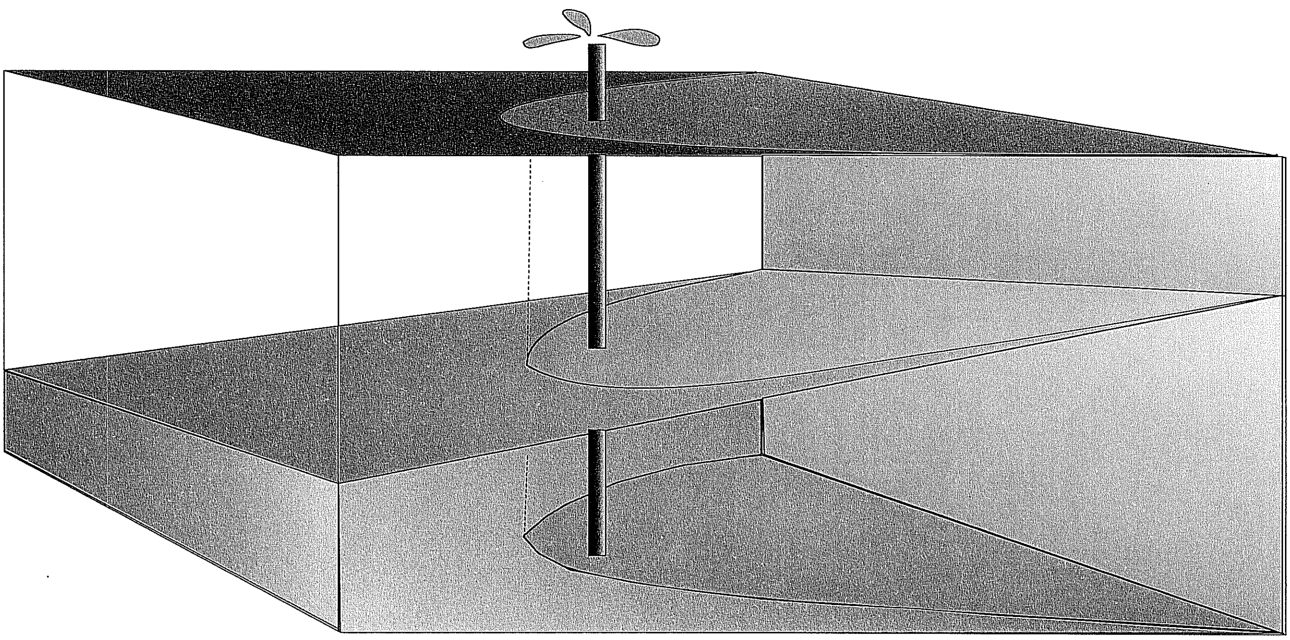
Wellhead Protection: A Model Plan for Iowa Water Suppliers



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MODEL PLAN

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STATE OF IOWA
TERRY E. BRANSTAD, GOVERNOR
DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

September 9, 1996

To All Model Plan Holders:

During the many years of working with Iowa's drinking water suppliers, we at the Iowa Department of Natural Resources have come to know that Iowa water utilities abide by one common, overriding principle. Though they serve a variety of populations, use different treatment strategies, and are organized in various ways, Iowa's water suppliers aspire to deliver to their consumers a steady supply of safe, quality drinking water. We believe this guiding principle is not diminished in the face of an emergency, but in many instances, becomes more critical. The need to be vigilant becomes very acute when the actual wellhead itself is threatened.

To help water utilities across the state meet their obligations and the expectations of their consumers, we have charged the Des Moines Water Works, working with the Howard R. Green Company, with developing a reference source which will be suitable for assisting water utilities in locating, delineating, and providing protective measures for their respective wellheads.

With the cooperation and funding from the United States Environmental Protection Agency and valuable input from the Iowa Geological Survey Bureau, we have worked with Des Moines Water Works for several months to put together what we feel is an exceptional program. When the projects are completed, it will enable all water utilities to plan to meet challenges that may await them.

We ask that all of you join in our commitment to this project and the heightened reliability it offers to Iowa's drinking water community. We hope further that you will find "Wellhead Protection: A Model Plan for Iowa Water Suppliers" a valuable and useful tool in your community.

Sincerely,

Darrell McAllister
Chief, Water Quality Bureau
Iowa Department of Natural Resources

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Introduction

Wellhead Protection - Is It an Issue for Iowa?

Across the country, the practice of wellhead protection is becoming a more common operation within a water utility. Simply stated, wellhead protection is a program which protects a community's groundwater supply against contamination - for present and future generations. The program involves education, investigation, land management, documentation, and public participation, all of which are necessary for success. Our society is dependent upon clean water, yet many people don't realize their everyday operations, and day-to-day living, can harm the quality of the drinking water supplies they need.

More than half of this nation's drinking water is provided by groundwater sources. Historically, groundwater was thought to be well-protected from contamination hazards. After all, these water supplies are often located hundreds of feet below the earth's surface. Unfortunately, scientists are now learning this notion is far from true. In fact, groundwater sources are often deemed to be just as vulnerable as surface water supplies, so much so the Environmental Protection Agency's (EPA) Surface Water Treatment Rule has deemed some groundwater sources "under the influence of surface water," requiring them to be treated in much the same manner.

In Iowa, groundwater contamination is a serious issue. Eighty percent of Iowa's drinking water use is provided by groundwater sources, drawn from surficial aquifers and five principal bedrock aquifers. Several public water suppliers are dealing with problems of one or more human-caused contaminants in their supply wells. Most are eventually able to drill new, contaminant-free wells, or connect to a neighboring system. Some have had to provide bottled water, or even shut down one or more of their wells to be able to continue to deliver drinkable water. And, in several towns there are no feasible alternative aquifer sources available to them. In these cases, local governments, residents, and businesses have been severely burdened by expensive cleanup of hazardous contaminations that have affected their water supply, if the contaminations can be cleaned up. All of these situations are costly and disruptive.

Dealing with groundwater contamination cleanup is always more costly than prevention of contamination, which can be provided through a well-designed and implemented wellhead protection plan. Just ask the cities of Decorah or Galva; these communities have experienced contamination and can attest to the burdens that it imposed upon their communities and residents.

What a Wellhead Protection Program Entails

Wellhead protection is a program designed to manage uses of land so a community's water supply is protected against contamination. When hazardous substances are present in or nearby a community, the well(s) and groundwater source may be at risk of contamination. An effective wellhead protection program will help water utilities determine whether any such hazards exist, and, if they do, what is the likelihood those hazards will deteriorate the safety and quality of their rinking water supply. Knowing this information, water utilities can work with community leaders to develop plans to manage hazardous situations and minimize, or even avoid, emergencies that could leave the community without an adequate supply of safe drinking water.

Developing a wellhead protection plan will also help your utility be prepared if contamination does occur. Planning alternative water supply options, and knowing how to respond if contamination cannot be avoided, will reassure community residents the drinking water they depend on will be available for generations to come.

As you begin this study of wellhead protection and review this model plan, there are likely to be terms used that may be unfamiliar to you. At the end of the model plan, a ***Glossary of Definitions*** has been included to assist you.

Purpose of the Wellhead Protection Model Plan

This model wellhead protection program is designed to teach water suppliers, and the communities they serve, the skills needed to evaluate existing and future risks to their drinking water supplies. When water utilities understand fully the risks posed by certain businesses, operations, and land uses in their community, they can present these issues to the community and together weigh the options for protecting the water supply. The model plan, when completed with information pertinent to your utility, will document characteristics of your water sources, strategies to protect them, and procedures to be followed if a contamination should occur. This model plan meets criteria set out by the EPA for preparing vountary wellhead protection initiatives. While the EPA has not mandated the development of these plans, it is clear from the agency's 1996 Drinking Water Redirection Initiatives Report this type of voluntary program in a partnership-oriented approach with water utilities is desired.

This model plan describes in detail seven steps to be followed to implement wellhead protection planning. For each step, there are one or two fill-in-the-blank forms which need to be completed by water utilities. While many technical aspects of wellhead protection are incorporated into this plan, they are presented in common-sense approaches that are easy to understand and affordable for the smallest communities. This non-traditional strategy will enable Iowa water utilities to use the resources and information they already have available to them to implement wellhead protection plans.

Funding and Technical Assistance

As you review this model plan, there are two steps which may require in-depth, analytical processes, likely to be provided by engineering consultants or groundwater professionals. For these activities, funding and technical assistance may be needed to allow your utility to proceed with full development of a wellhead protection plan.

Funding for smaller cities may be available, in the form of grants, from sources like the Department of Housing and Urban Development, the Rural Development Administration, and the Clean Water Partnership Program. Technical assistance varies, depending upon your town's proximity to a larger community, and its professional business base. The following organizations may be able to provide technical assistance or resources:

Iowa Department of Natural Resources (IDNR) -
Water Quality Division
IDNR - Geological Survey Bureau
Extension Services, or Departments of
Geography and Geology of State Universities
U.S. Environmental Protection Agency - Region VII
Regional Planning Council
Iowa Ground Water Association
Iowa Department of Agriculture
National Rural Water Association/Iowa Rural Water Association
Iowa Department of Economic and Community Development

Seven Steps to a Successful Wellhead Protection Plan

This model plan provides suggestions for wellhead protection program organizing, prioritizing, planning and training. Simple template-style forms included in the seven steps of the model plan require information from your utility or community, and need to be completed as part of your utility's wellhead protection plan. When all forms pertaining to your utility have been completed, this model plan will detail the critical information about your water utility necessary to guard against contamination, prioritize potential hazards, identify appropriate resources, and list measures to keep the plan up to date and useful for your community.

Follow these guidelines to complete the seven steps of the model plan:

1. Complete the ***Wellhead Protection Team Coordinators*** form first. This form will provide basic contact information about each key member of your Wellhead Protection Team. These team members are likely to organize several sub-teams to work on various aspects of the program.

2. Complete the ***Wellhead Information Table*** for each well you use, next. Gathering this information is the first step in identifying your Wellhead Protection Area (WHPA) and will be needed for other steps of the model.

3. Complete the ***Contaminant Inventory Table*** for each well you use, remembering to diagram the locations of possible contaminants on a city street or zoning map, if available. With this information, you will have a "snapshot" of possible risks to your well.

4. Complete the ***Risk Assessment Table*** and ***Risk Consolidation Table*** to prioritize possible risks. These forms cause you to direct resources to those hazards most likely to impact your water system.

5. Complete the ***Contaminant Source Management Log Sheet*** to record strategies you determine are needed to sufficiently protect your well sites.

6. Complete the ***Water Supplier General Information Sheet*** and the ***Contingency Plan Table*** to record key contact information and outline measures arranged to assure a continued supply of water is available in the event of a contamination emergency.

7. Complete the ***Public Participation Log Sheet*** to record your initiatives to educate and

involve the community in your wellhead protection program.

When completing all forms, it is important to remember to record enough information to allow someone in a back-up capacity to function in a particular team position.

Iowa Aquifers and Recharge Areas

Many of the towns in Iowa use wells to pump their drinking water from aquifers. Before you can design and put into place an effective wellhead protection program, you need to know what type of aquifer supplies your well, and how your particular aquifer is recharged.

An aquifer is a water-bearing geologic formation that transports and stores groundwater. These formations supply water at a rate large enough to serve as a reliable, long-term source.

The aquifers in Iowa fall into two broad categories: **surficial** and **bedrock**. **Surficial** aquifers are aquifers that have formed within the layers of sand, gravel, and soil which cover most of the state. **Bedrock** aquifers are aquifers that have developed in the deeper geologic, or bedrock, formations beneath the soil.

In addition to being either surficial or bedrock, each aquifer is also either **confined** or **unconfined**. An aquifer is said to be **confined** if it contains layers of material, above and below the aquifer, through which water does not easily flow. **Unconfined** aquifers do not have these layers, so water can flow into them over their entire surface area. Knowing whether an aquifer has a confining layer is important because the way an aquifer is recharged, or replenished, depends not only on the type of aquifer but also whether it is confined or unconfined.

Surficial Aquifers

Surficial aquifers are aquifers that have formed in the layers of earth above Iowa's bedrock. There are three types of surficial aquifers: alluvial, drift, and buried channel. The alluvial and buried channel deposits yield moderate to large quantities of groundwater. Some of the most productive wells in Iowa draw their water from these deposits. Glacial drift deposits serve as a source of smaller quantities of groundwater. These deposits are significant, however, because they are widespread and they serve as an important source in many rural areas.

Alluvial Aquifers - Alluvial aquifers are large sand and gravel deposits found next to present-day rivers and streams. These aquifers were formed by the rivers and streams when they deposited the sands and gravels in their valleys. Water flows easily through the spaces between the loose particles and, because of their direct connection to the neighboring stream, these aquifers can produce large quantities of water. Within the Missouri River valley a number of wells produce from 1,000 to 1,500 gallons of water per minute. Industrial, irrigation, and municipal wells in the Mississippi River valley regularly pump at the 1,000 to 2,000 gallons per minute (gpm) level. Wells that tap alluvial deposits along Iowa's interior streams commonly yield 200 to 600 gpm. Figure 1 shows the principal alluvial aquifers of Iowa.

