlots: *Local NRCS Office, NCDA*

Hard copy files: local, county, and state governments may have information on the location and type of PCS. Examples include:

- County septic tank permit records,
- The location of homes and businesses that are not on the PWS. These are likely locations for wells that can provide a direct route for contaminants to enter the ground water if not properly constructed.
- Cemeteries, landfills, and other land uses that may lead to ground-water contamination

Aerial photos: if aerial photos or other remote images exist, they can be used to learn about areas that are not accessible, or to measure the size of a large PCS such as a landfill or waste dump. Orthophotoquads, which are black and white images in map format, may be available for your area. Annual crop compliance slides from your county's Farm Service Agency office "USDA-FSA" may also be a useful source of information. The North Carolina Geological Survey has a collection of aerial photographs. The North Carolina Department of Transportation's Photogrammetry unit also has a collection of aerial photos, and if your WHPA is near a major road, photos may be available. Digital orthophotoquad quarter quadrangles are available from NCDOT and the United States Geological Survey at a scale of 1:12,000. Contact information including web addresses are given in the "Resources and References section" of this chapter.

Other published information: for compliance with emergency planning and Right-to-Know regulations, industries must notify emergency planning committees and fire departments of the use and storage of certain materials. Information from the North Carolina Department of Revenue, sales tax division, may provide information on retail sales of PCSs. The yellow pages of the local phone book and the directory of local businesses supplied by the Chamber of Commerce are also potential sources of information.

## Locate PCSs on a preliminary map

Begin marking locations of known or suspected PCSs on a working map.

After gathering preliminary data from existing records, it is a good idea to plot the PCSs that have been identified so far on a map or aerial photo. This map does not have to be complex or highly technical; often paper copies of city street maps, plat maps, or USGS topographic maps will work well. Large scale aerial photos in the range of 1:3,000 to 1:12,000 are usually the most suitable for mapping. If no aerial photos or orthophotos are available, the information can be transferred to a USGS quadrangle or county road map. The USGS mapping center sells 1:24,000 scale topographic maps. A contact number and web address is given in the "Resources and References" section in this chapter.

Documenting the locations of known PCSs will help guide site visits to confirm these sources and may suggest land use patterns or situations that need additional investigation. Identification of several contamination sites close together, for example, may suggest that a common historical source might exist.

## Identify additional PCSs and characterize each PCS

PCSs not identified from existing databases and information will need to be identified and documented. In addition, information on PCSs already identified in the initial search needs to be verified and possibly updated.

To collect up-to-date information about sources already identified, it may be necessary to conduct surveys of cooperating PCS owners or operators. The surveys should concentrate on gathering information for the PCS Data Sheet (Attachment 1), such as the amount and type of potential contaminants stored, produced, or disposed of at each site. Each sheet must also be labeled with the appropriate PCS Identity Code. This same code will be used on the final map of PCSs and on the Inventory of PCSs described below.

To find additional unrecorded sources, it will be necessary to do some detective work in the WHPA, where community sources of information may be as important as government records. A key step is to find out if private and community wells are serving as conduits for ground-water contaminants. Poorly constructed and improperly abandoned wells are numerous, and there are no records for many of them. Information from members of the community and visual surveys of the WHPA will be the primary ways to identify these.

Past PCSs are important to document and may not appear in current official records. Personal interviews with community residents can be extremely valuable sources of such information. Knowledge that a service station once stood on what is now a home site may lead to the discovery of an old underground storage tank. Retired facility operators, public officials such as firefighters, road commissioners, planning and zoning officials, building inspectors, health inspectors, and long-term residents can give an historical perspective, possibly revealing sources that cannot be identified any other way. The preliminary PCS map is a useful tool in collecting community information. Although interviews can be fruitful, they also require a substantial investment of time. Additional time is required to verify the information obtained as a result of these interviews.

There are several approaches to collecting local information:

Investigate undocumented PCSs by gathering community information through observations, surveys, and interviews.

**"Windshield" Surveys** are done by driving through the WHPA, and simply looking through the windshield for anything that might be a potential source of a contaminant. This can be done to find new leads or to confirm information from electronic databases, hard copy files, and the public. Land uses can indicate the types of PCSs to look for: private wells and septic tanks in rural residential areas, storage tanks in commercial areas, etc.

**On-Site Surveys** include visits to reported or possible PCSs to complete the detailed information that is required.

**Contact with Individual Land Owners** is time consuming but may be the only way to gather specific information. These surveys can be conducted by mail, telephone, or door-to-door. Be sure to collect all of the information required to complete your PCS Data Sheet and to ask about the history of the site.

Before you begin any individual contacts, especially door-to-door surveys, it is essential to notify the public of the upcoming inventory. You can involve the media to promote the inventory through local publicity. Preparing the public for

Involving the public through publicity in local media can improve the quality of information you collect about PCSs.

this survey and explaining its purpose will often increase the response rate and improve the quality of information you collect.

Once all additional information collection is complete, you should update all PCS Data Sheets with additional information gained during this process and complete a Data Sheet for each new PCS identified. You should also update the preliminary PCS map.

## Summarize the information from all PCS Data Sheets

Now that all information on PCSs within the WHPA has been collected from official and community sources, it is time to summarize the information in the most useful form before moving to the next step. The goal is to organize the information so that PCSs and pollutants are consistently identified in the WHPA and to make the task of ranking sources easier.

### Complete the PCS Code Form for each WHPA

The PCS Identity Code Form (Attachment 2) lists PCSs by category and is used to assign a unique identification number to each individual PCS. First, number the categories that you found in your WHPA. For example, if you found only three categories — cemeteries, dry cleaners, and gas stations, you would number these categories 1, 2, and 3, respectively on the inventory form. If there is more than one source in a category, label each source with a different letter. If there were two cemeteries, they would be designated 1A and 1B; three dry cleaners would be designated 2A, 2B, and 2C; and the single gas station would be identified as 3. These same codes should be copied onto each individual PCS data sheets and the final map described below. These codes will also be transferred to the Final Inventory Form after the PCSs have been ranked by risk.

Complete the inventory by organizing, summarizing, and mapping the final information.

### Plot the locations of all PCSs on the final inventory map

Place a corresponding number on the final inventory map, indicating the location of the source using the PCS Identity Code assigned to each. This map is basically a revised, clean version of the preliminary working map developed earlier in the inventory process. If there are zoning ordinances in effect, it will be helpful to combine this with a zoning map. This will help to determine later whether new or existing ordinances are needed to protect the PWS. A sample map is shown in a partial plan example in Attachment 5.

## Estimate risks and rank potential contaminant sources

Once the PCSs are identified, the next step is to estimate the risks posed to your water supply. You will rank each PCS according to the threat it poses to the water supply wells. Then you can determine which PWS wells are most vulnerable as a guide for management and protection. A systematic evaluation of the relative risk of contamination from each PCS identified in the inventory will allow you to determine (1) which water supply well is at the greatest risk of contamination, and (2) which PCSs should be considered first because they pose the greatest threat. Good risk assessment is the best basis for setting priorities to manage PCSs and protect your water supply.

**Table 2. General risk ranking of PCSs (adapted from EPA, 1993; Oregon DEQ, 1996).**

| Commercial/Industrial | Agricultural/Rural | Residential/Municipal | Miscellaneous |
|---|---|---|---|
| | **HIGHER RISKS** | | |
| Automobile repair shops/gas stations | Auction lots | Airports – maintenance/ fueling areas | Historic gas stations |
| Boat services/ repair/refinishing | Confined animal feeding operations (CAFOs) | Landfills/dumps | Historic waste dumps/landfills |
| Chemical/petroleum processing/storage | Farm machinery repair | Railroad yards/ maintenance/fueling areas | Injection wells/drywells/sumps |
| Chemical/petroleum processing/storage | Machine shops | Septic systems – high density – >1/acre | Military installations |
| Dry cleaners | Lagoons/liquid wastes | Stormwater discharges | Road salt storage areas |
| Electrical/electronic manufacturing | Pesticide/fertilizer/petroleum storage, handling, mixing, and cleaning areas | Utility stations – maintenance areas | Underground storage tanks |
| Fleet/trucking/bus terminals | Unauthorized/illegal waste disposal | | Utility right-of-ways – pesticide use areas |
| Furniture repair/manufacturing | | | |
| Home manufacturing | | | Wells |
| Junk/scrap/salvage yards | | | |
| Machine shops | | | |
| Metal plating/finishing/fabricating | | | |
| Mines/gravel pits | | | |
| Parking lots/malls – >50 spaces | | | |
| Photo processing/printing | | | |
| Plastics/synthetics producers | | | |
| Research laboratories | | | |
| Wood preserving/treating | | | |
| Wood/pulp/paper processing and mills | | | |
| | **MODERATE RISKS** | | |
| Car washes | Crops – irrigated** | Drinking water treatment plants | Above ground storage tanks |
| Cement/concrete plants | Greenhouses, vegetables | Golf courses | Construction/demolition areas |
| Food processing | Boarding stables | Housing – high density – >1 house/0.5 acres | Freeways/state highways |
| Funeral services/graveyards | Land application sites | Motor pools | Hospitals |
| Hardware/lumber/parts stores | | Parks | Managed forests |
| Medical/vet office | | Waste transfer/ recycling stations | Sludge disposal areas |
| | | Wastewater treatment plants/collection stat's. | Railroads |
| | | | Random dumpsites |
| | **LOWER RISKS** | | |
| Office buildings/complexes | Crops – nonirrigated Christmas trees, grains, grass seeds, hay, pasture | Apartments and condominiums | Surface water – streams/lakes/rivers |
| RV/mini storage | Rangeland | Campgrounds/RV parks | |
| | Septic systems – low density – <1/acre | Fire stations | |
| | | Schools | |

* Facility-specific management practices are not taken into account in estimating risks and assigning these categories.
** Note: Drip-irrigated crops are considered lower risks.

GW\WH5868CG (November 1, 1996)

A very general approach to estimating risk can be based on a simple grouping of PCSs into categories of lower, moderate, or higher risk. Examples are shown in Table 2. While this kind of approach is fairly broad, it may give a reasonable basis for initial prioritization in situations where detailed background information and technical expertise is lacking.

Ranking PCSs by risk is the basis for setting priorities to protect your drinking water supply.

The next level of risk assessment considers both the ranking of the PCS itself and its distance from the well, an indication of the likelihood that the PCS can actually contribute contamination to the well. For example, a moderate risk PCS that is close to the water supply well may be of more concern than a higher risk PCS located far from the well where it is unlikely to affect the water supply.

There are more sophisticated systematic risk assessment methods available to evaluate the various risk factors and arrive at a numeric score for each pollution hazard. Some methods are better suited for assessing the risks posed by a variety of sources; others focus on evaluating risks from a single source. EPA's risk assessment tools include:

- DRASTIC (Aller et al., 1987), a modeling tool that evaluates the vulnerability of ground water to contamination
- The ground-water pathway of the Hazard Ranking System
- The abandoned well risk assessment methodology
- The Priority Setting Approach

EPA's Priority Setting Approach is the basis for the method recommended in this guidance. Details of the approach are contained in the EPA Technical Assistance Document, Managing Ground Water Contamination in Wellhead Protection Areas: A Priority Setting Approach (EPA/570/9-91-023).

Risk evaluation for PCS may be based on

- Simple ranking by relative risk categories from published sources
- Ranking of sources plus distance to well
- Systematic risk assessment based on consideration of the severity of the contaminant plus the likelihood of release plus the probability of delivery to the well

The risk associated with a particular PCS can be considered as the product of three factors: (1) the severity of the source (e.g., its size, the amount and toxicity of the contaminant); (2) the likelihood and magnitude of a release from the source; and (3) the likelihood of the released contaminant reaching the well. For each WHPA, the PCSs identified in the inventory could be assigned to a relative risk category based on a multiplication of numeric scores assigned to each factor. These scores could, for example, represent the magnitude of each factor: 1-lower, 2-moderate, and 3-higher. Multiplying these scores would result in an overall risk score ranging from 1 (least risk) to 27 (highest possible risk). An example risk calculation sheet is presented in Attachment 3.

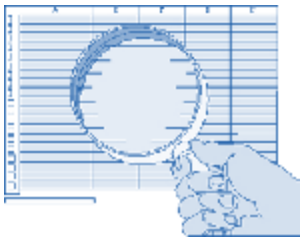
Factors to consider in developing the index include:

- **Severity of Contamination**
  - Toxicity of each contaminant (The OSHA designations of chemicals inventoried at some facilities can be used)
  - Persistence of the contaminant in the environment (how quickly the contaminant breaks down after release)
  - Mobility and attenuation (how easily the contaminant moves through the soil and how much may be held by the soil)
  - Quantity of the contaminant that could be released by this source

- **Likelihood of Contamination Release**
  - Nature of the source activity (Is the activity weather dependent? Carefully controlled?)
  - Compliance history of a permitted facility (Do current practices and history suggest that there is a good probability of release?)
- **Likelihood of delivery to well**
  - Distance to well
  - Time of ground-water travel to well (ground-water velocity under pumping conditions)
  - Characteristics of the WHPA (hydraulic conductivity, pathways for contaminant movement to ground water and ground-water movement through the aquifer, e.g. rock fractures)

Note that the likelihood of contaminant delivery to a well varies with WHPA characteristics. Due to overlapping WHPA, a PCS may occur in multiple WHPAs. In such a situation, the PCS must be ranked with respect to each of the WHPA's wells.

## Complete the master scoresheet



Sort the PCSs in the risk assessment worksheet by risk category for each well. Transfer these PCSs to the WHPA PCS Inventory form. An inventory form is required for each well in the WHPA. An example form is provided in Attachment 4. Record each PCS on the form by PCS category, PCS Identity Code, name, location, and risk category. In a 1-3 scoring system, overall risk scores of 1-9 would be categorized as "lower risk sources", risk scores of 10-18 would be considered "moderate risk sources", and risk scores of 19-27 would be considered "higher risk sources". Categorizing PCSs will help you later in prioritizing management strategies to protect your WHPA.

## Involving the public

Public information & education and public involvement in the inventory process can promote awareness of drinking water protection, provide better information on PCSs, and lead to improved management.

A public information and education program and public involvement in WHP can create greater awareness of pollution prevention and drinking water protection and lead to better management. If residents understand that the purpose is protecting their drinking water, their investment, and their health, they will likely support the effort. Broad public support can lead to better participation in surveys and more complete information. The effectiveness of your Wellhead Protection (WHP) Program can only be as good as the information gathered in this step; if a serious PCS is overlooked, your drinking water cannot be protected from it. Therefore, it is important to get public cooperation in making the inventory as thorough as possible.

The public can provide helpful input in many phases of the inventory and ranking process. Residents may know of unused wells or buried wastes that are not recorded elsewhere. Educating the public about the purpose of wellhead protection usually leads to improved cooperation and better information.

The data-gathering activity is an excellent opportunity to understand the needs and perceptions of the community. Residents may believe, for example,

that a PCS exists in a former industrial site. Investigation of this situation may lead to the discovery of a new PCS, or it may be shown that there is no cause for concern. In either case, the process will demonstrate that community concerns are taken seriously and that the resulting WHP plan will address local needs.

Local volunteers may be used for surveys to collect community information. Following the initial inventory, students, retirees, and other volunteers can help you complete a field search for existing and potential contaminants. In most cases, volunteers will need training in administering the survey and knowing what to look for in the field. Confidentiality issues must also be addressed.

The public can also be included in the ranking activities. It is critical that the Planning team listen to the concerns of the community. At the same time, it should be cautioned that risk is often seriously misunderstood by the public and public perceptions of risk may not always agree with actual risk assessment. A public process can be a good opportunity to educate the community with regard to actual risks associated with drinking water contamination.

# Products that should result from Step 3, to be included with the final plan:

When you've completed this step, you should have the following information to include with the final plan you submit to PWS:

1. **List of sources used to identify PCSs**.
   List the electronic databases that were used, document files that were reviewed, surveys conducted, and any other sources used.
2. **Printouts showing search results of each electronic database searched.**
   Be sure the name of the database is included with its results. Indicate which items in the database search results were included as PCSs in the plan, and which lie outside the WHPA
3. **A sample of each survey questionnaire used to gather basic site information.**
   Include questions about the amount and type of potential contaminants stored, produced, or disposed of at each site.
4. **Summary of data from each type of survey** (keep individual responses on file locally)
5. **Data Sheet for each PCS included in the Plan** (Attachment 1)
6. **WHPA PCS Identity Code Form for each well or zone, showing categories of PCSs found** (Attachment 2)**.**
   You may adjust the categories for your specific situation. For instance, if you have many hog lagoons, you may wish to have that as a category, rather than "holding pond/lagoon" so that the exact nature of the PCS is known.
7. **Criteria used for deciding which PCSs to include and the ranking system used.**
   The ranking system presented earlier in this chapter is suggested for ease of adaptation, however no one particular system is required. You will need to indicate the ranking system that you selected.
8. **WHPA Inventory List of PCSs grouped by higher, moderate, and lower risk for each well** (Attachment 4)
9. **Map(s) of PCSs with Identity Codes**
10. **Documentation of public citizen involvement**

# Resources and References

Aller, L., T. Bennett, J. H. Lehr, R. J. Petty, and G. Hackett, 1987. DRASTIC: A Standardized System For Evaluating Ground-water Pollution Potential Using Hydrogeologic Settings. U.S. Environmental Protection Agency, EPA/600/2-87/035, 622 pp.

ATSDR ToxFAQsTM, a series of summaries about hazardous substances in the environment; online at http://www.atsdr.cdc.gov/toxfaq.html#-A-

INTEGRATED RISK INFORMATION SYSTEM (IRIS), prepared and maintained by the U.S. Environmental Protection Agency (U.S. EPA), an electronic data base containing information on human health effects that may result from exposure to various chemicals in the environment; online at http://www.epa.gov/iris/intro.htm

Oregon DEQ 1996. Oregon Wellhead Protection Program Guidance Manual.

POTENTIAL DRINKING WATER CONTAMINANT INDEX, A list of potential drinking water contaminants and their potential sources associated by three categories of land use: Commercial/Industrial, Residential/Municipal and Agricultural/Rural; online at http://www.epa.gov/OGWDW/swp/vcontam3.html

POTENTIAL SOURCES OF DRINKING WATER CONTAMINATION INDEX, a list of some potential facilities and activities where one might find the contaminants referred to in the contaminant index above; online at http://www.epa.gov/OGWDW/swp/sources1.html

USEPA. 1990. A Review of Sources of Ground-Water Contamination from Light Industry. EPA/440/6-90-005.

USEPA. 1991. Guide for Conduction Contaminant Source Inventories for Public Drinking Water Supplies. U.S. EPA Technical Assistance Document. EPA 570/9-91-014. Washington D.C.

USEPA. 1991. Managing Ground-water Contamination Sources in Wellhead Protection Areas: A Priority Setting Approach. EPA 570/9-91-023, Washington, DC.

USEPA. 1993. Wellhead Protection: A Guide for Small Communities. EPA/625/R-93/002. Office of Research and Development, Cincinnati, OH.

Wyoming DEQ. 1997. Wyoming's Wellhead Protection Program Guidance Document. November; online at http://www.wrds.uwyo.edu/wrds/deq/whp/

## Photos/Maps

GISDataDepot. (downloadable digital Orthophotos) http://www.gisdatadepot.com

NCDOT Photogrammetry Unit. (Aerial Photos) Contact: Keith Johnston, PE, PLS (919) 250-4167 http://apps01.dot.state.nc.us/apps/directory/680.html

NCSU Libraries GIS Data Archive (Digital Orthophotoquads)
http://www.lib.ncsu.edu/stacks/gis/themes/term0410.html

USGS National Mapping Information. USGS topographic maps and aerial photographs. http://mapping.usgs.gov/esic/to_order.html
1-888-ASK-USGS (1-888-275-8747)

## Regulatory Databases Containing PCS Information

**ASTDR:** Agency for Toxic Substances and Disease Registry
http://www.atsdr.cdc.gov/hazdat.html
Responsible Agency: U.S. Department of Health and Human Services
The database contains records for 75 sites in North Carolina that contain information on chemicals associated with these sites.

