

Source Water Protection Operational Guide to AWWA Standard G300

Second Edition



Richard W. Gullick, PhD



American Water Works
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Source Water Protection
Operational Guide to ANSI/AWWA G300

Richard W. Gullick, PhD

2016

Operational Guide to ANSI/AWWA G300

Source Water Protection

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Contents

SECTION 1: ACKNOWLEDGMENTS	1
SECTION 2: FOREWORD	3
SECTION 3: INTRODUCTION.....	6
SECTION 4: REQUIREMENTS	15
Sec 4.1 Source Water Protection Program Vision and Stakeholder Involvement, 15	
Sec 4.2 Characterization of Source Water and Source Water Protection Area, 19	
Sec 4.3 Source Water Protection Goals, 29	
Sec 4.4 Action Plan, 31	
Sec 4.5 Program Implementation, 37	
Sec 4.6 Evaluation and Revision, 40	
SECTION 5: VERIFICATION	41
SECTION 6: GLOSSARY OF ABBREVIATIONS	42
SECTION 7: RESOURCES	44
SECTION 8: ANNOTATED BIBLIOGRAPHY FOR SELECT INFORMATION SOURCES.....	52
SECTION 9: REFERENCES	59
SECTION 10: WORKSHEETS	68
SECTION 11: CASE STUDIES FOR SOURCE WATER PROTECTION.....	94



G300 Operational Guide

Source Water Protection

SECTION 1: ACKNOWLEDGMENTS

This *Operational Guide to AWWA Standard G300: Source Water Protection* is the result of a series of ongoing efforts over the past decade and a half. In the fall of 2000, the American Water Works Association (AWWA) requested that the volunteer AWWA Source Water Protection (SWP) Committee develop accreditation criteria and supporting guidance for SWP activities performed by water utilities. Led by SWP Committee chair Pamela P. Kenel, P.E. (Black & Veatch), a workgroup of approximately 18 SWP professionals from across the United States met in Kansas City, Kansas, on December 4–5, 2000, to develop an outline of the accreditation criteria. The majority of the worksheets included in this guide were developed at that workshop. Members of the workgroup included the following:

Pamela P. Kenel (Chair), Black & Veatch Engineers, Gaithersburg, Md.

Christopher S. Crockett, Philadelphia Water Department, Philadelphia, Pa.

Andrew F. DeGraca, San Francisco Public Utilities Commission, San Francisco, Calif.

Richard W. Gullick, American Water Works Service Company, Voorhees, N.J.

Betsy Henry, US Environmental Protection Agency, Washington, D.C.

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William C. Lauer, AWWA (liaison), Denver, Colo.

Steve Via, AWWA (liaison), Washington, D.C.

A draft version of the Source Water Protection and Management Program Accreditation document was completed in June 2002, led by Dr. Richard W. Gullick (American Water).

AWWA's planned accreditation program evolved into a new series of utility management standards for water and wastewater utilities (described in the Foreword). The AWWA Standards Committee on Source Water Protection was formed and chaired by Edward A. Holland (Orange Water & Sewer Authority). That committee approved ANSI/AWWA G300, Standard for Source Water Protection, in 2006, and the AWWA Board of Directors approved the standard in 2007.

AWWA then requested the SWP Committee to edit the 2002 draft accreditation document into an Operational Guide to ANSI/AWWA Standard G300. The text was expanded, a few unfinished worksheets were completed, and three case studies and more extensive lists of resources were added. Coauthors of the 2010 version of the guide included Dr. Chi Ho Sham (Cadmus Group Inc.), Dr. Richard W. Gullick (Environmental Engineering & Technology, Inc.), Dr. Sharon C. Long (Wisconsin State Laboratory of Hygiene and University of Wisconsin–Madison), and Pamela P. Kenel, P.E. (Black & Veatch); all four are former chairs of the AWWA SWP Committee.

The AWWA Standards Committee on Source Water Protection (chaired by Dr. Chi Ho Sham, Cadmus Group Inc.) updated ANSI/AWWA Standard G300 in 2014. This revised version of the Operational Guide to ANSI/AWWA Standard G300 was prepared in 2016 by Dr. Richard W. Gullick (Rivanna Water & Sewer Authority).

AWWA is grateful to the following drinking water utilities that allowed their SWP programs to be described as case studies in this guide: Philadelphia Water (Pa.), Central Arkansas Water (Little Rock), and Remsen Municipal Utilities (Iowa). The following personnel contributed to the writing of their respective case study descriptions:

Kelly Anderson, Source Water Protection Program Manager, Philadelphia Water

Elizabeth Ventura, Source Water Protection Program, Philadelphia Water

Alison Aminto, Source Water Protection Program, Philadelphia Water

Molly D. Hesson, Source Water Protection Program, Sage Services LLC (for Philadelphia Water)

Paul R. “Randy” Easley, Director of Water Quality, Central Arkansas Water

John Tynan, Watershed Protection Manager, Central Arkansas Water

Becky Ohrtman, Source Water Protection Coordinator, Iowa Department of Natural Resources (for Remsen)

Dr. Chi Ho Sham, Chief Scientist and Vice President, Eastern Research Group (for Remsen)

The following subject experts reviewed this guide and provided constructive commentary: Nancy Toth, Eugene Water & Electric Board; Paul R. “Randy” Easley, Director of Water Quality, Central Arkansas Water; Pamela P. Kenel, P.E., Black & Veatch; and Jonathan Keck, California Water Service Company. AWWA staff members Paul Olson, Bill Lauer, Dawn Flancher, John Anderson, Martha Ripley Gray, Daniel Feldman, and Gay Porter DeNileon also contributed to this effort.

SECTION 2: FOREWORD

AWWA’s primary goal is to support water utilities in the evaluation and improvement of their water quality, operations, maintenance, and infrastructure. Several programs and types of publications are used to support this mission.

A key program is the AWWA Standards Program, which has existed for more than 100 years to produce peer-reviewed standards for the materials and processes used by water and wastewater utility industries. These standards, which are American National Standards Institute (ANSI) approved, are recognized worldwide and have been adopted by many utilities and organizations. The AWWA Standards Program is designed to assist water and wastewater utilities and their service providers

in meeting the expectations of their customers, investors, and government regulators. The standards developed under the program are generally intended to improve a utility's overall operations and service.

Recently, AWWA also developed a series of management standards for water and wastewater utilities. The Utility Management Standards Program provides a means to assess service quality and management efficiency based on recognized standards for best available practices. Through these standards and formal recognition by professional organizations, the program serves water and wastewater utilities by promoting improvements in the quality of services and efficient management.

The utility management standards address the utility manager's need to have consistency and reliability and to know what is expected in the management and operation of a utility. These standards are also valuable resources for the many issues that utilities face, including increased scrutiny on accountability, increased regulation, and difficult economic realities such as aging infrastructure, changing demand for water, and a shrinking workforce.

The utility management standards are designed to cover the principal activities of a typical water and/or wastewater utility and include the following:

- G100, Water Treatment Plant Operation and Management
- G200, Distribution Systems Operation and Management
- G300, Source Water Protection
- G400, Utility Management System
- G410, Business Practices for Operation and Management
- G420, Communications and Customer Relations
- G430, Security Practices for Operation and Management
- G440, Emergency Preparedness Practices
- G480, Water Conservation Program Operation and Management
- G481, Reclaimed Water Program Operation and Management
- G510, Standard for Wastewater Treatment Plant Operations and Management

The utility management standards are developed using the same formal, ANSI-recognized, AWWA-managed process. Volunteers on the standards committees establish standard practices in a uniform and appropriate format. Formal standards committees are formed to address the individual standards of practice for the diverse areas of water and wastewater utility operations.