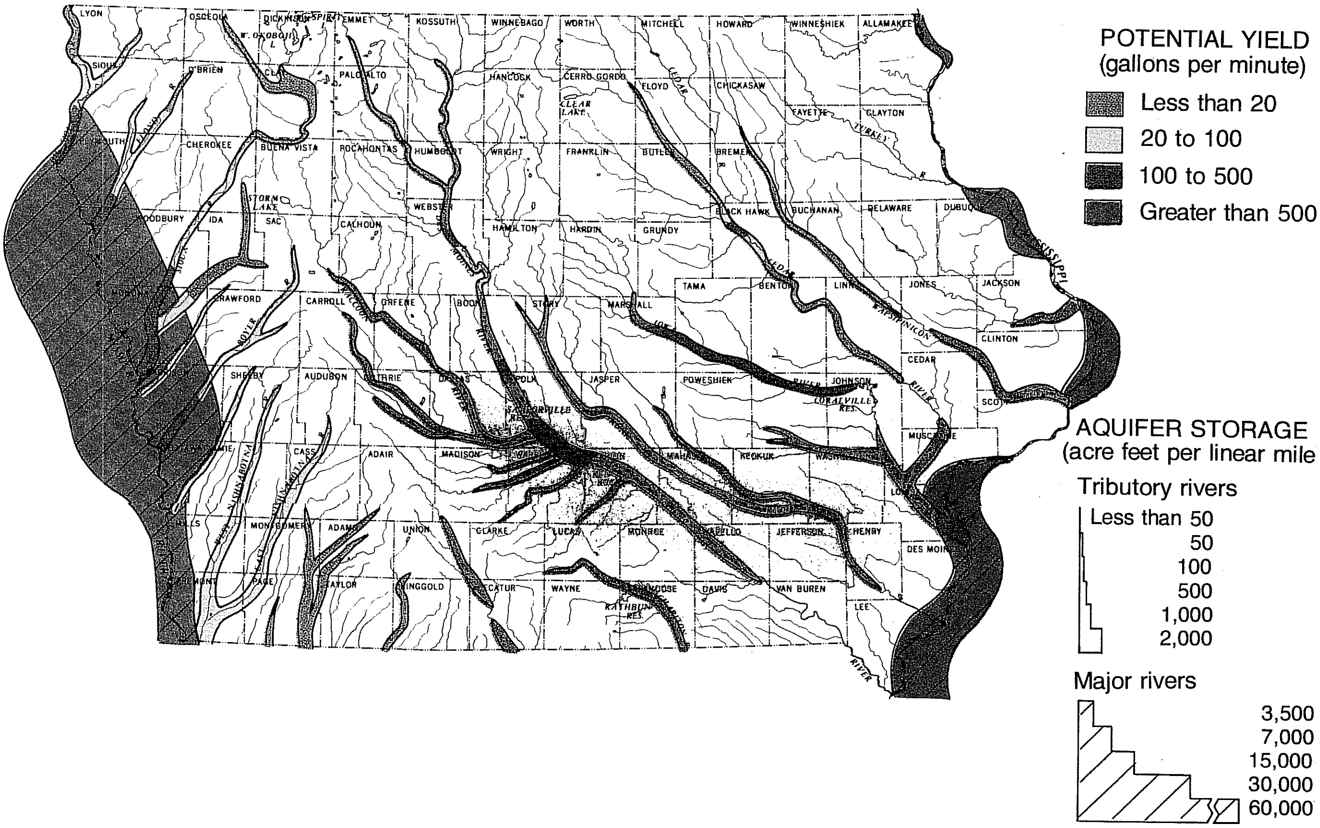


Figure 1: Principal Alluvial Aquifers of Iowa

Drift Aquifers - Drift aquifers are localized pockets of sand and gravel distributed within the layers of glacial drift which cover most of the state. The term glacial drift describes any material deposited by glaciers and streams as the glaciers moved into and out of the state. Drift aquifers are generally limited in size and produce only a few gallons of water per minute. Wells in these aquifers are usually shallow, but in some cases exceed 400 feet in depth. Drift aquifers are an important source of water for rural residents in western and southern Iowa, because the bedrock aquifers in that part of the state are deeply buried and often contain poor quality water.

Buried Channel Aquifers - Buried channel aquifers are sand and gravel deposits left by ancient rivers in pre-glacial bedrock valleys. These stream beds were covered when glaciers passed forming buried channels of water-bearing material in various parts of the state. Wells which tap these deposits provide water yields that range from 10 to 100 gpm. The most productive buried channel aquifers are situated in central and eastern Iowa. Figure 2 shows the principal buried channel aquifers of Iowa.

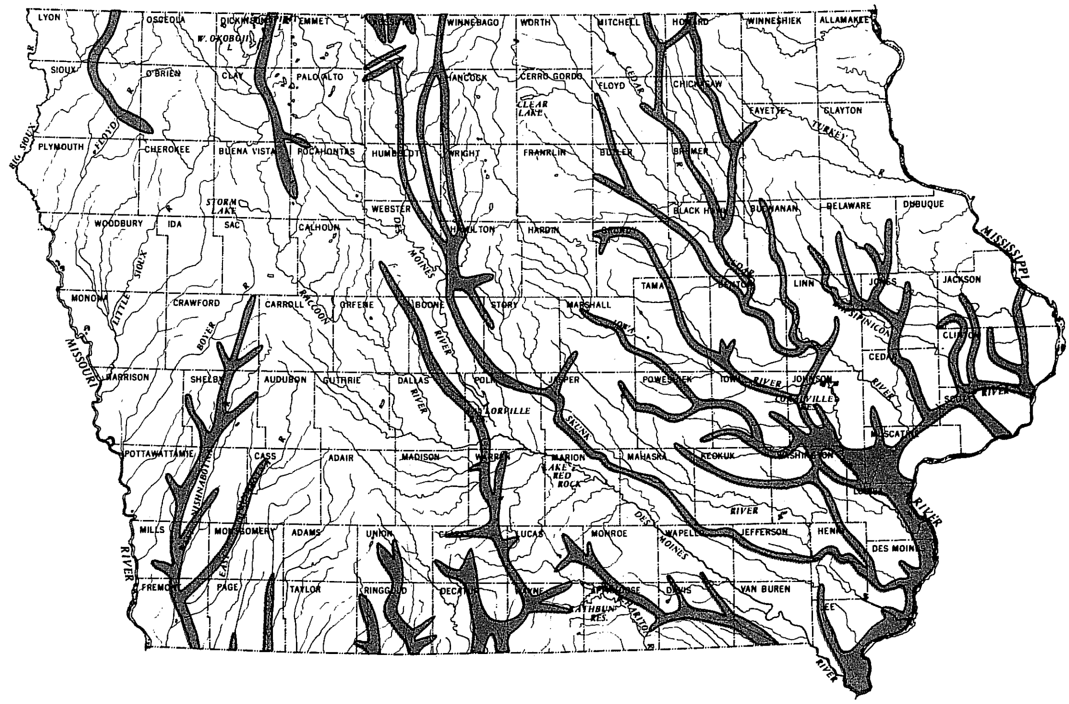


Figure 2: Principal Buried Channel Aquifers of Iowa

Surficial Aquifer Recharge - Surficial aquifers can be recharged or replenished from a number of sources. Many are recharged by precipitation which seeps into the aquifer, or by groundwater which flows in from adjacent areas. Some are also recharged by seepage from underlying bedrock. Alluvial aquifers can be recharged continuously from a nearby stream anytime the water level in the aquifer falls below the water level of the stream.

Some surficial aquifers cannot be recharged directly from the surface because layers of impermeable material separate the aquifer from the surface and groundwater sources. In these cases, the aquifer is said to be confined and the impermeable material is the confining layer. A confining layer is typically made up of clay or other material which limits the movement of water. A confined aquifer is recharged by water which flows in from outside the boundaries of the confining layers, or seeps through the confining beds. Buried channel aquifers are typically confined while alluvial aquifers are typically unconfined.

Surficial Aquifer Water Quality - Water in surficial aquifers is typically hard, but generally less hard than water found in bedrock aquifers. This water often has iron concentrations above the secondary Maximum Contaminant Level (MCL) of 0.3 mg/L. Alluvial aquifers and drift aquifers less than 100 feet deep are susceptible to nitrate and other surface contamination. Surficial aquifers tend to have a lower dissolved solids concentration than water in bedrock aquifers, because the amount of dissolved material in the water is related to the length of time the water has been in contact with the aquifer material. Generally, water in alluvial aquifers and shallow drift aquifers has the lowest dissolved solids concentration, because it has been in the ground the shortest time. Deep glacial drift aquifers (over 100 feet) and buried channel aquifers generally contain more mineralized water than alluvial aquifers.

Bedrock Aquifers

The bedrock under the state of Iowa was formed over millions of years when the state was repeatedly covered, or partially covered, by shallow seas. With the passage of time, the enormous weight of overlying layers compressed the material deposited on the bottom of these seas to form layers of rock.

Some of these layers of rock hold large quantities of water. The water is stored in sandstones and fractured carbonate rocks. In a sandstone deposit, water is held in the spaces between the grains of sand. In the carbonate rocks, as the sediments harden and undergo structural stresses, cracks develop. Groundwater enters through these openings and dissolves some of the carbonate, thus enlarging the openings, and providing significant water storage. These layers are Iowa's bedrock aquifers, and they fall into two main categories: fractured bedrock aquifers and granular bedrock aquifers.

Fractured Bedrock Aquifers - The two most common types of rock in these formations are limestone, which is primarily calcium carbonate, and dolomite, which consists of both calcium and magnesium carbonates. Limestone and dolomite are both typically very hard and dense with little natural water-holding or transporting capacity. However, once these formations have been fractured by the weight of overlying layers or other forces, water can enter the cracks and slowly dissolve the carbonates forming an interconnected network of channels and caverns. These cracks, channels, and caverns provide the pathways necessary for water movement. The Mississippian aquifer and the Silurian-Devonian aquifer are examples of fractured bedrock aquifers.

Granular Bedrock Aquifers - Sandstone is the rock found in Iowa's granular bedrock aquifers. Sandstone is formed when other rocks are worn away and redeposited by the elements; the resulting material is compressed into rock. Most sandstone is composed of quartz grains which have been cemented together by natural agents. Quartz is common in sandstone because it is very hard and it can survive the weathering process. The flow rate through a granular bedrock aquifer depends on a number of factors, including the amount of cementing material between the grains of sand. Water flows slowly through the spaces between the grains if the spaces are nearly filled with cementing material. Flow tends to increase as the amount of natural cementing material decreases, or is dissolved away. Yield from these formations also tends to increase if the formation is fractured. The Dakota aquifer is an example of a granular bedrock aquifer.

Bedrock Aquifer Recharge - Bedrock aquifers can be recharged through the infiltration of precipitation or surface water, if they are open to the surface. When this is the case, the aquifer is said to be unconfined and the recharge area will be in the immediate vicinity. More commonly, however, this type of recharge is blocked by impermeable layers, such as shale or glacial till, and the aquifer is recharged only in areas where the rock formations are exposed to the surface, or where holes exist in the impermeable layer. When an impermeable layer exists above the aquifer, the aquifer is said to be confined, and the recharge area can be a great distance from the point of use. In Iowa, most bedrock formations generally slope downward from northeast to southwest. The recharge areas for many of the confined bedrock aquifers in Iowa are located in the northeast part of the state and in the southern parts of Minnesota and Wisconsin. In these areas, the rock formations which make up the aquifers are exposed to the surface, or are shallow enough not to be overlain by an impermeable layer.

Bedrock Aquifer Water Quality - Because of their depth, most bedrock aquifers tend to be less susceptible to contamination by human activities than surficial aquifers. Thick layers of material, including confining layers, slow the movement of contaminants and protect the deep water reserves. As an example, nitrate concentrations in water from the bedrock aquifers tend to be very low. There are, however, some exceptions where bedrock aquifers are close to the surface. These shallow bedrock aquifers can be susceptible to contamination from surface drainage or point sources, such as septic tanks, chemical spills, and refuse dumps. However, even in the case of deep bedrock aquifers, direct pathways, such as improperly abandoned wells, may allow contaminants to enter the aquifer and threaten water quality.

Water quality in bedrock aquifers is also affected by the length of time water has been stored in the aquifer. Over time, water tends to dissolve materials found in the aquifer and hold these materials in solution. Generally, the longer the water is in contact with the aquifer materials, the higher the concentration of dissolved materials will be. In most of Iowa's bedrock aquifers, water tends to move downward from northeast to southwest, allowing higher concentrations of dissolved materials in the southern and western parts of the state. At some point in most of the aquifers the water becomes so highly mineralized as to be a poor-to-objectionable source for most uses. Constituents which tend to increase as time spent in the aquifer increases include: dissolved solids, hardness (calcium and magnesium), iron, manganese, radium, sulfate, and chloride.

