

# Groundwater-Based Source Water Protection

## Background



Source water is a raw, untreated supply of water – typically surface water or groundwater – used for current or potential future drinking water.

Source water protection is a proactive, front-line defense to safeguard, maintain, or improve the quality of drinking water sources and their contributing areas. Protecting source water provides economic, environmental, social, and public health value. As an integral part of a series of strategic safeguards (also known as multiple barriers) to protect drinking water, source water protection can be more cost-effective compared to the use of advanced treatment technologies and other measures to remove contaminants. The goals, scope, and actions of a source water protection program can vary based on physical setting, source water quality, contaminant threats and concerns, financial and technical resources, degree of community involvement, and many other factors. Source water protection planning and program implementation can focus on statewide, regional, or local policies and activities.

## The Challenge of Protecting Groundwater Sources



Contamination of surface water is often easily observed (e.g., muddy color, oil sheen, or floating algal mats) and generally of shorter duration in some surface waters (e.g., free flowing streams and rivers). Therefore, measures to address temporary impairment of surface water sources can be relatively straightforward, for example through monitoring water quality upstream of intakes, shutting down intakes to allow contaminated water to pass by, and issuing drinking water advisories. On the other hand, surface water sources can be associated with large watersheds. Addressing potential and actual contamination sources and emergency incidents upstream of the intakes for these sources may require extensive stakeholder involvement.

In contrast, subsurface conditions that control groundwater movement are hidden from sight and challenging to characterize. Accordingly, effective management of groundwater quality relies on our understanding of the local groundwater flow that is often less clearly understood when compared to surface water drainage patterns. This presents an added challenge for local decision-makers and the general public in understanding and managing the movement and fate of groundwater-based drinking water supplies and avoiding or controlling contamination threats and incidents.

Compared to surface water, groundwater may derive an added layer of protection from the filtering and diffusion offered by soil, sediment, loose rock layers, and other geologic formations, as the water moves from the ground surface to drinking water wells. Nevertheless, shallow groundwater is subject to contamination originating from the land surface because of the short pathways. Deeper groundwater is generally better protected by the greater travel distance and time from the land surface. Deeper groundwater can also be significantly older compared to shallow groundwater and surface water, and free of contamination from human-made chemicals produced, used, and disposed of in the last century.

Both shallow and deeper groundwater sources can be affected by land use activities including agriculture, industrial use, stormwater infiltration (e.g., green infrastructure and stormwater drainage basins/wells), and waste disposal among others. The presence of chemical contaminants in groundwater can only be identified and verified through monitoring efforts, such as collection and analysis of samples from drinking water and monitoring wells. Many groundwater systems have not installed monitoring wells because of the associated expense and lack of identified needs. Furthermore, groundwater and surface

water sources may contain unregulated contaminants for which there may be no federal or state guidance on monitoring or treatment. Water systems may not even know to monitor for these substances.

### **Federal and State Programs for Groundwater Protection**



The 1986 amendments to the Safe Drinking Water Act (SDWA) required states to establish wellhead protection programs. Because of the complexities of geology and resource and technical limitations of many smaller groundwater-based systems, states were given a great deal of flexibility in delineating wellhead protection areas, ranging from arbitrary fixed-radius circles around wells to sophisticated groundwater contributing areas generated by mathematical models. Although the delineated wellhead protection areas can vary greatly in terms of accuracy and consistency, the overall success of the wellhead protection program led to the inclusion of additional source water protection for surface water sources 10 years later. The 1996 SDWA Amendments required states to delineate source water protection areas for all drinking water systems, identify potential contaminants and potential/actual contamination sources, and make the results publicly available. However, the SDWA did not require regular updates or revisions to the delineation and assessment of source water protection areas. Many states have also incorporated their original wellhead protection programs into their source water protection program. Although the SDWA does not mandate source water protection programs, some states have adopted rules requiring certain water systems to develop and implement source water protection plans, while such activities are voluntary in other states.

Other federal, state, and local frameworks or programs that focus on protection of groundwater supplies include:

1. **Underground Injection Control (UIC) Program**, established under SDWA in 1974, under which EPA develops minimum federal requirements for state or other UIC programs and other safeguards

to protect public health by preventing injection wells from contaminating current and future underground sources of drinking water. UIC programs are overseen by EPA or by states, territories, or tribes with appropriate enforcement authority.

2. **Sole Source Aquifer (SSA) Program, established under SDWA**, which authorizes EPA to designate an aquifer as a sole source of drinking water and establish a review area. EPA reviews proposed projects that will both (a) be located within the review area and (b) receive federal funding. The review area includes the area overlying the SSA and may also include the source areas of streams that flow into the SSA's recharge zone. EPA's review is intended to ensure that the projects do not contaminate the SSA.
3. **Various Clean Water Act Programs**, including the Section 319 Nonpoint Source Management Program, which provides grant funding for technical and financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects. In some states, including Nebraska, Section 319 funds have been used for wellhead protection projects. Furthermore, the use of Section 319 funds for wellhead protection is allowable if source water protection has been included in the state's Intended Use Plan.
4. **State Groundwater Quality Standards**, for example, those established by the State of Washington to protect existing and future beneficial uses through the reduction or elimination of contaminants discharged to the subsurface.
5. **Numerous regulatory programs under federal statutes such as the Underground Storage Tank (UST)**, Comprehensive Environmental Response, Compensation, and Liability Act (also known as Superfund), Resource Conservation and Recovery Act (RCRA), Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and Toxic Substance Control Act (TSCA).