ANSI/AWWA Standard G300, Source Water Protection, is the definitive standard for a drinking water utility to use to protect its drinking water supply source(s). The first edition of ANSI/AWWA G300 became effective on July 1,

2007, and was revised on June 1, 2014. The standard outlines the six primary components of successful source water protection (SWP) programs and the requirements for meeting the standard.

Given that every water system is unique, SWP elements vary from utility to utility. The standard can be used to guide development of a SWP program by following the framework presented. Also, it can be used to evaluate the completeness and potential effectiveness of an existing SWP program by comparing a program's components with those listed in the standard to ensure all important parts are included.

This guide is intended to provide support and guidance to help utilities plan, develop, and implement successful SWP programs that will meet the criteria listed in ANSI/AWWA G300. However, it is not intended to be a complete instructional guide for implementation of ANSI/AWWA G300 and may not apply to all situations encountered by individual utilities. It also does not have any specific regulatory linkage and does not specifically address source water selection or certain aspects of source water management (e.g., treatment of reservoir water to control algal growth and stratification).

This guide starts with acknowledgments (Sec. 1) of key individuals who assisted in the development of ANSI/AWWA G300 and this associated operational guide. Section 2 (this Foreword) describes the basic tenets of the AWWA Utility Management Standard Program and describes the outline of this guide.

Section 3, Introduction, includes basic information and guidance about SWP programs and activities and a brief description of the six essential elements (or phases) that comprise a successful SWP program. This section explains how this guide can be used to assess whether a SWP program has met the criteria of ANSI/AWWA Standard G300.

Section 4, Requirements, lists the specific requirements of the SWP standard. There are six subsections, one for each of the six basic elements of a successful SWP program. Each subsection includes a description of the rationale for the specific requirement, a description of the program component and related issues, some suggested approaches, and, for some elements, a list of resources for further information.

Section 5, Verification, includes a description of documentation and human resources needed to verify compliance with the standard.

Section 6, Glossary of Abbreviations, lists the abbreviations used in this guide.

Section 7, Resources, lists relevant national-level stakeholders.

Section 8, Annotated Bibliography for Select Information Sources, provides descriptions and web links for helpful reports, websites, databases, and other sources of information and guidance.

Section 9, References, lists all references cited in this guide.

Section 10, Worksheets, contains many questions in checklist format that utilities can use to self-assess their progress. These questions serve as the basis for reporting progress related to ANSI/AWWA G300, Standard for Source Water Protection. These worksheets are not intended to serve as blueprints to all SWP programs. However, a utility that has all the components represented in the checklists is likely to have the principle elements of the ANSI/AWWA standard incorporated into its SWP program and practices. The worksheets can be used to ensure that important subjects are covered for each component, to find additional ideas that may not have been included in the existing program, and to help identify gaps that may exist in a utility's current procedures compared to the requirements of the standard. The worksheets also serve to solicit proof and documentation that procedures are indeed in place where called for by the standard.

Section 11, Case Studies for Source Water Protection, describes three successful SWP programs for the following utilities: Philadelphia Water (Pa.), Central Arkansas Water (Little Rock), and Remsen Municipal Utilities (Iowa). Each case study follows the framework of the ANSI/AWWA Standard and thus provides examples of different ways to accomplish each necessary component. They also show innovative elements that go beyond the minimum requirements of the standard. Philadelphia Water and Remsen Municipal Utilities are past recipients of the AWWA Exemplary Source Water Protection Award, which is based on following the concepts laid out in the standard.

SECTION 3: INTRODUCTION

The goal of drinking water suppliers is to provide their customers with sufficient quantities of high-quality water at affordable rates. The best way to ensure high-quality drinking water for public consumption is to use a multiple barrier approach (e.g., O'Connor 2002; CCME 2002). This approach includes (1) selecting the highest-quality source water possible; (2) protecting that source; (3) treating the water (with more than one method); (4) maintaining quality in the distribution system; (5) monitoring quality at those various stages; and (6) when

necessary (if other barriers fail), implementing adequate emergency response procedures. Sound management practices and an adequate regulatory structure provide a method and a framework for proper implementation of this approach. Each step in this process should be optimized when responding to high customer expectations for drinking water quality, increased regulatory requirements, and uncertainties associated with the growing number of drinking water contaminants as well as climate change.

Given the great importance of source water protection (SWP) as one component of the multiple-barrier approach, ANSI/AWWA G300, Source Water Protection, was developed. First published in 2007, it was revised in 2014 (AWWA 2014). The standard was established to provide a general framework to help guide drinking water systems of any size and to provide the conditions for developing SWP programs that are locally specific and highly variable in scope. It also provides a tool for assessing the completeness and effectiveness of a SWP program.

Background

Contaminants of concern for drinking water result from either natural sources or anthropogenic activities within the water supply watersheds and aquifers and from unintended collateral effects of the treatment processes used to deal with certain contaminants in source waters (e.g., disinfection by-products). Therefore, high-quality source water is an important barrier in preventing contaminants from entering or being created within the water supply system. AWWA's support of this premise is noted in its official policy statement on the quality of water supply sources: "AWWA strongly supports securing drinking water from the highest quality sources available and protecting those sources to the maximum degree possible" (AWWA 2010).

The primary objectives of SWP programs are to maintain, safeguard, and/or improve the quality of a given water source. A clear and important aspect of this premise is that pollution prevention is often preferable to remediation or treatment of contaminated source water. SWP programs should not only emphasize the reduction in current contamination but also provide a means to assess and prevent future contamination.

Numerous benefits may be achieved from SWP, and each may be considered an incentive or driver for a utility to develop and implement SWP activities. The potential incentives include the following:

- Increasing public health protection by ensuring higher-quality raw water (and thus presumably higher-quality treated water), especially for sensitive subpopulations. In addition to reduction in illnesses and mortalities, public health protection can provide economic benefits in terms of reduced health care costs and reduced loss of productivity and work time.
- Supporting water and land resource sustainability goals, legislation, and regulation.
- Increasing the likelihood of complying with existing and future drinking water regulations (including maximum contaminant levels).
- Qualifying for a 0.5-log removal credit for watershed control programs under the US Environmental Protection Agency's (USEPA's) Long-Term 2 Enhanced Surface Water Treatment Rule.
- Providing a means to respond to uncertainties presented by the growing number of unknown or unregulated microbiological and chemical contaminants (i.e., preventing contamination that treatment may not remove).
- Avoiding costs of contamination, including
 - Reducing water treatment challenges and costs (e.g., more consistent influent water quality, and lower current and future capital and operating treatment costs)
 - Saving potential future expenses associated with land and water contamination remediation
 - Saving monitoring, engineering, and legal expenses
 - Saving expenses related to finding and obtaining alternate water supplies
 - Reducing the potential for more indirect financial costs, such as real estate devaluation or lost jobs and tax revenue
- Maintaining or improving source water quality for uses other than drinking (e.g., fish habitat, recreation)
- Protecting aesthetic water quality (i.e., prevention of taste, odor, and color problems)
- Meeting utility customer expectations, and improving or preventing a decline in customer/citizen perceptions and confidence
- Providing for general environmental stewardship for current and future generations (e.g., improving the overall environmental quality of watersheds and aquifers)
- Receiving recognition as a steward of the environment