The best quality water tends to be found near an aquifer's recharge area, where the water has been in the ground for the shortest amount of time. Unfortunately, these are also the areas which are most susceptible to surface contamination.

For specific information about the bedrock aquifers in Iowa, turn to Appendix One.

Team Formation ~ Step 1

Why Form a Team?

Local involvement or ownership of your wellhead protection plan is vital to its success. One way to ensure ownership is through the building of a Wellhead Protection Team. It's strongly suggested the water utility lead the wellhead protection initiative, however, it will be difficult to implement a comprehensive plan all by yourself. Involving the community early and often builds support for your program. Additionally, if key residents in your community understand and support your efforts, the likelihood of other citizens becoming involved in actively managing the protection area (Step 7) is high. Conversely, if people are left "out of the loop," their acceptance and involvement will be lukewarm at best (hostile at worst), and the probability of a voluntary effort succeeding will be low. Forming a local Wellhead Protection Team is a good way to begin the public involvement process.

Who to Recruit

Although the size and membership of your Wellhead Protection Team may differ from one community to the next, it is important to make sure your planning team represents all interests in your community. If there are existing groups in your community that have worked together successfully on important local or state issues in the past, it may be useful to include them in a planning team or even build the planning team around them.

Some groups to consider when forming your Wellhead Protection Team are:

- water suppliers
- elected officials
- local government agencies
  - health
  - planning
  - natural resources
- local well drillers
- businesses
- land developers
- community service organizations
- environmental groups
- public interest groups
- farmers
- interested citizens

Perhaps most important is the selection of a leader who can keep the planning team organized and on track. A local official or community leader who has already gained community support may be a good choice for this position. They can assist with management options and strategies that may be needed.

Your team will also benefit tremendously from the advice of a hydrogeologist, engineer, or land planner who may teach others in the group or act as the group's Technical, Regulatory, or Planning Coordinator. The local extension service, Natural Resource Conservation Services (NRCS) (formerly known as the Soil Conservation Service), or state Geological Survey Bureau may be able to help you find candidates with these qualifications.

Whatever its makeup, your Wellhead Protection Team should include representatives of all groundwater stakeholders in your community. In the following table, the Wellhead Protection Team responsibilities that will need to be carried out are identified. In choosing your team, remember one person can serve more than one role. If you have only a few people interested and available, consider combining responsibilities, as it makes sense for your community. At the same time, recognize to truly do everything needed, you're going to need other people, beyond yourself and the key coordinators shown here, working in each of these areas. Make the most of groups already in existence; see if they will take on a key wellhead protection responsibility within their organization.

Position	Basic Responsibilities
Team Leader (suggested people: mayor, city manager, water superintendent/operator)	• identify and invite key players and agencies to participate • ensure all stakeholders are represented • delegate, coordinate and integrate all leaders and work groups • help develop budget • serve as focal point for public • perform oversight • facilitate public involvement sessions
Financial Coordinator (suggested people: city manager, city clerk, local accountant)	• develop budget with Team Leader • identify and solicit funding sources • distribute funds and keep appropriate financial records
Technical Coordinator (suggested people: water superintendent/operator, retiree, civic organization)	• work with Team Leader to identify pool of experts • collect data • preliminary identification of WHPAs • determine potential contaminants • assess risks • research/evaluation • design control/management program • interaction with technical experts, as needed
Regulatory Coordinator (suggested people: city official, consultant, city attorney, health department representative)	• identify regulatory measures already in place and those needed • perform and coordinate monitoring and inspections using appropriate agencies • enforcement
Planning Coordinator (suggested people: water superintendent/operator, city planner, consultant, business leader)	• work with Technical and Regulatory Coordinators to develop source management plan • identify consumption patterns • develop and plan infrastructure • establish priorities • identify future threats
Communication Coordinator (suggested people: local media employee, retiree, civic organization, business leader, farmer)	• work with Team Leader to coordinate meetings • report on information gathering • act as team recorder/secretary • facilitate public outreach program
Water Service Coordinator (suggested person: water operator, city clerk)	• document, administer, and update wellhead protection forms • monitor water service before, during, and after an emergency

How to Recruit

Once the word has been spread that a team is forming, informational packets should be sent to each organization or individual expressing an interest or identified as being a key stakeholder. Those responding should be asked to suggest others whose careers, backgrounds, or hobbies might make them candidates for participation. Remember, a technical background is helpful, but not necessary. The primary criteria for volunteer participation are interest and willingness to serve.

As recommendations for team members are received, be prepared to provide prospective recruits with a full explanation about what wellhead protection is, and be able to "sell" the need for it in your community. Seek help from nearby utility superintendents, your consultant, or the regional IDNR contact to develop your strategy for "selling" the need for wellhead protection. You must be able to convince others of the value of wellhead protection or your effort may not be successful. After a reasonable time has elapsed, an organizational meeting should be held. Invite all interested parties. Use this meeting to answer any questions and appoint the members of your Wellhead Protection Team. Upon appointment, record the contact information for each member on the ***Wellhead Protection Team Coordinators*** form.

Instructions for Completing the *Wellhead Protection Team Coordinators* Form

In the ***Name*** section, record the appropriate name of the team member beside each team member position assigned. Remember, one person may act in more than one team function.

In the ***Work Number, Pager Number, Cellular Number, Fax Number*** and ***Home Number*** sections, write down the applicable numbers for each coordinator position of your Wellhead Protection Team. It is vital to include as many phone numbers as are available, because a contamination emergency can occur during any time of the day of night.

Wellhead Protection Team Coordinators

Wellhead Protection Team Coordinator Names and Telephone Numbers						
Position	Name	Work Number	Pager Number	Cellular Number	Fax Number	Home Number
Team Leader						
Financial Coordinator						
Technical Coordinator						
Regulatory Coordinator						
Planning Coordinator						
Communication Coordinator						
Water Service Coordinator						

Delineation of Wellhead Protection Areas - Step 2

Importance of Wellhead Protection Area Delineation

Having learned something about the aquifers in Iowa, your first step is to identify the aquifer(s) that supplies your well(s). When you've investigated your specific aquifer, you can begin a process to delineate your Wellhead Protection Area (WHPA), or your well's area of influence. Delineate means to determine the area surrounding your well which you need to protect from contamination. Your well's area of influence includes land immediately surrounding the well, and may extend a few feet to a few miles away from the well. The WHPA differs for every well, depending on the aquifer serving the well, its material, and the amount of water being withdrawn. WHPAs are usually odd shaped, rather than being circular areas around the well. Accurately defining the WHPA is important because any contamination occurring in this region could eventually affect your well. If the boundaries established are not correct for your well's usage and the aquifer's groundwater flow characteristics, you may be trying to protect an entirely too large, or too small, area. In this step of the model plan, you will be guided through preliminary data gathering to help you later, in the event a full-scale scientific delineation process is needed.

Beyond the WHPA, you also need to be concerned about the aquifer's recharge area. For some aquifer types, such as alluvial aquifers, the recharge area may be very near the well, and by protecting the land around your well, you can protect at least some part of the recharge area. Many times, however, aquifers recharge some distance from the well. The recharge area is the region most vulnerable to contamination because it is often in direct contact with surface exposures such as spills, runoff, and precipitation. Any contaminant entering the aquifer in this area ends up moving toward the well.

It is important to know where your aquifer's recharge area is because the closer this area is to your well, the faster some contaminants may travel to your well. While you may not be in a position to control or even influence activities that occur in the recharge area, you should at least know whether manufacturing, production, or other facilities are close to the recharge area. This will allow you to be alert to potentially hazardous situations that could affect your utility's water sources, and for you to alert owners/operators of these facilities of the importance of their operations on your community's water supply.

Defining and Mapping the Wellhead Protection Area

Defining and mapping your wellhead protection area is considered the most critical step in your wellhead protection plan; it is also the most complex. For these reasons, this model plan suggests a two-part approach to defining the WHPA for each well. The first part is to thoroughly study the characteristics of each well used in your drinking water supply system. This can be accomplished by obtaining and reviewing the well log and summary report compiled by the well driller. Additional information is also available from the Geological Survey Bureau and other sources at minimal to no cost, as shown in the following *Data Requirements* table.

DATA SOURCE	POSSIBLE LOCATION	TYPICAL COST
WELL LOG RECORDS: Showing owner, location, depth, name of driller, date of installation, well construction details, geology, intended use, static (pre-pumping) water level, pumping water level, pumping rate, duration of pumping, chemical analysis	Well log records are available from several sources. First, search the well owner's files for copies of pertinent logs or test results; second, contact the Geological Survey Bureau of the Iowa Department of Natural Resources (IDNR-GSB) at(319)335-1575. The driller is required to submit this information; third, contact the driller and request a copy of the records.	If available, this information is usually free, or available for the cost of reproduction and postage.
MAPS: U.S.G.S. 7½-Minute Topographic Map Bedrock Contour Map Geologic Map Aquifer Vulnerability Map Water Level Map (as available)	Maps are available from several sources. Among them are the owner's files, local planning agencies, libraries, university and college Map Libraries or Geology Departments, County Assessor's Offices, IDNR-GSB, and the U.S. Geological Survey at (319)337-4191.	Typically less than $10 each.
LITERATURE: Regional Water Atlas (IDNR-GSB) Regional Geologic or Hydrogeologic Reports By IDNR-GSB or U.S.G.S. Site-Specific Geologic or Hydrogeologic Reports by Consultants	Published reports on a wide variety of geologic and hydrogeologic topics can be found at the IDNR-GSB or the U.S.G.S. A summary of pertinent test results are typically provided by the consultant who designed or directed the installation of your well(s).	Cost varies, but typically ranges from a few to tens of dollars, or the cost of reproduction and postage. This cost can be expensive.
PHOTOGRAPHS: Aerial Photos (1:100,000 and 1:20,000 scales)	Photographs can be obtained from several sources including local planning agencies, the U.S. Dept. of Agriculture -Farm Service Agency (county office), the Natural Resource Conservation Service (formerly Soil Conservation Service) Soil Survey Reports, U.S.G.S., County Auditor, Corps. of Engineers, and commercial aerial photography businesses.	Usually a few to tens of dollars and postage. Delivery may take several weeks.
PERSONAL COMMUNICATIONS:	Typically with the driller, a consultant, or a representative from the IDNR-GSB or U.S.G.S.	Usually free or relatively inexpensive (several dollars per minute).

Using this information you have collected, you need to complete a ***Wellhead Protection Information Table*** for each well. The ***Wellhead Protection Information Table*** prompts you to record, in one location, the information about your operations and the well itself that will be needed to calculate exact boundaries of your WHPA, when the time comes for that to occur. It will also cause you to become more familiar with the components of your well, the aquifer, and will enable you to gain a better understanding of how water is actually delivered to your well site.

The following pages provide detailed instructions for completing the ***Wellhead Protection Information Table***, along with a blank ***Wellhead Protection Information Table*** form. A pocket has also been provided for you to keep a copy of the well logs and summary reports for each well for future reference.

Determining and mapping the exact boundaries of your WHPA is the second part of this model's wellhead protection delineation process. Generally, defining a WHPA can be done using one of three methods: 1) simple/fixed radius; 2) moderate/analytical equations; or 3) complex/numerical flow and transport modeling. Each of these methods and a description of their distinct advantages and disadvantages can be found in Appendix Two. At the very least, using the information recorded on the ***Wellhead Protection Information Table***, you can determine a fixed radius WHPA for your well. This is a good beginning effort, until you have gone further into Steps 3 and

4 of this model, at which time, you may determine more extensive scientific processes are needed.

To define your WHPA to the fullest extent possible, and to make the delineation viable and accurate, the boundaries must be based on scientific information, rather than "rules of thumb." If a hazard truly does exist within the protection area's boundaries, your utility and community could be faced with some difficult decisions down the road to assure the safety of the water supply. In favorable situations, changes can be negotiated and put in place over agreed upon time periods. In worst-case scenarios, those responsible for the hazard source or property may oppose any measures needed to protect the water supply. If this happens, legal issues may arise, and you want to be in a firm position with sound science backing up the WHPA boundary decisions. Appendix Three contains a list of engineering consultants operating in Iowa with technical expertise to conduct these types of studies.

In the ***Well No.*** section, record the specific number of the well this table refers to.

In the ***Aquifer Name*** section, enter the name of the aquifer supplying your well.

In the ***Aquifer Classification*** section, use information from your well driller, this model plan's ***Iowa Aquifers and Recharge Areas*** section, and data contained in Appendix One to check each box that applies to the aquifer. You will check at least two boxes under either the ***Surficial*** section or the ***Bedrock*** section, because every aquifer can be classified as either confined or unconfined.