**CERCLIS**: Comprehensive Environmental Response, Compensation, and Liability Information System
http://www.epa.gov/superfund/sites/cursites/nccerlst.htm
Responsible Agency: Division of Waste Management, Superfund Section
CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by the state, municipalities, private companies, and private individuals pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The database contains information on over 130 sites. The database contains lattitude and longitude for each facility.

**Large On-Site Wastewater Facilities**
Responsible Agency: Division of Environmental Health, On-Site Wastewater Section
http://www.deh.enr.state.nc.us/oww/Inspecti/inspect.htm
This page lists onsite wastewater system operators by county.

**NPDES** (National Pollutant Discharge Elimination System)
Responsible Agency: Division of Water Quality, Water Quality Section
http://h2o.enr.state.nc.us/NPDES/permits.html#lists
The NPDES database identifies facilities permitted for the operation of point source discharges to surface waters in accordance with the requirements of Section 402 of the Federal Water Pollution Control Act. The database includes information on the type of waste and the permitted flow of over 1,600 municipal and industrial facilities in the state. The database contains lattitude and longitude for each facility.

**NPL** (National Priority List – Superfund)
www.epa.gov/region4/wastepgs/sf/supfnd.htm
Responsible Agency: Division of Waste Management, Superfund Section
The NPL is a subset of CERCLIS and identifies sites for priority cleanup under the Superfund Program. The database contains information on approximately 20 sites in North Carolina and the lattitude and longitude for each site.

**PADS** (PCB Activity Database System)

www.epa.gov/ceppo/ds-epds.htm#title3

Responsible Agency: Office of Pollution Prevention and Toxics, EPA

PADS identifies generators, transporters, commercial storers and/or brokers and disposers of PCBs. The database contains the physical address for over 110 sites.

**PIRF** (Pollution Incident Reporting Form)

http://gw.ehnr.state.nc.us

Responsible Agency: Division of Water Quality, Groundwater Section

The Groundwater Section maintains the State's incident management database which contains information on all ground-water contamination sites including sites that are handled by other agencies. The database contains an inventory of reported leaking underground storage tank incidents and other ground water and soil contamination incidents. Additionally, ground-water incidents which are not regulated by other agencies and involve pollutants such as those from above ground storage tanks, chemicals, nitrates, pesticides, and other organic and inorganic contaminants are included. The database includes lattitude and longitude for over 4,400 sites where ground-water contamination occurred and the sites are not considered closed.

**Petroleum Contained Soils**

http://ust.enr.state.nc.us/docs/dedsoil.pdf

Responsible Agency: Division of Waste Management, UST Section

Database contains information on 27 permitted, dedicated sites where soil contaminated by leaking petroleum or chemical storage tanks can be taken to remove threats to health and the environment. The database contains the physical address for each of the permitted facilities.

**Pre-Sanitary Landfill Dumps**

http://wastenot.enr.state.nc.us/SFHOME/Landfills_012002.pdf

Responsible Agency: Division of Waste Management, Solid Waste Section

Database contains an inventory of over 600 sites that are old municipal dumps which were not permitted since they pre-existed the effective date of the permitting rules. These sites are not currently in operation. The database contains lattitude and longitude for each facility.

**Septage Database**

Responsible Agency: Division of Waste Management, Solid Waste Section

This database contains information on over 160 permitted, dedicated sites where septage is land applied. The septage management program assures that septage (a fluid mixture of untreated and partially treated sewage solids, liquids and sludge of human or domestic origin that is removed from a septic tank system) is managed in a responsible, safe and consistent manner across the state. The database contains lattitude and longitude for each facility.

**Stormwater Database**

Responsible Agency: Division of Water Quality, Water Quality Section

This database contains municipal and industrial facilities that have been issued a stormwater permit. Examples of permitted facilities are vehicle maintenance areas, wood chip mills and mining sites. The database contains lattitude and longitude for each of over 3,400 facilities.

**UIC** (Underground Injection Control Permit Database)

Responsible Agency: Division of Water Quality, Groundwater Section, UIC Program

The UIC program permits Class V injection wells which do not inject waste into the subsurface. Examples of permitted Class V facilities include heat pump/air conditioning water wells, remediation wells, tracer wells, and experimental technology wells. There are over 200 permitted wells and lattitude and longitude are included for over 150. Physical addresses are known for the remaining permitted wells.

Contact Evan Kane (919) 715-6165 for database.

### Above Ground Storage Tanks

DENR.

Contact DENRs customer service center Contact Information Center (Telephone 1-877-623-6748) for possible database information.

### Animal Feedlots

Local NRCS office – http://www.nc.nrcs.usda.gov/Directory/directory.htm

Check with your local NRCS office for locations of animal feedlots in your area.

### Chemical Substances

FEMA – www.fema.gov

Registry of Toxic Effects of Chemical Substances (RTECS)
http://www.usfa.fema.gov/fedguide/ch4-14.htm

USEPA – www.epa.gov
http://www.epa.gov/ceppo/pubs/camtrain/cameoim.pdf
http://www.epa.gov/ceppo/pubs/camtrain/cameosm.pdf
Chemical emergency response and planning software

### De-Icing Salts

NC DOT – http://www.dot.state.nc.us/public

County Maintenance Offices – http://www.dot.state.nc.us/news/maintenance_offices.html

Phone listing of County NCDOT maintenance offices

### Fertilizer Applications

Local NRCS office – http://www.nc.nrcs.usda.gov

Check for typical fertilizers used and fertilizer recommendations

North Carolina State Cooperative Extension Service – http://www.ces.ncsu.edu/counties/

Contact local office for information on typical fertilizers, application rates and potential transport and fate

North Carolina Department of Agriculture (NCDA) – http://www.ncagr.com/stats/otherept.htm#chem

This site lists typical chemical applications by crop

**Hazardous Waste Management Facilities**

DENR, Division of Solid Waste Management, Hazardous Waste Section
http://wastenot.enr.state.nc.us/hwhome/HWHOME.htm
The harzardous waster section holds a database for all hazardous waste TSD's, generators, and transporters as defined by RCRA. The database contains lattitude and longitude for over 5200 facilities. Contact DENRs customer service center Contact Information Center (Telephone 1-877-623-6748) for possible database information.

http://wastenot.enr.state.nc.us/HWHOME/guidance/guidance.htm
This page contains guidance documents for various hazardous waste compounds and issues.

USEPA
RCRIS and RCRA: Resource Conservation and Recovery Information System – www.epa.gov/epaoswer/hazwaste/data/notify.htm

**Inactive Hazardous Sites**

http://wastenot.enr.state.nc.us/SFHOME/ihs_inv_by_cty_012002.pdf
Responsible Agency: Division of Waste Management, Superfund Section
The database contains information on over 1100 sites with confirmed or suspected hazardous substance contamination. The database contains the physical address for each of the sites.

**Land Application of Waste**

Responsible Agency: Division of Water Quality, Water Quality Section
The non discharge database identifies industrial and municipal facilities that are permitted to operate any sewer system, treatment works, disposal system, petroleum contaminates soil treatment system, animal waste management system, stormwater management system or residual disposal/utilization system which does not discharge to surface waters of the state, including systems which discharge waste onto or below land surface. The database contains the physical address for over 1,200 permitted facilities.

ftp://h2o.enr.state.nc.us/pub/Non-Discharge/
The site has a spreadsheet ("sprayirrigation.xls) listing facilities that spray irrigate with wastewater

ftp://h2o.enr.state.nc.us/pub/Non-Discharge/Animal%20Operations%20Info/
This site has a spreadsheet ("location.csv") listing animal operations that spray irrigate with wastewater, and their locations

Non-Discharge permits, DENR, Water Quality Section, Permits and Engineering – http://h2o.enr.state.nc.us/ndceu/laws.html

**Landfills**

DENR, Division of Solid Waste Management, Solid Waste Section
http://wastenot.enr.state.nc.us/swhome/newhom.htm

http://wastenot.ehnr.state.nc.us/SWHOME/facil.htm
This page contains lists of all permitted solid waste facilities by type in North Carolina along with contact information

http://wastenot.ehnr.state.nc.us/SWHOME/mswlst.pdf
This page contains a list of all municipal waste facilities (landfills) in North Carolina with contacts.

**Mine Tailing/Storage Piles**

DENR, Division of Land Resources, Land Quality Section
http://www.dlr.enr.state.nc.us/DLR.htm

http://www.geology.enr.state.nc.us/Permitted%20Mines%201999-2000/permitte.htm
Contains a list of permitted active and inactive mines in North Carolina, and maps.

**Pesticide Applications**

NCDA, Food and Drug Division, Pesticide Division
http://www.agr.state.nc.us/fooddrug/pesticid/index.htm

NCDA
http://www.ncagr.com/stats/otherept.htm#chem
Lists herbicide, insecticide and fungicide usage in North Carolina by crop.

http://www.ncagr.com/stats/otherept.htm#rest
Restricted Pesticide Usage
Lists Herbicides and Pesticides which use is restricted in North Carolina.

North Carolina Pesticide Applicator Training Program
http://ipmwww.ncsu.edu/ncpat/
Information of Licensing and Certification, and training.

**Septic Tanks**

County Health Department; DENR, Division of Solid Waste Management, Solid Waste Section
http://wastenot.enr.state.nc.us/swhome/newhom.htm

**Shallow Injection Wells**

DENR, Groundwater Section
http://www.dwr.ehnr.state.nc.us/hms/gwbranch/GWB.htm
http://gw.ehnr.state.nc.us/rules.htm##2C200
Lists criteria and standards applicable to injection wells as part of NC ground-water protection rules.

http://www.epa.gov/safewater/uic/c5stimp.pdf
"Revisions to the Underground Injection Control Regulations for Class V Injection Wells". This guide has been developed to assist States and EPA Regions in implementing the "Class V Rule" *(Revisions to the Underground Injection Control Regulations for Class V Injection Well*s, 64FR 68546).

**Surface Impoundments**

DENR, Division of Environmental Health, Public Health Pest Management Section
http://www.deh.enr.state.nc.us/phpm/pages/index.htm

Applicator License
http://www.deh.enr.state.nc.us/phpm/pages/Applicator%20license.htm
These pages apply to pesticide application for mosquito control

**Underground Storage Tanks**

DENR, Division of Waste Management, Underground Storage Tank Section
http://wastenot.enr.state.nc.us

Petroleum Underground Storage Tank Database
http://wastenot.enr.state.nc.us/dbases.htm#UST Facilities
http://204.211.90.139/database.html
Responsible Agency: Division of Waste Management, UST Section
These facilities are regulated under Subtitle I of the RCRA and must be registered with the state and receive a operating permit annually. The database contains information on over 10,400 facilities with over 98,800 registered active tanks. Over 90 percent of these facilities met the December 22, 1998 deadline for having tanks upgraded with spill and overflow prevention devices. The database contains the physical address for each of the permitted facilities.

USEPA
http://www.epa.gov/swerust1/regions/index.htm
Regional EPA offices for underground storage tanks.

## Attachments:

Beginning with the next page, you will find attachments that are provided to make it easier for you to prepare your plan document.

Remember, the attachments that are labeled "Example" are only to give you ideas.

- **Attachment 1: Example of a Potential Contaminant Source Data Sheet**
- **Attachment 2: Example of a Potential Contamination Source Identity Code Form**
- **Attachment 3: Example of a Risk Assessment Worksheet.** This worksheet may be copied and used directly, or may be adapted as required. You may also want to develop a spreadsheet or database to list the PCSs and perform the ranking calculations and perform final sorting.
- **Attachment 4: Example of a WHPA PCS Inventory Form**
- **Attachment 5: Example of a partial plan, showing the portions of the plan that result from this step.** The example plan shows you the kind of information that you are expected to include in the plan that you submit for approval. Your final plan will be different than the fictional Town of Clearwater plan that is provided as an example. Your list and types of PCSs may be different and the number of wells in your WHPA may be different.

# Attachment 1: Example of a Potential Contaminant Source Data Sheet

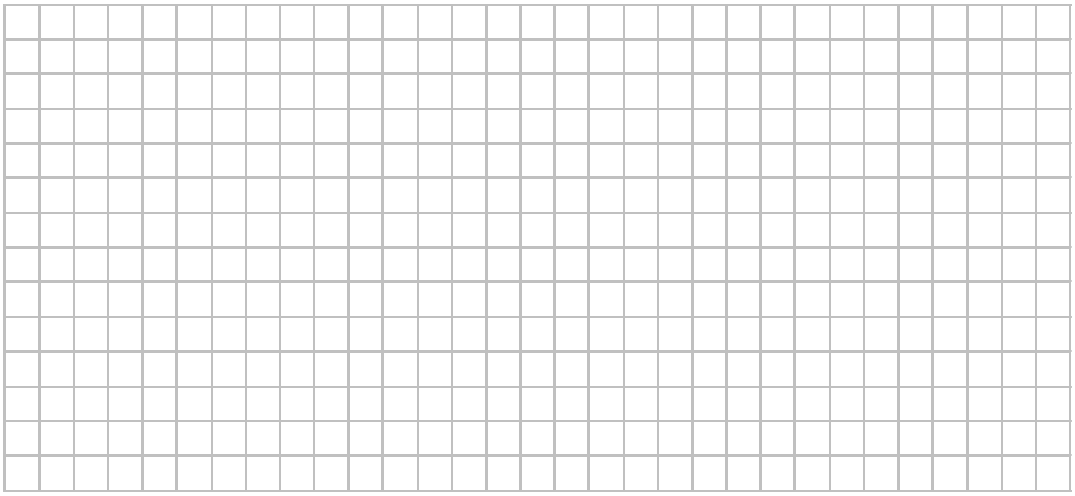
POTENTIAL CONTAMINANT SOURCE DATA SHEET

Wellhead protection area for PWS: [insert name]_____

Facility Name
Operating Status (open/closed/abandoned)
Address
Phone #:
Owner's Name
Owner's Address
Owner's Phone #
Well number, if applicable_____
Permit, if applicable_____
Zone, if applicable_____

| Possible contaminant substances ( use additional space below if necessary) | Maximum quantity anticipated on premises | Type of storage and containment: |
|---|---|---|
| Example: methylene chloride | Example: 110 gal. | Example: 55-gallon drums stored on loading dock and in shop. |
| | | |
| | | |
| | | |

Draw sketch outlining property, locating major buildings and potential contaminants



PCS Identity Code, assigned after completing PCS Inventory_____

# Attachment 2: Example of a Potential Contamination Source Identity Code Form

**WHPA**
**Potential Contaminant Source Identity Code Form**
**For WHPA (or zone) _____**

Place a number next to each category that you identify in your WHPA. Place a corresponding number on the delineation map at the location of the source. If there is more than one source for a category, label each site with a letter (1A, 1B, 1C, 2A, 2B). Record the name of the business, owner's name, address, and specific PCS information for each site on a separate WHPA PCS Data Sheet.

**___ABANDONED WELLS**
**___ABOVEGROUND STORAGE TANK**
**___AGRICULTURAL FACILITIES**
**___AIRPORT**
**___ANIMAL FEEDLOT/WASTE STORAGE**
**___ASPHALT PLANT**
**___AUTO REPAIR**
**___BODY SHOP/SALVAGE**
**___CEMETERY**
**___CHEMICAL PRODUCTION**
**___CHEMICAL MIXING/STORAGE**
**___DOT STATIONS**
**___DRAINAGE CANAL**
**___DUMPS**
**___ELECTROPLATERS/METAL FINISHERS**
**___FERTILIZER/PESTICIDE MIXING/STORAGE**
**___FERTILIZER/PESTICIDE PRODUCTION**
**___FUNERAL HOMES**
**___GAS STATIONS**
**___GOLF COURSES**
**___HOLDING POND/LAGOON**
**___INACTIVE/ABANDONED HAZARDOUS WASTE SITES**
**___INJECTION WELLS**
**___LABORATORIES**
**___LAUNDROMAT/DRY CLEANERS**
**___LIFT STATIONS**
**___MACHINE SHOPS**
**___MAJOR HIGHWAYS**
**___MAJOR RAILROADS**
**___MILITARY BASES**
**___MINING**
**___NURSERIES**
**___OIL/GAS PIPELINE**
**___OIL WELLS**
**___OTHER WELLS**
**___PHOTO PROCESSOR**
**___PRINTER**
**___POWER LINES**
**___REFINERIES**
**___REFINISHING**
**___SEPTIC SYSTEMS**
**___SPRAY FIELD**
**___SUBSTATIONS**
**___SEWAGE PLANT**
**___UNDERGROUND STORGE TANKS**
**___WASTE PILES**
**___WOOD PRESERVING**

**OTHER (SPECIFY)**

**___ _____**
**___ _____**
**___ _____**

**PLEASE CONTACT YOUR EMERGENCY MANAGEMENT COORDINATOR AND ASK FOR A COPY OF ALL RECORDS ON HAZARDOUS MATERIAL/SITES IN YOUR AREA. CONTACT YOUR LOCAL FIRE DEPARTMENT AS MSDS FORMS SHOULD BE FILED WITH THEIR DEPARTMENT FOR HAZARDOUS CHEMICALS STORED OR USED BY BUSINESSES IN YOUR AREA.**

# Attachment 3: Risk Assessment Worksheet: Well # _____

**Risk Assessment Worksheet**

| PCS Identity Code | Severity (1) | Likelihood of Occurrence (2) | Likelihood of Delivery (3) | Overall Score (1) * (2) * (3) | Risk Category (b) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

(a) In a 1-3 scoring system, Lowest Possible Risk will be 1, Highest Possible Risk will be 27. Add wells as necessary.
(b) Higher 19-27; Moderate 10-18; Lower 1-9

# Attachment 4: Example of a WHPA PCS Inventory Form

## WHPA PCS Inventory Form

Well[1] _____

| HIGHER RISK SOURCES | | | |
|---|---|---|---|
| PCS Category | PCS Identity/ Map Code | Name | Address/Location |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| MODERATE RISK SOURCES | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| LOWER RISK SOURCES | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

[1] Repeat form for each well in WHPA

# Attachment 5: Example of a partial plan, showing the portions of the plan that result from this step

### *Introduction*

Two WHPAs representing the three wells in the Clearwater water system as delineated in Step 2 were used as the basis for the potential contaminant source (PCS) inventory. Methods used to conduct a PCS inventory included performing a database search of existing state and federal databases, conducting a windshield survey, and making on-site visits to each of the PCSs identified.

### *Database search*

(Name) conducted a database search on Clearwater. The databases searched, and results of the search are summarized below:

FTP://h2o.enr.state.nc.us/pub/ — this address links to the first four databases:

1. Animal Operations Database DWQ
2. Class A Biosolids DWQ
3. Class B Biosolids DWQ
4. Spray Irrigation of Wastewater DWQ
5. Solid Waste Facilities DWM/SWS
   http://wastenot.ehnr.state.nc.us/swhome/permfr.htm
6. Pollution Incident Reporting Form (PIRF) Department of Environment and Natural Resources, Division of Water Quality, Groundwater Section
   http://gw.ehnr.state.nc.us/WebClass1.ASP
7. Underground Injection Control Permit Database (UIC): Division of Water Quality, Groundwater Section
8. Division of Emergency Management Database: Department of Transportation
9. Pollution Control System (PCS) Database (Water Discharge Permits): Environmental Protection Agency
10. Toxic Release Inventory System Database (TRIS): Environmental Protection Agency
11. Resource Conservation and Recovery Information System (RCRIS) Database: Environmental Protection Agency/Division of Waste Management, Hazardous Waste Section
12. Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) Database: Environmental Protection Agency/Division of Waste Management, Superfund Section
13. Agency For Toxic Substances and Disease Registry (ATSDR): U.S. Department of Health and Human Services

The database search found no Superfund sites, no ATSDR sites and no spills were found on the Emergency Management database. There were five RCRIS sites but only two, Bob's Chevrolet and Piedmont Furtniture, were in the WHPA. The three TRIS sites were out of the WHPA. There were four PCS sites, but only one was located in a WHPA, the N.C. National Guard Armory. Eleven ground-water contamination incidents were found with a Clearwater address, but only Clearwater Tribune, Jones and Company, the N.C. National Guard Armory and Clearwater College Maintenance were inside the WHPA.