- Maintaining or improving bond ratings, for example, by improving the overall resiliency of the water system
- Increasing funding opportunities (e.g., in some cases, communities with SWP programs may receive higher priority for low-cost loans and grants related to drinking water or watershed management programs)
- Increasing aesthetic beauty and/or economic value of residential and commercial properties through use of attractive best management practices (BMPs) such as artificial ponds or wetlands
- Improving communication and cooperation among stakeholders. Effective collaboration can at times help drinking water utilities avoid the need to play the primary role and allow them to be a supporting catalyst for change and activity
- Improving operations and reducing expenses for various industries and commercial establishments (e.g., nutrient management plans may reduce the need for fertilizer, sediment control BMPs can maintain soil resources, and improvement in energy and water efficiency can reduce carbon and water footprints)
- Realizing social benefits and greatly improved relations with upstream neighbors resulting from SWP efforts

To minimize impacts from chemical and microbiological contaminants, pollutant sources that SWP programs can address include the following:

- Agricultural, commercial, and residential use of fertilizers and pesticides
- Fuel and other chemical use, storage, transportation, and disposal (e.g., aboveground and underground storage tanks)
- Accidental spills or releases of contaminants (e.g., transportation accidents)
- Deliberate spills or releases of contaminants (e.g., vandalism and terrorism)
- Mining and oil and gas extraction
- Solid waste and hazardous waste disposal sites
- Commercial and industrial establishments
- Changes in land-use patterns such as new residential and commercial development or intensification of agriculture
- Stormwater runoff from natural events that involve contaminants such as microorganisms, nutrients, heavy metals, organic chemicals, and sediment
- Treated and untreated municipal and industrial wastewater discharges
- Combined and sanitary sewer overflows
- Septic systems

- Abandoned, injection, and production wells
- Animal waste from livestock, pets, and wildlife
- Highways and transportation systems such as airports (including deicing and other maintenance activities) and railroads

Lists of various regulated and unregulated drinking water contaminants can be found on the USEPA website (www.epa.gov/safewater/contaminants/index.html). These lists include contaminants that are subject to the National Primary Drinking Water Regulations and National Secondary Drinking Water Regulations. USEPA lists of unregulated contaminants include those found on the Drinking Water Contaminant Candidate List website (www.epa.gov/safewater/ccl/index.html), those subject to the Unregulated Contaminant Monitoring Program (www.epa.gov/dwucmr), and those included in the National Contaminant Occurrence Database (www.epa.gov/dwucmr/national-contaminant-occurrence-database-ncod). Additional chemicals of interest can be found through the USEPA's Toxic Release Inventory Program (www.epa.gov/toxics-release-inventory-tri-program).

A wide variety of technical and managerial SWP practices are available for use, including the following:

- Contaminant source reduction and management
- Management practices for point and nonpoint pollution sources
- Stormwater management
- Wastewater treatment plant upgrades and maintenance
- Rules and assistance for maintaining septic systems
- Agricultural management practices, incentives, and land stewardship programs
- Erosion and sediment control for construction projects
- Regulations and permits such as construction and operating standards, equipment operation and maintenance, and public health regulations
- Land-use controls, including zoning, subdivision growth controls, acquisition of development rights, conservation easements, land-use prohibitions, and land purchases
- Forestry management programs
- Wildlife control
- Visual inspection of water supplies and potential contaminant sources
- Source water monitoring (including early warning monitoring for spill events and chemical and microbial pollutant source tracking)
- Spill prevention, control, and countermeasure plans and implementation

- Emergency response (contingency) planning and implementation
- Stakeholder coalitions and collaborations
- Sanitary surveys
- Education programs

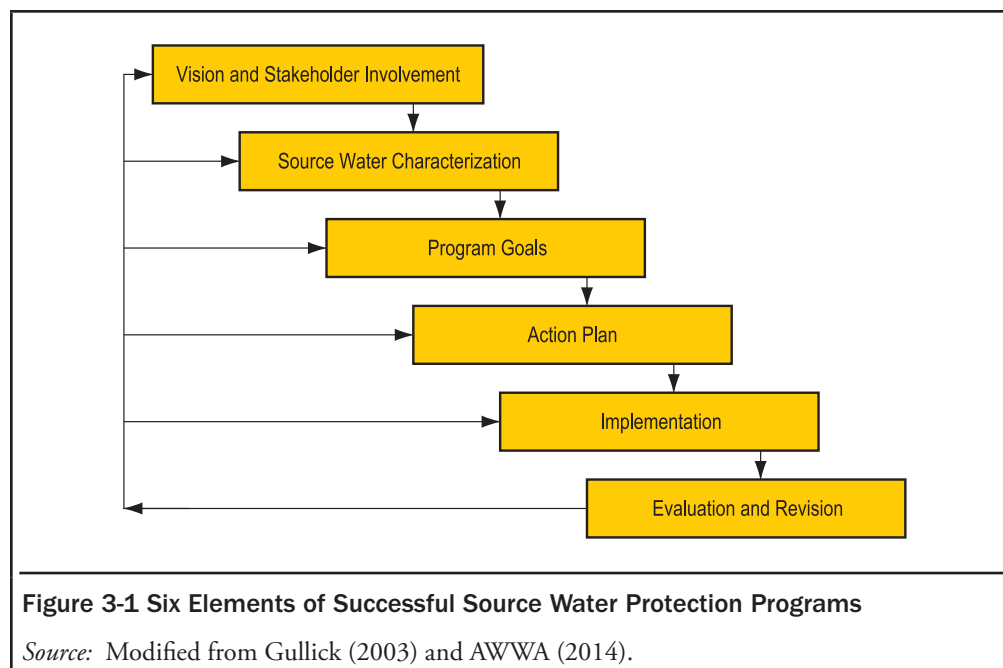
Numerous resources are available for detailed guidance; some are listed in Secs. 7, 8, and 11. These include guides for developing and implementing SWP programs, information on monitoring methods, lists of funding possibilities, manuals and databases that describe implementation and effectiveness of management practices, and other related topics.

Basic Elements of the Source Water Protection Standard

SWP is a highly site-specific process. Different water sources require widely different approaches. For example, substantially different SWP programs would be appropriate for pristine mountain streams, for the lower reaches of highly developed rivers, and for groundwater supplies. Even similar types of water supplies may require different program components as a result of the differing characteristics of their watersheds, accompanying land uses, potential contaminant sources, active stakeholders, and available resources. Therefore, a general framework for the development and implementation of SWP programs, as opposed to contaminant-specific guidance and ratings, is the most appropriate approach for a universal standard. Within this broad framework, specific SWP programs must account for local conditions, incorporate diverse stakeholder interests, seek commitment to the SWP process by all involved parties, and strive to be sustainable over the long term.

Six main elements (or steps) comprise the process of developing and implementing a successful SWP program at the water utility level, as shown in Figure 3-1, and ANSI/AWWA G300, Standard for Source Water Protection, is based on these steps. The primary objectives and components of each element are discussed in the following sections:

- A SWP program *vision and stakeholder involvement*
- Source water *characterization*
- SWP *goals*
- SWP *action plan*
- *Implementation* of the action plan
- Periodic *evaluation and revision* of the entire program



Although each of the six primary steps may differ greatly in terms of complexity or effort, each step is vital to the success of every SWP program. Accordingly, basic success in each area must be demonstrated in order for a utility to meet the criteria of ANSI/AWWA G300 Standard for Source Water Protection (AWWA 2014).

Source Water Protection Vision

A formalized vision guides the development and implementation of a SWP program. The vision helps to align priorities and resources for the effort. Involvement of outside stakeholders is usually essential for a successful SWP program. It is best to involve stakeholders throughout the process, including in development of the vision.

Source Water Characterization

Characterization and assessment of the source water and the land or subsurface area from which it is derived provide information for conducting a source water susceptibility analysis that is used to identify and prioritize the key water quality issues and contamination sources. Program goals are then developed based on this analysis and the utility's and other stakeholders' priorities and capabilities.