6. **Agriculture Improvement Act of 2018 (the Farm Bill)**, which includes several provisions that make source water protection a goal and specific focus of the conservation programs. The Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture is directed to work with water utilities and spend at least 10% of conservation funds (except for the Conservation Reserve Program) on source water protection.
7. **Local land use ordinances, zoning bylaws**, or other measures instituted by local governments, which can be coupled with federal and state programs to strengthen source water assessment and protection efforts.

### Elements of a Groundwater Protection Framework



Although most source water protection activities are voluntary, there is a range of approaches that states and drinking water systems can use to support the protection of groundwater supply sources. These approaches include, but are not limited to:

### CAPACITY BUILDING AND ENGAGEMENT

- **Engage** with the U.S. Geological Survey and state Geological Survey to better characterize groundwater quality, groundwater movement, and contaminant fate in the subsurface.
- **Develop** partnerships with governmental, private, non-profit environmental, and other groups, and industry, agriculture, and other organizations to develop and implement strategies and best management practices to minimize and eliminate the release of contaminants within source water protection areas.

### RESEARCH AND DATA COLLECTION

- **Collect** data and information on historic land use and agricultural, industrial, or commercial activities in the protection area to identify any potential legacy problems. It should be noted that legacy

contamination can be very expensive to uncover and mitigate. Due to the long residence time and slow movement of most groundwater, legacy contaminants can go undetected for years.

- **Review** results of past source water assessments and other research on the source water and source water protection area to update source water protection areas, identify contaminants of concern, and formulate strategies to develop and implement effective source water protection programs.

### FUNDING

- **Work** with organizations including the NRCS and state environmental and public health departments to leverage funding available for source water protection, such as Farm Bill Conservation and Forestry Titles for both agricultural and forestry, Clean Water and Drinking Water State Revolving Funds, and Section 319 grant funding.

### IMPLEMENTATION

- **Characterize** the potential threats posed by contaminants on the basis of the nature of releases (e.g., emplacement of contaminated fluids via injection wells or infiltration/percolation of applied chemicals or contaminated stormwater from the land surface), as well as their potential to affect water supply sources.
- **Develop** and implement a monitoring program to evaluate the movement of contaminants of concern and implement risk mitigation measures, especially when there are strong indicators that contaminants are entering into or present in aquifers.
- **Develop** and implement outreach and educational programs targeting landowners with properties within the wellhead or source water protection area.
- **Incorporate** water resource management considerations into local land use planning through model ordinances, zoning requirements, and other institutional controls to protect groundwater.



Examples of proactive/model state strategies for protecting ground water:



**MINNESOTA** adopted a watershed approach to address the state's 81 major watersheds. As a part of the watershed approach, restoration and protection strategies are being developed to help prioritize and target local efforts to restore watershed and groundwater resources as part of local water planning process. Groundwater Restoration and Protection Strategies (GRAPS) reports use existing state data and information about groundwater and land-use practices that affect groundwater in watersheds to identify key groundwater quality and quantity concerns. The reports suggest targeted strategies and actions to restore and protect the groundwater, in conjunction with Watershed Restoration and Protection Strategies (WRAPS) reports in developing local watershed management plans.

<https://www.health.state.mn.us/communities/environment/water/cwf/localimplem.html>



**NEBRASKA's** Natural Resources Districts (NRDs) are involved in the conservation and protection of the state's natural resources such as groundwater used for water supply. Using funds from a range of sources, including the NRCS, NRDs work with producers on the use of best management practices (BMPs) in ground water management areas (GWMAs) to protect groundwater quality. NRDs can also provide financing and technical assistance for proper closure of abandoned and unused wells. As needed, NRDs can develop programs to help communities to protect their drinking water supply sources.

<https://www.nrdnet.org/programs/water>



**NEW HAMPSHIRE** Department of Environmental Services (NHDES) provides grants and technical support to communities and water suppliers for the development and implementation of drinking water source protection plans. Technical support includes training and model groundwater protection ordinances and regulations. Grants to permanently protect water supply lands are available from the state's Drinking Water and Groundwater Trust Fund. NHDES also encourages collaboration

across multiple communities to perform long-term source water protection planning and supports communities and water suppliers in reclassifying specific groundwater resources (aquifers, wellhead protection areas, and other locally designated groundwater). Groundwater reclassification involves state designation and state-local implementation of land use restrictions and other protections.

[https://www.des.nh.gov/organization/divisions/water/dwgb/dwspp/nh\\_source.htm](https://www.des.nh.gov/organization/divisions/water/dwgb/dwspp/nh_source.htm)



**INDIANA** Department of Environmental Management (IDEM)'s Ground Water Section provides guidance for public water systems in establishing Wellhead Protection Plans, Source Water Assessment Plans, as well as guidance to private well owners and characterizing ground water statewide. The Section has been collecting untreated water samples from wells statewide as part of a Ground Water Monitoring Network (GWMN). Collected groundwater data have been used to characterize ground water and raise awareness of local and statewide groundwater quality. The fundamental goals of the GWMN are to characterize groundwater across the state of Indiana and to identify areas of the state that may have impaired groundwater quality due to naturally occurring or human influences upon the environment.

<https://www.in.gov/idem/cleanwater/2450.htm>



**NEVADA's** Integrated Source Water Protection approach benefits small public water systems (PWSs). Small PWSs in Nevada are almost exclusively groundwater systems and many serve non-community populations in rural areas. These PWSs typically have limited capacity and authority to develop and implement source water protection programs. Nevada has addressed this challenge by focusing on the development of countywide plans that include protection for all PWSs within the county. This approach ensures small PWSs are included and protected under regional plans at the county level at which each county has authority and capacity to implement source water protection practices.

<https://ndep.nv.gov/water/source-water-protection/integrated-source-water-protection>