In the ***Well Location Description*** section, write a general description of where your well is located that includes, if possible, an address. For example, you may write "One-quarter mile north of Acme Manufacturing at 123 Madison St., between Elm and Maple Streets, directly adjacent to the old feed mill." Also, record the legal description, including section, township, and range, if available. This may be helpful to gather additional information from IDNR-GSB.

In the ***Well Construction Details*** section, write down the date your well was constructed, the contractor who built your well, the engineer who designed your well, and the well's depth. Check whether the well is a primary water supply source, or strictly a standby or secondary source. If you have alluvial wells, information about the bore hole will be important. Complete the diameter, length, and gravel-pack areas as appropriate. If your well has a casing, check the appropriate box, and record the type of casing material contained in your well, its diameter, and how many feet of that material your well contains. A well can be made up of more than one type or diameter of casing material, so remember to record all of them. Use a separate blank page if you need more room. If your well is grouted, check the appropriate box for each segment of casing. Mark the appropriate box to indicate if your well has a screen, and record the type of well screen material contained in your well, its length and diameter. Record, in both gallons per minute (gpm) and feet Total Dynamic Head (TDH), your well's pump capacity, how many gallons per minute and hours per day or week your well typically operates, along with the appropriate pump type. If your pump is an "other," make sure you write in the space provided the type of pump used in your well. The ground surface elevation and static and pumping water levels should be recorded next. Finally, it is important to note which aquifer layers the well is open to. In other words, if your well does not have casing or is screened in all or any section of it, what type of aquifer material does it pass through? In this section you need to record at what depth this open area of the well begins, how long the open area is, and the proper name and description of the aquifer formation it is exposed to. For example, at a depth of 500 feet your well's casing material stops and for the next 25 feet there is screen material enclosing your well. At this section, your well is then exposed to the St. Peter sandstone formation.

In the ***Well Log Report*** section, attach both the well log and any chemical/mineral analysis documentation you have and file them in the pocket page provided in this model plan. If you don't have any or all of this information, call the IDNR-GSB phone number recorded in the ***Well Log Report*** section; they may be able to provide some missing details.

In the ***Diagram Your Well*** section, draw a picture of your well that includes the depth, length, diameter and make-up of each casing and screen type. If possible, include a description of the aquifers and other layers running the length of your well. A sample diagram is provided in the upper left corner of the diagram page.

In the ***Well Maintenance History*** section, enter descriptions, dates, and names of people who have performed maintenance or repairs on the well, casing(s), pump, etc. Also, record the date when these items should next be checked in a preventive maintenance routine.

Well Log Report

Wellhead Protection Information Table

Well No. ____________________

Aquifer Name

Aquifer Classification (check all that apply):

Surficial:
- alluvial ❑
- buried channel ❑
- drift ❑
- confined ❑
- unconfined ❑

Bedrock:
- fractured ❑
- granular ❑
- confined ❑
- unconfined ❑

Well Location Description

Legal Description

Well Construction Details

Date of construction

Contractor	Engineer
Depth	Primary ❑ Standby ❑

❑ Bore hole
diameter (inches) __________ ______________ length

Gravel-Pack:
yes ❑ no ❑
from ________ feet
to ________ feet

❑ Casing

Diameter	Length	Material	Grouted:
			yes ❑ no ❑
			yes ❑ no ❑
			yes ❑ no ❑

Screened: yes ❑ no ❑
Well screen material, length and diameter
____________ material ____________ length ____________ diameter

Pump capacity
_________ gpm at _________ feet TDH

Typically operated at
_________ gpm

Pump type: submersible ❑
line shaft ❑
other ❑ ____________

Typically operated
____________________ hours/day
____________________ hours/week

Ground surface elevation: ______________ feet, mean sea level
Static water level: depth from ground surface ______________ feet
elevation ______________ feet, mean sea level

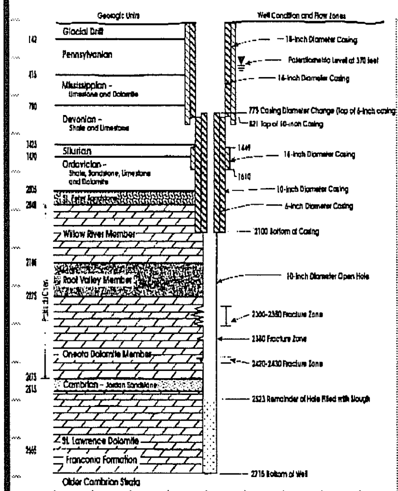
Pumping water level: depth from ground surface ______________ feet
elevation ______________ feet, mean sea level

Parts of well open to aquifer layers (formations)
from _____ to _____ depth ________ length ______________ formation name
from _____ to _____ depth ________ length ______________ formation name
from _____ to _____ depth ________ length ______________ formation name

Well Log Report

Please place your well log report and chemical/mineral analysis, if available, in the pocket page provided directly after this section. If you don't have a copy of your well log report, call IDNR-GSB in Iowa City at (319) 335-1575.

Diagram Your Well



Well Maintenance History

Activity	Date	By Whom	Next Review

Contaminant Inventory - Step 3

This step of the model plan provides information to help you identify existing and potential sources of groundwater contamination that may impact your well(s). It is also a building block which will outline measures to protect your groundwater supply for Step 5, Contaminant Source Management.

Identify Activities Within the Wellhead Protection Area That Are Potential Sources of Contamination

Identifying sources of contamination can be an intimidating proposition in many communities. Stories of hazardous cleanups and their enormous costs can frighten a community, particularly smaller ones already operating under rigid financial conditions. No one wants to hear about contaminated water sources, let alone have one. It's perfect reasoning for involving the community in your wellhead protection process. It is vital for all stakeholders to make the commitment up front to work together to alleviate any contamination hazards discovered. If people believe they can be part of the solution, rather than the problem, they will be more willing to help gather the vital information needed.

Choose several key community leaders to help in the contaminant identification process. To keep the activity informal and non-threatening, go to the community rather than having them come to you. Organize meetings at the local Lions or Elks Club building, the fire station, community center, high school library, or other community building. Consider holding one or more sessions where you talk about buildings, land uses, business activities, and other functions that surround each well site, or wellfield, if a number of wells are in close proximity to one another. Remember to include discussion about plans for the future, as well as current operations and past activities. Contamination of the groundwater could have occurred years in the past, the true danger of which could still be undetected.

If you find it difficult to recruit team members and others to assist in this process, you can still work individually to identify contaminant sources affecting the well. While a participative process is desired for all the reasons stated above, it may not be possible for your community. Follow these same processes: start by completing a ***Contaminant Inventory Table*** for each well or wellfield. Use a community aerial photography map, or street or zoning map if available. (If a map is not available, use the diagramming sheet in this section.) Begin by locating each well, then sketching a circle around the well. Allow the circle to represent a distance of 500 feet from the well. Begin identifying various operations that currently or previously existed inside the circle. After all operations have been identified for the first 500-foot circle, proceed to another circle 500 feet outside of the first. Work outward from the well, establishing target-like rings around the well, and discussing the existence of possible hazards in each. Repeat this process until a minimum 2,500-foot radius from the well has been developed, or until the entire delineated WHPA (if determined) has been covered.

While discussing or thinking about potential hazards that currently or previously existed within each circle on the diagram or map, use the ***Contaminant Inventory Table***, and place a check mark beside each hazard identified. Plot its approximate location on the map or grid form being used. Use the space on the ***Contaminant Inventory Table*** to the right of each hazard to provide further details. For example, quantity, storage, form (liquid, dry, gas), etc.

In marking contaminant sources, consider past and present storage and disposal sites, some of which might be recognizable as sewage treatment works, dumps, landfills, or underground injection wells. Be careful to also locate small commercial and industrial storage and disposal areas, such as storage tanks, lagoons, agricultural chemical supplies, and drywells. Residential underground septic systems should also be included. The waste materials discharged at these sites can include solid waste, sludge, liquids, solvents, and oils. Investigate whether any of the wastes discharged in your community are hazardous under the Resource Conservation and Recovery Act (RCRA).

When identifying land uses, again consider both present-day and historical uses, such as capped landfills, underground fuel storage tanks, abandoned mines, or the present-day Dairy Sweet that used to be a Clark gas station. Many of these facilities may not be apparent today, but could pose a significant threat to the present water quality of an aquifer. For example, land that was used for agricultural purposes at one stage may contain traces of pesticides that were used, stored, or disposed of on-site.

If you use a zoning map in the identification process, it will show the sections of the community which have been approved for specific land uses, whether it is residential, commercial, or industrial. A zoning map is helpful because it displays concentrations of businesses. If these concentrations are located very near the well or in the recharge zone of the aquifer, they can increase the threat to your water resource. For example, if an industrial area is nearby your well, any spills of chemicals in those operations could reach the aquifer more quickly than a spill from a location at the edge of town, or far from the well. Also, many industries are built along transportation routes that follow river valleys where high-yield aquifers are often located. Looking at a zoning map will identify these areas, and with adequate wellhead protection planning, your community can be sure appropriate zoning is in place to limit high-risk activities.

In addition to contaminants, you need to identify other production pumping and municipal well locations. Plot these on the map, also. While they are not contaminants, they can alter the groundwater flows and speed, and affect the amount of time a potential contaminant can take to reach the well.

In-Depth Review of Potential Sources of Contamination

The informal sessions and ***Contaminant Inventory Table*** forms completed in those sessions will identify general information and offer leads to possible hazards. It is then up to the Wellhead Protection Team to determine when additional interviews or field visits are needed. This decision should be made either during or following Step 4 - Risk Assessment.

When you determine more investigation is needed, particularly about past activities, there are many sources of information within your community that can be researched. These include, but are not limited to, interviews with long-time residents of the community; Chamber of Commerce membership lists; the local phone book; local newspapers; the police and fire departments; fishermen; the utility companies serving the community; and community boards such as planning, conservation, health, engineering, and public works. Information can also be obtained from state and federal environmental agencies on the transportation and discharge of hazardous materials, groundwater discharge permitting, and discharges to surface waters. Information regarding underground commercial storage tanks is also available from the Iowa Department of Natural Resources.

It is also important that any known contaminated waters be identified at this stage of the process. This identification may involve contacting state water pollution control officials, state drinking water managers, water companies, and waste management agencies. The regional health director can also advise you of known contamination problems. It is likely you will already know of problems of this nature in the vicinities of your well(s), but if you haven't studied the aquifer's recharge area, this is a good time for you to make inquiries to discover possible contaminations in that area.

Along this line, identify the location of any ***point source*** discharges within the community or in any neighboring communities that may affect your well(s). Point sources discharge waste at a single location and generally consist of pipe outfalls to surface waters. Examples include sewage treatment plant outfalls, water treatment plant outfalls, storm sewers and industries. These discharges are regulated and usually require monitoring. Monitoring logs are an additional source of water quality information and are available from the Iowa Department of Natural Resources - Wastewater Section.

Non-point sources are widespread sources of contamination that cumulatively present a threat to groundwater. These sources are not regulated by permits and may be more difficult to track down. Examples include roadway and parking lot drainage, landfill runoff, agricultural runoff, and runoff from stockpiles of roadway deicing materials, such as salt.

Field visits are particularly helpful, as you can investigate known sites and also be on the alert for other activities that may present hazards. An example might be unidentified gallons or barrels stored behind a garage or other building. Field visits are another excellent opportunity to get your community involved. Divide the circular areas from your inventory process into smaller sections and enlist local volunteers to canvass specific areas. Community organizations such as 4-H Clubs or FFA groups might be willing to participate in this effort. It is the responsibility of the Wellhead Protection Team to instruct volunteers in how to survey for potential contaminant sources. Once the volunteers confirm an activity that could undermine groundwater quality, they should write a description of the activity, its location, the volume of material or chemical(s) stored and handled, and the name of an individual to contact for additional information. Following the field visits, more exact locations of the hazard sites can be plotted on the circle diagrams for each well. (See Appendix Four for an individual site-specific form to use when recording information from field visits.)

With this process completed, you now have a series of ***Contaminant Inventory Tables*** and maps showing potential contaminant sites pertinent to each well or wellfield. The maps or diagrams should show land uses, business activities, waste disposal sites, point sources, underground septic systems, underground storage tanks, and other contaminant sites that could threaten your water supply. It should also indicate where groundwater quality has been degraded or where there is a good possibility that it will be. Consider using different symbols on the map or diagram to distinguish between different sources of contamination.

The following pages provide detailed instructions for completing the ***Contaminant Inventory Table*** and the diagram of the inventory circles.

In the ***Well No.*** section, write the appropriate number of your well or well field.

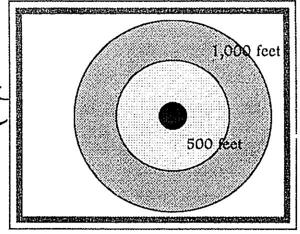
In the ***Date of this inventory*** section, write the date on which this inventory occurs. If more than one day is needed to complete the survey, write down every date applicable.