Program Goals

Goals and objectives need to be formulated to guide the SWP program and its specific elements. The goals should be developed in response to specific problem

areas identified through the source water characterization and risk assessment processes, and they should address each driver that motivates the SWP program, including the SWP vision. Goals, which may address both current and potential future issues, should be prioritized to reflect the concerns of greatest importance and ideally should specify temporal and qualitative and/or quantitative dimensions (e.g., specific timelines and measurable goals). Both internal and external stakeholders should be involved in development of the goals.

Action Plan

The action plan lays out a road map of activities to conduct in order to achieve the desired watershed protection goals based on the vision, source water area characterization, and susceptibility analysis. The plan identifies actions that are required (e.g., regulations, agreements, practices) to mitigate existing and future threats to source water quality, develops priorities for implementation, and includes a timetable for implementation, identification of necessary resources and ways to obtain those resources (e.g., funding), and metrics for measuring success of each plan component. These priorities may be based on the perceived risk from different contaminant sources, the resources available to implement actions, the likelihood of success of different actions, and the obstacles to success that exist for different contaminant sources.

Implementation of the Action Plan

Implementation of the action plan is the core of any SWP program. Planning without implementation does not provide results. Without this step, no actual protection takes place. Development of a comprehensive and implementable plan supports effective implementation, and use of an adaptive and iterative management approach can help to respond to unexpected challenges and barriers.

Source Water Protection Program Evaluation and Revision

Any type of administrative program requires periodic (or continuous) evaluation and revision. A good SWP program includes provisions for reviewing and, if necessary, modifying the utility's SWP vision, characterization, goals, action plan, and implementation elements. This should be done periodically and also in response to changes in the source water area, changes in contaminant sources, and performance of implemented programs. This step is intended to measure the accomplishment or completion of projects, programs, and activities identified in the action plan and to identify obstacles to success and ways to overcome those

obstacles. The evaluation and revision aspects of the SWP program should be designed as iterative and interactive processes. SWP plans should be living documents that are continuously improved and updated.

ANSI/AWWA G300 Assessment Process

As noted previously, each of the six primary steps in the SWP program framework are likely to differ greatly in terms of complexity or effort, but each step is vital to the success of any SWP program. Accordingly, basic success in each area must be demonstrated in order for a utility to meet the criteria of ANSI/AWWA G300, Standard for Source Water Protection.

To provide guidance and serve as a tool to assist in the assessment process, 23 worksheets with a series of questions to be considered are provided in Sec. 10. There is one worksheet for each element of the SWP program process (worksheets A, B, C, D, E, and F). Additional worksheets with greater detail are provided for the characterization phase (worksheets B-1 through B-8), planning (worksheets D-1 and D-2), and program implementation (worksheets E-1 through E-6). A final worksheet (worksheet G) covers the verification and record-keeping components of the standard. General qualitative assessment criteria are provided for the answers to most questions via a high/medium/low (or high/medium/low/none) rating system, with “high” being the best rating.

Note that the answers to specific questions may be qualitative or subjective, and specific quantitative criteria are often difficult to develop given the inherent diversity between different source water land areas, different water suppliers, and other factors. In addition to following the six steps in the SWP process, the evaluation should also consider how well the utility has tailored its program to fit the specific needs of its water sources and the utility’s unique characteristics.

Note that SWP is a process that typically spans more than one year and a variety of external obstacles from outside of the water utility could be encountered (e.g., Sklenar et al. 2012; Gullick 2014). Therefore, although it would be ideal to complete or make progress on each primary step in SWP, it is not necessary for a utility to complete all aspects of the implementation and evaluation phases of its SWP program in order to meet the standard’s requirements. A comprehensive SWP plan should be used to guide the implementation and evaluation of SWP activities. Nevertheless, a well-conceived plan without on-the-ground execution of specific activities would be just a paper exercise that does not offer any real public health protection or improvement to a utility’s overall operations and service.

SECTION 4: REQUIREMENTS

This section discusses the six main steps (Figure 3-1) in the process of developing and implementing a successful source water protection (SWP) program at the water utility level. These steps comprise the basis of ANSI/AWWA G300, Standard for Source Water Protection. Text in *italics* is quoted from the standard.

Sec 4.1 Source Water Protection Program Vision and Stakeholder involvement

A formalized vision guides the development and implementation of a source water protection program. A vision statement explicitly expresses the policy of the organization as set forth by the decision-making body of the utility and helps to align priorities and resources. The vision or policy statement is the official declaration of the utility's commitment to source water protection.

4.1.1

Vision

The utility shall have a vision or policy that expresses a commitment to source water protection. The vision or policy (or other similar utility document, or consistent practice) shall include a commitment of, or intention to commit, sufficient resources to the source water protection effort. A written version of the vision is strongly encouraged because it would serve to preserve institutional history and allow future generations to be reminded of the vision, along with the opportunities to review and update the vision.

4.1.2

Stakeholder Involvement

Involvement of relevant outside stakeholders is usually essential for development and implementation of a successful source water protection program. The utility shall identify source water area stakeholders, their roles, and existing initiatives in which they may be engaged. Cooperation or partnerships with relevant stakeholders shall be realistically assessed and actively pursued throughout program development and implementation. The formation of collaborative associations at the watershed and local levels is an effective approach to engage stakeholders and partners. Stakeholder involvement may result in improved coordination of partnership activities, additional volunteer efforts, and potential funding opportunities. It is expected that various stakeholders may be involved in each stage of the source water protection program process, but also that not all of the same stakeholders may be involved in each of the stages.

Rationale

Having a vision will help in setting goals and in planning and implementing the program. The vision states a utility's SWP policy as put forth by the utility's decision-making body and helps to align priorities and resources. This commitment from the governing body is important as it helps to ensure staff have the necessary supporting resources to not only plan but to implement SWP practices.

The vision may be articulated in a vision/mission statement or policy. It is the utility's "call to action" and is a statement of the utility's commitment to SWP. As such, the AWWA standard requires that a utility have a vision or policy statement that formally expresses a commitment to SWP or at least a consistent practice of committing sufficient resources to the SWP effort.

A vision/mission statement may include any number of the following considerations:

- Protecting public health
- Protecting against taste and odor
- Reducing treatment costs
- Increasing reliability of treatment technology
- Increasing supply reliability
- Knowing what contaminants are regulated
- Addressing contaminants that are emerging or unknown
- Providing regulatory incentives
- Addressing needs of sensitive subpopulations
- Knowing customer expectations and perceptions
- Balancing risks
- Protecting investment in water sources
- Being aware of bond ratings
- Performing environmental stewardship and sustainability
- Knowing the objectives of other stakeholders

The long-term success of a SWP program often depends on the acceptance, buy-in, and participation of key stakeholders. These stakeholders can include other water users and suppliers; government officials; important commercial, industrial, and agricultural interests; environmental and citizen groups; landowners; and the public. Their contributions and buy-in to the vision can help to garner support for subsequent phases and can form the initial framework for planning and implementing the process. Accordingly, basic principles of good stakeholder involvement and

communication are discussed here. These principles also apply to the other basic elements and phases of successful SWP programs.

The start of the process, when the vision is being developed, is an appropriate stage for collaborating with a variety of stakeholders who share a common interest in the water supply, land use, SWP, and other related issues. It is important that the program's vision, mission, and goals are clearly defined at the outset and that all stakeholders have an opportunity to provide input and receive information at all stages. These stakeholders typically do not expect every decision or action to benefit them directly; however, clearly defining and adhering to a formal and transparent decision-making process usually helps to generate a level of comfort with the various stakeholders.