Numerous animal operations are located in Clearwater County, but none were found in the WHPAs. There was one Underground Injection Site in Clearwater County, but it too was outside the WHPAs. There were no Spray Irrigation sites and no Class A or Class B Biosolids sites found. The solid waste landfill for Clearwater County is not located in the WHPAs. Data sheets were filled out for all sites found to be in the WHPAs during this database search and these were added to the list of PCSs found otherwise.

Planning team members [Name], [Name] and [Name] used the delineated topography map to identify potential contamination sources within the WHPAs. A "windshield survey" was conducted in the WHPA to determine PCSs. [Name] and [Name] visited each possible contamination source found in the database search and the windshield survey. Education about wellhead protection and ways to reduce the potential of contamination were discussed with owners/managers at each location. Assistance was also offered to help educate personnel at these locations.

There are four facilities within the WHPAs that are confirmed soil or ground-water contamination incidents.

Information about each is provided below.

1. Clearwater Tribune — No facility ID # — A petroleum spill was reported at this site on February 1999. A Limited Site Assessment was received by the Washington Regional Office (WARO) Groundwater Section on April 2, 1999. A letter requiring No Further Action at the site was written by the WARO on May 12, 1999.

2. Jones and Company — Incident # 1234 — This incident was reported in January 1990, and was the result of a leak from a 500-gallon fuel oil tank. According to a Soil Remediation and Groundwater Assessment Report submitted to the WARO on January 24, 1991, 46 tons of contaminated soil has been removed from the site. Samples collected from the remaining soil show maximum Total Petroleum Hydrocarbons (TPH) of 22 ppm. The soil standard is 10 ppm. One ground-water monitoring well had been installed at the site and a sample collected showed no compounds detected above quantitation limits. There was no additional correspondence following the submittal of the report.

3. N.C. National Guard Armory — Incident #5678 — A Tank Closure Report was submitted for this site on October 26, 1995. Samples collected from monitoring well MW-1 show Benzene concentrations to be 17,000 ppb. The site was accepted for State Lead clean-up status, and in a letter written on June 22, 1995 by Arther Mouberry, Groundwater Section Chief. The site was ranked as being 50 out of 56 sites in the Coastal Plain Region. The site will be cleaned up after the first 49 sites are finished.

4. Clearwater College Maintenance Building — Incident # 9876 — On October 21, 1991, a Site Assessment submitted to the WARO, showed minor soil contamination at the site. There was a slightly elevated concentration of Naphthalene at 43 ppm. On February 9, 2000, the WARO sent a letter to the responsible party requesting that a Limited Site Assessment be submitted within 120 days of receipt of the letter.

A Multi-System Query at http://www.epa.gov/enviro/index_java.html gives you information about all of the following:

1. National Pollutant Discharge Elimination System (NPDES). Identifies permitted facilities that discharge to surface waters — There are six facilities that have permits to discharge to surface waters. They are the Clearwater Wastewater Treatment Plant which discharges to the NE Cape Fear River, the Clearwater Water Treatment Plant which discharges backwash that drains to the NE Cape Fear River, and the Clearwater Pickle Company which discharges to a drainage ditch that eventually reaches the NE Cape Fear River. It is believed that permits issued to The Boling Group, The National Guard, and Sonocco Products are issued for stormwater drainage.
2. Toxic Release Inventory (TRIS) — Three facilities on this list permitted for air releases are outside of the WHPAs.
3. Hazardous Waste Handler (RCRIS) — There are two facilities located within the WHPAs that appear on this list, Bob's Chevrolet and Piedmont Furniture.
4. Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS). EPA/DWM/Superfund Section — There were no facilities within the WHPAs.
5. Biennial Reporting System. EPA/DWM/Superfund Section. Information from Large Quantity Generators (LCG) and Treatment, Storage and Disposal facilities — None were located within the WHPAs.
6. North Carolina Superfund Section — None were located within the WHPAs.
7. Inactive Hazardous Sites Inventory — None were located within the WHPAs.

There was one spill found on the Emergency Management data, but it too was outside the WHPAs.

The solid waste landfill for Clearwater County was found to be outside the WHPAs.

Five RCRIS sites were found with two of them located inside the WHPA: Bob's Chevrolet and Piedmont Furniture. Bob's Chevrolet is listed on this database because of a 250-gallon storage tank used to store waste oils, fluids, etc. from automotive work performed on-site.

This tank is pumped out by a contracted firm once every six weeks. Freon that is captured from older automobile air conditioners is also stored on-site and disposed of by a contract firm on a regular basis. Piedmont Furniture is on this database list because of glues, lacquers, oils, and stains that are used in their manufacturing process. The over-spray from the processes using these potential contaminants is collected and stored in 55-gallon drums on-site. These drums are collected by a contract firm when a truckload (approximately 100 drums) is available to be hauled. These waste products are re-cycled by the contract firm. There is also a 2,000 gallon diesel tank, 550 gallon diesel tank, 550 gallon gasoline tank, 3-2,000 gallon bulk tanks, 280 gallon used oil tank, coal storage, PCB transformers, boiler chemicals, and other smaller containers containing potential contaminants stored on site. These factors were considered along with location and history of the facilities when ranking these sites in the PCS inventory.

There were no Class A or B biosolids sites, no Superfund sites, no ATSDR sites, no underground injection sites, and no spray irrigation sites found in the database search. The sites found in the database search to be in the WHPAs were the first sites included in the PCS Survey. Detailed sheets on each site found inside the WHPAs are included in the back of the Wellhead Protection Plan.

**Windshield Survey**

[Name] conducted an extensive windshield survey of the delineated Wellhead Protection Areas. Using an EPA list of potential contamination sources (PCSs), he identified locations where contamination sources might exist. He conducted onsite visits to all of the facilities located within the area where potential contamination sources might be located and collected information about types, quantities and locations of known contaminants. He recorded information about each of these facilities on individual PCS sheets that are included with this document.

**Septic Tanks**

The Town of Clearwater operates a municipal sewage system within the town limits. There are approximately 100 residents located within the town that are still on individual septic tank systems.

**Abandoned Wells**

Locations of known abandoned wells are noted in the list of PCSs.

**Risk Assessment**

A risk assessment was conducted for each PCS and a worksheet is shown below. PCS data sheets are attached. In assessing the risk, the nature of the PCSs, the number of PCSs, the location of each PCS in relation to the well's location, and the history of compliance of the facility with any state or federal rules that may apply were all taken into consideration. The ranking of the vulnerability of the water supply wells is as follows with the well at the highest risk designated as number one:

The Wellhead Protection Committee feels that well #1 is at the greatest risk of contamination because of the close proximity of manufacturing and chemical storage in the immediate areas. Well #2 is subject to the next highest risk primarily due to the petroleum storage facility in the area. These factors were considered when determining priorities in managing the potential contamination sources in an effective manner.

**Risk Assessment Worksheet: Well # 1**

| PCS Identity Code | Severity (1) | Likelihood of Occurrence (2) | Likelihood of Delivery (3) | Overall Score (a) (1)*(2)*(3) | Risk Category(b) |
|---|---|---|---|---|---|
| 13A | 3 | 2 | 3 | 18 | Higher |
| 14A | 1 | 1 | 3 | 3 | Lower |
| 22A | 2 | 2 | 1 | 4 | Lower |
| 25A | 2 | 2 | 1 | 4 | Lower |
| . | . | . | . | . | . |
| For illustration purposes: only the PCSs shown on the map are presented here | | | | | |

(a) Lowest Possible Risk will be 1, Highest Possible Risk will be 27

(b) Higher 19-27; Moderate 10-18; Lower 1-9

## LIST OF POTENTIAL CONTAMINANT SOURCES

A PCS inventory is shown below. The potential contamination sources in each zone are organized in the order of their potential risk or threat of contamination to the system. In each risk category, the sources are listed in the order of their ranking from highest to lowest risk. This order was determined by the WHP planning team using materials included in the guidance documents, the history and proximity of each potential contamination source to the well sites and information gathered during the on-site visits to each site. A map of PCS locations for WHPA #1 is shown in Figure 1.

| **Well #1 (Zone #1).** ***Note: For purposes of example brevity, wells #2 and #3 omitted in this table*** | | | |
|---|---|---|---|
| ***HIGHER RISK SOURCES*** | | | |
| Category | Map Code | Name | Location |
| Chemical mixing and storage | 3A | Manufacturer | |
| Gas Station | 13A | Sanders' Market | |
| Gas Station | 13B | Quick-E-Mart | |
| GW PIRF | 8B | Clearwater Tribune | |
| GW PIRF | 8D | Jones and Co. | |
| Lift Station | 14B | Lift Station #3 | |
| Refinishing | 10A | Furniture maker | |
| Sewage Plant | 6B | Gordon St. WWTP | |
| UST | 1A | Simpson's Fuels | |
| UST | 1C | Abandoned gas station | |
| AST | 26A | Town of Clearwater Maintenance Yard | |
| ***MODERATE RISK SOURCES*** | | | |
| Auto Repair | 2B | Service Center | |
| Auto Repair | 2C | Tire Service & Repair | |
| Auto Repair | 2D | Garage | |
| Chem mix/storage | 3A | Food Processing Plant | |
| Fert/pesticide mixing | 16A | Fertilizer plant | |
| Fert/pesticide stg. | 15A | Ag. Supply store | |
| Gas Station | 13A | Convenience store | |
| Gas Station | 13C | Convenience store | |
| GW PIRF | 8C | National Guard Armory | |
| Lift Station | 14C | Lift Station #3 | |

| ***LOWER RISK SOURCES*** | | | |
|---|---|---|---|
| GW PIRF | 8H | Clearwater College Maintenance Building | |
| Holding pond/ Lagoon | 25A | Farm | |
| Laundromat/ Dry Cleaner | 21A | Clearwater Cleaners | |
| Laundromat/ Dry Cleaner | 21B | Laundromat | |
| Lift Station | 14A | Lift Station #5 | |
| Lift Station | 14C | Lift Station #1 | |
| Lift Station | 14D | Lift Station #4 | |
| Major Hwy | 22A | US 117 Bypass | |
| Military Base | 7A | NC Army National Guard | |
| Other Wells | 4A | Town of Clearwater Plant 2 | |
| Printer | 18A | Clearwater Times | |
| Printer | 23A | Clearwater Copy & Print | |
| Sewage Plant | 5A | Town of Clearwater WWTP | |
| UST | 1B | Used Cars #1 | |
| UST | 1D | Used Cars #2 | |

**Potential Contamination Source Inventory Summary**

It is considered that the major sources of potential contamination occur within the WHPA surrounding wells #1 and #2, and the sources for the greatest concern are in proximity to well #1. There are an above-ground diesel fuel tank and maintenance equipment near the well. Also, left-over public works materials are stored on the site and there is concern about deteriorating sewage lines and lift stations that are on streets near the well site. Also of concern are the confirmed soil and groundwater contamination incidents that have occurred within the WHPAs.

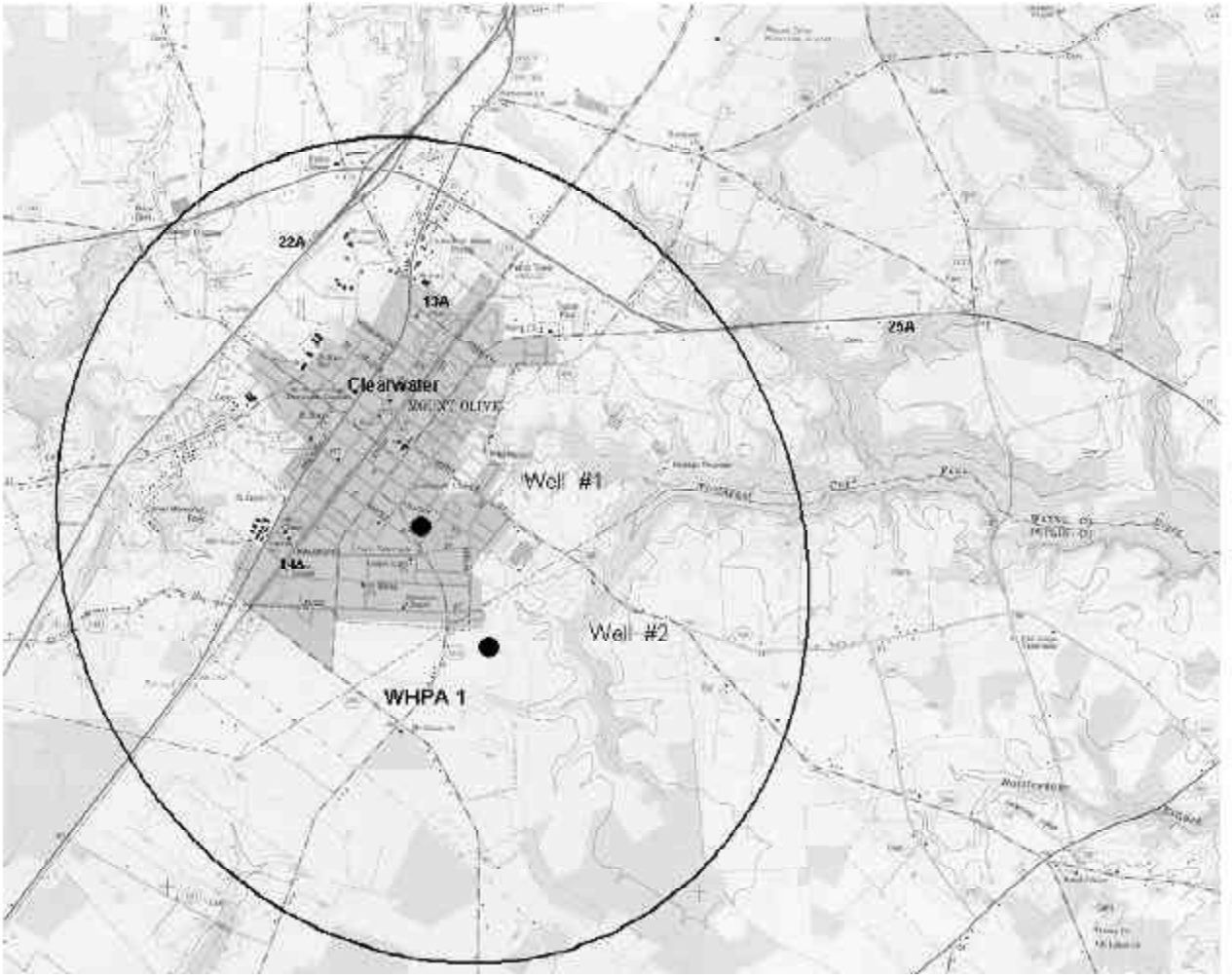



**Figure 1. Final PCS Map with Identity Codes.** (Note: For illustration purposes only; not all PCSs shown. Larger scale map copies may be necessary to show all PCSs for your WHPA.)

# Potential Contaminant Source Data Sheet

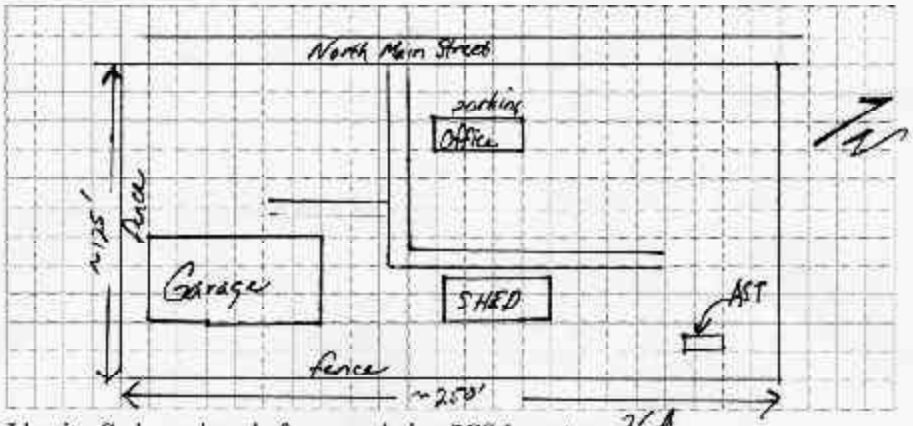
## POTENTIAL CONTAMINANT SOURCE DATA SHEET

Wellhead protection area for PWS: WHPA 1

Facility Name Town of Clearwater Maintenance Yard
Operating Status (open/closed/abandoned)
Address 150 North Main St.
Phone #: 919-111-1111
Owner's Name Town of Clearwater
Owner's Address 100 North Main St.
Owner's Phone # 919-111-2222
Well number, if applicable 1
Permit, if applicable _____
Zone, if applicable _____

| Possible contaminant substances ( use additional space below if necessary) | Maximum quantity anticipated on premises | Type of storage and containment: |
|---|---|---|
| Diesel Fuel #2 | 500 gallons | Above Ground Storage Tank (AST) |
| | | |
| | | |
| | | |

Draw sketch outlining property, locating major buildings and potential contaminants




PCS Identity Code, assigned after completing PCS Inventory 26A

# 4 Step 4: Developing Management Strategies

## Introduction: what this step is about

When you have completed your inventory of existing and potential contaminant sources (PCSs) and ranked them by level of risk (Step 3), you are ready to make specific plans to reduce the potential for contamination of your community's drinking water supply. The delineated wellhead protection area (WHPA) (Step 2) defines the area that needs to be managed. In this step, the Planning Team will develop a **management plan** that sets up methods for managing the threat posed by each PCS identified in the inventory. Approaches to managing the threat posed by PCSs may be regulatory, nonregulatory, or a combination of these strategies. Additionally, some contamination sources may not be a threat and may not require management. At this point, the Team may need to set new goals and priorities based on the information that has been gathered up to this point.

Local government is responsible for wellhead management, but pollution prevention is the job of the whole community.

Local government is usually responsible for managing the WHPA; however, the process of developing a management strategy can be an opportunity for community involvement in efforts to preserve the resource and manage future growth. New laws or regulations, for example, obviously require government authority, but everyone in the community can make lifestyle changes that prevent pollution. If your WHPA falls in more than one jurisdiction, you will need to cooperate with neighboring communities in joint management of the WHPA.

Your community can use a number of strategies to manage the land around its wells and protect the wells from contamination. The following sections describe both regulatory and nonregulatory (voluntary) controls that can be used in your management plan. Regulatory controls include new local ordinances, zoning and subdivision restrictions, and health regulations. Nonregulatory controls can be local or regional, and include education programs, community programs for proper disposal of hazardous materials, programs for businesses within the WHPA to minimize potential pollution, and conservation easements or even outright purchase of property around the public water supply (PWS) wells. Some specific management measures – sometimes called Best Management Practices (BMPs) – are presented in this chapter as possible tools for your management plan.

Management plans can use regulatory and nonregulatory controls to prevent ground-water contamination.

You should keep several points in mind in developing a management plan. First, an entirely nonregulatory approach alone may work, but a completely regulatory approach will rarely be successful. Education is a critical part of any program to protect an unseen resource like ground water. Second, understand that not every approach will work in every town or region. Management approaches must fit the local natural, social, economic, and political landscape. This is an important reason for local wellhead protection (WHP) efforts. North Carolina's WHP Program provides local governments with the ability to broaden the protection already provided through state regulatory programs, better control the

location of future PCSs, and protect public water supplies from PCSs that are not currently regulated. Third, the place to start is with the most urgent problems or highest risks. Immediate threats should be dealt with first and then the Team can work to prevent future contamination. Finally, in deciding what management tools are appropriate, the Team should first assess whether existing programs are adequate to protect ground water before proposing new strategies.

Key Points for Your Management Plan

- Education is a critical part of any management plan
- Management strategies must fit local conditions
- Start with the highest risk sources first
- Assess existing programs first before proposing new ones

# Procedure: what you need to do to complete Step 4 toward your WHP plan

The management plan must provide a method for managing the threat from each PCS source occurring within the WHPAs (e.g., highways, railroads, airports, septic systems, above ground storage tanks). Examples of management strategies, options, and practices that may be employed in the WHPA are discussed in the following pages. The planning Team may also wish to contact the North Carolina Rural Water Association (see "Resources and References section") for examples of additional management options for the identified PCSs.