In the ***Recorded by*** section, write down the name of the person who is documenting the brainstorming session or conducting the individual inventory process. (It would also be a good idea to write on a separate piece of paper the names of the people who participate in the brainstorming sessions.)

In the ***Potential Sources of Contamination*** section, place a check mark beside each hazard that already is, or poses a potential contamination threat to this particular well. In the space provided to the right of each hazard, or in the ***Notes*** section, record such information as the distance and direction from the well, quantity of each hazard, if there is more than one site where this hazard can be found, and any other pertinent information. For example, in the Herbicide use/storage sites entry, you could record "700' N., 2 gallons of atrazine at the Smith farm."

For plotting potential contaminant sources, it is recommended that an aerial photography city map, or city street or zoning map be used if available. A USGS map showing the town and surrounding area would also work well. If none of these prepared maps is available, use the diagram provided in this section of the model plan. Follow these directions using either the map or diagram: Begin by recording the well location. Then sketch in a circle around the well. Allow the circle to represent a distance of 500 feet from the well. Begin identifying various operations that may exist or previously existed inside the circle. When all information related to the first 500-foot circle has been recorded, proceed to the next 500-foot circle outside of that. Work outward from the well, establishing target-like rings around the well, and recording possible hazards in each. Repeat this process until a minimum 2,500-foot radius from the well has been developed, or until the entire delineated WHPA (if determined) has been covered.

Contaminant Inventory Table



Well No. ______________

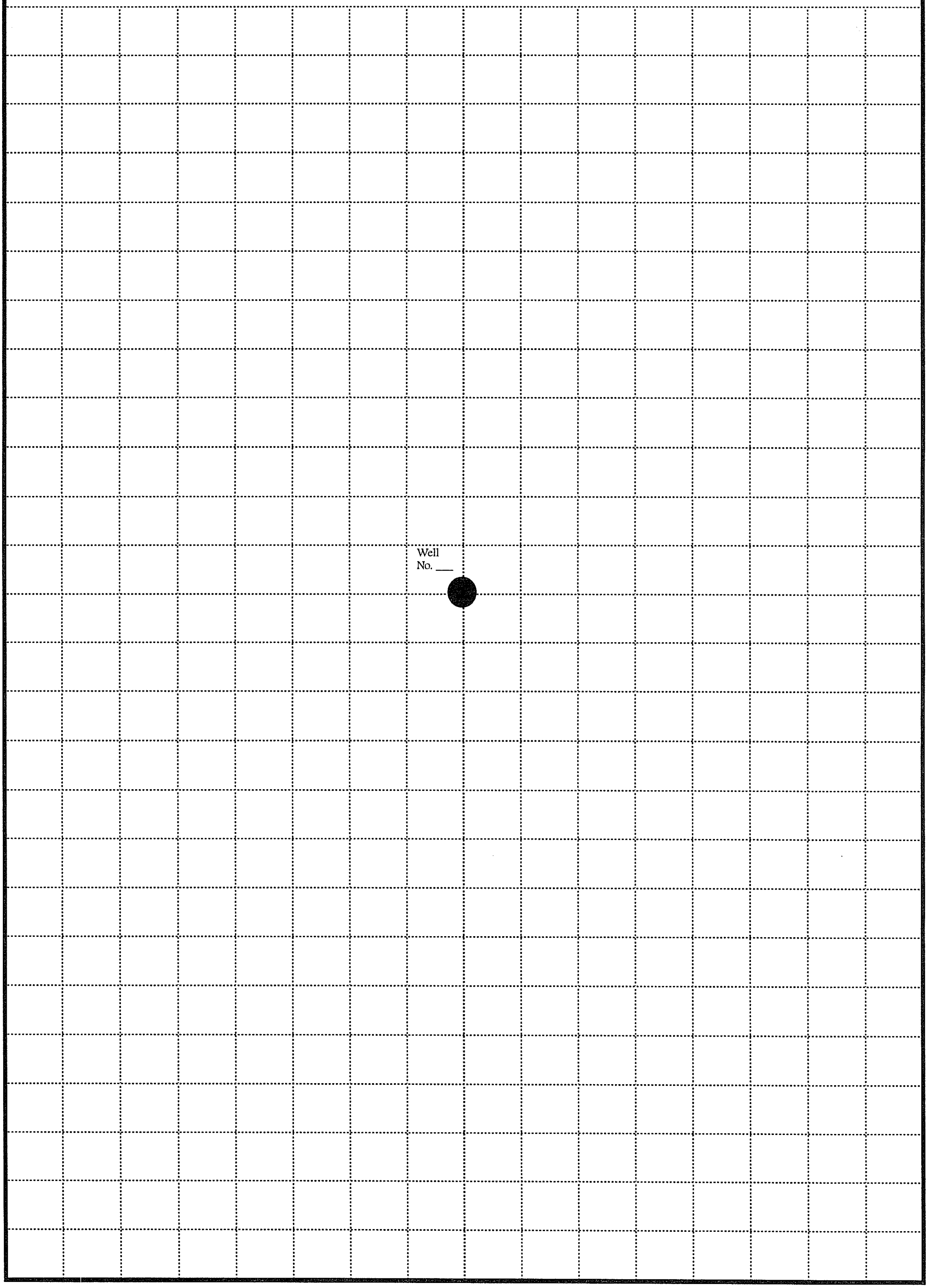
Date of this inventory	Recorded by
Potential Sources of Contamination	
Place a check mark beside each potential hazard listed below you have identified might have an impact on your well.	
✓	Potential Source
	Above-ground storage tanks
	Airports (operating/abandoned)
	Animal burial sites
	Animal feedlots, stables, kennels
	Artificial recharge
	Asphalt plants
	Auto repair, service, salvage sites
	Boatyards
	Car washes
	Cemeteries
	Cesspools
	Chemical manufacture/storage sites
	Construction sites
	Drainage wells/ditches/tiles
	Dry cleaners
	Dumps
	Electronics manufacture
	Electroplaters
	Fertilizer use/storage sites
	Foundries/metal fabricators
	Fuel oil use/storage sites
	Furniture stripping/refinishing
	Gas stations
	Golf courses
	Grain storage bins
	Hazardous waste landfills
	Herbicide use/storage sites
	Highways
	Holding ponds/lagoons
	Household hazardous products
	Household lawns
	Injection wells
	Irrigation sites
	Irrigation wells
	Wood preserving facilities
	Jewelry/metal plating establishments
	Notes:

✓	Potential Source
	Landfills
	Laundromats
	Machine/metalworking shops
	Manure spreading sites/pits
	Medical institutions
	Mining and mine drainage
	Municipal incinerators
	Municipal landfills
	Municipal sewer lines
	Oil/Gas wells
	Open burning sites
	Paint manufacture/storage sites
	Petroleum production/storage sites
	Photography/printing establishments
	Pesticide use/storage sites
	Pipelines
	Quarries
	Railroad tracks and yards
	Recycling/reduction sites
	Research laboratories
	Road deicing operations
	Road maintenance depots
	Scrap and junkyards
	Septage lagoons and sludge
	Septage overflows
	Septic systems
	Service station disposal wells
	Sewer lines
	Storage tanks
	Storm water drains/basins
	Storm sewers
	Streams (lakes, rivers, creeks)
	Swimming pools
	Toxic and hazardous spill sites
	Transfer stations
	Underground storage tanks
	Wells (operating/abandoned)
	* Residential
	* Municipal
	* Production
	Other
	Notes:

N

Diagram of hazard locations

Scale = ________________



W

E

S

Risk Assessment - Step 4

Why Risk Assessment?

The purpose of risk assessment is to prioritize the contaminant sources identified in the prior steps of the model program. Completing this step of the model plan will allow you to determine exactly how vulnerable your well is due to its construction and condition, as well as the degree of risk associated with each contaminant. This information is then combined to identify those contamination sources that present the greatest risk to each well and your water system as a whole.

Risk Assessment vs. Risk Screening

Traditional risk assessment, as defined by the EPA, has four steps: hazard identification, exposure assessment, dose-response assessment, and risk characterization. It basically identifies who will be exposed, to what contaminants, at what concentration, and for what duration. This information is then combined with a health effects assessment (generally dose-response or epidemiologic data) in order to categorize risk from a given contaminant. This traditional process, like the standard wellhead protection area delineation process, involves a series of numeric calculations and analyses. Again, this exercise may require outside assistance or technical expertise. For the same reasons as stated in the delineation step of this model program, it is recommended a simplified form of risk assessment or "risk screening" be used initially.

Completing a Risk Screening

Risk screening is something most water utilities can undertake themselves, using the information already gathered in the previous steps of this program, and with the help of several indices published by the EPA. This model uses a relatively simple, two-component screening approach.

The first component evaluates how vulnerable each well or wellfield is. In this portion of the screening, you look at characteristics of the well itself, how it was constructed, and aquifer characteristics to determine if the well is at risk because of any of these conditions, aside from the presence of any contaminant source. Several factors used in this portion of the assessment relate to IDNR's determination of the well as either vulnerable or not vulnerable. Appendix Two's discussion of the fixed radius delineation method also contains specific separation distances used by IDNR when determining your well's vulnerability. This information may be helpful as you complete the ***Risk Assessment Table***, in this section of the model plan, for each well or wellfield.

The second component rates each contaminant source in three categories. The first category is its threat to public health. This means how dangerous is the contaminant to people? Will the contaminant cause drinking water to look or smell bad? Will people become sick if exposed to it in their drinking water? Or, could it be life-threatening if consumed? This model uses a one to three rating, based upon toxicity ratings assigned by the EPA for specific land uses and chemicals. Appendix Five contains the adapted indices needed to determine the specific rating for each contaminant on your ***Risk Assessment Table.*** If you know the exact chemical compound, you can locate the rating by name of the chemical. If you do not know the chemical name, but you do know the nature of the land use or business activity, such as agriculture or dry cleaners, the index found in Appendix Five will also allow you to assign a rating based on this broader, general-use category.

The second category rates each contaminant in terms of its ability to move within the water source, called "mobility." Again, this model plan uses a one to three rating, based upon mobility ratings assigned by the EPA for specific land uses and chemicals. These ratings are also found, along with the toxicity ratings, in Appendix Five.

The third category rates each contaminant source's location to the well and/or recharge area. The closer the source is to the well/recharge area, the greater the risk of contamination to the well may be. Again, a one to three rating system is used, based on a contaminant source's distance from the well/recharge area. In this portion of the rating, location is used as a simplified expression of time-of-travel concepts. If advanced WHPA delineation and transport modeling has been completed, more precise risks in this category will be known. In fact, you would likely have 2-, 5-, and 10-year times of travel defined for a particular contaminant source. However, in the absence of this advanced study, distance of the contaminant from the well/recharge area is substituted.

You should complete a ***Risk Assessment Table*** for each well or wellfield which has significantly different locations, operating or construction methods, or aquifer sources.

The completed ***Risk Assessment Table*** will show contaminants and sources which require immediate attention, and assist in developing long-term, contaminant management strategies to protect each of your groundwater wells. To know which hazard, from which specific WHPA, offers the highest potential risk, you need to consolidate all the risk assessment data into one sheet. The ***Risk Consolidation Table*** allows you to do this overall prioritization. Those contaminant sources having the highest risks, when taking into account both the well's vulnerability and the specific contaminants, should be attended to first. If desired, once you have priorities established, you can map the risks (using the same map or diagram used in Step 3) to show areas of highest concern and potential threat to the utility's groundwater supply.

In the ***Well No.*** section, record the specific number of the well or wellfield this table will refer to.

In the ***Vulnerability of Your Well*** section, answer questions one through nine with regard to this particular well. If you answer "Yes" for any question, record a check mark in the ***Yes*** box for that question. If the answer is "No" for any question, record a check mark in the ***No*** box for that question. If you do not know the answers to these questions, IDNR can help. For assistance with questions one through five, contact your IDNR field office, or the central office in Des Moines. This information may also be found on your operating permit or sanitary survey issued by IDNR. For help with question six, contact IDNR-GSB at (319) 335-1575. Questions seven through nine should be answered with operating knowledge of water utility staff. After answering each question, add the number of check marks in the ***Yes*** boxes. Write that number in the ***Yes Total*** square. If you answer "no" to all questions, still record a 1 in the ***Yes Total***, to represent the well as being active. The ***Yes Total*** number may range from a minimum of 1 to a maximum of 9.

In the ***Contaminant*** section, list by name, being specific as possible, each contaminant source you have identified that could affect this well. Remember to use the Step 3 form to properly record the contaminants you have identified.

In the ***Threat to Public Health/Toxicity, Mobility*** and ***Location to Well*** sections, determine the impact each contamination would have on your water utility's individual and commercial users. Using a scale of one to three, with one being a low risk and three being a high risk, assign a number assessing the impact of each factor.

- **Threat to Public Health/Toxicity**
  Enter the rating number 1(low), 2 (moderate) or 3 (high) for the specific source category or chemical contaminant from the adapted EPA index sheets in Appendix Five.