The purpose of a stakeholder involvement program is at least fourfold: (1) to bring diverse stakeholders together so everyone involved can understand the benefits and impacts of the proposed program, (2) to jointly identify a variety of opportunities and alternatives, (3) to bring various resources, such as expertise, staffing, and funding, to the program effort; and (4) to identify common ground that relates to the improvement of watershed health and/or aquifer conditions.

An initial step is to understand and describe each stakeholder's goals and concerns, as well as to identify watershed protection practices currently used or supported by each stakeholder and possible constraints that prevent implementation of other methods. It is important that stakeholders understand the mechanisms that will be used to allow input into the program and related products, such as reports and results of analyses. In this way, stakeholders will not view technical analyses as mysterious and will be able to meaningfully participate in the program.

Workshops with the stakeholders should be held at key decision points throughout the program. Experience shows that workshops ensure that effective communication takes place in an efficient manner and allow for everyone's concerns and ideas to be identified and addressed. An external facilitator who is not connected to any of the stakeholders in the program can implement the workshops. The facilitator should provide support before and after each workshop to ensure that the time allocated to these meetings is highly productive. Orientation material, including an agenda, appropriate reference materials, and a clear description of the desired outcomes, should be distributed to the participants before each workshop. Following each workshop, summary meeting notes should be prepared and disseminated.

Also, open meetings should be held at critical junctures of the program to inform the general public and obtain input. Other outreach techniques such as newsletters, flyers, and websites are also effective ways to inform the public.

A program website can enhance communications among stakeholders and other interested parties and is an efficient repository of information. Websites can be made secure from anyone without the appropriate passwords, allowing only authorized staff and stakeholders access to project information. If appropriate, a read-only component could be linked to the website to enhance access of project information to the general public.

Worksheets

See Worksheet A, Developing a Vision and Coordinating with Stakeholders, in Sec. 10 for guidance in developing a vision and working with stakeholders.

Resources

- Fletcher, Angie, Susan Davis, and Grantley Pyke. 2005. *Water Utility/Agricultural Alliances: Working Together for Cleaner Water*. Denver, Colo.: Water Research Foundation.
- Herpel, Rachael. 2004. *Source Water Assessment and Protection Workshop Guide. 2nd ed.* Lincoln, Neb.: Groundwater Foundation. <http://www.groundwater.org/action/resources-info.html>.
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- Sklenar, Karen and Laura J. Blake. 2010. *Drinking Water Source Protection Through Effective Use of TMDL Processes*. Denver, Colo.: Water Research Foundation.
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Sec. 4.2 Characterization of Source Water and Source Water Protection Area

[This is the initial information collection and analysis phase of SWP programs.] Characterization and assessment of the source water, the land or subsurface area from which the source water is derived, and the potential sources of contamination (PSCs) in those areas is essential for obtaining the understanding and knowledge needed to develop the goals and plans that will realize the source water protection vision. Using that information, a risk assessment or susceptibility analysis is conducted to identify and prioritize the key water quality and SWP issues and contamination sources. In some cases, it will be appropriate and expected that users of this standard will have gone beyond state-performed source water assessments to better define watershed characteristics and have obtained extensive public participation in defining implementation components of the source water protection program.

4.2.1 Delineation

The utility shall geographically delineate its source waters and the areas of concern from which they are derived. This standard is valid for both groundwater and surface water.

4.2.2 **Water Quality and Quantity Data**

At a minimum, the watershed or delineated wellhead area must be the same one(s) covered in the source water assessment. The utility shall maintain appropriate water quality data from the point of withdrawal from the source(s). In addition, water quality data from a variety of locations throughout the watershed or delineated wellhead area, where practicable, should be obtained to identify those areas that require additional scrutiny. Once these data are collected and analyzed, a subset of data and subwatersheds or wellhead zones should be described that effectively reflect real and potential problem areas. Sanitary surveys may be appropriate sources of further information pertinent to each watershed or delineated wellhead area under surveillance. The initial monitoring should be thorough and intense, leading ultimately to the development of a data-based framework for ongoing, time- and event-sensitive monitoring. Emerging issues, for example methyl tert-butyl ether, endocrine disruptors, perchlorate, hexavalent chromium, harmful algal blooms from nutrient enrichment, etc., should be carefully followed. As an adjunct part of a utility's standard operational activity, water quantity data should be gathered and analyzed in those areas where quantity issues are of real or potential concern. When deemed appropriate, the utility should work with partner organizations to establish water quality standards for its source water, which could encourage collaboration across multiple sectors. The sharing of water quality data among appropriate stakeholders and partners would further facilitate such collaborative processes to protect source water.

4.2.3 **Contaminant Sources and Land Use**

The utility shall maintain appropriate information and documentary support about known contaminant sources, land use activities, and other relevant information from the delineated area(s) of concern. Information about existing activities, controls, and management practices and their probable and real effectiveness in those areas shall be documented and maintained. The role of controls shall be adequately reviewed for appropriate use. Measurable results from these controls must be obtained. In addition, plans shall be in place to monitor future activities and development that may affect the watershed. Extreme events, such as floods, droughts and wildfire should be taken into considerations on source water characteristics. Utilities are encouraged to consider the regional long-term impact of climate change on source water quantity and quality. Water utilities should also

consider working with other water users on the evaluation of alternative climate scenarios and mitigation and adaptation planning and investments. Some utilities may choose to conduct a risk or vulnerability analysis to address the various existing and anticipated threats to their source water.

4.2.4

Inventory of Regulations

The utility should compile a list of local, state or provincial, and federal regulations concerning land use management and other relevant activities that apply to the source water protection area. The utility should consider these regulations in the formulation of an action plan.

Rationale

Characterization and assessment of the source water and the land areas that affect it, along with a risk assessment analysis of the susceptibility of the source water to potential contamination, are critical to properly understanding the state of the environment and to developing appropriate goals and plans that will achieve the vision of the SWP program.

Characterization and Vulnerability Assessments

The characterization should, at a minimum, include the following:

- Delineation of the SWP area (surface water and/or wellhead)
- Baseline water quality and quantity information
- An inventory of the activities and potential contaminant sources in the SWP area (e.g., types of potential contaminant sources, the location of these sources, travel times from sources to public water supply intakes or wells)
- A risk assessment to determine the potential susceptibility of the water source to contamination from potential contaminant sources, as well as the risk inherent in that susceptibility (i.e., potential consequences)
- The risk assessment should be used to prioritize the threats from the various existing and potential contaminant sources

Under the 1996 Safe Drinking Water Act (SDWA) amendments, each state was required to develop source water assessment programs (SWAPs) and conduct source water assessments for all public water systems within their jurisdictions. Information collected and analyzed through these assessments was required to be made available to the public and was intended to be used voluntarily by local

stakeholders to determine priorities for the establishment and implementation of successful SWP programs. Most of these source water assessments have been completed (USEPA 2006). However, because states had a limited time frame and limited resources, these baseline assessments were usually based on readily available data and therefore may be lacking local data of sufficient detail. In addition, given that many assessments were completed in the early 2000s, changes in land uses and other activities may have rendered the baseline assessments out of date. A USEPA manual is available to help guide stakeholders in updating their baseline assessments (USEPA 2006).

Additional data collection and analysis, along with other research activities, may be warranted to fill the information gaps and needs. A more comprehensive characterization process for source waters and SWP areas includes assessment of all relevant water quality data (including both regulated and unregulated contaminants), with associated consideration for potential spatial and temporal variability.