Public involvement in the process of developing a management plan must be documented and included in your plan.

## *Non-regulatory options*

Management of your WHPA does not have to include regulation of land use or activities to protect your drinking water supply. Voluntary management strategies can reach a broad spectrum of the community and cross municipal boundaries. Ground-water protection is possible only if the entire community joins together to protect this community resource, regardless of political boundaries. These measures can be taken by themselves or in combination with regulatory approaches.

### Acquisition


Purchases of property, development rights, or conservation easements are secure but potentially expensive ways to protect the wellhead area. The only way to absolutely guarantee community control over the activities on lands in the WHPA may involve outright purchase of the land or of a more limited interest, such as surface-use rights. These may be accomplished using fee simple purchase, purchase of partial interests, conservation easements or restrictive covenants. Setting priorities as part of a long-range plan can decrease the cost of acquisition, as can the encouragement of donations and bargain sales.

### Monitoring regulated or potentially regulated sites

Monitor PCS compliance with existing state regulations – don't assume that discharges and storage tanks regulated by other programs are always in compliance.

The state maintains and enforces rules and regulations governing ground-water protection. These include rules regulating point and nonpoint sources of contamination, underground injection, underground storage tanks, mining, landfills, coastal concerns, hazardous waste facilities, and well construction. Because these existing rules and regulations provide a baseline of protection to PWS wells, developing a local WHP program is voluntary in North Carolina. Local governments and PWS suppliers are not expected to manage PCSs that are state regulated. However, the town may choose to monitor compliance with existing ground-water protection measures. Monitoring the performance of protection measures that are part of another management program requires that the Team work with both the lead agency of that regulatory program and with the operator(s) of the facility itself. The goals are (1) to make sure that operators of

potential sources of contamination fully understand their responsibilities and are complying with their permits; and (2) that the regulatory agencies are fully aware of conditions and activities in the WHPA. The following are examples of PCSs that relate to existing regulatory programs:

- If **facilities permitted to discharge** waste to the land surface are located within the WHPA (Non-NPDES Permitted Facilities), the Team should contact the Division of Water Quality to ensure that such operations are in compliance with applicable regulatory and permit requirements, such as routine monitoring and reporting requirements.
- If any soil or ground-water **contamination incidents** have been identified within the WHPA, the Team should contact the property owners and the Division of Water Quality, Groundwater Section, to insure that remediation efforts proceed in accordance with schedules established by these agencies. The Team should also notify the State agency of the location of the facility within the WHPA and its proximity to a public water supply well.

- All owners/operators of regulated **underground storage tanks (USTs)** and other facilities subject to federal and/or state regulations located within the WHPA should supply documentation that their facility is in compliance with said regulations. The Team should obtain copies of the UST permit for each facility. If any UST sites are found to be non-compliant, the Division of Waste Management, UST Section, should be notified.
- If an **abandoned UST site** is found within the WHPAs, the Team should contact the Division of Waste Management, UST Section, to determine if a closure report was submitted. This will document that no soil or ground-water contamination was identified during the closure of the USTs. If a closure report was not submitted, the Team should notify the UST Section of the location of the facility within the WHPA and its proximity to a public water supply well.
- Any individual, industry, business, or government agency installing or planning to **install a regulated UST** within the WHPA should be notified of the North Carolina UST Regulation 15A NCAC 2N .0301 stipulating specific siting and secondary containment requirements for UST systems installed after January 1, 1991. These regulations specify that no UST system may be installed within 100 feet of a public water supply well or within 50 feet of any other well used for human consumption and requires secondary containment for UST systems within 500 feet of a public water supply well or within 100 feet of any other well used for human consumption. Violations of this regulation should be reported to the Division of Waste Management, UST Section. The UST Section should also be notified of the location of the facility within the WHPA and its proximity to a public water supply well or any other well used for human consumption

- Facilities with an underground buried storage capacity of more than 42,000 gallons of oil, or an aggregate above ground storage capacity greater than 1320 gallons of oil, or an above ground storage capacity of a single container in excess of 660 gallons are subject to the Oil Pollution Prevention regulations contained in Federal Regulations found at 40 CFR 112. These facilities must prepare and implement a Spill Prevention Control and Countermeasures (SPCC) Plan. The Town should verify the status of the SPCC Plan for each subject facility located within the WHPA. The North Carolina General Statutes require registration of any facilities storing more

than 21,000 gallons of petroleum product. Subject facilities not in compliance with these regulations should be notified of their regulatory responsibility under this regulation. The Team should also notify the Division of Water Quality, Groundwater Section if such facilities do not promptly come into compliance.

- **Injection wells** are subject to rules as set forth in North Carolina Administrative Code 15A NCAC 2C.0200. Monitoring and reporting may be required if the injection well is part of a ground-water remediation system requiring a non-discharge permit. The Division of Water Quality, Ground Water Section, administrates the Underground Injection Control Program.

- **Abandoned dumps** are regulated by the Division of Waste Management, Solid Waste Section. Management strategies include installation of a monitoring well between the dump and the water supply well to monitor for contaminants; or proper closure of the facility, that may involve constructing an impermeable cap on top of the dump to reduce infiltration from precipitation.
- **Pesticide** laws are enforced by the North Carolina Department of Agriculture, Pesticide Section. They State of North Carolina Pesticide Board licenses pesticide dealers and applicators. If you have large areas of intensive agriculture in your WHPA, you may want to contact the Pesticide Section (see "References and Resources" section) to see if growers in the WHPA or their contracted applicators have current pesticide applicators licenses.


## Educational programs

Public education and involvement are essential parts of any WHP effort. Public education can be used first to inform community residents about the connection between land use in the WHPA and the quality of their drinking water. Sometimes common, legal activities can pose threats to drinking water, and these behaviors can change only through awareness and learning. Through public education, communities can work to prevent ground-water pollution through applying BMPs. Communities can also use education programs to build support for regulations.

Public education and involvement are essential parts of any wellhead protection effort. Communities can use education programs to prevent ground-water pollution through voluntary actions or to build support for regulations.

Education efforts can be targeted to businesses, industries, farms, and residents within the WHPA. Education programs may be the best, and only, way to apply a WHPA management strategy across multiple political jurisdictions. Some of these kinds of educational activities can work for your community:

- **Brochures and public notices** can publicize the WHP effort to all sectors of the community. Use the creativity and knowledge of your planning Team to develop effective materials for your community, including **public service announcements**, **editorials** in local papers, and other **media** events. **Signs along major roads** can alert people that they are entering the WHPA.

- **Pollution prevention information** should be systematically provided to all businesses, industries, farms, residents, and other PCSs within the WHPA. The Team should distribute information on waste handling practices, best management practices, standard operating procedures, and waste disposal methods that could reduce the potential for ground-water contamination, along with information about the North Carolina Division of Pollution

Prevention and Environmental Assistance (DPPEA). The DPPEA provides free technical and other nonregulatory assistance to reduce the amount of waste released into the air and water and on the land and serves as a central repository for waste reduction and pollution prevention information (919-715-6500 or 800-763-0136). Examples of target audiences include:

- Personnel at **municipal owned and/or operated facilities**
- Facilities within the WHPA that store types and amounts of hazardous materials and are subject to the reporting requirements of SARA Title III Section 312, Emergency Planning and Community Right to Know Act.
- All businesses in the WHPA that produce **auto wastes** (oils, acids, antifreeze, etc.)
- Facilities within the WHPA with **pesticide** storage or otherwise involved with the application of pesticides (Ensure that each has pesticide operators licensed by the State of North Carolina, and that proper records are maintained to ensure compliance with all NC Pesticide laws)

- The Team should provide information regarding the threat posed by **improperly constructed/abandoned wells** to owners of such wells identified within the WHPA. Owners of such wells should be encouraged to have wells properly closed in accordance with the state's well construction standards found at 15A NCAC 2C.0100, "Criteria and Standards Applicable to Water Supply and Certain Other Wells".
- All farms, residents, businesses, and industries in the WHPA with **septic systems** should be provided information on the WHP Program and on proper septic system maintenance.

- Homeowners should be educated on the use and disposal of **household hazardous wastes.** Household products that contain hazardous substances such as oil-based paints, solvents, or pesticides may be a threat to ground water when disposed of improperly such as in septic systems. At a minimum, brochures, such as the appropriate publications available from the NC Cooperative Extension Service, should be provided to homeowners.

A good source of information for homeowners on ground-water protection is the series of Home*Assessment*System (Home*A*Syst/Farm*A*Syst) publications (see "Resources and References" section). This series includes "Protecting Your Drinking Water Supply," covering well construction, protection, and abandonment; and "Improving your Septic System".

## Community action programs

In addition to focusing on specific cases within the WHPA, community action programs can generate awareness and participation in general pollution prevention activities. Examples include:

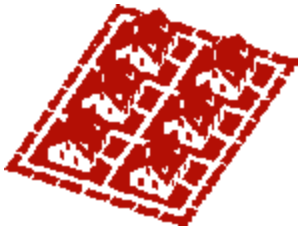
- Hazardous waste disposal;
- Proper closure of abandoned wells;
- Removal of old buried tanks;
- Identifying and upgrading improperly functioning septic systems;

- Promotion of pollution prevention and best management practices for the WHPA; and
- Hosting household hazardous waste collection days.

## Regulatory strategies

In general, regulatory tools require sufficient administrative and technical resources to carry them out. Regulations must be specific; to avoid court challenge, regulations must address actual threats or problems appropriately. Because regulatory tools require legal authority, issues of jurisdiction must be dealt with at the start. A town with a WHPA entirely inside its borders can control planning, management, and future development through town policies and ordinances. A town with all or part of its WHPA outside its own borders cannot zone the entire WHPA. The town must cooperate with the neighboring town(s) or approach the county to include it in the county-wide zoning program. Other water providers, such as a Conservancy District or a corporate-owned utility usually lack any legal jurisdiction and must make the best use of non-regulatory options.

### Zoning ordinances



Zoning is the division of land in a town or county into districts and applying land use regulations uniformly through each district. Within each district, the zoning ordinance can specify permitted uses, lot size, and design and performance requirements for specific activities. Zoning is widely used by towns to guide development under a comprehensive plan and can be adapted to protect wellhead areas. In North Carolina, the use of zoning to protect water supplies is within the scope of local government authority "to promote public health and welfare and provide water, sewerage, and other public requirements."

Zoning has some drawbacks. It can be politically contentious to enact new zoning or change existing zones. Usually zoning affects future development rather than existing uses, although nonconforming uses can be phased out eventually. Uniform zoning can be difficult when more than one town is involved or if the WHPA is located outside planning jurisdictions. In North Carolina, municipalities may extend zoning boundaries up to one mile beyond their city limits. County zoning only applies outside of municipal jurisdiction.

Zoning can be used to set development standards that specify:

- The location of specific land use activities
- Density of development
- Design, construction, and ongoing operation of land use activities

Some useful zoning options include:

- **Overlay Districts.** WHP districts can be incorporated into existing zoning with an overlay district, a district with more restrictive controls superimposed over or within an existing district(s). Because it has been defined through the delineation process, using the WHPA as an overlay is usually legally defensible. Overlays may specify different density requirements, source prohibitions, or design standards for the protection of the sensitive wellhead area.
- **Zoning for Source Controls.** Because zoning is meant to promote public health and safety, limiting or banning the use of specific hazardous substances for the purpose of protecting water supplies is a permissible zoning measure. Zoning districts, especially overlay districts, can be defined to prohibit the use of substances that would be hazardous to the drinking water supply, or activities that use such substances.

- **Zoning for Performance and Design Standards.** Through zoning, local government can guide structure design and set standards to ensure that certain activities do not threaten the drinking water supply. Design standards can require certain safety precautions for activities that might threaten ground water, such as facilities that store or handle pesticides or solvents. Performance zoning sets standards for permissible **effects** of land use activities; any use is allowed in the zone as long as standards are met. This technique is commonly used to set standards for noise and dust in industrial areas; for WHP, performance standards can limit the amount of hazardous substances stored on site or promote control of runoff from storage and loading areas.
- **Zoning for Density Standards.** Reducing the number of housing units can reduce the impact of residential development within the WHPA. Requiring large lots in unsewered developments, for example, reduces the number of units within the WHPA, reducing the amount of septic system leachate. Cluster zoning or Planned Unit Development (PUD) increases density in a section of a zone while the remaining area of the zone is left in open space. Average density throughout the zone remains the same. Cluster zoning can be used to guide more dense residential development to outside the WHPA, while not restricting the total number of units allowed.

## Subdivision regulations

Subdivision regulations can:

- Require low-leakage sewers
- Require advanced wastewater treatment facilities
- Regulate the design of drainage systems
- Limit pavement coverage
- Direct the location of development within the subdivision
- Require land for set-aside

Subdivision ordinances are applied when a piece of land is actually being divided into lots for sale or development to ensure that growth does not outpace available local facilities. Subdivision ordinances are therefore useful primarily for controlling new development. Like zoning, subdivision regulations can establish source controls, density standards, and design/performance standards. An important feature of subdivision regulations for WHP is the open space dedication requirement. In North Carolina, towns can require developers to set aside some land to be preserved as open space. Locating the open space lands within WHPA boundaries could be an important protection tool. Because many public community wells in North Carolina serve single subdivisions, subdivision regulations can be a very useful tool for protecting those wells.

## Building code enforcement

Cities and counties have the authority to establish building codes that govern the construction and maintenance of buildings and other structures. Under this authority, structures can be inspected during and after construction to ensure that codes are followed. By including WHP design standards in the building code, especially for industrial and commercial facilities, application of the standards can be enforced.

## Health regulations

The local board of health may have the authority to adopt more stringent rules in the WHPA to protect the public health, safety, and welfare. Specific measures could include regulation of or prohibition of underground fuel storage tanks, regulation of small private sewage treatment plants, septic system mainte-

nance programs, toxic and hazardous material handling regulations, and private well inspection/protection. Health ordinances might be used to require developers within the WHPA to monitor ground water for contaminants.

### WHP ordinance

Local governments can develop and enforce their own standards and permitting systems by creating a freestanding wellhead protection ordinance.

Land use regulations within a WHPA can be enforced under a town's general ordinance-making authority. This authority enables local governments to regulate or prohibit activities that are damaging to the health, safety, and general welfare of its citizens. Under this authority, a community can draft a free-standing WHP ordinance that sets source controls, density standards, and performance/design standards within the WHPA. Local ordinances must be written carefully; a WHP ordinance that attempts to regulate too broadly may be susceptible to legal challenge.

### Site plan reviews

Site plan review is a critical part of all of the above options. A systematic site plan review procedure for all proposed development provides an opportunity to verify and enforce other requirements. However, this tool requires sufficient administrative and technical resources, and must be specific in its application to actual threats in order to avoid court challenge. Site planning places the burden of proof on the developer, and like other regulatory tools, it is more effective for future development than for existing development.

## *Special considerations for regulatory options*

- **Agriculture**. Farms cannot be zoned by a county with the exception of swine farms (see North Carolina General Statute (NCSG) 153A-140 and 153A-340), or if they are used for "non-farm" purposes. The North Carolina Department of Agriculture has some regulatory authority as set forth in NCGS Chapter 106.
- **Enforcement.** What can you realistically do with the staff that you have? Don't let enforcement be your only tool for accomplishing protection.
- **Plan review**. Provide guidance and clear expectations for developer application requirements. Consider developing a checklist.
- **Permits.** What data do you need on the permit? What kind of format should the data be in? Who is to review the permit? How will compliance be monitored?
- **Construction inspections**. If you are enforcing design standards, you need field staff to ensure that specific design requirements are being met.
- **Fees**. Determine and publish your fee structure.
- **Abandonment requirements.** Set requirements for closing facilities and clean-up, especially for sites housing potential pollutants. Pay attention to proper sealing of abandoned wells.
- **Inspection protocols**
- **Penalties and fines**
- **Appeals, variances, and waivers**

## Best Management Practices (BMPs)

Best Management Practices are tools that work to control or prevent ground-water contamination. BMPs can be structures or behaviors; can apply to farms, factories, businesses, or homes; and can be written into regulations or promoted as voluntary measures.

Best Management Practices are protective measures that have worked in many locations to prevent or control threats to drinking water quality. BMPs may be structures like improved storage tanks or behaviors like reduction of the amount of household hazardous materials used in the WHPA. Some BMPs are farming practices that reduce the chances for fertilizers or pesticides to be lost from farmland and enter the water supply. Other BMPs are design, operation, and maintenance requirements for commercial and industrial facilities. Still others may be small lifestyle changes for homeowners that reduce pollution potential.

In some cases BMPs may be written into a regulatory requirement, such as in setting design standards in a zoning overlay district. Most often though, BMPs are voluntary measures that can be encouraged through public education and community action programs or through technical assistance and cost-share programs such as those offered by the USDA – Natural Resources Conservation Service for agricultural land.

Several attachments to this chapter provide a selection of BMPs that have proven to be effective in protecting water quality. These are not complete lists of all possible BMPs, but represent practices that address most commonly occurring PCSs. Your Team must select and tailor these measures to the needs of your WHPA. NCRWA consultants and PWS Section representatives can discuss specific management techniques that have worked in other communities, and advise on the feasibility of proposed management strategies.

## Involving the public

Determining a Public Involvement Strategy

- Identify the target audience (people using the water system, landowners in the WHPA)
- Involve the public in deciding how to generate community awareness
- Determine the message(s) used
  - o Identify public awareness techniques and publicity methods
  - o Personal contact
  - o Meetings
  - o Exhibits/speakers
  - o Fact sheets, brochures
  - o Newspapers, radio, TV, internet
- Determine resources and costs
- Develop methods to let the public know how they can participate, where to submit comments, how to obtain additional information

Effective management of your WHPA will rely heavily on public support and public action. Community involvement with and sense of ownership of its water supply generate support for the work and cost involved in protecting drinking water supplies. Educating the public about the importance of good drinking water and the damage that seemingly harmless activities can have builds awareness. Heightened awareness, along with information about how to prevent pollution of the water supply, is a key ingredient of an effective management program. An educated, involved public can make informed decisions about the future of its water supply, including changing their own practices and supporting new regulations. The fact is, because so many ground-water protection measures are voluntary, management of your WHPA cannot succeed without public involvement. The community must be involved in the process of choosing the management strategies for protection of their water supply.

How can you involve the community? Start public meetings and education programs when you first begin your WHP effort. Because drinking water is often taken for granted and ground water is so often misunderstood, the first efforts might address topics like:

- Where the drinking water comes from
- How ground water behaves
- Relationships between land use and ground-water quality
- Threats to ground-water quality

- Costs of ground-water protection vs. clean-up of contaminated water supplies

Organize a citizen advisory group or subcommittee of the Planning Team to develop a public involvement strategy and coordinate outreach activities. The work of this group could include developing and carrying out public information campaigns, organizing community action efforts like hazardous waste pick-ups, and developing a system for soliciting public input to the management plan. It is vital to build a foundation for sustainable community involvement; the need for WHP will not go away after the plan is written.

Finally, document and record all public involvement in the process.

**Examples of Community Outreach Activities**

- **Surveys:** conduct a community-wide water knowledge survey
- **Signs:** post signs along roads and in housing areas to identify your WHPA
- **Guidance:** distribute BMP guidelines to appropriate audiences
- **Speakers:** provide speakers to community groups to discuss topics like septic system maintenance and underground storage tanks
- **Newsletters:** distribute newsletters or bill inserts about the WHP program
- **Media coverage:** submit press releases, stories, and articles to local media to keep public informed on progress and issues
- **Schools:** encourage local school districts to participate, e.g., by adding wellhead protection to curriculum, holding art or essay contests
- **Volunteer monitoring:** Set up a volunteer monitoring program for ground-water quality and/or land use activities in the WHPA
- **Water festivals:** organize public activities to promote the management program, present progress, and recognize the protection effort

# Products that should result from Step 4, to be included with the final plan:

When you've completed this step, you should have the following information to include with the final plan you submit to PWS:

1. Management strategies adopted for each PCS type occurring within the WHPA including:
   - Educational strategy
   - Procedures developed to address problem PCSs
2. Documentation of public involvement in the process of choosing management strategies

# Resources and References

Farm*A*Syst Home*A*Syst. These are a series of fact sheets that detail Best Management Practices to protect water quality on the farm and at home. Available from your county center of North Carolina Cooperative Extension (or http://www.soil.ncsu.edu/assist/index.html).