- **Mobility**
  Enter the rating number 1, 2 or 3 for the specific source category or chemical contaminant from the adapted EPA index sheets in Appendix Five.

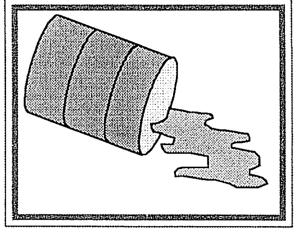
  NOTE: If you have a source category or chemical contaminant which cannot be found in Appendix Five, consider this an"unknown" hazard and rate it a 3 until you can consult other resources such as IDNR or EPA to determine more accurate ratings for toxicity and mobility for this contaminant.

- **Location to Well**
  If the contaminant source is contained within the first concentric circle (500 feet) around your well, rate it a 3. If the contaminant source is located between 500 and 1,000 feet from your well, rate it a 2. If the contaminant source is greater than 1,000 feet from your well, rate it a 1.

Add together the ratings for ***Toxicity, Mobility*** and ***Location*** for each contaminant and enter the sum in column 5 of the form.

You have now determined the vulnerability of the well and from the numbers recorded in column 5, it is easy to see the hazards presenting the greatest risk to this particular well (those hazards with the highest sums). You now need to consolidate this information from each well, so you can determine overall priority among all wells. Use the *Risk Consolidation Table* contained in this section to complete this process.

Risk Assessment Table



Well No. ____________

Component 1:

Vulnerability of Your Well	Yes	No
1) Has your well ever yielded water with nitrate concentrations higher than half the MCL of 10 mg/L (as N)?	☐	☐
2) Does your well have a history of water quality detects for man-made chemicals or contaminants?	☐	☐
3) Does surface drainage flow toward the well, or has it been determined by IDNR to be groundwater under the influence of surface water?	☐	☐
4) Are there any potential contaminant sources closer to the well than the distances set out by IDNR as site separation limits?	☐	☐
5) Are there any known leaking underground storage tanks, or other uncontrolled contaminant sites nearby the well?	☐	☐
6) Is the well supplied by an unconfined aquifer?	☐	☐
7) Is this a primary well (rather than used only for standby or secondary supply)?	☐	☐
8) Is the well casing leaking?	☐	☐
9) Is the well ungrouted, or is the grout seal in poor condition?	☐	☐
NOTE: If you answered "no" to all questions, give this well a 1 in the *Yes Total* just for being an active well.	Enter the total number of check marks in the *Yes* boxes above: Yes Total	

Component 2:

Ranking of Contaminants					
1. Contaminant		2. Threat to Public Health/Toxicity (See Appendix Five)	3. Mobility (See Appendix Five)	4. Location to Well: <500' 500'-1,000' >1,000'	5. Sum of Columns 2, 3, 4
No.	Chemical name or land use category	Low 1 - High 3			
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					

Component 2:

Ranking of Contaminants					
1. Contaminant		2. Threat to Public Health/Toxicity	3. Mobility	4. Location to Well	5. Sum of Columns 2, 3, 4
No.	Chemical name or land use category	Low 1 - High 3			
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					
31.					
32.					
33.					
34.					

Instructions for Completing the *Risk Consolidation Table*

You will need to use all the ***Risk Assessment Tables*** to complete the ***Risk Consolidation Table.***

Begin with the ***Risk Assessment Table*** for your Well No. 1, and follow the next steps until all information for each well's ***Risk Assessment Table*** has been transferred to the ***Risk Consolidation Table.***

In the ***Well No.*** section, write the well or wellfield number from the ***Risk Assessment Table.***

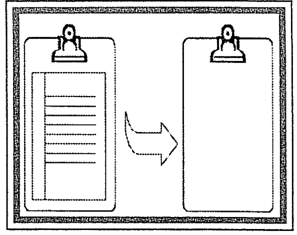
In the ***Contaminant No.*** section, write the number directly left of the first entry on the ***Risk Assessment Table's Chemical Name or Land Use*** column. Write in the chemical name or land use on the ***Risk Consolidation Table,*** also.

Still working with the first chemical/land use item, multiply the figure written in column 5 of the ***Risk Assessment Table*** by the ***Yes Total*** from ***Component 1*** on the top portion of the ***Risk Assessment Table.*** Enter the product in the ***Index Rating*** column on the ***Risk Consolidation Table.***

Perform these steps for each contaminant entered on the ***Risk Assessment Table.*** When information regarding all contaminants (chemicals and land uses) from all ***Risk Assessment Tables*** has been transferred to the ***Risk Consolidation Table*** as instructed above, you can prioritize all potential contaminants.

On the ***Risk Consolidation Table,*** prioritize these hazards in ascending numerical order by placing a 1 in the ***Ranking*** column on the row which has the highest ***Index Rating.*** This will be your first priority risk. Find the next highest ***Index Rating,*** and enter a 2 in the appropriate row of the ***Ranking*** column, and so on until all contaminants entered on the ***Risk Consolidation Table*** have been assigned a priority.

Risk Consolidation Table



Well Number	Contamination Number	Chemical Name or Land Use	Index Rating*	Ranking

* From the previous ***Risk Assessment Tables***, multiply the number from column 5 by the number in ***Yes Total*** and enter the product in the ***Index Rating*** box.

Contaminant Source Management - Step 5

After the potential contaminants which threaten each of your wells have been prioritized, you can begin to form a management strategy which will help protect your existing water supply from contamination and prevent development of new threats for these and future drinking water wells. You will want to begin by implementing practices which manage the highest ranking contaminants on your list, if possible, realizing it may not be possible to manage every potential source of contamination.

Before proceeding with contaminant management options, it is important at this time to be sure you have accurately defined the boundaries of your WHPA. As mentioned earlier, technical assistance will likely be necessary to establish or delineate these boundaries. Should the need arise, you will want to be in a position to defend your WHPA statistics in order to implement measures that will safeguard the wells and groundwater supply.

There are a number of tools water suppliers can use to manage potential sources of contamination. Most often these tools are divided into two broad categories: regulatory and nonregulatory. As the name implies, regulatory controls involve ordinances or other enforceable measures, while nonregulatory controls are typically voluntary. Many of the tools in both categories are preventive in nature, that is, they are designed to insure potential sources of contamination never have the chance to develop in a location where they could threaten your well. Some, however, can also be used to manage existing sources.

Regulatory Measures to Control Existing Sources of Potential Contamination

At this point, you may have identified potential sources of contamination which already exist in your area. Because you will need to manage those sources knowing they will remain in the area, the following paragraphs list a number of tools which can be used to manage existing sources. But, before you begin exploring management options, it would be a good idea to review various ordinances, standards, and permitting requirements already enacted. Determine if these measures will provide the levels of safety and protection you desire. Evaluate terms, procedures, and enforcement provisions for each protection measure. If you find the measures will address the existing contaminant sources, you simply need to make sure sufficient monitoring occurs to serve as a check and balance of the effectiveness of that protection alternative. If the measures seem adequate, but aren't producing the results you desire, consider how terms, procedures, responsibilities or other factors could be changed. And, if you find the measures do not offer adequate protection, evaluate some of the following management strategies.

Chemical Storage Requirements - There are any number of activities which require the use of hazardous materials. Dry cleaners, auto service stations, agricultural chemical suppliers and users, and manufacturing plants, just to name a few. In all of these cases local regulations can limit the quantity of hazardous material stored, specify how the material is stored, and/or outline how the material is collected or disposed of.

Operating Standards - Standards can be implemented which govern any number of activities taking place within the WHPA. For example, in certain locations, special use or operating permits may be needed for a particular type of business or land operation. A special use permit may allow a specific function to occur, but only with appropriate protective disposal procedures or containment measures.

Compliance Inspections - Periodic inspections can be required, by ordinance, to insure that rules established to protect your community's water supply are being followed. Chemical storage, handling, and use facilities, sewer systems, drainage systems, and solid waste disposal sites may all require inspection. For some operations, such as waste disposal, the authority to conduct inspections will remain the state's, rather than the city's or the utility's. However, most state agencies are receptive to requests for inspection, particularly if the safety of the water supply may be in question.

Septic System Regulations - An ordinance can be adopted which requires periodic inspections, and upgrade if necessary, for septic systems and other sewage disposal systems.

Many of the regulatory approaches to WHPA management require considerable technical expertise and administrative support. In-depth knowledge of each system to be regulated is necessary before an ordinance can be drafted. In addition, those affected by the new regulations may raise political or legal opposition if the new requirements will significantly impact the way they do business. If one of those affected by the proposed regulations is the primary employer in the area, it may not be practical to require operating standards which they are unable to follow.

Nonregulatory Measures to Control Existing Sources of Potential Contamination

Nonregulatory controls, although not always as effective, may be more politically acceptable and less likely to result in opposition. These measures may be a good starting point, and they can form the foundation for more comprehensive wellhead protection measures later, if needed.

Public Education - Public education is perhaps the most important tool for managing contaminants in a WHPA. It is vital the public understand the connection between land use within the area and drinking water quality. Only after this connection is made will the program receive the support necessary to be successful. Education programs can be as simple as informational fliers included with water bills or displays set up at local gatherings. More intensive education can be provided through seminars involving individuals who will be significantly impacted by the program.

Best Management Practice - A Best Management Practice (BMP) is a proven set of standard operating procedures that can be used in a particular industry or activity to limit the threat to the environment. These practices are common in the agricultural industry. Voluntary Best Management Practices can be an effective tool in controlling contamination if combined with an educational program to promote their use, and many times some financial incentives are included.

Monitoring - Groundwater monitoring can be an effective way to insure that contaminants are discovered before they enter the drinking water supply. Monitoring does not, however, prevent a contaminant from entering the supply, and it is expensive to continue on a long-term basis.

Land Transfer - In some instances, the property on which the suspect activity is taking place can be purchased by, or donated to, your community. The potential source of contamination can be removed and then the property can be set aside for park land or other public use, or the property can be resold with restrictions on future use.

Conservation Easements - Many times it is not practical or financially feasible to purchase property outright. In these cases it may, however, be feasible to purchase conservation easements which limit the future use of the land. In the case of land which is in agricultural production, it may be possible to purchase an easement which will allow the land to stay in production, but will limit the amount of fertilizer or pesticide used. Easements can be purchased with any number of mutually agreeable conditions or restrictions placed on future use.

These are only a few examples of the types of controls which can be used to help limit the potential for contamination due to existing sources. Many other approaches have been used successfully by communities across the nation. Additional information can be obtained from the Environmental Protection Agency or the Iowa Department of Natural Resources.

It is important to remember that no single control measure will be totally effective in the effort to protect your groundwater supply. Each tool will be most effective when used as part of an integrated wellhead protection program.

Regulatory Measures to Prevent Future Sources of Potential Contamination

After existing sources of potential contamination are addressed, preventive control measures can be put in place which will further limit your well's exposure to contamination from new sources. The following paragraphs describe a number of tools which can prevent activity in the wellhead area which is inconsistent with your wellhead protection goals.

Zoning Regulations

Zoning - Zoning regulations are used to separate different land uses into different areas of a community. Although zoning is not an effective means of managing existing sources of contamination, it is a good mechanism for controlling future development. Zoning techniques that can be used in wellhead protection include:

- overlay water resource protection districts
- prohibition of various land uses
- special permitting
- large lot zoning
- transfer of development rights

Overlay groundwater protection districts - A groundwater protection district is an area within which more strict regulations will be enforced to protect the groundwater. This area could be the area of influence of a well, the recharge area of an aquifer, etc. Within this area there are more stringent protection regulations, regardless of zoning. These regulations may require a minimum lot size, limit impervious area, or restrict chemical storage and handling. An outline of this area is often drawn on a transparent sheet which is laid over a map of the community. This outline shows the areas which will be affected by the more stringent regulations.

Prohibition of various land uses - In most communities, zoning prohibits certain land uses in specific sections of the community. These prohibitions may not be directly related to groundwater protection, but they can serve that function if land uses which involve the use, storage, and disposal of toxic or hazardous materials are not allowed in WHPAs.

Special permitting - Special permits can be used to regulate development that could threaten groundwater quality. For example, many communities use the special permitting process to evaluate the risks posed by underground storage tanks within designated WHPAs.

Large lot zoning - The purpose of large lot zoning is to limit the potential for groundwater contamination by reducing the number of buildings and, therefore, septic systems within a WHPA. Large lot zoning has limited effectiveness because zoning law provides protection to land owners whose property may decrease in value if minimum lot sizes are increased. Large lot zoning within WHPAs can still be an effective tool against groundwater contamination considering that septic systems may be one of the most likely causes of groundwater contamination.

Transfer of development rights - In some cases, a town can limit development within a WHPA by allowing a developer who owns property in the area to sell a portion of their development rights to another developer who owns property outside the area. In other words, a developer inside the protection area would agree to develop fewer lots and would sell the rights to the additional lots to a receiving developer outside the protection area. The outside developer would then be allowed to develop more lots on their property than normally allowed by zoning. The town would need to designate areas which are able to "receive" additional development and a perpetual easement or some other development restriction would need be recorded with the deed of the donor parcel.