For example, in some cases rigorous approaches to delineating SWP areas could potentially make assessments scientifically defensible and credible for protection management. Starting with a copy of the existing SWAP report, a utility should evaluate the level of detail and sophistication of the methods used to delineate the SWP areas. A utility may then desire to perform more accurate delineations of SWP areas (e.g., using more sophisticated models and mapping), use higher spatial and temporal resolution for land-use data (e.g., retrieval of historical land-use data and modeling of build-out scenarios), and perform more detailed evaluations for susceptibility analyses (e.g., using contaminant fate and transport modeling and/or quantitative risk assessments).

The order of increasing accuracy and sophistication of the methods for delineating groundwater-based SWP areas is as follows (USEPA 1987, 2006):

- Arbitrary fixed radii
- Calculated fixed radii
- Simplified variable shapes
- Analytical methods (e.g., uniform flow equation)
- Hydrogeologic mapping
- Numerical flow/transport models (e.g., US Geological Survey's [USGS's] MODFLOW model)

For surface water systems, some states delineated SWP areas as entire watersheds upstream of the intakes up to the watershed/hydrologic boundaries or to the state boundaries. Given that some watersheds are very large, a segmentation

approach can be used to identify smaller “critical areas” as high-priority areas for contaminant source inventories and susceptibility determinations. However, a utility may decide to expand existing critical areas because monitoring data and other information indicate that important potential contamination sources lie outside the currently defined critical area.

Generally one of the following four approaches is used to delineate critical areas for surface water intakes (USEPA 2006):

- An area defined by an arbitrary distance upstream or around the intake
- A stream time-of-travel distance upstream of an intake (stream only, not adjacent lands)
- A buffer-zone setback
- A stream time-of-travel area (stream plus watershed land)

More accurate and sophisticated methods are often associated with a higher degree of data requirements and costs. Consultation with local USGS district office staff, state geological survey office staff, university faculty members and research staff, and USEPA regional water staff can help in determining the level of accuracy and sophistication needed for the delineation process.

In certain cases, some of the desired data may not be available. Information gaps may need to be addressed before further activities can be completed.

Once a SWP area is appropriately delineated, information on land use and potential contaminant sources should be collected. Depending on the size of the source area being assessed and the level of detail desired, the characterization may involve the creation of maps and databases and the use of models and a geographic information system (GIS) to make collected data useable for the characterization process and for decision-making. Sources of information include the following:

- Zoning maps and build-out analyses
- Sanitary surveys
- Water quality monitoring data
- Citizen group activities
- National Pollutant Discharge Elimination System permits
- Resource Conservation and Recovery Act reporting
- USEPA’s Drinking Water Mapping Application to Protect Source Waters system (www.epa.gov/sourcewaterprotection/dwmaps)

As part of the SWAP process, many states conducted only desktop exercises using a database of regulated activities to compile contaminant source inventories (CSIs), which sometimes lack the spatial resolution for assessing the risk associated

with these contaminant sources. These original CSIs are snapshots in time and should be updated to reflect changing land use and activities. Here are a few ways to supplement, update, and/or enhance initial CSIs:

- Conduct a walk-through and/or a drive-through in the SWP area.
- Verify that the database information on regulated facilities and land uses is complete and accurate.
- Have sanitary survey technicians identify well/intake problems and additional potential contamination sources.
- Obtain information from various relevant reports and databases.
- Access USGS and state geological survey websites to determine the availability of water quality data and reports.
- Contact facilities identified through the CSI effort to verify their information.
- Conduct interviews and information searches to identify historic contamination events and locations.
- Add data with finer spatial resolution (e.g., from general land use to land parcel level).
- Replace and add data with more accurate locational attributes (e.g., through the use of a global positioning system).

Once supplemental and additional data are collected, a GIS can be used to manage, display, and analyze the data. Using GIS, a utility can gain a higher level of confidence of the identification of all significant potential contamination sources in the updated SWP area. Additional information that could make the characterization process more valuable in development of the SWP plan includes the following:

- Interviews, surveys, and tours of facilities, including reviews of facility regulatory permits and compliance records
- Interviews with municipal officials within the SWP area to further help identify current and potential contaminations sources
- Focused microbial source tracking investigations in areas where microbial contaminants have been previously detected to help identify the type and location of the contaminant source
- Identification of existing management practices and pollution prevention efforts

- Review of local and state land-use restrictions and regulations, planning documents, and permitting requirements associated with environmental and public health programs
- Identification and engagement of local citizens, organizations, and other stakeholders who are located within the SWP area or can affect source water quality

Once an understanding of the physical settings for the source water area is developed, it is important to assess the stakeholder, regulatory, and institutional attributes within the source water area where protection activities are desired. These characteristics require the identification of stakeholders' activities, roles, responsibilities, resources, and authority within the SWP area. An understanding of the relationships between the key players will ultimately lead to more effective planning and implementation. For example, permits, modifications of ordinances, or permission and participation from various parties to conduct activities on their lands may be needed to achieve various SWP goals. Furthermore, this may result in improved coordination of partnership activities, additional volunteer efforts, and potential funding opportunities. Therefore, engaging stakeholders and developing dialogues and long-term relationships with these entities over time is important and often productive in the long run.

The last step in the characterization process, which is an essential one, is to use the information gathered to perform a risk assessment analysis in order to determine the susceptibility of the source water to current or potential sources of contamination identified. This susceptibility analysis should prioritize the threats based on a variety of criteria, including likelihood of the current and potential contaminant sources to affect source water quality, the potential timeliness (e.g., continuous, frequent, infrequent, or rare) and magnitude of those potential water quality impacts, the potential adverse consequences caused by those impacts (e.g., to public health, regulatory compliance, treatment process integrity, aesthetic water quality), and other concerns.

There are many approaches to determining source water susceptibility. Typically, this involves combining data on potential contamination sources, settings and integrity of water intakes and wells, contaminant fate and transport, and ranking of contamination potentials. As an example, Louisiana conducted potential susceptibility analysis of its water supplies. A potential susceptibility analysis is a determination of the public water supply's susceptibility to contamination by significant potential sources identified within the SWP area. This consists of a

sensitivity analysis, which includes factors inherent to the system and source water, and a vulnerability analysis, which includes the number and types of significant potential sources of contamination identified. Therefore, the potential susceptibility analysis combines a hydrogeologic or hydrologic sensitivity analysis with a vulnerability analysis within the delineated areas (Louisiana Department of Environmental Quality [LDEQ], no date a, no date b). The results of the analysis can be used as a basis for determining appropriate new protection measures or for re-evaluating current protection efforts.

Specifically, for groundwater systems, Louisiana's potential susceptibility analysis considers the following factors (LDEQ, no date a):

- Depth of the well (the shallower, the more sensitive)
- Age of the well (the older, the more sensitive)
- Average groundwater velocity in the aquifer in which the well is screened (the higher, the more sensitive)
- Soil recharge potential (the higher, the more sensitive)

Specifically, for surface water systems, Louisiana considers the following factors in determining sensitivity for these systems (LDEQ, no date b):

- Age of the intake (the older, the more sensitive)
- Length of streams in the SWP area (the longer, the more sensitive)
- Runoff factors—high precipitation, steep slope, low vegetative cover, and low soil permeability contribute to high runoff (the higher, the more sensitive)

Worksheets

Nine worksheets related to source water and SWP area characterization are included in Sec. 10. These include

- Worksheet B: Source Water and Source Water Protection Area Characterization
- Worksheet B-1: Delineating the Source Area of Concern
- Worksheet B-2: Water Quality Information
- Worksheet B-3: Contaminant Source Inventory Data
- Worksheet B-4: Land-Use Analysis
- Worksheet B-5: Physical Barrier Effectiveness Determination
- Worksheet B-6: Intake Structure
- Worksheet B-7: Filling Information Gaps and Needs
- Worksheet B-8: Analysis of Vulnerability/Susceptibility