Inglese, O. 1992. *Best Management Practices for the Protection of Ground Water: A Local Official's Guide to Managing Class V UIC Wells*. Connecticut Department of Environmental Protection, Hartford, CT.

North Carolina Rural Water Association (NCWRA). Phone: 336-731-6963, http://www.ncrwa.com

North Carolina Department of Agriculture, Pesticide Section. Phone: (919) 733-3556, http://www.agr.state.nc.us/fooddrug/pesticid/index.htm

New England Interstate Water Pollution Control Commission. 2000. *Source Protection: A National Guidance Manual for Surface Water Supplies*. NEIWPCC, Lowell, MA.

North Carolina Cooperative Extension Service. Soil Facts-A series of publications including BMPs for ground-water protection. Available from your county center of North Carolina Cooperative Extension (or http://www.soil.ncsu.edu/extension/pubs.php).

US EPA. 1989. *Wellhead Protection Programs: Tools for Local Governments*. EPA 440/6-89-002. Office of Ground Water Protection, U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA. 1993. Wellhead Protection: A Guide for Small Communities. EPA/625/R-93/002. Office of Research and Development, Cincinnati, OH.

## Attachments:

Beginning with the next page, you will find attachments that are provided to make it easier for you to prepare your plan document.

Remember, the attachments that are labeled "Example" are only for you to give you ideas.

- **Attachment 1: Typical crop, chemical and water management BMPs for ground-water protection**
- **Attachment 2: General agricultural/rural BMPs for ground-water protection by PCS**
- **Attachment 3: General BMPs for commercial/industrial facilities by source**
- **Attachment 4: General residential/homeowner BMPs for ground-water protection**
- **Attachment 5: Example of a partial plan, showing the portions of the plan that result from this step**. The example plan shows you the kind of information that you are expected to include in the plan that you submit for approval. Your final plan will be different than the fictional Town of Clearwater plan that is provided as an example. Your management strategies will vary according to the PCS types in your WHPA.

# Attachment 1: Typical crop, chemical, and water management BMPs for ground-water protection[1]

| Crop | |
|---|---|
| **Typical BMP** | **Effect** |
| Crop rotation | Reduces pest/weed pressure → reduces pesticide requirements |
| Cover crop | Protects soil and reduces erosion |
| Realistic yield goals | Reduces tendency to over-fertilize → reduces potential leaching/runoff losses |
| Buffer zones | Filters and traps sediment and chemicals in runoff |
| Riparian and wetland protection | Protects sensitive areas |
| **Chemical** | |
| **Typical BMP** | **Effect** |
| Fertigation / chemigation | Reduces pest/weed pressure → reduces chemical requirements |
| Site specific management | Precise feeding → prevents leaching of excess nutrients |
| Nutrient management: soil testing and plant analysis | Reduces nutrient availability for loss by avoiding excessive or unnecessary applications |
| Manure management | Reduces leaching/runoff losses by proper amount, timing, and method of application |
| Nitrogen timing (split applications) | Minimizes residual N → reduces leaching/runoff losses |
| Integrated pest management | **Pesticide application timing** improves plant uptake, avoids unnecessary application<br>**Selection of less toxic or less persistent ingredients** may pose lower risk to ground water<br>**Sprayer calibration** promotes accurate and uniform application of chemicals, reduces chance of loss<br>**Field scouting** ensures pesticide application only when a pest exists at damaging levels → avoids unneeded chemical applications |
| Agrichemical mixing and handling | Protects groundwater by capturing accidental spillage and equipment wash-water |
| **Water Management** | |
| **Typical BMP** | **Effect** |
| Irrigation management | Reduces leaching and runoff of nutrients and agrichemicals |
| Controlled drainage | Reduces runoff/nitrification |

Adapted from: *Best Management Practices for Wheat*, 1994. National Association of Wheat Growers Foundation

[1] The Natural Resources Conservation Service (NRCS) has documented numerous agricultural BMPs. These may be obtained from your local NRCS office or may be found on the Web at http://www.ncg.nrcs.usda.gov/nhcp_2.html Also see "Soil Facts – Good Soil Management Helps Protect Groundwater" Publication AG-439-09 available from the North Carolina Cooperative Extension Service, or on the Web at http://www.soil.ncsu.edu/publications/Soilfacts/AG-439-09/

# Attachment 2: General agricultural / rural BMPs for ground-water protection by PCS[1]

**Private Wells:** Contaminants of any kind should be prevented from entering the well directly or from entering the soil in the vicinity of the well. The casing and well cap (seal) should be in good condition. Backflow protection should be maintained in the plumbing carrying water from the well. The water from the well should be periodically tested for contaminants, especially if it is a very old well or a well of questionable design. For further recommendations and information see the Farm-A-Syst publication "Protecting Water Supply", #1 WQWM-165 / AG-566-1 available from the NC Cooperative Extension Service.

**Abandoned Wells:** The well should be checked to see if it was properly abandoned according to the standards of the North Carolina DENR (http://gw.ehnr.state.nc.us/113C.htm and http://gw.ehnr.state.nc.us/rules.htm). If it was not, additional steps can be taken to correct or improve the abandonment. Contaminants should be prevented from entering the abandoned well directly or through the surrounding soil surface, particularly if the well was improperly abandoned.

**Pesticide Storage and Handling Areas:** Good pesticide handling includes special care with more leachable pesticides (see Soil Facts AG-439-31, *Protecting Groundwater in North Carolina: A Pesticide and Soil Ranking System* available from the NC Cooperative Extension Service or on the web at http://www.soil.ncsu.edu/publications/Soilfacts/AG-439-31/), care to prevent leaks or spills onto the soil where chemicals might leach to ground water, and storage accessible only to properly trained workers. Pesticides should always be stored downslope (or downgradient) and a sufficient distance (minimum 50 feet) away from any wells. Adequate containment such as concrete pads and curbs should be in place to prevent spills or leakage from reaching the soil and ground water. Mixing and loading should be done in such a way as to prevent leaks, spills, or overflows onto the soil. Equipment and plans should be in place for containment and cleanup in case a spill does occur. The water source for mixing should have adequate backflow protection. Sprayer tanks and equipment cleaning rinse water should be properly disposed of (sometimes it can be applied to crops that might benefit from it). Used containers should be properly disposed of. See the Farm-A-Syst publication "Improving Storage and Handling of Pesticides", #5 WQWM-169 / AG-566-5 available from the NC Cooperative Extension Service.

**Fertilizer Storage and Handling Areas:** Similar practices for pesticide storage and handling areas can also be applied to fertilizer storage and handling areas. The goal is to prevent large amounts of fertilizer from reaching the ground water. Spills and leaks should be prevented or minimized. Any fertilizer not being used by the plants is a potential threat to ground water and a waste of the farmer's money. For further recommendations and information see the Farm-A-Syst publication "Improving Storage and Handling of Fertilizer", #6 WQWM-170 / AG-566-6 available from the NC Cooperative Extension Service.

**Livestock Waste Storage and Treatment:** Leachate from stored manure should be prevented from reaching ground water. Large manure piles should be covered and rest on an impermeable surface. Unlined waste lagoons or manure pits should be located downslope and at least 100 feet away from any wells to prevent leachate from entering the well. For further recommendations and information see the Farm-A-Syst publication "Improving Storage, Handling, and Disposal of Livestock Waste", #7 WQWM-171 / AG-566-7 available from the NC Cooperative Extension Service.

## *Attachment 2 (Continued)*

**Petroleum Product Storage and Handling:** Overflows, spills and leaks of fuel can threaten ground water. The volumes of fuel, lubricants, hydraulic fluids, coolants, or other products added to and dispensed from underground tanks should be checked and recorded regularly – unaccounted-for product may indicate a leak. Abandoned tanks should be properly removed to prevent leakage to ground water of any residual fuel. Tanks, especially if underground, should be downslope and at least 100feet from any wells. Old tanks without adequate corrosion protection should be checked more frequently than newer ones for possible leaks. Protection should exist to prevent overflows, spills and leaks from reaching the ground water. Pumps, piping and hoses should be checked periodically for leaks. Small amounts of lubricants, hydraulic fluids, etc. should be stored under cover to prevent rainwater from carrying contaminants to the soil or weather conditions from damaging containers. All materials should be labeled properly to prevent misuse and used materials should be recycled or disposed of properly Soil testing or ground water in the vicinity of the tank should be tested if serious questions remain about the integrity of an underground tank. For further recommendations and information see the Farm-A-Syst publication "Improving Fuel Storage, #2 WQWM-166 / AG-566-2" available from the NC Cooperative Extension Service.

**Hazardous Waste Management:** Unused farm, vehicle/equipment maintenance, and home chemicals should be recycled or disposed of properly. The storage of hazardous materials near wells should be avoided and these chemicals should never be allowed to leak or to be dumped onto soil in the vicinity of any wells. Empty chemicals containers should be recycled or disposed of properly. Temporarily stored hazardous materials should be promptly and safely transported to a proper disposal facility. Used vehicle/equipment batteries should be recycled or disposed of properly. For further recommendations and information see the Farm-A-Syst publication "Improving Storage and Handling of Hazardous Waste", #3 WQWM-167 / AG-566-3 available from the NC Cooperative Extension Service.

**Household Wastewater Management:** Chemicals that might harm the organisms in the septic tank and make treatment less effective should not be introduced into the wastewater system. Drainfields should be downslope and at least 100 feet away from any wells. Solid residues from septic tanks need to be pumped out every 2 to 3 years. For further recommendations and information, see the Farm-A-Syst publication "Improving Septic Systems", #4 WQWM-168 / AG-566-4 available from the NC Cooperative Extension Service.

**Farm or Farm Household Waste Disposal/Fill Areas:** Materials that may readily leach through the soil and contaminate ground water should not be disposed of onto the soil in the wellhead protection area. Dead animals should not be buried in the wellhead protection area if there is a significant chance that infectious organisms or nitrates from decaying corpses might contaminate the ground water. The risk of ground water contamination increases with larger quantities of animals buried. Unmonitored public access to a disposal area that could lead to improper, or unknown, disposal should be prohibited. For further recommendations and information on poultry composting, see the "Composting Poultry Mortality in North Carolina Publication Number: PS Facts #11 " and "Greene County Animal Mortality Collection Ramp Publication Number: EBAE-186-93 " available from the NC Cooperative Extension Service and at http://www5.bae.ncsu.edu/programs/extension/publicat/wqwm/psfact11.html and http://www5.bae.ncsu.edu/programs/extension/publicat/wqwm/ebae186_93.html, respectively.

## *Attachment 2 (Continued)*

| |
|---|
| **Milking Center Wastewater Handling Facilities:** The storage or discharge of untreated milking center wastewater such that it might contaminate ground water should be avoided. Discharge of wastewater should be downslope and away from any wells. If the wastewater is stored in unlined lagoons or lined lagoons that might leak, there should be confidence that significant amounts are not leaching to the ground water. Steps should be taken to collect, store, and agronomically apply the wastewater. For further recommendations and information, see the Farm-A-Syst publication "Improving Storage, Handling, and Disposal of Livestock Waste", #7 WQWM-171 / AG-566-7 available from the NC Cooperative Extension Service. |
| **Confined Animal Feeding Operations (CAFO):** CAFOs or feedlots should be located downslope and away from any wells. If a CAFO is unpaved, the threat of excess nutrients leaching to ground water should be investigated. Runoff from paved CAFOs, if collected, should be diverted into treatment systems, and away from any wells. Where possible, excess solid wastes should be scraped off yards periodically and stored properly to reduce nutrient concentration of runoff. Large concentrations of livestock pose a higher threat to ground water if wastes are not managed properly. |
| **Livestock Grazing and Pastures:** If chemicals are applied to grazing areas for weed or pest control, management should consider the threat to ground water. The threat to ground water may increase with increasing herd density. For further recommendations and information, see the Farm-A-Syst publication "Grazing Livestock and Water Quality", #8, AG-566-08 / E00-38848, available from the NC Cooperative Extension Service. |

[1]Most of the referenced publications are available at: http://www.soil.ncsu.edu/publications/farmassist/

# Attachment 3: General BMPs for commercial/ industrial facilities by source

| Source | Description |
|---|---|
| **Design BMPs** | |
| **Floor Drains** | Eliminate floor drain discharges to the ground, septic systems, storm sewers, or any surface water body from any location in the facility. If connection to sanitary sewer is impossible, storage in a holding tank and pump-out may be required. If no floor drains are installed, all discharges to the floor should be collected, contained, and disposed of by an appropriate waste hauler in accordance with federal and state requirements. |
| **Dry Wells** | Dry wells should be eliminated in ALL cases unless they receive ONLY CLEAN WATER DISCHARGES that meet all established Maximum Contaminant Levels (MCLs) promulgated under the *Safe Drinking Water Act*, meet other state and local standards for drinking water, and comply with any other state and local requirements. |
| **Storage Facilities** | Loading, unloading, and storage of materials and waste should be done within an enclosed or roofed area with secondary containment and isolated from floor drains to prevent potential spills from contaminating storm water or discharging to the ground. |
| | Underground storage tanks should not be used, unless explicitly required by fire codes or other federal, state or local regulations. Where required, underground tanks should have double-walled construction or secondary containment such as a concrete vault lined or sealed with an impermeable material and filled with sand. Tanks should have appropriate secondary containment monitoring, high level and leak sending alarms, level indicators, and overfill protection |
| | Above-ground tanks should have 110 percent secondary containment or double-walled construction, alarms, and overfill protection, and should be installed in an enclosed area isolated from floor drains, storm water sewers, or other conduits which may cause a release into the environment. |
| | Tanks and associated equipment should be tested periodically for structural integrity. |
| **Cooling Water** | Cooling water may be discharged to a storm sewer, sanitary sewer, or stream, provided all federal, state, and local requirements are met. Any cooling water from solvent recovery systems should be free of contamination from solvent, metals, or other pollutants and should not discharge to the ground. Closed-top cooling systems should be considered to eliminate cooling water discharges. |
| **Storm Water Management** | Materials and wastes should be isolated in roofed or enclosed areas to prevent precipitation and runoff contact with materials and wastes. Uncovered storage areas should have a separate storm water collection system which discharges to a tank. Storm water from building roofs may discharge to the ground. |
| **Work Areas** | Consolidate waste-generating operations and physically separate them from other operations to reduce the total work area exposed to solvents. |

## *Attachment 3 (Continued)*

| | |
|---|---|
| **Connection of Municipal Sanitary Sewers** | Existing and future facilities should connect their sanitary facilities to municipal sanitary sewer systems where they are available. |
| **Cross-Connections** | Cross-connections such as sanitary discharges to storm sewers, storm water discharges to sanitary sewers, or floor drain discharges to storm sewer systems, should be identified and eliminated. |
| **Holding Tanks** | Facilities should discharge to holding tanks if they are located where municipal sanitary sewers are not available, subsurface disposal systems are not feasible, existing subsurface disposal systems are failing, or if they are high risk facilities located in wellhead protection areas. |
| **Operational BMPs** | |
| **Material & Waste Inventory Control** | Conduct monthly monitoring of inventory and waste generation. |
| | Order raw materials on an as-needed basis to avoid waste and reduce inventory. |
| | Ensure materials and waste containers are properly labeled |
| | Maintain products Material Safety Data Sheets to monitor in inventory and the chemical ingredients of wastes. Make MSDS sheets available to employees. |
| **Preventative & Corrective Maintenance** | Implement a regularly scheduled internal inspection and maintenance program to service equipment, to identify potential leaks and spills from storage and equipment failure, and to take corrective action as necessary to avoid a release to the environment. At a minimum, the schedule should address<br>• Tanks, drums, containers, pumps, equipment, and plumbing;<br>• Work stations and waste disposal stations;<br>• Storage areas, and storm water catch basins and detention ponds;<br>• Evidence of leaks or spills within the facility and on the site;<br>• Areas prone to heavy traffic from loading and off loading of materials and wastes;<br>• Proper handling of all containers;<br>• Drippage from exhaust vents;<br>• Proper operation of equipment, solvent recovery, and emission control systems. |
| **Spill Control** | Use emergency spill kits and equipment. Locate them at storage areas, loading and unloading areas, dispensing areas, work areas. |
| | Clean spills promptly and as prescribed in Material Safety Data Sheets (MSDS); all spilled materials should be collected, handled, and disposed of in accordance with federal, state, and local regulations. |
| | Minimize the use of disposable granular or powder-absorbents. |

## *Attachment 3 (Continued)*

| | |
|---|---|
| **Materials & Waste Management** | Store materials in a controlled, enclosed environment to prolong shelf life, minimize evaporative releases, and prevent moisture from accumulating. |
| | Keep containers closed to prevent evaporation, oxidation, and spillage. |
| | Place drip pans under containers and storage racks to collect spillage. |
| | Segregate wastes, e.g., hazardous from non-hazardous, acids from bases, and oils from solvents, to minimize disposal costs and facilitate recycling and reuse. |
| | Use dry cleanup methods and mopping rather than flooding with water. |
| | Dispose of accumulated wastes through an appropriately licensed waste transporter in accordance with federal, state, and local regulations. |
| **Management** | Involve management in conducting a waste stream analysis to determine the potential for waste reduction and pollution prevention. This analysis should include the following steps:<br>• Identify plant processes where chemicals are used and waste is generated;<br>• Evaluate existing waste management and reduction methods;<br>• Evaluate feasibility of waste reduction options;<br>• Implement measures to reduce wastes; and<br>• Periodically evaluate waste reduction program. |
| **Employee Training** | Employees should be trained prior to working with equipment or handling of materials, and should be periodically refreshed when new regulations or procedures are developed. Training programs should include the following:<br>• Proper operation of process equipment;<br>• Loading and unloading of materials;<br>• Purchasing, labeling, storing, transferring, and disposal of materials;<br>• Leak detection, spill control, and emergency procedures; and<br>• Reuse/recycling/material substitution. |
| | Improve employee awareness of the environmental and economic benefits of waste reduction and pollution prevention. |
| **Record Keeping** | Facility plans, plumbing plans, and subsurface disposal system plans and specifications must be updated to reflect current facility configuration. Copies of associated approvals and permits should be maintained on file. |
| | OHSA requirements, health and environmental emergency procedures, materials management plans, inventory records, servicing/repair/inspections logs, and hazardous waste disposal records must be maintained up to date and made available for inspection by regulatory officials. |

Source: Inglese, O. 1992. *Best Management Practices for the Protection of Groundwater: A Local Official's Guide to Managing Class V UIC Wells*. Connecticut Department of Environmental Protection, Hartford, CT, 138 pp

# Attachment 4: General residential/homeowner BMPs for ground-water protection

| Source | Management Practices / Programs |
|---|---|
| **Septic Systems** | Septic system maintenance ordinance – ensures systems are inspected and pumped out regularly to prevent malfunction |
| | Septic system tracking program – requires registration of all systems and encourages routine maintenance |
| | Municipal septic system program – town assumes responsibility for system maintenance, fee charged to homeowner |
| | Homeowner education program |
| **Lawn Care**[1] | Minimize groundcover disturbance to reduce need for turf-care chemicals and excessive watering |
| | Select low-maintenance vegetation to reduce need for fertilizers and pesticides |
| | Fertilizer/pesticide management<br>• Soil test before fertilizing to reduce excessive applications<br>• Select slow-release formulations to reduce leaching<br>• Use minimum dosage of pesticides to achieve adequate pest control to reduce amount of chemical available for loss<br>• Calibrate application equipment to minimize application rate<br>• Don't apply lawn chemicals before a heavy rainfall to avoid chemical leaching and runoff |
| | Water wisely; reduced watering lessens transport of pesticides and nutrients into ground water |
| **Household Hazardous Waste** | Proper storage of hazardous materials reduces the possibility of leaks and spills |
| | Recycle and reuse to community household hazardous waste collections minimize possibility of improper disposal or accidental release |
| | Storm drain stenciling with messages such as "Dump No Wastes – Water Supply Protection Area" discourages use of storm drains for unwanted chemicals |

Source: New England Interstate Water Pollution Control Commission. 2000. Source Protection: A National Guidance Manual for Surface Water Supplies. NEIWPCC, Lowell, MA.