Drainage requirements - Runoff often contributes contaminants to surface waters, which can influence the quality of a groundwater source. To help control this problem, drainage requirements may be established by local planning commissions and boards as part of subdivision review processes. Effective drainage management can minimize the volume of runoff generated, and enhance the natural filtration process.

Site design/landscaping - Land development that incorporates buffer zones, natural landscaping, specific percent cover standards, and alternative roadway designs can act as a groundwater quality protection measure. In establishing landscaping requirements, communities can encourage xeriscaping techniques. Xeriscaping focuses on the use of native plant materials having lower water and nutrient requirements than standard landscape plantings.

Health Regulations

Health regulations are an effective part of a regulatory protection program. The following paragraphs describe two potential sources of groundwater contamination that can be managed with appropriate health regulations.

Underground storage tanks - Leaking underground storage tanks are the single largest source of groundwater contamination in the nation. The larger underground gasoline storage tanks associated with automotive service stations have caused numerous groundwater contamination incidents. Regulations can require construction standards for new tanks, leak testing for existing tanks, or prohibition of all new underground tank installations within the WHPA.

Septic system regulations - The maintenance of on-site septic systems is an important consideration in wellhead protection. Both improperly treated sewage and the chemicals used to clean poorly maintained systems can degrade groundwater quality. To minimize the risk of contamination and to ensure proper maintenance of septic systems, many communities have developed a voluntary septic system maintenance program.

Nonregulatory Measures to Prevent Future Sources of Potential Contamination

Land acquisitions - Land acquisitions, land donations, and conservation easements are all management techniques that may be more efficiently conducted by nonprofit land conservation organizations than by municipalities. These organizations are tax-exempt, not-for-profit entities. Therefore, donations and bargain sales to the organization are usually considered charitable donations and may have positive federal and state tax consequences for the donors. These organizations can provide expertise in: arranging land transfers; drafting conservation easements; explaining advantages and disadvantages of real estate transfers to both land purchasers and sellers; coordinating with and soliciting aid from various foundations; and, in some cases, providing funds for acquisition or to serve as landowners and stewards.

Conservation easements - Easements can effectively assist a community in protecting land from development by restricting all or a portion of the property to open space or limited development uses. The granting of a conservation easement does not involve the transfer of ownership of the land; instead, it means giving up certain development rights of the property. For example, a conservation easement may restrict the number of houses to be built upon a parcel; restrict the types of development allowed on the parcel; or specify that portions of the parcel remain undeveloped.

Hazardous waste collection - Another nonregulatory protection tool is the collection of household hazardous waste. Although these materials are generated in small amounts, they can represent significant threats to surface and groundwater quality. Motor oil allowed to drain onto the land surface when automobile oil is changed, excess paint discarded in the gutter, and fungicides and herbicides left in a shed that is flooded are possible routes from contaminant container to water. To avoid these scenarios, many communities have implemented hazardous waste collection days several times per year.

Public education - The importance of public education to successful implementation of a comprehensive wellhead protection program can not be stressed enough. Public education can be used to build support for regulatory measures or to kick off voluntary programs. It can also be used to assess the political climate prior to enactment. It will be more difficult for individuals and groups to resist your wellhead protection efforts if they understand the relationship between land use and groundwater contamination.

These are just a few of the many options available to utilities for managing contamination possibilities. The table at the end of this section provides a more comprehensive list of options, and points out some legal and administrative considerations of those options, as well. The Environmental Protection Agency has documented numerous alternatives used by utilities across the nation. For copies of the EPA's documents on this subject and related matters, call the Non-Point

Information Exchange at (202) 260-3665, the Office of Water Resource Center at (202) 260-7786, or the Safe Drinking Water Hotline at 800-426-4791. You can also browse the Internet, using "EPA" and "wellhead" to locate numerous other information sources.

Once you have selected the management strategy that best fits your community and the specific contaminants posing risk to your utility's water supply, the ***Contaminant Source Management Log Sheet*** will help you track efforts to implement your control strategies. This form should be completed as you design ordinances, programs, and other tools. Record when activities begin, when specific targets are attained, and who is responsible for implementation and/or enforcement details. This form should include at least one control strategy for contaminants with the highest priorities listed on the ***Risk Consolidation Table***.

Options for Contaminant Source Management

	Applicability to Wellhead Protection	Land Use Practice	Legal Considerations	Administrative Considerations
Regulatory: Zoning				
Overlay GW Protection Districts	Used to map wellhead protection areas (WHPAs). Provides for identification of sensitive areas for protection. Use in conjunction with other tools that follow.	Community identifies WHPAs on practical base/zoning map.	Well-accepted method of identifying sensitive areas. May face legal challenges if WHPA boundaries are based solely on arbitrary delineation.	Requires staff to develop overlay map. Inherent nature of zoning provides "grandfather" protection to pre-existing uses and structures.
Prohibition of Various Land Uses	Used within mapped WHPAs to prohibit groundwater contaminants and uses that generate contaminants.	Community adopts prohibited uses list within their zoning ordinance.	Well-organized function of zoning. Appropriate techniques to protect natural resources from contamination.	Requires amendment to zoning ordinance. Requires enforcement by both visual inspection and on-site investigations.
Special Permitting	Used to restrict uses within WHPAs that may cause groundwater contamination if left unregulated.	Community adopts special permit "thresholds" for various uses and structures within WHPAs. Community grants special permits for "threshold" uses only if groundwater quality will not be compromised.	Well-organized method of segregating land uses within critical resource areas such as WHPAs. Requires case-by-case analysis to ensure equal treatment of applicants.	Requires detailed understanding of WHPA sensitivity by local permit granting authority. Requires enforcement of special permit requirements and on-site investigations.
Large-Lot Zoning	Used to reduce impacts of residential development by limiting numbers of units within WHPAs.	Community "down zones" to increase minimum acreage needed for residential development.	Well-recognized prerogative of local government. Requires rational connection between minimum lot size selected and resource protection goals. Arbitrary large lot zones have been struck down without logical connection to Master Plan or WHPA program.	Requires amendment to zoning ordinance.
Transfer of Development Rights	Used to transfer development from WHPAs to locations outside WHPAs.	Community offers transfer option within zoning ordinance. Community identifies areas where development is to be transferred "from" and "to."	Accepted land use planning tool.	Cumbersome administrative requirements. Not well suited small communities without significant administrative resources.
Cluster/PUD Design	Used to guide residential development outside of WHPAs. Allows for "point source" discharges that are more easily monitored.	Community offers cluster/PUD as development option with zoning ordinance. Community identifies areas where cluster/PUD is allows (i.e., within WHPAs).	Well-accepted option for residential land development.	Slightly more complicated to administer than traditional "grid" subdivision. Enforcement/inspection requirements are similar to "grid" subdivision.
Growth Controls/Timing	Used to time the occurrence of development within WHPAs. Allows communities the opportunity to plan for wellhead delineation and protection.	Community imposes growth controls in the form of building caps, subdivision phasing, or other limitation ties to planning concerns.	Well-accepted option for communities facing development pressures within sensitive resource areas. Growth controls may be challenged if they are imposed without a rational connection to the resource being protected.	Generally complicated administrative process. Requires administrative staff to issue permits and enforce growth control ordinances.

	Applicability to Wellhead Protection	Land Use Practice	Legal Considerations	Administrative Considerations
Regulatory: Zoning (continued)				
Performance Standards	Used to regulate development within WHPAs by enforcing predetermined standards for water quality. Allows for aggressive protection of WHPAs by limiting development within WHPAs to an accepted level.	Community identifies WHPAs and established "thresholds" for water quality.	Adoption of specific WHPA performance standards requires sound technical support. Performance standards must be enforced on a case-by-case basis.	Complex administrative requirements to evaluate impacts of land development within WHPAs.
Regulatory: Subdivision Control				
Drainage Requirements	Used to ensure that subdivision road drainage is directed outside of WHPAs. Used to employ advanced engineering designs of subdivision roads within WHPAs.	Community adopts stringent subdivision rules and regulations to regulate road drainage/runoff in subdivisions within WHPAs.	Well-accepted purpose of subdivision control.	Requires moderate level of inspection and enforcement by administrative staff.
Regulatory: Health Regulations				
Underground Fuel Storage Systems	Used to prohibit underground fuel storage systems (USTs) within WHPAs. Used to regulate USTs within WHPAs.	Community adopts health/zoning ordinance prohibiting USTs within WHPAs. Community adopts special permit or performance standards for use of USTs within WHPAs.	Well-accepted regulatory option for local government.	Prohibition of USTs requires little administrative support. Regulation USTs requires moderate amounts of administrative support for inspection follow-up and enforcement.
Privately Owned Wastewater Treatment Plants (Small Sewage Treatment Plants)	Used to prohibit small sewage treatment plants (SSTP) within WHPAs, or to allow an SSTP to avoid numerous individual septic system installations.	Community adopts health/zoning ordinance within WHPAs. Community adopts special permit or performance standards for use of SSTPs within WHPAs.	Well-accepted regulatory option for local government.	Prohibition of SSTPs requires little administrative support. Regulating SSTPs requires moderate amount of administrative support of inspection follow-up and enforcement.
Septic Cleaner Ban	Used to prohibit the application of certain solvent septic cleaners, a known groundwater contaminant, within WHPAs.	Community adopts health/zoning ordinance prohibiting the use of septic cleaners containing 1, 1, 1-trichlorethane or other solvent compounds within WHPAs.	Well-accepted method of protecting groundwater quality.	Difficult to enforce even with sufficient administrative support.
Septic System Upgrades	Used to require periodic inspection and upgrading of septic systems.	Community adopts health/zoning ordinance requiring inspection and, if necessary, upgrading of septic systems on a time basis (e.g., every 2 years) or upon title/property transfer.	Well-accepted purview of government to ensure protection of groundwater.	Significant administrative resources required for this option.
Toxic and Hazardous Materials Handling Regulations	Used to ensure proper handling and disposal of toxic materials/waste.	Community adopts health/zoning ordinance requiring registration and inspection of all businesses with WHPA using toxic/hazardous materials above certain quantities.	Well accepted as within purview of government to ensure protection of groundwater.	Requires administrative support and on-site inspections.

	Applicability to Wellhead Protection	Land Use Practice	Legal Considerations	Administrative Considerations
Regulatory: Health Regulations (continued)				
Private Well Protection	Used to protect private on-site water supply wells.	Community adopts health/zoning ordinance to require permits for new private wells and to ensure appropriate well-to-septic-system setbacks. Also requires pump and water quality testing.	Well accepted as within purview of government to ensure protection of groundwater.	Requires administrative support and review of applications.
Non-Regulatory: Land Transfer and Voluntary Restrictions				
Sale/Donation	Land acquired by a community with WHPAs, either by purchase or donation. Provides broad protection to the groundwater supply.	As non-regulatory technique, communities generally work in partnership with non-profit land conservation organizations.	There are many legal consequences of accepting land for donation or sale from the private sector, mostly involving liability.	There are few administrative requirements involved in accepting donations or sales of land from the private sector. Administrative requirements for maintenance of land accepted or purchased may be substantial, particularly if the community does not have a program for open space management.
Conservation Easements	Can be used to limit development within WHPAs.	Similar to sales/donations, conservation easements are generally obtained with the assistance of non-profit land conservation organization.	Same as above.	Same as above.
Limited Development	As the title implies, this technique limits development to portions of a land parcel outside of WHPAs.	Land developers work with community as part of a cluster/PUD to develop limited portions of a site and restrict other portions, particularly those within WHPAs.	Similar to those noted in cluster/PUD under zoning.	Similar to those noted in cluster/PUD under zoning.
Non-Regulatory: Other				
Monitoring	Used to monitor groundwater quality within WHPAs.	Communities establish groundwater monitoring program within WHPA. Communities require developers to monitor groundwater quality downgradient from their development.	Accepted method of ensuring groundwater quality.	Requires moderate administrative staffing to ensure routine sampling and response if sampling indicates contamination.
Contingency Plans	Used to ensure appropriate response in cases of contaminant release or other emergencies within WHPA.	Community prepares a contingency plan involving wide range of municipal/county officials.	None.	Requires significant up-front planning to anticipate and be prepared for emergencies.
Hazardous Waste Collection	Used to reduce accumulation of hazardous materials within WHPAs and the community at large.	Communities, in cooperation with the state, regional planning commission, or other entity, sponsor a "hazardous waste collection day" several times per year.	There are several legal issues raised by the collection, transport, and disposal of hazardous waste.	Hazardous waste collection programs are generally sponsored by government agencies, but administered by a private contractor.