Resources

- AWWA (American Water Works Association). 2006. *Source Water Protection Best Management Practices* (2006 Participant Manual). Denver, Colo.: AWWA.
- . 2007. *Manual of Water Supply Practices. M50, Water Resources Planning*. 2nd ed. Chapter 11: Watershed Management and Groundwater Protection. Denver, Colo.: AWWA. <http://www.awwa.org/store/productdetail.aspx?productid=6738>.
- CDM (Camp Dresser & McKee, Inc.). 2002. *Source Water Protection Reference Manual* (CD-ROM). Denver, Colo.: Water Research Foundation and AWWA.
- Corona Environmental Consulting LLC. 2016 (in progress). *A Methodology for Locating and Managing Dynamic Potential Source Water Contaminant Data*. Denver, Colo.: Water Research Foundation. www.watersuite.com.
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- . 1997c. *State Source Water Assessment and Protection Programs: Final Guidance*. EPA 816-R-97-009. Washington, D.C.: USEPA Office of Water. <https://semsub.epa.gov/work/HQ/124655.pdf>.
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- . nd. *USEPA Watershed Central*. www.epa.gov/watershedcentral.
- . nd. *Drinking Water Mapping Application to Protect Source Waters (DWMAPS)*. www.epa.gov/sourcewaterprotection/dwmaps.

Sec. 4.3 Source Water Protection Goals

Goals shall address water quality issues, such as public health and aesthetic concerns (e.g., taste and odor), and also may include other considerations, such as environmental stewardship, ecological balance, socioeconomic and political equity, trade-offs with competing policy objectives (such as transportation, housing, economic development, etc.), and others. Utilities are encouraged to develop their goals in cooperation with various stakeholders.

4.3.1

Program Goals

The utility should have written goals for the source water protection program. The utility shall include stakeholders in the development of the goals and shall document that involvement. At a minimum, the goals shall

- Address the specific problems or issues identified in the source water characterization element;
- Be expressed in terms that can be measured or otherwise evaluated in the future; and
- Meet or surpass existing and pending regulations, and provide the flexibility to incorporate future regulatory compliance.

The established goals could become the foundation of a strategy and/or strategic plan that would lead to the development of an Action Plan.

Rationale

The development of strategic goals that connect back to both the vision/mission statement and the source water area characterization and susceptibility analysis is an essential step in development of a SWP program. Such goals, often referred to as “key objectives,” “critical business factors,” or “critical success factors” in quality programs, become the basis for developing interim projects or activities for the program.

Some goals may be developed in response to specific problem areas identified during the characterization and susceptibility process, while other goals may be less technical or specific, such as “improve public education.” Goals may address both current and potential future issues. Both internal and external stakeholders should be involved in development of the goals.

The goals should be prioritized to reflect the concerns of greatest importance and the areas and projects where success is most likely. To the extent practical, the goals should be SMART—specific, measurable, attainable, relevant, and timely). Goals should be realistic and obtainable in that there are no physical, environmental, institutional, financial, political, or social obstacles that are insurmountable.

Typically, the SWP program strategic goals are relatively high level and broad based and do not need to be modified for several years after being established. During implementation of SWP program projects and activities, additional information will be developed that may require the addition of new goals, modification of

existing goals, or removal of existing goals once they have been achieved or deemed unnecessary or unachievable. Periodic review of the SWP program should include an evaluation of each goal as a measure of overall program success.

Worksheets

Worksheet C, Source Water Protection Goals, in Sec. 10 can be used when establishing goals.

Resources

- Central Arkansas Water. 2007. *Lake Maumelle Watershed Management Plan*. Prepared by Tetra Tech, Inc. http://www.carkw.com/wp-content/uploads/2011/09/Lake_Maumelle_Watershed_Mgmt_Plan_May_07_reduced.pdf
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Sec. 4.4 Action Plan

The action plan identifies required actions (management practices, statutory or regulatory changes, agreements, and so on) needed to mitigate existing and future threats to source water quality. It establishes priorities and sets a timetable to implement source water protection goals. The action items in the plan shall include the following:

- 4.4.1 Specific projects, programs, or other activities needed to achieve each of the source water protection goals shall be identified.
- 4.4.2 Specific projects, programs, and activities shall be prioritized, as appropriate, based on their likely effectiveness, availability of necessary resources, timing, stakeholder buy-in, political feasibility, and other considerations.
- 4.4.3 Necessary resources shall be identified, such as staff, funding, special expertise (e.g., police, health department and fire department), and provisions for obtaining them shall be included in the plan.
- 4.4.4 Potential barriers or obstacles to the action plan's implementation shall be acknowledged, and provisions for resolving them shall be incorporated into the plan.
- 4.4.5 Controls to monitor project/program progress, to document progress and successes, and to monitor funding or budgetary changes shall be identified.
- 4.4.6 Compliance With Regulatory Requirements - The utility should determine and document relevant local, state or provincial, federal, or other source water protection regulations that apply to their utility and its source water protection area. The utility shall comply with all applicable regulations for source water protection.
- 4.4.7 Security Planning and Implementation - The utility should have documentation that addresses security issues and describes, in detail, the response of personnel in the event of a security incident. Elements that address the protection of personnel and the water supply shall be included. The applicable vulnerability assessment shall be reviewed and consideration must be given to access control and other relevant security issues.
- 4.4.8 Emergency Preparedness and Response - The utility shall have documentation that describes emergency plans and provides specific directions to personnel in the event of an emergency. The program shall satisfy applicable regulatory requirements.
- 4.4.9 Health and Safety Management - The utility should document health and safety procedures that are designed to safeguard the employees and visitors engaged in operational activities pertaining to watershed management. The documentation may be specific to the source water(s) or part of a company-wide program.

Rationale

An action plan lays out a road map of activities to be conducted in order to achieve the desired SWP goals. The plan identifies selected actions (e.g., regulations, agreements, practices) to mitigate existing and future threats to source water quality. Protection of both current water supplies as well as potential new surface water sources or wells should be addressed. The action plan can also complement the broad sweep of community objectives, including economic development, quality of life, and other local issues.

The plan should prioritize actions as they relate to the goals developed for SWP based on characterization of the source and the susceptibility analysis. The prioritization analysis can include consideration, as appropriate, of the basis of the perceived risk from different contaminant sources, the likely effectiveness of different protection activities, availability of necessary resources, timing, stakeholder buy-in, political feasibility, the obstacles to success that exist for different contaminant sources and protection activities, and other considerations.

The action items may include such diverse SWP practices as land-use restriction and control regulations, public education, source water and early warning monitoring, structural best management practices for pollution control, and emergency response planning. Given that SWP is not mandated in most locales and that utilities typically have little or no regulatory authority or other legal mechanism to enforce specific practices, successful programs often must rely on their own merits and the voluntary actions of various stakeholders.

The action plan should include specifics as to how each action item will be accomplished and a timetable for implementation of each part of the plan. Necessary resources for accomplishing the plan, including staffing, special expertise, and the funding necessary to implement specific components of the plan (including budgets, identification of sources of funds, and a plan for securing that funding), should be identified. Potential problems and obstacles should be identified as fully as possible. Means and metrics for monitoring program effectiveness should also be defined. It is especially useful to designate someone to be responsible for championing the SWP program.

One challenging aspect of successful action plans is anticipating future needs. Future needs assessments should take into account potential future land-use patterns and regulatory activities. Use of a build-out analysis as part of the characterization process may help with assessment of the maximum potential change in land use.