[1]Specific Guidance for North Carolina Lawn Care BMPs is presented in "Soil Facts – Managing Lawns and Gardens to Protect Water Quality", Publication AG-439-21 available from the North Carolina Cooperative Extension Service or http://www.soil.ncsu.edu/publications/Soilfacts/AG-439-21/

# Attachment 5: Example of a partial plan, showing the portions of the plan that result from this step

**Introduction.**
There are two approaches to managing a Wellhead Protection Area (WHPA), regulatory and non-regulatory. The Town of Clearwater has chosen a non-regulatory approach to manage their Wellhead Protection Area. The Clearwater Town Board is responsible for implementing the Wellhead Protection Program; they have accepted the recommendations submitted by the Wellhead Protection Committee for management of the potential contamination sources found during Step 3 of the Wellhead Protection planning process. The implementation of Clearwater's Wellhead Protection Program will begin upon approval of the program by the NC Public Water Supply Section, and will be completed within ninety days.

The Clearwater WHP Management Plan identifies three general areas for non-regulatory management efforts: (1) General education/public information; (2) Pollution prevention using Best Management Practices (BMPs) focused on specific source types; and (3) Compliance monitoring with existing state ground water management regulations or programs. As a result of public comment and concern, the Plan also identifies some initial regulatory approaches that could be taken should such steps become necessary.

**General Education and Public Information.**
The Planning Committee recommends that a Wellhead Protection Brochure be developed to convey the following information:

- An explanation of what ground water is and information about the wells in the Clearwater water system
- An explanation of the Wellhead Protection Program
- Sources of ground water pollution
- Tips on protecting their water supply
- Phone numbers to contact for more information

The Planning Committee recommends that brochures be delivered to each resident, business and industry within the Wellhead Protection Areas. Copies of this brochure will be made available at the Town Hall, Public Library, and other locations deemed necessary for public education on Wellhead Protection. Distribution of a brochure to all town residents should be considered, possibly by mailing a copy in each water bill.

The Planning Committee recommends the Town put up signs indicating that one is entering a Wellhead Protection Area at the appropriate locations on Highways 61 and 99 as soon as they are made available from NCDOT. Spill response numbers will also be posted at the Town Hall.

All Town personnel at the Town of Clearwater garage, wastewater treatment plant, and water plant will be educated on wellhead protection, including why their activities are considered a potential contamination source and steps that they can take on the job to reduce the potential for contamination. The town building inspector and health inspector will receive general training in wellhead protection issues, including potential contamination sources and pollution prevention measures, so that they may be observant of potential problems in the course of their duties.

## *Attachment 5 (Continued)*

**Pollution prevention.**
The Planning Committee recommends site visits to all businesses and Town operations on the PCS list that handle significant amounts of potential contaminants. High-risk sites identified in Step 3 will be targeted first:

*In this example, only WHPA zone 1 (well #1) shown in following table*

| CATEGORY | MAP CODE | NAME | LOCATION |
|---|---|---|---|
| Gas station | 13A | Sanders' Market | North Main St. |
| Gas station | 13B | Quick-E-Mart | Hwy 61 South |
| Underground storage tank | 1A | Simpson's Fuels | Hwy 61 & North Main St. |
| Underground storage tank | 1C | Abandoned gas station | Hwy 61 & Pine St. |
| Above ground storage tank | 26A | Town of Clearwater Maintenance Yard | North Main St. |

These visits will ensure that personnel at these sites are informed about wellhead protection. Wellhead Protection brochures will be distributed, and information specific to the sites will be provided. Specific information will include; why the sites are considered a potential contamination source, specific steps they can take to reduce the potential for contamination, (e.g., information about best management practices, standard operating procedures, waste handling practices, etc.), and information for contacting the Division of Pollution Prevention and Environmental Assistance (DPPEA) to investigate further steps that they can take to reduce the amount of waste released.

During the PCS inventory, conducted as part of Step 3, Team members documented facility numbers, certification numbers, and the number and size of tanks at every facility with an underground storage tank (UST). All locations have current UST permits in place. In the future, if any location is found not to be in compliance with UST rules and regulations, the Division of Waste Management, Underground Storage Tank Section will be immediately notified. Likewise, facilities with above ground storage tanks (ASTs) subject to Oil Pollution Prevention regulations, contained in Federal Regulations found at 40 CFR 112, will be asked for a copy of their Spill Prevention Control and Countermeasures (SPCC) Plan. The Town of Clearwater will verify the compliance status with regard to this regulation of each subject AST located within the WHPAs. Facilities with subject ASTs found not to be in compliance with this regulation will be notified of their responsibility under this regulation.

The Town of Clearwater will notify any individual, industry, business, or government agency installing or planning to install an underground storage tanks within the Town's wellhead protection area of the following regulation:

> North Carolina Underground Storage Tank (UST) Regulation 15A NCAC 2N .0301 stipulates specific siting and secondary containment requirements for UST systems installed after January 1, 1991:
>
> > (1) No UST system may be installed within 100 feet of a public water supply well or within 50 feet of any other well used for human consumption.

## *Attachment 5 (Continued)*

(2) Secondary containment is required for UST systems within 500 feet of a well serving a public water supply or within 100 feet of any other well used for human consumption.

Violations of this regulation will be reported to the Division of Waste Management, Underground Storage Tank Section. The UST Section will also be notified of the location of the facility within the WHPA and its proximity to a public water supply well or any other well used for human consumption. Similar notification will be given regarding new aboveground storage tanks (ASTs) subject to regulation.

Members of the Planning Committee will visit all pesticide storage/users in the WHP area to educate them about why they are considered a potential contamination source and steps they can take to reduce the potential for contamination from their operations. The Planning Committee recommends that Town personnel be observant in the vicinity of the cemetery to watch for proper herbicide use in the area.

The Planning Committee will distribute a fact sheet available from the Clearwater County Cooperative Extension office on proper septic system operation and maintenance to be delivered to each residence using an on-site wastewater system within the WHP. Public service announcements encouraging people to pump septic tanks regularly are also being prepared.

Owners of improperly constructed/abandoned wells identified within the WHPAs will be provided information regarding proper closure of these wells. Owners will be encouraged to have these wells properly abandoned in accordance with the state's well construction standards found at 15A NCAC 2C.0100, "Criteria and Standards Applicable to Water Supply and Certain Other Wells". If information exists that a well is improperly constructed or is contributing to the contamination of ground water, the Town of Clearwater will notify the Ground water Section, Division of Water Quality.

Smith Trucking is under contract by the town to collect household waste, but does not collect hazardous waste. The County is presently developing a hazardous waste site at the County Landfill at Fayston; this site is scheduled to be open to the public two days per week to dispose of hazardous household wastes such as oil-based paints, oil, solvents, etc. When this project is completed, the Town will publicize that the facility is open to the public. In the meantime, the Planning Committee recommends that the Town offer a Household Hazardous Waste Collection Day twice a year, so that residents may dispose of hazardous waste properly. This information will be included in the wellhead protection brochure.

The Town of Clearwater Wastewater Treatment Facility employees perform a daily inspection of all lift stations for leaks and/or overflows and maintain a daily log on any incidents found. The wastewater collection system is checked visually on a monthly basis, with problem areas inspected more often. Scheduled maintenance and repairs are performed during the warm months of the year.

## *Attachment 5 (Continued)*

Emergency numbers for the Railroad are located at crossings in the WHPAs and at Town Hall. The Railroad will be contacted in the event of an emergency situation along the sections of railroad crossing the Wellhead Protection Areas.

**Compliance Monitoring.**
Planning team members have contacted the Division of Water Quality regarding facilities permitted to discharge wastewater to the land surface (Non-NPDES Permitted Facilities) to ensure that any such operations located within the WHPA were in compliance with applicable regulatory and permit requirements.

The Planning Committee has evaluated two abandoned gas stations. The first site has been visited and the underground storage tanks have been removed. The site at Highway 61and Pine St. is being followed up on to determine the status of the tanks. If they are found to be still on site, the Underground Storage Tank Section of the Division of Waste Management will be notified.

The Town of Clearwater will contact the State Division of Waste Management's UST section to determine if a closure report was submitted on any other abandoned underground storage tanks found in the future, and that no soil or ground water contamination was identified during the removal of UST's. If a closure report was not submitted, the Town of Clearwater will contact the UST Section with the location of the facility within the WHPA and its proximity to a public water supply well.

All ground water contamination sites that were still shown to be in remediation were visited by planning team members to find out the current status of the site. The Town is gathering documentation of the current status of these sites, and calls will be made to the State agencies responsible for overseeing the remediation efforts of any questionable sites.

If any soil or ground water contamination events occur within the WHPA, the Town of Clearwater will contact the property owners and the State agencies with oversight responsibilities for remediation efforts to ensure that cleanup proceeds in accordance with any schedules established by these agencies.

Town of Clearwater officials have been made aware of the problem of potential contamination sources that exists in the area around Well # 1, and immediate action will be taken to clean up any potential sources of contamination. The above ground diesel storage tank near Well #1will be moved and sewer lines will be inspected and replaced where necessary.

## *Attachment 5 (Continued)*

**Public input.**
Four public meetings were held in the process of developing Clearwater's Wellhead Protection Plan. The last two meetings focused on discussion of the final ranked list of PCSs developed in Step 3 and on initial suggested management strategies. Some meeting participants suggested that the railroad should be given a much higher ranking because of the potentially disastrous impacts of overturned tank cars. It was decided that, while the consequences of such an event were great, the likelihood was a very low and few local management practices could be applied. Appropriate response to such events will be addressed in the Contingency Plan.

The fourth public meeting collected numerous ideas from participants concerning education and pollution prevention ideas for management of the wellhead protection areas. Many of these specific ideas have been included in this plan. Some participants expressed doubt that a completely voluntary approach would be adequate to protect the town drinking water supply, especially given the rapid development currently underway nearby. Those at the public meeting questioned whether current zoning regulations are adequate for the protection of Clearwater's wells. Areas around well sites #1 and #2 are currently zoned for residential use only and some participants urged that the town consider the use of cluster zoning or planned unit development to guide septic systems away from the wellhead protection area. Several residents suggested updating town subdivision regulations to encourage open space dedication within the WHPA and to promote ground water protection BMPs in new residential developments. The area around Well #1 could continue to acquire new businesses under current zoning for commercial and light industrial use. Meeting participants suggested that the town consider developing a zoning overlay district for the entire WHPA that could regulate the use and storage of hazardous materials from commercial and industrial activities. As a result of these concerns, the Planning Committee recommends that the Board investigate these and other zoning modifications or regulations to keep additional hazardous materials out of this WHPA.

Public notification was made to the citizens of Clearwater that the completed draft of Clearwater's Wellhead Protection Program was available at Town Hall for a period of thirty days for review and comment. The public notice appeared in the local paper and was included in customers' water bills the previous month. Written comments will also be considered in the implementation phase of Clearwater's Wellhead Protection Program.

# 5 Step 5: Developing a Contingency Plan

## Introduction: what this step is about

The best way to make sure that your community continues to receive potable water is to anticipate possible problems with a **contingency plan** – a set of procedures prepared in advance to respond to contamination or disruption of the water supply.

In other words:
BE PREPARED.

The main goal of your wellhead protection (WHP) program is to protect your community's drinking water supply by preventing the contamination of its ground-water source. Unfortunately, even with the best plans and programs in place, occasional disruptions in supply can still occur. More than 6,000 incidents of ground-water contamination had been reported in North Carolina by the end of 2001, occurring in every county in the state[1]. Leaking underground storage tanks, accidental spills, power outages, vandalism, and natural disasters are familiar events and they could occur in your wellhead protection area (WHPA). The most effective way to make sure that your community continues to receive potable water is to be prepared for such events with a **contingency plan**.

A contingency plan is a set of procedures prepared in advance to respond to contamination or disruption of the water supply. A good contingency plan is tailored to your particular situation and addresses the potential contaminant sources identified in Step 3. By anticipating problems and planning for them, your community can rapidly mobilize the technical, financial, and administrative resources needed to keep a spill from entering the distribution system or to get a new water supply developed. To respond effectively to emergencies, procedures must already be in place when threats occur.

The process you will follow to develop a contingency plan will require you to: 1) carefully assess the physical components of your supply system, some of which are documented in Step 2; 2) identify the most likely causes of supply disruption, including the Potential Contaminant Sources (PCSs) identified in Step 3; and 3) coordinate and establish broad support from emergency responders and the community.

By anticipating problems, the community can rapidly mobilize the technical, financial, and administrative resources needed to keep a spill from entering the distribution system or to get a new water supply up and running.

[1]Pollution Incident Reporting Form (PIRF) Database

# Procedure: what you need to do to complete Step 5 toward your WHP plan

You must include plans for both short-term contingencies (for example, power loss, line breaks, mechanical failures, or other emergency situations that would last less than 48 hours) and long-term contingencies (for example, drought or contamination of extended duration when an alternate supply will be needed). As you work through each phase of the contingency planning process, consider short- and long-term effects at each point.

Key considerations in developing your contingency plan are:

- Water system features, including supply, treatment, and distribution components;
- Principal contamination threats, including both stationary PCSs and mobile sources like rail cars and tank trucks;
- Supply disruption threats, such as power loss, line breaks, or mechanical failures;
- Water supply alternatives, including supplies within and outside the existing system, water conservation, additional water treatment, or aquifer remediation;
- Available logistical and financial resources; and
- Response agencies and personnel, both local and state.

Developing a contingency plan can be done in a series of steps. First, set some priorities based on knowledge of the principal water system, possible disruptions (contamination or other), and community needs, both short-term and long-term. Second, determine what procedures will be necessary to respond to the most serious threats. Third, inventory the resources available to you, including services, expertise, funding, and equipment, and determine if additional resources are needed. Finally, define procedures and responsibilities to determine who will do what in an emergency.

Contingency planning helps you answer questions like:

- What are the likely threats to community water supplies?
- What steps must be taken to respond to those threats?
- Who is responsible for each step in the response plan?
- How can response actions be coordinated?
- Where can replacement water supplies be obtained?
- Where can technical and financial resources be obtained?

## *Set priorities*

Start with the PCS inventory from Step 3, then add to the list other sources of contamination or disruption, such as rail car spills, truck accidents, power outages, vandalism, etc. Make judgments about probabilities of these threats occurring, and the severity of disruption caused, then rank risks and set priorities accordingly (See Table 1). Setting priorities allows the greatest threats to receive your most urgent attention.

Regardless of how you set your priorities, your first objective should be to protect the health of those who drink the water. The next priority is to minimize the contamination of your ground-water supply, because remediating or replacing your water supply would be a major challenge.

Steps in developing a contingency plan:

- Set priorities based on likelihood and severity of possible disruptions
- Determine what procedures will be necessary to respond to disruptions
- Inventory available resources
- Define procedures and responsibilities for emergency response

**Table 1. Example of Emergency Prioritization Table**

| Type of Emergency | Probability (1) | Severity (2) | Risk** (1)*(2) | Remarks |
|---|---|---|---|---|
| **Natural** | | | | |
| Drought | 7 | 5 | 35 | Severity can vary; lessened by availability of alternate sources |
| Flood | 7 | 5 | 35 | Especially pump station #2 |
| Ice/Snow Storm | 5 | 1 | 5 | |
| Hurricane | 1 | 1 | 1 | |
| **Human-caused** | | | | |
| Fire | 1 | 4 | 4 | |
| Explosion | 5 | 5 | 25 | |
| Vandalism | 5 | 10 | 50 | Currently a problem |
| Power Failure | 8 | 3 | 24 | |
| Rupture/Leak | 4 | 5 | 20 | Higher likelihood in old sectors |
| **Contamination*** | | | | |
| Train derailment | 3 | 10 | 30 | Along old C&O line near Hwy. 61 |
| Tank truck accident | 5 | 8 | 40 | Centered on I-85 |

* PCSs identified in Step 3 added as appropriate
** 1–lowest, 100–highest

## Identify response procedure needs

Before you can identify resources or establish emergency procedures, you may need to gather more information about the nature of the problems that could be caused by a given PCS or water supply disruption. For example, different sources of chemical contamination may require specific methods of neutralization or containment. Learn what responses are appropriate for each PCS that could require an emergency response. One source of information is the Material Safety Data Sheet (MSDS) that lists safety hazards and emergency concerns for each chemical that a business uses. Copies of MSDS must be available at the place of business and can be obtained from chemical vendors. Other sources of information are included in Step 3.

Learn what control measures would be required at each PCS to keep an accidental spill from entering ground water. If a major highway or rail line passes through your WHPA, numerous contaminants could potentially be spilled by an overturned truck or train accident. Trucks containing hazardous materials must display a placard that provides certain information about the contents. (A pair of binoculars for reading the truck's placard without entering the spill area can be an important asset.) Some shippers place a code number on the placard that corresponds to the record of the hazardous material and subscribe to a telephone service that can provide complete information to emergency responders. This phone number should be included with other contact numbers. It may be worthwhile to learn about materials that are routinely shipped through your WHPA so that you can be prepared for emergencies. Knowledge of local and regional industry and observations made by local residents can be useful in gathering such information.

In identifying possible response procedures, you may find that a particular PCS requires a response that is especially costly, labor-intensive, or technically challenging. This information will be important later, when deciding whether additional resources will be needed to prepare for threats to your water supply.

## Identify resources

A key purpose of a contingency plan is to ensure that the proper personnel, equipment, technical, and financial resources will be available when needed. The contingency plan should enable local officials and water system managers to rapidly identify and coordinate resources in an actual emergency. Resources to consider in your plan include:

- **Personnel**
  - Existing utility staff
  - Technical assistance: Where is the nearest well drilling firm and what sort of mobilization time can they guarantee? Are there local contractors who would be willing to enter into an agreement to provide emergency services?
  - Response agencies: local (e.g., police, fire, EMS), state, and federal
  - Technical experts from local, state, federal, and private organizations
- **Financial resources**
  - Existing local revenues dedicated for water system maintenance and water supply protection
  - Long-term and emergency financial reserves
  - Financial, equipment, and personnel resources available through existing agreements with neighboring localities, state or federal agencies
  - State and federal grants and funds such as the state UST trust fund, state and federal Superfund programs, and Federal Emergency Management Agency funds
  - Organizations that can provide in-kind (non-monetary) assistance
- **Essential services, equipment and supplies**
  - Water supply alternatives

    *Supply from within the system*: can other wells or surface sources be brought online, or diverted as needed?

    *Supply from outside the system*: are cooperative arrangements needed with neighboring public water utilities?
  - Water sampling and analysis equipment and supplies
  - Portable pumps and generators
  - Chemical supplies
  - Treatment equipment
  - Repair facilities and spare parts
  - Alternative distribution equipment
  - Vehicles and equipment for emergency evacuation and transportation
  - Personnel protection equipment and supplies
  - Heavy equipment contractors

A key purpose of your contingency plan is to ensure that the proper personnel, equipment, technical, and financial resources are available to enable local officials to identify and coordinate the response to an actual emergency.

Depending on the size of the water system and whether the system is a private company or a public utility, the required resources may be found in-house or may be available from another branch of local government, an adjoining county or municipality, from a state agency, or the National Guard. Response services and equipment that are identified as essential but cannot be secured at the present time must be highlighted. Contact information for external resources that may be needed in an emergency should be recorded prominently and kept up to date.

## *Define emergency response procedures*

After you have prioritized the potential threats to your water supply, determined any special emergency response needs, and defined the resources necessary to respond to threats or emergencies, the next step is to establish the specific procedures for your emergency response. These response procedures form the core of your contingency plan. The procedures should be carefully thought out and, where possible, tested before you need them.