	Applicability to Wellhead Protection	Land Use Practice	Legal Considerations	Administrative Considerations
Non-Regulatory: Other				
Public Education	Used to inform community residents of the connection between land use within WHPAs and drinking water quality.	Communities can employ a variety of public education techniques ranging from brochures detailing their WHPA program, to seminars, to involvement in events such as hazardous waste collection days.	No outstanding legal considerations.	Requires some degree of administrative support for programs such as brochure mailing to more intensive support for seminars and hazardous waste collection days.
Legislative				
Regional WHPA Districts	Used to protect regional aquifer systems by establishing new legislative districts that often transcend existing corporate boundaries.	Requires state legislative action to create a new legislative authority.	Well-accepted method of protection regional groundwater resources.	Administrative requirements will vary depending on the goal of the regional district. Mapping of the regional WHPAs requires moderate administrative support, while creating within the WHPA will require significant administrative personnel and support.
Land Banking	Used to acquire and protect land within WHPAs.	Land banks are usually accomplished with a transfer tax established by state government empowering local government to impose a tax on the transfer of land from one party to another.	Land banks can be subject to legal challenge as an unjust tax, but have been accepted as a legitimate method of raising revenue for resource protection.	Land banks require significant administrative support if they are to function effectively.

In the ***Well No.*** section, be sure to record the specific well this table will refer to.

In the ***Hazard*** section, list each contaminant you have identified as a potential threat to your well. Begin your list with the contaminant(s) you've identified as the highest risk, and given the highest priority to, in Step 4.

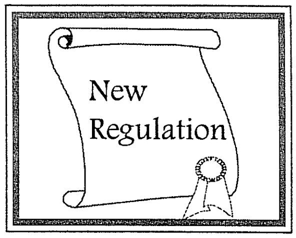
In the ***Approach for Control*** section, write down whether you'll be using regulatory, non-regulatory or both approaches to control the potential contamination; write in specifically the approach to be taken, such as zoning ordinances, monitoring programs, etc.

In the ***Date Initiated*** section, record the date you begin efforts to create each particular control method.

In the ***Date Drafted*** section, record the date the particular strategy is first released for comment by citizens, interested groups, or those who are potentially affected by the measure.

In the ***Date Enacted*** section, record the date you successfully put into place each particular control method, such as the date of passage of an ordinance, construction completion date, etc.

In the ***Person Responsible*** section, write down the name(s) of each person assigned as the responsible party for carrying out or monitoring the approved control strategies. This could be the water utility operator in the case of a monitoring program, or perhaps the planning and zoning commission, in the case or new zoning ordinances or granting of special use permits.



Contaminant Source Management Log Sheet

Well No. ______________

Hazard	Approach for Control		Date	Date	Date	Person Responsible
	Regulatory	Non-Regulatory	Initiated	Drafted	Enacted	

Contingency Plans - Step 6

Planning for a Contamination Emergency

As part of your wellhead protection program, you must think about, plan, and prepare strategies for dealing with emergencies that may contaminate your drinking water well(s), and possibly, recharge area(s). Contingency plans are designed to provide water suppliers with a plan to follow if their water source is contaminated or threatened. This involves having a team of people available and trained in preventing the contamination before it occurs, responding to a contamination incident, and restoring your water supply well(s) to safe, reliable operation following a contamination emergency.

Such a team is likely to be made up of people different than your Wellhead Protection Team, although there may be some common individuals on both, for example, the water system superintendent/operator. Basic areas that need to be covered by your emergency response team include:

- overall coordination of the emergency response;
- communication with consumers;
- management of the specific emergency response operations; and
- assessment of damage including finding out what will be needed to return your well(s) to operation.

It is vital that you be able to contact these people, regardless of time of day, home/office location, etc. Your emergency response plan should include information that tells you how to reach your team 24 hours a day, seven days a week.

You will also need assistance from outside agencies if a drinking water contamination emergency occurs at your utility. It is a good idea to have the same 24-hour, seven-day contact information for these agencies as well. Your emergency plan should provide this information for: health and rescue agencies (such as the police, fire, county and state emergency contacts, etc.), contractors and suppliers of materials that might be needed (plumber, well driller, laboratory services, engineering firms, etc.), and contacts for other utilities (gas, power, telephone, etc.).

All of this information can be easily recorded in the ***Water Supplier General Information Sheet***, a form previously developed by Des Moines Water Works in IDNR's "Emergency Preparedness: Preparing for the Unanticipated" emergency planning model. And, if you've already completed that model document, you are one step further in the process to be prepared for a potential contamination of your well(s).

In addition to overall preparedness, special arrangements should be made, far before any contamination emergency, to assure your consumers will be provided with a reliable water supply in the event yours is interrupted or suspended due to such an emergency. You should explore both short- and long-term alternatives, and develop procedures for initiating either strategy should they become necessary. Short-term solutions may include water hauling services, bottled water purchases, additional treatment of the existing supply, and possibly water conservation measures.

In a short-term situation, it may also be important to look into measures that would reduce the quantity of a contaminant released. Long-term options could include back-up sources of supply, stand-by connections to a neighboring community or rural water system, and "in-the-drawer" plans for construction of additional wells. The ***Contingency Plan Table*** provides a place to document the different options implemented by your utility. For each alternative, record the contact names, telephone numbers (24 hours a day), and a brief description of the service arrangement. If formal contracts, agreements, or procedural documents are involved, copies of those should be included in this section of the wellhead protection model plan. These documents should reflect specific details of how water will be provided and in what quantities. Financial projections for each alternative should also be included.

As part of your effort to be prepared for a contamination emergency, if your wellhead protection area contains buildings, equipment, highways, or other transportation avenues that could introduce hazardous materials into your aquifer, you have some additional work to do. You should become aware of procedures in place with agencies, such as the fire department or a special hazardous materials team (if applicable), who would actually deal with firefighting and hazardous materials, or surface spills and toxic chemical releases. You should know specific contact names, and again, 24-hour contact numbers. Discussing these issues with the other emergency agencies will accomplish two things: 1) you will be aware of their procedures and have the opportunity to identify additional impacts upon your well(s) that may be created in the firefighting/hazardous clean-up process; and 2) you can alert the other agencies to the specific location(s) and possible risk(s) to your well(s). Again, this is information that could be recorded in the ***Water Supplier General Information Sheet***.

In preparing your wellhead contamination emergency response plan, you will also need to access various pieces of information learned and recorded earlier in Step 2, when you gathered information about your well(s), and also in Steps 3 and 4, when you determined the hazards most likely to contaminate your water supply. Facts from the ***Wellhead Protection Information Table,*** such as aquifer type, confining layers, aquifer layers exposed to the well, and casing depths will be very helpful in determining any barriers to the contamination. Also, information gathered in the ***Contaminant Inventory Table*** and ***Risk Assessment Table*** will allow you to determine the exact location of the contaminant source in the protection area, and assist in calculating how quickly that contaminant could travel to your well, if this process has not already been completed.

Another very important fact to keep in mind for the contingency planning effort is the velocity, or speed, of the groundwater flow in the aquifer supplying your well. If you have not already sought outside help to determine the time it will take for contaminations to travel to the wellhead site, you should initiate this action at least for the highest priority risks determined in Step 4, particularly if the safety of the public's health is an issue. Remember, typically, groundwater movement is very slow, and in most cases, unless a contamination site is in the immediate vicinity of your well, water utilities will have days and sometimes months to implement the responses needed to protect your water supply.

You should be prepared to initiate your contingency plan if: 1) you have one well and it becomes contaminated and cannot be treated to resolve the problem; or 2) you have multiple wells, but those available and free from contamination won't reliably supply your customers' average daily demand.

Responding to groundwater contamination will be unlike most other emergencies that pose immediate danger to your water system. However, the fact that less than urgent responses may be possible does not remove the need to address such an important threat to the community. In fact, while this is true scientifically, public perceptions may not be tolerant of such a response. For this reason, short- and long-term alternatives should be pre-arranged, recorded on the ***Contingency Plan Table***, and implemented if needed.

Instructions for Completing the *Water Supplier General Information Sheet*

The ***Water Supplier General Information Sheet*** is to be used to list important information about the water utility, who to contact for direct response and support during an emergency, and to list your utility's critical water users.

In the ***Utility name*** section, fill in the appropriate response with regard to your water utility's:

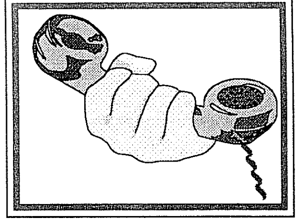
- ***Public water supply ID number (PWSID)*** - the Iowa Department of Natural Resources issues this number.
- ***Water source*** - check the box that describes your utility's raw water source.
- ***Population served*** - fill in the population number your utility serves.
- ***Water storage tank capacity*** - enter storage capacity in gallons.
- ***Average daily pumpage*** - enter the average daily pumpage in gallons per day.

In the ***Treatment process*** section, check the applicable process types for your water utility.

In the ***Emergency telephone notification listing*** section, fill in the appropriate responses in as much detail as possible, including daytime and after-hours phone numbers for:

- ***Basic Emergency Response Team*** - list the personnel who are employed by your utility or in the community who would be directly involved in responding to an emergency.
- ***Officials outside the utility*** - list the support agencies and personnel who can be called for direct assistance in responding to recover from an emergency.
- ***Contracted services/supplies*** - list the companies, vendors, lab services, contractors, suppliers frequently used by your utility.
- ***Utilities*** - list the utilities that provide power, gas or general communication services for your water utility.
- ***Mutual aid coordination*** - list the communities that have entered into an agreement with your water utility to provide equipment, water or materials in an emergency.
- ***Critical water users*** - list the users in the service area that require a continuous water supply in an emergency. Also include what the water is used for and the volume that is needed.

Water Supplier General Information Sheet



Utility name:			Date:	
Public water supply ID number (PWSID)	Water source	Population served	Water storage tank capacity (gallons)	Average daily pumpage (gallons per day)
	❑ Surface			
	❑ Groundwater			

Treatment process			
Iron removal	❑ Yes ❑ No	Chlorination	❑ Yes ❑ No
Coagulation, sedimentation, filtration	❑ Yes ❑ No	Fluoridation	❑ Yes ❑ No
Softening	❑ Yes ❑ No	Other	❑ Yes ❑ No

Emergency telephone notification listing

Positions	Name	Work	Pager	Cellular	Fax	Home
Emergency Response Team						
Emergency Coordination						
Public Communication						
Operations Management						
Damage Assessment						
Officials outside the utility						
Fire department						
Police/Sheriff						
County Emergency Coordinator						
State Office of Emergency Management		515-281-3231				
IDNR - Field Office						
Department of Transportation						
Contracted services/supplies						
Plumber						
Electrician						
Well driller						
University Hygienic Lab (UHL)		319-335-4500				
Contracted laboratory						

Contracted services/suppliers						
Positions	Name	Work	Pager	Cellular	Fax	Home
Engineering firm(s)						
Water storage tank manufacturer						
Property & casualty insurance						
Materials & equipment						
Chemicals						
Fuel						
Utilities						
Iowa One-Call						
Power company						
Gas company						
Telephone						
Radio/Cellular						
Mutual aid coordination						
Equipment						
Water						
Materials						
Critical water users						
Health care						
Critical use:					Volume:	
Nursing home						
Critical use:					Volume:	
Public shelter						
Critical use:					Volume:	
Other						
Critical use:					Volume:	

Complete both ***Short-Term Supply Alternatives*** and ***Long-Term Supply Alternatives*** sections with the following information:

In the ***Type of Supply*** section, write a brief description of the type of service or arrangement developed. For example, enter bottled water if arrangements have been made to purchase quantities of bottled water from a distributor or local vendor in the event of an emergency. Or, connection to "Town XYZ" to describe a back-up connection to another water supplier.

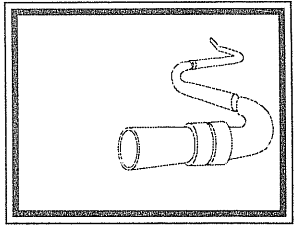
In the ***Location*** section, record an appropriate street address with city and state, or an approximate description of a physical location where a connection to a standby supply can be found.

In the ***Contact Name*** section, enter the person's name who you have negotiated arrangements with, or the name of the person to be reached to initiate the particular supply alternative.

In the ***Work*** section, record the daytime area code and telephone number for the contact person. Likewise, record ***Home*** telephone numbers, and ***Fax*** numbers in the appropriate boxes for each contact name.

In the ***Documentation Included*** section, check either "yes" or "no" to indicate if there is a formal document or procedure that has been inserted in the plan. A pocket folder is included for storage of this document at the end of this section.

Contingency Plan Table



Short-Term Supply Alternatives						
Type of Supply	**Location**	**Contact Name**	**Work**	**Home**	**Fax**	**Documentation Included**
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
Long-Term Supply Alternatives						
Type of Supply	**Location**	**Contact Name**	**Work**	**Home**	**Fax**	**Documentation Included**
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑
						yes ❑ no ❑

Please place copies of mutual aid agreements, contracts for service, or written procedures to initiate a specific alternative in the pocket page provided directly after this section.