As noted earlier, development of the SWP plan should be coordinated with regulatory agencies at all appropriate governmental levels. The utility staff should be aware not only of the regulations applicable to their utility but also of key regulations and ordinances that may affect other stakeholders and can potentially help the utility meet SWP goals. These could include, but are not limited to, zoning laws, land-use ordinances, state requirements for SWP activities, and activities associated with applicable total maximum daily loads.

An ongoing stakeholder education and involvement program should be included. Stakeholder involvement is typically essential for obtaining buy-in for the program and for leveraging resources and funding opportunities.

Security issues and emergency and contingency planning related to source waters should be addressed in order to the water system's overall resiliency (e.g., ANSI/AWWA J100 Risk and Resilience Management of Water and Wastewater Systems (2010)). Security issues should be addressed in the assessment and planning process, and the utility should have written plans that describe the expected response of personnel in the event of a security incident. Elements that address the protection of personnel and the water supply need to be included. The source water vulnerability assessment can be used to help identify key security threats.

The program should include an emergency plan that details infrastructure and equipment in order to address accidents within the delineated area. Basically, all source waters are subject to contamination from a variety of potential sources, including accidental spills or releases of contaminants, impacts from major weather storms or other natural disasters (such as earthquakes and fire), and from deliberate terrorist activities. The utility should have documentation that describes plans and provides specific directions to personnel in the event of an emergency.

The program should also include contingency plans for locating and providing alternate drinking water supplies in the event of contamination. A good contingency plan ensures adequate planning for disasters, encourages reliability and consistency, contains measures to ensure continuity of operations, and creates uniform response protocols.

The health and safety of utility employees, contractors, and the general public are of utmost importance. Safety procedures, including appropriate safety gear, should be used to ensure the safety of all utility personnel and others who are working as part of the SWP program.

Worksheets

Three worksheets are provided in Sec. 10 for assistance in developing an action plan. These include

- Worksheet D: Source Water Protection Action Plans
- Worksheet D-1: Prioritization and Planning
- Worksheet D-2: Contingency Planning

Resources

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Sec. 4.5 Program Implementation

Implementation of the action plan is the key to a successful source water protection program. Responses to unexpected challenges and barriers to implementation of the action plan items should also be assessed in determining compliance with this standard. It is expected that some projects may be led or conducted by stakeholders other than the water utility or utilities.

As noted earlier, given that source water protection is a continuous, ongoing process that can span many years, it is not expected that a water utility would complete all aspects of its source water protection program within five or even 10 years from the initiation of the program. However, a water utility shall complete or demonstrate substantial progress in all six (6) elements of its source water protection program (as described in this standard), especially with regard to the implementation of key action items of its program. Performing source water assessment and developing a source water protection plan by themselves are not enough to satisfy the criteria of this standard. Completion or substantial implementation of action items is essential for a source water program to be deemed “in action” and for the generation of true results. Taking demonstrative steps in using this standard to achieve comprehensive source water protection is strongly encouraged.

4.5.1 The utility should, where appropriate, develop, promote, or implement a combination of voluntary and regulatory programs and sound practices such as

- Watershed planning
- Wellhead protection planning
- Land conservation
- Land use controls
- Contaminant source management
- Contingency planning
- Education and training
- Outreach and awareness programs
- Riparian buffers
- Green infrastructure and low-impact design standards
- Erosion and sediment control programs for construction projects
- Stormwater best management practices (BMPs)
- Agricultural best management incentives
- Watershed stewardship programs
- Responses to impacts from climate change and extreme events such as droughts and floods

- Security plan
- Health and safety plan
- Risk mitigation plan
- System vulnerability plan
- Operations plans

Rationale

As noted above, planning without implementation does not provide results, and without the implementation step, no actual protection is provided. Nonetheless, development of a comprehensive and implementable plan and use of an adaptive management approach to respond to unexpected challenges and barriers are integral to successful implementation of a SWP program. Accordingly, implementation success depends heavily on the groundwork performed up to this point. If a high-quality, comprehensive action plan is developed, the utility should have a good idea whether implementation of the plan will be successful.

When using a SWP program, a utility must be able to adequately gauge progress of the current implementation efforts and note how it has adapted to instances of adversity and challenge. The ability to work within and overcome institutional obstacles is a hallmark of a SWP program's viability. Forging new partnerships as well as strengthening traditional alliances are also critical.

Worksheets

Worksheet E, Program Implementation, and the six supplementary worksheets in Sec. 10 walk the user through important considerations for implementing a SWP program. Supplementary worksheets include:

- Worksheet E-1: Assessing Key Milestones
- Worksheet E-2: Roles and Responsibilities
- Worksheet E-3: Resources
- Worksheet E-4: Water Quality Monitoring
- Worksheet E-5: Biological/Habitat Monitoring
- Worksheet E-6: Stakeholder and Public Relations

Resources

- USEPA (US Environmental Protection Agency). 1999. *Protecting Sources of Drinking Water: Selected Case Studies in Watershed Management*. EPA 816-R-98-019, April 1999. Washington, D.C.: USEPA Office of Water.
- . 2000. *Watershed Success Stories—Applying the Principles and Spirit of the Clean Water Action Plan*. Washington, D.C.: USEPA.
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Sec. 4.6 Evaluation and Revision

Source water protection programs shall be periodically evaluated and revised in response to changes in the area of source water delineation, new data or information, new regulatory initiatives, changes in local priorities, actual performance of implemented programs, and so forth.

4.6.1

Evaluation Procedures

The source water protection program should include provisions for periodically reviewing and, if necessary, modifying the utility's source water protection vision, characterization, goals, and implementation elements. This adaptive management approach (as a step in the process) is intended to measure the accomplishment or completion of projects, programs, and activities identified in the action plan. It also aims to identify gaps and shortcomings in the program for making future improvements.

Rationale

Any type of administrative program requires periodic (or continuous) evaluation and revision. A good SWP program includes provisions for reviewing, benchmarking, and, if necessary, modifying the SWP vision, characterization, goals, action plan, and implementation elements. These tasks should be conducted periodically and also in response to changes in the source water area, changes in contaminant sources, new data, performance of implemented programs, and other changes. This step of the process is intended to measure the accomplishment or completion of projects, programs, and activities identified in the action plan and also to recognize obstacles to success and identify ways to overcome those obstacles.

Methods for measuring the effectiveness of as many facets of the SWP program as possible must be established. In particular, measurement of the effectiveness of the specific action plan items implemented is important (e.g., efficacy of specific BMPs). In addition, the program should have a mechanism to evaluate and respond to new data collected, to changes in the watershed over time, and to the measured performance of implemented action items. The evaluation and revision facets of the SWP program should be designed with the idea that SWP is an iterative and interactive process, enabling the SWP plan to be a living document that continuously undergoes improvement.

Worksheet

Worksheet F, Program Evaluation and Revision, in Sec. 10 can be used for assistance with SWP program evaluation and revision.

Resources

- USEPA (US Environmental Protection Agency). 2006. *How-to Manual: Update and Enhance Your Local Source Water Protection Assessments*. Washington, D.C.: USEPA Office of Ground Water and Drinking Water. <https://www.epa.gov/sites/production/files/2015-06/documents/816k06004.pdf>.
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SECTION 5: VERIFICATION

It is essential that the utility maintain adequate records and documents of its source water protection program to verify compliance with this standard. Such records shall include, but not be limited to, executed resolutions and recorded minutes of the utility's governing body; summaries or minutes of relevant public hearings, advisory committee, or stakeholder meetings; technical studies, monitoring data, memoranda, or other documents that support the delineation, goal-setting, characterization, and implementation elements of the source water protection program.