### Identify the primary and backup persons (or positions) responsible for implementing the contingency plan in the event of an emergency

These individuals may not necessarily be the same parties that are responsible for implementing the rest of the WHP plan. They must have experience and knowledge of the local water system, strong management capabilities, a willingness to work with others and seek consensus, and be locally available on short notice. He or she should have the community's respect and be capable of acting with authority. Responsibilities for other aspects of the emergency response should also be carefully matched to the team members' capabilities to insure smooth and effective functioning when it is needed the most.

### Establish standard operating procedures (SOPs) for water plant operators

These procedures will include the Emergency Contact Sheet (Attachment 1) and additional instructions for handling emergency situations.

### State in the Plan how wells that are contaminated can be isolated from the public water supply system

The Plan should clearly state that if evidence of well contamination exists, the well will be taken off line immediately and not returned to service until it is determined that water quality from the affected well is in compliance with standards governing public water supplies. The plan must state clearly who has the responsibility and authority to declare that a well is actually or potentially contaminated in an emergency.

## The Plan should describe the procedure used if contaminated water enters the public water supply system

Describe how the system would be flushed/purged of contamination following such an event. State the criteria (such as sampling and analysis) that would be used to determine when the flushing/purging is successful. Describe how the public will be notified of such events.

The following specific procedures should be addressed in your contingency planning. Coordinate actions with your local emergency planning committee or emergency responders.

- Emergency identification—determination that emergency exists
- Internal communications
  - Information gathering during emergency notification
  - Notification of key personnel
  - Notification roster, beyond initial contact person/ persons
- Incident direction and control
  - Development of a chain of command
  - Identification of individual and agency roles
- Public communications/community relations
  - Advance public information, emergency plans
  - Notification of emergency, including instructions to boil water/not to drink the water until it is determined to be safe
  - Status reports during the emergency
  - Guidelines for citizens to minimize damage
- Contamination assessment and management
  - Identification and isolation of the contamination source
  - Contamination mapping
  - Site response (neutralization of chemical, disinfection, etc.)
  - Response agreements with neighboring communities
- Ongoing incident assessment
  - Status of water system
  - Status of response effort
  - Estimated time of system recovery
- Obtaining alternative supplies
  - Identification of agencies/organizations that will provide short-term emergency water supplies
  - Establishment of plans for long-term alternative supplies
- Water use restrictions
  - Identification of categories of water use restrictions based on severity of disruption
  - Modification or reduction of water use
- Water treatment
- Aquifer remediation

Your plan should include a training agenda and timetable for utility workers and local responders. This training program will be ongoing, as conditions in the WHPA and the techniques for dealing with contamination both change.

Contingency planning should improve your ability to respond when a potential threat becomes a reality. Test the plan to identify any problems that may interfere with its smooth operation. The plan should be reviewed and updated regularly. Specific steps clearly understood by the operators on duty and by the public will allow problems to get the prompt attention necessary to minimize their impact.

## Involving the public

Bring in emergency personnel to discuss options, if they are not already members of the planning team.

The contingency plan must reflect public concerns about their water supply and must tell residents how they will get information about an actual emergency.

Present possible emergency plans for public input. Without support at the local level, response to a real threat can be slow and cumbersome. Coordination can be as important as access to technical assistance when it comes to developing the team and getting the job done. The public's response may be an indication of the feasibility of your proposed plan. Those who have a part in creating a plan are more likely to cooperate in the event of a real emergency.

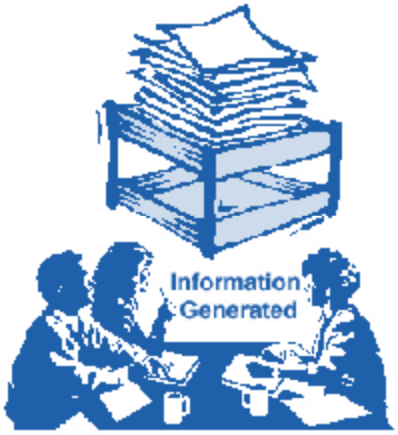
Public meetings may be useful in setting priorities for contingency planning. Town residents may present reasons for ranking threats that differ from those perceived by public officials. Public support will be necessary to make public investment in new equipment or services.

It is critically important to make the public aware of the contingency plans that are produced. Additional public education efforts should be directed toward the public's own part in any emergency response. Residents should know how to report a potential contamination incident, how they will be notified of an emergency, what to do in an emergency, and how to conserve water when the number of wells online is reduced for some reason.

# Products that should result from Step 5, to be included with the final plan:

When you've completed this step, you should have the following information to include with the final plan you submit to PWS:

1. Forms and information for emergency contacts;
2. SOP documents for water supply workers;
3. Long-term and short-term response procedures; and
4. Documentation of public citizen participation in developing emergency procedures and plan for publicity and public education on contingency plan.



# Resources and References

Guide to Ground-Water Supply Contingency Planning for Local and State Governments: Technical Assistance Document. 1990. EPA 440-6-90-003. Office of Water, Office of Ground Water Protection, U.S. Environmental Protection Agency. Paper, 83 pages; 14

USEPA. 1993. Wellhead Protection: A Guide for Small Communities. EPA/625/R-93/002. Office of Research and Development, Cincinnati, OH.

North Carolina Rural Water Association (NCWRA). Phone: 336-731-6963
http://www.ncrwa.com/

North Carolina Water Supply Plans
http://www.ncwater.org/Water_Supply_Planning/Local_Water_Supply_Plan/
Information on water sources, wells, principal water users and distribution systems for North Carolina communities.

North Carolina Division of Water Resources Water Conservation Information
http://www.dwr.ehnr.state.nc.us/wsas/conserve/wc_main.htm

North Carolina Drought Monitoring Council
http://www.ncwater.org/Water_Supply_Planning/
Drought_Monitoring_Council/
Current water supply conditions, outlooks, and list of Public Water Supplies under water use restrictions

## Attachments

Beginning with the next page, you will find attachments that are provided to make it easier for you to prepare your plan document.

Remember, the attachments labeled “Example” are only to give you ideas.

- **Attachment 1: Forms for emergency contacts**
- **Attachment 2: Example Contingency Plan**

# Attachment 1 (example): Emergency contact information

**In the event of an emergency, the Operator in Charge will immediately notify emergency personnel, beginning with the top name on the emergency contact list below. The Operator in Charge will continue down the list until an appropriate person is contacted.** Those people named on the emergency contact list each have a list of additional emergency numbers to call. They will confirm the nature of the event, and direct the Operator in Charge in additional actions.

**Emergency Contact Numbers**

Director of Public Works _____
- Office _____
- Home _____
- Pager _____

Water Plant Superintendent _____
- Office _____
- Home _____
- Pager _____

Town Manager_____
- Office _____
- Home _____
- Pager _____

Fire and rescue chief _____
- Office _____
- Home _____
- Pager _____

County emergency coordinator_____
- Office _____
- Home _____
- Pager _____

Building Inspector _____
- Office _____
- Home _____
- Pager _____

Additional Operators _____
- Office _____
- Home _____
- Pager _____

Other numbers:

- Railroad emergency number _____
- DOT emergency number _____
- Regional PWS office _____
- Local National Guard office _____

# Attachment 2: Example of a contingency plan resulting from this step

**Physical Components of the Clearwater Water Supply**

The Wellhead Protection Areas around the three municipal wells have been delineated and characterized during the development of Clearwater's Wellhead Protection Plan. The facilities of the water system – including the wells, pumps, storage tanks, distribution system, and buildings – are fully documented in the Water Department and Department of Public Works. System specifications are updated annually or whenever major changes or upgrades are made.

**Potential Disruptions to the Clearwater Water Supply**

The top-priority contingencies identified during the wellhead protection process were chemical spills from tank truck accidents in the vicinity of Well #1 and vandalism around Well #3, which is a current ongoing problem. Because of their relatively high probability of occurrence, both drought and flood are also considered high priority disruptions.

**Response Procedure Needs**

Materials Safety Data Sheets (MSDS) for all chemicals known to be used or stored by businesses within the WHPA (see Step 3, PCA Inventory) are on file at the Clearwater Fire Department and in the office of the Director of Public Works. The WHP Planning Team has contacted the two companies that routinely ship hazardous materials through the town and has arranged for MSDS to be provided and updated semi-annually for all materials shipped through the WHPA.

The planning team is working with the Clearwater Police Department and the State Patrol to address the concerns over vandalism at Well #3.

There is little that the town of Clearwater can do to reduce the likelihood of flood or drought. Water Department personnel have procedures and information in place to notify residents of water shortages and to provide information on water use restrictions and water conservation measures.

**Identify Resources**

The Clearwater Director of Public Works is the primary person responsible for implementing the contingency plan. The Clearwater Town Manager will be the back-up person responsible for implementation.

The Director of Public Works maintains a list of well-drilling firms and other contractors that can respond promptly to a disruption of water supply. The Department of Public Works maintains an inventory of portable pumps and generators, repair facilities and spare parts, vehicles and equipment, personnel protection equipment and supplies, chemical supplies, and water sampling gear that can be rapidly deployed in the event of an emergency.

In the event of a power failure, a back-up diesel generator is available for Well # 1. There is no emergency power for the other two wells, but National Guard generators would be requested and used until power is restored. Application has been made with Emergency Management for two mobile generators to reduce dependence on National Guard generators. An on-site generator is available at the Water Plant to pump water from a well to the aboveground storage tanks.

In the event of a loss of local water supply due to drought, flood, or contamination, water can be purchased from the surrounding county, which is tied into Clearwater's distribution system. National Guard tankers could also bring potable water to central locations. Water conservation plans and use restrictions are in place.

**Define Emergency Response Procedures**

Should a major oil or chemical spill or discharge occur within the Wellhead Protection Area, appropriate emergency agencies will be notified. The Operator in Charge at the Clearwater Water Treatment Plant is in the primary position to minimize the impact should an emergency arise. Therefore, an emergency contact sheet (attached) is posted in a prominent location at the treatment plant. The first to be notified would include the Director of Public Works, who would in turn contact the Clearwater Fire Department, the County Emergency Coordinator, and others on the contact list.

EMERGENCY PHONE NUMBERS
Clearwater Fire Department 911 or 555-1212
County Emergency Coordinator 555-1111

The regional office of the Public Water Supply Section would also be notified of the situation and asked for assistance. In the event of a spill or discharge in the WHPA that had not reached the well, the Groundwater Section of NC-DENR will be notified and asked for assistance in monitoring movement of the contaminant.

Standard Operating Procedures (SOPs) are being drafted for water treatment plant operators to guide their initial response to an incident. These SOPs will address emergency contact and notification procedures and instructions for shutting off portions of the water system to isolate contamination.

The Director of Public Works has the responsibility and authority to declare that a well is contaminated. If any of Clearwater's wells becomes contaminated, or if a potentially contaminating spill occurs within the WHPA, the well will immediately be isolated by closing a valve at the well site. This valve will be chained and locked to protect the water system. If Wells #2 or 3 were to be affected, both wells will be assumed to be contaminated because of their close proximity; and both wells will be taken off line. The well (or wells) will not be returned to service until it has been determined that water quality from any impacted well is in compliance with drinking water standards. Samples will be taken from numerous locations throughout the system, and tested to determine the extent of contamination.

If only a portion of the system is affected, that portion will be isolated from the rest of the system by closing valves around the contaminated section. The affected portion, or the entire system if necessary, will be systematically flushed until sample results show that the contaminant is no longer present and the water meets drinking water standards. In the case of sewage or similar biological contamination, the well and distribution system will be disinfected according to PWS Section guidelines. Depending upon the type of contaminant involved, the flush water can be collected in tankers and disposed of as per State requirements, if needed. After consultation with the Public Water Supply Section, notification that the water supply is safe to drink will be made to the citizens of Clearwater.

If contamination has occurred, water system customers will be notified by Police and Fire Depart-

ment personnel using loud speakers and by local radio and television broadcasts. If a water shortage occurs for any reason, Water Department personnel will go door-to-door, notifying residents of the problem, and providing information on water use restrictions and water conservation measures. Public service announcements will also be placed in the local media.

Over the short term, there is enough water in the storage tanks (when full) for three days normal water demand. If the wells could not be restored to use, other areas outside the likely area of contamination will be considered to drill new wells for long-term water supply purposes. In the meantime, water could be purchased from the surrounding county, which is tied into Clearwater's distribution system. National Guard tankers could also bring potable water to central locations. Brochures and public service announcements on water conservation would be disseminated throughout the community. Consumers with special needs, such as medical facilities, are being identified and their emergency needs defined, to be sure these needs can be met.

Training for chemical spill response has been added to the Fire Department's ongoing training programs. Additional funding is being pursued to allow the purchase of chemical containment supplies for use by emergency responders. Another emergency planning priority is a security system being installed around well 3, not only to reduce the likelihood of vandalism but also to allow a faster response time by public safety personnel.

The Emergency Management Plan, prepared when the Water Supply Management Plan was submitted, (under Title 15A Subchapter 18C of the North Carolina Administrative Code, section .0307) has been updated to include new information and procedures arising from the wellhead protection planning process.

# 6 Step 6: Implementing, Maintaining and Updating Your WHP Plan

## Introduction: what this step is about

A wellhead protection plan must include the means and the timetable for putting the Plan into action.

When you submit your wellhead protection (WHP) plan, it must include the means and a timetable for putting it into action. Once your WHP program is in place, continued administration and periodic evaluation and possibly revision of the program will be necessary to continue protection of your drinking water supply. Administration includes the establishment of wellhead protection areas (WHPAs) for new wells, periodic well and well site inspection, regular updating of Potential Contaminant Sources (PCS) inventories, and the review and revision of WHP management strategies.

Your WHP plan cannot be a static document. It must be maintained and revised to respond to changing conditions in your town.

## Procedure: what you need to do to complete Step 6 toward your WHP plan

### *Implementing your plan*

You must anticipate and plan for implementation while you are developing your WHP plan. After your plan is approved, implementation can begin. Implementation details will vary by community but will need to address the following items:

Implementation Steps:
- Appoint a WHP Administrator
- Notify property owners
- Initiate management strategy
- Begin community education
- Finalize contingency plans

- **Appoint a local WHP program administrator**
  The assignment of a person to oversee the administration of a WHP plan is critical. Responsibility and appropriate authority must be given to this person for the plan to be implemented successfully. This may or may not be the same person who led the plan preparation and need not be a new hire or new position, but it is important that adequate resources be allocated to the administrator. Examples of local WHP program administrators include town Public Works Director, Town Manager, and town water plant superintendent.
- **Notify property owners within the WHPA**
  Property owners contacted in Step 3 should be contacted again when the plan is implemented. Give high priority to PCSs identified in Step 3. Information sheets regarding their PCS and appropriate management measures, including Material Safety Data Sheets, should be shared at this point. An educational approach, including some of the activities outlined in Steps 3 and 4 should be carried out or revisited at this time.

- **Initiate management strategy**
  Implementation of your WHP plan includes application of the management measures you outlined in Step 4 of the plan. If general public education efforts were proposed, begin developing the educational material (e.g., a brochure) and specific plans for distribution. Site visits to PCSs should be scheduled and carried out. Establish regular contacts with the appropriate State and/or Federal agencies to monitor compliance with discharge permits, underground storage tank (UST) management, and other regulatory programs. If you proposed any local regulatory elements such as zoning overlay districts or building code modifications, begin the political and administrative process of adoption as soon as possible.
- **Community Education**
  Plans for broad-based community education drawn up in Steps 3 and 4 should be put into action. While tangible steps need to be taken at the outset to raise community awareness, remember that education and public involvement is an ongoing effort.
- **Contingency Plan Coordination and Assignments**
  Personnel, equipment, and other resources needed to respond to contingencies (Step 5) should be checked and verified. Any training or additional resource needs identified in Step 5 must be part of the implementation of your plan. If financial resource needs were identified in Step 5, plans to raise necessary revenues should also be included in implementation of your plan. Personnel assignments for short-term (emergency) and long-term problems need to be made immediately. Coordination with other community departments or units such as the fire department and with response agencies outside the town should be established early.

## Maintaining your plan

Maintaining your local WHP program is a continuous process of adjusting to the growth and changes that take place in your community. Maintaining and updating your WHP plan includes monitoring chemical use and land use in the WHPA, updating PCS inventories on a regular basis, maintaining public awareness and involvement, and adding any new water supply wells to the existing plan. After your plan is adopted and implemented, you may want to maintain your WHP planning team as a standing town committee to maintain the plan.

Maintain your plan:
- Monitor chemicals used in the WHPA
- Track changes in land use and development
- Maintain public awareness
- Update PCS inventory
- Review management strategies

Consider these activities to keep your WHP plan up to date:

- **Monitor chemicals used in the WHPA**
  As new industry comes into the WHPA or land use changes occur, planning team members and city officials should be aware of new chemical sources and practices that could affect ground-water quality. Use the instructions, examples and resources in Step 3 “Potential Contaminant Source Inventory” and Step 4 “Developing Management Strategies” to update PCS inventories and to update management strategies for any new contaminants identified. Ask emergency responders to report additional hazardous materials that are registered with them.
- **Monitor land use within the WHPA**
  Land use changes may affect the WHPA and potentially your ground-water supply. It is important to keep up to date with these changes in order to

update your plan and to protect ground-water resources. Maintain communication with people responsible with planning and zoning in your town; tracking applications for building or zoning permits is a good way to keep up with development in the WHPA. Planning team members may also be a good resource for monitoring land use changes. Simple "windshield surveys" conducted at regular intervals can be helpful. Finally, the public awareness and participation developed during the planning process may encourage residents to watch over activities in their WHPA.

- **Maintain public awareness programs**
  Educational programs are crucial in letting residents of the WHPA know how important it is to be careful with any substance that could affect ground-water quality. The educational programs you developed in Step 4 should be implemented as part of your WHP efforts. Information and education programs may need to be revised and/or repeated periodically after the initial effort.
- **Update the PCS inventory**
  Even in the absence of new development or major land use change, it is a good idea to update your PCS inventory on a defined schedule. Public records available at facilities identified as PCSs should be reviewed annually to insure program compliance. Every three years, the PCS inventory should be updated using the same procedures used to develop the original PCS inventory. At this time any new PCSs can be added to the inventory; any sites eliminated through business or industry closure or modification can be removed from the active inventory. Additionally any new chemicals registered with the local fire department should be evaluated with respect to their potential effect on the drinking water supply. This also is a good time to review hazard ratings for PCS entries and make necessary changes. Follow procedures outlined in Step 3.
- **Review management strategies**
  If new PCSs are identified, management strategies identified in your plan should be reviewed and amended if necessary. If new chemicals or processes are added, you may need to revisit the procedures in Step 4 to make sure that your plan includes the management strategies appropriate to all of the threats to water quality in your WHPA.
- **Include new water supply wells to your plan**
  When adding new wells to the existing WHP plan, the local WHP program administrator should work closely with the community's public works personnel and any consultants involved with planning and constructing the well.

  The first step in adding a new well or wells to an existing WHP plan is to delineate the WHPA for the proposed well. Next, a new PCS inventory must be developed for the proposed well.

  This preliminary information should be given to the person responsible for the local WHP program (local WHP Program Administrator) for review. At this point, the local WHP Program Administrator may wish to consult with the Public Water Supply (PWS) Section's WHP Program Manager regarding the delineation of the preliminary WHPA. Any information required by the PWS Section relating to development of new PWS wells must also be submitted. If the person responsible for the local WHP program grants provisional approval of the proposed WHP plan and the PWS Section grants

Addition of new wells to your water system will require an update of your plan.

approval to construct or expand the PWS well or well system, then work may proceed with well construction. Once the well has been constructed, the revised WHP plan can be finalized. This involves finalizing the WHPA delineation and the PCS inventory. It may also be necessary to revise other WHP plan components (e.g., management plan, contingency plan, etc.) to deal with any new PCSs identified in the new well's PCS inventory. The revised WHP plan should then be sent to the PWS Section for review and approval. Once approval is received, implementation of the revised WHP plan can begin.

- **Monitor PCS and drinking water supplies**
  Some of the sources you searched to develop your initial PCS inventory in Step 3 should be rechecked periodically to track changes in PCS activity. Consult electronic databases to monitor incidents of known ground-water contamination. Check with the UST Section of the NC Division of Waste Management to track issues related to USTs in your WHPA. You may wish to check with the NC Division of Water Quality to verify that operators of permitted facilities continue to comply with applicable regulatory and permit requirements.

  North Carolina Regulations require monitoring of public drinking water supplies. It is a good idea to establish communication with the operator of your water provider so that you may be apprised of any change in water quality. If you anticipate a long-term problem with a PCS, you may want to consider developing a ground-water monitoring program.

- **Measure effectiveness**
  Ultimately, the effectiveness of your WHP plan can be judged by the continued quality of your drinking water supply. In addition, some features of your plan can be tracked to see how your plan is working. If your community has used some regulatory tools, public record of zoning and subdivision permits, site plan reviews, and health or building code inspections can provide insight into how these tools are working. State agencies can provide records on monitoring of permitted facilities, USTs, and any documented ground-water contamination incidents. Effectiveness of public information and education can be tracked by documenting public participation in household hazardous waste pick-ups, septic tank maintenance, requests for information, participation in public meetings, etc.

## Updating your plan

Even with regular evaluation and maintenance, your WHP plan should be thoroughly re-evaluated on a regular basis, perhaps every three to five years. If you have been careful about maintaining your WHP plan, this job will be relatively easy. A major update of your WHP plan will be necessary if any of the following apply:

If you have been careful about maintaining your WHP plan, updating the plan will be relatively easy.

- Water supply or pumping volumes changes;
- New potential sources of contamination or new potential contaminants;
- Land use changes within the WHPA;
- New required or proposed management strategies;
- Contingency planning and emergency response procedure changes; or
- Addition of new water supply wells.

Updating your WHP plan may not require you to completely repeat each of the steps in the process. Addition of a new well, for example, may require an expanded WHPA and additional PCS inventory, but unless a completely new PCS is added, existing management approaches and contingency plans may be sufficient. Residential growth within the WHPA may stimulate discussion of new management approaches, but may not add new PCSs to manage. It may be wise to maintain your WHP plan development team as a standing town committee to make major plan updates easier.

### Plan for the future of your ground-water supply

Forecasting future water supply and demand will help prepare for WHP plan updates.

Forecasting future water demand and water supply will help your community anticipate WHP plan updates. Future demand will depend on population change, the type of development (residential, industrial, etc.), and the safe yield of existing and future water supplies. The average North Carolinian uses between 50 and 75 gallons of water per day for domestic use. Commercial and industrial use may vary from 10 to 75 gallons per person per day, with lower uses associated with small residential communities. Public uses (water used in parks, civic buildings, schools, churches and hospitals, etc.) can range from 15-25 gallons per person per day. Water use varies by season, with the peak daily use typically about 180 percent of the annual average daily use.[1]

You should also consider the safe yield of existing wells and of the entire local ground-water supply when anticipating WHP plan updates. North Carolina General Statute G.S. 143-355(l) requires all units of local government that provide or plan to provide public water service to prepare a Local Water Supply Plan (LWSP) and to update that plan at least every five years. A LWSP is an assessment of a water system's current and future water needs and its ability to meet those needs. By looking at current and future needs, local governments are better able to manage water supplies and better prepared to plan for water supply system improvements. Having a LWSP reduces the potential for water conflicts and water shortages. Early identification of these issues allows more time for resolution. Additionally, local governments must have an adopted current LWSP on file with the Division of Water Resources to qualify for certain grants and loans available for water supply systems in North Carolina. Comparing future water demand with safe yield of available ground-water supplies will help in anticipating the need for new wells or well fields that would require major WHP plan updates and revisions. In some areas of North Carolina, ground-water use is becoming regulated in the form of *capacity use areas*. The Central Coastal Plain capacity use area effective August 1, 2002, for example, requires registration of uses above 100,000 gallons per day, and establishes certain reporting requirements, including a water conservation plan for PWS systems. Additionally, users drawing from certain aquifers must reduce usage over a period of time from an established base rate.

## *Involving the public*

The relationships you have developed in the planning process through communicating with your stakeholders need to be maintained throughout the process. If you do it right, and your support is broad enough, then you will

[1]Linsley, R.K., J.B. Franzini, D.L. Freyberg, and G. Tchobanoglous. 1992. Water Resources Engineering. McGraw-Hill.

maintain support for the program even when your elected administration changes. The effort to develop a truly representative stakeholder group at the beginning will bring rewards in the long run.

Some examples of how town residents can help in local WHP program implementation and maintenance include:

- **Citizen observations**
  Citizens will be more aware of PCSs after education and awareness, and should be encouraged to notify town officials when they see potential contamination events;
- **Voluntary submission of updates**
  By emphasizing that the goal of WHP is protecting drinking water, not just complying with regulations, operators of PCS facilities can be encouraged to volunteer information on changes in their facilities, to consider management options for new chemicals, and to approach the WHP committee for management ideas and information.
- **Future surveys**
  Future surveys for monitoring WHP plan effectiveness and for plan updates will depend on cooperation of town residents and on volunteers to assist in information collection.
- **Public education**
  Planning team members and members of the community at large can be of assistance in public education. Specifically, members and volunteers can help disseminate educational materials by various modes, including mailings, door-to-door delivery and postings at public buildings, schools and churches. Refer to step 4 for other ideas.

## RWA and PWS Section contributions

The North Carolina Rural Water Association (NCRWA) can assist in this step just as they assist in the original development and submission of the WHP plan. In particular, they are well suited to help you in the delineation of WHPAs for any new wells.

The PWS Section can assist in administrative and technical matters, especially the requirements for any revisions of the originally submitted plan.

If you had a consultant help you in the development and submittal of your original plan, you may wish to consider retaining the consultant for assistance in updating your plan.

- **North Carolina Rural Water Association**
  Phone: (336) 731-6963
  Ncrwa@aol.com
  http://www.ncrwa.com/
- **Public Water Supply Section**
  **Wellhead Protection Program**
  1634 Mail Service Center
  Raleigh, NC 27699-1634
  Phone (919) 715-2853

# Resources and References

## North Carolina Cooperative Extension

*Ground Water in North Carolina* Publication Number: RE-6
http://www5.bae.ncsu.edu/programs/extension/publicat/wqwm/re6.html

*Ground Water in the Coastal Plain of North Carolina* Publication Number WQWM-1\ AG-450
http://www5.bae.ncsu.edu/programs/extension/publicat/wqwm/ag450.html

*Ground Water in the Piedmont and Blue Ridge Provinces of North Carolina* Publication Number WQWM-9\AG-473-6

*Focus on Residential Water Conservation* Publication Number HE-250
http://www.bae.ncsu.edu/programs/extension/publicat/wqwm/he250.html

## Division of Water Resources, NC DENR

*North Carolina State Water Supply Plan* — January 2000 Draft
http://www.dwr.ehnr.state.nc.us/wsas/swsp_jan2000/swsp_j00.htm

*Capacity Use Area #1*
http://www.dwr.ehnr.state.nc.us/hms/gwbranch/cua1.htm

*Central Coastal Plain Capacity Use Area*
http://www.dwr.ehnr.state.nc.us/hms/gwbranch/ccpcua.htm

*Central Coastal Plain Capacity Use Area Rules*
http://www.dwr.ehnr.state.nc.us/hms/gwbranch/HOR/HORwebpage.htm

*Central Coastal Plain Capacity Use Area Fact Sheet*
http://www.dwr.ehnr.state.nc.us/hms/gwbranch/ccpcua.htm

## Division of Environmental Health, NC DENR

*North Carolina's Rules Governing Public Water Systems*
http://www.deh.enr.state.nc.us/pws/rules/contents.htm

*Public Water System Capacity Development Guidance Document*
(This document provides guidance on the capacity development program which contain rules governing expansion or creation of a PWS system.)
http://www.deh.enr.state.nc.us/pws/CapDev/FINALguid.pdf

## Attachments

Beginning with the next page, you will find an attachment provided to make it easier for you to prepare your plan document.

Remember, the attachments labeled "Example" are only to give you ideas.

- **Attachment 1: Example of a partial plan showing the portions of the plan that results from this step.** Your final plan will be different than that of the fictional town of Clearwater provided as an example.

# Attachment 1: Example of plan language related to this step

The following is some sample language related to this step.

## Implementation

The Town of Clearwater will implement its local WHP program by taking the following steps:

- **Appointment of a local WHP program administrator**
  It is anticipated that the Town Public Works Director will be appointed as local WHP Program Administrator. The person currently in this position has co-chaired the WHP planning team during the development of the WHP plan.
- **Notification of property owners within the WHPA**
  Property owners contacted in the course of the PCS inventory will be notified of plan adoption and implementation. Each owner will receive a mailing that will include information related to their PCS and the relevant management measures contained in the plan. The information brochure developed in the planning process will also be included in the mailing.
- **Community education**
  A WHP brochure containing information about ground water, wellhead protection, ground-water pollution, and the town's local WHP program will be delivered to each resident, farm, business, and industry within the WHPA. Copies of this brochure will be made available at the Town Hall, Public Library, and other locations.
- **Contingency plan coordination and assignments**
  Personnel assignments for responsibilities identified in the Contingency Plan will be made and the emergency contact information list will be completed with current information. Material Safety Data Sheets for all chemicals identified in the PCS inventory will be assembled and filed in the Public Works Office and in the Clearwater Fire Department. Training for Fire Department personnel in spill response will be scheduled as soon as possible.
- **Monitoring of PCS and drinking water supplies**
  The local WHP Program Administrator will periodically consult electronic databases to monitor incidents of known ground-water contamination. The Administrator will initiate a program of semiannual checks with the UST Section of the NC Division of Waste Management to track issues regarding USTs and with the NC Division of Water Quality to verify that operators of permitted facilities continue to comply with their permit requirements. Regular consultations between the Administrator and the water system operator will ensure that drinking water quality is routinely tracked.

  Implementation of the Town of Clearwater local WHP program will take place according to the schedule listed below. For each implementation step listed on the vertical axis, the beginning of the horizontal bar represents the start-up time in months following approval of the WHP plan. The length of

each bar represents the expected duration of implementation and the end of the bar indicates the expected completion date for the step. Note that the "Monitor PCS" step is a continuous process and does not end at 25 months. Similarly, some educational programs would continue or repeat beyond the 25th month.

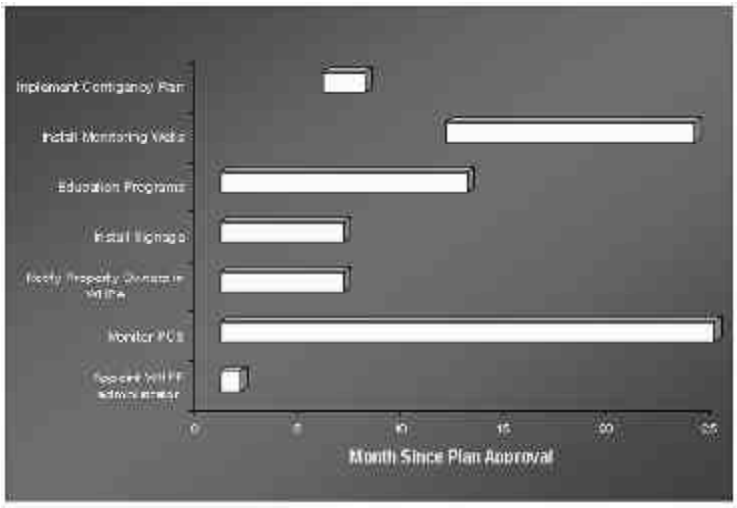



**Figure 6-1. WHP plan implementation schedule**

## Maintaining and updating the plan

The Town of Clearwater is aware that an effective local WHP program is an ongoing process. The Town of Clearwater will review public records available at hazardous waste and waste disposal facilities and other PCS sites located within the WHPAs annually in order to ensure program compliance. Every three years, the PCS inventory will be updated using the same procedures used to develop the original contaminant source inventory. The Town of Clearwater will fully update the plan every five years. Additionally, the plan will be updated at any time a new well is constructed for use with the city's water supply system, a new PCS is located within the WHPA, or major land use changes occur in the WHPA.

The WHP planning team will be maintained as an advisory committee to the local WHP Program Administrator. This WHP committee will assist in tracking development and land use change in the WHPA, update the PCS inventory and applicable management measures as necessary, and track state agency reports and monitoring programs relevant to ground water and drinking water. An annual review of proposed developments in the WHPA such as shopping centers, industrial parks, and subdivisions will be performed in consultation with planning and zoning staff. The WHP committee will also be responsible for informing town residents and responding to questions concerning the Clearwater WHP program.

The Town of Clearwater will amend its WHP plan to include any new well(s) added to its water system. The WHP team for the Town of Clearwater recommends the following steps:

1. Develop a preliminary WHPA for the proposed well in order to determine the area of vulnerability.
2. Develop a contaminant source inventory for the preliminary WHPA.
3. Submit the information obtained in items 1 and 2 above to the local WHP Program Administrator and the WHP planning team identified in Step 1. Any information required by the PWS Section relating to the development and construction of new PWS wells must also be submitted.
4. If the local WHP Program Administrator grants provisional approval of the proposed WHP plan and the PWS Section grants approval to construct or expand the PWS well or well system, then work may proceed with well construction.
5. Finalize the WHPA delineation for the new well.
6. Finalize the contaminant source inventory for the WHPA.
7. Submit finalized WHPA and contaminant source inventory to the local WHP Program Administrator.
8. Once approval is received, implement any necessary regulatory and or nonregulatory PCS management practices.
9. Submit the amended WHP plan and all necessary supporting information to the PWS Section for review and approval.

# 7 Step 7: Submitting Your WHP Plan

## Introduction: what this step is about

Once your draft Wellhead Protection (WHP) plan is complete, you need to submit it to the Public Water Supply (PWS) Section of the North Carolina Department of Environment and Natural Resources. There, your plan will be reviewed to verify that it is complete, has followed all the steps outlined previously, and meets the requirements of the North Carolina Wellhead Protection Program.

The approval process typically involves some additions or revisions to the initial draft plan. PWS Section staff may have questions or issues that need to be clarified, or some necessary elements may have been omitted. Revisions may add several months to the time required for approval of your plan. If you follow the guidance in Steps 1 through 6, however, the need for revision should be minimal.

## Procedure: what you need to do to complete Step 7 toward your WHP plan

### *What to submit*

There are few specific requirements for the format of your WHP plan. The plan should start with a cover page that includes:

- Name of the water system
- Town and county
- PWS identification number (PWSID)
- Date
- Contact information for the person(s) submitting the plan

The Plan should include a chapter for each of the steps in the WHP plan process, plus maps, data forms, and other supporting information. A checklist for the plan contents is shown at the end of this chapter.

The plan should be well-organized; all text, tables, maps, and drawings should be typed or printed neatly and legibly; and the report should be stapled or bound so that all the pieces will stay together. One copy should be submitted; always keep at least one back-up copy in a safe place.

## Where to submit your WHP plan

Submit your plan to:

Public Water Supply Section
Wellhead Protection Program
1634 Mail Service Center
Raleigh, NC 27699-1634
Ph: (919) 715-2853 Fax: (919) 715-4374

## What to expect after you submit your plan

The time necessary for PWS Section staff to review your plan and respond to you varies depending on the number of plans under review at the time. The office strives for a two to four week response time. You may receive requests for additional information or suggestions for revision.

What kind of questions or requests can you expect? The questions or suggestions you receive depend on how thorough your planning team has been in developing your plan. Examples of requests that could be made following initial review are:

- Clarify the methods used to delineate the Wellhead Protection Area (WHPA);
- Give more detail on the Potential Contaminant Source (PCS) inventory and the risk classifications;
- Identify person/position responsible for certain elements of the plan;
- Provide a process for providing public notification on the availability of the WHP plan;
- Document the process for providing information to businesses located within the WHPA; and
- Consider a provision for managing threats from improperly constructed or abandoned wells within the WHPA.

You will receive a detailed letter stating any questions or comments and explaining what is needed for approval. There are no time limits for your response to such requests. However, revisions should be completed and submitted within a reasonable time; otherwise, a plan component such as a PCS inventory may become outdated and need to be redone.

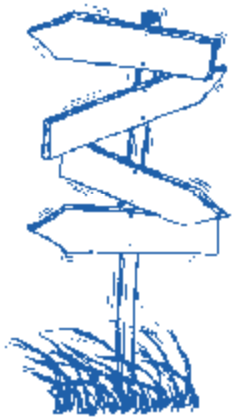
## Help with revisions

Members of the planning team can help answer some of the review questions. You may need to revisit your PCS inventory or decide on who is responsible for some of the plan implementation elements. If you need to seek outside help to respond to necessary revisions, you may wish to contact the North Carolina Rural Water Association ( P.O. Box 540, Welcome, NC 27374; 336-731-6963). Public Water Supply Section staff can also assist you.

## What to do with your plan

When your plan receives final approval, you will be notified in writing. When you receive this notification, take a few minutes and congratulate yourselves for the efforts you and your planning team made to ensure safe drinking water for your community's residents. Make sure local businesses and citizens know that your town has an approved local WHP program.

Remember, though, that just having an approved local WHP program is not the end of the story. Proper implementation, maintenance, and updating of your WHP plan are essential for your WHP program to be successful. Follow through on the plans you made and the strategy you outlined in Step 6. Keep in touch with the North Carolina PWS Section to stay up to date on water supply protection information and programs, such as the Source Water Assessment Program (SWAP). Periodically contact the North Carolina Division of Pollution Prevention and Environmental Assistance (DPPEA) for assistance in waste reduction and pollution prevention. Finally, remember to keep good records of your progress in implementing the plan. Documentation of proper implementation, maintenance, and updating of the approved WHP plan may be required to obtain priority rating points for future loan and grant applications.



# Checklist for a complete WHP plan

## Step 1: The Planning Team

- ❒ Names and roles of planning team members
- ❒ Problems and needs identified by planning team
- ❒ Goals of WHP plan and planning team
- ❒ Strategy for public participation

## Step 2: Delineating the Wellhead Protection Area

- ❒ Basic information on water supply wells, e.g.:
  - Well owner, system name, location, town or community served
  - Date drilled
  - Well depth, casing depth, location of screens
  - Source of supply (aquifer)
  - Well yield, pumping rate, pumping period
- ❒ Map showing each well location, with a WHPA delineated
- ❒ Documentation and justification for method used to delineate WHPA

## Step 3: Conducting a Potential Contaminant Source Inventory

- ❒ List of sources used to identify PCSs
- ❒ Printouts showing search results of each electronic database searched
- ❒ A sample of each survey questionnaire used to gather basic site information
- ❒ Summary of data from each type of survey
- ❒ Data Sheet for each PCS included in the WHP plan
- ❒ Inventory of PCSs for each well
- ❒ Criteria used for deciding which PCSs to include and the ranking system used
- ❒ List of PCSs grouped by higher, moderate, and lower risk for each well
- ❒ Documentation of public citizen involvement

## Step 4: Developing Management Strategies

- ❒ Management strategy adopted for each PCS type occurring within the WHPA
- ❒ Documentation of public citizen involvement in the process of choosing management strategies

## Step 5: Developing a Contingency Plan

- ❒ Forms and information for emergency contacts
- ❒ SOP documents for water supply workers
- ❒ Long-term and short-term plans addressing response procedures
- ❒ Documentation of public citizen participation in developing emergency procedures
- ❒ Plan for public notification in the event of emergency involving disruption of the water supply

## Step 6: Implementing, Maintaining and Updating Your Plan

- ❒ Process for appointment of a local WHP program administrator
- ❒ Notification procedure for property owners within the WHPA
- ❒ Community Education brochure(s)
- ❒ Personnel assignments for responsibilities identified in the contingency plan
- ❒ Plans for training programs for local personnel
- ❒ Program for monitoring of PCSs and drinking water supplies through electronic databases, state agencies, and local personnel
- ❒ Implementation schedule
- ❒ Schedule and procedures for regular plan maintenance and update
- ❒ Procedures to update plans following construction of new well, after introduction of any new PCS located within the WHPA, or following any major land use changes in the WHPA